FILE FOLDER

DESCRIPTION ON TAB:

Groundwater

Resources Study

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UNITED STATES MARINE CORPS
Marine Corps Base
Camp Lejeune, North Carolina 28542-5001

7000
FAC

JUN 2 6 1989

From: Assistant Chief of Staff, Facilities
To: Assistant Chief of Staff, Comptroller

Subj: TRANSFER OF FUNDS FOR GROUNDWATER SUPPLY STUDY, FINAL PHASE

Encl: (1) Work Plan and Project Costs
(2) NC Dept of Nat'l Resources and Comm Dev ltr of 14 Apr 89

1. Request funds in the amount of $116,038.00 be transferred to the U.S. Geological Survey (USGS), Raleigh, NC. The fund transfer document should specifically indicate:

a. $109,000.00 is being transferred for Phase III of the Camp Lejeune Groundwater Study (per enclosure (1)).

b. $7,038.00 is being transferred for Camp Lejeune's share of the Castle Hayne Aquifer Study (see enclosure (2)).

2. Cost code per Diane Ward, NREAD, is BN947E5034760. The administrative point of contact for USGS is Mrs. Nancy Williams, (919) 856-4510. Facilities point of contact is Mr. Bob Alexander, extension 3034.

B. W. ELSTON

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WORK PLAN FOR PHASE 1
(April 1, 1986 - April 1, 1987)

Work items to be accomplished during Phase 1 will be based almost entirely on existing data.

WORK TASK I Compile all available ground-water data from USGS, State, and Camp Lejeune files for the area, including water-level, water-quality, water-use, and well log data. Construct a computer data set of this data that will facilitate future statistical analysis.

a. Compile USGS data sources.

b. Compile N.C. Department of Natural Resources and Community Development data sources.

c. Compile Camp Lejeune data resources.

d. Inventory existing wells, take water-quality samples, and evaluate field parameters including chloride concentration, bromide concentration, pH, temperature, dissolved oxygen, specific conductance.

WORK TASK II Develop preliminary maps and other information products describing the geohydrologic framework beneath the base and adjacent areas in Onslow County.

a. Evaluate the general lithic character, thickness, extent, and continuity of confining beds and aquifers, from examination of geophysical logs made in existing wells in the study area.

b. Run new geophysical logs for existing wells where additional data is needed. These logs may include gamma-ray, neutron, bulk density, sonic gravel-time, and caliper logs.

WORK TASK III Map potentiometric surfaces of the water-supply aquifer from water-level measurements made primarily in existing wells

a. Make two sets of water-level measurements in wells and local creeks and streams, one in "wet" and one in the "dry" season.

b. Establish water-level recorders on selected existing and available wells.

c. Construct a few shallow wells if needed to prepare a water-table map.

The information from WORK TASKS I, II, and III will be used to make a preliminary assessment of the hydrogeologic framework beneath Camp Lejeune. This assessment will be reviewed in Phase 2a (WORK TASK I) to determine the location and number of test wells to be drilled.

ENCL (1)

WORK TASK IV Prepare report on the results of the Phase 1 investigations with appropriate illustrations and data tables. The proposed title of the Phase 1 report is "A preliminary geohydrologic framework of the Camp Lejeune Marine Corps Base area, N.C."

WORK PLAN FOR PHASE 2
(Years 2 and 3 (April 1, 1987 - March 30, 1989)

Phase 2 will extend over a two-year period and will be devoted to test drilling and the collection and analysis of additional water quality, hydrogeologic, and aquifer hydraulic-parameter data. The work tasks associated with the drilling, testing, and analysis of new well data will be divided into two subphases, 2a and 2b. Phase 2a will be a drilling phase and Phase 2b will be a testing and data-analysis phase. In order to keep drilling costs at a minimum, an effort is to be made to complete all test drilling scheduled for Phase 2 in the first year (Phase 2a). At the end of Phase 2a, a data report describing the hydrogeology of the new wells will be prepared. The report will include information on geologic formations and aquifer materials penetrated by the test wells, water quality in the wells, and geophysical logs completed by the end of 2a. During the third year of the study, or Phase 2b, geophysical logging of wells will be completed, analysis of the geophysical logs will be completed, editing and refinement of the preliminary hydrologic framework developed during Phase 1 will be completed, and aquifer tests on test wells and existing wells will be conducted to determine hydraulic properties of the aquifers and confining beds. At the end of Phase 2b, a report on the revised hydrogeologic framework will be prepared. This report will include information on the hydraulic and water-quality properties of the aquifers and confining beds and the spatial variability of these properties beneath the base.

PHASE 2a
Year 2 (April 1, 1987 - March 30, 1988)

WORK TASK I Review available geologic, hydrologic, and chemical data and determine exact location and number of test wells to be drilled.

a. Coordinate drilling and additional data collection with the data compiled during the NACIP investigations at Camp Lejeune in order to share information and minimize expense where possible.

b. It is estimated that about four test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area. Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the freshwater-saltwater interface and its relation to supply-well pumping.

WORK TASK II Prepare drilling specifications, distribute specifications for bids, and award contract.

WORK TASK III Drill test wells and collect data needed to determine and verify the physical and chemical characteristics of the aquifer and confining-bed materials and fluids that overlie and occur within the deep, limestone water-supply aquifer.

a. Collect split-spoon samples of aquifer and confining-bed materials at specified depth intervals and analyze selected samples to determine chemical and hydraulic characteristics.

b. Collect ground-water samples from test wells at specified depths and analyze samples for selected constituents including concentrations of chloride, heavy metals, and organic compounds that can be associated with the work activities at Camp Lejeune.

c. Make water-level measurements and selected hydraulic tests at specified depth intervals in the test wells to determine the distribution of hydraulic head and hydraulic conductivity.

d. Make geophysical logs in test wells selecting combinations of gamma-ray, neutron, bulk density, sonic travel-time, resistivity, spontaneous potential, and conductivity surveys best suited to data needs.

WORK TASK IV Prepare report on the results of Phase 2a investigations with appropriate illustrations and data tables. This will be a data report that describes test- and observation-well construction and the new hydrogeologic data from the test wells. The proposed title of the Phase 2a report is "Well logs and hydrologic data from test wells at Camp Lejeune Marine Corps Base, North Carolina." The well logs will include both geophysical and lithologic logs.

PHASE 2b

Year 3 (April 1, 1988 - March 30, 1989)

WORK TASK I Complete drilling, sampling, and hydraulic tests of test wells. (This is first priority work item if drilling and testing of test wells was not completed during Phase 2a or if the drilling of additional wells became necessary.)

WORK TASK II Complete geophysical logging of new and existing wells. Analyze logs.

a. Analyze the geophysical and lithologic logs to identify depths to aquifer units and confining beds.

b. Construct fence diagrams to determine the lateral extent of aquifer units and confining beds.

WORK TASK III Conduct aquifer tests on new and existing wells to determine hydraulic properties of aquifer unit(s) and confining beds.

WORK TASK IV Based on new findings, refine and edit the preliminary assessment of the hydrogeologic framework that was developed during Phase 1.

WORK TASK V Prepare a report that describes the refined hydrogeologic framework. The proposed title of the phase 2b report is "Hydrogeologic framework beneath Camp Lejeune Marine Corps Base, North Carolina."

WORK PLAN FOR PHASE 3
Year 4 (April 1, 1989 - March 30, 1990)

WORK TASK I Construct a finite-difference ground-water flow model of the hydrogeologic system in and around Camp Lejeune based on the data and interpretations that resulted from investigations during Phases 1 and 2.

a. Determine grid system for area and discretize appropriate maps of aquifer and confining-bed characteristics (such as structure tops, thicknesses, hydraulic conductivity, potentiometric surfaces, etc.).

b. Determine boundary conditions.

c. Develop a steady-state digital model for unstressed (pre-pumping) conditions in the area.

d. Evaluate different ground-water pumpage and development schemes to determine which alternatives will reduce the chances for contamination of the water-supply aquifer (optimization analysis).

The ground-water flow model will be a management aid that can be used (1) to guide site selection for new wells through prediction of water-level drawdowns that will occur in response to planned pumping rates at potential well sites, and (2) to evaluate water-level drawdowns at existing production wells through prediction of drawdowns that would occur in response to alternative pumping schedules. The potential benefits to be gained from model studies are less well interference, lower pumping costs, and reduced chance for contamination of the water supply.

WORK TASK II Prepare report on the results of Phase 3 investigations with appropriate illustrations and data tables. The proposed title of the Phase 3 report is "Ground-water supply and potential for contamination--Camp Lejeune Marine Corps Base, North Carolina."

MANPOWER:

Project chief:	Hydrologist	GS-12/13	Full time
Project staff:	Hydrologist	GS- 7/ 9	Part time
	Hydrologic technician	GS- 7/ 9	Part time

COSTS: Estimated costs for each phase of the project are summarized below:

Phase 1 (Fiscal Year 1986[?])	
Data collection and compilation.	$ 20,000
Data analysis and synthesis.	30,000
Report preparation	30,000
Fiscal Year 1986(?) Subtotal	$ 80,000
Phase 2 (Fiscal Year 1987[?] and 1988[?])	
Construction and equipment	
Well drilling, construction, sampling and testing (4600 feet at an estimated $25/foot)	$115,000
Water sampling equipment	3,000
Geophysical logging (10 days @ $1000/day).	10,000
Laboratory services (40 samples @ $500/sample) . .	20,000
Data collection, analysis, interpretation, and report preparation	80,000
Fiscal Years 1987 and 1988 Subtotal	$228,000
Fiscal Year 1987. . . . .$114,000	
Fiscal Year 1988. . . . .$114,000	
Phase 3 (Fiscal Year 1989)	
Computer time and support personnel.	$ 29,000
Data preparation, analysis, interpretation, and report preparation	80,000
Fiscal Year 1989 Subtotal	$109,000

COST SUMMARY

U. S. Marine Corps Funds

Phase 1 (FY 1986[?]).	$ 80,000
Phase 2 (FY 1987[?]).	114,000
Phase 2 (FY 1988[?]).	114,000
Phase 3 (FY 1989[?]).	109,000
GRAND TOTAL	$417,000

4/17/89

State of North Carolina
Department of Natural Resources and Community Development
Division of Water Resources
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
William W. Cobey, Jr., Secretary

John N. Morris
Director

April 14, 1989

Mr. Robert E. Alexander
Assistant Chief of Staff Facilities
Headquarters Bldg. #1
Camp Lejeune, NC 28542

Dear Mr. Alexander:

The U.S. Geological Survey and the North Carolina Department of Natural Resources and Community Development have been planning a study of the Castle Hayne Aquifer in cooperation with those local governments which use or could potentially use the aquifer as a water supply source. As the economy and population grow in eastern North Carolina, our use of water increases. We need to make sure that adequate water supplies are available to allow healthy economic growth to continue. The Castle Hayne Aquifer can be a major source of water for eastern North Carolina's future.

The purpose of the proposed study is to gather accurate information about the present condition of the aquifer and to construct a computer model that will help us predict the response of the aquifer to future increases in water withdrawals. The proposed study will give us a sound basis for planning water use from the aquifer and for protecting it from depletion.

The key to the study is arranging adequate funding. As we have explained in a number of meetings throughout the area served by the aquifer, funds are needed from the local, federal, and State levels for the study to be possible.

ENCL (2)

The Department of Natural Resources and Community Development has contributed cash, test drilling services, and staff resources to the study. Local governments have been invited to make cash contributions to the study in proportion to the use and potential use of the aquifer by each jurisdiction. The federal government will match State and local government contributions to the study dollar for dollar through the U.S Geological Survey.

If the study is to proceed, the USGS needs a letter of commitment from each local government participant assuring funding support by May 15, 1989. After receiving these letters of commitment, the USGS will decide in May if there is sufficient support to allow the study to begin on July 1, 1989.

As previously communicated to you, the suggested * proportionate share of the study allocated to Onslow Co. Area is $15,300 for each year during the three year extent of the study.

I hope that you can participate in this important partnership effort with the USGS and NRCD. If you have any questions about the study, please contact me or Mr. David Crawford of the Division of Water Resources, or Mr. Jim Turner of the USGS at (919) 856-4510.

Sincerely yours,

John N. Morris

John N. Morris

* 46% of water use: 40% share of Ons Co-area funds
= $7,038
USGS desires $ by 1 July 88.

WATER FACT SHEET

U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

REGIONAL STUDY OF THE CASTLE HAYNE AQUIFER OF EASTERN NORTH CAROLINA

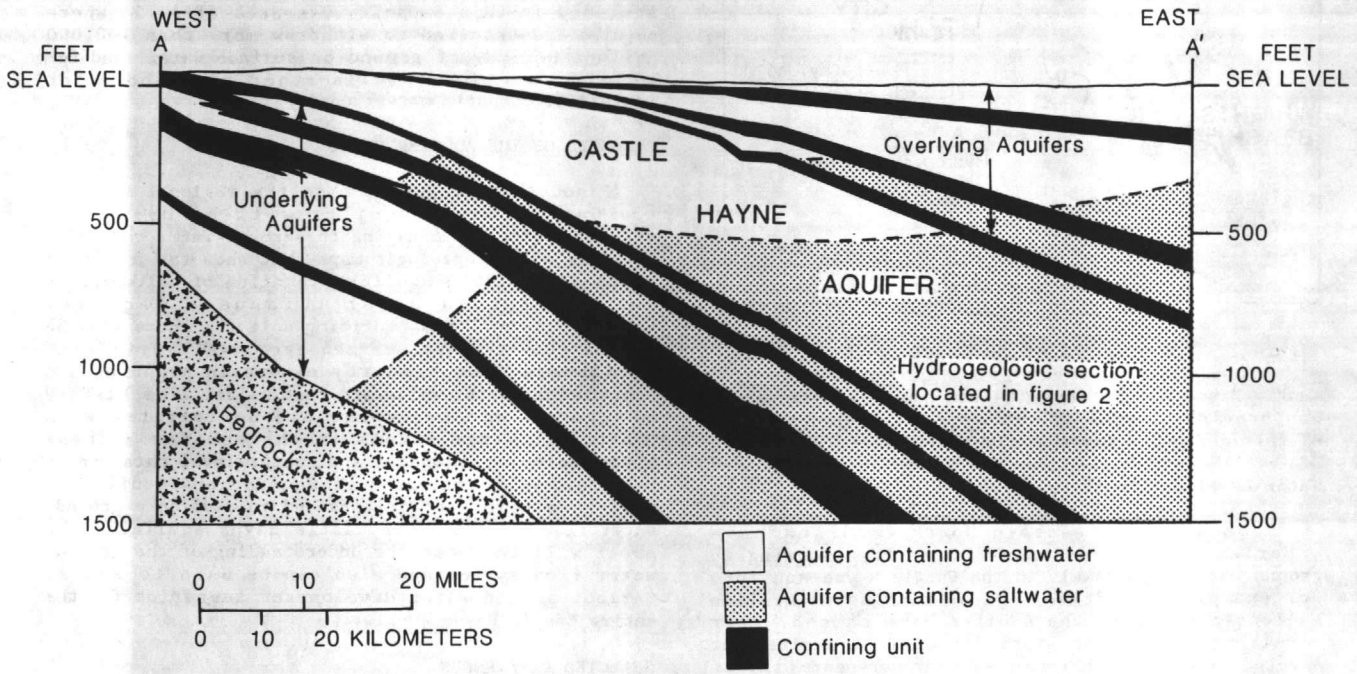

Figure 1. Hydrogeologic section through the eastern part of North Carolina.

WHAT IS THE CASTLE HAYNE AQUIFER?

The Castle Hayne aquifer is an eastward sloping and thickening wedge of limestone and sandstone (fig. 1), which is located in a 12,500 square-mile area in the eastern part of North Carolina (fig. 2). The Castle Hayne aquifer is the major source of freshwater for much of coastal North Carolina, and, in many parts of eastern North Carolina where the aquifers underlying the Castle Hayne contain saltwater (fig. 1), it is the only source of freshwater. The Castle Hayne also is the most productive aquifer in the State; more water is pumped from it than any other single aquifer, and maximum yields of individual wells are greater than yields from wells tapping other aquifers. Over 100 million gallons of water per day are withdrawn for municipal, industrial (including mining and quarrying), and irrigation uses. Well yields commonly range from 200 to 500 gallons per minute, although yields have been known to exceed 2,000 gallons per minute.

The freshwater and saltwater parts of the aquifers in eastern North Carolina are shown in figure 1. Saltwater is defined as containing more than 250 milligrams of chloride per liter of water, the limit used as a drinking water standard by the U.S. Environmental Protection Agency. The Castle Hayne aquifer is filled with water that contains less than 250 milligrams of chloride per liter in the freshwater area and with water exceeding that concentration in the saltwater area. Throughout extensive areas, freshwater is found in the upper part of the aquifer and saltwater is found in the lower part.

REGIONAL AQUIFER STUDY

A regional study of the Castle Hayne aquifer will provide definitive information on the declines in water levels and of saltwater intrusion in the area. Ground-water withdrawals from the Castle Hayne aquifer are regulated by the State of North Carolina in part of the region. A better understanding of the hydrology and the ground-water resource potential of the aquifer is necessary for effective management. The U.S. Geological Survey, the North Carolina Department of Natural Resources and Community Development, and several counties and municipalities are considering a cooperative study in order to better understand the aquifer. This paper summarizes some of the water problems that have been identified in the

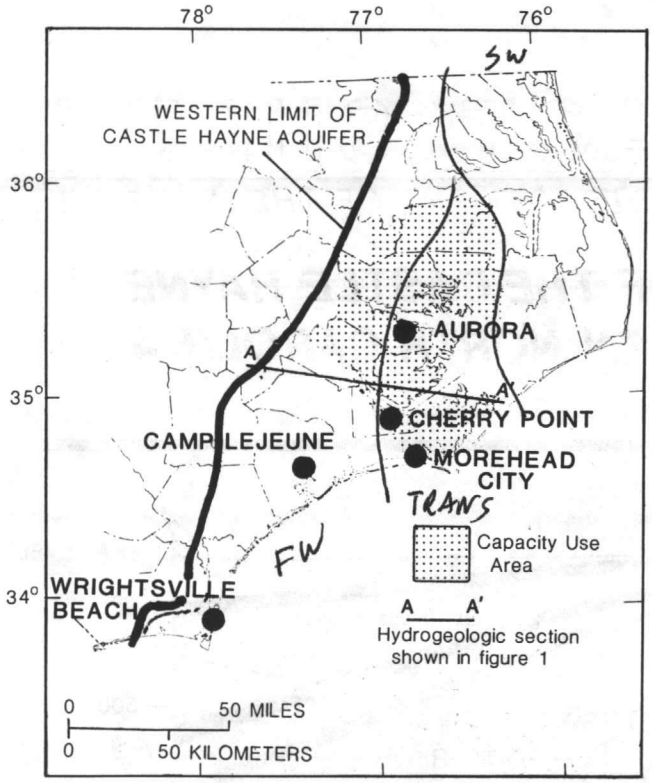

Figure 2. Areal extent of the Castle Hayne aquifer.

Castle Hayne aquifer and outlines how an aquifer study can provide useful information for better management of this and other major ground-water resources.

Water-Level Declines

Some areas in eastern North Carolina have experienced a lowering of water levels owing to ground-water withdrawals in the Castle Hayne aquifer. For example, withdrawals of as much as 65 million gallons a day from the aquifer have caused water levels to decline at least 125 feet at a mine near Aurora. Water levels in a well near Morehead City in Carteret County (fig. 2) have gradually declined about 2.5 feet from 1976 to 1986 as a result of withdrawals by several water-supply systems in that area. Water levels, which are lowest in July and August and show recovery beginning in early September, are affected primarily by ground-water withdrawals from the Castle Hayne aquifer during the summer tourist season.

Saltwater Intrusion

Saltwater intrusion is a major concern to water-system managers in coastal areas, and saltwater has intruded into the Castle Hayne aquifer in some areas of the North Carolina Coastal Plain: at a mine near Aurora; in some water-supply wells at the U.S. Marine Corps' Camp Lejeune (fig. 2); and in the public water supply during the summer tourist season in the Town of Wrightsville Beach on the southern coast (fig. 2). Saltwater can be drawn toward pumping wells from at least one of the following sources: (1) from underlying aquifers that contain saltwater in a process called upconing, (2) from nearby estuaries, and (3) from the Castle Hayne aquifer itself, owing to the lateral movement of saltwater from within the aquifer.

Saltwater intrusion into well fields is of primary concern where freshwater occupies the upper part of the Castle Hayne aquifer and saltwater is in the lower part. An increase in chloride concentration owing to the upconing of the saltwater in the lower part of the aquifer can occur in deep wells that penetrate to only a short distance above the saltwater. An increase in incidents of saltwater intrusion can be expected as development continues and more ground water is withdrawn.

Regulation of Ground-Water Resources

About 2,500 square miles of the study area was designated in 1968 by the State of North Carolina as the State's first and only (1987) capacity-use area in response to concerns about the effects of ground-water withdrawals from the Castle Hayne aquifer in a mining area near Aurora. A capacity-use area is defined as an area where the use of water resources exceeds, or threatens to exceed, the renewal or replenishment of the resource to the extent that regulation is, or will be, needed. All or parts of eight counties are included in this capacity-use area (fig. 2) where permits are required to withdraw more than 100,000 gallons per day of ground or surface water, and for construction of any wells other than those for individual domestic water supplies.

PRODUCTS OF THE AQUIFER STUDY

Products that result from the regional study of the Castle Hayne aquifer will be useful in understanding and managing the ground-water resource. A series of hydrogeologic maps that show the altitude of the top of the aquifer, location of saltwater in the aquifer, aquifer thickness, aquifer transmissivity, and confining-unit thickness will be useful to water-systems managers, well drillers, irrigators, and property owners in planning and constructing water wells and test holes. The history of ground-water pumpage can be compared with historical water-levels in the aquifer. These hydrogeologic, pumpage, and water-level data can be used to develop estimates of aquifer and confining-unit hydraulic coefficients and to develop a ground-water flow model for the Castle Hayne aquifer. The model will increase the understanding of the ground-water flow system and also can be used to assess various ground-water development scenarios for the entire Castle Hayne aquifer.

SELECTED REFERENCES

Coble, R.W., Giese, G.L., and Eimers, J.L., 1984, North Carolina ground-water resources in National Water Summary: U.S. Geological Survey Water-Supply Paper 2275, p. 329-334.

Coble, R.W., Giese, G.L., and Winner, M.D., Jr., 1987, Application of regional aquifer systems analysis for ground-water management in North Carolina: American Water Resources Association Monograph, 12 p. [in press].

North Carolina Groundwater Section, 1974, Status report on groundwater conditions in capacity use area no. 1, central Coastal Plain, North Carolina: North Carolina Department of Natural and Economic Resources Groundwater Bulletin No. 21, 146 p.

U.S. Environmental Protection Agency, 1984, National secondary drinking water regulations, 37 p.

Prepared by: William L. Lyke and Ronald W. Coble

For further information, contact:

District Chief
U.S. Geological Survey, WRD
Post Office Box 2857
Raleigh, North Carolina 27602

Open-File Report 87-571

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Titles on Media:

USGS GD-Water Study

City, county to cooperate in water study

9/18

By MIKE DART
City Editor

The Jacksonville City Council authorized the city Tuesday night to participate in a study of the area's groundwater supply.

Jacksonville and Onslow County officials have pushed for the study because the groundwater supply they share is declining.

The council approved the city taking part in the study after City Manager James E. Caldwell said a U.S. Geological Survey official had told him and County Manager Rick Leary that U.S.G.S. workers could begin the study by the new year.

"They probably won't actually begin it until November or December," Caldwell said after the council's Tuesday night meeting. "It might even be the first of January."

But they can begin the paperwork immediately, he said.

County Clerk Belinda Formyduval said the Onslow Board of Commissioners approved participating in the study about three meetings ago. No further action should be required unless questions arise, she said.

The 24-month study will cost about $200,000, most of which will be paid by the federal government. The city will pay up to $35,000 over three fiscal years, $7,500 of it this fiscal year. The county would be responsible for a like amount. Jones County would pay about $5,000 for the small portion of that county that would be studied.

In recommending that the city participate in the study, Caldwell said he and the city's utilities director, A.F. McRorie, feel "it is going to be critical to us to know where to locate wells in the future."

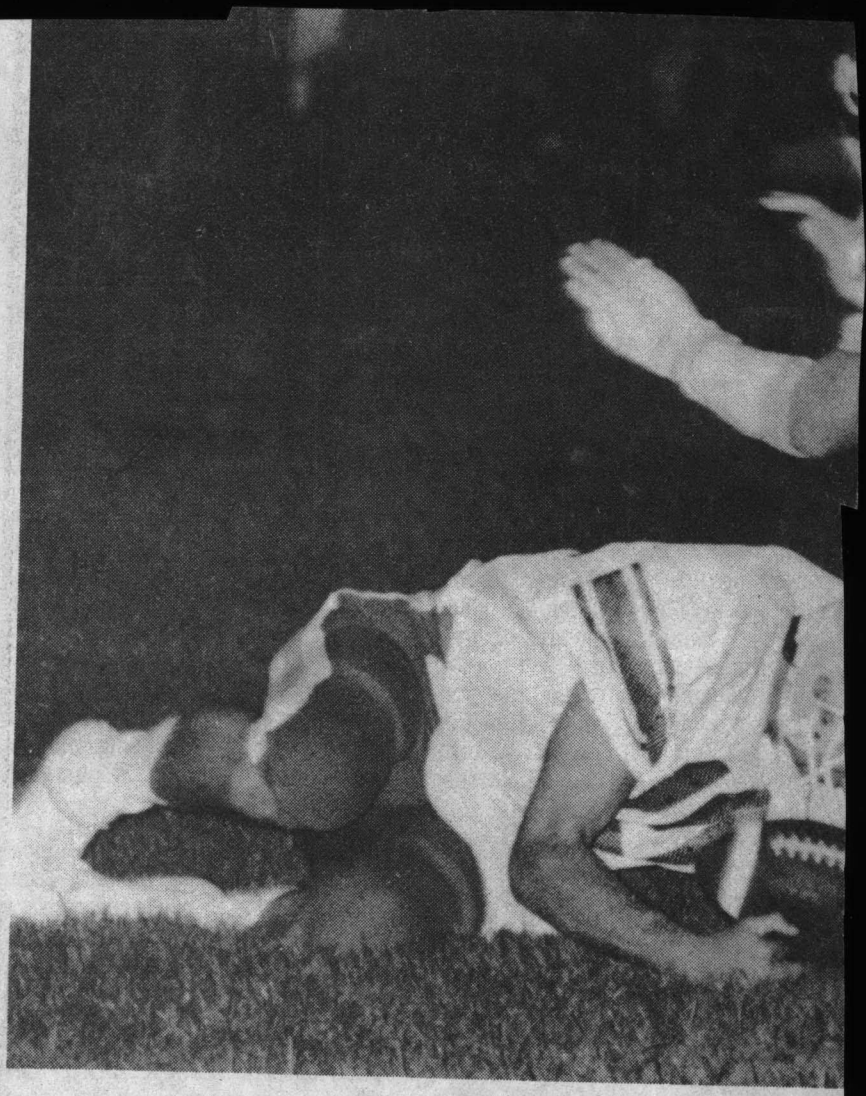
The city has been experiencing a lot of drawdown, he said. This drawdown is the lowering of the groundwater level due to pumping from wells.

Locating wells in the best locations will help keep the city from "having to lower the pumps every year or every other year," the city manager said.

In other business:

- Caldwell said the state Department of Transportation has approved the lowering of the speed limit on the newly widened and improved section of Gum Branch Road from 55 to 45 mph. "As soon as construction is completed, the signs will be erected," Caldwell said.

- The council accepted ownership of, and agreed to maintain, water and sewer lines at Triangle Plaza Mobile Home Park.



White Oak quarterback Mike McCarty scrambles

White Oak preps fo

By BRIAN DUNN
Daily News Staff

White Oak continues its steady diet of 1-A schools this week, but the Southwest Stallions should offer more of a challenge than what the

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their conference and make

Last year, Southwest d
on its way to a 9-1 reco
playoffs

UNITED STATES MARINE CORPS
Marine Corps Base
Camp Lejeune, North Carolina 28542-5001

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From: Assistant Chief of Staff, Facilities
To: Assistant Chief of Staff, Comptroller

Subj: FUNDING TRANSFER TO U.S. GEOLOGICAL SURVEY: GROUNDWATER SUPPLY STUDY, PHASE II

Ref: (a) CMC msg 302009Z Dec 86

Encl: (1) Work Plan

1. Request funds in the amount of $112,000.00 be transferred to the U.S. Geological Survey, Raleigh, North Carolina. FY 87-88 work to be accomplished in Phase II of the study is shown on the enclosure. Specifically, Phase IIA effort in FY 87-88 includes siting and drilling a number of test wells to study the water supply aquifers. Phase IIB will continue this effort in FY 88-89 provided CMC funds the work in FY 88. The reference approved funding for Phase IIA.

2. The U.S. Geological Survey administrative contact is Mrs. Nancy Williams, FTS 672-4510. Our point of contact is Mr. Bob Alexander, extension 3034.

K. J. KIRIACOPOULOS
By direction

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EnvEngr

UNITED STATES DEPARTMENT OF THE INTERIOR
Marine Corps Base
Camp Lejeune, North Carolina 28542-5001

7000
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APR 0 7 1987

From: Assistant Chief of Staff, Facilities
To: Assistant Chief of Staff, Comptroller

Subj: FUNDING TRANSFER TO U.S. GEOLOGICAL SURVEY: GROUNDWATER SUPPLY STUDY, PHASE II

Ref: (a) CMC msg 302000Z Dec 86

Encl: (1) Work Plan

1. Request funds in the amount of $112,000.00 be transferred to the U.S. Geological Survey, Raleigh, North Carolina, FY 87-88 work to be accomplished in Phase II of the study is shown on the enclosure. Specifically, Phase II A effort in FY 87-88 includes drilling and outfitting a number of test wells to study the water supply aquifers. Phase II B will continue this effort in FY 88-89 provided CMC funds the work in FY 88. The reference authorized funding for Phase II A.

2. The U.S. Geological Survey administrative contact is Mrs. Nancy Williams, FTS 672-4510. Our point of contact is Mr. Bob Alexander, extension 2034.

C. J. KIRKPATRICK
By direction

Copy to:
BMO

assessment of the hydrogeologic framework that was developed during Phase 1.

WORK TASK VI Continue preparation of GIS dataset and coordination with Camp Lejeune GIS system.

WORK TASK VII Prepare a report that describes the refined hydrogeologic framework. The proposed title of the phase 2b report is "Hydrogeologic framework beneath Camp Lejeune Marine Corps Base, North Carolina."

WORK PLAN FOR PHASE 3
Year 4 (April 1, 1989 - March 30, 1990)

WORK TASK I Construct a finite-difference ground-water flow model of the hydrogeologic system in and around Camp Lejeune based on the data and interpretations that resulted from investigations during Phases 1 and 2.

a. Design grid for modeled area and determine boundary conditions.

b. Discretize appropriate maps of aquifer and confining-bed characteristics (such as structure tops, thicknesses, hydraulic conductivity, potentiometric surfaces, etc.).

c. Develop a steady-state digital model for unstressed (pre-pumping) conditions and a transient model simulating the stressed conditions through present time.

d. Evaluate different ground-water pumpage and development schemes to determine which alternatives will reduce the chances for contamination of the water-supply aquifer (optimization analysis).

The ground-water flow model will be a management aid that can be used (1) to guide site selection for new wells through prediction of water-level drawdowns that will occur in response to planned pumping rates at potential well sites, and (2) to evaluate water-level drawdowns at existing production wells through prediction of drawdowns that would occur in response to alternative pumping schedules. The potential benefits to be gained from model studies are less well interference, lower pumping costs, and reduced chance for contamination of the water supply.

WORK TASK II Prepare report on the results of Phase 3 investigations with appropriate illustrations and data tables. The proposed title of the Phase 3 report is "Ground-water supply and potential for contamination--Camp Lejeune Marine Corps Base, North Carolina."

The proposed title for the report is: "Seismic Sub-Bottem Profiles of the New River at Camp Lejeune Marine Corps Base, North Carolina."

PHASE 2b
Year 3 (April 1, 1988 - March 30, 1989)

WORK TASK I Review available geologic, hydrologic, geophysical, and chemical data and determine exact location and number of test wells to be drilled. Coordinate drilling and additional data collection with the data compiled during the NACIP investigations at Camp Lejeune in order to share information and minimize expense where possible.

WORK TASK II Drill test wells and collect data needed to determine and confirm the physical and chemical characteristics of the aquifer and confining-bed materials and fluids that overlie and occur within the deep, limestone water-supply aquifer.

a. Collect split-spoon samples of aquifer and confining-bed materials at specified depth intervals and analyze selected samples to determine chemical and hydraulic characteristics.

b. Collect ground-water samples from test wells at specified depths and analyze samples for selected constituents including concentrations of chloride, heavy metals, and organic compounds that can be associated with the work activities at Camp Lejeune.

c. Make water-level measurements and selected hydraulic tests at specified depth intervals in the test wells to determine the distribution of hydraulic head and hydraulic conductivity.

d. Make geophysical logs in test wells selecting combinations of gamma-ray, neutron, bulk density, sonic travel-time, resistivity, spontaneous potential, and conductivity surveys best suited to data needs.

WORK TASK III Analyze geophysical logs.

a. Analyze the geophysical and lithologic logs to identify depths to aquifer units and confining beds.

b. Construct cross sections to determine the lateral extent of aquifer units and confining beds.

WORK TASK IV Conduct aquifer tests on new and existing wells to determine hydraulic properties of aquifer unit(s) and confining beds.

WORK TASK V Based on new findings, refine and edit the preliminary

9-17-87

AN APPRAISAL OF THE GROUND-WATER RESOURCES OF THE CAMP LEJEUNE MARINE CORPS BASE, N.C.

WORK PLAN FOR PHASE 2
(Years 2 and 3 (April 1, 1987 - March 30, 1989)

Phase 2 will extend over a two-year period and will be devoted to geophysical surveying, construction of a Graphical Information System (GIS) dataset, test drilling, and the collection and analysis of additional water quality, hydrogeologic, and aquifer hydraulic-parameter data. The work tasks will be divided into two subphases, 2a and 2b. Phase 2a will be a geophysical survey and GIS phase, and Phase 2b will be a drilling, testing, GIS, and data-analysis phase. At the end of Phase 2a, a data report describing the results of the geophysical survey will be prepared. The report will include cross-sections based on the results of Phase 1 and the geophysical survey results. During the third year of the study, or Phase 2b, well-drilling and geophysical logging of wells will be completed, analysis of the geophysical logs will be completed, editing and refinement of the preliminary hydrologic framework developed during Phase 1 and 2a will be completed, and aquifer tests on test wells and existing wells will be conducted to determine hydraulic properties of the aquifers and confining beds. At the end of Phase 2b, a report on the revised hydrogeologic framework will be prepared. This report will include information on the hydraulic and water-quality properties of the aquifers and confining beds and the spatial variability of these properties beneath the base.

PHASE 2a
Year 2 (April 1, 1987 - March 30, 1988)

sub-bottom GIS

WORK TASK I Continue examination of existing data, establish new cross sections, and make revisions in the Phase I report as necessary.

WORK TASK II Plan and execute a geophysical survey of the New River, using seismic sub-bottem profiling. The survey will be designed to extend the cross sections that can be drawn using existing well data.

WORK TASK III Initiate GIS database to be used in generating the data grid for the model. Coordinate database generation with The Camp Lejeune GIS system.

a. Learn GIS.

b. Prepare preliminary data sets.

WORK TASK IV Prepare report on the results of Phase 2a investigations with appropriate illustrations and data tables. This will be a data report that descibes the results of the sub-bottom profiling geophysical survey.

1760 9

6280/9
FAC
JUN 0 3 1987

From: Commanding General, Marine Corps Base, Camp Lejeune
To: Commandant of the Marine Corps (Code LFL), Washington, D.C. 20380
Commander, Atlantic Division, Naval Facilities Engineering Command (Code 40), Norfolk, Virginia 23511-6287

Subj: GROUNDWATER SUPPLY STUDY BY U.S. GEOLOGICAL SURVEY (USGS)

Encl: (1) USGS ltr dtd 7 May 1987

1. We are forwarding the results of our in-progress review of the Phase I study at the enclosure. The issues addressed in the USGS letter are described below.

2. For CMC (LFL). Request additional funding support for FY-87 and 88 in the amount of $75,000 for each of the two years. Please advise if additional funds are not available in order to revise the Phase II workplan.

3. For LantNavFacEngCom (Code 40). Problems with reduced well yields were discussed during the April 16th meeting and are mentioned in the enclosure. One solution to improving well efficiency is to require well logs to be completed during well drilling and these logs be used by the well construction contractor in setting the depths of the well screens. To accomplish this, current well construction contract specifications may have to be modified. We would like your input on this.

4. This procedure would require the expertise of a hydrogeologist in interpreting the geophysical logs in a short time frame to avoid well construction contract delays in finishing the well. The USGS personnel in Raleigh have indicated they could provide such technical assistance in a 48-hour turn around after receiving the logs.

5. Due to the limited number of wells planned for construction in the future and the long-term benefits to be gained by requiring geophysical logs, we would like your input on the feasibility of using this procedure in the future. If you think it is feasible, we will work with USGS to develop a set of standard specifications for the geophysical logging for use by our Public Works Division and your design staff.

6. The draft Phase I report which we are providing by separate correspondence indicates the water supply aquifer lacks protection from potential surface contamination by hazardous materials. This issue is a critical one and must be fully addressed by both the NACIP program and the ongoing Hazardous Waste Control program at Camp Lejeune.

Subj: GROUNDWATER SUPPLY STUDY BY U.S. GEOLOGICAL SURVEY (USGS)

6. Our point of contact in this matter is Mr. Alexander, Marine Corps Base Environmental Engineer, Autovon 484-3034/3035.

B. W. ELSTON
By direction

Copy to:
LANTNAVFACENGCOM (Codes 114 & 09A)
USGS, Raleigh

Blind copy to:
BMO
NREA
PWO
EnvEngr

Writer: Mr. Alexander, EnvEngr, FAC, X3034
Typist: M. Ballentine, 29 May1987

UNITED STATES MARINE CORPS
Marine Corps Base
Camp Lejeune, North Carolina 28542-5001

7000
COMP-B
13 Oct 87

FIRST ENDORSEMENT on AC/S FAC Memo 7000 FAC of 24 Sep 87

From: Deputy Comptroller, Marine Corps Base, Camp Lejeune
To: Assistant Chief of Staff, Facilities, Marine Corps Base, Camp Lejeune

Subj: FUNDING TRANSFER TO U. S. GEOLOGICAL SURVEY ADDITIONAL FUNDS FOR GROUNDWATER SUPPLY STUDY PHASE II

1. Returned without action.

2. Upon receipt of the request and based on telephone conversation with Base Maintenance, Mrs. Brown, Fiscal Year 1987 P1 funds were not available to fund the requested $12,000.

M. E. EASON

OPNAV 5216/144A (Rev. 8-81)
S/N 0107-LF-052-2320

DEPARTMENT OF THE NAVY

Memorandum

7000
FAC

DATE: SEP 24 1987

FROM: Assistant Chief of Staff, Facilities, Marine Corps Base, Camp Lejeune

TO: Assistant Chief of Staff, Comptroller

SUBJ: FUNDING TRANSFER TO U. S. GEOLOGICAL SURVEY ADDITIONAL FUNDS FOR GROUNDWATER SUPPLY STUDY PHASE II

Encl: (1) USGS ltr dtd 21 Sep 87 w/encl
(2) NAVCOMPT form 2275 dtd 10 Apr 87

1. Request funds in the amount of $12,000 be transferred to the U. S. Geological Survey, Raleigh, North Carolina. Remaining FY-87 P-1 funds which were provided by HQMC should be used for this transfer.

2. FY-87/88 work to be accomplished in Phase II (a) of the study is shown in enclosure (1). Total budget for Phase II (a) is $124,000; $112,000 was transferred per enclosure (2). The additional funds will provide for geophysical surveys and data collection for input into the LUMS data base.

32. The U. S. Geological Survey administrative contact is Mrs. Nancy Williams, FTS 672-4510. Our POC is Bob Alexander, extension 3034.

B. W. ELSTON
Acting

Copy to:
BMO
EnvEngr

United States Department of the Interior

GEOLOGICAL SURVEY

Water Resources Division
P.O. Box 2857
Raleigh, NC 27602
(919) 856-4791

September 21, 1987

Mr. Robert E. Alexander
Assistant Chief of Staff, Facilities
Marine Corps Base
Camp Lejeune, North Carolina 28542

Dear Bob,

Enclosed, as you requested September 18, 1987, is the revised version of the funding projections for the U.S. Geological Survey ground-water study. The revisions include an accounting for real costs of support services, increases in the cost of doing business, and two elements not accounted for in the earlier projection: geophysical surveys and GIS.

If you have any questions about these projections, please call.

Sincerely,

Douglas A. Harned
Hydrologist

Enclosure

DAH/kh

RECEIVED
25 SEP 1987

9/21/87

FUNDING REVISIONS FOR U.S. GEOLOGICAL SURVEY GROUND-WATER STUDY

	Original a+b	Revised Phase IIa and IIb		Revised a+b
		April 1987-March 1988 (a)	April 1988-March 1989 (b)	
Construction and equipment:				
--Well drilling, construction, sampling, and testing	$115,000	$ 11,000	$ 75,000	$ 86,000
--Water sampling safety equipment	3,000	3,000	4,000	7,000
Geophysical logging	10,000	7,000	12,000	19,000
Geophysical surveys	--	10,000	3,000	13,000
Laboratory services	20,000	5,000	15,000	20,000
GIS training, data set	--	8,000	4,000	12,000
Data collection, analysis, interpretation, and report preparation	80,000	48,000	48,000	96,000
Support services (computer, support personnel)	--	32,000	28,000	60,000
Total	$228,000	$124,000	$189,000	$313,000

ORDER FOR WORK AND SERVICES—NAVCOMPT FORM 2275 (REV. 8-81) S/N 0104-LF-702-2751 Page 1 of Pages

1. THIS ORDER MUST BE ACCEPTED ON A REIMBURSABLE BASIS ONLY AND IS SUBJECT TO THE CONDITIONS LISTED ON THE REVERSE SIDE.				2. DOCUMENT NUMBER M6700187PO00010
3. REFERENCE NUMBER	4. FUNDS EXPIRE ON	5. WORK COMPLETION DATE 30 Sep 89	6. DATE PREPARED 10 Apr 87	7. AMENDMENT NO. NEW

8. FROM: Commanding General
Marine Corps Base
Camp Lejeune, North Carolina 28542

9. FOR DETAILS CONTACT:
Mr. Bob Alexander
FTS: 676-3034/5925

10. TO:
UIC
U. S. Geological Survey
P. O. Box 2857
Raleigh, NC 27602-2857

11. MAIL BILLINGS TO:
Accounting Division
Comptroller Department
Marine Corps Base
Camp Lejeune, N.C. 28542

12. ACCOUNTING DATA TO BE CITED ON RESULTING BILLINGS

A. ACRN	B. APPROPRIATION	C. SUB-HEAD	D. OBJ. CLASS	E. BU. CONTROL	F. SA	G. AAA	H. TT	I. PAA	J. COST CODE	K. AMOUNT
	1771106	2720	000	67001	0	067001	2D	000000	723 2084 2310Q	$112,000
L.									TOTAL THIS DOCUMENT	$112,000
M.									CUMULATIVE TOTAL	$112,000

13. THIS ORDER IS ISSUED AS A ☒ PROJECT ORDER ☐ AN ECONOMY ACT ORDER AND IS TO BE ACCOMPLISHED ON A ☐ FIXED PRICE ☒ COST REIMBURSEMENT BASIS. WHEN THE FIRST BLOCK IS CHECKED, THIS ORDER IS PLACED IN ACCORDANCE WITH THE PROVISIONS OF 41 U.S. CODE 23 AND DOD DIRECTIVE 7220.1. THE FOLLOWING SUPPLEMENTARY ITEMS ON REVERSE ALSO APPLY AND ARE AN INTEGRAL PART OF THIS ORDER: 1,2,3,4,5,6,7,9

14. DESCRIPTION OF WORK TO BE PERFORMED AND OTHER INSTRUCTIONS

Funds authorized for an appraisal of the Ground-Water Resources of Marine Corps Base, Camp Lejeune, NC in accordance with the attached project proposal.

Funds authorized will not be exceeded without prior approval of this Headquarters.

Blind Copy To:
Base Fiscal (EOB)
Base Maint. (FA 23)
AC/S Facilities

Request acceptance by signing block 16 below and returning to Commanding General, Attn: AC/S Comptroller, MCB, Camp Lejeune, NC 28542-5001

15. I CERTIFY THAT THE FUNDS CITED ARE PROPERLY CHARGEABLE FOR THE WORK OR SERVICES REQUESTED.	AUTHORIZING OFFICIAL (NAME, TITLE AND SIGNATURE) R. J. HERKENHAM, MAJ, USMC, DEP COMP.	DATE 10Apr8
16. THIS ORDER IS ACCEPTED AND THE WORK OR SERVICES WILL BE PROVIDED IN ACCORDANCE HEREWITH.	ACCEPTING OFFICIAL (NAME, TITLE AND SIGNATURE)	DATE

6280/9

5050
FAC

OCT 0 8 1987

Environmental Engineer

Assistant Chief of Staff, Facilities, Marine Corps Base, Camp Lejeune

TRIP REPORT MEETING WITH LANTDIV AND ENVIRONMENTAL SCIENCE AND ENGINEERING, INC. REGARDING INSTALLATION RESTORATION PROGRAM 16 SEPTEMBER 1987

1. From LANTDIV, Code 114: Mr. Rakowski, Mrs. Barnette, Mr. Wallmeyer.
From ESE: Mr. Gregory, Mr. Geden, Mr. Farrell.
From MCB: Mr. Alexander.

2. The Purpose of the Meeting: To review the Installation Restoration Program status, specifically to review the proposed remedial actions for the Hadnot Point groundwater problems and to examine data collected to date on the remaining 22 contaminated sites aboard Camp Lejeune.

3. A summary of the Hadnot Point groundwater problem follows:

a. In the shallow aquifer 15 volatile organic compounds (VOC) have been identified; the four most serious compounds violate recommended State and EPA standards.

b. Two large plumes have been identified in the shallow aquifer. One includes a portion of the industrial area between Building 1700 and the Burger King extending from Holcomb Boulevard to Louis Street. The second includes the area from the fuel farm on Ash Street northeastward to Sneads Ferry Road and from Holcomb Boulevard to Louis Street on the Southeast.

c. One of the most significant issues currently being addressed is the issue of "how clean is clean". Neither State nor EPA standards are clearly defined although North Carolina has provided their Maximum Contaminant Limits for seven of the problem pollutants. (Note: State of North Carolina is proposing revised standards. We should get these and comment as needed.)

d. Recent deep well monitoring has identified an additional contaminant, methol ethyl ketone (MEK), in the deep aquifer. This new data will compound the problem of identifying groundwater treatment options for the deep aquifer because MEK is not treated with the same methods as the other pollutants identified to date.

AK

/ed

Subj: TRIP REPORT MEETING WITH LANTDIV AND ENVIRONMENTAL SCIENCE AND ENGINEERING, INC., REGARDING INSTALLATION RESTORATION PROGRAM 16 SEPTEMBER 1987

e. ESE described a tentative list of short and long term remedial options to be presented in a report in a comparison of effectiveness and total cost.

f. Groundwater treatment options currently being examined will cause additional environmental emissions through one or all of the following media:

--Sewage treatment plant
--Air emissions
--Packaged VOC for hazardous waste disposal off base

g. We recommend pulling the pumps and equipment at the eight contaminated water supply wells in the Hadnot Point area, leaving them available for sampling only.

4. An estimated schedule of events for the Hadnot Point groundwater problem includes:

a. ESE will send a draft Remedial Investigation/ Feasibility Study Report to LANTDIV and Camp Lejeune in early October (RI/FS).

b. We will review the report ASAP and return to ESE for a final draft.

c. Upon revision, we will send the report to the State and EPA (estimated in mid November) for their review over a 30 day period. Some time within that 30 day period a briefing will be held here at Camp Lejeune with the State and EPA officials.

5. Regarding the other 22 IRP sites.

a. We recommend discontinuing work at nine sites due to the lack of documented contamination of any significance.

b. We recommend doing a Risk Analysis at six sites to determine if additional contaminants exist and/or are causing environmental problems.

c. We recommend continued monitoring and development of clean up options at seven sites and development of a change order for the ESE contract to produce a report regarding the findings at these sites. This report should be available at the end of the second quarter FY-88.

Subj: TRIP REPORT MEETING WITH LANTDIV AND ENVIRONMENTAL SCIENCE AND ENGINEERING, INC., REGARDING INSTALLATION RESTORATION PROGRAM 16 SEPTEMBER 1987

6. I have discussed these findings with Mr. Hubbel, CMC LFL, and he feels that MCB and LANTDIV should discuss the release of some of this information to the public in accordance with the superfund amendments. We will need to review these regulatory requirements for public involvement with the JPAO and develop a cooperative effort in light of these rules and the possibility that Camp Lejeune sites could be named to the EPA National Priority List.

R. E. ALEXANDER

Copy to:
JPAO
SJA
NREAD
PWO
BMO

United States Department of the Interior

GEOLOGICAL SURVEY

Water Resources Division
P.O. Box 2857
Raleigh, NC 27602
(919) 856-4791

September 21, 1987

Mr. Robert E. Alexander
Assistant Chief of Staff, Facilities
Marine Corps Base
Camp Lejeune, North Carolina 28542

Dear Bob,

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If you have any questions about these projections, please call.

Sincerely,

Douglas A. Harned

Douglas A. Harned
Hydrologist

Enclosure

DAH/kh

SEP 21 1987
RECEIVED

9/21/87

FUNDING REVISIONS FOR U.S. GEOLOGICAL SURVEY GROUND-WATER STUDY

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S/N 0104-LF-702-2751 Page 1 of Page

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Marine Corps Base
Camp Lejeune, North Carolina 28542

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U. S. Geological Survey
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Base Maint. (FA 23)
AC/S Facilities

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R. J. HERKENHAM, MAJ, USMC, DEP COMP.

DATE
10Apr8

16. THIS ORDER IS ACCEPTED AND THE WORK OR SERVICES WILL BE PROVIDED IN ACCORDANCE HEREWITH.

ACCEPTING OFFICIAL (NAME, TITLE AND SIGNATURE)

DATE

WORK PLAN FOR PHASE 1
(April 1, 1986 - April 1, 1987)

Work items to be accomplished during Phase 1 will be based almost entirely on existing data.

WORK TASK I Compile all available ground-water data from USGS, State, and Camp Lejeune files for the area, including water-level, water-quality, water-use, and well-log data. Construct a computer data set of this data that will facilitate future statistical analysis.

a. Compile USGS data sources.

b. Compile N.C. Department of Natural Resources and Community Development data sources.

c. Compile Camp Lejeune data resources.

d. Inventory existing wells, take water-quality samples, and evaluate field parameters including chloride concentration, bromide concentration, pH, temperature, dissolved oxygen, specific conductance.

WORK TASK II Develop preliminary maps and other information products describing the geohydrologic framework beneath the base and adjacent areas in Onslow County.

a. Evaluate the general lithic character, thickness, extent, and continuity of confining beds and aquifers, from examination of geophysical logs made in existing wells in the study area.

b. Run new geophysical logs for existing wells where additional data is needed. These logs may include gamma-ray, neutron, bulk density, sonic gravel-time, and caliper logs.

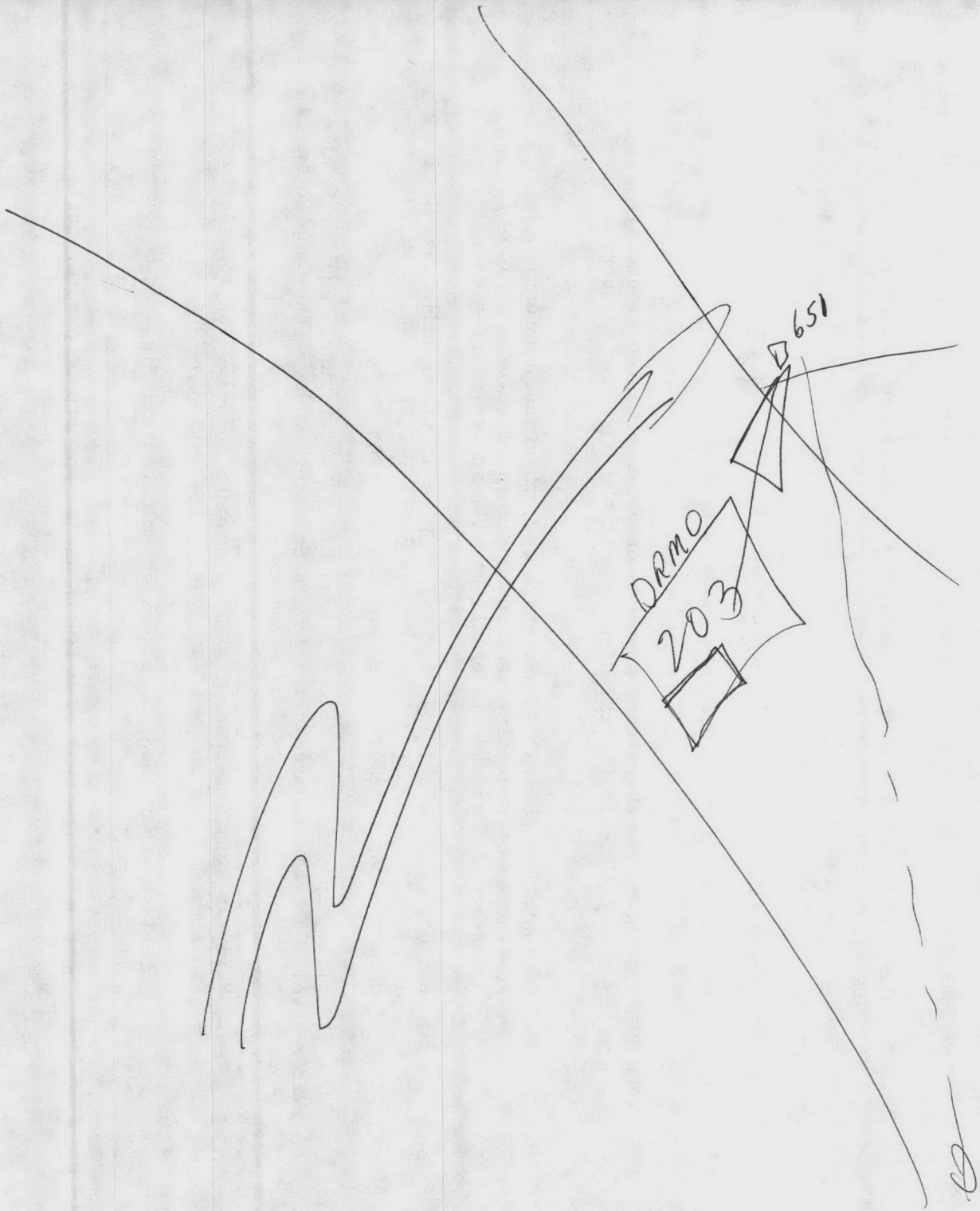
WORK TASK III Map potentiometric surfaces of the water-supply aquifer from water-level measurements made primarily in existing wells in the Camp Lejeune area.

a. Make two sets of water-level measurements in wells and local creeks and streams, one in "wet" and one in the "dry" season.

b. Establish water-level recorders on selected existing and available wells.

c. Construct a few shallow wells if needed to prepare a water-table map.

The information from WORK TASKS I, II, and III will be used to make a preliminary assessment of the hydrogeologic framework beneath Camp Lejeune. This assessment will be reviewed in Phase 2a (WORK TASK I) to determine the location and number of test wells to be drilled.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203

WORK TASK IV Prepare report on the results of the Phase 1 investigations with appropriate illustrations and data tables. The proposed title of the Phase 1 report is "A preliminary geohydrologic framework of the Camp Lejeune Marine Corps Base area, N.C."

WORK PLAN FOR PHASE 2
(Years 2 and 3 (April 1, 1987 - March 30, 1989)

Phase 2 will extend over a two-year period and will be devoted to test drilling and the collection and analysis of additional water quality, hydrogeologic, and aquifer hydraulic-parameter data. The work tasks associated with the drilling, testing, and analysis of new well data will be divided into two subphases, 2a and 2b. Phase 2a will be a drilling phase and Phase 2b will be a testing and data-analysis phase. At the end of Phase 2a, a data report describing the hydrogeology of the new wells will be prepared. The report will include information on geologic formations and aquifer materials penetrated by the test wells, water quality in the wells, and geophysical logs completed by the end of 2a. During the third year of the study, or Phase 2b, geophysical logging of wells will be completed, analysis of the geophysical logs will be completed, editing and refinement of the preliminary hydrologic framework developed during Phase 1 will be completed, and aquifer tests on test wells and existing wells will be conducted to determine hydraulic properties of the aquifers and confining beds. At the end of Phase 2b, a report on the revised hydrogeologic framework will be prepared. This report will include information on the hydraulic and water-quality properties of the aquifers and confining beds and the spatial variability of these properties beneath the base.

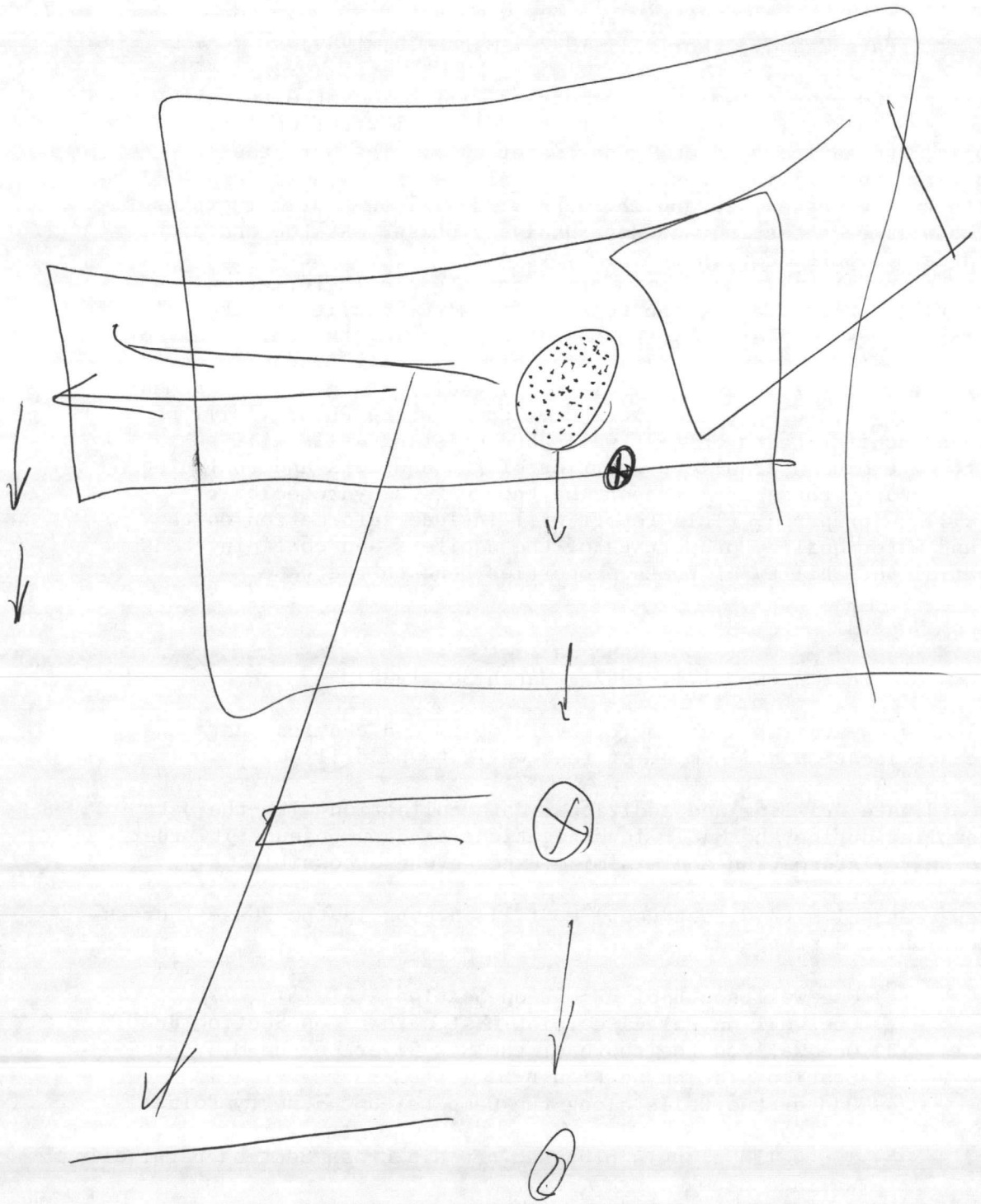
PHASE 2a
Year 2 (April 1, 1987 - March 30, 1988)

WORK TASK I Review available geologic, hydrologic, and chemical data and determine exact location and number of test wells to be drilled.

a. Coordinate drilling and additional data collection with the data compiled during the NACIP investigations at Camp Lejeune in order to share information and minimize expense where possible.

b. New test wells (200 feet deep) to fill in gaps in the Phase I cross sections are proposed:

1) One well south of HP-632 on Section A-A'
2) One well on Paradise Point east of NW-3 on Section B-B'
3) One well on the shore of the New River on the M.C. Air Station side on Section B-B'
4) One or two wells along the Camp Lejeune--Cherry Point Railroad
5) Two wells along a proposed new dip Cross Section paralleling Wallace Creek



Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the freshwater-saltwater interface and its relation to supply-well pumping in the M.C. Air Station area.

Finally, it is estimated that three test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area, however, project funding is not sufficient to allow the drilling of these wells (April 1987).

WORK TASK II Prepare drilling specifications, distribute specifications for bids, and award contract.

WORK TASK III Drill test wells and collect data needed to determine and verify the physical and chemical characteristics of the aquifer and confining-bed materials and fluids that overlie and occur within the deep, limestone water-supply aquifer.

a. Collect split-spoon samples of aquifer and confining-bed materials at specified depth intervals and analyze selected samples to determine chemical and hydraulic characteristics.

b. Collect ground-water samples from test wells at specified depths and analyze samples for selected constituents including concentrations of chloride, heavy metals, and organic compounds that can be associated with the work activities at Camp Lejeune.

c. Make water-level measurements and selected hydraulic tests at specified depth intervals in the test wells to determine the distribution of hydraulic head and hydraulic conductivity.

d. Make geophysical logs in test wells selecting combinations of gamma-ray, neutron, bulk density, sonic travel-time, resistivity, spontaneous potential, and conductivity surveys best suited to data needs.

e. Make surficial geophysical surveys over the New River and elsewhere as feasible to supplement data obtained from the test wells.

WORK TASK IV Prepare report on the results of Phase 2a investigations with appropriate illustrations and data tables. This will be a data report that describes test- and observation-well construction and the new hydrogeologic data from the test wells. The proposed title of the Phase 2a report is "Well logs and hydrologic data from test wells at Camp Lejeune Marine Corps Base, North Carolina." The well logs will include both geophysical and lithologic logs.

PHASE 2b
Year 3 (April 1, 1988 - March 30, 1989)

WORK TASK I Complete drilling, sampling, and hydraulic tests of test wells. (This is first priority work item if drilling and testing of test wells was not completed during Phase 2a or if the drilling of additional wells became necessary.)

WORK TASK II Complete geophysical logging of new and existing wells. Analyze logs.

a. Analyze the geophysical and lithologic logs to identify depths to aquifer units and confining beds.

b. Construct fence diagrams to determine the lateral extent of aquifer units and confining beds.

WORK TASK III Conduct aquifer tests on new and existing wells to determine hydraulic properties of aquifer unit(s) and confining beds.

WORK TASK IV Based on new findings, refine and edit the preliminary assessment of the hydrogeologic framework that was developed during Phase 1.

WORK TASK V Prepare a report that describes the refined hydrogeologic framework. The proposed title of the phase 2b report is "Hydrogeologic framework beneath Camp Lejeune Marine Corps Base, North Carolina."

WORK PLAN FOR PHASE 3
Year 4 (April 1, 1989 - March 30, 1990)

WORK TASK I Construct a finite-difference ground-water flow model of the hydrogeologic system in and around Camp Lejeune based on the data and interpretations that resulted from investigations during Phases 1 and 2.

a. Determine grid system for area and discretize appropriate maps of aquifer and confining-bed characteristics (such as structure tops, thicknesses, hydraulic conductivity, potentiometric surfaces, etc.).

b. Determine boundary conditions.

c. Develop a steady-state digital model for unstressed (pre-pumping) conditions in the area.

d. Evaluate different ground-water pumpage and development schemes to determine which alternatives will reduce the chances for contamination of the water-supply aquifer (optimization analysis).

The ground-water flow model will be a management aid that can be used (1) to guide site selection for new wells through prediction of water-level drawdowns that will occur in response to planned pumping rates at potential well sites, and (2) to evaluate water-level drawdowns at existing production wells through prediction of drawdowns that would occur in response to alternative pumping schedules. The potential benefits to be gained from model studies are less well interference, lower pumping costs, and reduced chance for contamination of the water supply.

WORK TASK II Prepare report on the results of Phase 3 investigations with appropriate illustrations and data tables. The proposed title of the Phase 3 report is "Ground-water supply and potential for contamination--Camp Lejeune Marine Corps Base, North Carolina."

UNITED STATES MARINE CORPS
Marine Corps Base
Camp Lejeune, North Carolina 28542-5001

04/2M
405
5280/9
FAC
Review & return
JUN 02 1987

From: Commanding General, Marine Corps Base, Camp Lejeune
To: Commandant of the Marine Corps (LFL)
Commander, Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA 23511-6287 (Code 114)

Subj: GROUNDWATER SUPPLY STUDY, REVIEW OF PHASE I USGS DRAFT REPORT

Encl: (1) USGS ltr dtd 7 May 87 w/Encl Draft Report

1. We are forwarding the enclosure for your review and comment. Phase I provides the basis for continued analysis of the groundwater supply, contamination, and future development to meet water supply needs through the 1990's.

2. Please address all comments or suggestions, telephonic or written, to Mr. Bob Alexander, AV 484-3034.

K. J. KIRIACOPOULOS
By direction

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UNITED STATES COAST GUARD

6280/9
FAC
AUG 0 6 1987

Mr. Wallace E. Venrick, P.E.
Branch Head
NC Department of Human Resources
Division of Health Services
P.O. Box 2091
Raleigh, North Carolina 27602-2091

Re: REVIEW OF DRAFT GROUNDWATER SUPPLY STUDY: PHASE I

Dear Mr. Venrick:

As discussed between Mr. Mike Bell of your Greenville office and Mr. Alexander, Marine Corps Base, Camp Lejeune, on 23 July 1987, we are forwarding this draft report for your information and review. As you know, we have been pursuing a detailed study of Camp Lejeune's groundwater supply and contamination issues in order to manage the water supply needs through the 1990's. This report provides preliminary information upon which to develop further groundwater studies by the U. S. Geological survey.

We would greatly appreciate any suggestions or data that you may have regarding the information in this report. Please contact Mr. Bob Alexander, Marine Corps Base, Environmental Engineer, (919) 451-3034 if you desire further details.

Respectfully,

K. J. KIRIACOPOULOS
Lieutenant Colonel, U. S. Marine Corps
Facilities Management Officer
By direction of the Commanding General

Blind copy to:
EnvEngr

AUG 05 1987

copy clipped pg 1 for Alex + return

(804) 445-2930

6280
1141JJH

6 APR 1987

From: Commander, Atlantic Division, Naval Facilities Engineering Command
To: Commanding General, Marine Corps Base, Camp Lejeune

Subj: ENGINEERING SERVICE REQUEST TO STUDY THE WATER SYSTEMS AT THE MCAS NEW RIVER AND CAMP GEIGER

Encl: (1) ESR Study of the Potable Water Systems at the MCAS New River and Camp Geiger

1. Enclosure (1), the ESR, is forwarded as a preliminary study report. Please review the contents carefully, particularly Attachment B, and address comments and questions to Mr. J. J. Harwood, AUTOVON 565-2930.

J. R. Bailey

J. R. BAILEY
By direction

(804) 445-2930

6280
1141JJH

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To: Commanding General, Marine Corps Base, Camp Lejeune

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J. R. BAILEY
By direction

ENGINEERING SERVICE REQUEST TO STUDY THE POTABLE WATER SYSTEMS AT THE MCAS NEW RIVER AND CAMP GEIGER, CAMP LEJEUNE, NORTH CAROLINA

MARCH 1987

ENVIRONMENTAL QUALITY BRANCH
UTILITIES, ENERGY, AND ENVIRONMENTAL DIVISION
ATLANTIC DIVISION, NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511-6287

Prepared by:

J. J. HARWOOD, P.E.
Environmental Engineer

Encl (1)

LIST OF ATTACHMENTS

A. Water Rehabilitation Guide

B. Contract Outline

Scope of Work - Valve and Leakage Survey

Cost Estimate

LIST OF ENCLOSURES

(1) C Factor Tests
(2) Water Budget
(3) Skeletonized Water System
(4) Existing MCAS Small Pumps
(5) Existing MCAS and Camp Geiger Plant Pipes
(6a) Improved System - New Line to Camp Geiger Reservoir (Model)
(6b) New Line Connection to Camp Geiger Reservoir - Scheme I
(6c) New Line Connection to Camp Geiger Reservoir (Map) - Scheme I
(7a) New Line Connection to Camp Geiger (Model) - Scheme II
(7b) New Line Connection to Camp Geiger (Map) - Scheme II
(8) Modified MCAS Pump Station
(9) New Pumps
(10) Tower Storage Sketches
(11a) 1983 Fire Protection Survey MCAS
(11b) 1985 Fire Protection Survey Camp Geiger
(12a) MOQ Pump House (AS2003)
(12b) MOQ Pump House Typical Fire Pump Curves
(13) NCO Club
(14) MOQ
(15) WHSE AS 3525
(16) Hangar AS 840
(17) Trailer Park
(18) EM Club with C=120
(19) Contaminated Fuel Tanks
(20) O'Club (MCAS)

1. Introduction

The Marine Corps Base, Camp Lejeune, North Carolina, submitted an Engineering Service Request for a study of the potable water systems of the MCAS, New River and Camp Geiger. Originally, each activity had its own water supply wells, treatment, pumping and storage facilities. An emergency 8-inch line connected both systems. A new water treatment and pumping plant was built at the Air Station which now supplies water to both the Air Station and Camp Geiger via the 8-inch emergency line.

2. Because of concerns about the reliability of the system, parts of which are quite old (1940 era), equipment and operational problems, and the need for a reliable system that will support present needs and future expansion plans, a complete system study in accordance with the Navy water pipe rehabilitation guide is needed (Attachment A). The five steps of the study are:

a. Site visit to collect data and make preliminary tests.

b. Hydraulic Analysis to identify improvements that are needed assuming the existing system is in usable condition.

c. Contracted field examinations to identify parts of the system which are not in usable condition.

d. Design of system improvements from b and c.

e. Two part construction contract to install the designed improvements.

(1) To replace valves and inspect pipe

(2) Replace pipe (if needed), and construct recommended system improvements.

3. Step a - Site Visit by Mr. J. Harwood, Code 114 was in April 1986.

This is a report of Steps a and b and it makes recommendations and provides cost estimates and scopes of work for Steps c and d which are to be accomplished by contract. Plans and specifications for Step e will be done by Step d.

The report covers operational and hydraulic equipment problems and makes specific improvement recommendations for adequate water flow, pressure and storage for present and future, normal and fire protection needs. It also addresses problems common to aging water systems.

4. Details

Operational and hydraulic equipment problems

a. Each system, Camp Geiger and the Air Station, have two elevated water storage towers. The new Air Station treatment and pumping plant is located at the Air Station near Camp Geiger. Treated water is pumped into lines going to Camp Geiger in one direction and the Air Station in another. Apparently, there is insufficient pumping capacity to fill the Air Station and Camp Geiger tower at the same time during periods of high water usage. The lines to the Air Station must be closed to fill the furthest Camp Geiger tower (STC 606). Water is still stored in a Camp Geiger reservoir and pumped into the system when needed to augment the Air Station pumps, and for emergencies.

b. Other reported problems were insufficient fire protection in the MOQ area; keeping the chlorine residual at the MOQ reservoir; insufficient fire protection for Hangar 840; the pumps at Camp Geiger loose their prime if the water level in the Camp Geiger ground storage reservoir gets too low; Camp Geiger elevated tower STC 1070 overflows before tower STC 606 fills unless the STC 1070 valve in the tower feed line is throttled; and much of the system is old and felt not to be reliable.

c. Recommendations to provide deluge sprinkler water supplies for Hangar 840 were also requested.

This report will provide specific recommendation that address these problems and improve the system to support present needs and future planned expansions.

5.

a. Information about population, water consumption, future plans and operation and facility problems were gathered during the site visit in April 1986. Preliminary tests to determine the condition of the pipe interiors were made and the following "C" factors were measured (enclosure (1)):

MCAS MCAVOY Road - between Campbell and Curtis; C = 119 (Good)

(This line was reported to have been previously cleaned by "pigging").

MCAS - MOQ Longstaff St; C = 111 (Good)
Camp Geiger D Street; C = 74 (Fair)

b. The results hold no surprises. The older Camp Geiger pipes are fair and the newer, probably cement lined, and cleaned pipes are in good condition.

c. A Water budget (enclosure (2)) indicates:

Average demand	= 896 KGPD
Expected usage	= 630 KGPD
Unaccounted for water	= 266 KGPD

$100 \times \frac{266}{890} = 30$ percent A good part of the 30 percent is probably leakage. This would also be expected from old parts of a water system.

6. a. A skeletonized computer model of the water system was made (enclosure (3)). The two smaller pumps (enclosure (4)) at the existing MCAS and Camp Geiger pumping stations were used, enclosure (5). A 48-hour extended period simulation was made for a maximum day (2.5 x average water usage). The results are graphically presented in Figure 1a for Tower STC 606. Note how the Tower STC 606 empties. This agrees with the operating experience if the Air Station is not valved off during Camp Geiger filling periods. A tower emptying is unacceptable. Notice that it empties about 0700 hours and does not recover during a maximum day of water usage.

b. A second simulation was made for the existing system using the large MCAS pumps (enclosure (4)). The results, shown in Figure 1b, also show Tower STC 606 emptying.

7. Two schemes were analyzed by computer model to resolve the hydraulic problems. Scheme I uses both MCAS and Camp Geiger pump stations and Scheme II uses only the MCAS pump station.

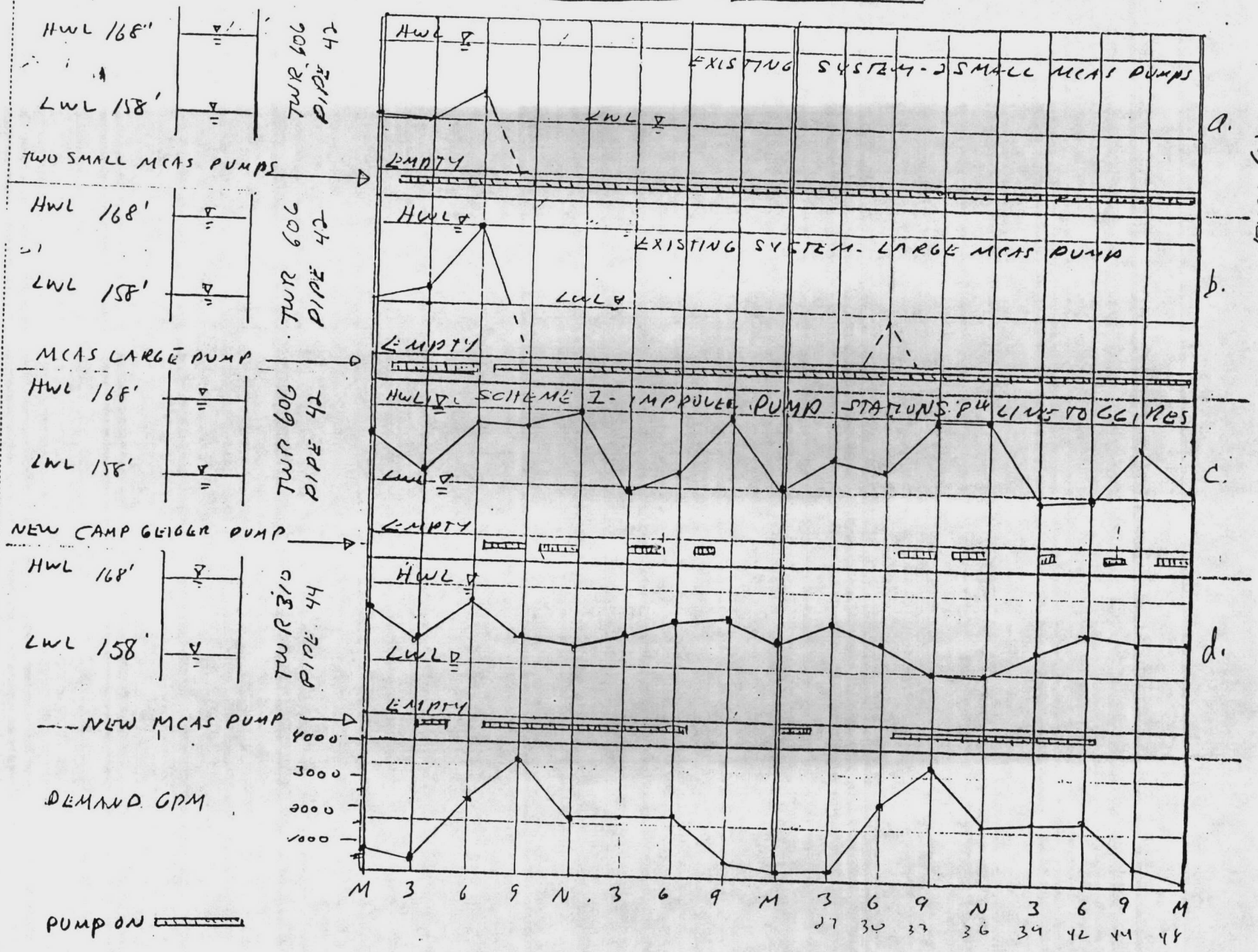
a. Scheme I - The computer model was improved by adding another 8-inch PVC line from the MCAS pump station to Camp Geiger, connecting at the Camp Geiger ground level reservoir, (enclosures (6a) and (7)). The flow rate to the reservoir is controlled by orifice plate (enclosure (6b)). The MCAS pump station was modified as shown in enclosure (8), and three new 6x8x18A Aurora pumps with 15 1/4-inch impellers were installed at the MCAS pump station, and two at the Camp Geiger pump station, (enclosure (9)).

b. Altitude values were installed at the towers and the high water levels set at elevations of 168 feet for all the towers. The pumps were set to turn on and off at the following tower water levels:

	Tower	HWL	LWL
MCAS Pump	STC 310	168	162
Camp Geiger Pump	STC 606	168	158

c. The two MCAS tank low water levels (LWL) were set at 162 feet to provide adequate fire reserve stored in the tower. The LWLs were set at 158 feet on the two Camp Geiger tanks because there is not enough storage capacity in the Camp Geiger elevated tanks for normal fluctuating operating demands and fire reserve. The fire reserve for Camp Geiger will have to come from the ground storage tanks. (Please see enclosure (10)).

FIGURE 1 - MAXIMUM DAY



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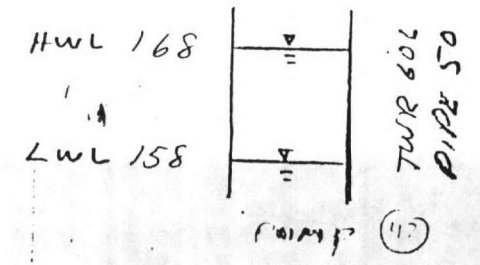
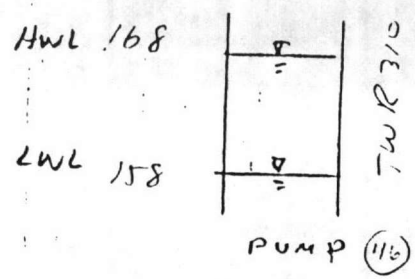
JOB NO. .....

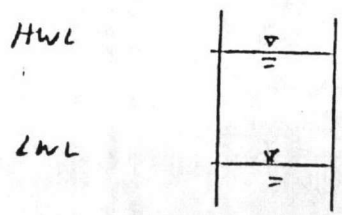
ENCL (6)

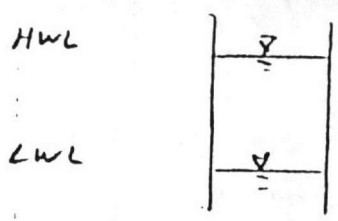
FIG 1 - MAXIMUM DAY

SCHEME II - IMPROVED SYSTEM - 10" M.I. TO CR GEIGER

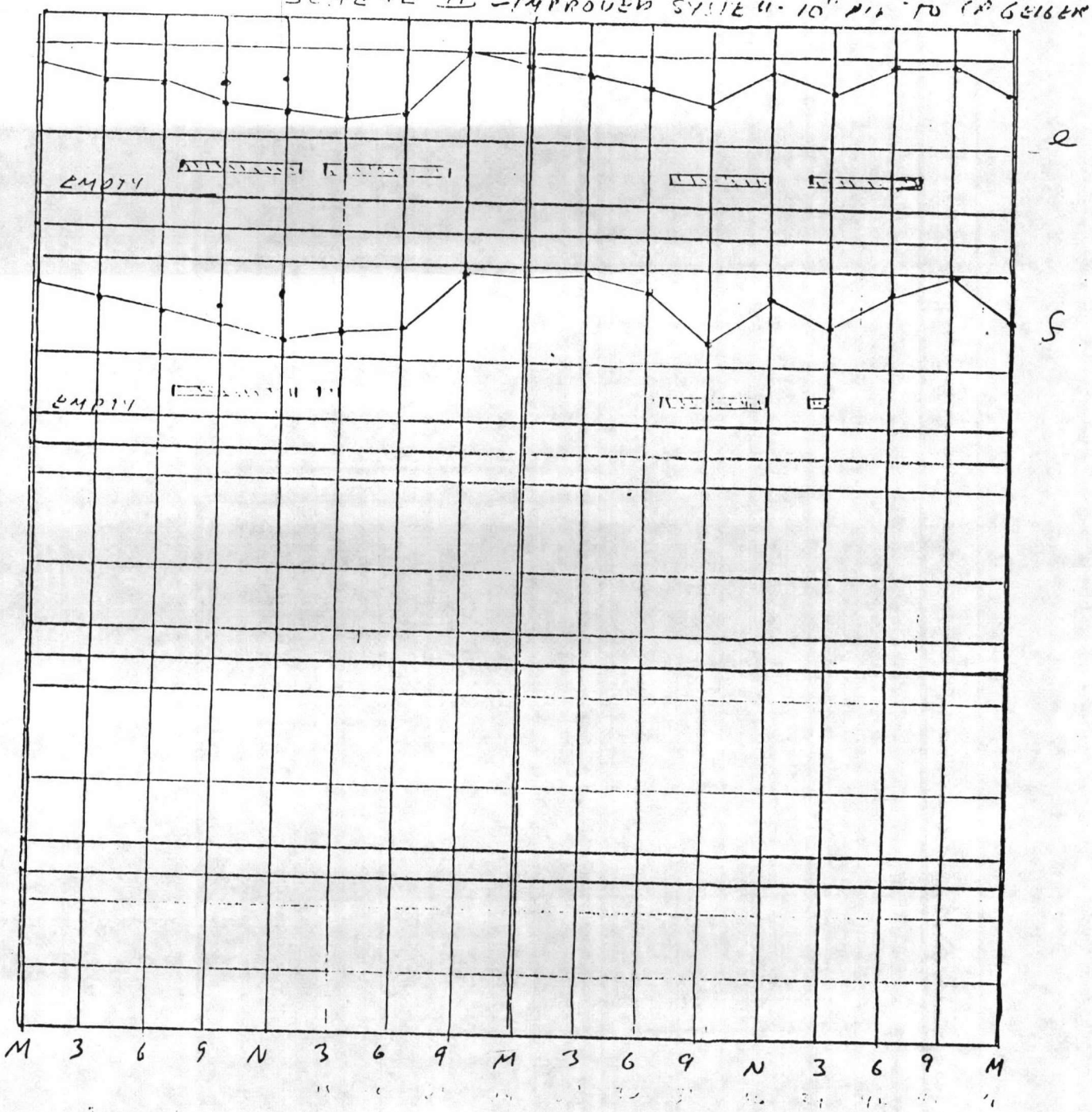








DEMAND GPM



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d. A 48-hour maximum day simulation was made for the improved system and the results show that the tanks do not empty (figure (1-c and d)). The MCAS pump operated for a total of 28 hours out of the 48, and the Camp Geiger pump operated 15 hours.

e. Enclosures (11a) and (11b) are excerpts from the 1983 and 1985 LANTNAVFACENGCOM fire protection surveys for the MCAS and Camp Geiger respectively. They show that fire protection capacity overall is good except for three locations at the MCAS. They are the MOQ area, Warehouse 3525 and the O'Club. The improved system model was used to simulate fire flows at those and other locations of Camp Geiger and the MCAS. The results are summarized as follows:

(FIRE FLOWS) SCHEME 1

Location	JCT	Flow GPM	Resid PSIG	Subtract PSIG	Final PSIG		Comments
1. Hangar AS 4106	24	7000	61	-	61	g.t.	20 OK
2. CG Bldg 10	5	1500	60	-	60	g.t.	20 OK
3. CG BEQ	1	1500	59	-	59	g.t.	20 OK
4. TRL PK	7	1500	55	47	8	l.t.	20 (1)
5. MCAS EM Club	33	1000	61	42	19	a.e.	20 (2)
6. MCAS O'Club	16	1000	49	24	25	g.t.	20 OK
7. Cont. Fuel Tks	24	3000	61	170	-109	l.t.	20 (3)
8. NCO Club		1000	(see encl (13))		40	g.t.	20 OK
9. Officers Housing		1000	(see encl (14))		54	g.t.	20 OK
10. Hangar AS 840		New pump REQ, see encl (16)					
11. Warehouse 3525		New pump and RES REQ, see encl (15)					

g.t. = greater than
l.t. = less than
a.e. = about equal

f. The NCO Club and MOQ are presently supplied fire flows and pressures from reservoir AS 2002 and pump station AS 2003. These locations were done by hand computations shown in enclosures (12), (13), and (14). The MCAS O'Club hand computations are shown in enclosure (20). Warehouse 3525 and Hangar AS 840 are remote and require flow and pressures above the capacities of present equipment. They will require separate storage tanks and booster pumps (please see enclosures (15) and (16)).

Scheme II. For this scheme, in addition to improving the MCAS pump station as shown in enclosure (8), the MCAS to Camp Geiger connection is a 10-inch PVC line from the pump station connecting Camp Geiger near Tower STC 1070 and south of Tower STC 600 (enclosures (7a) and (7b)). Altitude valves were set the same as for Scheme I, and two Aurora 6x8x18a pumps were used in the MCAS pump station. Towers STC 606 and AS 301 did not empty during a 48-hour maximum day simulation (Figure 1e and 1f). The two MCAS pumps operated 17 and 13 hours respectively.

(FIRE FLOWS) SCHEME 2

Location	JCT	Flow GPM	Resid PSIG	Subtract PSIG	Final PSIG		Comments
1. Hangar AS 4106	24	7000	62	-	62	g.t.	20 OK
2. CG Bldg 10	5	1500	57	-	57	g.t.	20 OK
3. CG BEQ	1	1500	46	-	46	g.t.	20 OK
4. TRL PK	7	1500	54	47	7	l.t.	20 (1)
5. MCAS EM Club	33	1000	62	42	20	e.t.	20 OK
6. MCAS O'Club	16	1000	51	24	27	g.t.	20 OK
7. Cont. Fuel Tks	24	3000	63	170	-107	l.t.	20 (3)
8. NCO Club		1000	(see encl (16))				
9. Officers Housing		1000	(see encl (14))				
10. Hangar AS 840		New pump req., see encl (16)					
11. Warehouse 3525		New pump and res. req., see encl (15)					

g.t. = greater than
l.t. = less than
a.e. = about equal
e.t. = equal to

COST COMPARISON

	Scheme I	Scheme II
Improve Pump Station	Same Cost	Same Cost
New Pump w/controllers	5 Pumps at 30K = 150K	3 pumps = 30K = 90K
New PVC Connections	5120'-8" @ 17.25 = 87K	3500'-10" @ 21 = 73.5K
Totals	237K	163.5K

Scheme I is more costly but it affords extra reserve fire protection storage water.

NOTES:
(1) Additional lines will be needed at TRL park - see enclosure (17).
(2) 20 PSIG residual can be obtained by cleaning line - see enclosure (18).
(3) Storage tank and pump will be needed at site - see enclosure (19).

8. Conclusions

a. In addition to adding pipes, pumps, etc., to the system to provide adequate capacity and operation, the condition of the existing system must be inspected, tested and improved to provide reliable service. Appendix B is an outline of steps for contracts to efficiently test the existing system and provide repairs and designs for installing the needed additional equipment identified by the hydraulic analysis. Appendix B pages I through VIII are scopes of work, cost estimates and costing information. The step sequences are based on previous examination of the system to determine what is needed for the next test or examination.

b. Initial flow tests (enclosure (1)) indicate some corrosion/scale build-up inside the pipes, but not enough to seriously affect operation. However, the 8-inch lines along Curtis and Flounder roads are suspect for low "C" factors, and should be tested. If C is less than 90, the pipe should be cleaned by pigging. The Langelier water stablization index is slightly positive, and therefore pigging is an appropriate method for cleaning and restoring low "C" factors. At this point, it suggested that the Navy Rehabilitation Guide, Attachment A, be read for information about rehabilitating older systems.

c. Scheme I affords more automatic reserve water storage with Camp Geiger's reservoirs and pumps. There is, however, sufficient storage available from the MCAS treatment plant reservoirs for daily operations and fire needs. Camp Geiger's reservoir and pump station can still be retained and used manually for its additional capacity.

d. The trailer park area use is minimal at present, and no improvements are recommended.

Recommendations for system improvements excluding the trailer park area:

1. Award a contract to:

a. Manipulate and test about 215 hydrants and hydrant valves and 560 isolation and maintenance valves 6 inches and larger (1). The test will be for condition, proper operation and valve leakage.

b. Perform a sonic leakage survey on all the exterior station pipes. There are about 25 miles of pipe.

c. Perform a soil resistivity/copper sulfate reference (Cathodic Protection) survey of the pipelines.

d. Perform "C" factor flow tests for pipes on Flounder and Curtis Roads by method shown in "Water Rehabilitation Guide", Attachment A.

e. Excavate and inspect the pipes for external condition at locations identified as corrosive from 1c (see Attachment B page VIII).

f. Prepare plans and specifications to replace leaking or inoperative valves hydrants and pipes from paragraphs 1a, 1b and 1c; and the following list of improvements:

LIST OF PROJECTS FOR DESIGN AND CONSTRUCTION

A. Install 10-inch PVC line from MCAS treatment plant to Camp Geiger - Scheme II, see enclosures (7a and 7b).

B. Modify the MCAS pump house piping and install new pumps in MCAS and Camp Geiger pump houses as shown in enclosures (8) and (9). The pumps will be controlled by pressures at Towers STC 606 and AS 310 as shown in the enclosures and in paragraph 6b of this report.

NOTES:
(1) Exclusive of trailer park, valves = about 511 plus 10 percent for counting errors = 560.

C. Provide for an inspection of the AS 2003 pump house and make any needed repairs to place it in proper operation. The pump house has piping to recirculate water through Reservoir AS 2002. Install a chlorinator in the pump house and recirculate chlorinated water through the reservoir in order to keep the chlorine residual.

D. Design and construct a new fire pump house which will take water from Reservoir AS 2002 and service a deluge sprinkler system in Hangar AS 408, (see enclosure (16)).

E. Provide a ground level reservoir and fire pump for fire protection at Warehouse AS 3525, and the contaminated fuel tanks, enclosures (15) and (19).

F. Provide Towers STC 606 and STC 1070 with two-way altitude valves. Repair the altitude valves at Towers AS 310 and 4130 if needed. All valves should close at elevation 168 feet.

Attachments C and D are a scope of work and cost estimate for the valve testing and pipe leakage survey.

2. Purchase and stock replacement valves, pipe and pipe repair parts for those valves and pipes identified in recommendations 1a, 1b and 1e. Using plans and specifications from 1e above, award a second contract to excavate and replace the leaking valves and repair the worst pipe leaks identified in 1a and 1b. Attachment B - pages VIII and VII are special specifications for valve repair work, pipe examination and unit costs. When the number of valves that need replacement is known from 1a, the unit costs of Attachment D can be used to develop a cost estimate for this second contract.

3. The excavations and pipe inspections should start at those locations where the soil is most corrosive and the pipe exteriors would be expected to be the worst. These locations will be identified by the cathodic protection survey of 1c. The information from this survey is to be used with the result of 1a and 1b to plan the sequence of valve and pipe excavation replacements/repairs. The pipes, especially the exteriors of the older pipes, should be examined at corrosive soil locations. Leaking valves and attached pipes at these corrosive areas should be the first to be excavated, inspected and the valves replaced. If a pipe or valve, in a corrosive location, is excavated and the exterior of the pipe is in good condition, it can be assumed that other pipes of the same age in a less corrosive location will also be in good condition.

4. Clean by "pigging" those lines found to have internal buildup from inspections of paragraph 3 and "C" factor tests of 1d.

5. Change Order the design contract 1e to provide plans and specs to replace pipes found to be deteriorated from paragraph 3.

6. Award a construction contract to replace pipes of paragraph 5 and make improvements recommended in this report and designed by paragraph 1f.

WATER BUDGET

AV WATER DEMAND = 896 KGPD

POPULATION - WATER USAGE DISTRIBUTION

CAMP GETTLER - 24 HR POP

PERMANENT PARTY	2996	6 JETS
STUDENTS	1020	
ON BASE BILLETS	2494	

6510 x 50 GPCD = 325,500 GPD

325,500 (1440 x 6 jets) = 37.7 gpm / JET (1,2,3,4,5,6)

BIR (C10) = 300/3 = 100 x 50 = 5,000 GPD

TOTAL 24 HR = 6610

EXPECTED WATER USE @ 50 GPCD = 330,000 GPD

MCAS NEW RIVER

MOQ = 114 HS6 UNITS x 4 PERS @ 50 = 22,800 GPD

22800 / (4 jets x 1440) = 4 gpm / JET (28, 29, 30, 31)

MEQ : 321 UNITS x 4 PERS @ 50 = 64,200 GPD

64,200 / (6 jets x 1440) = 7.4 gpm / JET (10, 11, 12, 13, 14, 15)

BEQ (4000 AREA) = 1396 x 50 = 69,800 GPD

69,800 / (3 jets x 1440) = 16.0 gpm / JET (25, 26, 27)

(200 AREA) = 814 PERS @ 50 = 40,700 GPD

40,700 / (1 jets x 1440) = 28.3 gpm / JET (17)

ENCL (2)

ENCL (2)

BEQ/BOQ (700 ARCH) = 195 pers @ 50 = 9750 gpd
9750 / (1440 x 1 jct) = 6.8 gpm (16)

SHR POP: MIL = 2400
CIV = 300
TOT = 2700 @ 50/3 = 51,670 GPD
51,670 / (1440 x 32 jcts) = 1.1 gpm / JCT

258,920 GPD - MCAS
41,080 GPD - INDUSTRIAL USE
300,000 GPD - TOTAL MCAS
330,000 " - TOTAL CP GEIGER
630,000 GPD - TOTAL EXPECTED USAGE

TOTAL AU DEMAND = 896 K GPD
" EXP. CONSUMPTION = 630 K GPD
UNACCOUNTED FOR WATER = 266 K GPD = 5.6 gpm / JCT
1,440 x 32 JCTS

SHR PERI USAGE

CP GEIGER = 5000 gpd
MCAS = 51670
56670 gpd / (1440 x 32 JCTS) = 1.2 gpm / JCT
ALL JCTS = 7.0 gpm/JCT

(1) TEST H (2) LOCATION MCAS

ENCL (3)

ENCL (2)

6280/9
FAC

APR 0 3 1987

North Carolina Department of
Environmental Management
Attn: Mr. Rick Shiver
7225 Wrightsville Avenue
Wilmington, North Carolina 28403-3969

Re: Groundwater Resources Study by
U.S. Geological Survey

Dear Mr. Shiver:

You are invited to participate in an in-progress review of the subject study scheduled April 16, 1987. The meeting will be held at 10:00 a.m. in the Building 1 Conference Room.

We are nearing completion of Phase I of the study which documents the extent of our knowledge of the aquifer serving the Camp Lejeune complex. The U.S. Geological Survey will present an overview of this groundwater and geologic data in preparation for Phase II, which defines aquifer properties through test well drilling. Phase II plans will also be previewed.

Please contact Mr. Bob Alexander, Marine Corps Base Environmental Engineer, at (919) 451-3034 for further information on this review.

Sincerely,

T. J. DALZELL
Colonel, U.S. Marine Corps
Assistant Chief of Staff, Facilities
By direction of the Commanding General

Copy to:
N.C. Division of Health Services
U.S.G.S., Raleigh, NC
CMC (LFL)
NAVFACENGCOM (Code 114)
Environmental Science & Engineering,
Gainesville, FL

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...T OF THE NAVY
...TIC DIVISION
...ENGINEERING COMMAND
...RGINIA 23511-6287

TELEPHONE NO.
(804) 445-2930
IN REPLY REFER TO:
6280
1141JJH

25 SEP 1986

Rerouted to ENV Engineer NREAD Kept a copy one copy DRS for Dale + file 30 Sep

From: Command... Division, Naval Facilities Engineering Command
To: Commanding General, Marine Corps Base, Camp Lejeune

Subj: COMMENTS ON U.S. GEOLOGICAL SURVEY (USGS) PROPOSAL TO STUDY THE WATER AQUIFER

Ref: (a) MARCORB Camp Lejeune ltr 6280/4 FAC of 5 Sep 85 (subj: Requesting Comments on USGS proposal)

1. The USGS proposal is for an ambitious aquifer study program which will be part of North Carolina's and the USGS's effort in studying the groundwater. Marine Corps concerns are groundwater contamination and an adequate potable water supply for the future.

While both the USGS and the Marine Corps concerns are for the groundwater, the extent and depth of the studies needed to satisfy each need are different. The USGS proposal would have the Marine Corps fund a study suited for the USGS goals, but considerably beyond the needs of the Marine Corps.

2. Based on the project proposal, there appears to be some overlap between the USGS study and the NACIP Confirmation Study being conducted by Environmental Science and Engineering, Inc. The chemical tests described under Phase II will be performed by ESE on composite samples from all existing wells in October 1986. Should any parameters exceed analytical detection limits or Maximum Contaminant Levels, as applicable, individual wells will be sampled for that contaminant. USGS Phase III goal of determining alternative groundwater use and management practices to reduce the chances for contamination is also being addressed by the NACIP program. At the conclusion of the Confirmation Study, ESE will have evaluated the potential for both horizontal and vertical contaminant migration from each site under study. If the potential exists for contaminant migration into your water supply aquifer, they will look at remedial alternatives, which may include changes in your groundwater use and management practices. As you are aware, ESE will commence this extensive investigation for the Hadnot Point water supply aquifer this fall.

3. Adequacy of the water supply is determined by pump tests to determine aquifer capacity and analyses of groundwater samples to determine quality. Three or four tests, properly performed, should provide adequate aquifer data to estimate the water supply potential. These could be done at the existing water wells at a considerably lower cost than the USGS proposal.

Cost/well (estimate)

Remove Marine Corps pump, inspect the pump and make minor adjustments/repairs and replace after test 350.00

6250/FAC

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511-6287

TELEPHONE NO.
(804) 445-2930

IN REPLY REFER TO:
6280
1141JJH

25 SEP 1986

From: Commander, Atlantic Division, Naval Facilities Engineering Command
To: Commanding General, Marine Corps Base, Camp Lejeune

Subj: COMMENTS ON U.S. GEOLOGICAL SURVEY (USGS) PROPOSAL TO STUDY THE WATER AQUIFER

Ref: (a) MARCORB Camp Lejeune ltr 6280/4 FAC of 5 Sep 85 (subj: Requesting Comments on USGS proposal)

1. The USGS proposal is for an ambitious aquifer study program which will be part of North Carolina's and the USGS's effort in studying the groundwater. Marine Corps concerns are groundwater contamination and an adequate potable water supply for the future.

While both the USGS and the Marine Corps concerns are for the groundwater, the extent and depth of the studies needed to satisfy each need are different. The USGS proposal would have the Marine Corps fund a study suited for the USGS goals, but considerably beyond the needs of the Marine Corps.

2. Based on the project proposal, there appears to be some overlap between the USGS study and the NACIP Confirmation Study being conducted by Environmental Science and Engineering, Inc. The chemical tests described under Phase II will be performed by ESE on composite samples from all existing wells in October 1986. Should any parameters exceed analytical detection limits or Maximum Contaminant Levels, as applicable, individual wells will be sampled for that contaminant. USGS Phase III goal of determining alternative groundwater use and management practices to reduce the chances for contamination is also being addressed by the NACIP program. At the conclusion of the Confirmation Study, ESE will have evaluated the potential for both horizontal and vertical contaminant migration from each site under study. If the potential exists for contaminant migration into your water supply aquifer, they will look at remedial alternatives, which may include changes in your groundwater use and management practices. As you are aware, ESE will commence this extensive investigation for the Hadnot Point water supply aquifer this fall.

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Cost/well (estimate)

Remove Marine Corps pump, inspect the pump and make minor adjustments/repairs and replace after test 350.00

Subj: COMMENTS ON U.S. GEOLOGICAL SURVEY (USGS) PROPOSAL TO STUDY THE WATER AQUIFER

Install test pump and perform test			6,000.00
Drill 1-1/4 inch Observation Well at $18.50/feet			3,650.00
		Total	$10,000.00/well
5 well tests			= 50,000.00
Contingencies	at 10 percent		= 5,000.00
Escalated to 1987	at 10 percent		= 5,000.00
		Total	=$60,000.00

Well test analyses can be done in-house by LANTNAVFACENGCOM using the modified Theis Method.

4. Salt water intrusion can be determined by periodically sampling the chloride levels at various depths of some of the existing wells near and away from the ocean. The intrusion rate can be estimated by dividing the difference of the distances of two wells from the coastline by the time required for the chloride concentration of the furthest well to reach the chloride concentration that existed in the closest well when the sampling began.

5. While a groundwater model such as proposed may be useful for the large area USGS groundwater type of study, other more economical methods are available to determine groundwater draw down levels induced by Marine Corps pumping over a period of time.

6. A simple network program based upon the Theis equation that can be run on a desktop PC Computer with user instructions could be developed by this office. This should be adequate for Marine Corps needs. New well locations can be evaluated and drilled where the computer model indicates drawdowns would be smallest. Well pumping routines simulated on the computer showing those wells that produce the minimum drawdowns and can be selected for well pump operation.

J. R. Bailey

J. R. BAILEY
By direction

6280/9
FAC
14 AUG 1986

Mr Bruce Lloyd
U.S. Geological Survey
P.O. Box 2857
Raleigh, North Carolina 27602-2857

Re: Coordination of NACIP Study and USGS Appraisal of Groundwater Resources, Marine Corps Base, Camp Lejeune

Dear Mr. Lloyd:

We are forwarding the site maps and scope of work (SOW) for the characterization step of the Navy Assessment and Control of Installation Pollutants (NACIP) study. As noted in the SOW, the Hadnot Point water supply aquifer will be studied in detail during the coming months.

Your views on the SOW and any assistance you can provide to the contractor will be greatly appreciated. Our POC is Mr. Bob Alexander, FTS 676-3034.

Sincerely,

T. J. DALZELL
Colonel, U. S. Marine Corps
Assistant Chief of Staff, Facilities
By direction of the Commanding General

Encl: (1) Scope of Work
(2) Site Maps

Copy to:
LANTDIV (Code 114) w/o Encl
NCDEM, Wilmington Regional Office

Blind Copy to:
BMO
NREAD
EnvEngr

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511-6287

TELEPHONE NO.
(804) 445-1814
IN REPLY REFER TO:
5090
1143CFB
22 JUL 1986

U.S. Environmental Protection Agency
Attn: Mr. Jim Holdaway
Region IV
345 Courtland Street
Atlanta, GA 30365-2401

Re: NACIP Confirmation Study, Marine Corps Base, Camp Lejeune

Gentlemen:

As discussed in a telephone conversation between Jim Holdaway and Cherryl Barnett of July 19, 1986, we are enclosing the scope of work for additional NACIP efforts at Camp Lejeune. We hope you will have a chance to review this prior to our meeting of July 31, 1986, and that it may answer some of your comments on our previous submittal, the Round One Sampling report. We anticipate the NACIP contractor, Environmental Science and Engineering, Incorporated, beginning these efforts in the August/September timeframe.

Sincerely,

J. R. BAILEY, P.E.
Head, Environmental Quality Branch
Utilities, Energy and Environmental Division
By direction of the Commander

Encl:
(1) Scope of Work for Round Two Sampling and Characterization/Feasibility

Copy to:
MARCORB Camp Lejeune

Division of Environmental Management
Attn: Mr. R. Paul Williams
Director
P.O. Box 27687
Raleigh, NC 27611-7687

Enclosure (1)

APPENDIX A (REVISION 1) 8 July 1986

CONTRACT N62470-83-C-6106
SCOPE OF WORK FOR ROUND TWO SAMPLING
AND CHARACTERIZATION/FEASIBILITY

1. Verification Step Efforts

a. Site 1, French Creek Liquids Disposal Area: Sample and test surface water and sediments in two locations on Cogdels Creek; sample and test the six shallow wells. Add o,m,p-xylene, MEK, MIBK, EDB, and hexavalent Cr to the analytical parameters for round one.

b. Site 2, Former Nursery/Day Care Center: Sample and test Well 2GW1. Sample soil at four locations (0-1' composite) in the vicinity of sample 2S4; sample surface water and sediment from the drainage ditch in two locations; install four shallow two-inch wells in locations directed by the EIC. Sample new wells twice at an interval of 60 days. Analyze each sample for OCP, OCH, dioxin, and VOA.

c. Site 6, Storage lots 201 and 203: Install eight shallow two-inch wells in locations directed by the EIC. Sample wells twice at a 60-day interval. Sample surface water and sediment both upgradient and downgradient at Bearhead and Wallace Creeks adjacent to the site. Analyze all samples for DDT-R and VOA.

d. Site 9, Fire Fighting Training Pit: Resample and test the two shallow wells. Install a third well in a location directed by the EIC and sample twice at a 60-day interval. Analyze all samples for o,m,p-xylene, MEK, MIBK, EDB and hexavalent Cr in addition to round one parameters.

e. Site 21, Transformer Storage Lot 140: Sample soil at eight locations around perimeter of site, including two samples from drainage ditch. Sample four depths at each location (0-1', 1-3', 3-5', and at 5') and analyze for OCP, OCH, PCB, dioxin. Resample well GW21-1 and analyze for VOA, OCP, OCH, PCB, dioxin, xylene, MEK, MIBK, EDB, and oil and grease.

f. Site 24, Industrial Area Fly Ash Dump: Install two downgradient wells in locations directed by the EIC. Sample new wells twice at a 60-day interval. Sample five shallow wells, existing surface water locations and two new surface water/sediment locations on tributaries to Cogdels Creek and analyze all samples for metals A, VOA, and hexavalent Cr.

g. Site 28, Hadnot Point Burn Dump: Install new upgradient well and sample twice at a 60 day interval. Sample three existing shallow wells, New River surface water and sediments in four locations, resample surface water sediment at two previously identified locations, and one new surface water/sediment location in Cogdels Creek near new upgradient well. Analyze all samples for round one parameters, dioxin, o,m,p-xylene, MIBK, MEK, and hexavalent Cr.

h. Site 30, Combat Town Training Area: Install another well downgradient and sample twice at a 60-day interval. Sample shallow well, surface water/sediment in French Creek and analyze all samples for same parameters as listed for round one plus xylene, MEK, MIBK, and EDB.

i. Site 35, Camp Geiger Area Fuel Farm: Install three shallow two-inch wells in locations directed by the EIC. Sample twice at a 60-day interval. Sample surface water and sediments from Brinson Creek in two locations; analyze all samples for Pb, VOA, EDB, xylene, and O&G.

j. Site 36, Camp Geiger Area Dump: Install new upgradient well; sample twice at a 60-day interval. Resample four shallow wells; sample surface water and sediments from Brinson Creek and unnamed creek south of site in two locations. Analyze all samples for parameters listed in round one, o,m,p-xylene, MEK, MIBK, EDB, and hexavalent Cr.

k. Site 41, Camp Geiger Dump: Resample four shallow wells. Add new upgradient well and sample twice at a 60-day interval. Sample surface water and sediment from Tank Creek in two locations and unnamed creek in two locations and analyze all samples for parameters listed in round one plus dioxin, o,m,p-xylene, MEK, MIBK, and hexavalent Cr.

l. Site 45, Campbell Street Underground Fuel Storage Area: Install new well south of fuel farm; sample twice at 60-day interval. Resample three shallow wells and surface water/sediment from the drainage ditch in two locations. Analyze water samples for Pb, O&G, VOA, EDB, and xylene. Sample soil in six locations along perimeter of fuel farm and avgas storage. Composite 5' borings into 3 samples, 0-1', 1-3', and 3-5', analyze soil and sediment samples for Pb, O&G.

m. Site 54, Crash Crew Fire Training Burn Pit: Install one upgradient and one downgradient well at site and sample twice at a 60-day interval. Resample Well 54GW1, drainage ditch surface water and sediments in three locations and analyze for round one parameters, o,m,p-xylene, MEK, MIBK, EDB, and hexavalent Cr.

n. Site 68, Rifle Range Dump: Resample three shallow wells and analyze for round one constituents plus o,m,p-xylene, MEK, MIBK, and EDB.

o. Site 69, Rifle Range Chemical Dump: Resample eight shallow wells and three surface water locations. Sample surface water and sediments from two unnamed guts southeast of site. Analyze all samples for parameters listed in round one plus dioxin, o,m,p-xylene, MEK, MIBK, and EDB.

p. Site 73, Courthouse Bay Liquid Disposal Area: Replace failed Well 73GW4 at a location closer to Courthouse Bay to allow for construction activities in that area. Install new upgradient well and sample twice at a 60-day interval. Resample four shallow wells and sample Courthouse Bay surface water and sediments in three locations. Analyze all samples for parameters listed in round one, o,m,p-xylene, MEK, MIBK, EDB, and hexavalent Cr.

q. Site 74, Grease Pit and Pest Control Area: Install a third well west of site; sample twice at a 60-day interval. Resample two shallow wells and analyze all samples for OCP, OCH, PCBs, dioxin, and VOA.

r. Site 75, MCAS Basketball Court: Resample three shallow wells and analyze for VOA, chloropicrin, and dioxin.

s. Site 76, MCAS Curtis Road: Resample two shallow wells and analyze for VOA, chloropicrin, and dioxin.

t. Site A, MCAS (H) Officers Housing Area: Install three shallow wells along the perimeter of the site described in Attachment A. Sample wells twice at a 60-day interval; analyze for VOA, O&G, and free chlorine. Sample surface water and sediment and analyze for free chlorine (SW only), O&G, and VOA.

u. For the 54 wells installed under round one: Install two additional protective bollards and fill with concrete. Pour 5' x 5' concrete pad around well and bollards; paint well bollards day-glo orange. Use monitoring well construction specifications, Attachment B, for installation of new wells.

v. Sample all potable wells on MCB Camp Lejeune and MCAS New River (approx. 100). Composite samples from a maximum of ten wells serving the same water treatment plant (except for "contaminated" wells listed below) and analyze for priority pollutants except VOA; and barium, nitrate, chloride, iron, manganese, sodium, sulfate, THMs, color, TDS and turbidity; and EDB. Analyze all 100 samples for VOA, xylene, MEK and MIBK. If any parameter(s) from the composite exceed(s) regulatory limits or suggested guidelines for potable water, analyze samples for only that (those) parameters from the individual wells in the composite to pinpoint the source of contamination. Scope and analysis to be adjusted as needed by the EIC pending composite sample results. These "contaminated" wells have been shut down by MCB Camp Lejeune: 601, 602, 608, 634, 637, 651, 652 and 653. Sample these wells individually and analyze for priority pollutants, xylene, MEK, and MIBK, barium, nitrate, chloride, iron, manganese, sodium, sulfate, THMs, color, TDS, and turbidity.

w. For the contaminated wells 651, 652, and 653, conduct an extensive physical survey and document review to identify potential sources of contamination. Perform a 150 point (two-week) soil gas investigation to delineate potential contamination source areas; install additional shallow wells (up to six per potable well for cost estimating purposes) to verify findings. Perform two rounds of sampling at these wells; analyze samples for volatile organics, xylene, MEK, and MIBK.

x. Close out contaminated wells at Sites 36, 41, and 68 in accordance with state regulations (15 NCAC 2C). Submit an abandonment report including round one data and evaluation for these wells, to MCB Camp Lejeune for forwarding to the appropriate state agency.

y. Within 80 days of initiation of the on-site verification investigations, evaluate all data generated with the two sampling events and discuss quantitatively whether contamination has the potential to or is presently affecting the environment or human health. Present the findings as part of the monthly progress reports. Furnish the EIC with two copies and the activity with three copies of the progress report with the study results. The report should include: a description of all sampling and chemical analytical methods used; a presentation and evaluation of the analytical data; an assessment of actual/potential contamination and migration; ground level elevations and water levels (0.01 ft. accuracy) in all wells; boring logs; a detailed surveyed site plan showing the location of suspected contaminant sources, wells, etc.; known toxicity information on contaminants found; current standards/criteria for acceptable levels of contaminants found, including those issued/published by EPA, CDC, NIOSH, OSHA, State and local regulatory/health agencies and/or any other established regulatory/advisory agencies as approved by the EIC; and recommendations for immediate site clean up or third round monitoring. Government comments and recommendations will be made via the EIC within 30 calendar days after receipt of the progress report.

2. Characterization/Feasibility Step Efforts

a. In accordance with the original scope of work, conduct Step IB, Characterization, for the Hadnot Point industrial area (bounded by Sneads Ferry Road, Codgels Creek, the New River, and Wallace Creek) and for the deep potable water aquifer influenced by wells serving the Hadnot Point treatment plant. The pump houses for these wells are numbered:

601	613	633	642
602	614	634	650
603	615	635	651
606	616	636	652
608	620	637	653
609	621	638	654
610	626	639(2)	655
611	627	640	LCH-4006
612	632	641	LCH-4007

The objectives of the characterization step are as follows:

(1) Locate source of VOCs detected in deep water supply wells 601, 602, 608, 634, 637, and 642.

(2) Determine concentration of detected parameters in source area(s).

(3) Determine aquifer characteristics: transmissivity, hydraulic conductivity, permeability, storage coefficients and degree of confinement for both deep and shallow aquifers.

(4) Determine rate and direction of groundwater and contaminant flow for the deep potable water supply aquifer influenced by wells listed above, and for the shallow aquifer in the Hadnot Point industrial area.

Conduct an extensive physical survey and document review for activities within the industrial area to identify potential sources of contamination. Perform a 150 point (two week) soil gas investigation to delineate the source areas; install additional wells to verify findings. Fourteen additional shallow wells will be required in this area, including seven which will form pairs with potable wells 601, 602, 603, 608, 634, 637, and 642. Perform an estimated three rounds of sampling at the seventeen Site 22 shallow wells at 60-day intervals; add xylene, MEK, MIBK, and EDB to the round one verification step parameters.

Perform 144 hour aquifer testing to determine aquifer characteristics and rate and direction of ground water and contaminant flow. Install three observation wells of 70', 90' and 200' for aquifer testing. Potable water wells shall be evaluated for various well pumping combinations. Access holes will be drilled, threaded and removable plugs installed in the tops of potable wells to provide a means of logging the depths of the water levels in the wells under study. The elevations of these plug holes above mean-sea-level shall be accurately determined by surveying. The method described in Attachment C or another commonly used method/model, as approved by the EIC, shall be used to determine the flow characteristics and contaminant profiles of the aquifers under study.

Within 30 days of completion of the Characterization Step on-site investigation, submit the Step IB preliminary report of the study results. The report should

include: a description of all sampling and chemical analytical methods used; a presentation and evaluation of the analytical and geotechnical data; an assessment of actual/potential migration; detailed surveyed site plan with surface elevations, well locations (horizontal and vertical from benchmarks as directed by the EIC) and water levels (0.01 ft. accuracy) in all wells; the location and levels of suspected contaminant plumes and/or contaminant sources; known toxicological information on contaminants found, and current standards/ criteria for acceptable levels of contaminants found, including those issued/ published by EPA, CDC, NIOSH, OSHA, State and local regulatory/health agencies, and/or any other established regulatory/advisory agencies as approved by the EIC. Requirements for preliminary and draft report, submissions for Step IB are outlined in Section 3.

b. Conduct Step II Feasibility for the Hadnot Point industrial area. Specify and evaluate five each interim and long-term feasible alternatives for cleanup of contaminated aquifers; include projected effectiveness and cost estimate for each alternative in your evaluation.

c. At the Government's option, conduct additional services at the prenegotiated prices as described below:

(1) Conduct additional laboratory sampling and analysis per the Marine Corps Base, Camp Lejeune Round Two Sampling and Analysis Summary Table attached.

(2) Conduct additional well drilling at a total cost of $39.00 per foot.

(3) Conduct additional one week (75 points) soil gas investigation at a total cost of $23,356 each.

Within 30 days of submission of the characterization step draft report, submit a preliminary report of the feasibility study. Preliminary and draft report submission requirements for Step II are outlined in Section 3.

3. Preliminary and Draft Confirmation Study Reports

In accordance with the completion dates established for each step, furnish the EIC with five copies and the activity with five copies of the preliminary report. Within 30 days, the Government will review and provide comments to the contractor via the EIC. Present EIC/Activity debriefing at the activity during the Government review period. Address the comments, and within 30 days provide five copies of the draft report to the EIC and five copies of the draft report to the activity for issuance to the regulatory agencies for their review.

Present the findings of the draft report for each study step to EPA Region IV and to the North Carolina Division of Environmental Management. These briefings shall be held at the Marine Corps Base, Camp Lejeune as arranged by the EIC and in consort with the activity representative.

MILESTONE CHART

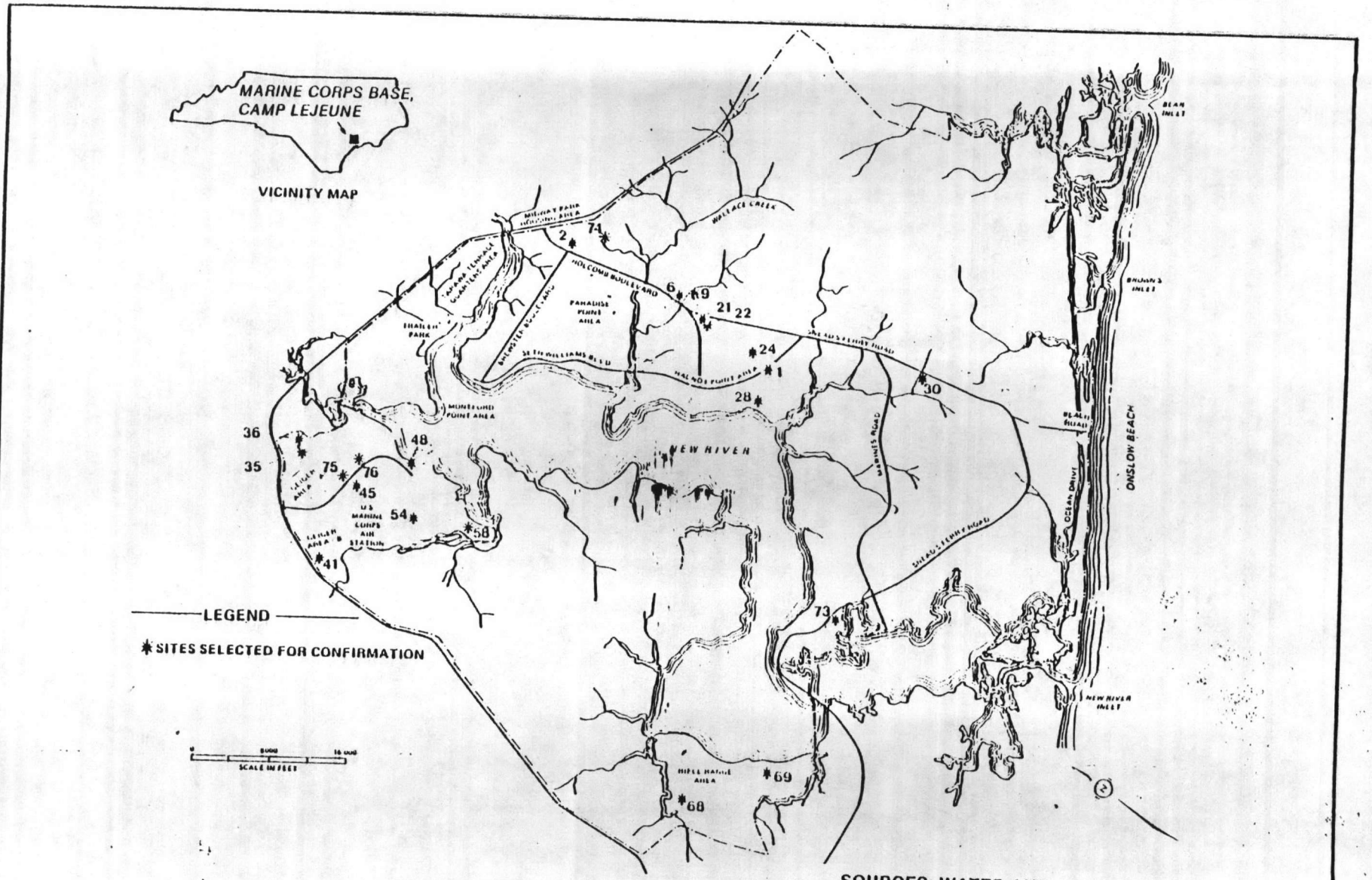
Milestone	Day
Government Issuance of Change Order	0
Submit POA&M and Safety/Contingency Plan for Characterization Effort	10
Government Approval of POA&M and Safety/Contingency Plan	17
Initiate Characterization On-Site Investigations for Hadnot Point Industrial Area	45
Initiate Round Two Sampling, Verification Step	45
Initiate Potable Well Sampling	45
Submit Report with Round Two Results, Potable Well Results	125
Return of Government Comments	155
Complete Characterization On-Site Investigation	260
Submit Preliminary Report with Hadnot Point Characterization Step Results	290
Return of Government Comments	320
Submit Characterization Step Draft Report for Hadnot Point	350
Submit Preliminary Feasibility Step Report for Hadnot Point	380
Return of Government Comments	410
Submit Feasibility Step Draft Report for Hadnot Point	440

SCOPE OF WORK FOR ADDITIONAL SOIL BORINGS,
MCAS (H) NEW RIVER FUEL PIPELINE INVESTIGATION

1. Perform 23 soil borings to depths of 10' at the locations shown in Attachment A. (The attached sketch is from a 1983-Soil and Materials Engineering-Study which was forwarded to you on 8 February 1984). A drill rig will be required for this effort, since previous attempts at hand augering have been unsuccessful. Note the presence or absence of fuel by visual inspection during the drilling. After a period of 24 hours, measure and record the depth to water or fuel in each borehole; sample the liquid and note the presence or absence of fuel and the thickness of the fuel lens.

2. Prepare a separate report on this investigation, to include boring logs and sketches, and submit three copies to this Command and three copies to MCB Camp Lejeune.

3. This investigation should be completed within ninety days of contract award.



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-1
SITE MAP SHOWING LOCATIONS OF SITES OF POTENTIAL CONTAMINATION AT MARINE CORPS BASE, CAMP LEJEUNE

CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE

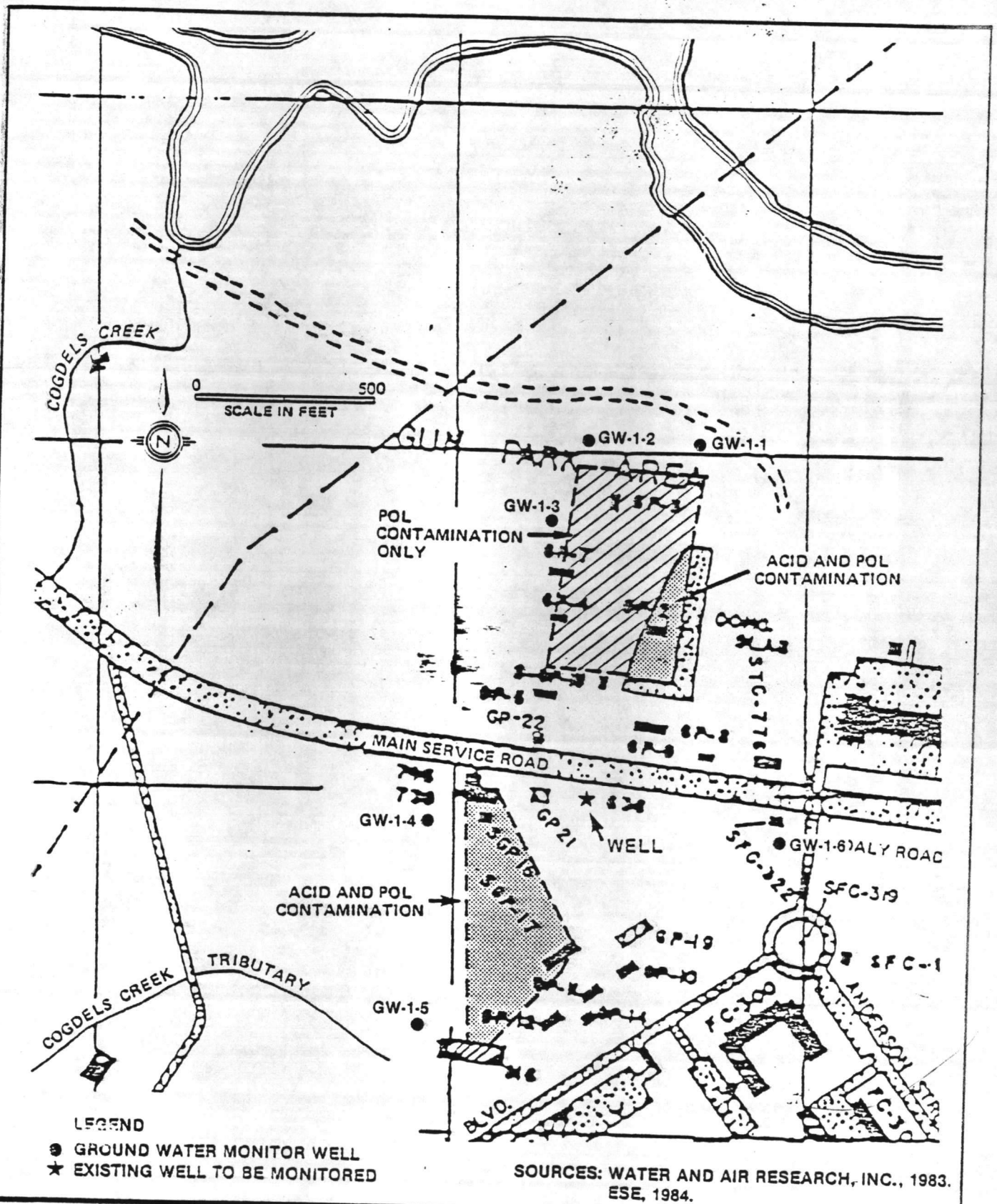
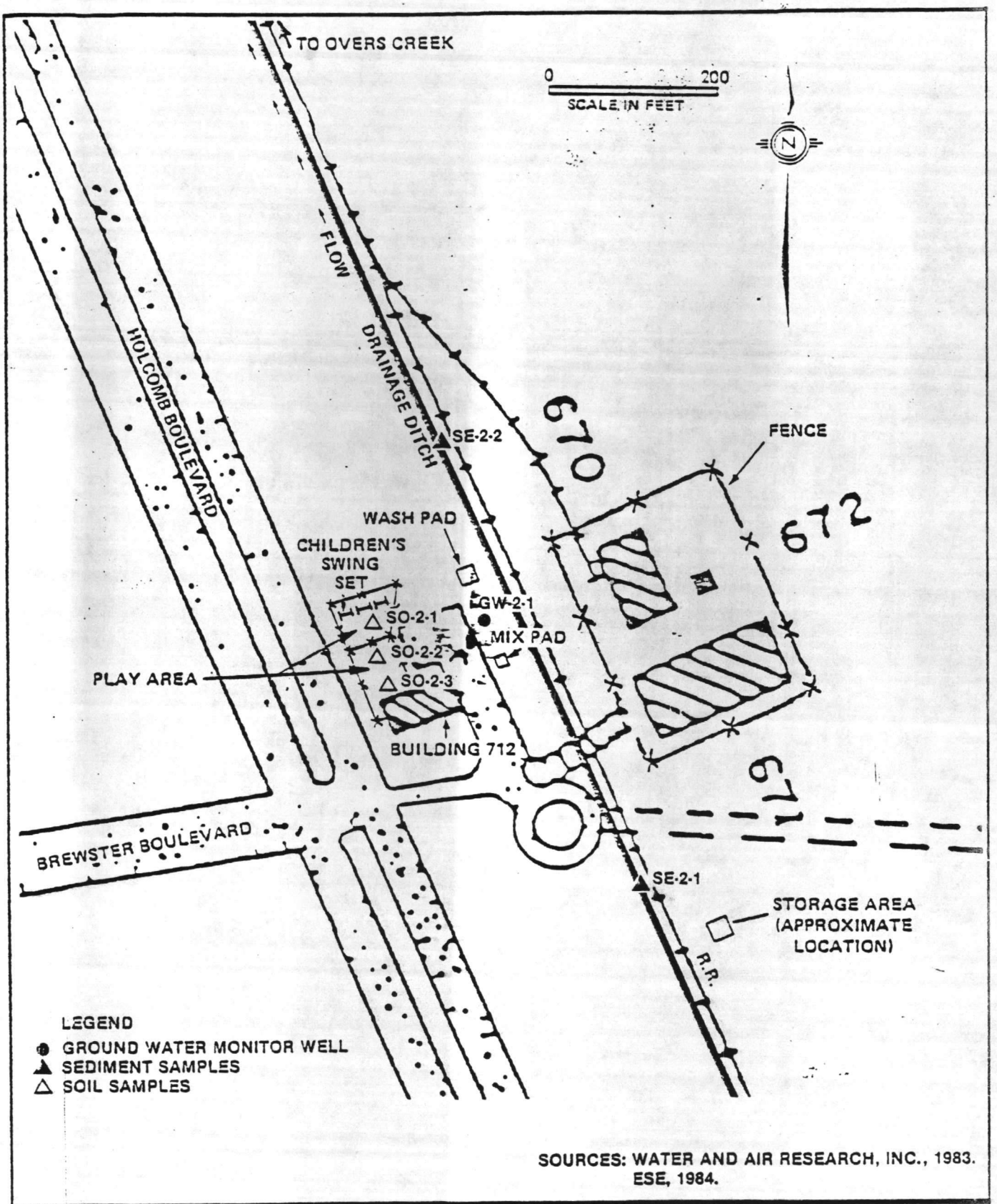


Figure 2-2
PROPOSED SAMPLING LOCATIONS AT SITE NO. 1, FRENCH CREEK LIQUIDS DISPOSAL AREA

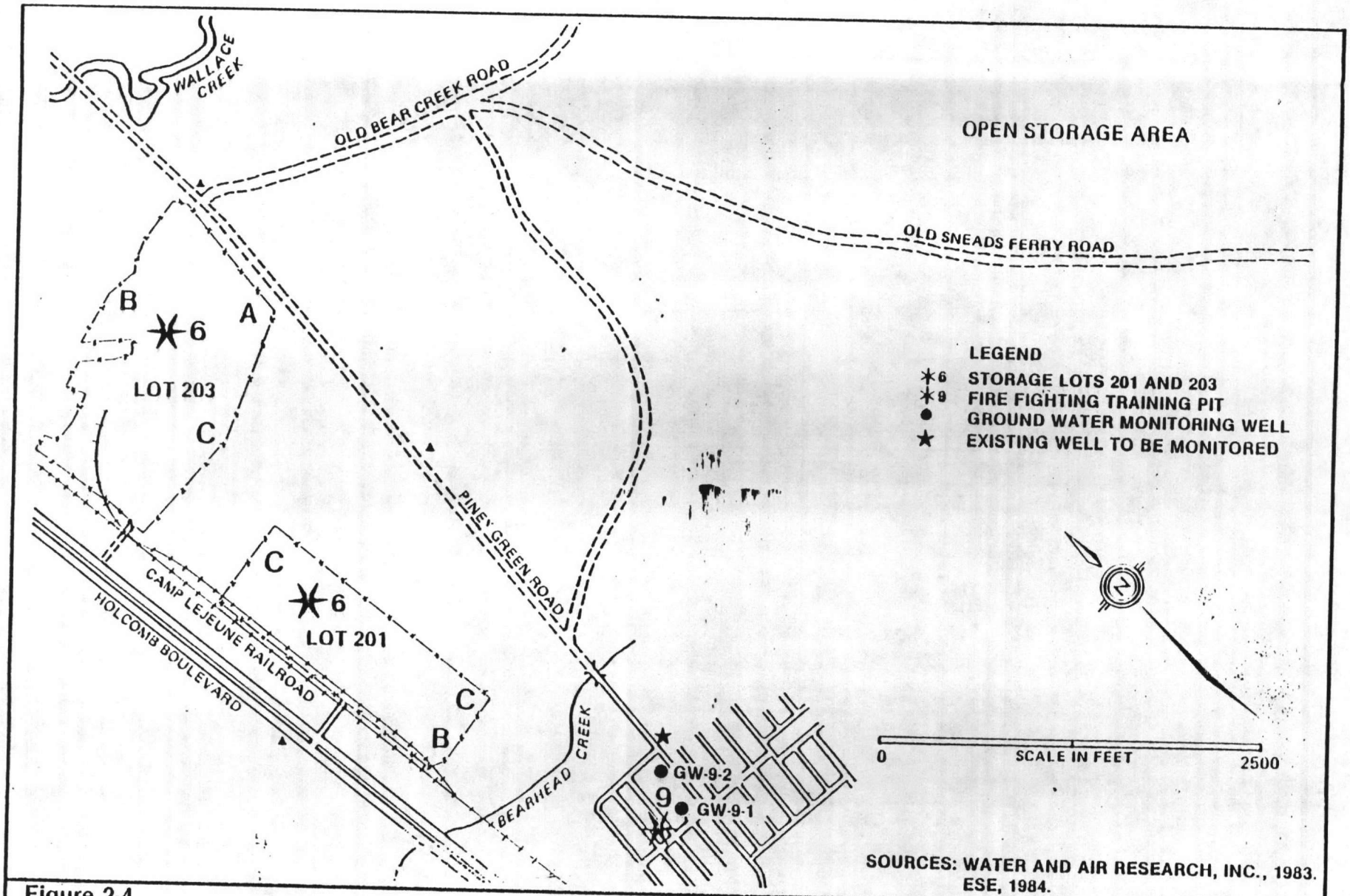
CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-3
PROPOSED SAMPLING LOCATIONS AT SITE NO. 2, FORMER NURSERY/DAY CARE CENTER

CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-4
PROPOSED SAMPLING LOCATIONS AT SITE NOS. 6 AND 9, STORAGE LOTS 201 AND 203 AND FIRE FIGHTING TRAINING PIT

CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE

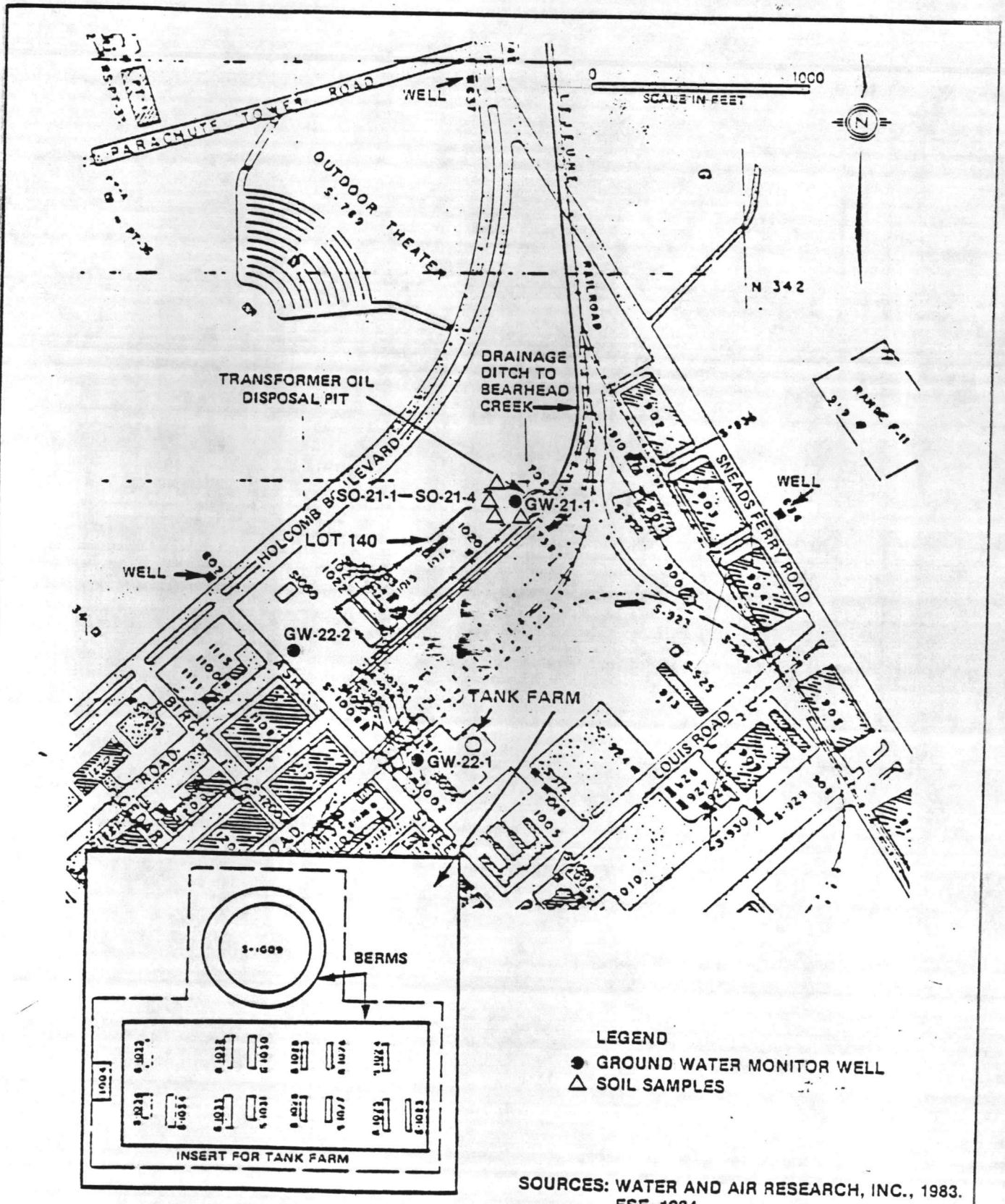
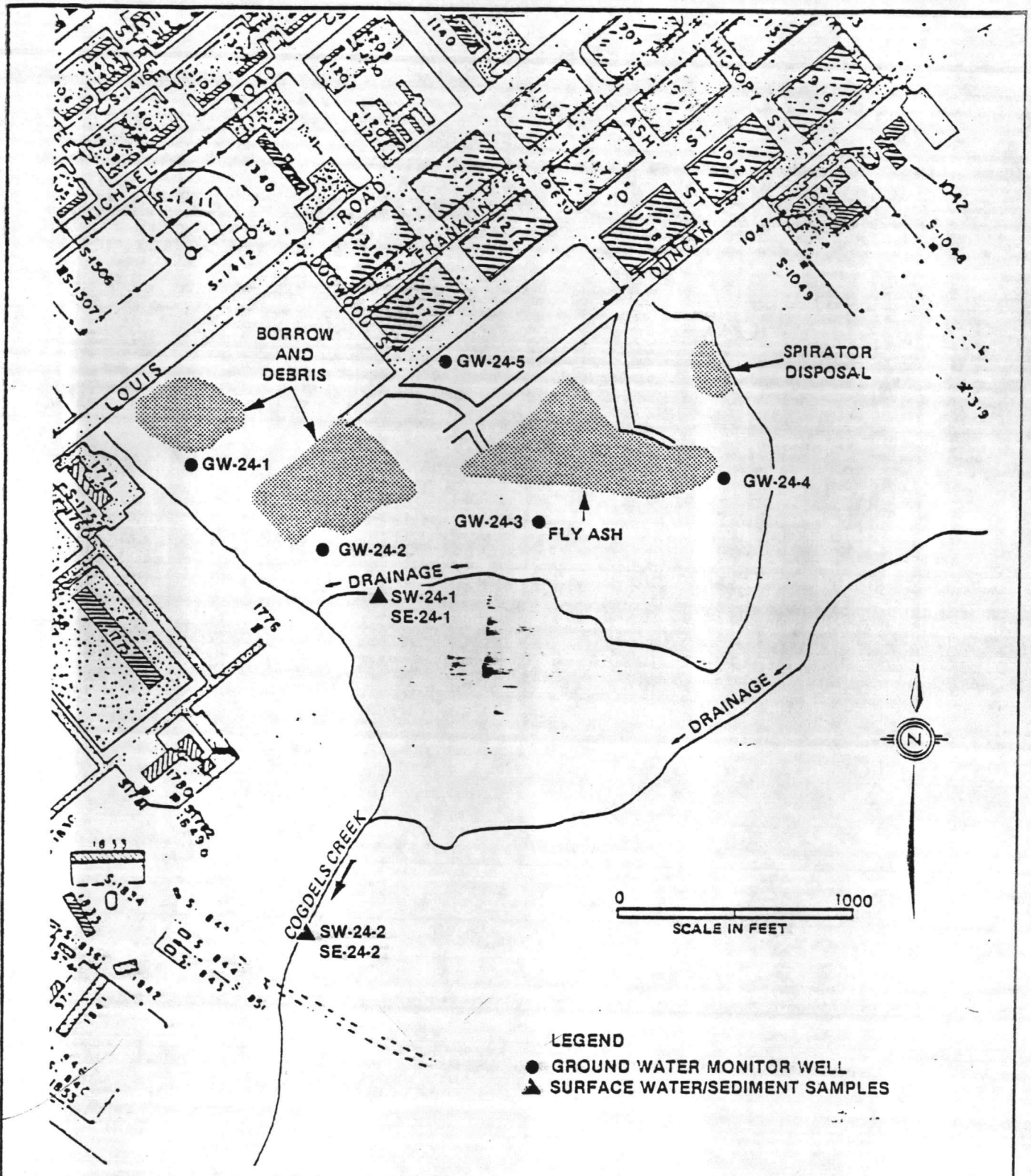


Figure 2-5
PROPOSED SAMPLING LOCATIONS AT SITE NOS. 21 AND 22, TRANSFORMER STORAGE LOT 140 AND INDUSTRIAL AREA TANK FARM

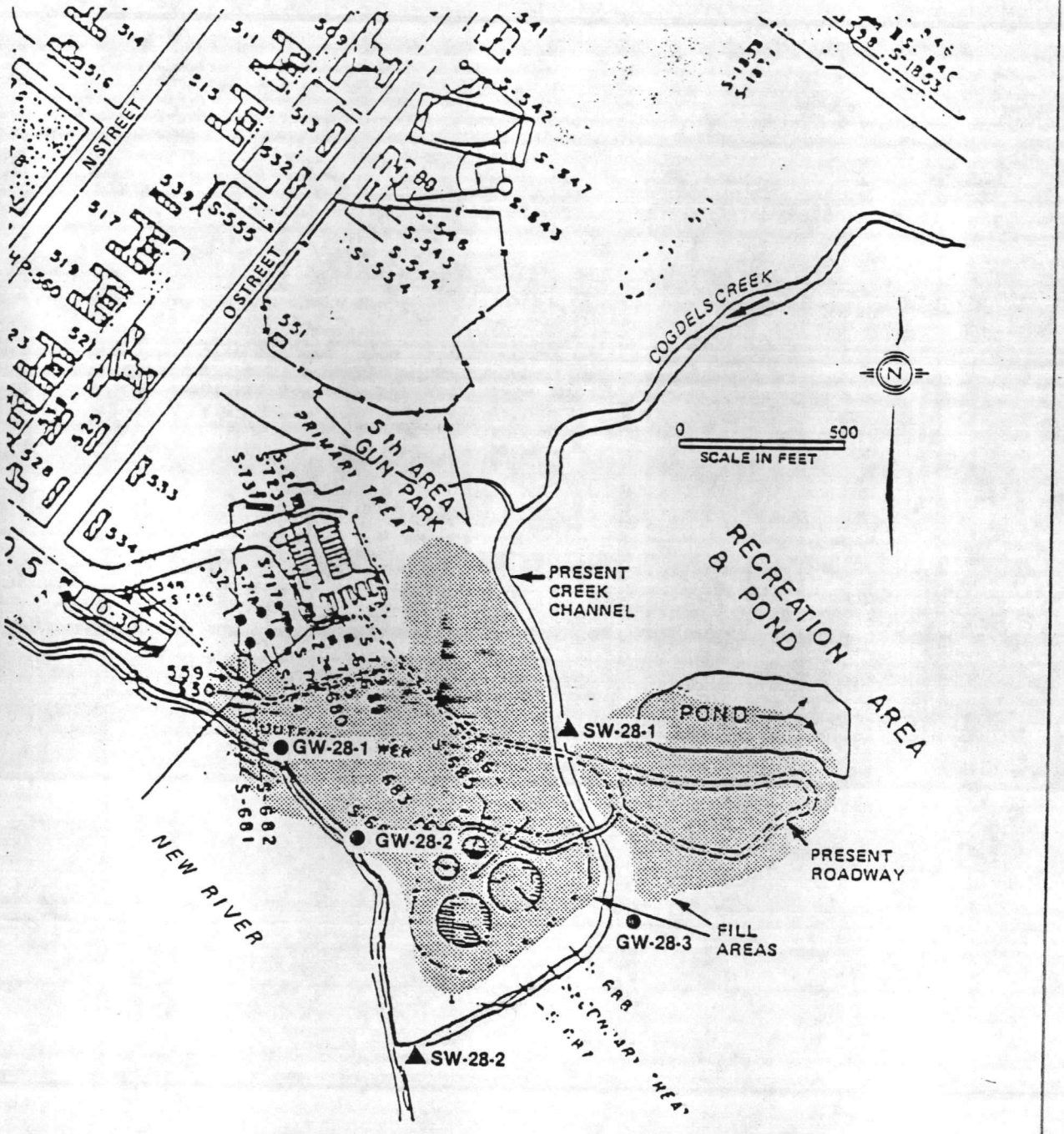
CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-6
PROPOSED LOCATIONS AT SITE NO. 24,
INDUSTRIAL AREA FLY ASH DUMP

CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-7
PROPOSED SAMPLING LOCATIONS AT SITE NO. 28, HADNOT POINT BURN DUMP

CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE

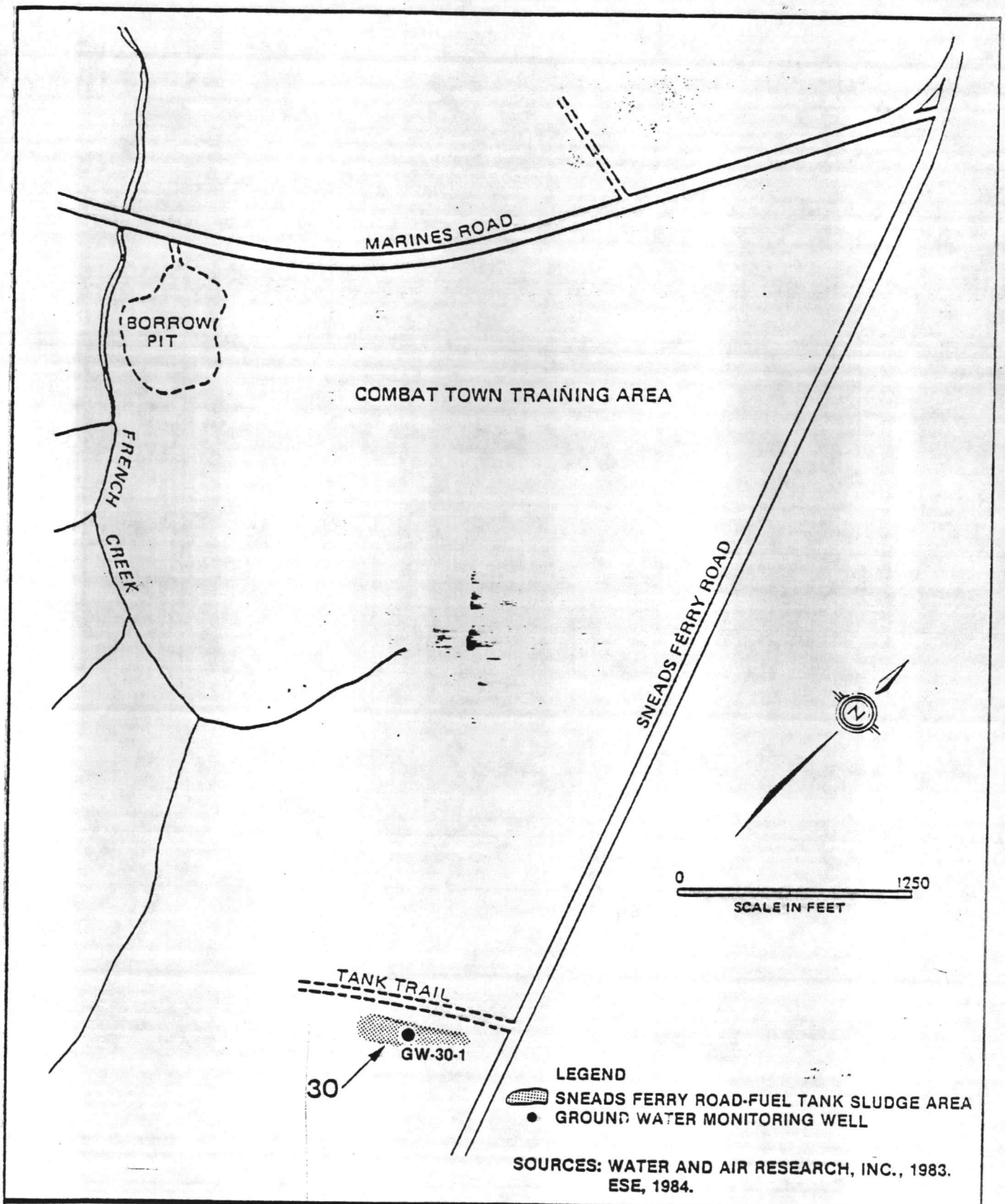


Figure 2-8
PROPOSED SAMPLING LOCATIONS AT SITE NO. 30, COMBAT TOWN TRAINING AREA

CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE

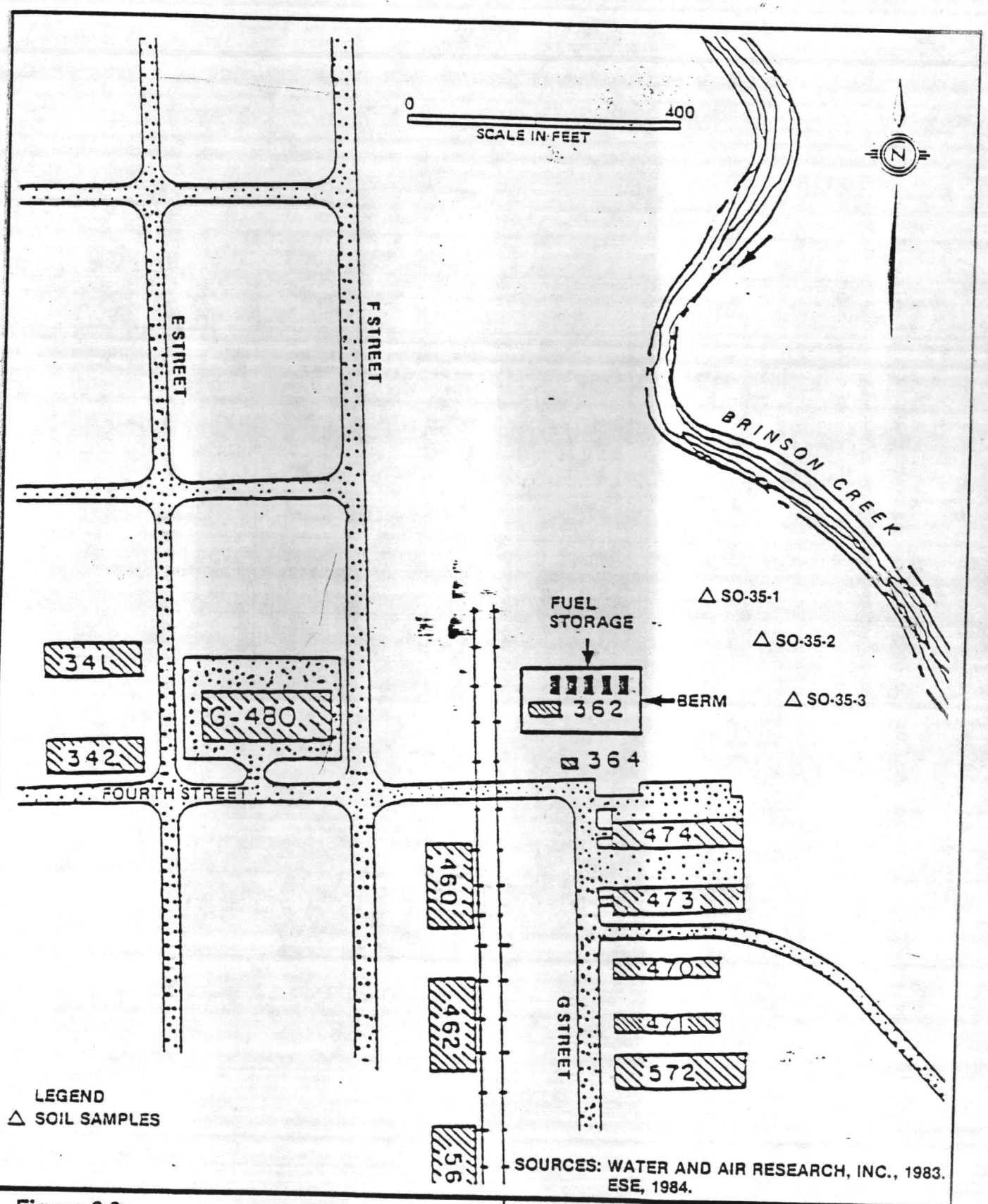
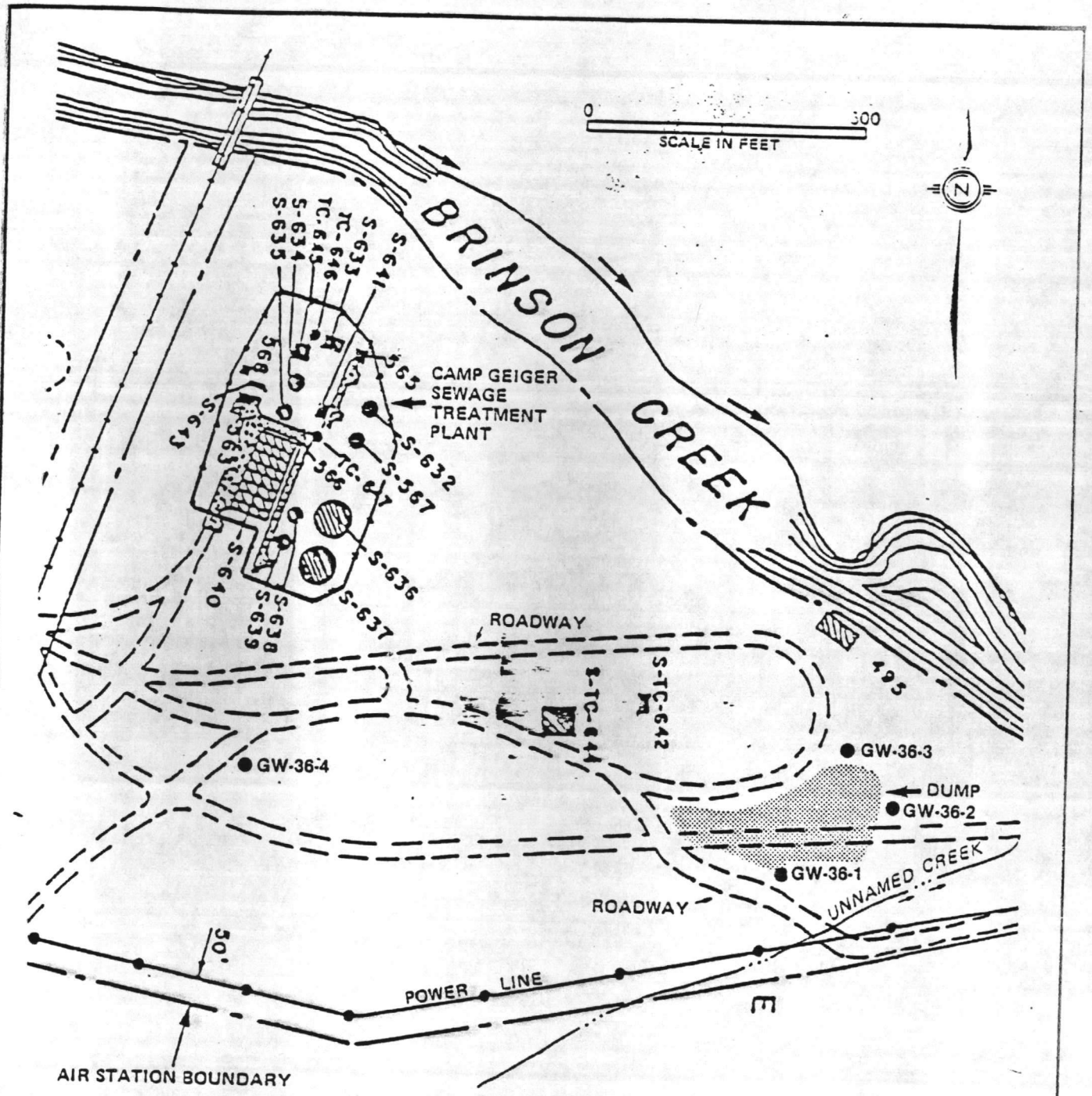


Figure 2-9
PROPOSED SAMPLING LOCATIONS AT SITE NO. 35, CAMP GEIGER AREA FUEL FARM

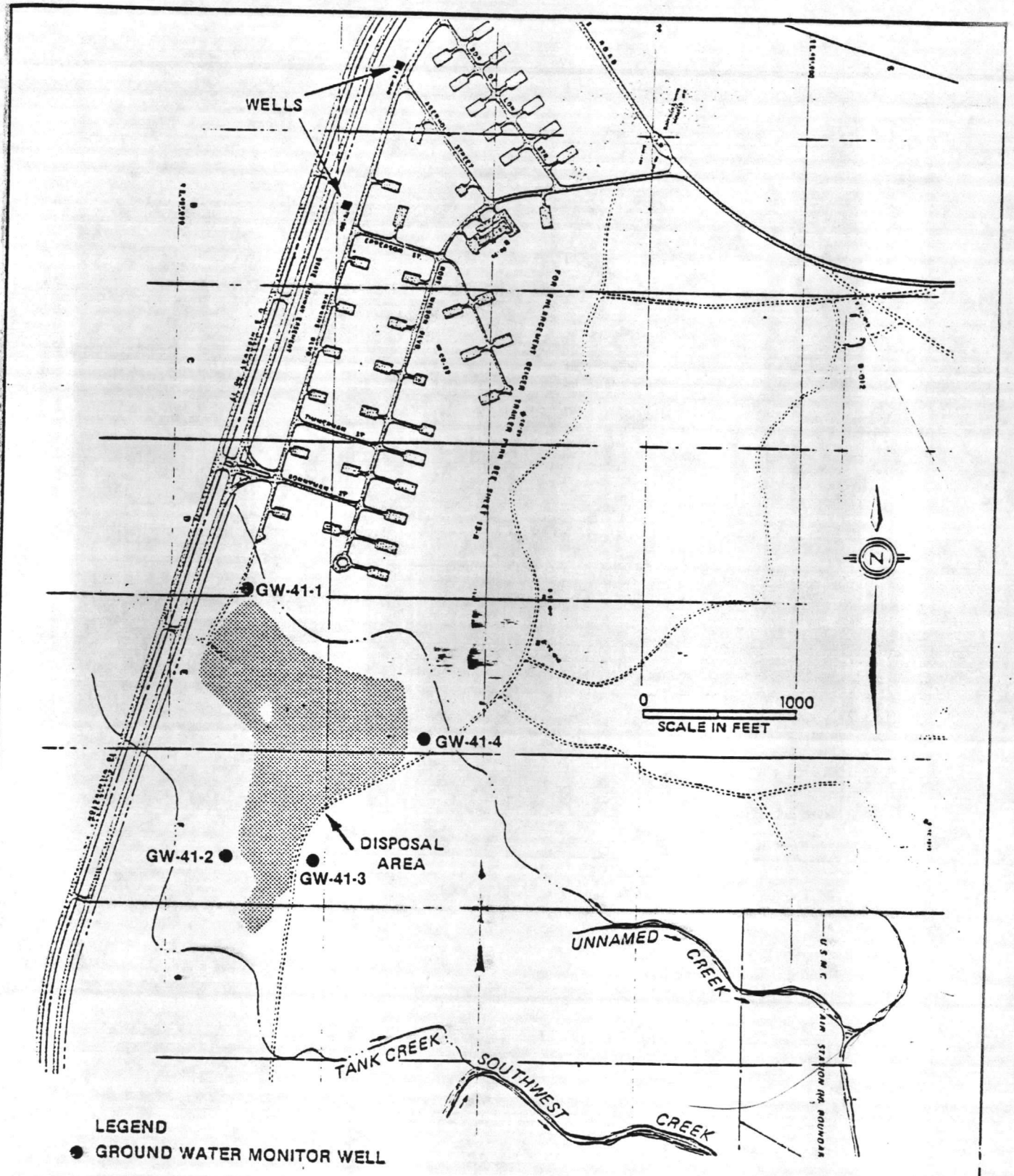
CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-10
PROPOSED SAMPLING LOCATIONS AT
SITE NO. 36, CAMP GEIGER AREA
DUMP (NEAR STP)

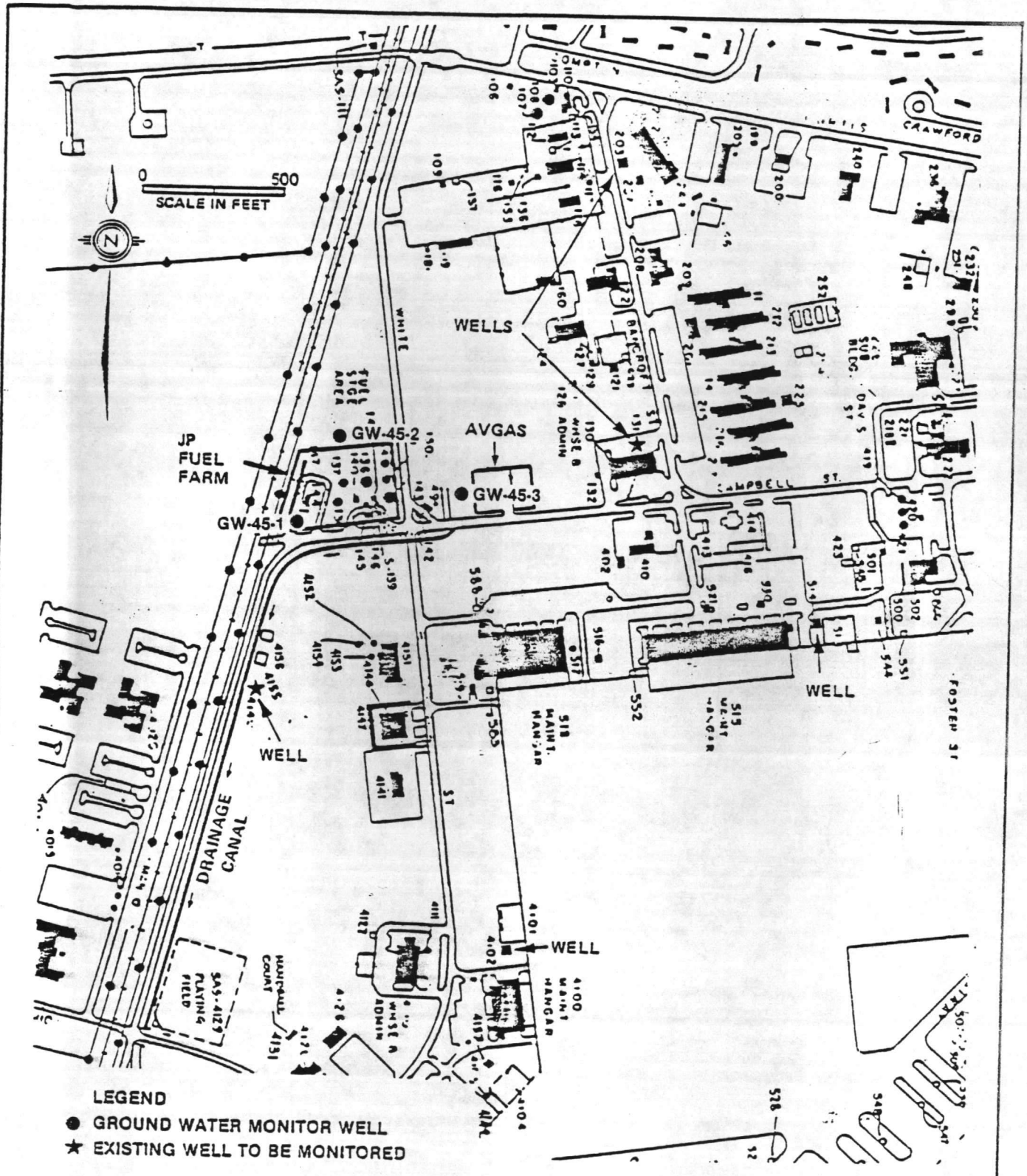
CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-11
PROPOSED SAMPLING LOCATIONS AT SITE NO. 41, CAMP GEIGER DUMP (NEAR FORMER TRAILER PARK)

CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-12
PROPOSED SAMPLING LOCATIONS AT SITE NO. 45, CAMPBELL STREET UNDERGROUND FUEL STORAGE AREA

CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE

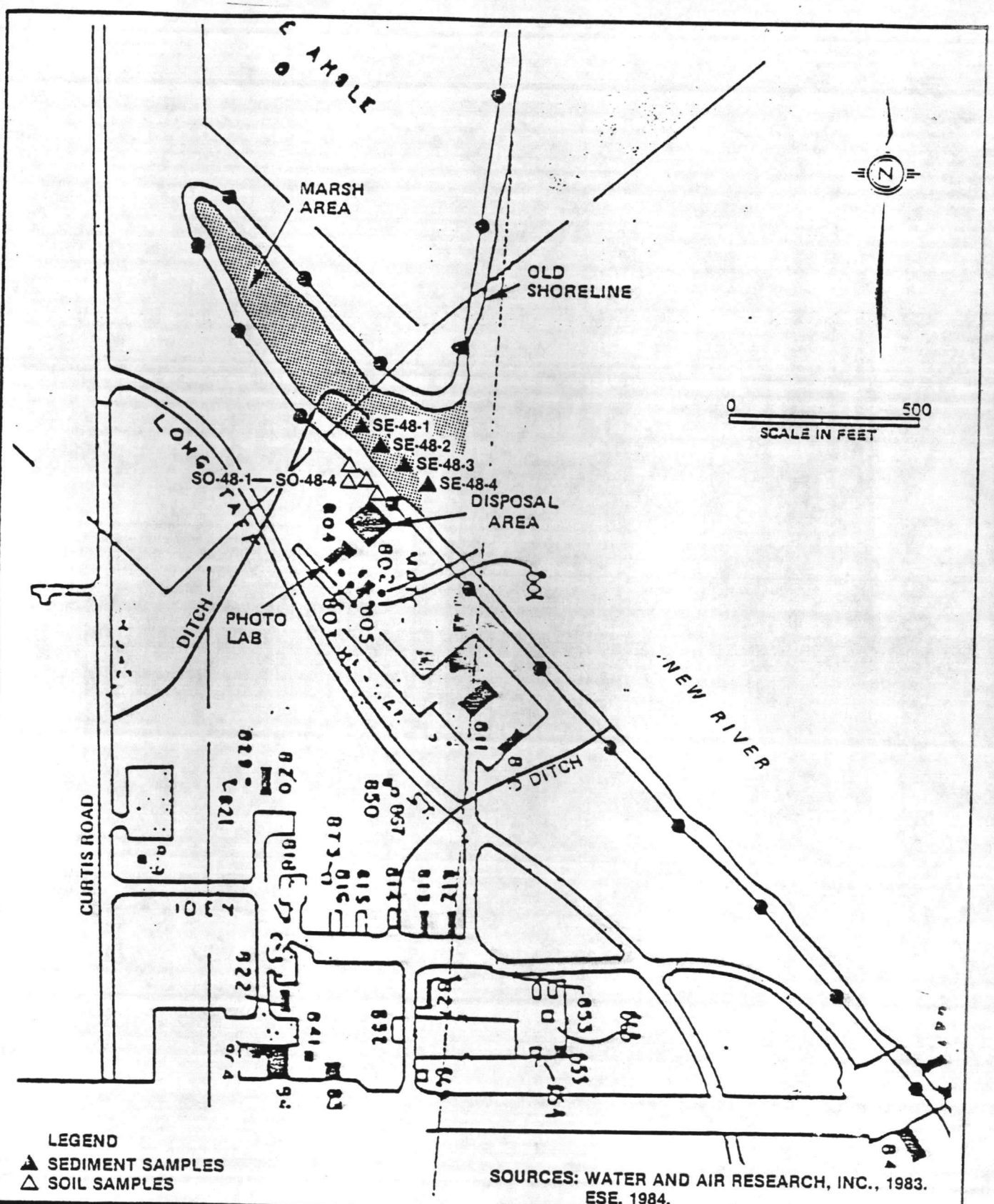
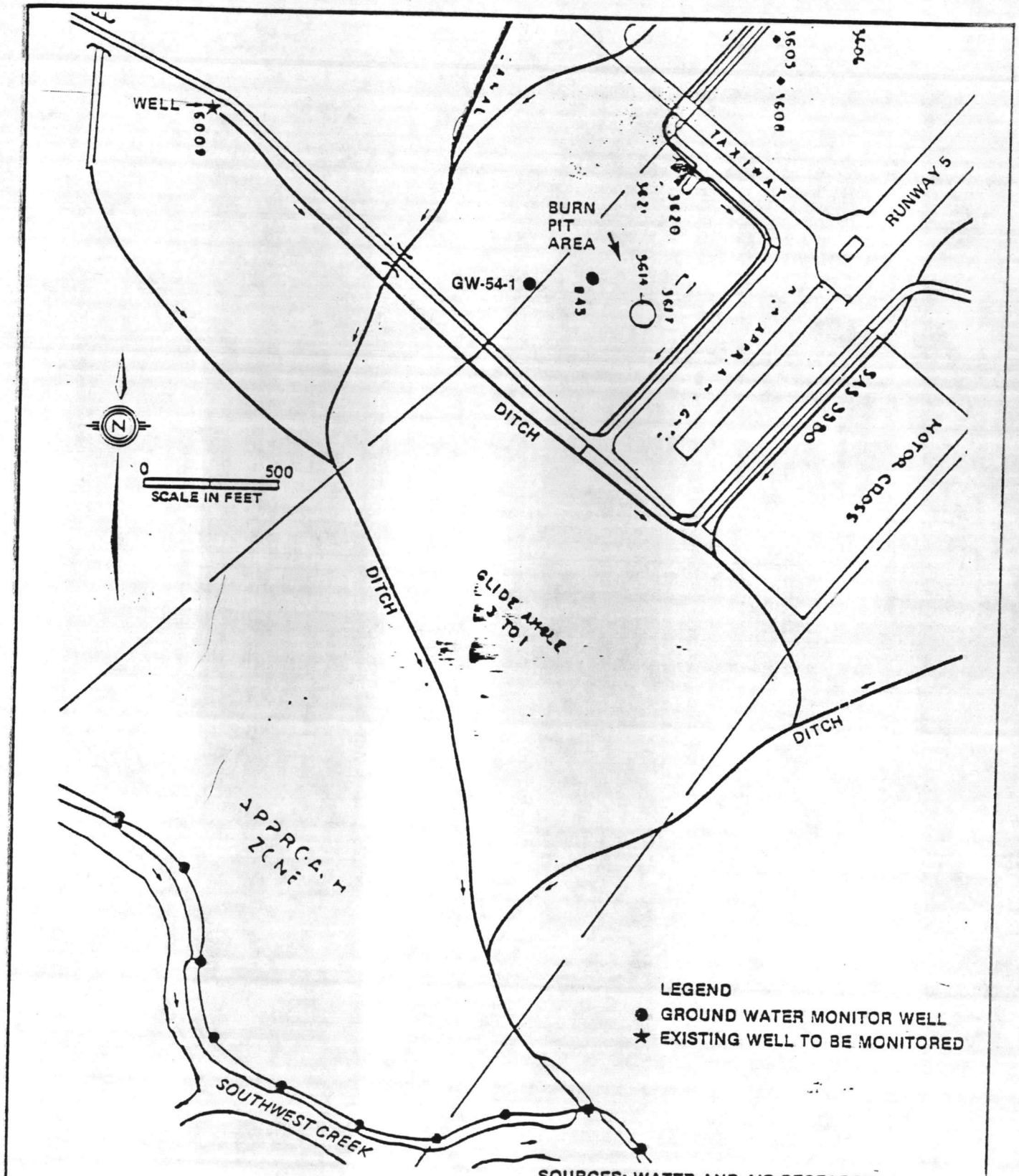


Figure 2-13
PROPOSED SAMPLING LOCATIONS AT SITE NO. 48, MCAS NEW RIVER MERCURY DUMP SITE

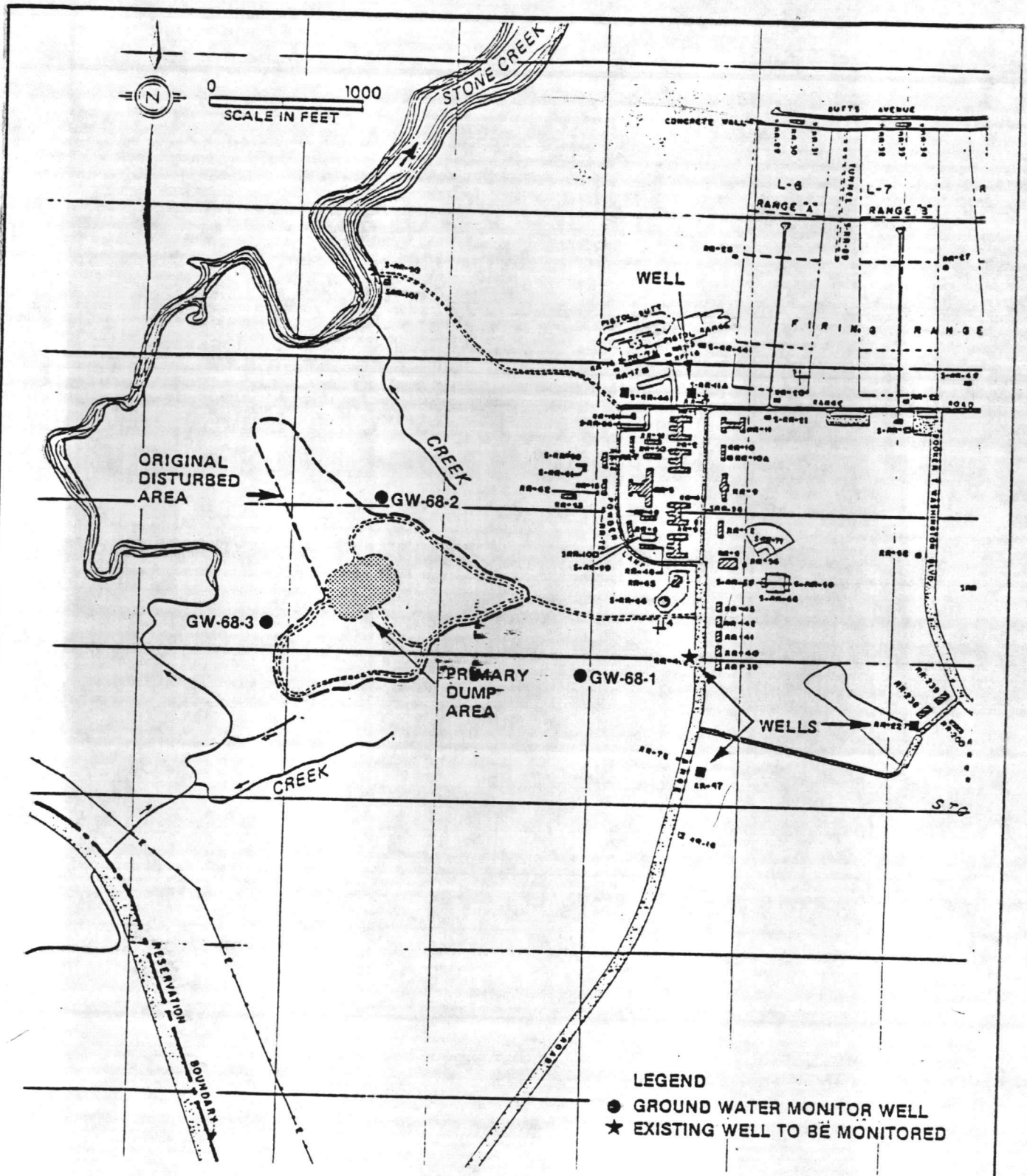
CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-14
PROPOSED SAMPLING LOCATIONS AT SITE NO. 54, CRASH CREW FIRE TRAINING BURN PIT

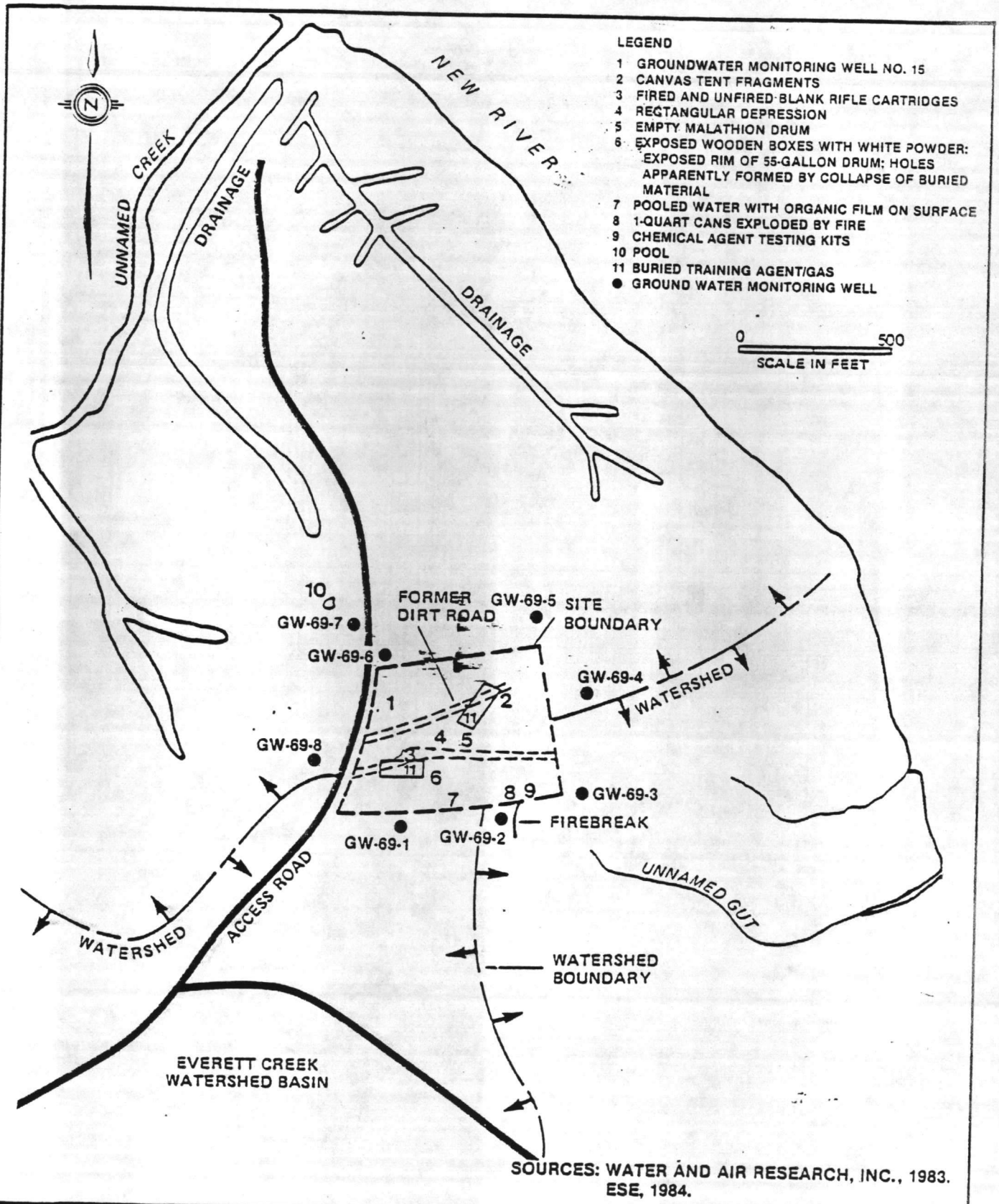
CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-15
PROPOSED SAMPLING LOCATIONS AT
SITE NO. 68, RIFLE RANGE DUMP

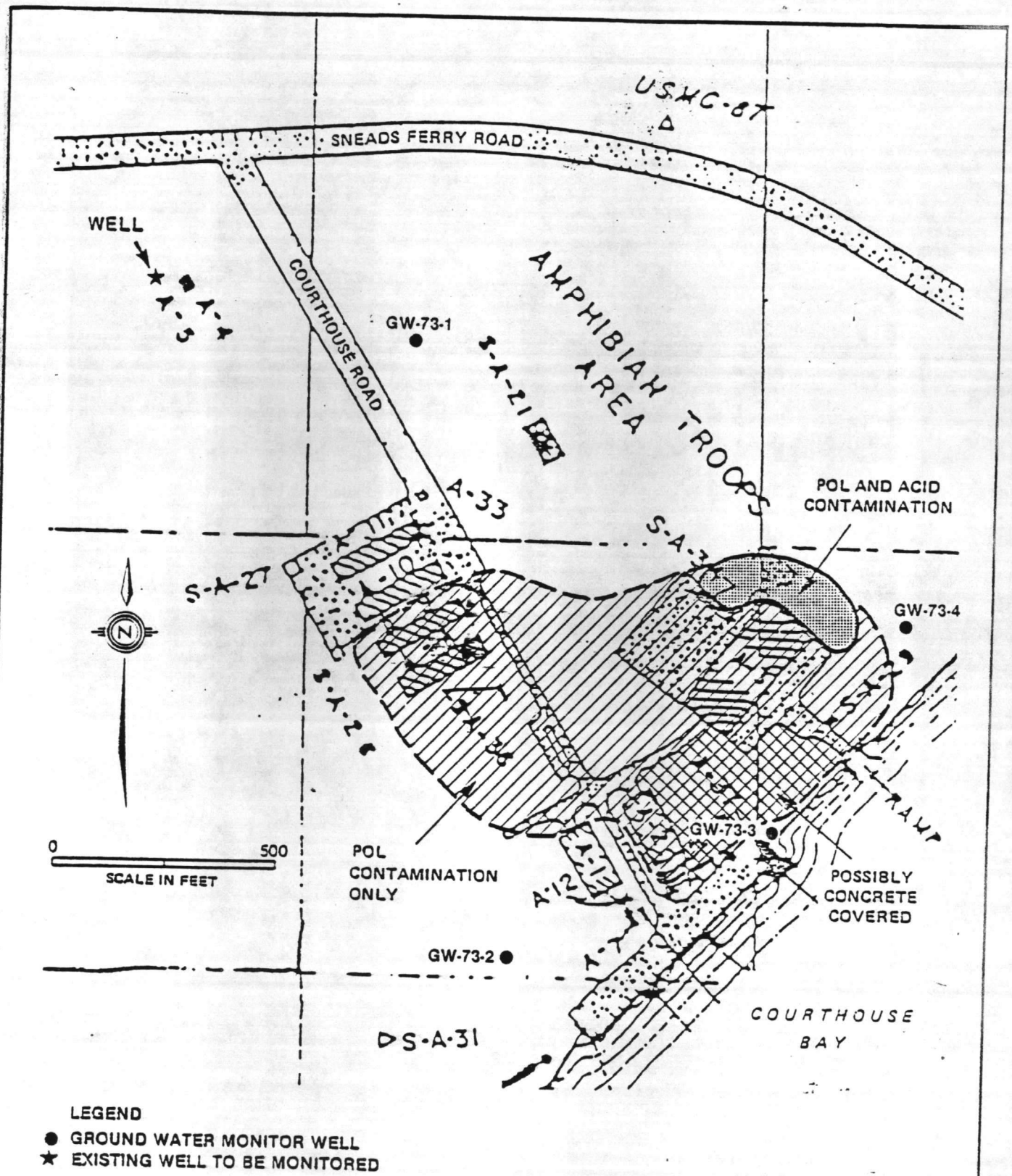
CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-16
PROPOSED SAMPLING LOCATIONS AT SITE NO. 69, RIFLE RANGE CHEMICAL DUMP

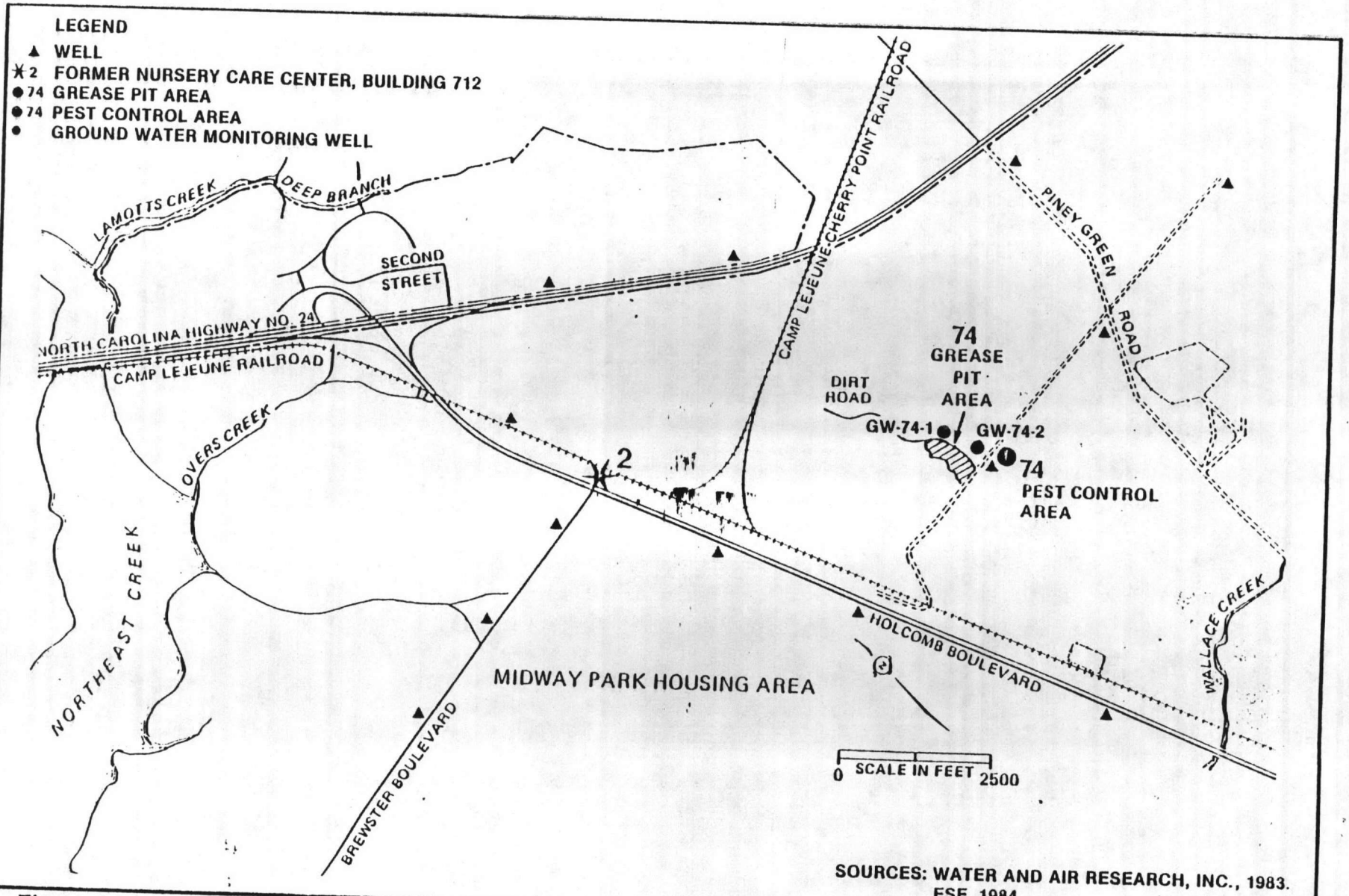
CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-17
PROPOSED SAMPLING LOCATIONS AT SITE NO. 73, COURTHOUSE BAY LIQUID DISPOSAL AREA

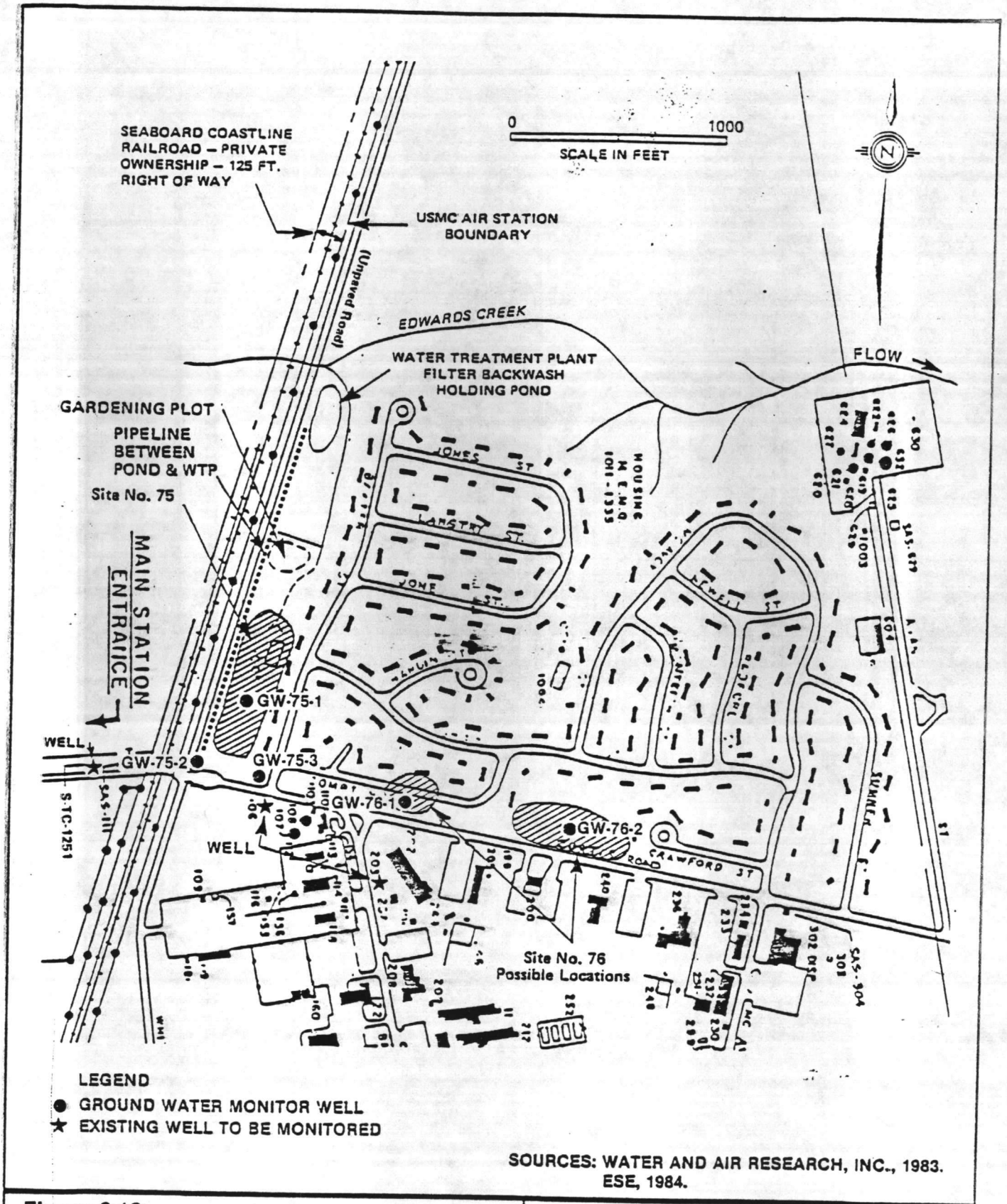
CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE



SOURCES: WATER AND AIR RESEARCH, INC., 1983.
ESE, 1984.

Figure 2-18
PROPOSED SAMPLING LOCATIONS AT SITE NO. 74, GREASE PIT AND PEST CONTROL AREA

CONFIRMATION STUDY
MARINE CORPS BASE
CAMP LEJEUNE


SEABOARD COASTLINE RAILROAD – PRIVATE OWNERSHIP – 125 FT. RIGHT OF WAY
USMC AIR STATION BOUNDARY
0
1000
SCALE IN FEET
N
(Unpaved Road)
EDWARDS CREEK
WATER TREATMENT PLANT FILTER BACKWASH HOLDING POND
FLOW
GARDENING PLOT
PIPELINE BETWEEN POND & WTP
Site No. 75
MAIN STATION ENTRANCE
JONES ST
LANGTRY ST
JONE ST
HOUSING
GW-75-1
GW-75-2
GW-75-3
WELL
GW-76-1
GW-76-2
WELL
CRAWFORD ROAD
Site No. 76
Possible Locations
SUMMERALL ST
SAS-111
SAS-904
SAS-905
SAS-906
SAS-907
SAS-908
SAS-909
SAS-910
SAS-911
SAS-912
SAS-913
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SAS-936
SAS-937
SAS-938
SAS-939
SAS-940
SAS-941
SAS-942
SAS-943

T 6280/4

In Reply Refer To:
WGS-Mail Stop 443 (356B)

April 9, 1986

Commanding General
U.S. Marine Corps Base
Camp Lejeune, North Carolina 28542-5001
ATTN: AC/S, Comptroller, MCB

Dear Sir:

Enclosed are two fully executed copies of your NAVCOMPT Form 2275, dated March 19, 1986, Document Number M6700186P000011, addressed to the U.S. Geological Survey (USGS), Raleigh, North Carolina. This order requests the USGS to do an appraisal of the Ground Water Resources of Marine Corps Base, Camp Lejeune, North Carolina, in accordance with the USGS project proposal.

The USGS is pleased to do this work for the U.S. Marine Corps. You will be billed on a reimbursable basis by our District Office, Raleigh, North Carolina, in an amount not to exceed the $80,000 authorized by your order.

It is understood that the results of this work will be available to the USGS for publication and use in connection with related work.

Sincerely yours,

William B. Mann IV
Assistant Chief Hydrologist
for Operations

2 Enclosures

UNITED STATES MARINE CORPS
Marine Corps Base
Camp Lejeune, North Carolina 28542-5001

6280/4
FAC

MEMORANDUM FOR THE COMMANDING GENERAL
CHIEF OF STAFF

25 APR 1986

Subj: GROUNDWATER SUPPLY STUDY BY U.S. GEOLOGICAL STUDY, PHASE I

1. Development of the subject study will commence on Tuesday 29 April with Phase I to be completed in March 1987.

2. The purposes of the plan are:

a. Determine groundwater use and management practices required to reduce potential for future contamination.

b. Assure future water supply needs are met.

3. FY-86 funding IAO $80K which was provided by CMC (LFL), has been transferred to the USGS, Raleigh, NC. The total effort will require four years of study and an estimated cost of $417K. I have requested FY-87 funding from CMC (LFL) for Phase II IAO $115K.

4. Phase I will accomplish two things:

a. Define water consumption: past, present and projected.

b. Describe the groundwater aquifer in geologic terms.

Phases II & III will develop test wells to define aquifer data for groundwater supply estimates. Phase IV will culminate with a groundwater production plan to estimate capacity and recommend locations for new and replacement wells. Throughout this study, the NACIP study will be coordinated to share data on groundwater contamination and remedial measures being considered.

Very respectfully,

R. A. TIEBOUT
AC/S, Facilities

Copy to:
BMO
NREAD
EnvEngr

WORK PLAN FOR PHASE 1
(April 1, 1986 - April 1, 1987)

Work items to be accomplished during Phase 1 will be based almost entirely on existing data.

WORK TASK I Compile all available ground-water data from USGS, State, and Camp Lejeune files for the area, including water-level, water-quality, water-use, and well log data. Construct a computer data set of this data that will facilitate future statistical analysis.

a. Compile USGS data sources.

b. Compile N.C. Department of Natural Resources and Community Development data sources.

c. Compile Camp Lejeune data resources, & future demand.

d. Inventory existing wells, take water-quality samples, and evaluate field parameters including chloride concentration, bromide concentration, pH, temperature, dissolved oxygen, specific conductance.

WORK TASK II Develop preliminary maps and other information products describing the geohydrologic framework beneath the base and adjacent areas in Onslow County.

a. Evaluate the general lithic character, thickness, extent, and continuity of confining beds and aquifers, from examination of geophysical logs made in existing wells in the study area.

b. Run new geophysical logs for existing wells where additional data is needed. These logs may include gamma-ray, neutron, bulk density, sonic gravel-time, and caliper logs.

WORK TASK III Map potentiometric surfaces of the water-supply aquifer from water-level measurements made primarily in existing wells~~, in the Air Station area~~.

a. Make two sets of water-level measurements in wells and local creeks and streams, one in "wet" and one in the "dry" season.

b. Establish water-level recorders on selected existing and available wells.

c. Construct a few shallow wells if needed to prepare a water-table map.

The information from WORK TASKS I, II, and III will be used to make a preliminary assessment of the hydrogeologic framework beneath Camp Lejeune. This assessment will be reviewed in Phase 2a (WORK TASK I) to determine the location and number of test wells to be drilled.

WORK TASK IV Prepare report on the results of the Phase 1 investigations with appropriate illustrations and data tables. The proposed title of the Phase 1 report is "A preliminary geohydrologic framework of the Camp Lejeune Marine Corps Base area, N.C."

WORK PLAN FOR PHASE 2
(Years 2 and 3 (April 1, 1987 - March 30, 1989)

Phase 2 will extend over a two-year period and will be devoted to test drilling and the collection and analysis of additional water quality, hydrogeologic, and aquifer hydraulic-parameter data. The work tasks associated with the drilling, testing, and analysis of new well data will be divided into two subphases, 2a and 2b. Phase 2a will be a drilling phase and Phase 2b will be a testing and data-analysis phase. In order to keep drilling costs at a minimum, an effort is to be made to complete all test drilling scheduled for Phase 2 in the first year (Phase 2a). At the end of Phase 2a, a data report describing the hydrogeology of the new wells will be prepared. The report will include information on geologic formations and aquifer materials penetrated by the test wells, water quality in the wells, and geophysical logs completed by the end of 2a. During the third year of the study, or Phase 2b, geophysical logging of wells will be completed, analysis of the geophysical logs will be completed, editing and refinement of the preliminary hydrologic framework developed during Phase 1 will be completed, and aquifer tests on test wells and existing wells will be conducted to determine hydraulic properties of the aquifers and confining beds. At the end of Phase 2b, a report on the revised hydrogeologic framework will be prepared. This report will include information on the hydraulic and water-quality properties of the aquifers and confining beds and the spatial variability of these properties beneath the base.

PHASE 2a
Year 2 (April 1, 1987 - March 30, 1988)

WORK TASK I Review available geologic, hydrologic, and chemical data and determine exact location and number of test wells to be drilled.

a. Coordinate drilling and additional data collection with the data compiled during the NACIP investigations at Camp Lejeune in order to share information and minimize expense where possible.

b. It is estimated that about four test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area. Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the freshwater-saltwater interface and its relation to supply-well pumping.

WORK TASK II Prepare drilling specifications, distribute specifications for bids, and award contract.

WORK TASK III Drill test wells and collect data needed to determine and verify the physical and chemical characteristics of the aquifer and confining-bed materials and fluids that overlie and occur within the deep, limestone water-supply aquifer.

a. Collect split-spoon samples of aquifer and confining-bed materials at specified depth intervals and analyze selected samples to determine chemical and hydraulic characteristics.

b. Collect ground-water samples from test wells at specified depths and analyze samples for selected constituents including concentrations of chloride, heavy metals, and organic compounds that can be associated with the work activities at Camp Lejeune.

c. Make water-level measurements and selected hydraulic tests at specified depth intervals in the test wells to determine the distribution of hydraulic head and hydraulic conductivity.

d. Make geophysical logs in test wells selecting combinations of gamma-ray, neutron, bulk density, sonic travel-time, resistivity, spontaneous potential, and conductivity surveys best suited to data needs.

WORK TASK IV Prepare report on the results of Phase 2a investigations with appropriate illustrations and data tables. This will be a data report that describes test- and observation-well construction and the new hydrogeologic data from the test wells. The proposed title of the Phase 2a report is "Well logs and hydrologic data from test wells at Camp Lejeune Marine Corps Base, North Carolina." The well logs will include both geophysical and lithologic logs.

PHASE 2b

Year 3 (April 1, 1988 - March 30, 1989)

WORK TASK I Complete drilling, sampling, and hydraulic tests of test wells. (This is first priority work item if drilling and testing of test wells was not completed during Phase 2a or if the drilling of additional wells became necessary.)

WORK TASK II Complete geophysical logging of new and existing wells. Analyze logs.

a. Analyze the geophysical and lithologic logs to identify depths to aquifer units and confining beds.

b. Construct fence diagrams to determine the lateral extent of aquifer units and confining beds.

WORK TASK III Conduct aquifer tests on new and existing wells to determine hydraulic properties of aquifer unit(s) and confining beds.

WORK TASK IV Based on new findings, refine and edit the preliminary assessment of the hydrogeologic framework that was developed during Phase 1.

WORK TASK V Prepare a report that describes the refined hydrogeologic framework. The proposed title of the phase 2b report is "Hydrogeologic framework beneath Camp Lejeune Marine Corps Base, North Carolina."

WORK PLAN FOR PHASE 3
Year 4 (April 1, 1989 - March 30, 1990)

WORK TASK I Construct a finite-difference ground-water flow model of the hydrogeologic system in and around Camp Lejeune based on the data and interpretations that resulted from investigations during Phases 1 and 2.

a. Determine grid system for area and discretize appropriate maps of aquifer and confining-bed characteristics (such as structure tops, thicknesses, hydraulic conductivity, potentiometric surfaces, etc.).

b. Determine boundary conditions.

c. Develop a steady-state digital model for unstressed (pre-pumping) conditions in the area.

d. Evaluate different ground-water pumpage and development schemes to determine which alternatives will reduce the chances for contamination of the water-supply aquifer (optimization analysis).

The ground-water flow model will be a management aid that can be used (1) to guide site selection for new wells through prediction of water-level drawdowns that will occur in response to planned pumping rates at potential well sites, and (2) to evaluate water-level drawdowns at existing production wells through prediction of drawdowns that would occur in response to alternative pumping schedules. The potential benefits to be gained from model studies are less well interference, lower pumping costs, and reduced chance for contamination of the water supply.

WORK TASK II Prepare report on the results of Phase 3 investigations with appropriate illustrations and data tables. The proposed title of the Phase 3 report is "Ground-water supply and potential for contamination--Camp Lejeune Marine Corps Base, North Carolina."

ASSISTANT CHIEF OF STAFF, FACILITIES
HEADQUARTERS, MARINE CORPS BASE

DATE 4/23/86

TO:

- BASE MAINT O
- PUBLIC WORKS O
- COMM-ELECT O
- DIR., NAT. RESOURCES & ENV. AFFAIRS
- CONSTR. COORD
- DIR, FAMILY HOUSING
- DIR, BACHELOR HOUSING
- BASE FIRE CHIEF

ATTN: U.S.G.S. GROUNDWATER STUDY

1. Attached is forwarded for info/action.
   WORK PLAN ATTACHED.

   MTG to kick off study:
2. Please initial, or comment, and return all papers to this office.
   Date: TUESDAY, 29 APR.

   Time: 2:00 p.m.
3. Your file copy.
   Loc'n: Fac Conf. Rm, Bldg 1

Call if ?'s.

"LET'S THINK OF A FEW REASONS
WHY IT CAN BE DONE"

MCBCL 5216/21 (REV. 04-85)

United States Department of the Interior

GEOLOGICAL SURVEY

P.O. Box 2857
Raleigh, NC 27602

April 21, 1986

Mr. Robert E. Alexander
Assistant Chief of Staff Facilities
Marine Corps Base
Camp Lejeune, North Carolina 28542

Dear Mr. Alexander:

Enclosed is a proposed work plan for the ground-water study at Camp Lejeune. The work plan covers three phases of work covering four years of study.

As we discussed at our meeting on April 18, 1986 here in Raleigh, we plan a trip to Camp Lejeune April 29-30. Members of our study team including Wanda Meeks, Hydrologic Studies Section Chief, Douglas Harned, Camp Lejeune Project Chief, Charles Daniel, Cherry Point Project Chief, and Steve Howe, Hydrologic Studies Section Technician, will come to meet your staff and tour some of the facilities.

I will contact you by phone Monday, April 28, to discuss scheduling arrangements.

Sincerely,

Douglas A. Harned

Douglas A. Harned
Hydrologist

Enclosure

DAH/kh

WORK PLAN FOR PHASE 1
(April 1, 1986 - April 1, 1987)

Work items to be accomplished during Phase 1 will be based almost entirely on existing data.

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c. Compile Camp Lejeune data resources.

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(Years 2 and 3 (April 1, 1987 - March 30, 1989)

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PHASE 2b

Year 3 (April 1, 1988 - March 30, 1989)

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Year 4 (April 1, 1989 - March 30, 1990)

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6280/4
FAC

12 MAR 1986

Assistant Chief of Staff, Facilities, Marine Corps Base, Camp Lejeune
Assistant Chief of Staff, Comptroller

GROUNDWATER SUPPLY STUDY BY U.S. GEOLOGICAL SURVEY, PHASE I

Ref: (a) CMC (LFL) msg 070133Z Feb 86

Encl: (1) Project Proposal, U.S.G.S. dtd 14 Aug 85
(2) Cost Account Information

1. Request funding IAO $80K be transferred to the U. S. Geological Survey, Raleigh, NC to initiate Phase I of the subject study as described in the enclosures. The reference approved funding for this effort.

2. The purpose of the study is to determine groundwater use and management practices in order to reduce potential for future contamination and to assure future water supply needs are met. To initiate this work, a work plan and milestone will be developed by U. S. Geological Survey by 1 April 1986.

3. The U.S. Geological Survey administrative contact is Mrs. Nancy Williams, FTS 672-4510. Our point of contact is Mr. Bob Alexander, ext. 3034.

R. A. TIEBOUT

Copy to:
BMO
NREAD
EnvEngr

PROJECT PROPOSAL

AN APPRAISAL OF THE GROUND-WATER RESOURCES OF CAMP LEJEUNE MARINE CORPS BASE NORTH CAROLINA

U. S. Geological Survey
Raleigh, North Carolina
August 14, 1985

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PROJECT PROPOSAL

TITLE AND LOCATION: Ground-water resources of Camp Lejeune Marine Corps Base, North Carolina.

Camp Lejeune Marine Corps Base, an area of about 170 square miles, is located southeast of the city of Jacksonville in Onslow County, North Carolina. The Base is bounded on the north by N.C. Highway 24, the east by N.C. Highway 172 and Bear Creek, the southeast by the Atlantic Ocean, the southwest by the New River and an irregular line that roughly parallels N.C. Highway 172, and on the west by U.S. Highway 17 (see fig. 1).

PROBLEM: Since Camp Lejeune was first opened in the late 1930's, water supply has been derived from wells that tap freshwater-bearing aquifers (sands and limestone) which occur between land surface and about 400 feet below land surface in the area (see figs. 2 and 3). Clay and silty clay confining beds are interlayered with the aquifer material but are estimated to be thin and discontinuous beneath the Base. Salty water occurs in the deep sand aquifers that underly the area and in the shallow aquifer material adjacent to the Atlantic Ocean and the tidal reaches of the New River and its tributaries.

Over the years, more than 100 wells have been drilled and operated to satisfy increasing demands for water as the Base functions and population grew. At present, ground-water withdrawals are estimated at eight million gallons per day, and Base population is about 100,000.

An increase in the amount of waste generated by Base operations accompanied the growth. As a result, significant amounts of several kinds of wastes containing hazardous and toxic organic compounds have been disposed of or spilled at numerous sites on the base (see fig. 4).

Most of the disposal and spill sites are directly underlain by sand and lack natural or synthetic barriers to contain the wastes and prevent them from moving downward into the ground-water system. Consequently, some of the wastes have infiltrated to the water table and contaminated some of the ground water in the shallow and supply aquifers. Many of the waste-disposal and spill sites are near water-supply wells (see fig. 4), and use of a number of supply wells has been discontinued recently because organic compounds have been detected in the well water.

PROBLEM: continued

Ground-water withdrawals from wells that are near the tidal reaches of the New River and its tributaries may cause salty water in these drainage-ways to move into and through the shallow sand and limestone aquifers toward the pumping wells (see figs. 2 and 3). It is also possible that salty water could be drawn upward from deeper parts of the aquifer system by wells pumping large amounts of ground water from the deep sand aquifers or the lower parts of the limestone aquifer.

Growing water-supply needs coupled with the threat of present and future contamination of existing wells (by disposed wastes or brackish and saline water) has prompted the Marine Corps to request the U.S. Geological Survey to study the geohydrology of the Base and environs and determine ground-water use and management practices that will reduce the chances of further contamination and help assure that future water-supply needs are met.

OBJECTIVES: The objective of this study is to describe the ground-water resources of the Base and to construct an appropriate ground-water flow model that will be used to evaluate alternative ground-water use and management practices that will reduce chances for further contamination and help assure that future water-supply needs are met.

SCOPE: The study area will include the Marine Corps Base and environs. Study elements will include determining (1) the lateral extent, thickness, and hydraulic characteristics of aquifers and confining beds, (2) the potentiometric surfaces of the aquifers, (3) the amounts of ground-water recharge and discharge, (4) the quality of freshwater contained by the aquifers, and (5) the relationship between the freshwater and saltwater in the aquifers. The data collected during these study elements will be used to construct the fine-grid finite-difference ground-water flow model.

Water-level and water-quality data obtained from more than 50 wells that were drilled during the second phase of the Navy Assessment and Control of Installation Pollutants (NACIP) program at the Base will be used in conjunction with data to be collected during the USGS study. The NACIP data will help define the hydrology and any potential and existing water-quality problems. The wells drilled for the NACIP program are designed to test the ground-water quality to a depth no more than ten feet below the water table and are located adjacent to 22 waste-disposal or spill sites at the Base. Analyses of soil, rock, and water samples collected from these wells are being used to confirm whether or not the shallow ground-water and aquifer material have been contaminated.

APPROACH:

1. Water-resources budget--Data on precipitation, evapotranspiration, runoff, water levels and water use will be collected, compiled and analyzed to estimate ground-water recharge and discharge in the area.

2. Geohydrologic framework--The depth to and thickness and lateral extent of the aquifers and confining beds will be determined and mapped from a study of geophysical and lithologic logs made from existing wells and a few new wells that may be constructed for the study.

3. Ground-water movement through the geohydrologic framework--Data from geophysical and lithologic logs will be used in conjunction with aquifer test data from existing and new wells to determine and map the water transmitting and storage capabilities (hydraulic conductivity and storage coefficient, respectively) of the aquifers and confining beds. In addition, water-level data collected from existing and new wells will be used to determine and map the potentiometric surfaces of the aquifers. The water-level data indicate the hydraulic gradient throughout the aquifer systems. The hydraulic gradient, hydraulic conductivity and storage coefficient are needed to determine the direction and rate of ground-water movement in the area.

4. Quality of ground water--Water samples will be collected from existing and new wells and analyzed for concentrations of major ions, including chloride, and organic compounds, heavy metals, and other appropriate chemicals that can be associated with the work or waste disposal at the Base. The water-quality data will be used to identify, quantify, and determine the source of chemical constituents in the fresh ground water and to help determine the position of fresh water-saltwater interface in the Base area.

5. Ground-water flow model--The compiled and analyzed data will be used to construct and calibrate the fine-grid, finite-difference ground-water flow model. The model will be the basic tool with which to analyze the effects of alternative ground-water supply development scenarios for the Base. It will be run on the USGS PRIME computer in the North Carolina District office in Raleigh; however, the model can be transferred to other computer(s) on the Base or elsewhere.

APPROACH: continued

6. Test drilling--A major part of the study can be implemented with data that is either presently available or can be collected from existing wells. However, some new test drilling will be needed to better define the geohydrologic framework, the factors that control ground-water movement through the framework, and the ground-water quality. It is estimated that about four test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area. Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the saltwater-freshwater interface and its relation to supply-well pumping.

It is assumed that the drilling and sampling of the NACIP program will describe and define the nature and extent of ground-water contamination from hazardous-waste sites on the Base. Therefore, drilling done for the USGS study will be located away from the hazardous-waste sites, as much as possible, to reduce the expense of required and special drilling and safety procedures (like those needed at Cherry Point Marine Corps Air Station).

REPORTS: A report will be written for the USMC describing the results of each completed phase of the investigation (see TIME FRAME for phase descriptions). The completion of the study will result in an interpretative report entitled, "An appraisal of the ground-water resources of Camp Lejeune Marine Corps Base, North Carolina." Additional interpretative reports may be written on various technical aspects of the study. Written progress reports will be prepared and submitted to the USMC quarterly.

RELATION TO LONG-RANGE PLAN: This study relates directly to the North Carolina District's long-range plan (dated May 12, 1980) concerning the quality and availability of ground water in the Coastal Plain.

RELATION TO STATE AND WRD PROGRAMS: The North Carolina Department of Natural Resources and Community Development and the Department of Human Resources are interested and involved in classifying, mapping, and regulating water-use, waste-disposal, and land-use practices throughout the State.

The USGS has a mandate from the U.S. Congress to study and report on the quality and availability of water resources throughout the United States. Ground-water quality is of high national priority for the USGS.

TIME FRAME: The study is tentatively planned for four years and will be divided into three phases. The second phase is extended over a two-year period because of the cost of the work tasks. A brief description of work tasks for each phase follows:

Phase 1 (Fiscal Year 1986[?]) - Collect, compile and analyze all available data on water budget, water use, geohydrologic framework, hydraulic characteristics of aquifers and confining beds, and head and quality of water in aquifers. Prepare a report that describes the available data and new data needs.

Phase 2 (Fiscal Year 1987[?] and 1988[?]) - To fill data needs described in Phase 1 report, design and construct new test wells and new observation wells, and make geohydrologic and chemical tests on new and pre-existing wells. Prepare a report that describes test- and observation-well construction, and the new geohydrologic and chemical data.

Phase 3 (Fiscal Year 1989[?]) - From the analysis of data collected in Phases 1 and 2, construct and calibrate a finite-difference model of ground-water flow through the aquifer and confining-bed materials that underlie the Base area. Determine alternative ground-water use and management practices that will reduce chances for further ground-water contamination and help assure that the future water-supply needs of Camp Lejeune are met effectively and efficiently with the least amount of environmental impact. Recommend a long-term water-level and water-quality monitoring system that will help assure the quality and quantity of the Base water supply. Prepare a report describing the results of Phase 3.

BASE MAINTENANCE DIVISION
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA 28542

From: Supervisor, Finance and Property Management Section
To: Cost Accounting

Subj: Job Order for Minor Work or Contract Authorization

1. The following Job Order has been established for accomplishment of minor work/contract authorization as indicated.

a. Labor Class Code 05

b. Service Work Authorization No. _____

c. CAC P1 9171 12002

d. Date Authorized 18 Feb 1986

e. Job Order No. Charges Amb-23-2095-2310Q

f. Building Involved _____

g. Description of Work Phase I Ground Water Study to U.S. Geog - Survey
$80,000.00

h. Work requested by L. Alex

B Geo

Copy to:

MCBCL 4701/1 (REV. 7-81)

ASSISTANT CHIEF OF STAFF, FACILITIES
HEADQUARTERS, MARINE CORPS BASE

DATE 4/23/86

TO:
BASE
PUBL
COM
DIR.,

Re: GROUNDWATER STUDY

COL T. -

USGS staff arrive TUES a.m. 4/29

I've arranged mtg + will escort, etc

Tues afternoon, Wed morning.

Will a QUICK IN-BRIEF be OK on Tues ?

V/R Ade

ATTN:

1. Att

MTG TO Kick off study:

2. Please initial, or comment, and return all papers to this office.

Date: TUESDAY, 29 APR.

Time: 2:00 p.m.

3. Your file copy.

Loc'n: FAC Conf. Rm, Bldg 1

Call if ?'s.

"LET'S THINK OF A FEW REASONS
WHY IT CAN BE DONE"

Looks good Bob,

Please ensure that Janet gets it on my Calendar

Thanks

DR

ASSISTANT CHIEF OF STAFF, FACILITIES
HEADQUARTERS, MARINE CORPS BASE

DATE 4/23/86

TO:

BASE MAINT O
PUBLIC WORKS O
COMM-ELECT O
DIR., NAT. RESOURCES & ENV. AFFAIRS

CONSTR. COORD
DIR, FAMILY HOUSING
DIR, BACHELOR HOUSING
BASE FIRE CHIEF

ATTN: U.S.G.S. GROUNDWATER STUDY

1. Attached is forwarded for info/action.

WORK PLAN ATTACHED.

MTG to kick off study:

2. Please initial, or comment, and return all papers to this office.

Date: TUESDAY, 29 APR.

Time: 2:00 p.m.

3. Your file copy.

Loc'n: FAC Conf. Rm, Bldg 1

Call if ?'s.

"LET'S THINK OF A FEW REASONS
WHY IT CAN BE DONE"

Looks good Bob,

Please ensure that Janet gets it on my Calendar

Thanks

DR

United States Department of the Interior

GEOLOGICAL SURVEY

P.O. Box 2857
Raleigh, NC 27602

April 21, 1986

Mr. Robert E. Alexander
Assistant Chief of Staff Facilities
Marine Corps Base
Camp Lejeune, North Carolina 28542

Dear Mr. Alexander:

Enclosed is a proposed work plan for the ground-water study at Camp Lejeune. The work plan covers three phases of work covering four years of study.

As we discussed at our meeting on April 18, 1986 here in Raleigh, we plan a trip to Camp Lejeune April 29-30. Members of our study team including Wanda Meeks, Hydrologic Studies Section Chief, Douglas Harned, Camp Lejeune Project Chief, Charles Daniel, Cherry Point Project Chief, and Steve Howe, Hydrologic Studies Section Technician, will come to meet your staff and tour some of the facilities.

I will contact you by phone Monday, April 28, to discuss scheduling arrangements.

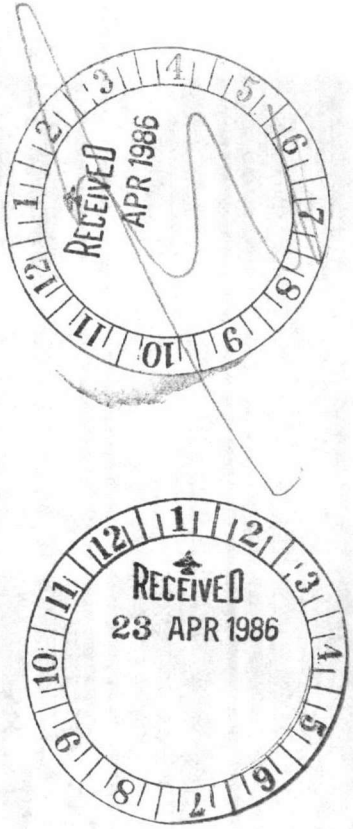
Sincerely,

Douglas A. Harned

Douglas A. Harned
Hydrologist

Enclosure

DAH/kh


RECEIVED
APR 1986

RECEIVED
23 APR 1986

United States Department of the Interior

GEOLOGICAL SURVEY

P.O. Box 2857
Raleigh, NC 27602

February 10, 1986

Mr. Robert E. Alexander
Assistant Chief of Staff Facilities
Marine Corps Base
Camp Lejune, North Carolina 28542

Dear Mr. Alexander:

This letter is a follow-up to your communication of January 27 (attachment 1) relating the contents of a phone conversation between you and Mr. Bruce Lloyd regarding the U.S. Geological Survey ground-water study at Camp Lejune. Clarification of several points in this communication is necessary so that there will be no misunderstanding of the objectives to be accomplished in each project phase and the time frame in which they will be accomplished.

First, I call attention to item 3 (attachment 1) that describes mathematical modeling during FY 88. The study proposal that we submitted calls for no less than 4 years effort to complete all necessary work tasks. The first 3 years would be necessary to complete all data collection and analyses, test drilling, aquifer tests, and development of a hydrogeologic framework for the Camp Lejune area. The hydrogeologic framework would be the basis for mathematical modeling in the fourth year. Thus the earliest that mathematical modeling could now be undertaken would be FY 89.

Work items to be accomplished during Phase 1 (item 2, attachment 1) will be based almost entirely on existing data. Once available data are collected and compiled, they will be analyzed to determine the current status of our knowledge regarding items 2.A-E (attachment 1). The extent to which we can accomplish these work items will be determined by the availability of data and the extent to which we can supplement this data with our own work, particularly geophysical logging of existing wells, during Phase 1. Our primary goals during Phase 1 will thus be (1) to develop preliminary maps and other information products describing the geohydrologic framework beneath the base and adjacent areas in Onslow County and (2) to make a study of past, present, and projected water consumption. The data that are collected to meet these two objectives will allow us to begin work on a ground-water budget and a data base describing hydraulic characteristics of the aquifers and confining beds, head distribution in the aquifers, and information on the quality of water in the aquifers. Contrary to one of the stated accomplishments outlined in 2.C (attachment 1), we do not expect, by the end of Phase 1, to be able to do more than approximate the depth to saltwater. We already know from a review of available data that this can only be accomplished by test drilling during Phase 2.

We expect findings from Phase 1 to guide planning and execution of Phase 2 well drilling and water sampling. Results from Phase 2 will be used to fill in gaps in our hydrologic knowledge identified in Phase 1 and to further refine this knowledge. In our present study proposal, Phase 2 would last two years. Due to possible budget restraints and your desire to carry out the study in 1-year increments, we propose that work elements under Phase 2 be subdivided into two phases, 2a and 2b. Thus the study will consist of 4 phases, each of 1-year duration. In order to keep drilling costs at a minimum we suggest that all drilling originally planned for Phase 2 be done during Phase 2a (FY 87). At the end of Phase 2a we would provide you with a data report describing the hydrogeology of the wells that were drilled. The report would include information on geologic formations and aquifer materials penetrated by the test wells, water quality in the wells, and geophysical logs completed by the end of 2a. During the third year of the study, or Phase 2b, geophysical logging of the wells would be completed, analysis of the geophysical logs would be completed, editing and refinement of the hydrologic framework developed during Phase 1 would be completed, and pumping tests on test wells would be conducted to determine hydraulic properties of the aquifers and confining beds. At the end of Phase 2b, a report on the revised hydrogeologic framework would be prepared. This report would include information on the hydraulic and water quality properties of the aquifers and confining beds and the spatial variability of these properties beneath the base.

Phase 3 will thus be entirely devoted to model development and calibration. At the end of Phase 3, we plan to have an operational model that can be transferred to one of your in-house computer systems. We hope to begin a sensitivity analysis during Phase 3 to evaluate various management options regarding impacts of changing pumping schedules and construction of new wells. We do not know how much of this analysis we can complete during Phase 3. Perhaps it is something that you will want to pursue further yourself or consider for further study at some later date.

Sincerely,

CC Daniel III

Charles C. Daniel III
Hydrologist

Attachment

CCD/kh

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ADMINISTRATIVE MESSAGE

ROUTINE

R 141550Z JAN 86 ZYB

FM CG MCB CAMP LEJEUNE NC

TO: CMC WASHINGTON DC

INFO LANTNAVFACENGCOM NORFOLK VA

UNCLAS //N06280//

CMC//CODEXLFL/LANTDIV FOR 114 AND 09P
SUBJ: FY-86 ENVIRONMENTAL/NATURAL RESOURCES/ARCHAEOLOGICAL RESOURCES MANAGEMENT PROGRAMS- O&MMC 'P' ALLOCATIONS

A. CMC 020130Z JAN 86
B. PHONECON BTWN MR. B. LLOYD, U.S. GEOLOGICAL SURVEY, AND

MR. ALEXANDER, MCB ON 8 JAN 86

1. THIS MSG CONFIRMS FEASIBILITY OF INITIATING PHASE I USGS GROUNDWATER STUDY AS REQUESTED BY REF A. REQ FUNDING IAO $80,000 BE PROVIDED FOR TRANSFER TO USGS.

2. PHASE I ACCOMPLISHMENTS WILL INCLUDE FOLLOWING, PER REF B:
A. GROUNDWATER BUDGET
B. CURRENT AND PROJECTED WATER CONSUMPTION
C. GEOHYDROLOGIC FRAMEWORK, OBTAIN GEOPHYSICAL LOGS OF EXISTING WELLS, CORRELATE UNDERLYING STRATA, DETERMINE NUMBER OF CONFINING BEDS, FIND DEPTH OF SALTWATER
D. HYDRAULIC CHARACTERISTICS OF AQUIFERS
E. HEAD AND QUALITY OF AVAILABLE AQUIFERS
THE ABOVE ITEMS WILL BE PROVIDED IN A DETAILED WORK PLAN WITH MILESTONES WITHIN 30 DAYS FOLLOWING TRANSFER OF FUNDS TO USGS.

3. PHASE I RESULTS WILL DEFINE DATA REQUIREMENTS FOR SUBSEQUENT TEST DRILLING AND MATHEMATICAL MODELING DURING FY87/88. THIS INFORMATION WILL ESTABLISH THE BASIS FOR WATER SUPPLY PROJECT PLANNING IN THE 1990'S AND BEYOND. THE COMPLETED STUDY, IN

BFAC(2)...ORIG FOR CG MCB CAMP LEJEUNE(8) /13/
BCOS(1) BSDO(1) CFOS(1) OICB(1) NREA(1) COMP(1)

RTD:000-000/COPIES:0008

563429/014 1 OF 2 MATA0562 014/23:08Z 141550Z JAN 86
CSN:RXIC00085 CG MCB CAMP LE

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CONJUNCTION WITH THE NACIP CHARACTERIZATION AND FEASIBILITY REPORT, WILL BE ESSENTIAL INFORMATION ON WHICH TO REDUCE CHANCES FOR FURTHER MOVEMENT OF GROUNDWATER CONTAMINATION.

BT

6280/4
FAC
5 SEP 1985

From: Commanding General, Marine Corps Base, Camp Lejeune
To: Commandant of the Marine Corps (Code LFL)

Subj: STUDY OF THE GROUND WATER AQUIFER BY U.S. GEOLOGICAL SURVEY

Ref: (a) CG, MCB Camp Lejeune NC 191947Z Aug 85

Encl: (1) USGS ltr dtd 14 Aug 85 with enclosed Project Proposal

1. Growing water supply needs, coupled with the threat of present and future contamination of existing wells by disposed wastes or brackish and saline water, prompted this Command to request U.S. Geological Survey to study the geohydrology of the Base and environs. This study will determine ground water use and management practices in order to reduce chances of further contamination and help assure future water supply needs are met.

2. The enclosed project proposal was developed by USGS and briefly describes work tasks and establishes cost as summarized below:

Phase 1 (Fiscal Year 1986).....$80,000

Analyze available aquifer data and develop report describing additional information requirements.

Phase 2 (Fiscal Year 1987 and 1988).....$228,000

Test drill (11-14 new wells) to establish the salt/fresh water interface and its relation to supply well pumping.

Well drilling sites will be coordinated with NACIP study for maximum coverage.

Phase 3 (Fiscal Year 1989).....$109,000

Develop ground water model and determine alternative management procedures.

Total Project Cost.....$417,000

Subj: STUDY OF GROUND WATER AQUIFER BY U.S. GEOLOGICAL SURVEY

3. Request you review and provide comments/concurrence with the proposed study. This requirement has been included with FY-86 other engineering support requirements as fowarded by the reference. For additional information regarding this study, please contact Mr. Bob Alexander, MCB Environmental Engineer, AV 484-3034.

R. A. TIEBOUT
By direction

Copy to:
U.S. Geological Survey, Raleigh (w/out Encl)
LANTNAVFACENGCOM (114 AND 09P)

Blind copy to:
AC/S COMP
PWO
BMO
NREAD
EnvEngr

Writer: Mr. Alexander
Typist: S. Schmitz,29Aug85

Post Office Box 2857
Raleigh, North Carolina 27602

August 14, 1985

Mr. Robert E. Alexander
Environmental Engineer
United States Marine Corps
Office of the Assistant
Chief of Staff Facilities
Camp Lejeune, North Carolina 28542

Dear Mr. Alexander:

Per your request when Ron Coble and I met with you and other staff members at Camp Lejeune on July 23, 1985, we have prepared a project proposal describing an investigation of the ground-water resources of the base and its environs. Four copies of the proposal are attached for your review and consideration. The cost of test drilling is high, but we feel the drilling is necessary to better insure the reliability of the data and, therefore, of the computer model. The estimated total cost of the project ($417,000) could be divided evently over a four year period to make the annual funding level more constant.

Please let us know if you have any questions, suggestions, or comments about the proposal. We are looking forward to working with you toward the solution of the water-supply problems at Camp Lejeune.

Sincerely,

Orville B. Lloyd, Jr.

Orville B. Lloyd, Jr.
Hydrologist

Encl.

OBL:ceh

Enclosure 1

PROJECT PROPOSAL

AN APPRAISAL OF THE GROUND-WATER RESOURCES OF CAMP LEJEUNE MARINE CORPS BASE, NORTH CAROLINA

U. S. Geological Survey
Raleigh, North Carolina
August 14, 1985

Revised August 22, 1985

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ILLUSTRATIONS

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Figure 2. Diagrammatic geologic and hydrologic cross section A-A' through Camp Lejeune Marine Corps Base, North Carolina . . 10

Figure 3. Diagrammatic geologic and hydrologic cross section B-B' through Camp Lejeune Marine Corps Base, North Carolina . . 11

Figure 4. Location of supply wells and waste-disposal sites at Camp Lejeune Marine Corps Base, North Carolina. 12

PROJECT PROPOSAL

TITLE AND LOCATION: An appraisal of the ground-water resources of Camp Lejeune Marine Corps Base, North Carolina.

Camp Lejeune Marine Corps Base, an area of about 170 square miles, is located southeast of the city of Jacksonville in Onslow County, North Carolina. The Base is bounded on the north by N.C. Highway 24, the east by N.C. Highway 172 and Bear Creek, the southeast by the Atlantic Ocean, the southwest by the New River and an irregular line that roughly parallels N.C. Highway 172, and on the west by U.S. Highway 17 (see fig. 1).

PROBLEM: Camp Lejeune plays an essential role in training many Marine Corps men and women for jobs that are necessary to preserve our national security. The Base is the only military training center in the eastern United States where joint amphibious training exercises can be carried out with all branches of the Armed Services.

A plentiful and good-quality water supply is vital for Camp Lejeune to carry out its mission and to maintain the operational readiness of the Fleet Marine Forces. Because it would be very difficult to impound large supplies of fresh water on the surface of the land in the area, Camp Lejeune relies on large amounts of ground water for water supply.

Since Camp Lejeune was first opened in the late 1930's, water supply has been derived from wells that tap freshwater-bearing aquifers (sands and limestone) which occur between land surface and about 400 feet below land surface in the area (see figs. 2 and 3). Clay and silty clay-confining beds are interlayered with the aquifer material but are estimated to be thin and discontinuous beneath the Base. Salty water occurs in the deep sand aquifers that underly the area and in the shallow aquifer material adjacent to the Atlantic Ocean and the tidal reaches of the New River and its tributaries.

Over the years, more than 100 wells have been drilled and operated to satisfy increasing demands for water as the Base functions and population grew. At present, ground-water withdrawals rank amoung the largest in the State and are estimated at 8 million gallons per day. The Base presently supports a population of about 100,000.

An increase in the amount of waste generated by Base operations accompanied the growth. As a result, significant amounts of several kinds of wastes containing hazardous and toxic organic compounds have been disposed of or spilled at numerous sites on the Base (see fig. 4).

PROBLEM: continued

Most of the disposal and spill sites are directly underlain by sand and lack natural or synthetic barriers to contain the wastes and prevent them from moving downward into the ground-water system. Consequently, some of the wastes have infiltrated to the water table and contaminated some of the ground water in the shallow and supply aquifers. Many of the waste-disposal and spill sites are near water-supply wells (see fig. 4), and the use of a number of supply wells has been discontinued recently because organic compounds have been detected in the well water.

Ground-water withdrawals from wells that are near the tidal reaches of the New River and its tributaries may cause salty water in these drainage-ways to move into and through the shallow sand and limestone aquifers toward the pumping wells (see figs. 2 and 3). It is also possible that salty water could be drawn upward from deeper parts of the aquifer system by wells pumping large amounts of ground water from the deep sand aquifers or the lower parts of the limestone aquifer.

Growing water-supply needs coupled with the threat of present and future contamination of existing wells (by disposed wastes or brackish and saline water) has prompted the Marine Corps to request the U.S. Geological Survey to study the geohydrology of the Base and environs and determine ground-water use and management practices that will reduce the chances of further contamination and help assure that future water-supply needs are met.

OBJECTIVES: The objective of this study is to describe the ground-water resources of the Base and environs and to construct an appropriate ground-water flow model that will be used to evaluate alternative ground-water use and management practices that will reduce chances for further contamination and help assure that future water-supply needs are met.

SCOPE: The study area will include the Marine Corps Base and environs. Study elements will include determining (1) the lateral extent, thickness, and hydraulic characteristics of aquifers and confining beds, (2) the potentiometric surfaces of the aquifers, (3) the amounts of ground-water recharge and discharge, (4) the quality of freshwater contained by the aquifers, and (5) the relationship between the freshwater and saltwater in the aquifers. The data collected during these study elements will be used to construct a fine-grid, finite-difference ground-water flow model.

SCOPE: continued

Water-level and water-quality data obtained from more than 50 wells that were drilled during the second phase of the Navy Assessment and Control of Installation Pollutants (NACIP) program at the Base will be used in conjunction with data to be collected during the USGS study. The NACIP data will help define the hydrology and any potential and existing water-quality problems. The wells drilled for the NACIP program are designed to test the ground-water quality to a depth of about 10 feet below the water table and are located adjacent to 22 waste-disposal or spill sites at the Base. Analyses of soil, rock, and water samples collected from these wells are being used to confirm whether or not the shallow ground-water and aquifer material have been contaminated. Confirmation of contamination in the shallow part of the ground-water system will provide an alert to potential contamination in the deeper supply aquifer.

APPROACH:

1. Water-resources budget--Data on precipitation, evapotranspiration, runoff, water levels and water use will be collected, compiled and analyzed to estimate ground-water recharge and discharge in the area.

2. Geohydrologic framework--The depth to and thickness and lateral extent of the aquifers and confining beds will be determined and mapped from a study of geophysical and lithologic logs made from existing wells and new wells that will be constructed for the study.

3. Ground-water movement through the geohydrologic framework--Data from geophysical and lithologic logs will be used in conjunction with aquifer-test data from existing and new wells to determine and map the water transmitting and storage capabilities (hydraulic conductivity and storage coefficient, respectively) of the aquifers and confining beds. In addition, water-level data collected from existing and new wells will be used to determine and map the potentiometric surfaces of the aquifers. The water-level data indicate the hydraulic gradient throughout the aquifer systems. The hydraulic gradient, hydraulic conductivity and storage coefficient are needed to determine the direction and rate of ground-water movement in the area.

4. Quality of ground water--Water samples will be collected from existing and new wells and analyzed for concentrations of major ions, including chloride, and organic compounds, heavy metals, and other appropriate chemicals that can be associated with the work or waste disposal at the Base. The water-quality data will be used to identify, quantify, and determine the source of chemical constituents in the fresh ground water and to help determine the position of the freshwater-saltwater interface in the Base area.

APPROACH: continued

5. Ground-water flow model--The compiled and analyzed data will be used to construct and calibrate the fine-grid, finite-difference ground-water flow model. The model will be the basic tool with which to analyze the effects of alternative ground-water supply development scenarios for the Base. It will be run on the USGS PRIME computer in the North Carolina District office in Raleigh; however, the model can be transferred to other computer(s) on the Base or elsewhere.

6. Test drilling--A major part of the study can be implemented with data that is either presently available or can be collected from existing wells. However, some new test drilling will be needed to better define the geohydrologic framework, the factors that control ground-water movement through the framework, and the ground-water quality. It is estimated that about four test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area. Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the freshwater-saltwater interface and its relation to supply-well pumping.

It is assumed that the drilling and sampling of the NACIP program will describe and define the nature and extent of ground-water contamination from hazardous-waste sites on the Base. Therefore, drilling done for the USGS study will be located away from the hazardous-waste sites, as much as possible, to reduce the expense of required and special drilling and safety procedures (like those needed at Cherry Point Marine Corps Air Station).

REPORTS: A report will be written for the USMC describing the results of each completed phase of the investigation (see TIME FRAME for phase descriptions). The completion of the study will result in an interpretative report entitled, "An appraisal of the ground-water resources of Camp Lejeune Marine Corps Base, North Carolina." Additional interpretative reports may be written on various technical aspects of the study. Written progress reports will be prepared and submitted to the USMC quarterly.

RELATION TO LONG-RANGE PLAN: This study relates directly to the North Carolina District's long-range plan (dated May 12, 1980) concerning the quality and availability of ground water in the Coastal Plain.

RELATION TO STATE AND WRD PROGRAMS: The North Carolina Department of Natural Resources and Community Development and the Department of Human Resources are interested and involved in classifying, mapping, and regulating water-use, waste-disposal, and land-use practices throughout the State.

The USGS has a mandate from the U.S. Congress to study and report on the quality and availability of water resources throughout the United States. Ground-water quality is of high national priority for the USGS.

TIME FRAME: The study is tentatively planned for four years and will be divided into three phases. The second phase is extended over a two-year period because of the cost of the work tasks. A brief description of work tasks for each phase follows:

Phase 1 (Fiscal Year 1986[?]) - Collect, compile and analyze all available data on water budget, water use, geohydrologic framework, hydraulic characteristics of aquifers and confining beds, and head and quality of water in aquifers. Prepare a report that describes the available data and new data needs.

Phase 2 (Fiscal Year 1987[?] and 1988[?]) - To fill data needs described in Phase 1 report, design and construct new test wells and new observation wells, and make geohydrologic and chemical tests on new and pre-existing wells. Prepare a report that describes test- and observation-well construction, and the new geohydrologic and chemical data.

Phase 3 (Fiscal Year 1989[?]) - From the analysis of data collected in Phases 1 and 2, construct and calibrate a finite-difference model of ground-water flow through the aquifer and confining-bed materials that underlie the Base area. Determine alternative ground-water use and management practices that will reduce chances for further ground-water contamination and help assure that the future water-supply needs of Camp Lejeune are met effectively and efficiently with the least amount of environmental impact. Recommend a long-term water-level and water-quality monitoring system that will help assure the quality and quantity of the Base water supply. Prepare a report describing the results of Phase 3.

MANPOWER:

Project chief:	Hydrologist	GS-12/13	Full time
Project staff:	Hydrologist	GS- 7/ 9	Part time
	Hydrologic technician	GS- 7/ 9	Part time

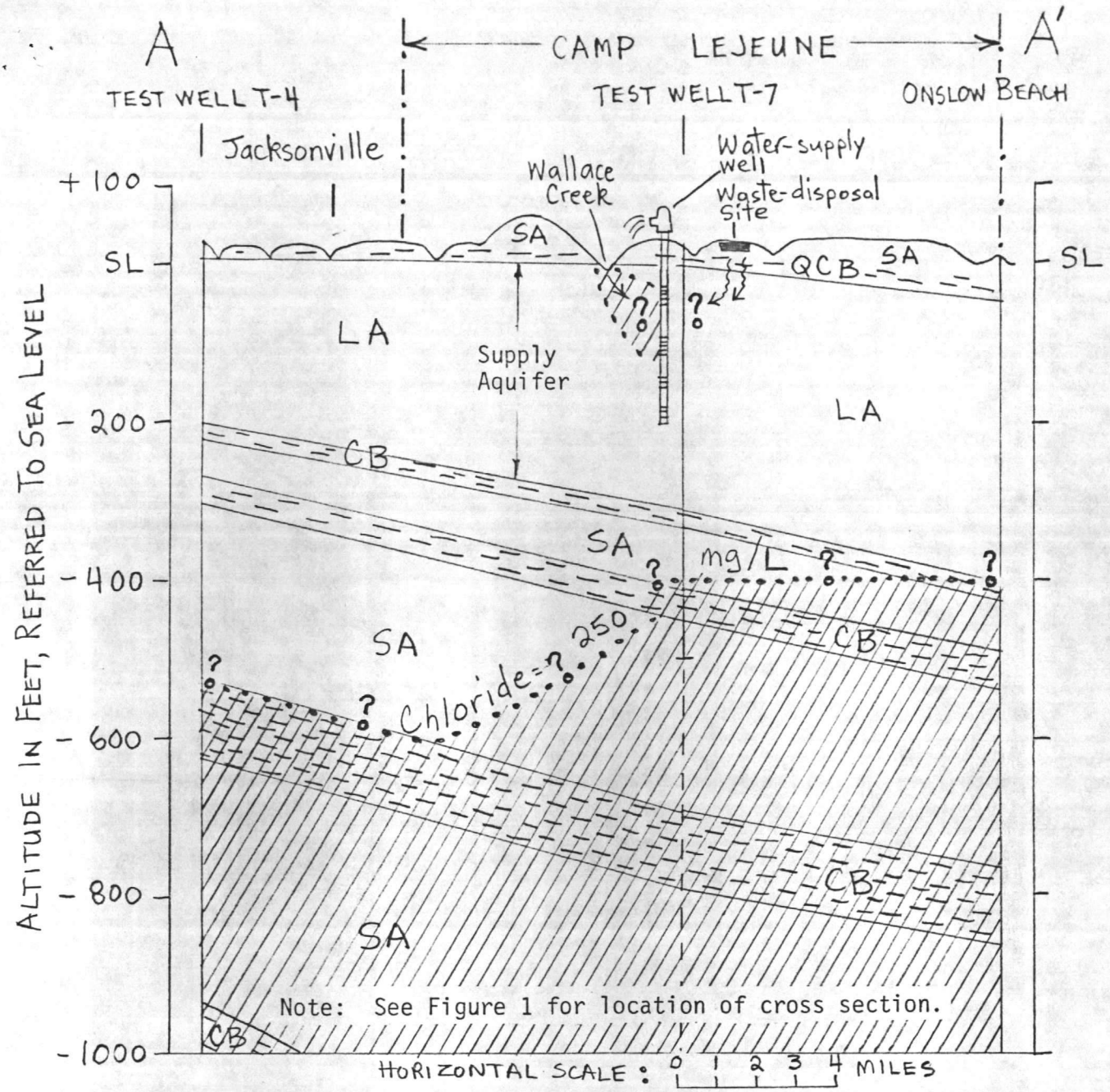
COSTS: Estimated costs for each phase of the project are summarized below:

Phase 1 (Fiscal Year 1986[?])	
Data collection and compilation.	$ 20,000
Data analysis and synthesis.	30,000
Report preparation	30,000
Fiscal Year 1986(?) Subtotal	$ 80,000
Phase 2 (Fiscal Year 1987[?] and 1988[?])	
Construction and equipment	
Well drilling, construction, sampling and testing (4600 feet at an estimated $25/foot)	$115,000
Water sampling equipment.	3,000
Geophysical logging (10 days @ $1000/day).	10,000
Laboratory services (40 samples @ $500/sample) . .	20,000
Data collection, analysis, interpretation, and report preparation	80,000
Fiscal Years 1987 and 1988 Subtotal	$228,000
Fiscal Year 1987. . . . .$114,000	
Fiscal Year 1988. . . . .$114,000	
Phase 3 (Fiscal Year 1989)	
Computer time and support personnel.	$ 29,000
Data preparation, analysis, interpretation, and report preparation	80,000
Fiscal Year 1989 Subtotal	$109,000

COST SUMMARY

U. S. Marine Corps Funds

Phase 1 (FY 1986[?]).	$ 80,000
Phase 2 (FY 1987[?]).	114,000
Phase 2 (FY 1988[?]).	114,000
Phase 3 (FY 1989[?]).	109,000
GRAND TOTAL	$417,000



EXPLANATION

CB - Confining Bed

QCB - Questionable Confining Bed

LA - Limestone Aquifer

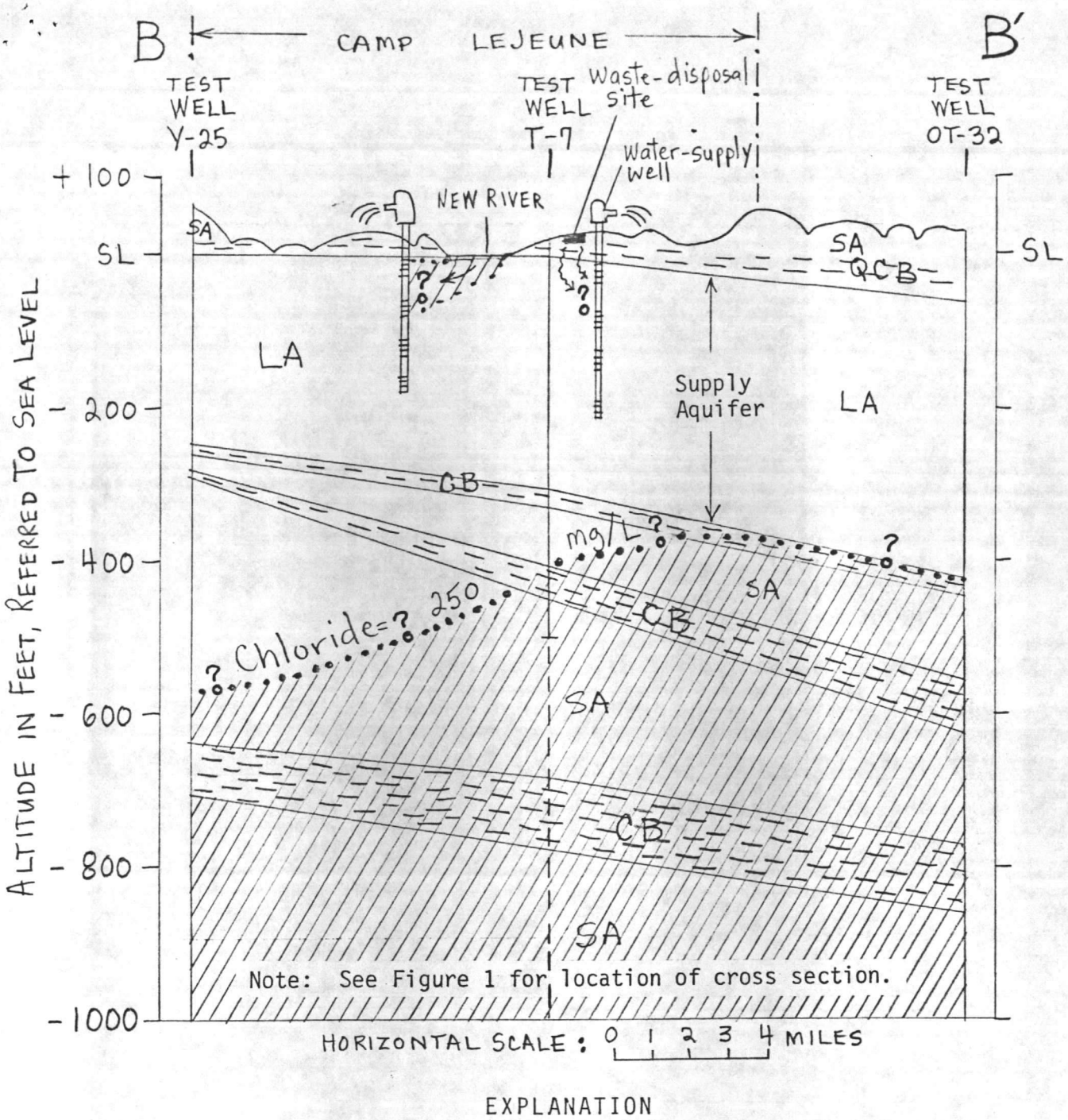
SA - Sand Aquifer

SL - Sea Level

mg/L - milligrams per liter

- Rock containing water with more than 250 mg/L Chloride

Figure 2.--Diagrammatic geologic and hydrologic cross section A-A', through Camp Lejeune Marine Corps Base, North Carolina.



EXPLANATION

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QCB - Questionable Confining Bed

LA - Limestone Aquifer

SA - Sand Aquifer

SL - Sea Level

mg/L - milligrams per liter

- Rock containing water with more than 250 mg/L Chloride

Figure 3.--Diagrammatic geologic and hydrologic cross section B-B', through Camp Lejeune Marine Corps Base, North Carolina.

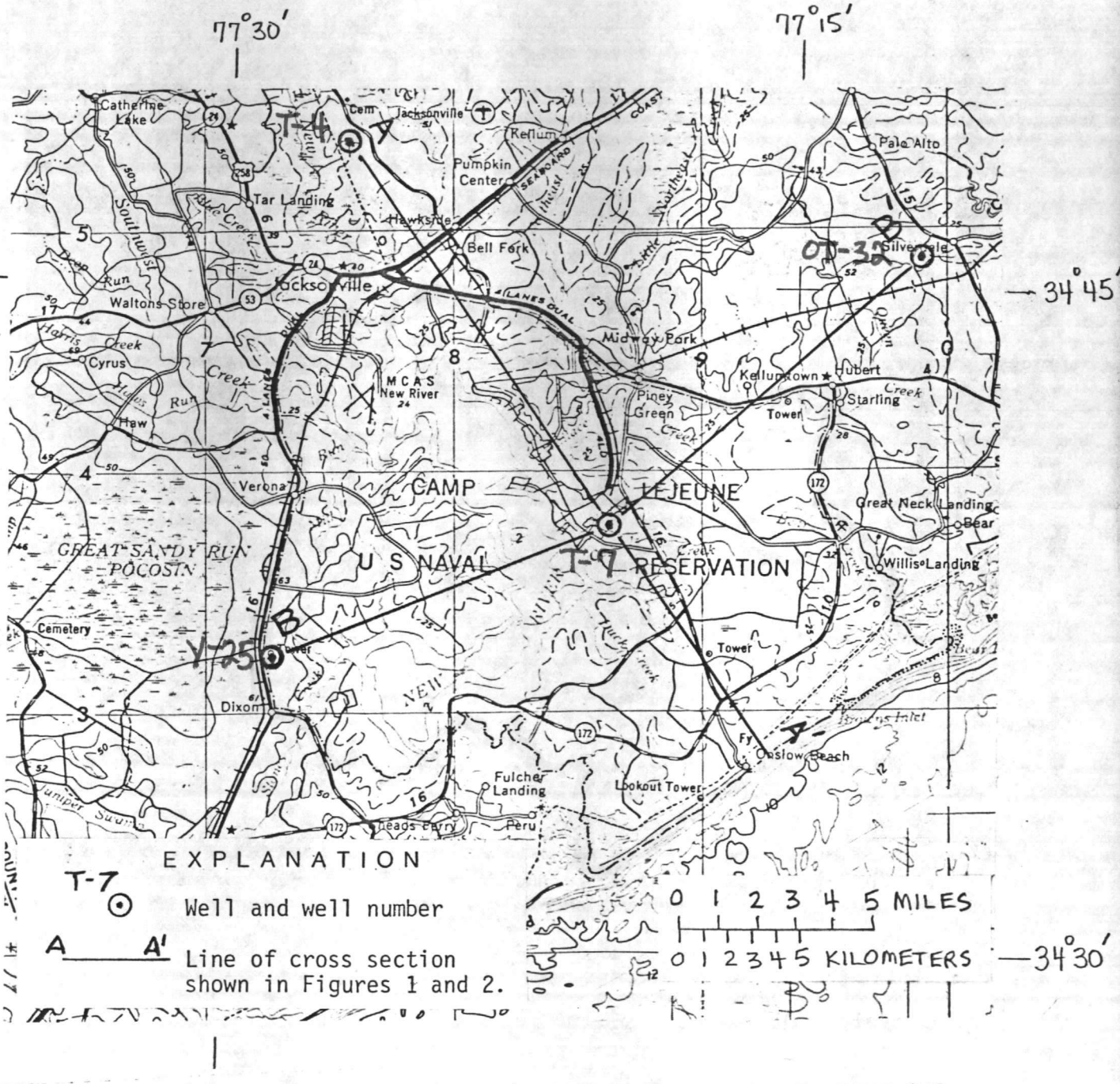

Figure 1.--Location of Camp Lejeune Marine Corps Base, North Carolina.

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Copy for BMO
&
US Geological Survey
Raleigh, NC
& return to A

ADMINISTRATIVE MESSAGE

ROUTINE

R 141550Z JAN 86 ZYB

FM CG MCB CAMP LEJEUNE NC

TO CMC WASHINGTON DC

INFO LANTNAVFACENGCOM NORFOLK VA

UNCLAS //N06280//

CMC//CODEXLFL/LANTDIV FOR 114 AND 09P
SUBJ: FY-86 ENVIRONMENTAL/NATURAL RESOURCES/ARCHAEOLOGICAL RESOURCES MANAGEMENT PROGRAMS- O&MMC 'P' ALLOCATIONS

A. CMC 020130Z JAN 86
B. PHNECON BTWN MR. B. LLOYD, U.S. GEOLOGICAL SURVEY, AND

MR. ALEXANDER, MCB ON 8 JAN 86

1. THIS MSG CONFIRMS FEASIBILITY OF INITIATING PHASE I USGS GROUNDWATER STUDY AS REQUESTED BY REF A. REQ FUNDING IAO $80,000 BE PROVIDED FOR TRANSFER TO USGS.

2. PHASE I ACCOMPLISHMENTS WILL INCLUDE FOLLOWING, PER REF B:
A. GROUNDWATER BUDGET
B. CURRENT AND PROJECTED WATER CONSUMPTION
C. GEOHYDROLOGIC FRAMEWORK, OBTAIN GEOPHYSICAL LOGS OF EXISTING WELLS, CORRELATE UNDERLYING STRATA, DETERMINE NUMBER OF CONFINING BEDS, FIND DEPTH OF SALTWATER
D. HYDRAULIC CHARACTERISTICS OF AQUIFERS
E. HEAD AND QUALITY OF AVAILABLE AQUIFERS
THE ABOVE ITEMS WILL BE PROVIDED IN A DETAILED WORK PLAN WITH MILESTONES WITHIN 30 DAYS FOLLOWING TRANSFER OF FUNDS TO USGS.

3. PHASE I RESULTS WILL DEFINE DATA REQUIREMENTS FOR SUBSEQUENT TEST DRILLING AND MATHEMATICAL MODELING DURING FY87/88. THIS INFORMATION WILL ESTABLISH THE BASIS FOR WATER SUPPLY PROJECT PLANNING IN THE 1990'S AND BEYOND. THE COMPLETED STUDY, IN

BFAC(2)...ORIG FOR CG MCB CAMP LEJEUNE(8) /13/
BCOS(1) BSDO(1) CFOB(1) OICB(1) NREA(1) COMP(1)

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CONJUNCTION WITH THE NACIP CHARACTERIZATION AND FEASIBILITY REPORT, WILL BE ESSENTIAL INFORMATION ON WHICH TO REDUCE CHANCES FOR FURTHER MOVEMENT OF GROUNDWATER CONTAMINATION.

BT

563429/014 2 OF 2 MATA0562 014/23:08Z 141550Z JAN 86
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ADMINISTRATIVE MESSAGE

ROUTINE

R 141550Z JAN 86 ZYB

FM CG MCB CAMP LEJEUNE NC

TO CMC WASHINGTON DC

INFO LANTNAVFACENGCOM NORFOLK VA

UNCLAS //N06280//

CMC//CODEXLFL/LANTDIV FOR 114 AND 09P
SUBJ: FY-86 ENVIRONMENTAL/NATURAL RESOURCES/ARCHAEOLOGICAL RESOURCES MANAGEMENT PROGRAMS- O&MMC 'P' ALLOCATIONS

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BFAC(2)...ORIG FOR CG MCB CAMP LEJEUNE(8) /13/
BCOS(1) BSDO(1) CFOR(1) OICB(1) NREA(1) COMP(1)

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563429/014 1 OF 2 MATA0562 014/23:08Z 141550Z JAN 86
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CONJUNCTION WITH THE NACIP CHARACTERIZATION AND FEASIBILITY REPORT, WILL BE ESSENTIAL INFORMATION ON WHICH TO REDUCE CHANCES FOR FURTHER MOVEMENT OF GROUNDWATER CONTAMINATION.

BT

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ROUTINE

R 050131Z DEC 85

FM CMC WASHINGTON DC

TO CG MCB CAMP LEJEUNE NC

UNCLAS //N06280//

CMC//CODEXLFL/
SUBJ: FY 86 ENVIRONMENTAL/NATURAL RESOURCES/ARCHEOLOGICAL RESOURCES MANAGEMENT PROGRAMS O&MMC, (P) ALLOCATIONS

A. CG MCB CAMP LEJEUNE 7100 OVER NREAD DF 10 APR 85
B. CG MCB CAMP LEJEUNE 6280/4 OVER FAC DF 5 SEP 85

1. REFS (A) AND (B) HAVE BEEN REVIEWED AND FOLLOWING TASKS/AMTS ARE AUTHORIZED FOR EXECUTION UNDER SUBJECT PROGRAMS:

TASK	AMT AUTH
A. ENDANGERED SPECIES MANAGEMENT AND SURVEYS	$ 6,800
B. WILDLIFE MANAGEMENT TRAVEL AND TRAINING	$ 3,000
C. WILDLIFE HABITAT PLANTING AND FERTILIZER	$24,000

2. A PRIMARY THRUST OF THE REF (B) REQUEST IS WWTER AVAILABILITY. DUE TO LIMITED FUND AVAILABILITY IN THE SUBJ PROG, RECOMMEND PURSUING THIS STUDY VIA THE ENERGY/UTILITIES PROGRAM.

3. FUNDING WILL BE BY OPBUD AMENDMENT UNDER SEP CORRES.

4. OBLIGATION STATUS OF EACH TASK IS REQUIRED BY MESSAGE TO CMC (LFL) NO LATER THAN 30 APR 86.

BT

DEC 11 1985

FAC ROUTING			
	ACTION	INFO	INT
FACO			
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BEAC(2)...ACT FOR CG MCB CAMP LEJEUNE(11)
BCOS(1) BSDO(1) CEOR(1) HOSP(4) NREA(1) OICB(1)

SERVICE/ SVC/

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CSN:AUIA01504 CMC WASHINGTON

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6280/5

10 JAN 1986

Environmental Engineer

Assistant Chief of Staff, Facilities

NC DIVISION OF ENVIRONMENTAL MANAGEMENT REQUEST FOR TEST WELL CONSTRUCTION SITE

Ref: (a) Meeting btwn Mr. Shiver, NCDEM, and Mr. Alexander, MCB EnvEngr, on 2 Jan 86

Encl: (1) Site Location Map near Wallace Creek and Base Stables

1. This note will give you advance notice of the state's request. A formal letter of request will follow in the next two weeks. The purpose of the well is to identify aquifer characteristics and groundwater production capacity.

2. A test well is recommended by the state in conjunction with the regional groundwater study involving several counties. The study is a cooperative effort by the NCDEM and the U.S. Geol Survey.

3. The proposed test well will be located as shown on the enclosure and will be drilled to "basement rock" about 1,500 deep. The state will test the well monthly for one to two ye Four or five additional shallower wells will be drilled in th immediate vicinity of the test well. The purpose of the well to identify aquifer characteristics and groundwater productio capacity. This type of test well is the same as that recomme for the U. S. Geological Survey groundwater study.

4. NCDEM will only request approval for development of the site, which is approximately 100 by 200 feet. No MCB resources are anticipated to be needed, such as electrical power or fencing of the site. During the referenced meeting, Mr. Shiver and I discussed this with Mr. Cone, Base Maintenance, and Mr. Jordan, Real Estate. No problems were encountered.

Copy for Alex

R. E. ALEXANDER

Drafter: R.E. ALEXANDER
Typist: Carol Brinkman, FAC, 9 Jan 86

6280/5

10 JAN 1986

Environmental Engineer

Assistant Chief of Staff, Facilities

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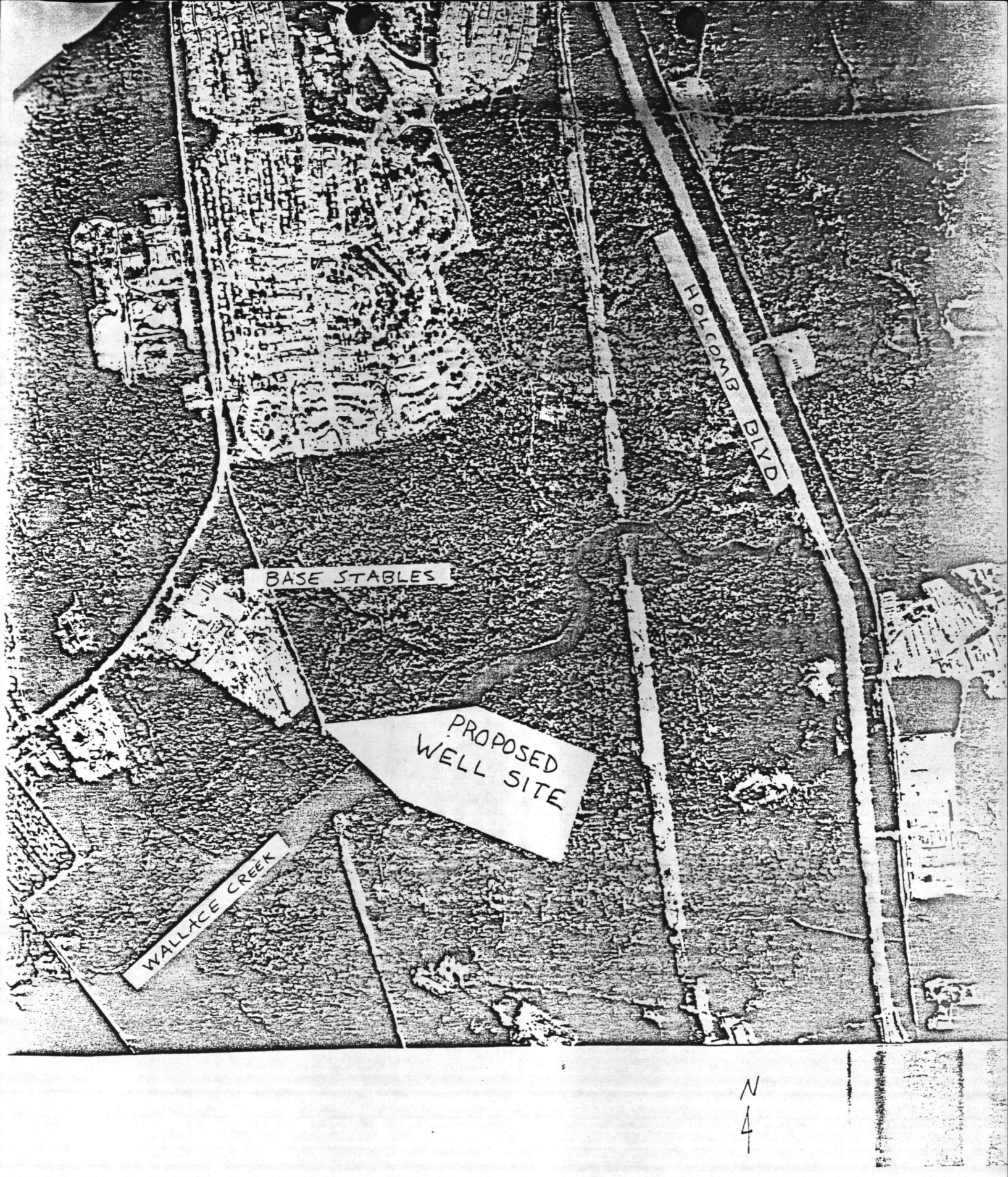
R. E. ALEXANDER

Drafter: R.E. ALEXANDER
Typist: Carol Brinkman, FAC, 9 Jan 86



Enclosure 1:
SITE LOCATION MAP

N.C.D.E.M. TEST WELL

OPNAV 5216/145 (Rev. 3-71)
SN-0107-778-8110
USE FOR URGENT LETTERS, ONLY

Naval Speedletter

T12410

DO NOT CLEAR THROUGH COMMUNICATIONS OFFICE

CHECK TYPE OF MAIL
☐ REGULAR ☐ REGISTERED
☐ AIR ☐ CERTIFIED
☐ SPECIAL DELIVERY

CLASSIFICATION
UNCLASSIFIED

DATE 15 OCT 1985

IN REPLY REFER TO 12410 FAC

INSTRUCTIONS

1. Message type phraseology is permissible.

2. Both addresses must be appropriate for window envelope or bulk mailing, as intended. Include attention codes, when known. Use dots and brackets as guides for window envelope addresses.

3. Give priority to processing, routing, and action required. Avoid time-consuming controls.

4. In order to speed processing, a readily identifiable, special window envelope, OPNAV 5216/145A, Speedletter Envelope, is provided for unclassified speedletters where bulk mailing is not used. Other window envelopes also may be used. In bulk mail, speedletters should be placed on top of regular correspondence.

To:
Commandant of the Marine Corps
(Code LFF-2)
Headquarters Marine Corps
Washington, DC 20380

Fold

STANDARD REFERENCES AND ENCLOSURES, IF ANY; TEXT AND SIGNATURE BLOCK

Subj: MARINE CORPS SPECIAL O & M "P" PROGRAM FUNDING FOR FY-86

Ref: (a) CMC Washington DC msg 281426Z Aug 85

Encl: (1) Studies
(2) Courses/Training

1. The enclosures are submitted as requested by the reference.

R. A. TIEBOUT
By direction

Alexi copy

copy for
CMC/LFF-2 ✓
CMC/LPC ✓
CMC/LPL
DMAIN/UTIL
Alex

Upgraded RPP only

Jerry Freedman
694-2171/1425

Fold

COPY TO

From:
Commanding General
Attn: AC/S Facilities
Marine Corps Base
Camp Lejeune, NC 28542-5001

← ADDRESS REPLY AS SHOWN AT LEFT; OR, REPLY HEREON AND RETURN

CLASSIFICATION
UNCLASSIFIED

B-17088

OPNAV 5216/145 (Rev. 3-71)
SN-0107-778-8110
USE FOR URGENT LETTERS, ONLY

Naval Speedletter

T12410

DO NOT CLEAR THROUGH COMMUNICATIONS OFFICE

CHECK TYPE OF MAIL
☐ REGULAR ☐ REGISTERED
☐ AIR ☐ CERTIFIED
☐ SPECIAL DELIVERY

CLASSIFICATION
UNCLASSIFIED

DATE
15 OCT 1985

IN REPLY REFER TO
12410 FAC

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(Code LFF-2)
Headquarters Marine Corps
Washington, DC 20380

Fold

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1. The enclosures are submitted as requested by the reference.

R. A. TIEBOUT
By direction

Alexi
ORIG

Jerry Freedman
694-2171/1425

Fold

COPY TO

From:
Commanding General
Attn: AC/S Facilities
Marine Corps Base
Camp Lejeune, NC 28542-5001

← ADDRESS REPLY AS SHOWN AT LEFT; OR, REPLY HEREON AND RETURN

CLASSIFICATION
UNCLASSIFIED

B-17088

STUDIES AND SURVEYS
PROPOSED FOR FY 86

Priority	Study/Survey Description	Estimated Cost	Benefits	Number of Attendess
1	Monitoring of Water and Wastewater Treatment Plants Provide a feasibility study of monitoring the water and wastewater treatment plants. This study should develop methods of monitoring the chemical content of the influent and effluent at each plant; the elevated tanks and reservoirs for levels and intrusion; wastewater lift stations for power failure, generator failure, high level and hazardous gas presence, in plant equipment status and in plant treatment processes.	$60,000	This study should make recommendations and provide complete cost data to develop a project.	
2	Investigate the Water Distribution System Serving Marine Corps Air, New River This study should investigate the entire distribution system for the Geiger-Air Station Area, including all delivered water pumps and elevated or ground storage tanks for capacities, dead ends and pressure losses.	$80,000	The study should provide preliminary drawings and cost estimates sufficient to develop a project to resolve the problems.	
3	Study of the Ground Water Acquifer by U.S. Geological Survey Ground water supply needs, coupled with the threat of present and future contamination of existing wells by disposed wastes or brackish and saline waters prompted this study.	$80,000	This study will determine ground water use and management practices in order to reduce chances of future contamination and help assure future water supply needs are met.	
4	Facilities Energy Plan Perform a F.E.P. survey for 80 miscellaneous buildings aboard Camp Lejeune.	$80,000	This study will identify energy conservation investment opportunties which will be submitted as projects at a later date.	

Encl (1)

TRAINING COURSES AND SEMINARS
PROPOSED FOR FY86

Priority	Course/Seminar Description	Cost	Benefits	Number of Attendees
1	Wallace & Tiernan Chlorinator School Belleville, NJ	$2,700	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	3
2	Energy Management (CECOS)	$1,500	"	1
3.	Steam Turbine Maintenance Norfolk, VA	$ 500	"	1
4.	Boiler Maintenance and Repair Norfolk, VA	$1,500	"	1
5.	Comprehensive Lighting Design	$1,600	To achieve efficient, cost effective lighting systems designs.	1
6.	Energy Auditing Seminar Anaheim, CA	$1,906	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	1
7.	Air Conditioning Piping Systems	$1,700	To better understand piping systems so that the designer may have the tools to design more energy efficient heating and air conditioning systems.	1
8.	Electronics/Electrical Controls, San Diego, CA	$4,500	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	3
9.	Air conditioning Air Distribution	$1,700	Latest techniques on how to design a more energy efficient system. Course teaches selection of related energy efficient equipment, insulation and ductwork design.	1

Priority	Course/Seminar Description	Cost	Benefits	Number of Attendees
10	Water Pollution Controls Conference Los Angeles, CA	$3,000	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	2
11	Water Supply & Distribution	$1,000	Will aid on-going program to improve and maintain the efficiency of our water supply system.	1
12	Boiler Inspection Certification	$3,000	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	1
13	Sanitary Sewer Lift Station Design	$1,400	Provide current design techniques to enable cost savings in construction and operations.	1
14	Certification for Backflow Preventors	$3,700	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	40
15	Residential Energy Auditing	$1,600 ea	Correct procedures to use, useful instruments, time/budget constraints, energy savings and economic benefits in evaluating residential structures.	2
16	Combustion Control (Network 90) Bailey Meter Wickliffe, OH	$2,500	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	1
17	Advanced Energy Auditing	$1,700	Provide knowledge to design more energy efficient systems and perform energy audits and surveys.	1
18	Energy Conservation Trng Films	$ 600	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	

Priority	Course/Seminar Description	Cost	Benefits	Number of Attendees
19	Specifying Uninterruptible Power System (UPS)	$1,230	To provide knowledge in specifying UPS, as MCB, Camp Lejeune has installed many UPS's in recent years.	1
20	Cleaver Brooks Workshop	$1,200	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	2
21	Fundamentals of Energy Auditing	$1,350	Ability to apply the latest engineering techniques to determine energy requirements of buildings.	3
22.	Boiler Optimization Atlanta, Ga	$1,000	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	2
22	Energy Thermal Storage	$1,700	To learn current design techniques in thermal storage, one of the latest methods to conserve energy in heating and air conditioning.	2
22	Coal Fired Industrial Workshop New York, NY	$1,605	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	1
23	General Air Conditioning Manassas, Va	$1,200	"	1
24	A/C & Refrigeration Systems York, Pa	$2,106	"	2
25	Hegan Controls Westinghouse Training Division Pittsburgh, Pa	$1,738	"	2

6 SEP 1985

12410
FAC

Assistant Chief of Staff, Facilities, Marine Corps Base,
Camp Lejeune
DISTRIBUTION

MARINE CORPS SPECIAL O&M "P" PROG FUNDING FOR FY-86

Ref: (a) CMC Washington DC 281426Z Aug 85

1. The reference requests training courses, seminars, studies, surveys, etc., for possible funding FY-86. Request you please provide a prioritized list in the following format to this office no later than 7 October 1985 for consolidation and submission.

Course/Seminar Description	Cost	Benefits	No. Attendees

B. W. ELSTON
By direction

DISTRIBUTION:
~~PWO~~
~~BMO~~
~~NREA~~
~~FIRE~~
~~DFH~~
~~DBH~~
~~CEO~~

negative ID-1

Drafter: B. Elston
Typist: J. Peterson, 5 Sept 85

OPNAV 5216/144A (Rev. 8-81)
S/N 0107-LF-052-2320

DEPARTMENT OF THE NAVY

Memorandum

12410
FAC

DATE: 6 SEP 1985

FROM: Assistant Chief of Staff, Facilities, Marine Corps Base, Camp Lejeune
TO: DISTRIBUTION

SUBJ: MARINE CORPS SPECIAL O&M "P" PROG FUNDING FOR FY-86

Ref: (a) CMC Washington DC 281426Z Aug 85

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B. W. ELSTON
By direction

DISTRIBUTION:
PWO
BMO
NREA
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☆U.S. GOVERNMENT PRINTING OFFICE: 1985 — 505-012/18049

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AUG 30 1985

FAC ROUTING			
FACO	ACTION	INFO	INT
4A			
4B			
4C			
4D			
4E			
4F			
SEC			
CLR			

Mr Elston,
Please coordinate with all Branches to ensure a good consolidated effort. Maybe a Meet to them with a bit would be appropriate for this response

ROUTINE

R 281426Z AUG 85

FM CMC WASHINGTON DC

TO AIG ZERO ZERO EIGHT

UNCLAS //N04101//

CMC//CODEXLFF-2//
SUBJ: MARINE CORPS SPECIAL O&M "P" PROG FUNDING FOR FY86

1. SPCL PROG FUNDING IS AVAILABLE IN FY86 FOR ENERGY CONSERVATION AND UTILITIES OPERATIONS/MANAGEMENT. THESE FUNDS ARE MADE AVAILABLE FROM HDQTRS TO FIELD ACTIVITIES FOR STUDIES, SURVEYS, AND TRAINING RELATED TO ACTIVITY FY86 ENERGY/UTILITIES REQUIREMENTS WHICH ARE IN EXCESS OF TARGETED OTHER ENGINEERING SUPPORT AMTS PROVIDED IN COMMAND OPERATING BUDGETS.

2. ADDRESSES ARE REQUESTED AND HIGHLY ENCOURAGED TO SUBMIT, TO THIS HDQTRS (CODE LFF-2) BY 15 OCT 1985, THE FOLLOWING FOR SPCL PROG CONSIDERATION AND POSSIBLE FUNDING. PLEASE PUT THE REQUEST IN YOUR DESIRED PRIORITY OF ACCOMPLISHMENT.
A. TRAINING COURSES AND SEMINARS PROPOSED FOR FY86.
B. STUDIES AND SURVEYS PROPOSED FOR FY86.
INCLUDE DESCRIPTION, COST, AND BENEFITS. ACTUAL FUNDING OF THE SUBMITTED ITEMS WILL BE SUBJ TO PRIORITIES ESTABLISHED IN BEST INTEREST OF THE MARINE CORPS AND THE AVAILABLE FUNDING.

3. POC (AV 224-1425, 2171, 3188) IS MR. JERRY FRIEDMAN (HQMC/LFF-2).

BT

BFAC(2)...ACT FOR CG MCB CAMP LEJEUNE(11) 17000/ 2/0369
BADJ(4) BCOS(1) BMAN(1) BSDO(1) CEOB(1) OICB(1)

RTD:000-000/COPIES:0011

179004/241 1 OF 1 MATA0176 241/09:26Z 281426Z AUG 85
CSN:AUIA00537 CMC WASHINGTON

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OPNAV 5216/144A (Rev. 8-81)
S/N 0107-LF-052-2320

DEPARTMENT OF THE NAVY

Memorandum

7100
NREAD

DATE: 3 Oct 1985

FROM: Director, Natural Resources and Environmental Affairs Division, Marine Corps Base, Camp Lejeune

TO: Assistant Chief of Staff, Facilities, Marine Corps Base, Camp Lejeune

SUBJ: MARINE CORPS SPECIAL O & M "P" PROG FUNDING FOR FY-86

Ref: (a) AC/S FAC memo 12410 FAC of 6 Sep 85

1. The reference has been reviewed and a negative response is submitted.

2. As mentioned in the Base EIRB meeting of 3 Oct 85, it is recommended the Environmental Engineer explore the possibility of funding a potable water supply study (new well field). Also, a request for funding to study means of disposal of POL contaminated soil should be considered. Mr. Shiver, Division of Environmental Management, advised on 25 Sep 85 that he had discussed in a recent meeting with AC/S Facilities forthcoming State POL contaminated soil disposal procedures which would prohibit disposal in the Base Sanitary Landfill as is currently done.

Julian I. Wooten

JULIAN I. WOOTEN

☆U.S. GOVERNMENT PRINTING OFFICE: 1985 — 505-012/18049

OPNAV 5216/144A (Rev. 8-81)
S/N 0107-LF-052-2320

DEPARTMENT OF THE NAVY

Memorandum

12400
DFH

DATE: 16 Sep 85

FROM: Director, Family Housing Division, MCB, Camp Lejeune

TO: Assistant Chief of Staff, Facilities, MCB, Camp Lejeune

SUBJ: MARINE CORPS SPECIAL O&M "P" PROG FUNDING FOR FY86

Ref: (a) Your memo 12410 FAC dtd 6 Sep 85

1. The reference requested a prioritized list for subject funding; a negative report is submitted.

Very respectfully,

L. D. BRINN

☆U.S. GOVERNMENT PRINTING OFFICE: 1985 — 505-012/18049

OPNAV 5216/144A (Rev. 8-81)
S/N 0107-LF-052-2320

DEPARTMENT OF THE NAVY

Memorandum

12410
CEO

DATE: 12 September 1985

FROM: Communications-Electronics Officer, Marine Corps Base, Camp Lejeune

TO: Assistant Chief of Staff, Facilities, Marine Corps Base, Camp Lejeune

SUBJ: MARINE CORPS SPECIAL O&M "P" PROG FUNDING FOR FY-86

Ref: (a) AC/S Facilities Memo 12410 FAC dtd 6 Sep 1985

1. In accordance with the reference, a negative response is submitted.

Leslie A. Stensen

LESLIE A. STENSEN

☆ U.S. GOVERNMENT PRINTING OFFICE: 1983-605-010:8484

OPNAV 5216/144A (Rev. 8-81)
S/N 0107-LF-052-2320

DEPARTMENT OF THE NAVY

Memorandum

DATE: 8 Oct 1985

FROM: Base Fire Chief

TO: Assistant Chief of Staff, Facilities

SUBJ: MARINE CORPS SPECIAL O&M "P" PROG FUNDING FOR FY-86

1. A negative response for funding is submitted.

R. M. PINER, Jr.
By direction

☆ U.S. GOVERNMENT PRINTING OFFICE: 1985 — 505-012/18049

OPNAV 5216/144A (Rev. 8-81)
S/N 0107-LF-052-2320

DEPARTMENT OF THE NAVY

Memorandum

12410
MAIN

DATE: 07 OCT 1985

FROM: Base Maintenance Officer

TO: Assistant Chief of Staff, Facilities

SUBJ: MARINE CORPS SPECIAL O&M "P" PROG FUNDING FOR FY-86

Ref: (a) Your memo 12410 FAC of 8 Sep 85

Encl: (1) Training Courses and Seminars
(2) Studies and Surveys

1. Per your request, enclosures (1) and (2) are forwarded.

W. M. RICE

☆ U.S. GPO 1984 - 705-012/8623

TRAINING COURSES AND SEMINARS
PROPOSED FOR FY86

Priority	Course/Seminar Description	Cost	Benefits	Number of Attendess
1	Wallace & Tiernan Chlorinator School Belleville, NJ	$2,700	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	3
2	Energy Management (CECOS)	$1,500	" "	1
3	Steam Turbine Maintenance Norfolk, VA	$ 500	" "	1
4	Boiler Maintenance and Repair Norfolk, VA	$1,500	" "	1
5	Energy Auditing Seminar Anaheim, CA	$1,906	" "	1
6	Electronics/Electrial Controls San Diego, CA	$4,500	" "	3
7	Water Pollution Control Conference Los Angeles, CA	$3,000	" "	2
8	Boiler Inspection Certification	$3,000	" "	1
9	Certification for Backflow Preventors	$3,700	" "	40
10	Combustion Control (Network 90) Bailey Meter Wickliffe, OH	$2,500	" "	1
11	Energy Conservation Training Films	$ 600	" "	

Encl (1)

Priority	Course/Seminar Description	Cost	Benefits	Number of Attendess
12	Cleaver Brooks Workshop Lebanon, PA	$1,200	To help operational and managerial personnel in their work in the area of energy conservation and utility management.	2
13	Boiler Optimization Atlanta, GA	$1,000	" "	1
14	Coal Fired Industrial Workshop New York, NY	$1,605	" "	1
15	General Air Conditioning Manassas, VA	$1,200	" "	1
16	A/C & Refrigeration Systems York, PA	$2,106	" "	2
17	Hagan Controls Westinghouse Training Division Pittsburgh, PA	$1,738	" "	2

OPNAV 5216/144A (Rev. 8-81)
S/N 0107-LF-052-2320

DEPARTMENT OF THE NAVY

Memorandum

DATE: 7 Oct 1985

FROM: Public Works Officer, Marine Corps Base, Camp Lejeune

TO: Assistant Chief of Staff, Facilities

SUBJ: MARINE CORPS SPECIAL O&M "P" PROG FUNDING FOR FY-86

Ref: (a) Your memo 12410 FAC of 6 Sep 1985

1. In response to the reference, the following training courses are submitted in priority as listed for possible FY-86 funding:

Course Description	Cost	Benefits	NO. Attendees
Comprehensive Lighting Design	$1600	To achieve efficient, cost effective lighting systems designs.	1
Air Conditioning Piping Systems	$1700	To better understand piping systems so that the designer may have the tools to design more energy efficient heating and air conditioning systems.	1
Air Conditioning Air Distribution	$1700	Latest techniques on how to design a more energy efficient system. Course teaches selection of related energy efficient equipment, insulation and ductwork design.	1
Water Supply & Distribution	$1000	Will aid on-going program to improve and maintain the efficiency of our water supply system.	1
Sanitary Sewer Lift Station Design	$1400	Provide current design techniques to enable cost savings in construction and operations.	1
Residential Energy Auditing	~~$3200~~ $1600 ea	Correct procedures to use, useful instruments, time/budget constraints, energy savings and economic benefits in evaluating residential structures. ~~(Cost includes total for two)~~	2*
Advanced Energy Auditing	$1700	Provide knowledge to design more energy efficient systems and perform energy audits and surveys.	1
Specifying Uninterruptible Power System (UPS)	$1230	To provide knowledge in specifying UPS, as MCB, Camp Lejeune has installed many UPS's in recent years.	1

*Second attendee prioritized as #14

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Subj: MARINE CORPS SPECIAL O&M "P" PROG FUNDING FOR FY-86

Fundamentals of Energy Auditing	~~$4050~~ $ 1350	Ability to apply the latest engineering techniques to determine energy requirements of buildings ~~(Cost includes total for three)~~.	3**
Energy Thermal Storage	~~$3400~~ $ 1700	To learn current design techniques in thermal storage, one of the latest methods to conserve energy in heating and air conditioning. ~~(Cost includes total for two)~~	2***

**Second attendee prioritized as #11 and third attendee prioritized as #13
***Second attendee prioritized as #12

E. L. ROUSE
By direction

OPNAV 5216/144B (Rev. 8-81)
S/N 0107-LF-052-2322

DEPARTMENT OF THE NAVY

Memorandum

DATE: 12/19/85

FROM: Env Engr

TO: FACO

Via: Dep FACO

SUBJ: USGS GROU

Ref(a) CMC msg 09[illegible]

(b) Phonecon btwn Mr. Fr[illegible]

Encl(1) CG, MCB speed ltr dtd 15

1. Ref(a) suggests FUNDING BY L[illegible]
   Ref(b) indicates 86 $ will be provide[illegible]
   BASED ON PRIORITIES
   Pri:(1) Monitoring Util Plants = 0-
   (2) MCAS Water System = 80k
   (3) USGS Study = 80k
   #140k

2. Per ref(b), LFF-2 would concur if we chose to swith Pri(2) & Pri(3); I've NOT DISCUSSED w/ MAIN, yet; WILL PROCEED AS YOU DESIRE.

A: Sea Turtle Contracted
Woodpecker Habitat Burning
B. TAO scheduled per Annual Operation Plan
C. BMAIN jobs: materials & labor
(JOB ORDERS WRITTEN, WORK TO BE DONE SUMMER '86)

Per Charles P., NREAD 12/18

NREAD will update Envir # to CMC in SPRING '86.

(1):

V/R

U.S. GOVERNMENT PRINTING OFFICE: 1983-605-010:8686

OPNAV 5216/144B (Rev. 8-81)
S/N 0107-LF-052-2322

DEPARTMENT OF THE NAVY

Memorandum

DATE: 12/19/85

FROM: Env Engr

TO: FACO

Via: Dep FACO

SUBJ: USGS GROUNDWATER STUDY ; STATUS OF

Ref(a) CMC msg 091317Z Dec 85

(b) Phonecon btwn Mr. Friedman, CMC-LFF-2 and Mr. Alexander dtd 19 Dec85

Encl(1) CG, MCB speed ltr dtd 15 OCT

1. Ref(a) suggests FUNDING BY LFF-2 with utilities vice Envir $. Ref(b) indicates 86 $ will be provided for $140K, BASED ON PRIORITIES SHOWN IN ENCL(1):

Pri:(1) Monitoring Util Plants = 60K
(2) MCAS Water System = 80K
(3) USGS Study = 80K
$140K

U.S. GOVERNMENT PRINTING OFFICE: 1983-605-010:8686

2. Per ref(b), LFF-2 would concur if we chose to switch Pri(2) & Pri(3); I've NOT DISCUSSED w/ MAIN, yet; WILL PROCEED AS YOU DESIRE.

V/R

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Bob Alexander
Pls bf me on
impacts of this msg
RAF 1/5

ROUTINE

R 050131Z DEC 85

FM CMC WASHINGTON DC

TO CG MCB CAMP LEJEUNE NC

// COMM NOTE: MSG DISTR AS RECEIVED, WILL SERVICE UPON REQUEST //

UNCLAS //N06280//

CM(//CODEXLFL/
SUBJ: Y 86 ENVIRONMENTAL/NATURAL RESOURCES/ARCHEOLOGICAL RESOURCES MANAGEMENT PROGRAMS O&MMC, (P) ALLOCATIONS

A. CG MCB CAMP LEJEUNE 7100 OVER NREAD OF 10 APR 85
B. CG MCB CAMP LLJEUNE 6280/4 OVER FAC OF 5 SEP 85

1. REFS (A) AND (B) HAVE BEEN REVIEWED AND FOLLOWING TASKS/AMTS ARE AUTHORIZED FOR EXECUTION UNDER SUBJECT PROGRAMS:

	TASK	AMT AUTH
A.	ENDANGERED SPECIES MANAGEMENT AND SURVEYS	$ 6,800
B.	WILDLIFE MANAGEMENT TRAVEL AND TRAINING	$ 3,000
C.	WIIDLIFE HABITAT PLANTING AND FERTILIZER	$24,000

JOBS WRITTEN UP,
TO BE EXECUTED SUMMER '86

2. A PRJMARY THRUST OF THE REF (B) REQUEST IS WATER AVAILABILITY. DUE TO LIMITED FUND AVAILABILITY IN THE SUBJ PROG, RECOMMEND PURSUING TTIS STUDY VIA THE ENERGY/UTILITIES PROGRAM.

USGS Groundwater Study
MAYBE FUNDED FY-86

3. ?UNDING WILL BE BY OPBUD AMENDMENT UNDER SEP CORRES.

4. OBLIGATION STATUS OF EACH TASK IS REQUIRED BY MESSAGE TO CMC (LFL) NO ATER THAN 30 APR 86.

BT

BFAC(2)...ACT FOR CG MCB CAMP LEJEUNE(11) 06280/ 1/0179
BCOS(1) BSDO(1) CEOB(1) HOSP(4) NREA(1) OICB(1)

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465012/340 1 OF 1 MATA0056 340/01:32Z 050131Z DEC 85
CSN:AUIA00152 CMC WASHINGTON

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Bob Alexander
Pls bf me on
impacts of this msg
RAF

ROUTINE

R 050131Z DEC 85

FM CMC WASHINGTON DC

TO CG MCB CAMP LEJEUNE NC

// COMM NOTE: MSG DISTR AS RECEIVED, WILL SERVICE UPON REQUEST //

UNCLAS //N06280//

CM(//CODEXLFL/
SUBJ: Y 86 ENVIRONMENTAL/NATURAL RESOURCES/ARCHEOLOGICAL RESOURCES MANAGEMENT PROGRAMS O&MMC, (P) ALLOCATIONS

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	TASK	AMT AUTH
A.	ENDANGERED SPECIES MANAGEMENT AND SURVEYS	$ 6,800
B.	WILDLIFE MANAGEMENT TRAVEL AND TRAINING	$ 3,000
C.	WIIDLIFE HABITAT PLANTING AND FERTILIZER	$24,000

2. A PRJMARY THRUST OF THE REF (B) REQUEST IS WATER AVAILABILITY. DUE TO LIMITED FUND AVAILABILITY IN THE SUBJ PROG, RECOMMEND PURSUING TTIS STUDY VIA THE ENERGY/UTILITIES PROGRAM.

3. ?UNDING WILL BE BY OPBUD AMENDMENT UNDER SEP CORRES.

4. OBLIGATION STATUS OF EACH TASK IS REQUIRED BY MESSAGE TO CMC (LFL) NO ATER THAN 30 APR 86.

BT

BFAC(2)...ACT FOR CG MCB CAMP LEJEUNE(11) 06280/ 1/0179
BCOS(1) BSDO(1) CEOR(1) HOSP(4) NREA(1) OICB(1)

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465012/340 1 OF 1 MATA0056 340/01:32Z 050131Z DEC 85
CSN:AUIA00152 CMC WASHINGTON

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Alex's copy

ADMINISTRATIVE MESSAGE

PRIORITY

P 191947Z AUG 85 ZYB

FM CG MCB CAMP LEJEUNE NC

TO CMC WASHINGTON DC

UNCLAS //N11000//
SECTION 01 OF 02 //N11000//

FOR LFF-2
SUBJ: OTHER ENGINEERING SUPPORT (OES) STUDY REQUIREMENTS/FUNDS

A. CMC 171432Z JUL 85

1. THE REF REQ CANDIDATE PROJ FOR OES STUDIES. FOLLOWING LIST OF CANDIDATE STUDIES ARE PROVIDED FOR YOUR CONSIDERATION. THEY ARE LISTED IN ORDER OF DESIRED FUNDING AND INCLUDE REQUESTED SUPPORT INFORMATION.

A. TELEPHONE DISTRIBUTION

CWE: $193,000

SCOPE: PREPARE AS-BUILT DWG AND MAKE RECOMMENDATIONS FOR FUTURE REQUIRED EXPANSION/MODERNIZATION.

JUSTIFICATION: NEW MISSIONS, REORGANIZATION AND EXPANSION OF PLANT PROPERTY HAVE MADE EXISTING TELEPHONE DISTRIBUTION SYSTEM OBSOLETE. THIS STUDY IS ESSENTIAL TO DETERMINE PROPER IMPLEMENTATION TECHNIQUES.

B. GROUNDWATER AQUIFER STUDY

SCOPE: GROUNDWATER AQUIFER STUDY ELEMENTS WILL COVER FOLLOWING ISSUES.

(1) INTERFACE WITH ONGOING STUDY OF GROUNDWATER CONTAMINATION UNDER THE NACIP PROGRAM.

(2) DEFINITION OF THE GEOHYDROLOGY OF THE AQUIFER TO INCLUDE DETERMINING AQUIFER COEFFICIENTS AND DEFINING THE FRESH WATER/SALT WATER INTERFACE.

(3) DEVELOPMENT OF A DIGITAL MODEL FOR USE AS A GROUNDWATER MANAGEMENT TOOL.

(4) EST PRODUCTION CAPACITY OF EXISTING WELLS AND ALTERNATIVE SITES FOR NEW WELLS.

BFAC(2)...ORIG FOR CG MCB CAMP LEJEUNE(10) /13/
MAIN(1) BCEO(1) BPWO(1) COMP(1) BCOS(1) BSDO(1) CEOB(1) OICB(1)

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JUSTIFICATION: A GEOLOGIC EVALUATION OF THE CAMP LEJEUNE GROUNDWATER SUPPLY IS NECESSARY TO CHARACTERIZE THE CAPABILITY OF THE AQUIFER TO SUSTAIN PRESENT AND FUTURE WATER SUPPLY NEEDS. AN AGREEMENT IS BEING DEVELOPED WITH THE USGS, DEPT OF THE INTERIOR, TO INITIATE THIS FOUR-YEAR EFFORT IN FY-86. EXPEDITING THIS STUDY IS NECESSARY DUE TO RECENT DISCOVERY OF POSSIBLE SALT WATER INTRUSION IN ONE OF THE EIGHT WATER SYSTEMS. USGS HAS DEVELOPED A PRELIMINARY WORK PLAN WITH INITIAL COST ESTIMATE OF $417,000 FOR THE MULTI-YEAR EFFORT AS FOLLOWS:

FY-86 - $80,000
FY-87 - $114,000
FY-88 - $114,000
FY-89 - $109,000

C. ELECTRICAL DISTRIBUTION

CWE: $25,000

SCOPE: DETERMINE FUTURE ELECTRICAL DISTRIBUTION REQUIREMENTS FOR CAMP LEJEUNE, NEW RIVER AND ALL OUTLYING CAMPS.

JUSTIFICATION: CAMP LEJEUNE/NEW RIVER IS EXPERIENCING A MASSIVE DEVELOPMENT/REDEVELOPMENT THROUGH THE MCON PROGRAM. MODERN LARGE ELECTRICAL LOAD FACILITIES ARE BEING CONSTRUCTED. EACH MCON SPONSORED PROJ HAS ITS OWN STUDY, HOWEVER, THE BASEWIDE ELECTRICAL DISTRIBUTION SYSTEM NEEDS TO BE EVALUATED IN COORDINATION WITH ALL FUTURE PLANNED CONSTRUCTION.

D. STUDY OF WASTEWATER DISTRIBUTION LINES FROM MIDWAY PARK TO THE HADNOT PT WASTEWATER TREATMENT PLAN (BLDG 22).

CWE: $20,000

SCOPE: A COMPLETE STUDY OF WASTEWATER MAIN TRUNK DISTRIBUTION LINES FROM MIDWAY PARK TO BLDG 22 TO INCLUDE:

(1) IMPACT OF FUTURE CONSTRUCTION ON SYSTEM.
(2) CONDITION OF EXISTING MAINS.
(3) EXISTING MAINS' CAPABILITY OF HANDLING ADDITIONAL LOADS.
(4) CONDITION AND CAPACITY OF EXISTING PUMPING STATIONS.
(5) RECOMMENDATIONS FOR EXPANSION (LINE SIZES, ADDITIONAL PUMPS AND LOCATIONS).

JUSTIFICATION: FUTURE CONSTRUCTION IN NEW HOSPITAL AREA AND NEW HIGH SCHOOL WILL INCREASE LOADS ON EXISTING TRUNK MAINS WHICH WILL OVERLOAD THE SYSTEM IF NOT SIZED PROPERLY.

E. STEAM AND CONDENSATE DISTRIBUTION SYSTEM, MONTFORD PT

CWE: $30,000

SCOPE: A COMPLETE STUDY OF THE MONTFORD PT STEAM AND CONDENSATE SYSTEM TO INCLUDE:

(1) IMPACT OF FUTURE CONSTRUCTION ON SYSTEM.
(2) CONDITION OF EXISTING SYSTEM.
(3) EXISTING SYSTEM'S CAPABILITY OF HANDLING ADDITIONAL LOADS.
(4) CONDITION OF EXISTING CONDENSATE PUMPS.
(5) RECOMMENDATIONS FOR EXPANSION (LINE SIZES AND LOCATIONS).

JUSTIFICATION: FUTURE CONSTRUCTION OF FACILITIES WHICH

REQUIRE ADDITIONAL STEAM COULD OVERCOME THE EXISTING CAPACITIES OF THE STEAM AND CONDENSATE LINES.

F. BASIC FACILITY REQUIREMENT/ACTIVITY PLAN

CWE: $220,000

SCOPE: DETERMINE BASIC FACILITY REQUIREMENTS AND DEVELOP AN ACTIVITY PLAN IN ACCORDANCE WITH MCO P-11000.12C.

JUSTIFICATION: MAJOR MISSION CHANGES, REORGANIZATION AND MASTER PLAN CHANGES HAVE MADE IT NECESSARY TO COMPLETELY REWORK EACH AND EVERY EVALUATION WORKSHEET AND THE ACTIVITY PLAN. LIMITED AVAILABLE MANPOWER PRECLUDES IN-HOUSE ACCOMPLISHMENT.

G. UTILITY SYSTEMS (AS-BUILT)

CWE: $100,000

SCOPE: FIELD VERIFY WATER AND STEAM LINES FOR ONGOING AS-BUILT UTILITY SURVEY.

JUSTIFICATION: AS-BUILT DWGS ARE BEING PREPARED BY A/E CONTRACT. THIS EFFORT WAS FUNDED BY HQMC. HOWEVER, STUDY WAS INCOMPLETE DUE TO SHORTFALL OF FUNDS. AS-BUILT DWGS ARE THE KEYSTONE FOR ALL FUTURE PLANNING AND STUDIES. IT IS ESSENTIAL THIS WORK BE COMPLETED.

H. STORMWATER RUN-OFF MANAGEMENT

CWE: $20.000

SCOPE: AN ENGINEERING PLAN IS REQUIRED TO EXAMINE PROPOSED PROJ DESIGN AND CONSTRUCTION PRACTICES TO:

(1) DETERMINE THE PROJECTS WHICH, DUE TO LOCATION AND TYPE OF FACILITY, ARE LIKELY TO BE AFFECTED BY THESE RULES.

(2) DETERMINE THE IMPACT OF THESE REGULATIONS ON COSTS FOR FACILITIES CONSTRUCTION AND OPERATION.

(3) RECOMMEND ALTERNATIVE DESIGN AND CONSTRUCTION CONCEPTS FOR STORMWATER MANAGEMENT SUCH AS INCREASED USE OF POROUS PAVEMENTS OR OTHER MORE PERVIOUS MATERIALS.

JUSTIFICATION: ENGINEERING DESIGN FOR CURRENT AND FUTURE CONSTRUCTION PROJECTS INVOLVING LARGE AMOUNTS OF IMPERVIOUS AREAS SUCH AS ROOFTOPS AND PAVEMENTS WHICH DISCHARGE TO COASTAL WATERS MUST COMPLY WITH NORTH CAROLINA WATER QUALITY REGULATIONS FOR STORMWATER RUN-OFF (L5 NCAC 2B). THESE RULES REQUIRE STORMWATER STORAGE AND TREATMENT FOR STORM EVENTS BASED ON A 100-YEAR STORM (PROPOSED TO BE CHANGED TO A TWO-YEAR STORM) TO REDUCE COLIFORM BACTERIA DISCHARGING

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ADMINISTRATIVE MESSAGE

PRIORITY

P 191947Z AUG 85 ZYB

FM CG MCB CAMP LEJEUNE NC

TO CMC WASHINGTON DC

UNCLAS
FINAL SECTION OF 02 //N11000//

INTO SHELLFISH WATERS.

I. NEW LANDFILL SITE
CWE: $25,000
SCOPE: DETERMINE SITE AND SIZE OF LANDFILL.
JUSTIFICATION: PRESENT LANDFILL SITE WILL BE EXHAUSTED BY 1990.

J. ENVIRONMENTAL NOISE STUDY
CWE: $30,000
SCOPE: STUDY WOULD: (1) MEASURE EFFECTS OF NOISE GENERATED BY ARTILLERY, HELICOPTER, AND HARRIER AIRCRAFT TRNG UPON AREAS ON AND OFF-BASE, AND (2) PROVIDE DATA UPON WHICH TO EVALUATE THE SIGNIFICANCE OF NOISE IMPACTS ON FUTURE DEVELOPMENTS ON AND OFF-BASE; (3) DEVELOP NOISE CONTOUR BASED ON NOISE MEASUREMENTS AND MODELLING TECHNIQUES USING LATEST TECHNOLOGY AVAILABLE.
JUSTIFICATION: ALTHOUGH MCB USES A SYSTEM OF BLAST FOCUSING TO CONTROL TYPE, AMOUNT AND LOCATION OF LIVE FIRE TRNG, BLAST NOISE EFFECTS EXTEND FAR BEYOND BASE BOUNDARIES. ACFT NOISE FROM HELICOPTER TRNG CONTINUES TO AFFECT RESIDENTS OF AREAS ABUTTING THE INSTALLATION. IT IS REASONABLE TO ASSUME THAT AS THE AREA GROWS, PARTICULARLY RESIDENTIAL DEVELOPMENT, COMMUNITY ENCORACHMENT WILL CONTINUE IN THE FUTURE AND ACFT NOISE AND BLAST EFFECTS WILL BE MAJOR CONSIDERATIONS IMPINGING ON READINESS TRNG.

K. BUILDING AND STRUCTURES ENGINEERING EVALUATION
CWE: $180,000
SCOPE: DETERMINE CONDITION CODES OF ALL EXISTING FACILITIES AND STRUCTURES AT CAMP LEJEUNE/NEW RIVER AS PRESCRIBED IN NAVFAC P-78.
JUSTIFICATION: LAST ENGINEERING EVALUATION SURVEY WAS MADE OVER 20 YEARS AGO. IT IS ESSENTIAL THAT NEW EVALUATIONS BE

BFAC(2)...ORIG FOR CG MCB CAMP LEJEUNE(10) /13/
MAIN(1) BCEO(1) BPWO(1) COMP(1) BCOS(1) BSDO(1) CEOB(1) OICB(1)

RTD:000-000/COPIES:0010

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MADE TO SUPPORT FUTURE EXPANSION/PLANNING EFFORTS.

L. WAREHOUSING AND STORAGE REQUIREMENTS

CWE: $150,000

SCOPE:

(1) STUDY SHOULD ADDRESS ALL STORAGE REQUIREMENTS OF MCB AND MCAS, NEW RIVER.

(2) ADDRESS PROBLEMS WHICH MAY IMPACT ON 411 AND 412 CCN SERIES DUE TO NEW CRITERIA IMPOSED ON UNDERGROUND TANKS AND/OR WASTE OIL STORAGE FACILITIES.

(3) ADDRESS CONSOLIDATION, REHABILITATION AND/OR CONVERSION WHERE FEASIBLE OF ALL EXISTING SUBSTANDARD AND EXCESS FACILITIES.

(4) ANALYZE EXISTING FACILITIES AND MAKE RECOMMENDATIONS WITH ECONOMIC ANALYSIS TO JUSTIFY CONSTRUCTION VERSUS REHABILITATION AND/OR CONVERSION.

(5) CCN 451 SERIES SHOULD BE ADDRESSED FOR JUSTIFICATION OF EXISTING FACILITIES AND FOR POSSIBLY THE RELEASE OF SITES WHICH COULD BE IMPLEMENTED INTO THE ACTIVITIES SHORE STATION DEVELOPMENT PLAN.

(6) THE 421 CCN SERIES IS USED FOR STORAGE OF ARMS, AMMUNITION AND EXPLOSIVES AND REQUIREMENTS SHOULD BE REASSESSED TO DETERMINE IF ENCROACHMENT ON THE FRENCH CREEK PRIME REAL ESTATE NEEDED FOR FUTURE EXPANSION CAN BE ADJUSTED.

(7) THE 431 AND 441 CCN SERIES REQUIREMENTS HAVE, IN THE PAST, BEEN CONSTRUCTED BY USING NAVFAC P-272 DEFINITIVE DWGS AS GUIDELINES AND HAVE NOT KEPT UP WITH INCREASE OF T/O'S AND T/E'S OF USERS.

JUSTIFICATION: TO SUPPORT OUR FY-91/92 MCON PROGRAM FOR STORAGE FACILITY PROJECTS.

M. NEW RIVER SHORELINE PROTECTION STUDY

CWE: $20,000

SCOPE:

(1) DESCRIBE THE EROSION PROCESSES AND CAUSES OF EROSION OF THE NEW RIVER SHORELINE, AND DESCRIBE EROSION RATES AS CALCULATED IN FEET PER YEAR.

(2) IDENTIFY LINEAR EXTENT OF SIGNIFICANT EROSION SITES IN AT LEAST THREE PRIORITY CATEGORIES.

(3) DESCRIBE STRUCTURAL AND NON-STRUCTURAL MEANS OF SHORELINE PROTECTION WHICH CAN BE EMPLOYED AS RECOMMENDED BY ARMY CORPS OF ENGINEERS.

(4) EVALUATE EXISTING AND PROPOSED MARINE CORPS CONSTRUCTION PLANS FOR FY-86-91 WHICH WILL GENERATE MASONRY RUBBLE AND RECOMMEND MOST EFFICIENT USE OF RUBBLE FOR SHORELINE PROTECTION.

(5) RECOMMEND EROSION CONTROL MEASURES FOR EACH PRIORITIZED SITE, WITH A COST ESTIMATE AND ESTIMATED CONSTRUCTION TIMES COINCIDING WITH ABOVE CONSTRUCTION PROJECTS.

(6) PREPARE DRAFT AND FINAL REPORTS CONTAINING RESULTS OF TASKS 1-5 ABOVE.

JUSTIFICATION: LACK OF SHORELINE STABILIZATION RESULTS IN SEVERE EROSION ALONG MANY MILES OF NEW RIVER SHORELINE. THIS

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DEFICIENCY CONTINUALLY TAKES LAND FROM THE MARINE CORPS WHICH COULD BE USED FOR MILITARY TRAINING, CAUSES COSTLY REPAIRS TO RIPARIAN STRUCTURES, AND CREATES ADVERSE ENVIRONMENTAL AND AESTHETICALLY DISPLEASING CONDITIONS.

2. POC FOR THIS COMMAND IS MR. A. C. AUSTIN, AV 484-3034/5925.

BT

OPNAV 5216/1448 (Rev. 8-
S/N 0107-LF-052-2322

DEPARTMENT OF THE NAVY

Memorandum

pls send copy of ltrs to CMC w/ my note: ~~Orig of P-785~~ Return to Alex

DATE: 10/23/85

FROM: Bob Alexa LNC

TO: Paul Hutwell, Env Engr, CMC-LFL

SUBJ: LANTDIV REC'N TO MOVE WELL #9. (P-785

10 OCT 85 0942LB

We've received their ltr, are moving this well.
As we discussed, the USGS study will give us the info to ACT on our G/wtr supply, rather than REACT.

V/R Bob H.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1983-605-010:8686

OPNAV 5216/1448 (Rev. 8-81)
S/N 0107-LF-052-2322

DEPARTMENT OF THE NAVY

Memorandum

DATE: 10/23/85

FROM: Bob Alexander, Env Engr, MCB, CLNC

TO: Paul Hubbell, Env Engr, CMC-LFL

SUBJ: LANTDIV REC'N TO MOVE WELL #9. (P-785

10 Oct 85 0942IB

We've received their ltr, are moving this well.
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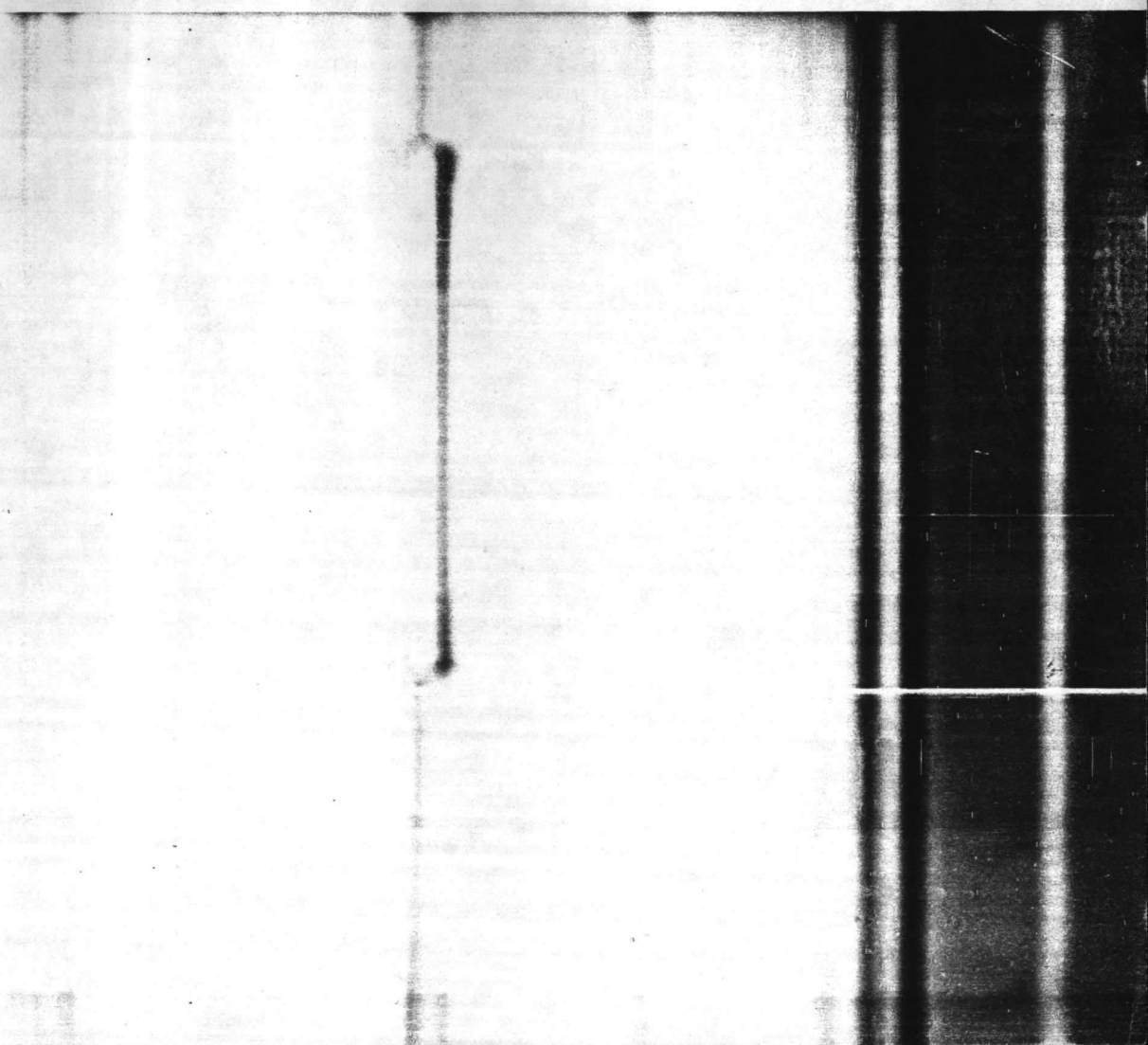
V/R Bob H.

* U.S. GOVERNMENT PRINTING OFFICE: 1983-605-010:8686



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11300
FAC
30 AUG 1985

Mr. Henry Cox
President
New River Nursery, Inc.
Route 2, Box 521
Hubert, NC 28539

Dear Mr. Cox:

I have reviewed your letter of August 20, 1985 and understand the concern regarding an adequate supply of water for your business. The engineering analysis for the new wells did not indicate any abnormal impact on the water table. Additionally, experience with our existing wells on the base do not indicate that the new wells will affect the water table supplying your business.

Please be assured that we continually monitor the water situation aboard the base to ensure it does not adversely affect your water requirements.

Sincerely,

R. A. TIEBOUT
Colonel, U. S. Marine Corps
Assistant Chief of Staff, Facilities
By direction of the Commanding General

Blind Copy to:
CS

Drafter: Mr. Elston/Col Tiebout
Typist: H Foster

P-785

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511-6287

TELEPHONE NO.
444-9704
IN REPLY REFER TO:
N62470-81-C-1644
09A21B
10 OCT 1985

From: Commander, Atlantic Division, Naval Facilities Engineering Command
To: Commanding General, Marine Corps Base, Camp Lejeune, North Carolina

Subj: CONSTRUCTION CONTRACT N62470-81-C-1644, FY 85 MCON PROJECT P-785, EXPAND HOLCOMB BOULEVARD WATER TREATMENT PLANT, MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA

Ref: (a) MCB Camp Lejeune ltr 11000 PWO dtd 28 Aug 1985

Encl: (1) Water System Plan

1. The engineering evaluation requested by reference (a) has been completed. Our investigation has revealed that Well No. 9 is located directly across North Carolina Highway 24 East from New River Nursery, Inc. At this location the raw water distribution system parallels North Carolina Highway 24 East with existing Well No. 650 located 2000 ft. west of Well No. 9 and proposed Well No. 10 located 2000 ft. east of Well No. 9. New River Nursery, Inc., has two wells located almost directly across the highway and spaced approximately 500 ft. and 600 ft. from Well No. 9. These separation distances are considered minimal for the wells under consideration, i.e. 90' to 110' deep.

2. The groundwater report used as the basis for development of your well field and our evaluation of the Castle Hayne Aquifer indicate this spacing of 500 to 600 ft., although minimal, is acceptable. However, extensive testing and/or mathematical modeling of the aquifer to determine its physical characteristics i.e. permeability, hydraulic gradient, thickness of the aquifer, etc. is required to prove that draw down from Well No. 9 will not impact New River Nursery's wells. The effort required to accomplish either the testing or the modeling will be very costly and time consuming. Consequently, it is considered in the best interest of the Government both financially and from a community relations standpoint to relocate Well No. 9. Enclosure (1) shows the proposed new location for Well No. 9. This proposed location has been coordinated with your Utilities Department.

3. Adequate technical data is available to assure that well No. 10 will not adversely impact the New River Nursery wells. This well will be constructed as shown in the subject construction contract documents.

E. L. Gulbronson

By direction

Copy to:
ROICC JAXNCA CAMP LEJEUNE NC

Water-supply study urged

8/16/85

By MIKE DART
City Editor

"Water, water, everywhere, and not a drop to drink."

This modernized saying by 18th century English poet Samuel Taylor Coleridge could reflect reality for Jacksonville, Onslow County and other area water users.

Though the Atlantic Ocean is at their doorstep, drinkable water is a limited commodity. Infiltration by saltwater from the ocean limits the usability of usual freshwater sources. What is left are sources described by officials as declining and in need of careful husbanding.

In light of this, the Jacksonville Water and Sewer Advisory Board has recommended that the City Council and other local governing boards place high priority on funding a study of the area's groundwater supply when money is available.

The Wednesday night action followed a call for cooperation between the city and Onslow County by the chairman of the county Board of Commissioners and a vote of confidence in such a study from a state water official.

John Morris, director of the Division of Water Resources, gave the advisory board a presentation on a North Carolina law that allows the state to require major water users to get a permit before drawing from water sources that may be approaching dangerously low levels. The division is part of the N.C. Department of Natural Resources and Community Development.

Morris concluded his presentation "by making a couple of suggestions." One was that local governments think about the effects on the area groundwater supply and existing wells when other wells are planned.

"The best way to find out is through a computer model of the aquifer," Morris said, referring to the layer of ground containing water. Morris noted the U.S. Geological Survey pays half the cost of these computer models.

His second suggestion was that users of the same water supply establish regular communications because the state "is very reluctant to" impose the permit requirement. Enforcing it, he said, takes a lot of manpower and money.

County board Chairman Cecil Morton took up this call for cooperation. He said county and city officials appeared interested in a computer-model study of the groundwater supply when Geological Survey representatives attended a recent meeting.

"As a matter of fact, I've been wondering why we haven't started on it," Morton said.

The situation could be critical because several entities are drawing

See WATER, Page 12A

• Water

From Page 1A

from what Morris described as "a finite amount of water" in the local aquifer. Officials said water has been drawn from the local aquifer faster than the water can be replenished by precipitation.

Morton said the county recently did for the first time what "even the state says is about impossible" and dug a dry well. "We spent thousands of dollars out here on this dry hole," he said.

City Public Utilities Director A.F. McRorie said the water level at city well No. 1 dropped from five feet in 1952 to 134 feet this summer.

The Geological Survey representatives "were talking in terms of $200,000" to conduct the study, he said. "We're talking about $65,000 of cost to be divided up among the participants in Onslow County."

Officials said the cost of obtaining water from continuously deeper wells also is expensive because more electricity is required.

Officials also said the amount of water needed is on the rise. Morton said, "The projections say we're going to triple the amount of water used" by the year 2000, when the county is expected to use 17 million gallons a day.

Morton cited another reason the study needs to be authorized soon. "It's 18 months away at a minimum to get reports from the computer model," he said. "So we really are desperate for time."

Local officials already know of some ways they can ease drawing water from the aquifer. Spacing wells further apart than the one-mile standard they have been using will result in a higher water level because closer spacing magnifies the "cone of depression" effect drawing from a well has on the water level.

County Commissioner Paul Starzynski suggested another water source during an interview: the White Oak River. Starzynski proposes damming it as a reservoir. "I think it needs to be talked about," he said.

But other communities have found out that even reservoirs need careful husbandry when a peak-use season coincides with dry conditions, which happened locally this year and led officials to impose emergency water conservation measures.

USFL picked off one of the top stars to come out of college — Kelvin Bryant, Herschel Walker, Doug Flutie and Mike Rozier.

Bryant signed with the USFL and went to Philadelphia. The instablility of the league was seen quickly when that team moved to Baltimore. Rozier has a similar tale. He started with the fledgling league's Pittsburgh franchise, which lasted a year before merging with another team. Rozier has now jumped leagues and is with the NFL's Houston Oilers.

Other USFL teams also have moved, some have folded, and there are others on the brink of disapperance.

The USFL's last spring season has ended, and there is a real question if the league will ever begin another season. The plan is to skip next spring and go head-to-head in a fall schedule with the NFL beginning in 1986. Maybe. There are so many financial problems in the league right now, death may be forthcoming.

This financial situation has brought they gave players.

The team which gave that contract, by the way, no longer exists, largely because of that contract.

Those most unhappy with this new situation are the player agents. They are advising players not to sign contracts at less than their 1982 and 1983 prices.

The problem, you see, is their 10 percent will be much less. The claim of the agents now is that the NFL is guilty of price-fixing, because of lower salary offers all around.

What is happening however, is that the free market is at work. Competition is on the ebb, and as a result, offers to untried rookie football players dipped to the levels of pre-USFL days. Some veterans — Eric Dickerson and Tony Dorsett, for example — also have felt the pinch in their attempts to renegotiate their contracts.

No matter the game or the business or the job, a person's service is worth what the market will bear — even in football.

That's Jake

We've all been there be landing in rain and thun and is bouncing all over remind ourselves if flyin people in the cockpit wo full-time job. .

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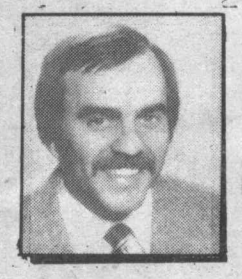

The love of one's cou emotion, and not inheren animate people to give

ration

ctor at St. Joseph's Hospital in Chicago ghts; Robert L. Charpentier, a logian at Berkeley Theologial Union in fornia; Anthony Padavano, a theologian Rompano College in New Jersey, and nk McGrath, who teaches religion at ago City College.

We...declare our love for the Catholic rch and our respect for its pastors, its , its tradition and its people," the ricans say in their proposed statement.

says studies show that 80 percent of the in Eruope and America "are ready to ot a married priesthood," and that a ening "dire shortage of priests" makes nge of policy urgent.

e statement says the the 1971 synod of ps narrowly turned down a proposal to for a married priesthood, and several nals, including England's Basil Hume, since suggested the church should der allowing married clergy.

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United States Department of the Interior

GEOLOGICAL SURVEY

Post Office Box 2857
Raleigh, North Carolina 27602

August 23, 1985

Mr. Robert E. Alexander
Environmental Engineer
United States Marine Corps
Office of the Assistant
Chief of Staff, Facilities
Camp Lejeune, N.C. 28542

Dear Mr. Alexander:

Per your suggestions and comments at our meeting on August 14, 1985, I have revised the proposal describing an investigation of the ground-water resources of the Base and environs. Four copies of the revised proposal text are attached. Please replace the old text material with this new version. The illustrations have not been changed; thus, they should be attached to the new texts.

Please let us know if you have any further question, suggestions or comments about the proposal (FTS 672-4791 or 672-4510).

Sincerely,

Orville B. Lloyd, Jr.

Orville B. Lloyd, Jr.
Hydrologist

Encl.

OBL:ceh

PROJECT PROPOSAL

AN APPRAISAL OF THE GROUND-WATER RESOURCES OF CAMP LEJEUNE MARINE CORPS BASE, NORTH CAROLINA

U. S. Geological Survey
Raleigh, North Carolina

August 14, 1985

Revised August 22, 1985

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ILLUSTRATIONS

Figure 1. Location of Camp Lejeune Marine Corps Base, North Carolina 9

Figure 2. Diagrammatic geologic and hydrologic cross section A-A' through Camp Lejeune Marine Corps Base, North Carolina . . 10

Figure 3. Diagrammatic geologic and hydrologic cross section B-B' through Camp Lejeune Marine Corps Base, North Carolina . . 11

Figure 4. Location of supply wells and waste-disposal sites at Camp Lejeune Marine Corps Base, North Carolina. 12

PROJECT PROPOSAL

TITLE AND LOCATION: An appraisal of the ground-water resources of Camp Lejeune Marine Corps Base, North Carolina.

Camp Lejeune Marine Corps Base, an area of about 170 square miles, is located southeast of the city of Jacksonville in Onslow County, North Carolina. The Base is bounded on the north by N.C. Highway 24, the east by N.C. Highway 172 and Bear Creek, the southeast by the Atlantic Ocean, the southwest by the New River and an irregular line that roughly parallels N.C. Highway 172, and on the west by U.S. Highway 17 (see fig. 1).

PROBLEM: Camp Lejeune plays an essential role in training many Marine Corps men and women for jobs that are necessary to preserve our national security. The Base is the only military training center in the eastern United States where joint amphibious training exercises can be carried out with all branches of the Armed Services.

A plentiful and good-quality water supply is vital for Camp Lejeune to carry out its mission and to maintain the operational readiness of the Fleet Marine Forces. Because it would be very difficult to impound large supplies of fresh water on the surface of the land in the area, Camp Lejeune relies on large amounts of ground water for water supply.

Since Camp Lejeune was first opened in the late 1930's, water supply has been derived from wells that tap freshwater-bearing aquifers (sands and limestone) which occur between land surface and about 400 feet below land surface in the area (see figs. 2 and 3). Clay and silty clay-confining beds are interlayered with the aquifer material but are estimated to be thin and discontinuous beneath the Base. Salty water occurs in the deep sand aquifers that underly the area and in the shallow aquifer material adjacent to the Atlantic Ocean and the tidal reaches of the New River and its tributaries.

Over the years, more than 100 wells have been drilled and operated to satisfy increasing demands for water as the Base functions and population grew. At present, ground-water withdrawals rank amoung the largest in the State and are estimated at 8 million gallons per day. The Base presently supports a population of about 100,000.

An increase in the amount of waste generated by Base operations accompanied the growth. As a result, significant amounts of several kinds of wastes containing hazardous and toxic organic compounds have been disposed of or spilled at numerous sites on the Base (see fig. 4).

PROBLEM: continued

Most of the disposal and spill sites are directly underlain by sand and lack natural or synthetic barriers to contain the wastes and prevent them from moving downward into the ground-water system. Consequently, some of the wastes have infiltrated to the water table and contaminated some of the ground water in the shallow and supply aquifers. Many of the waste-disposal and spill sites are near water-supply wells (see fig. 4), and the use of a number of supply wells has been discontinued recently because organic compounds have been detected in the well water.

Ground-water withdrawals from wells that are near the tidal reaches of the New River and its tributaries may cause salty water in these drainage-ways to move into and through the shallow sand and limestone aquifers toward the pumping wells (see figs. 2 and 3). It is also possible that salty water could be drawn upward from deeper parts of the aquifer system by wells pumping large amounts of ground water from the deep sand aquifers or the lower parts of the limestone aquifer.

Growing water-supply needs coupled with the threat of present and future contamination of existing wells (by disposed wastes or brackish and saline water) has prompted the Marine Corps to request the U.S. Geological Survey to study the geohydrology of the Base and environs and determine ground-water use and management practices that will reduce the chances of further contamination and help assure that future water-supply needs are met.

OBJECTIVES: The objective of this study is to describe the ground-water resources of the Base and environs and to construct an appropriate ground-water flow model that will be used to evaluate alternative ground-water use and management practices that will reduce chances for further contamination and help assure that future water-supply needs are met.

SCOPE: The study area will include the Marine Corps Base and environs. Study elements will include determining (1) the lateral extent, thickness, and hydraulic characteristics of aquifers and confining beds, (2) the potentiometric surfaces of the aquifers, (3) the amounts of ground-water recharge and discharge, (4) the quality of freshwater contained by the aquifers, and (5) the relationship between the freshwater and saltwater in the aquifers. The data collected during these study elements will be used to construct a fine-grid, finite-difference ground-water flow model.

SCOPE: continued

Water-level and water-quality data obtained from more than 50 wells that were drilled during the second phase of the Navy Assessment and Control of Installation Pollutants (NACIP) program at the Base will be used in conjunction with data to be collected during the USGS study. The NACIP data will help define the hydrology and any potential and existing water-quality problems. The wells drilled for the NACIP program are designed to test the ground-water quality to a depth of about 10 feet below the water table and are located adjacent to 22 waste-disposal or spill sites at the Base. Analyses of soil, rock, and water samples collected from these wells are being used to confirm whether or not the shallow ground-water and aquifer material have been contaminated. Confirmation of contamination in the shallow part of the ground-water system will provide an alert to potential contamination in the deeper supply aquifer.

APPROACH:

1. Water-resources budget--Data on precipitation, evapotranspiration, runoff, water levels and water use will be collected, compiled and analyzed to estimate ground-water recharge and discharge in the area.

2. Geohydrologic framework--The depth to and thickness and lateral extent of the aquifers and confining beds will be determined and mapped from a study of geophysical and lithologic logs made from existing wells and new wells that will be constructed for the study.

3. Ground-water movement through the geohydrologic framework--Data from geophysical and lithologic logs will be used in conjunction with aquifer-test data from existing and new wells to determine and map the water transmitting and storage capabilities (hydraulic conductivity and storage coefficient, respectively) of the aquifers and confining beds. In addition, water-level data collected from existing and new wells will be used to determine and map the potentiometric surfaces of the aquifers. The water-level data indicate the hydraulic gradient throughout the aquifer systems. The hydraulic gradient, hydraulic conductivity and storage coefficient are needed to determine the direction and rate of ground-water movement in the area.

4. Quality of ground water--Water samples will be collected from existing and new wells and analyzed for concentrations of major ions, including chloride, and organic compounds, heavy metals, and other appropriate chemicals that can be associated with the work or waste disposal at the Base. The water-quality data will be used to identify, quantify, and determine the source of chemical constituents in the fresh ground water and to help determine the position of the freshwater-saltwater interface in the Base area.

APPROACH: continued

5. Ground-water flow model--The compiled and analyzed data will be used to construct and calibrate the fine-grid, finite-difference ground-water flow model. The model will be the basic tool with which to analyze the effects of alternative ground-water supply development scenarios for the Base. It will be run on the USGS PRIME computer in the North Carolina District office in Raleigh; however, the model can be transferred to other computer(s) on the Base or elsewhere.

6. Test drilling--A major part of the study can be implemented with data that is either presently available or can be collected from existing wells. However, some new test drilling will be needed to better define the geohydrologic framework, the factors that control ground-water movement through the framework, and the ground-water quality. It is estimated that about four test wells (500 to 600 feet deep) will be needed to investigate the water-quality and water-bearing characteristics of the deep sand aquifers and the limestone aquifer in the base area. Also, about three or four observation wells (200 to 400 feet deep) will be needed to make an aquifer test in the supply aquifer, and an additional four to six observation wells (50 to 100 feet deep) will be needed to investigate the position of the freshwater-saltwater interface and its relation to supply-well pumping.

It is assumed that the drilling and sampling of the NACIP program will describe and define the nature and extent of ground-water contamination from hazardous-waste sites on the Base. Therefore, drilling done for the USGS study will be located away from the hazardous-waste sites, as much as possible, to reduce the expense of required and special drilling and safety procedures (like those needed at Cherry Point Marine Corps Air Station).

REPORTS: A report will be written for the USMC describing the results of each completed phase of the investigation (see TIME FRAME for phase descriptions). The completion of the study will result in an interpretative report entitled, "An appraisal of the ground-water resources of Camp Lejeune Marine Corps Base, North Carolina." Additional interpretative reports may be written on various technical aspects of the study. Written progress reports will be prepared and submitted to the USMC quarterly.

RELATION TO LONG-RANGE PLAN: This study relates directly to the North Carolina District's long-range plan (dated May 12, 1980) concerning the quality and availability of ground water in the Coastal Plain.

RELATION TO STATE AND WRD PROGRAMS: The North Carolina Department of Natural Resources and Community Development and the Department of Human Resources are interested and involved in classifying, mapping, and regulating water-use, waste-disposal, and land-use practices throughout the State.

The USGS has a mandate from the U.S. Congress to study and report on the quality and availability of water resources throughout the United States. Ground-water quality is of high national priority for the USGS.

TIME FRAME: The study is tentatively planned for four years and will be divided into three phases. The second phase is extended over a two-year period because of the cost of the work tasks. A brief description of work tasks for each phase follows:

Phase 1 (Fiscal Year 1986[?]) - Collect, compile and analyze all available data on water budget, water use, geohydrologic framework, hydraulic characteristics of aquifers and confining beds, and head and quality of water in aquifers. Prepare a report that describes the available data and new data needs.

Phase 2 (Fiscal Year 1987[?] and 1988[?]) - To fill data needs described in Phase 1 report, design and construct new test wells and new observation wells, and make geohydrologic and chemical tests on new and pre-existing wells. Prepare a report that describes test- and observation-well construction, and the new geohydrologic and chemical data.

Phase 3 (Fiscal Year 1989[?]) - From the analysis of data collected in Phases 1 and 2, construct and calibrate a finite-difference model of ground-water flow through the aquifer and confining-bed materials that underlie the Base area. Determine alternative ground-water use and management practices that will reduce chances for further ground-water contamination and help assure that the future water-supply needs of Camp Lejeune are met effectively and efficiently with the least amount of environmental impact. Recommend a long-term water-level and water-quality monitoring system that will help assure the quality and quantity of the Base water supply. Prepare a report describing the results of Phase 3.

MANPOWER:

Project chief:	Hydrologist	GS-12/13	Full time
Project staff:	Hydrologist	GS- 7/ 9	Part time
	Hydrologic technician	GS- 7/ 9	Part time

COSTS: Estimated costs for each phase of the project are summarized below:

Phase 1 (Fiscal Year 1986[?])	
Data collection and compilation.	$ 20,000
Data analysis and synthesis.	30,000
Report preparation	30,000
Fiscal Year 1986(?) Subtotal	$ 80,000
Phase 2 (Fiscal Year 1987[?] and 1988[?])	
Construction and equipment	
Well drilling, construction, sampling and testing (4600 feet at an estimated $25/foot)	$115,000
Water sampling equipment.	3,000
Geophysical logging (10 days @ $1000/day).	10,000
Laboratory services (40 samples @ $500/sample) . .	20,000
Data collection, analysis, interpretation, and report preparation	80,000
Fiscal Years 1987 and 1988 Subtotal	$228,000
Fiscal Year 1987. . . . .$114,000	
Fiscal Year 1988. . . . .$114,000	
Phase 3 (Fiscal Year 1989)	
Computer time and support personnel.	$ 29,000
Data preparation, analysis, interpretation, and report preparation	80,000
Fiscal Year 1989 Subtotal	$109,000

COST SUMMARY

U. S. Marine Corps Funds

Phase 1 (FY 1986[?]).	$ 80,000
Phase 2 (FY 1987[?]).	114,000
Phase 2 (FY 1988[?]).	114,000
Phase 3 (FY 1989[?]).	109,000
GRAND TOTAL	$417,000

OK-GO5MOOTH

UNITED STATES MARINE CORPS
Marine Corps Base
Camp Lejeune, North Carolina 28542-5001

A 8/28

6280/4
FAC

From: Commanding General, Marine Corps Base, Camp Lejeune
To: Commandant of the Marine Corps (Code LFL)

Subj: STUDY OF THE GROUND-WATER AQUIFER BY U.S. GEOLOGICAL SURVEY

Ref: (a) CG, MCB 191947Z Aug 85

Encl: (1) U.S.G.S. ltr dtd 14 Aug 85 with enclosed Project Proposal

1. Growing water supply needs coupled with the threat of present and future contamination of existing wells by disposed wastes or brackish and saline water prompted this Command to request U.S. Geological Survey to study the geohydrology of the Base and environs. This study will determine ground-water use and management practices in order to reduce chances of further contamination and help assure future water supply needs are met.

2. The enclosed project proposal was developed by U.S.G.S. and briefly describes work tasks and establishes cost as summarized below:

Phase 1 (Fiscal Year 1986).....$80,000

Analyze available aquifer data and develop report describing additional information requirements.

Phase 2 (Fiscal Year 1987 and 1988).....$228,000

Test drill (11-14 new wells) to establish the salt/fresh water interface and its relation to supply-well pumping.

Well drilling sites will be coordinated with NACIP study for maximum coverage.

Phase 3 (Fiscal Year 1989).....$109,000

Develop ground-water model and determine alternative management procedures.

Total Project Cost.....$417,000

provide comments/

3. Request your review and concurrence with the proposed study. ~~Further, request Fiscal Year 1986 funds in the amount of $80,000 be made available.~~ This requirement has been included with FY-86 other engineering support requirements as fowarded by the reference. For additional information reqarding this study, please contact Mr. Bob Alexander, MCB Environmental Engineer, AV 484-3034.

R. A. TIEBOUT
By direction

Copy to:
U.S. GEOLOGICAL SURVEY, RALEIGH (w/out Encl)
LANTNAVFACENGCOM (114 AND 09P)
PWO
BMO
NREAD

Blind copy to:
EnvEngr

Ltr shows drops by A/S COMPT

D R A F T

6280/4
FAC

Mr. James F. Turner
District Chief
U.S. Geological Survey
Dept of the Interior
P.O. Box 2857
Raleigh, N.C. 27802-2857

Re: Groundwater Aquifer Study
Camp Lejeune, NC

Dear Mr. Turner:

The purpose of this letter is to request your assistance on a reimbursable basis in developing a geologic study of the groundwater aquifer underlying the Marine Corps Base, Camp Lejeune. This request follows the on-site discussion between Mr. Bruce Lloyd and Mr. Ron Coble, USGS, Raleigh, and members of the Camp Lejeune staff on 23 July 1985.

The purpose of the study is to evaluate the Camp Lejeune ground water supply and to characterize the capability of the aquifer to sustain present and future water supply needs. During the July meeting the following issues, among many others, were discussed as relevant to the groundwater supply study:

- Interface with the study of groundwater contamination under the Navy Assessment and Control of Installation Pollutants (NACIP) Program.
- Definition of the geohydrology of the Castle Hayme aquifer, to include determing aquifer coefficients, and defining the fresh and salt water terface.
- Development of a digital model for use as a management tool.
- Aquifer testing including new test wells, pumping tests, and geophysical analyses.
- Estimates of production capacity of existing wells and alternative

sites for new wells.

In order to pursue funding and implementation of the study, this Command request a work plan be developed including a cost estimate. The enclosed documents are provided to assist in this effort.

The Camp Lejeune groundwater aquifer study will contain information which is considered essential to proper planning of Marine Corps facilities. We greatly appreciate the cooperative attitude of Mr. Lloyd and Mr. Coble in addressing this important subject.

Please contact Mr. Bob Alexander, Marine Corps Base Environmental Engineer at FTS 676-3034 for further information regarding this request.

R. A. TIEBOUT
Colonel, U. S. Marine Corps
Assistant Chief of Staff, Facilities
By direction of the Commanding General

Encl (1)"Evaluation of Well-Water Supply, MCB",
H. E. LeGrand, May, 1959
(2) "Interim Report of Groundwater Conditions at
Tarawa Terrace, Camp Lejeune, NC",
H.E. LeGrand, April, 1959
(3) Soil Survey of Camp Lejeune, NC,
U.S.D.A-S.C.S, December 1984

Copy to:
CMC (LFL)
LANTNAVFACENGCOM (09P & 114)

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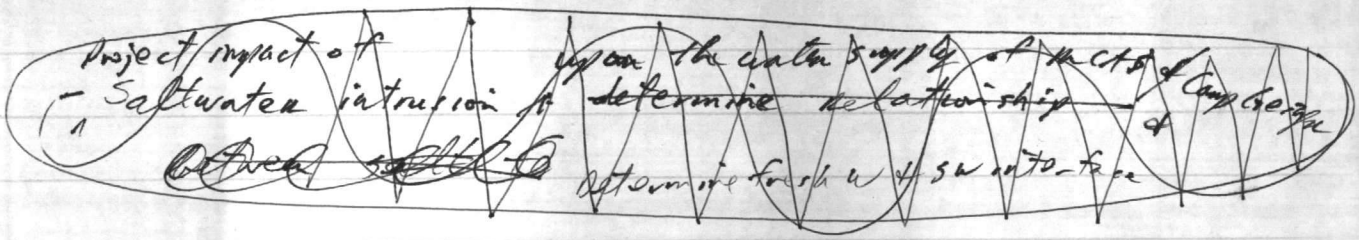
OBJ: Define capability of aquifer to sustain present and future water supply needs

~~Methods~~

Issues:

- Based on results of NACIP study, to identify the uncontaminated areas of aquifer



~~- Evaluate the CH aquifer~~

- Define geohydrology of CH aquifer, det aq. coefficients, def FW/SW interface, & develop digital model for use as a management tool.

~~Future growth & development~~

Procedures

- will include installation of new test wells, ppg tests, geophys logs, sample aquifer matl's,

DEPARTMENT OF THE NAVY SELF-DUPLICATING NOTE

Use only for an informal, preferably hand-written note. Make duplicate only when required for follow-up or working file. See correspondence manual for formal, official memoranda.

TO: MAIN (Attn: UTIL)

NREAD

☐ ACTION	☐ COORDINATE	☐ PREPARE FOR SIGNATURE
☐ AS DISCUSSED	☐ CORRECTION	☐ REPORT BACK
☐ CALL/SEE ME	☒ INFORMATION	☐ RETURN
☐ COMMENT/CLEAR	☐ PREPARE DRAFT	☐

SUBJ: GROUNDWATER RESOURCE STUDY

Encl: USGS ltr dtd 28 May

- This shows Cherry Point efforts mostly in the NACIP work
- USGS, Raleigh called yesterday + wants to ~~set~~ up a discussion of our needs: 23 JULY 85 (I'll send them a letter)
- Your input is needed on:
  - scope of work
  - questions to be answered
  - source of funds
  - etc.
- call if ?'s.

FROM: [signature]

DATE 6/19

EXT. 3034

OPNAV 5216/142 (Rev. 5-74) S/N 0107-LF-778-7110 ☆ U.S. Government Printing Office: 1982—505-106/8666 2-1

United States Department of the Interior

GEOLOGICAL SURVEY

P. O. Box 2857
Raleigh, North Carolina
27602

May 28, 1985

Mr. Douglas Nelson, Director
Natural Resources and Environmental
Affairs Division
Building 198, Stop 1
Marine Corps Air Station
Cherry Point, North Carolina 28533

Dear Mr. Nelson:

Per your request during our telephone conversation on May 10, 1985, we have made changes in the proposed study of ground-water supply at the Air Station to reduce costs. We will delete the five to seven shallow (60 to 75 feet deep) wells we had planned to construct for the purposes of sampling and analyzing soil and aquifer materials, and for monitoring ground-water quality and water-table fluctuations. This is done with the proviso that five to seven replacement wells are constructed according to the attached location map and specifications. The wells are numbered according to priority on the map, from highest priority (1) to lowest (7).

We checked with Mr. Ray Whitaker of Froehling and Robertson, Inc., and he told us they didn't have the equipment needed to construct the kind of wells we want for the study. So, we have scaled down the specifications for the shallow replacement wells to suit their equipment. These shallow wells are very important to the aquisition of data needed for the proposed study, and we are giving up our control on the amount and kind of samples that will be collected and the quality of the well construction. Consequently, the amount of the resulting data will be reduced and the quality of the data will have to be taken at face value.

The estimated drilling costs have been reduced to $110,000, and geophysical-logging and laboratory-service costs for PHASE 2 of the study have been reduced to $10,000 and $20,000, respectively.

Mr. Turner (District Chief) and I went to Reston, Virginia, to discuss the proposed study with USGS personnel at our National Headquaters on May 15 and 16, 1985. We requested that more USGS research personnel become involved in the planning and implementation of the project, particularly the research drilling and sampling team from Denver, Colorado. If the drilling and sampling team can work with us we can probably further reduce the drilling costs for the project. However, if they become involved we will have to be able to publish some reports on the results of the study, particularly on the drilling and sampling techniques used.

At present we had better plan on an estimated minimum amount of $110,000 as the cost of drilling, well construction, sampling and well testing. I'll let you know when we receive further information on the research people and their involvement.

I have revised the proposal and the preliminary work plans to reflect these new cost estimates and have enclosed copies of the documents for your information. Please call (919-755-4510) if you have any commments or questions about any of the enclosures.

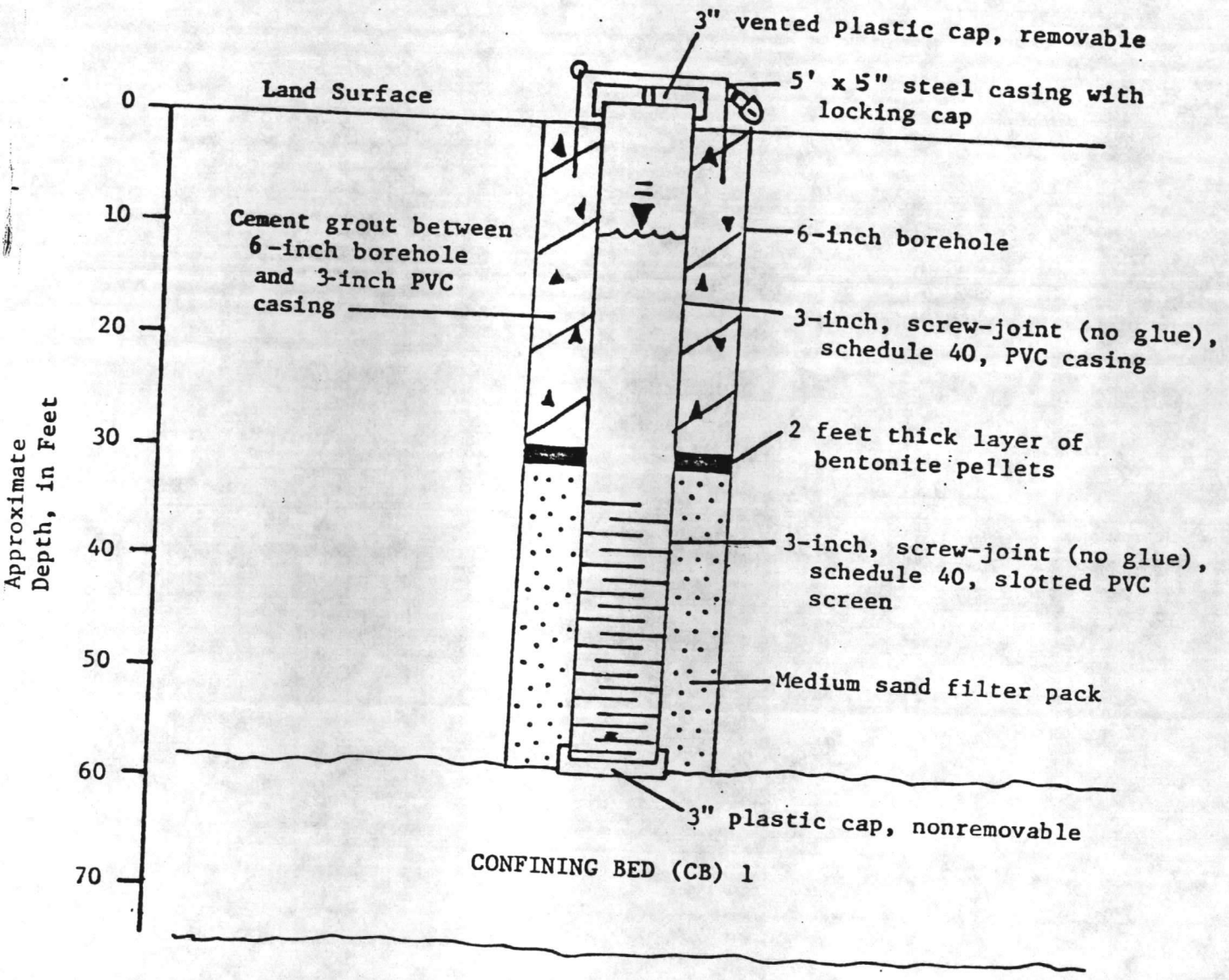
Sincerely,

Orville B. Lloyd, Jr.

Orville B. Lloyd, Jr.
Hydrologist

Enclosures

"REPLACEMENT WELLS"
SHALLOW OBSERVATION WELLS



Need from 5 to 7 of these wells located according to the attached map, and constructed according to the attached procedures.

Procedure for constructing shallow observation wells, 3-inch diameter

1. 60' split-spoon sampling (about one sample every 5 feet).
2. 60' x 6" borehole.
3. 37' x 3" screw-joint (no glue), schedule 40 PVC casing and
4. 25' x 3" screw-joint schedule 40 PVC casing (no glue) slotted
5. Swab and clean inside of schedule 40 PVC casing (slotted and unslotted) with strong detergent (Liqui-Nox for example) and rinse with clean water.
6. Place casing in 6" borehole centered from top to botton and
7. Place clean, washed, medium-grained, quartz sand in annular space between 6" borehole and 2" casing to a depth of about 32 feet below land.
8. Place 2 feet of bentonite pellets above sand filter pack and fill remainder of the annular space with grout back to land surface.
9. Pump well until water clears.
10. Clean rig plumbing and pumping system by pumping detergent and rinse water through the rig with its own pumps, and steam clean split-spoon equipment and drill stem and rods inside and out before moving rig and/or drilling another hole.

PRELIMINARY WORK PLAN FOR PHASE 1
(Fiscal Year 1986)

WORK TASK I. Determine the present quality of water from existing supply wells that tap the deep, limestone, water-supply aquifer in the Air Station area.

a. Collect water samples from existing supply wells in conjunction with the NACIP water-sampling program
b. Analyze samples with emphasis on determining the presence or absence of the hazardous and toxic wastes that have been disposed or spilled at the Air Station

WORK TASK II. Evaluate the general lithic character, thickness, extent and continuity of any confining beds and aquifers overlying the deep, limestone, water-supply aquifer from geophysical logs made in existing wells in the Air Station area.

a. Pull pumps from existing water-supply wells and make gamma-ray, neutron, bulk density and sonic travel-time logs in these and other available wells
b. Analyze logs to determine aquifer and confining bed lithology and porosity type and distribution

WORK TASK III. Map potentiometric surfaces of the shallow water-table aquifer and the deep, limestone, water-supply aquifer from water-level measurements made primarily in existing wells in the Air Station area.

a. Make two sets of water-level measurements in wells and local creeks and streams, one in "wet" and one in the "dry" season
b. Establish water-level recorders on selected existing and available wells that may occur in the shallow water-table aquifer and the deep water-supply aquifer
c. Construct a few shallow wells if needed to prepare a water-table map

WORK TASK IV. Prepare report on the results of the Phase 1 investigations with appropriate illustrations and data tables.

ESTIMATED COSTS FOR PHASE 1

Geophysical logging	$ 25,000
Laboratory services	43,000
Data collection, analysis, interpretation, and report preparation	50,000
Total estimated costs for Phase 1	$ 118,000

PRELIMINARY WORK PLAN FOR PHASE 2
(Fiscal Years 1987 and 1988)

WORK TASK I. Review available geologic, hydrologic and chemical data and determine exact location and number of test wells to be drilled.

a. Coordinate drilling and additional data collection with the data compiled during the NACIP investigations at the Air Station in order to share information and minimize expense where possible

b. At present, it is estimated that about four wells will be needed (one about 450 or 500 feet, and three about 120 feet in depth)

WORK TASK II. Prepare drilling specifications, distribute specifications for bids and award contract to a qualified drilling contractor.

NOTE: Because of the hazardous and toxic nature of some of the wastes disposed at the Air Station, the drilling specifications will include special and expensive well-construction procedures and personal-safety precautions that must be taken during this phase of the investigation to protect on-site workers, the general public, the environment and the water-supply aquifer. These procedures and precautions are listed in the appendix to the project proposal.

WORK TASK III. Drill test wells and collect data needed to determine and verify the physical and chemical characteristics of the aquifer and confining-bed materials and fluids that overlie and occur within the deep, limestone, water-supply aquifer.

a. Collect split-spoon samples of aquifer and confining-bed materials at specified depth intervals and analyze selected samples to determine chemical and hydraulic characteristics

b. Collect ground-water samples from test wells at specified depths and analyze samples for selected constituents including concentrations of chloride, heavy metals, cyanides, and organic compounds that can be associated with the work activities at the Air Station

c. Make water-level measurements and selected hydraulic tests at specified depth intervals in the test wells to determine the distribution of hydraulic head and hydraulic conductivity

d. Make geophysical logs in test wells selecting combinations of gamma-ray, neutron, bulk density, sonic travel-time, resistivity, spontaneous potential, and conductivity surveys best suited to data needs

WORK TASK IV. Prepare report on the results of Phase 2 investigations with appropriate illustrations and data tables.

ESTIMATED COSTS FOR PHASE 2

Construction and equipment	
Well drilling, construction, sampling and testing	$110,000
Safety equipment	
Air monitoring instruments	9,500
Personal protection respirators and clothing	7,500
Water-sampling equipment	3,000
Geophysical logging	10,000
Laboratory analytical services	20,000
Data collection, analysis, interpretation, and report preparation	114,000
Total estimated costs for Phase 2	$ 274,000 a/

a/ - This sum is to be divided over two fiscal years as follows:
Fiscal Year 1987 funds: $ 137,000
Fiscal Year 1988 funds: $ 137,000

PRELIMINARY WORK PLAN FOR PHASE 3
(Fiscal Year 1989)

WORK TASK I. Construct a finite-difference ground-water flow model of the hydrogeologic system in and around the Air Station from the data and interpretations that resulted from investigations during Phases 1 and 2.

a. Determine grid system for area and discretize appropriate maps of aquifer and confining-bed characteristics (such as structure tops, thicknesses, hydraulic conductivity, potentiometric surfaces, etc.)
b. Determine boundary conditions
c. Develop a steady-state digital model for unstressed (pre-pumping) conditions in the area
d. Evaluate different ground-water pumpage and development schemes to determine which alternatives will reduce the chances for contamination of the water-supply aquifer

WORK TASK II. Prepare report on the results of Phase 3 investigations with appropriate illustrations and data tables.

ESTIMATED COSTS FOR PHASE 3

Computer time and computer-support personnel.....	$ 29,000
Data preparation, analysis, interpretation and report preparation.....	79,000
Total estimated costs for Phase 3.....	$ 108,000

PROJECT PROPOSAL

NC 84F GROUND-WATER SUPPLY AND POTENTIAL FOR CONTAMINATION -- CHERRY POINT MARINE CORPS AIR STATION, NORTH CAROLINA

U.S. Geological Survey
Raleigh, N.C.

June 16, 1983
Revised 8-9-83
Revised 4-1-85
Revised 5-24-85

PREFACE

This proposal was prepared by the U.S. Geological Survey at the request of the U.S. Marine Corps. Years of accumulated hazardous and toxic wastes at the Marine Corps Air Station have created actual and potential water contamination problems for both the area ground-water and surface-water systems. This study deals with the ground-water problems and is divided into three phases. Phase 1 addresses the immediate need of the Air Station to evaluate the quality of the present ground-water supply regarding actual and potential contamination by the disposed wastes. The possibility of these hazardous and toxic substances being in the water-supply aquifer is of critical concern because of the relative location of supply wells to the disposal and spill areas. Phase 2 addresses the anticipated need for additional chemical, geologic and hydrologic data by proposed test-well drilling at selected locations to determine and verify the characteristics of the aquifers, confining beds and fluids that occur in the Air Station area. The data and interpretations obtained from Phases 1 and 2 will be needed for Phase 3, which will consist of constructing a finite-difference, ground-water flow model to determine alternative ground-water use and management practices that will help reduce the chances for contamination of the water-supply aquifer. The three phases are necessary because the water-supply contamination situation appears to be critical and this study approach allows the most pressing and important questions to be answered first and as quickly as the process of obtaining reliable answers will allow.

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PROJECT PROPOSAL

TITLE AND LOCATION: NC 84F Ground-water supply and potential for contamination -- Cherry Point Marine Corps Air Station, North Carolina

The Marine Corps Air Station, an area of about 18 square miles, is located in southeastern Craven County, North Carolina. The station is bounded on the north by the Neuse River, the east by Hancock Creek, the south by NC Highway 101 and the west by an irregular north-south line located about 0.75 miles west of Slocum Creek (see fig. 1 and 2).

PROBLEM AND NEEDS: Since the Air Station opened in 1942, water supply has been derived from a thick artesian-limestone aquifer, the top of which underlies the station at a depth of about 120 feet below sea level (fig. 3). Considerable amounts and various kinds of hazardous and toxic liquid wastes have been spilled or disposed of at numerous different landfill sites on the Air Station (fig. 2). These predominately sandy landfill sites, in use for over 40 years, lack natural or synthetic seepage barriers as required by today's standards.

The heaviest concentration of disposed wastes and spills is very near the line of production wells that supply most of the water for the Air Station. Supply wells partially penetrate the artesian-limestone aquifer and, in places, the potentiometric surface is below the water table thereby enhancing downward movement of contaminants from the water-table into the artesian aquifer. This potential for downward movement is greatest around the pumping supply wells (fig. 3). Potential contamination of the water supply aquifer is increased by the possibility of direct connection between the aquifers through deep wells via improper construction, incomplete plugging, or corroded or breached casing. In addition, the lower part of the water-supply aquifer contains saline water, which has the potential to encroach on the freshwater supply. The potential for movement of hazardous and toxic wastes and saline water into the area ground-water system, and the ground-water use and management practices that will reduce the chances of contamination, need to be evaluated.

PURPOSE OF PROJECT: The purpose of the proposed study is to evaluate (1) the quality of ground-water being pumped from the Air Station wells that tap the artesian-limestone aquifer (water-supply aquifer), (2) the potential for contamination of the water-supply aquifer by hazardous and toxic wastes that occur at various surface disposal sites at the Air Station, and by saline-water encroachment, and (3) alternative ground-water use and management practices that will help reduce the chances for contamination of the water-supply aquifer.

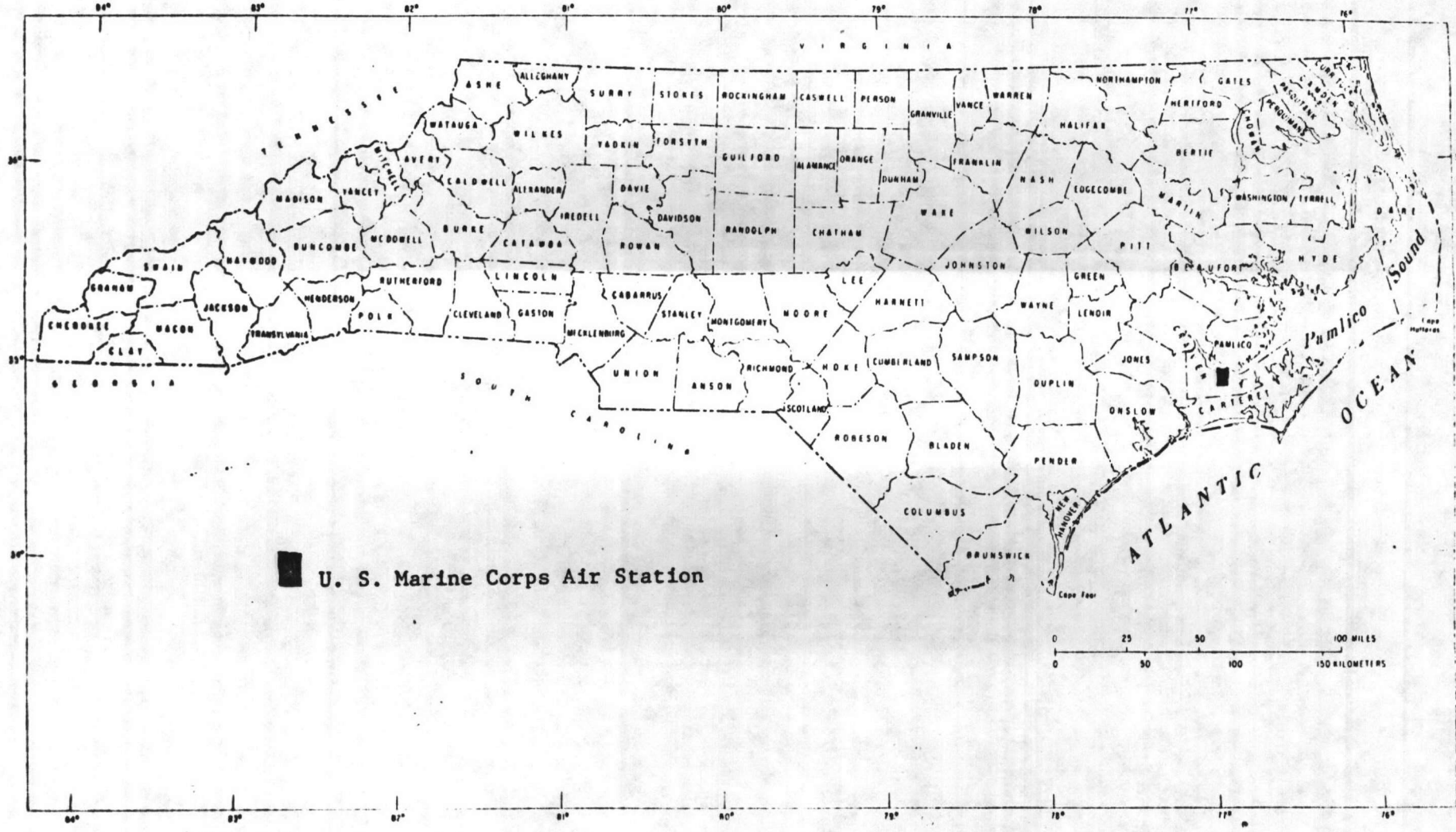


Figure 1.--Location of Cherry Point Marine Corps Air Station, Havelock, North Carolina.

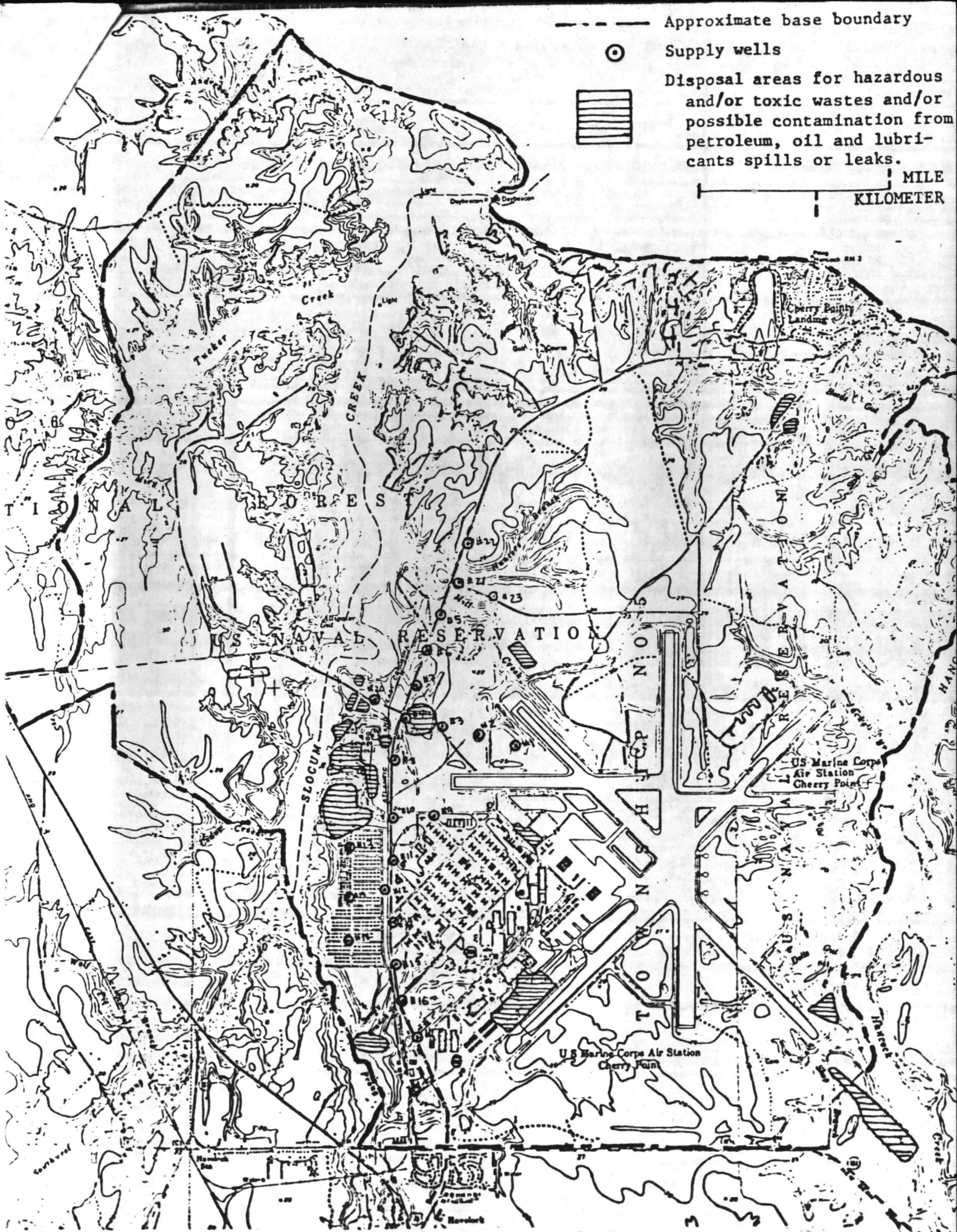
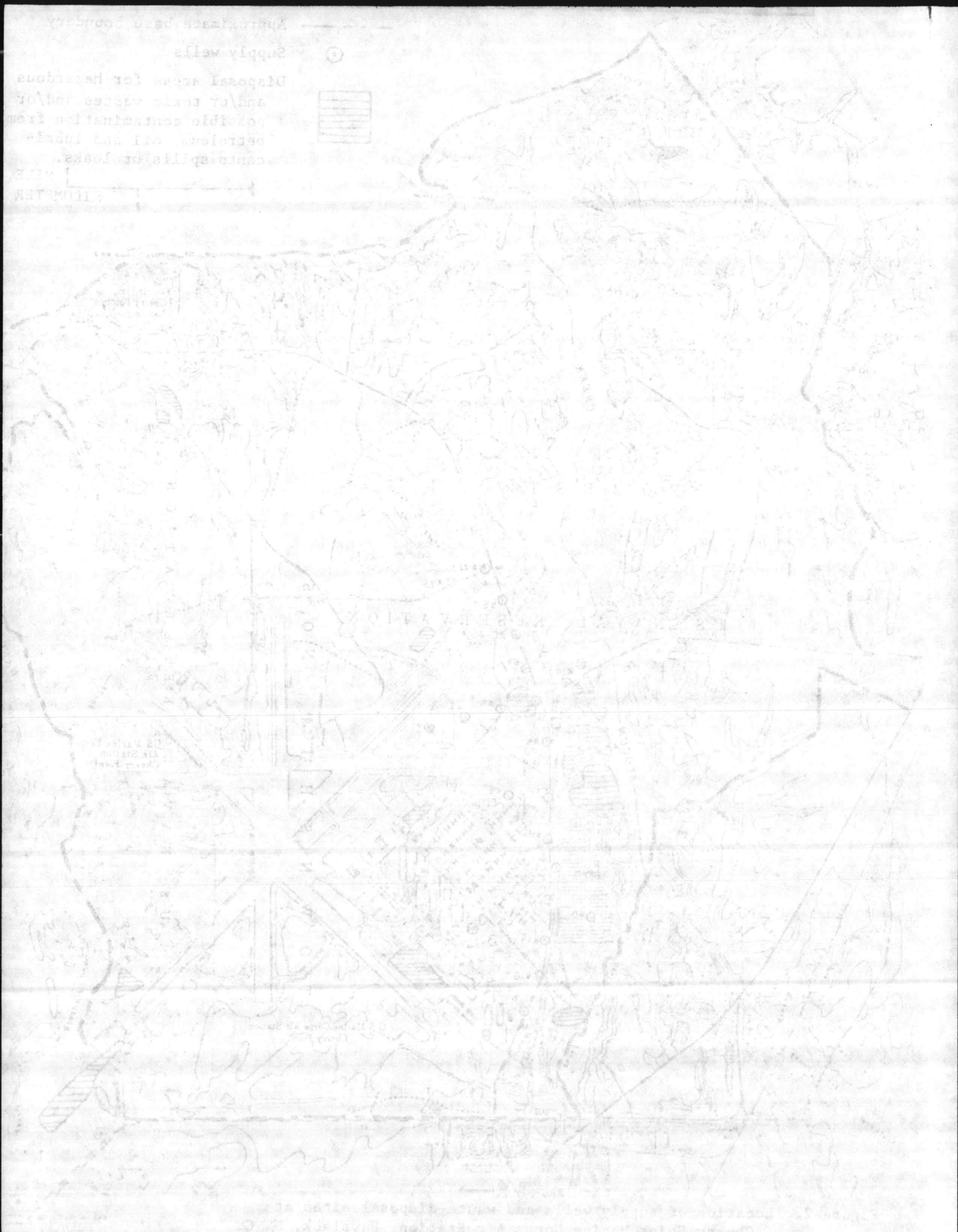


Figure 2. Location of supply wells and waste-disposal sites at Cherry Point Marine Corps Air Station, Havelock, N. C.



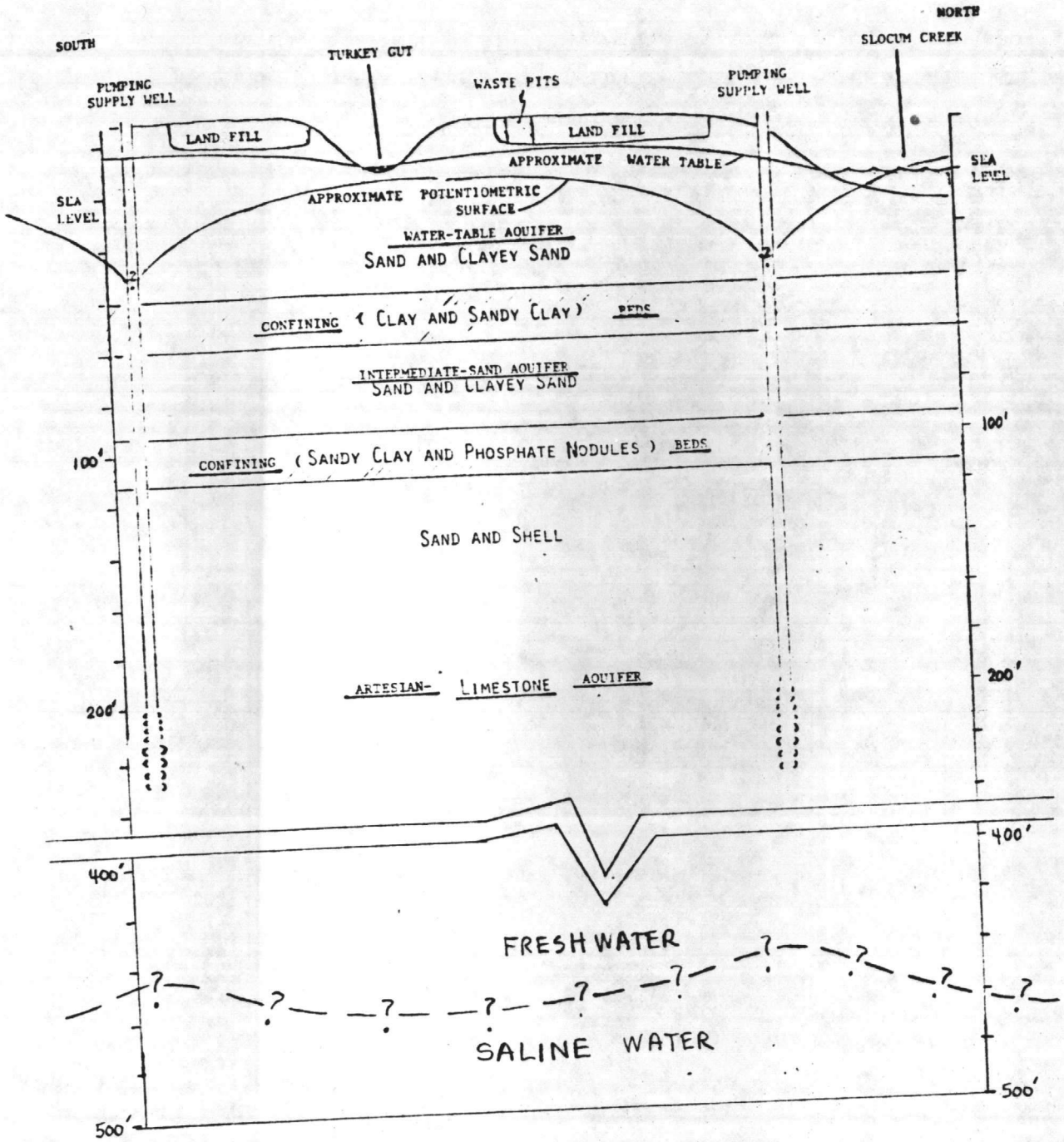
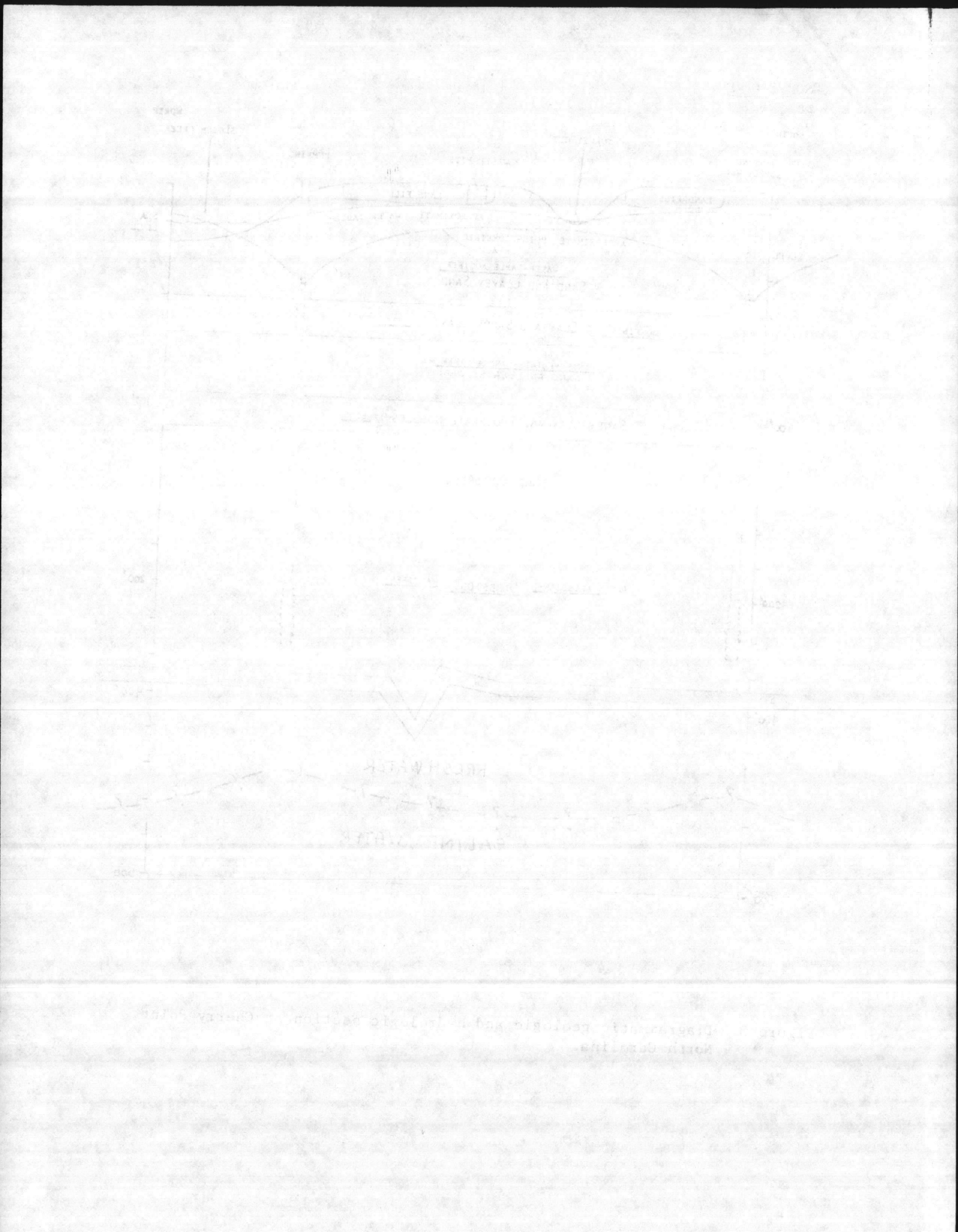


Figure 3. Diagrammatic geologic and hydrologic section at Cherry Point, North Carolina.



SCOPE OF PROJECT: The study area includes the Air Station and environs, but particular emphasis will be placed on the western half of the Air Station where the present water-supply wells and the greatest concentration of waste sites occur (fig. 2). Study elements will include determining the present quality (with appropriate emphasis on the hazardous and toxic wastes) of the ground water from wells that tap the artesian-limestone (water-supply) aquifer, the water-table aquifer, and the intermediate-sandy aquifer (fig. 3). Potential contamination of the water-supply aquifer by toxic and hazardous waste will be evaluated by determining the hydraulic potential for downward movement of contaminated water from the water-table to the artesian-limestone aquifer and estimating the amount and rate of movement. In addition, the depth of the freshwater/saline-water interface will be determined and the potential for upward movement of the saline water will be evaluated.

Water-level and water-quality data obtained from more than 50 wells that were drilled during the second phase of the Navy Assessment and Control of Installation Pollutants (NACIP) program at the Air Station, will be used in conjunction with the data to be collected during the proposed USGS study to help define the hydrology and any potential and existing water-quality problems. The wells drilled for the NACIP program range from 25 to 75 feet in depth, and were located adjacent to 14 disposal sites at the Air Station to confirm whether or not the shallow ground water has been contaminated by hazardous and toxic wastes.

Because of the hazardous and toxic wastes disposed at the Air Station, special and expensive well construction procedures and personal safety precautions must be taken during the course of the investigation to protect the on-site workers, the general public, the environment and the water-supply aquifer. These precautions are listed and discussed in the appendix to this proposal.

PROJECT PLANS:

1. Quality of ground water - Water samples will be collected from the individual water-supply wells and other selected wells that may tap the artesian-limestone aquifer; from three temporary observation wells that will be constructed in the intermediate sandy aquifer at locations between the hazardous-waste sites and the existing water-supply wells; from a temporary test well that will be drilled in the artesian-limestone aquifer (possibly in the vicinity of the golf course at the Air Station); and from existing water supply wells. Chemical analyses of the water samples will include determining the concentrations of chloride, heavy metals, cyanides and organic compounds that can be associated with work at the Air Station. The water quality determinations will be made primarily to identify, quantify, and determine the source of chemical constituents in the raw-water supply.

2. Hydraulic potential for ground-water movement - Water level data will be collected on the deep artesian-limestone aquifer, the intermediate artesian-sand aquifer and the water-table aquifer (fig. 3) from existing wells and from the proposed temporary test well and observation wells. Estimates of the water transmitting and storage capabilities of the artesian-limestone aquifer will be used to calculate water-level drawdowns in the limestone aquifer beneath the waste sites. Maps and cross sections of the water-table and potentiometric surfaces will be constructed from the water-level data, and the amount and spacial distribution of the head differences within and between the water-table and artesian aquifers will be determined.

3. Amount and rate of ground-water movement - Geophysical logs of open and available observation wells will be used to estimate the thickness and areal extent of the confining beds that separate the aquifers. From and in conjunction with this data, about three core holes will be located and drilled through the confining bed materials and the core samples will be tested in the laboratory for vertical hydraulic conductivity. Careful siting and special construction methods will be used to nullify the possible spread of contamination during the coring operations. In addition, these holes will be plugged with cement when sample collection and observations have been completed. The vertical conductivity data and the other hydrologic and geologic data collected will be used to construct a finite-difference digital model of the hydrologic system that in turn will be used to compute estimates of the amount and rate of water moving into the artesian water-supply aquifer. This model will be used to evaluate alternative ground-water use and management practices that will help reduce the chances for contamination of the water-supply aquifer.

RELATION TO LONG-RANGE PLAN: This study relates directly to the North Carolina District's long-range plan (dated May 12, 1980) involving deterioration of ground-water quality due to waste-disposal and land-use practices.

RELATION TO STATE AND WRD PROGRAMS: Several State agencies are involved in study or regulating waste-disposal and land-use practices. The Division of Environmental Management is looking at the Air Station's waste sites to determine the degree to which Slocum Creek may be contaminated by waste leachate. The Department of Human Resources, having adopted EPA Hazardous Waste-Site Regulations, is interested in the ground-water contamination and monitor-well programs everywhere in the State.

Ground-water contamination studies, including those involving waste disposal, are of high national priority FY 85 for the Geological Survey.

STUDY BENEFITS: Results of this study will provide information for operating and protecting the water-supply system and to help insure safe drinking water at the Air Station. In addition, the results should provide data that will lead to a better understanding of the movement of various types of contaminants in Coastal Plain sediments in humid regions.

REPORTS: A report will be written for the USMC describing the results of each completed phase of the investigation (see TIME FRAME for phase descriptions). The completion of all three phases of the study will result in an interpretive report entitled, "Ground-water supply and potential for contamination - Cherry Point Marine Corps Air Station, North Carolina." Additional reports may be written on various technical aspects of the investigation. Written progress reports on the study will be prepared and submitted quarterly.

TIME FRAME: The study is divided into three phases and is proposed to begin October 1, 1985 and end September 30, 1989. Because of the large expense of special well-drilling procedures and personal safety precautions, the middle phase has been extended over a two-year period. A brief discussion of the work tasks and the time frame for each of the phases follows:

Phase 1 (Fiscal Year 1986) - Appraise the quality of water in the deep, limestone, water-supply aquifer, and the hydrogeology, distribution of hydraulic head and configuration of the potentiometric surface in the deep, water-supply aquifer, and the shallow water-table aquifer, primarily with EXISTING WELLS.

Phase 2 (Fiscal Years 1987 and 1988) - Collect additional hydrogeologic and chemical data needed to determine and verify the hydraulic and chemical characteristics of aquifer and confining-bed materials and the fluids, respectively, that overlie and occur within the deep, limestone, water-supply aquifer, primarily with NEW TEST-WELL DRILLING.

Phase 3 (Fiscal Year 1989) - Construct a finite-difference model of ground-water flow through the aquifer and confining-bed materials in the Air Station area to determine alternative grond-water use and management practices that will reduce the chances for contamination of the water-supply aquifer in the Air Station area, primarily with DATA FROM PHASES 1 and 2.

MANPOWER: Manpower required to complete the study are summarized below, as follows:

Project chief:	Hydrologist,	GS-1315-12/13	Full time
Project staff:	Hydrologist,	GS-1315-7/9	Part time
	Hydrologic technician,	GS-1315-7/9	Part time

COSTS: Estimated costs for each phase of the project are summarized below:

Phase 1 (FISCAL YEAR 1986)

Geophysical logging	$ 25,000
Laboratory services	43,000
Data collection, analysis, interpretation and report preparation	50,000
Fiscal Year 1986 Subtotal	$118,000

Phase 2 (FISCAL YEARS 1987 and 1988)

Construction and equipment		
Well drilling, construction, sampling and testing		110,000
Safety equipment		
Air monitoring instruments		9,500
Personal protection respirators and clothing		7,500
Water Sampling equipment		3,000
Geophysical logging		10,000
Laboratory services		20,000
Data collection, analysis, interpretation and report preparation		114,000
Fiscal year 1987 and 1988 Subtotal		$274,000
FY 1987	137,000	
FY 1988	137,000	

Phase 3 (Fiscal Year 1989)

Computer time and support personnel	29,000
Data preparation, analysis, interpratation and report preparation	79,000
Fiscal Year 1989 Subtotal	$108,000

COST SUMMARY

U.S. Marine Corps Funds

Phase 1 (FY 1986)	118,000
Phase 2 (FY 1987)	137,000
Phase 2 (FY 1988)	137,000
Phase 3 (FY 1989)	108,000
GRAND TOTAL	$500,000

Estimated costs for each phase of the project are summarized below:

Phase 1 (FISCAL YEAR 1986)

Laboratory services . . . . . $ 43,000

Data collection, analysis, interpretation and report preparation. 0,000

Fiscal Year 1986 Subtotal $114,000

Phase 2 (FISCAL YEARS 1987 and 1988)

Air monitoring instruments . . . . . $ 9,500

Water sample equipment 3,000

Trucks 2,500

Data collection, analysis, interpretation and report preparation 114,000

Fiscal Years 1987 and 1988 Subtotal $ 274,000

FY 1987 137,000

FY 1988 137,000

Phase 3: (Fiscal Year 1989)

Computer time and support personnel 29,000

Data preparation, analysis, interpretation and report preparation. . . 74,000

Fiscal Year 1989 Subtotal $103,000

COST SUMMARY

A.S. Marine Corps Funds

Phase 1 (FY 1986). . . . . $ 114,000

Phase 2 (FY 1987). 137,000

Phase 2 (FY 1988). 137,000

Phase 3 (FY 1989). 103,000

GRAND TOTAL $490,000

APPENDIX
(Safety Precautions and Drilling Procedures)

Special considerations:

These wells will be drilled on a military installation and, to the best of our knowledge, near but not in old hazardous-waste dump sites. Nevertheless, precautions will be taken to protect the contractor and USGS personnel working at the borehole sites and the general public and environment in the event that the drill should accidently unearth some hazardous waste material. These precautions are listed as follows:

1. The air around the drilling rig will be monitored to help maintain proper protection measures. The monitoring will be done by USGS personnel.

2. Some self-contained breathing apparatus (30 minute and 5 minute escape type) and air-purifying respirators (full faced, canister equipped) provided by the USGS will be available at the site. However, a proper fit cannot be assured unless the contractor provides respirator masks that have been approved by the National Institute for Occupational Safety and Health (NIOSH) and fitted to their own pesonnel.

3. Protective clothing--it will be necessary for the contractor to provide protective clothing for their personnel. The following items will be needed for each worker to insure personal protection and safety:

   a. Chemical splash suit (2 piece) made of neoprene (best design includes jacket with nondetachable hood, without fabric-lined neck, and flap covering front buttons or zipper; bib overalls without fly).

   b. Boots, steel toe and shank, made of neoprene or nitrile (also referred to as Bunar-N, milled nitrile, nitrile laytex, NBR, and acrylonitrile) 12 to 14 inches high.

   c. Gloves (2 pair worn at once) inner glove of natural rubber (surgical type) and outer glove made of nitrile, gauntlet about 14 inches long.

   d. Hard hat, and face shield or safety glasses or goggles to protect face and eyes from splashes when full face-mask respirator is not worn.

4. If large amounts of water are to be discharged at the bore hole sites, arrangements will be made to discharge the water into a railroad tank car and run it through the industrial waste treatment plant at the installation. The Hazardous Waste Coordinator at the installation will help determine the necessity for such action, and will arrange for implementation if such action is necessary.

APPENDIX

(Safety Precautions and Drilling Procedures)

Special considerations:

These wells will be drilled on a military installation and, to the best of our knowledge, near but not in old hazardous waste dump sites. Nevertheless, precautions will be taken to protect the contractor and USGS personnel working at the borehole sites and the general public and environment in the event that the drill should accidentally unearth some hazardous waste material. These precautions are listed as follows:

1. The air around the drilling rig will be monitored by a properly protected person. The monitoring will be done by USGS personnel.

2. Those self-contained breathing apparatus (SCBA type) and air-purifying respirators (full faced, canister type) provided by the USGS will be used at the discretion of the driller. However, a driller will not be required to wear the equipment unless the contractor provides the USGS with documentation that the driller has been adjudged medically fit to wear the SCBA or respirator by the National Institute for Occupational Safety and Health (NIOSH) and fitted to their own personnel.

3. Protective clothing will be necessary for the contractor to provide protective clothing for their personnel. The following items will be needed for each worker to insure personal protection and safety:

a. Chemical splash suit (2 piece) made of neoprene (coat & pants includes hood with nonobstructable hood, without fabric-lined neck, and flap covering front buttons overlapping, bib overalls without fly).

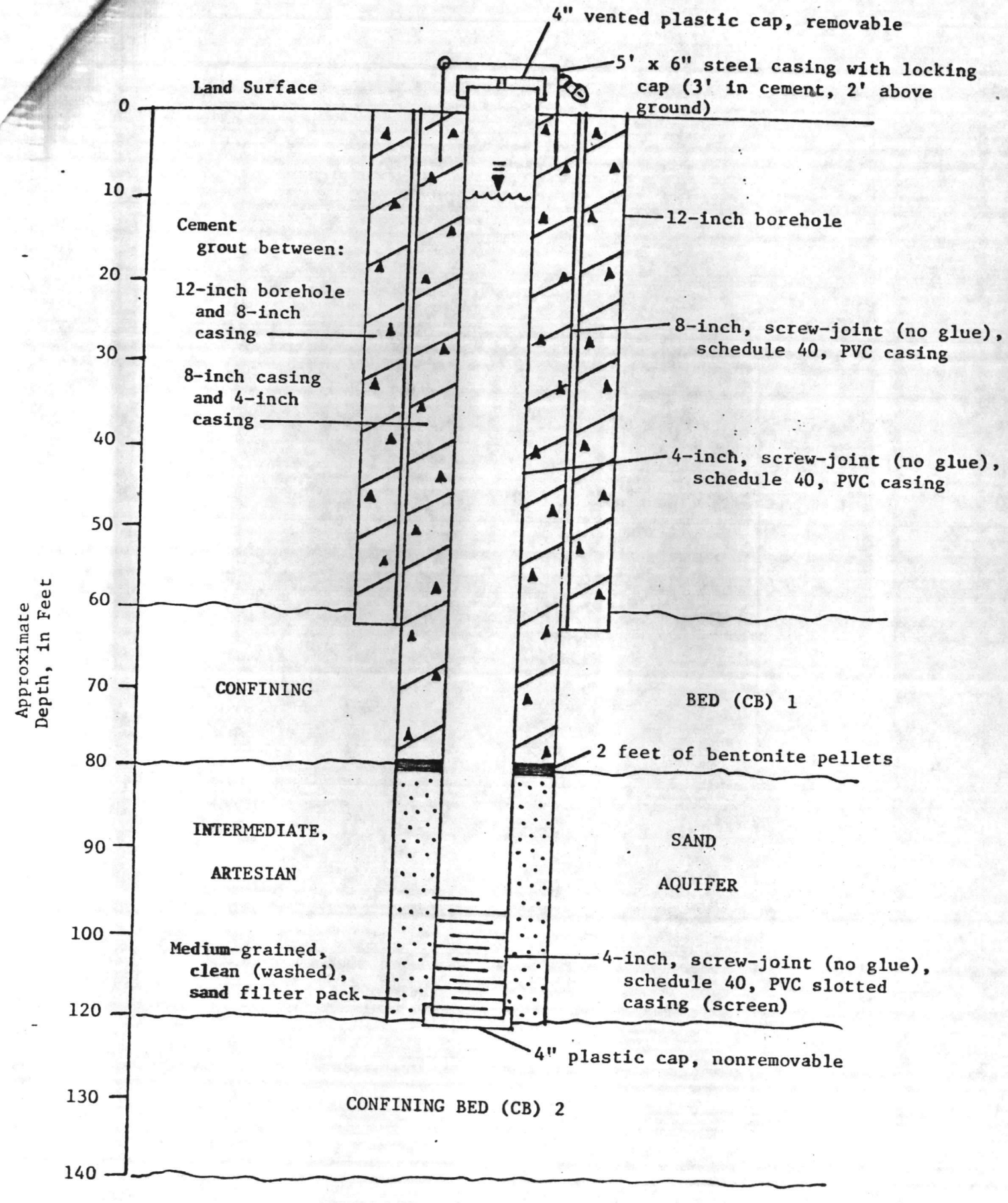
b. Boots, rubber toe and shank, made of neoprene or nitrile (also referred to as Buna-N, milled nitrile, nitrile Hypex, NBR, and acrylonitrile) 12 to 14 inches high.

c. Gloves (2 pair worn at once) inner glove of natural rubber latex type and outer glove made of nitrile (count at about 14 inches long).

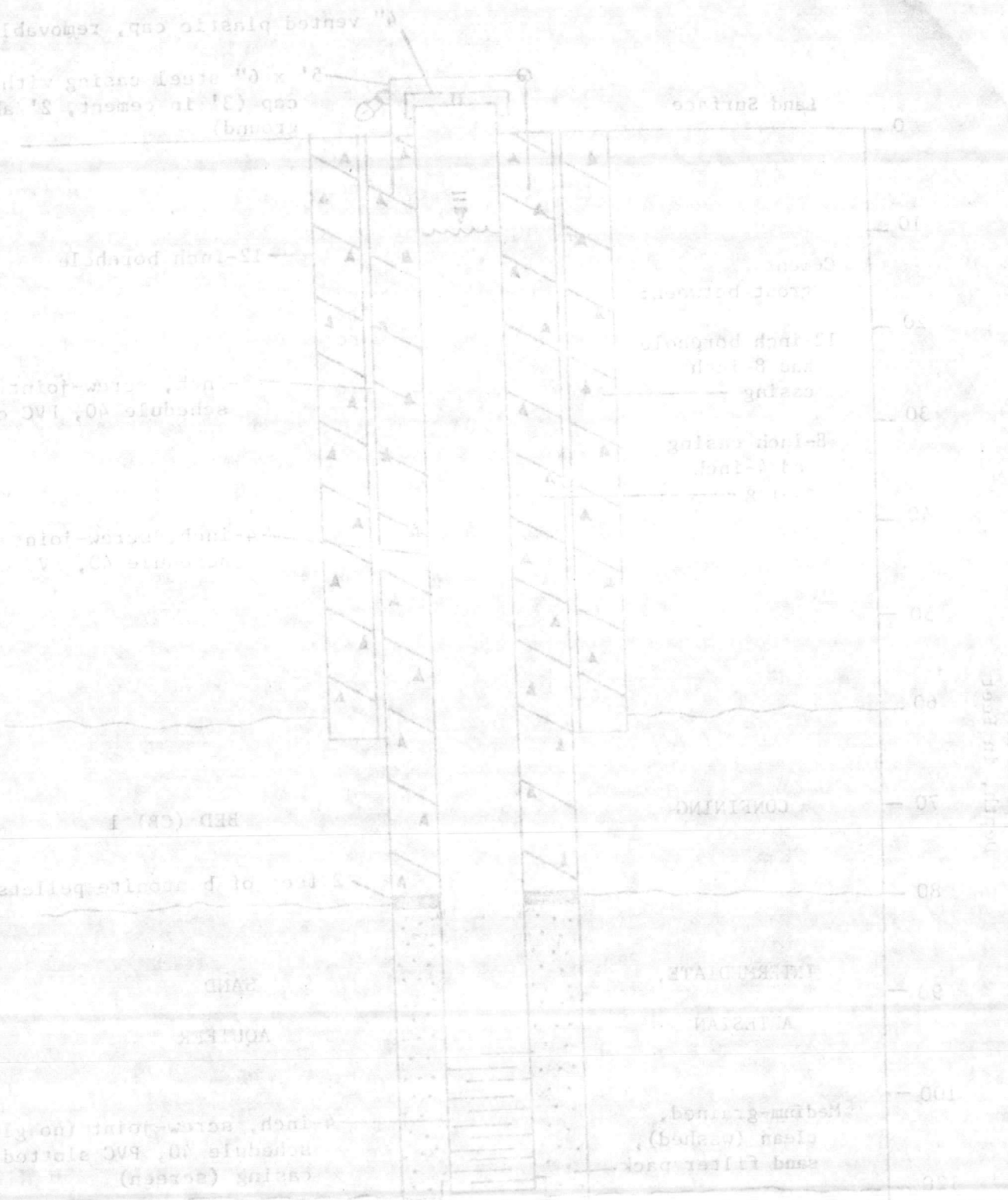
d. Hard hat, and face shield or safety glasses or goggles to protect face and eyes from splashes when full face-mask respirator is not worn.

e. If liquid wastes or water are to be discharged as the borehole site, arrangements will be made to discharge the water into a railroad tank car and run it through the industrial waste treatment plant at the installation. The Hazardous Waste Coordinator at the installation will help determine the necessity for decontamination, and will arrange for implementation of such action is necessary.

DEEP OBSERVATION WELLS



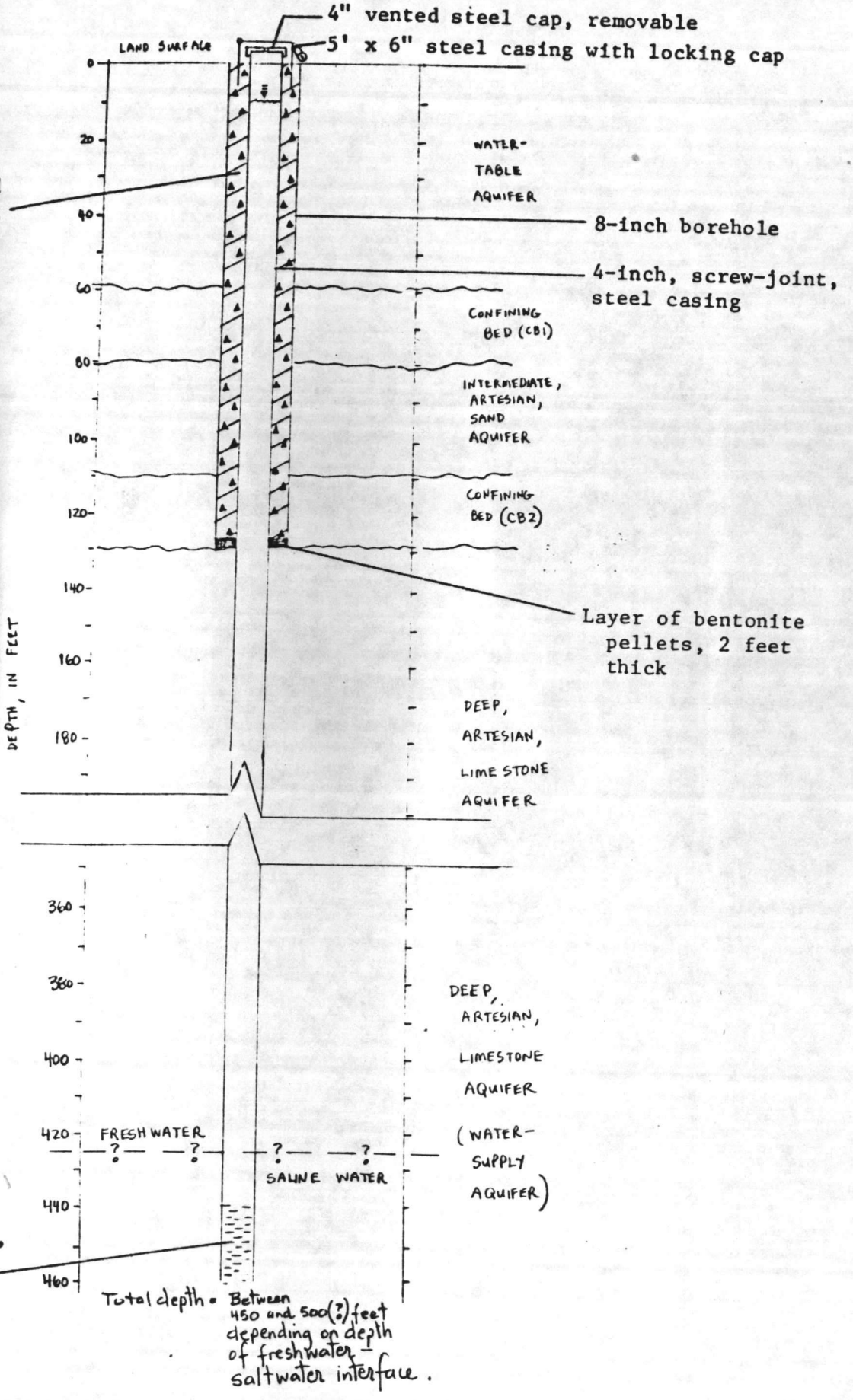
Need three of these wells



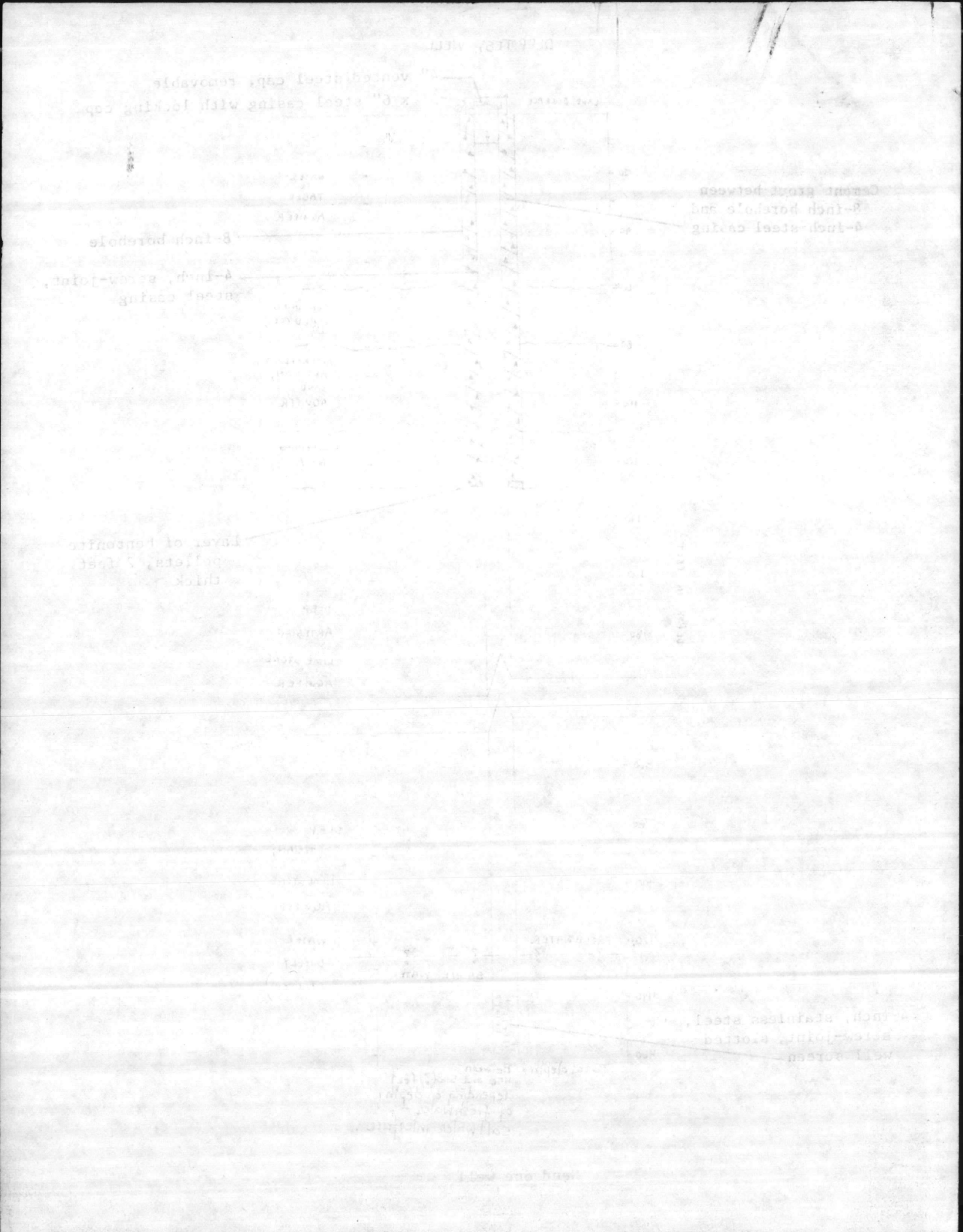
Procedure for construction of deep observation wells

1. 60' split-spoon sampling (about one sample every 5 feet).
2. 60' x 12" borehole.
3. 62' x 8" schedule 40, screw-joint (no glue) PVC casing.
4. Place grout between 12" borehole and 8" casing (centered).
5. Change mud, clean rig plumbing and puming system by pumping detergent and rinse water through rig with its own mud pumps, and steam clean split spoon and drilling stem and rods inside and out.
6. 1 Shelby-tube sample from about 60 to 62 feet.
7. 60' split-spoon sampling from about 62 to 122 feet (once about every 5 feet).
8. 60' x 7 5/8" borehole.
9. 1 Shelby-tube sample from about 122 to 124 feet.
10. Swab and clean inside of schedule 40 PVC casing (slotted and unslotted) with strong detergent (Liqui-Nox for example) and rinse with clean water.
11. 15' x 4", schedule 40, screw-joint (no glue) slotted PVC casing.
12. Place slotted and unslotted casing in 7 5/8" borehole and center from bottom to top.
13. Stand by 1 hour for USGS personnel to make gamma-ray log.
14. Set screen (slottted casing) and place clean, washed, medium-grained, quartz sand around screen in annular space between 7 5/8" borehole and 4" casing and pump well until water is clear. Then fill the rest of the annular space with the sand to a depth of about 80 feet below land.
15. Place 2 feet of bentonite pellets above sand filter pack and fill the remainder of the annular space with grout back to land surface.
16. Pump well until water clears.
17. Repeat step 5 above before moving to and/or drililng another well.

DEEP TEST WELL



Need one well



CAMP LEJEUNE (HADNOT POINT WATER SYSTEM), ONSLOW COUNTY

OWNERSHIP:

U.S. Government. Population served by all 9 of the water systems on the base was 34,549 in 1970. The Hadnot Point water system provides almost half of the base's water needs. There are no metered customers; water is provided without charge.

SOURCE:

Thirty-five wells (Nos. 1-3, 6, 8-17, 19-21, 25-27, 32-42, 51-52, M-1 and M-2). See table on following page.

TOTAL USE:

Average use (Mar. 1975 - Feb. 1976), 3.41 Mgal/d, metered; maximum daily (Feb. 1976), 3.89 million gallons, metered.

Average daily water use (Mgal/d), Mar. 1975-Feb. 1976

Mar. 1975--3.65	July 1975--3.50	Nov. 1975--3.51
Apr. 1975--3.00	Aug. 1975--3.37	Dec. 1975--3.52
May 1975 -3.01	Sept. 1975--3.47	Jan. 1976--3.56
June 1975--3.21	Oct. 1975--3.34	Feb. 1976--3.81

INDUSTRIAL USE:

There are industrial-type operations on the base, but water use is not metered.

TREATMENT:

Prechlorination, coagulation with lime, sedimentation, rapid sand filtration, lime process for softening, adjustment of pH with lime, postchlorination, and fluoridation.

RATED CAPACITY OF TREATMENT PLANT:

5.0 Mgal/d.

PUMPING CAPACITY:

Raw water, 5.5 Mgal/d; finished water, 4.6 Mgal/d.

RAW-WATER STORAGE:

One ground-storage tank, 500,000 gallons.

Source: Public Water Supplies in N.C., Part II, Southern Coastal Plains, U.S. Geological Survey, July 79 by Robison & Mann.

Well data for Camp Lejeune (Hadnot Point), Onslow County

Well No.	Bldg. No.	USGS No.	Latitude	Longitude	Driller	Date drilled	Total depth (ft)	Diam. (in)	Cased to (ft)	Type of finish	Screened intervals (ft)	Altitude of land surface (ft)	Static water level below land surface(ft)	Well yield (gal/min)	Pump capacity (gal/min)	Remarks
✓ 1	601	On-142	34 40 18	077 20 20	Layne Atlantic	9/1941	195	8	45	gravel, screen	45-60 95-100 115-130 175-195	22	9			
✓ 2	602	On-143	34 40 27	077 20 07		1941e	160	8	70	gravel, screen	70-80 100-105 120-125 145-150 155-160	25	13			
3	603	On-144	34 40 10	077 20 32		1941e	195	8	70	gravel, screen	70-80 100-110 130-140 160-170 190-195	22	13			
6	606	On-145	34 39 49	077 19 10	Layne Atlantic	12/1941	210	8	80	gravel, screen	80-90 110-120 140-150 170-180 200-210	20	14.5			
✓ 8	608	On-146	34 39 53	077 20 19	Layne Atlantic	3/1941	161.5	8	61.5	gravel, screen	61.5 - 81.5 91.5 - 101.5 121.5 - 131.5 151.5 - 161.5	27	20			
9	609	On-147	34 39 26	077 18 54		1942e	150	8	65	gravel,	65-80 100-110 130-150	19	17.3			

e - estimated

Well data for Camp Lejeune (Hadnot Point), Onslow County--continued

Well No.	Bldg. No.	USGS No.	Latitude	Longitude	Driller	Date drilled	Total depth (ft)	Diam. (in)	Cased to (ft)	Type of finish	Screened intervals (ft)	Altitude of land surface (ft)	Static water level below land surface(ft)	Well yield (gal/min)	Pump capacity (gal/min)	Remarks
10	610	On-148	35 41 12	077 19 54	Layne Atlantic	4/1942	190	8	60	gravel, screen	60-70 90-110 130-140 180-190	20	16			
11	611	On-149	35 42 09	077 21 07	Layne Atlantic	6/1942	161	8	61	gravel, screen	61-71 91-101 121-136 156-161	31	15.5			
12	612	On-150	34 42 26	077 20 48	Layne Atlantic	6/1942	190	8	60	gravel, screen	60-70 90-95 115-120 140-145 155-160 170-175 185-190	31	16.85			
13	613	On-151	34 42 29	077 20 20	Layne Atlantic	5/1942	150	8	60	gravel, screen	60-70 90-95 115-120 130-135 145-150	21	12			
14	614	On-152	34 42 37	077 21 21								32				No data
15	615	On-153	34 42 45	077 21 02	Layne Atlantic	6/1942	158	8	58	gravel, screen	58-68 88-98 108-128 148-158	32	16			
16	616	On-154	34 42 47	077 20 28	Layne Atlantic	7/1942	170	8	95	gravel, screen	95-115 130-140 160-170	32	20			

Well data for Camp Lejeune (Hadnot Point), Onslow County--continued

Well No.	Bldg. No.	USGS No.	Latitude	Longitude	Driller	Date drilled	Total depth (ft)	Diam. (in)	Cased to (ft)	Type of finish	Screened intervals (ft)	Altitude of land surface (ft)	Static water level below land surface(ft)	Well yield (gal/min)	Pump capacity (gal/min)	Remarks
17	617	On-155	34 42 28	077 19 49								32				No data
19	619	On-156	34 42 08	077 19 25								30				No data
20	620	On-157	34 42 30	077 18 52	Layne ? Atlantic	9/1944e	54	18	46 1/3	open, end		35	21			
21	621	On-158	34 42 53	077 19 16	Layne Atlantic	10/1942	77	8	57	gravel, screen	57-77	41	20			
25	625	On-159	34 39 08	077 19 05								35				No data
26	626	On-160	34 39 04	077 18 38			159	8	58	screen	58-63 82-92 108-123 129-139 144-154 154-159	30	16			
27	627	On-161	34 38 37	077 18 19			158	8	65	screen	65-75 92-102 117-122 133-158	30	18.3			
32	632	On-162	34 37 11	077 17 36		1957						35	10			
33	633	On-163	34 41 58	077 20 06		1959	205	8	55	screen	55-65 75-80 95-105 123-133 138-143 158-168 178-183 195-205	25				

e - estimated

Well data for Camp Lejeune (Hadnot Point), Onslow County--continued

Well No.	Bldg. No.	USGS No.	Latitude	Longitude	Driller	Date drilled	Total depth (ft)	Diam. (in)	Cased to (ft)	Type of finish	Screened intervals (ft)	Altitude of land surface (ft)	Static water level below land surface(ft)	Well yield (gal/min)	Pump capacity (gal/min)	Remarks
34	634	On-164	34 40 30	077 19 35		1959e	225	8	65	gravel, screen	65-70 73-78 83-88 93-98 107-117 124-129 135-140 153-163 170-175 195-200 215-225	30	14			
35	635	On-165	34 40 55	077 19 33		1959e	215	8	65	gravel, screen	65-75 93-108 122-127 136-146 150-155 170-175 185-190 210-215	16	15			
36	636	On-166	34 41 19	077 19 29		1959e	227	8	90	gravel, screen	90-100 115-120 130-135 140-150 158-163 170-175 185-190 200-210 222-227	29	13			

e - estimated

e - estimated

Well data for Camp Lejeune (Hadnot Point), Onslow County--continued

Well No.	Bldg. No.	USGS No.	Latitude	Longitude	Driller	Date drilled	Total depth (ft)	Diam. (in)	Cased to (ft)	Type of finish	Screened intervals (ft)	Altitude of land surface (ft)	Static water level below land surface(ft)	Well yield (gal/min)	Pump capacity (gal/min)	Remarks
37	637	On-167	34 40 39	077 19 54	Hartsfield	1969	172	8	90	gravel, screen	90-98 102-114 120-128 140-148 156-172	26	35	150	150	
38	638	On-168	34 39 12	077 19 43	Hartsfield	1969	196	8	106	gravel, screen	106-114 126-134 150-158 162-170 176-184 188-196	26	19.5	200	180	
39	639	On-169	34 38 05	077 18 00	Hartsfield	1969	176	8	62	gravel, screen	62-70 85-93 120-132 136-148 155-163 168-176	23	4	180	180	
40	640	On-170	34 37 38	077 17 46	Hartsfield	1969	176	8	64	gravel, screen	64-72 76-80 92-100 112-120 130-134 140-148 157-165 172-176	30	9.5	298	290	
41	641	On-171	34 42 29	077 19 22								32				No data
42	642	On-172	34 40 10	077 19 24								30				No data

Well data for Camp Lejeune (Hadnot Point), Onslow County--continued

Well No.	Bldg. No.	USGS No.	Latitude	Longitude	Driller	Date drilled	Total depth (ft)	Diam. (in)	Cased to (ft)	Type of finish	Screened intervals (ft)	Altitude of land surface (ft)	Static water level below land surface(ft)	Well yield (gal/min)	Pump capacity (gal/min)	Remarks
51	651	On-173	34 41 41	077 19 27								31				No data
52	652	On-174	34 40 19	077 18 47								30				No data
M-1	LCH 4007	On-176	34 43 11	077 19 53	Layne Atlantic	1946e	145.2	8	49.5	screen	49.5-59.5 69-99 120-130 140-145	41	23.7			
M-2	LCH 4006	On-175	34 43 27	077 20 17	Layne Atlantic	1941e	125	8	25	screen	25-40 60-70 75-95 115-125	33	16			

e - estimated

Note: All the wells are located in a flat area, have turbine pumps, and are completed in the limestone aquifer. A few wells may also tap the upper sandy aquifer.

CAMP LEJEUNE (HADNOT POINT WATER SYSTEM), ONSLOW COUNTY

FINISHED-WATER STORAGE:

Two clear wells, 75,000 and 2,000,000 gallons; four elevated tanks, 300,000 gallons each.

FUTURE PLANS:

Presently rebuilding filters.

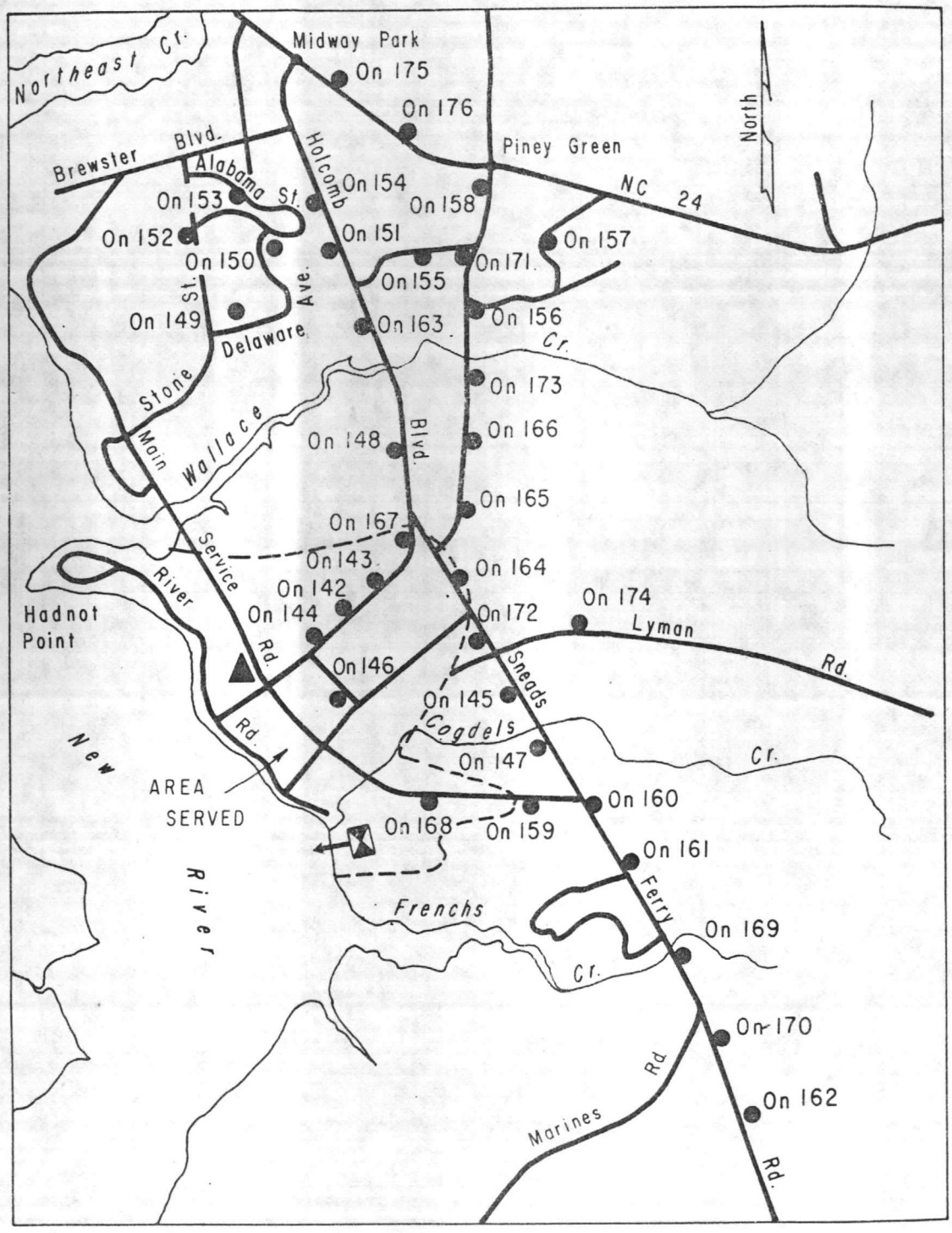
WATER-RESOURCES APPRAISAL:

Surface water: Camp Lejeune occupies much of south-central Onslow County. The topography is flat and, in places, swampy. The camp is bisected by the New River estuary and is drained by tributaries of the estuary. The estuary is always salty except in its upper reaches, where it is variably salty. The tributaries to the estuary are themselves estuarine in their lower reaches and are variably salty. The average stream discharge is 0.9 $(Mgal/d)/mi^2$. The minimum flows on Southwest Creek and Northeast Creek are 0.008 and 0.021 $(Mgal/d)/mi^2$, respectively. Their 7-day, 2-year low flows are 0.046 and 0.08 $(Mgal/d)/mi^2$, respectively. No surface water supply adequate for the camp's water needs is in the immediate vicinity of the camp.

Ground water: Camp Lejeune is underlain by moderately permeable sands of the upper sandy aquifer ranging in thickness from 20 feet in the northern part of the camp to 80 feet in the southern part. These deposits are underlain by the very permeable limestone aquifer, which ranges from 350 to 500 feet in thickness. This aquifer is capable of yielding over 2,000 gal/min to wells. However, the threat of vertical or lateral salt-water encroachment, particularly near the New River estuary or the coast line, makes lower yields more prudent. The limestone aquifer is underlain by moderately-permeable sands of the lower sandy aquifer. The lower sandy aquifer is over 1,000 feet thick. Most of this aquifer contains salt water, and any exploitation would require considerable testing.

The water from wells in the camp area is hard and may contain excessive concentrations of iron, hydrogen sulfide, and fluoride.

CAMP LEJEUNE MARINE CORPS BASE
(Hadnot Point Water System)



DDS

United States Department of the Interior

GEOLOGICAL SURVEY

Post Office Box 2857
Raleigh, North Carolina 27602

April 16, 1986

Mr. Robert Alexander
Environmental Engineer
Marine Corps Base
Assistant Chief of Staff Facilities
Camp Lejeune, North Carolina 28542

Dear Mr. Alexander:

We are pleased to send you the enclosed copy of the progress report on "Water-Resources Investigations in North Carolina--January-March 1986." This document describes program status, plans, and changes related to current operations of the U.S. Geological Survey in North Carolina. This report is prepared quarterly and provided to State, local, and Federal agencies with whom we have cooperative programs.

This is an unofficial document of the Geological Survey and is intended only for the internal use of the Survey and cooperating agencies. The report should not be duplicated or released without expressed written consent of the Geological Survey and cooperating agencies.

This copy is sent to you because of your interest in our cooperative programs. If you have questions or need further information, please let me know.

Very truly yours,

James F. Turner
District Chief

Enclosure

JFT/rjd

RECEIVED
21 APR 1986

WATER - RESOURCES INVESTIGATIONS IN NORTH CAROLINA

U.S. GEOLOGICAL SURVEY
QUARTERLY PROGRESS REPORT
JANUARY - MARCH 1986

MARCH 1986
RALEIGH, NORTH CAROLINA

WATER - RESOURCES INVESTIGATIONS IN NORTH CAROLINA

U.S. GEOLOGICAL SURVEY
QUARTERLY PROGRESS REPORT

Cooperating Agencies

North Carolina Department of Natural Resources
and Community Development
North Carolina Department of Human Resources
North Carolina Department of Transportation

Greene County
Guilford County
Jones County
Mecklenburg County
Onslow County
City of Charlotte
City of Durham
City of Greensboro
City of Kinston
City of New Bern
City of Raleigh
City of Rocky Mount
City of Jacksonville
Greenville Utilities Commission
Town of Ayden
Town of Farmville
Town of LaGrange
Town of Pinetops
Town of Snow Hill
Town of Stantonsburg

Environmental Protection Agency
Federal Emergency Management Agency
Federal Energy Regulatory Commission
Tennessee Valley Authority
U. S. Army Corps of Engineers
U. S. Soil Conservation Service

Raleigh, North Carolina

PREFACE

This is an unofficial publication of the U. S. Geological Survey. Information provided herein is for the internal use of the Survey and cooperating agencies. This document should not be duplicated or released in any form without expressed written consent of the Survey and cooperating agencies.

For additional information write to:

District Chief
U. S. Geological Survey
Post Office Box 2857
Raleigh, North Carolina 27602

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INTRODUCTION

The U. S. Geological Survey conducts a variety of water-resources investigations in North Carolina in cooperation with the North Carolina Department of Natural Resources and Community Development (NRCD) and other State, local, and Federal agencies. These activities include hydrologic records and hydrologic studies. This document summarizes progress on all water-resources investigations and activities conducted by the U. S. Geological Survey in North Carolina during the period January through March 1986. Program summaries, such as this, are prepared each quarter and provided to cooperating agencies to keep them informed of current status of on-going investigations.

HYDROLOGIC RECORDS

Hydrologic records activities include the routine collection and processing of data from streamflow, ground-water, water-quality, and sediment stations located across the State. Data for these stations are processed, analyzed, and stored in the National WATSTORE data base of the Survey located at Reston, Virginia, and are available on request. Data for selected stations are published as part of an annual report entitled, "Water-Resources Data for North Carolina," and in other formal publications of the Survey.

This section of the report summarizes water-resources conditions across North Carolina, progress on hydrologic records investigations and activities, and the number of gaging stations by source of funding.

Water-Resources Conditions

Streamflow for the quarter was below normal (in the lowest 25 percent of record) across the State. Monthly flows were at minimum levels which, on the average, occurs only once every 2 to 5 years during these months. Cumulative monthly runoff for the first half of the water year, October 1985 through March 1986, was also in the lowest 25 percent of record across the State, except in the eastern Piedmont where it was normal.

Monthly mean flows for selected stations, as compared to the median monthly flows for the 30-year reference period (1951-80), were as follows:

	January	February	March
French Broad River at Asheville (Blue Ridge)	0.51	0.49	0.56
South Yadkin River near Mocksville (Piedmont)	0.44	0.44	0.57
Contentnea Creek at Hookerton (Coastal Plain)	0.25	0.28	0.30

Ground-water levels in unconfined aquifers generally remained slightly above long-term averages in the Blue Ridge and Piedmont and slightly below long-term averages in the Coastal Plain.

SURFACE WATER

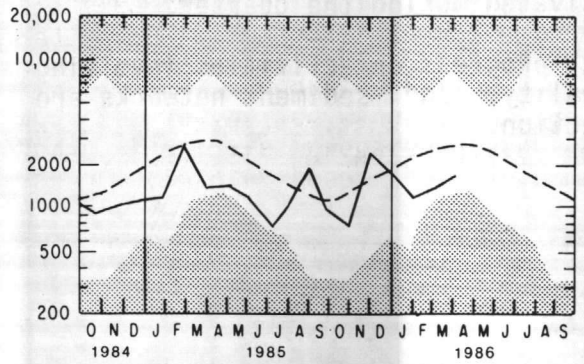
MONTHLY MEAN DISCHARGE IN KEY STREAMS

UNSHADED AREA INDICATES RANGE BETWEEN HIGHEST AND LOWEST RECORD FOR THE MONTH

DASHED LINE INDICATES MEDIAN OF MONTHLY STREAMFLOW IN PREVIOUS YEARS

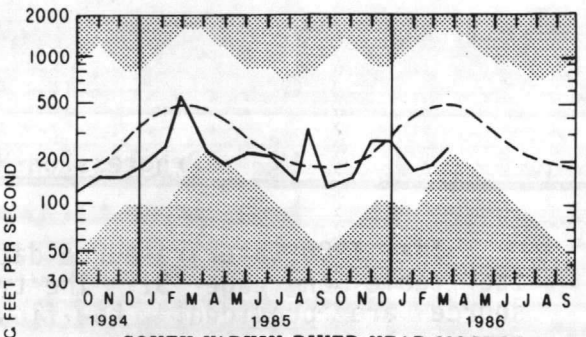
HEAVY LINE INDICATES MEAN FOR CURRENT PERIOD

BLUE RIDGE



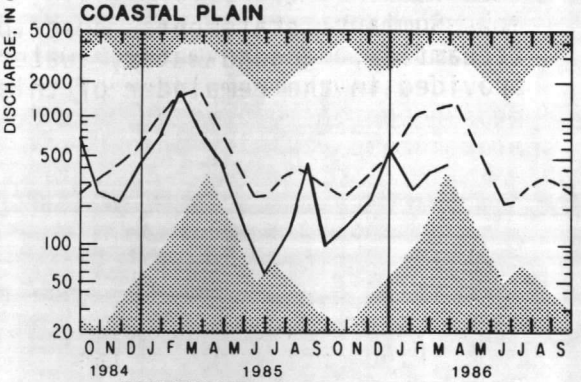
1 **FRENCH BROAD RIVER AT ASHEVILLE**
Records begin 1895

PIEDMONT

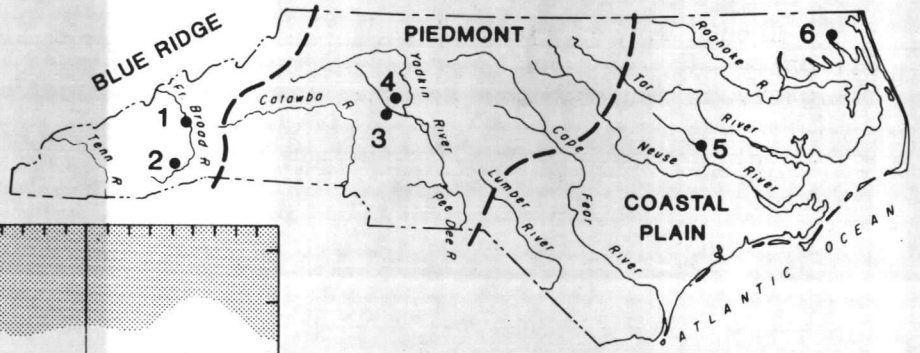


3 **SOUTH YADKIN RIVER NEAR MOCKSVILLE**
Records begin 1938

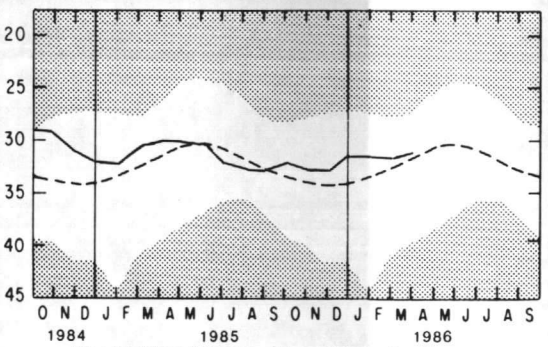
COASTAL PLAIN



5 **CONTENTNEA CREEK AT HOOKERTON**
Records begin 1928



BLUE RIDGE



2 **BLANTYRE WELL - Transylvania County, in granite, 58 ft. deep. Records begin 1932**

GROUND WATER

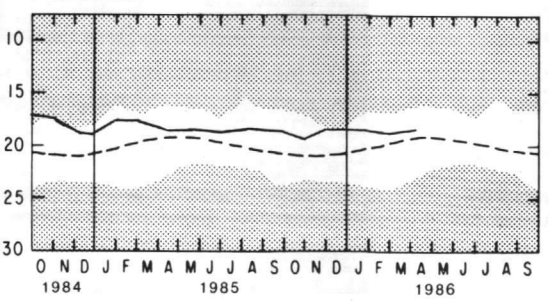
MONTH-END GROUND-WATER LEVELS IN KEY WELLS

UNSHADED AREA INDICATES RANGE BETWEEN HIGHEST AND LOWEST RECORD FOR MONTH-END LEVELS

DASHED LINE INDICATES AVERAGE OF MONTH-END LEVELS IN PREVIOUS YEARS

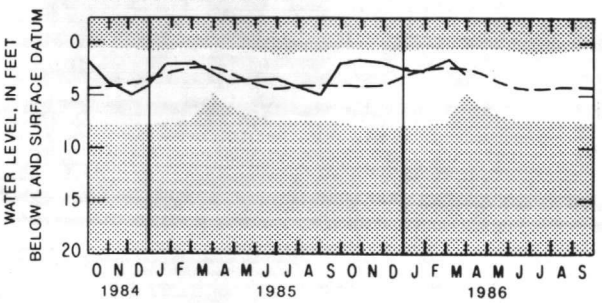
HEAVY LINE INDICATES MONTH-END LEVELS FOR CURRENT PERIOD

PIEDMONT



4 **MOCKSVILLE WELL - Davie County, in granite, 31 ft. deep. Records begin 1931**

COASTAL PLAIN



6 **ELIZABETH CITY WELL - Pasquotank County, in sand, 10 ft. deep. Records begin 1936**

Progress on Network Activities

The 1985 water-resource data-collection program is summarized in the table on page 5. The type and number of stations and funding source are provided. Low-flow partial-record stations that had previously been suspended were reactivated during the quarter.

Summary statements describing progress on activities involving streamflow, ground-water, water-quality, and sediment networks are provided in the remainder of this section.

SUMMARY OF WATER RESOURCES DATA COLLECTION PROGRAM FOR NORTH CAROLINA, 1985

Numbers of Stations by Funding Source

	Federal Noncooperative				Cooperative (USGS Matched)										Partial Support			Changes During Qtr.	
					State			Municipal					County						
	USGS	TVA	COE	USDA SCS	NRCD	DHR	DOT	Char-lotte	Dur-ham	Greens-boro	Rocky Mount	Raleigh	Guilford	Corporate thru NRCD	State (Matched)	Federal Agencies (Unmatched)	Licensees of FERC	Add	Disc.
SURFACE WATER CONTINUOUS RECORD STATIONS	4	3	25	2	61	2	5	8	3	2	2	4	4	16	24	30	6	**** 10	*** 1
SURFACE WATER PARTIAL RECORD STATIONS			4	2	105	1			1	** 6				7				** 6	
GROUND WATER OBSERVATION WELLS	2			8	44	47							18	1					
WATER QUALITY STATIONS	16		11	4	8	5		* 53					4					**** 6	*** 1

TVA - Tennessee Valley Authority
COE - U. S. Army Corps of Engineers
SCS - U. S. Soil Conservation Service
NRCD - North Carolina Department of Natural Resources and Community Development
DHR - North Carolina Department of Human Resources
DOT - North Carolina Department of Transportation
FERC - Federal Energy Regulatory Commission
USGS - U. S. Geological Survey

* 37 Ground-water stations, 16 Surface-water stations
** Greensboro project
*** 0208705200 Smith Creek at Grissom

**** 0209782150 New Hope River near Farrington
**** 0209257120 W.P. Brice Creek near Riverdale
**** 0210797940 Limeston Creek at Hadley
**** 0205356401 Chinkapin Creek Trib near Harrellsville
**** 0213024165 Shaw Creek near White store
**** 0210108450 Suck Creek Trib near Zion Grove
**** 0208732810 Marsh Creek at Millbrook
**** 0208721055 Perry Creek near Millbrook
**** 0209509100 S. Buffalo Creek at Mcleansville
**** 0209560800 Reedy Fork near Ossipee

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INVESTIGATION NC 00-001: Streamflow Network in North Carolina

PERIOD OF INVESTIGATION: 1927 - continuing

INVESTIGATION CHIEF: N. M. Jackson, Jr.

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD), U. S. Army Corps of Engineers, and others

OBJECTIVE: The overall objective of this investigation is to collect, analyze, and publish a statewide inventory of streamflow records for North Carolina. The data are required in the evaluation, planning, development, and management of surface-water resources of the State. Specific uses of the data include: (1) assessment of water resources; (2) operation of reservoirs or industries; (3) forecasting; (4) disposal of wastes and pollution control; (5) discharge data to accompany water-quality measurements; (6) compact and legal requirements; and (7) research of special studies. Data for analytical studies define statistical properties and trends in the occurrence of water in streams, lakes, estuaries, etc. for use in the planning and design.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Processing of 1985 water year records and preparation of the 1985 water-resources data report is near completion. Estimated completion date (shipped to printer) is April 18.

Changes in the gaging-station network are as follows:

1. Two rainfall-runoff stations for use by the City of Raleigh were constructed and placed in operation:
   0208732810 - Marsh Creek at Millbrook
   0208721055 - Perry Creek near Millbrook

2. A new station, Dan River near Pine Hall, was constructed and put into operation April 4.

3. Roanoke River near Oak City - design and construction are still on hold. High flows have prevented collection of design data, and construction may be delayed due to flow released for fish spawning.

4. Creeping Swamp near Vanceboro was discontinued. A new station will be built to replace this station in the network. Site selection is on hold pending a joint meeting with NRCD to review and adjust the statewide network of stations.

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Additional gaging stations were installed for projects NC 00-003 Water-Quality Network in North Carolina and for a new water-quality project in Greensboro.

PLANS FOR NEXT QUARTER:

1. Complete Dan River at Pine Hall.
2. Design and construct, if flows permit, gage on Roanoke River at Oak City.
3. See to the printing and distribution of the annual Water-Resources Data Report.
4. Bring computations of 1986 water-resources data up-to-date.
5. A meeting with NRCD is scheduled to discuss a limited re-design of the gaging station network in the USGS-NRCD cooperative program. Stations that have met their objective will be discontinued and new stations to meet changing needs will be established.

REPORT STATUS: Records collected as part of this program are published in the annual data report, "Water-Resources Data for North Carolina, Water Year 19___." The 1985 annual data report is in progress.

PUBLISHED REPORTS:

U. S. Geological Survey, 1984, Water-Resources Data for North Carolina, Water Year 1984: U. S. Geological Survey Water-Data Report NC-84-1. Similar data reports are available for previous water years.

Mason, R. R., and Jackson, N. M. Jr., Cost-effectiveness of the stream-gaging program in North Carolina: U. S. Geological Survey Water-Resources Investigations Report 85-4036.

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PROJECT HIGHLIGHTS:

A. Project stage: Ongoing.
B. Cooperator contacts: Meetings were held with NRCD and other State, local, and Federal agencies to discuss the FY 87 program. Currently, only minor reductions in funding are anticipated.
C. Changes affecting project elements: One station was activated.
D. Problems associated with project: None.
E. Hydrologic data released: Numerous requests for information were answered. The requests included average flows, 7-day, 10-year minimum flows, and statistical summaries of long-term flow data. Approximately 180 requests for low-flow statistics were answered for the Division of Environmental Management. Requests for 310 floodprone area maps were filled.

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INVESTIGATION NC 00-002: Ground-Water Network in North Carolina

PERIOD OF INVESTIGATION: 1943 - continuing

INVESTIGATION CHIEF: R. W. Coble

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD) and others

OBJECTIVE: The objective of this investigation is to collect, analyze, and publish a statewide inventory of water-level records for North Carolina. These data are needed in the evaluation, planning, development, and management of ground-water resources in North Carolina. These records provide a long-term data base for evaluating general response of the hydrologic system to natural climatic variations and induced stresses; known and potential problems can be defined early enough to allow proper planning and management. The data base also includes short-term records acquired in areal studies of: (1) assessment of the ground-water resources; (2) prediction of future conditions; and, (3) resource management.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Preparation of records for publication in the 1985 annual data report is complete; processing of 1986 water-year records for 45 observation wells is current. Preliminary discussions were held concerning selecting wells for the combined USGS and NRCD network in the Coastal Plain province.

PLANS FOR NEXT QUARTER: Continue collection and processing of records for 1986 water year. Updating of the ground-water site inventory (GWSI) files are to begin following the completion of the downloading of data onto the District's Prime computer.

Efforts to combine the USGS and NRCD statewide water-level monitoring networks will continue. R. Coble will work directly with Carl Bailey, Groundwater Section, NRCD, and his staff, to select sites for wells to define climatic effects and to monitor major cones of depression in the Coastal Plain province. Coble and Bailey will meet in early April to make preliminary selection of observation wells in the Coastal Plain.

REPORT STATUS: Records collected as part of this program are published in the annual data report, "Water Resources Data for North Carolina." The 1985 annual data report is in process.

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PUBLISHED REPORTS:

U. S. Geological Survey, 1984, Water-Resources Data for North Carolina, Water Year 1984: U. S. Geological Survey Water-Data Report NC-84-1. Similar data reports are available for previous years.

PROJECT HIGHLIGHTS:

A. Project stage: Ongoing.
B. Cooperator contacts: R. Coble conferred with C. Bailey about plans for combining the NRCD and USGS water-level observation-well networks.
C. Changes affecting project elements: Funding for this fiscal year is greater than funding in the past; this provides opportunities to improve the ground-water program.
D. Problems associated with project: None.
E. Hydrologic data released: Provided data in response to routine requests. All field and laboratory data are available through WATSTORE system.

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INVESTIGATION NC 00-003: Water-Quality Network in North Carolina

PERIOD OF INVESTIGATION: 1943 - continuing

INVESTIGATION CHIEF: C. E. Simmons

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD) and others

OBJECTIVE: The objective of this investigation is to collect, analyze, and publish a statewide inventory of chemical-quality records on streams in North Carolina. The primary emphasis of this investigation is to evaluate development-induced and pristine stream-quality conditions. Variability and long-term trends in levels of selected chemical constituents, and the extent to which these constituent levels are present and have increased in the aquatic environment, are monitored and evaluated. Federal NASQAN and Benchmark and NRCD-supported baseline (pristine) stations comprise the data-collection network of this project.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The collection and processing of samples were performed on a current basis.

Construction of the new pristine sampling network, in cooperation with NRCD, continued and will be completed by early April. Because of military maneuvers from Ft. Bragg into the basin of Flat Creek near Inverness (Hoke County), the site was discontinued from the network (site was mentioned in last quarter's report). Pristine sites where gaging stations are complete and sampling has begun are listed below:

03450000	Beetree Creek near Swannanoa (Buncombe Co.)
02123567	Dutchmans Creek near Uwharrie (Montgomery Co.)
0209782150	New Hope R. Trib. near Farrington (Chatham Co.)
0210108450	Suck Creek Trib. near Zion Grove (Moore Co.)
0209257120	West Prong Brice Crk. near Riverdale (Craven Co.)
0205356401	Chinkapin Crk. Trib. nr. Harrellsville (Hertford)
0210797940	Limestone Crk. at NC 24 Hadley (Duplin Co.)
0213024165	Shaw Crk. near White Store (Anson Co.)

As part of Headquarters' quality assurance efforts, all projects in the District related to water quality were reviewed by technical staff from Reston and Atlanta during March 3-7. Most review comments were positive and projects appear to be on track regarding techniques, approach, etc.

PLANS FOR NEXT QUARTER: Complete selection of remaining two baseline network stations and implement monitoring of streamflow and quality.

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REPORT STATUS: All records collected as part of this program are published in the annual data report, "Water-Resources Data for North Carolina." The 1985 data report is in process.

PUBLISHED REPORTS: Interpretive reports based on data collected as part of this investigation are as follows:

U. S. Geological Survey, 1984, Water Resources Data for North Carolina, Water Year 1984: U. S. Geological Survey Water-Data Report NC 84-1. (Similar data reports are available for previous years.)

Wilder, H. B., and Simmons, C. E., 1978, Program for Evaluating Stream Quality in North Carolina: U. S. Geological Survey Water-Supply Paper 2185-A, 15 p. (Previously published as U. S. Geological Survey Circular 764.)

Simmons, C. E. and Heath, R. C., 1979, Water-Quality Characteristics of Streams in Forested and Rural Areas of North Carolina: U. S. Geological Survey Water-Supply Paper 2185-B, 33 p. (Previously published as U. S. Geological Survey Water Resources Investigations Report 79-108.)

Daniel, C. C., III, Wilder, H. B., and Weiner, M. S.,1982, Water quality of the French Broad River, North Carolina--an analysis of data collected at Marshall, 1958-77: U. S. Geological Survey Water-Supply Paper 2185-C, 28 p. (Previously published as U. S. Geological Survey Water Resources Investigations Report 79-87.)

Harned, D. A., 1982, Water quality of the Neuse River, North Carolina--variability, pollution loads, and long-term trends: U. S. Geological Survey Water-Supply Paper 2185-D, 44 p. (Previously published as U. S. Geological Survey Water Resources Investigations Report 80-36.)

Harned, Douglas, and Meyer, Dann, 1983, Water quality of the Yadkin-Pee Dee River system, North Carolina--variability, pollution loads, and long-term trends: U. S. Geological Survey Water-Supply Paper 2185-E, 71 p. (Previously published as U. S. Geological Survey Open-File Report 81-643.)

Crawford, J. K., 1984, Water-quality characteristics for selected sites on the Cape Fear River, North Carolina, 1955-80--variability, loads, and trends of selected constituents: U. S. Geological Survey Water-Supply Paper 2185-F (in press). (Previously published as U. S. Geological Survey Open-File Report 83-526.)

PROJECT HIGHLIGHTS:

A. Project stage: Ongoing
B. Cooperator contacts: Several phone discussions were held with NRCD during the quarter to discuss progress.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: Data related to this project are on file in District Office and in WATSTORE.

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INVESTIGATION NC 00-004: Index Sediment Station-Yadkin River

PERIOD OF INVESTIGATION: 1943 - continuing

INVESTIGATION CHIEF: C. E. Simmons

COOPERATOR: Federal

OBJECTIVE: The objective of this investigation is to provide a national sediment data base for use by local, State, and Federal agencies in broad planning and action programs and to provide data for management of interstate waters. Sampling station is located on the Yadkin River at Yadkin College.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The collection of daily water samples was continued. Suspended-sediment concentrations were determined for approximately 95 routine samples. Laboratory analyses of concentrations are current.

PLANS FOR NEXT QUARTER: Sampling and laboratory analyses will continue.

REPORT STATUS: Suspended-sediment data collected as part of this project will be published in the annual report, "Water Resources Data for North Carolina." The 1985 data report is in process. The data collected as part of this project are used in conjunction with other projects and preparation of interpretive reports.

PUBLISHED REPORTS:

U. S. Geological Survey, 1984, Water-Resources Data for North Carolina, Water Year 1984: U. S. Geological Survey Water-Data Report NC-84-1. Similar data reports are available for previous water years.

PROJECT HIGHLIGHTS:

A. Project state: Ongoing Federal Index Station.
B. Cooperator contacts: None
C. Changes affecting project elements: None
D. Problems associated with project: None
E. Hydrologic data released: None

HYDROLOGIC STUDIES

Hydrologic investigations conducted by the Geological Survey in North Carolina include topics, such as: water use, impacts of channelization, non-point source pollution, sediment characteristics, water-quality characteristics of streams, sediment effects on stream biology, effects of land use on ground-water quality, ground-water development potential in the Piedmont and Blue Ridge (mountain) provinces, urban hydrology, and ground water in the Coastal Plain aquifer system. Results of these studies are published in a variety of scientific and technical reports, abstracts, and papers. Reports are provided to local cooperating agencies and various libraries and repositories.

Progress on Investigations

Summary statements describing progress on each investigation are provided in this section.

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INVESTIGATION NC 00-003: (Formerly NC 81-072) Effects of Highway Runoff on Receiving Waters

PERIOD OF INVESTIGATION: 1983-84

INVESTIGATION CHIEF: Douglas A. Harned

COOPERATOR: Federal

OBJECTIVE: The objective of this investigation is to evaluate the effects of runoff from a major highway on stream quality of a small basin in the Piedmont province of North Carolina. The hydrologic data were collected under project NC 81-072.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The final report has been revised based on suggestions from colleague reviewers.

PLANS FOR NEXT QUARTER: Submit the report for approval for publication.

REPORT STATUS: The following report has been revised according to suggestions from the colleague reviewers:

Harned, D. A., 1985, Impact of highway runoff on stream quality in the Sevenmile Creek basin near Efland, North Carolina: U. S. Geological Survey Water-Resources Investigations Report (in process).

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

A. Project stage: Investigation complete, except for final report.
B. Cooperator contacts: Federal program - no local cooperators.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: None.

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INVESTIGATION NC 83-005: Effects of Atmospheric Deposition on Water Quality of North Carolina Streams

PERIOD OF INVESTIGATION: 1983-92

INVESTIGATION CHIEF: J. Kent Crawford

COOPERATOR: U. S. Environmental Protection Agency and Federal Research Program--USGS

OBJECTIVE: To determine the extent and severity of acid deposition in the Sandhills area of southeastern North Carolina and the impact of acid deposition on the water quality of area streams.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Routine monitoring at the calibrated watershed site, peripheral stream sites, and at the atmospheric deposition site continued during the quarter. Data received from the November storm samples show decreasing pH and increasing aluminum with increasing discharge. The 1985 annual progress report to the U.S. Environmental Protection Agency (EPA) was drafted as an Open-File Report. Notice was received from the EPA that funding for peripheral stream monitoring is discontinued.

PLANS FOR NEXT QUARTER:

1. Continue stream and precipitation sampling;
2. Finalize the 1985 annual progress report to the Environmental Protection Agency as an Open-File Report; and
3. Transmit data from project to ADDNET data bank at Oak Ridge National Laboratory.

REPORT STATUS: Records collected as part of this study will be published in the annual data report, "Water Resources Data for North Carolina." The annual progress report for EPA is in review; it will be published as an Open-File Report.

PUBLISHED REPORTS: None.

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PROJECT HIGHLIGHTS:

A. Project stage: Data collection and processing.
B Cooperator contacts: Talked by phone with Charles Powers (EPA) about discontinuing EPA-funded portion of the project.
C. Changes affecting project elements: EPA funding for long-term monitoring of Sandhills streams near to Jordan Creek has been withdrawn.
D. Problems associated with project: Low field readings of pH compared to lab readings are still being observed. The use of Orion Ross electrodes and low-ionic strength buffers will be started this quarter in an attempt to correct the problems. Road at Jordan Creek site needs erosion control.
E. Hydrologic data released: None.

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INVESTIGATION NC 00-006: Flood Investigations

PERIOD OF INVESTIGATION: 1984 - continuing

INVESTIGATION CHIEF: N. M. Jackson, Jr.

COOPERATOR: Federal Emergency Management Agency

OBJECTIVE: The National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 provide for the operation of a flood insurance program. The Federal Emergency Management Agency (FEMA) needs flood studies in selected areas for administration of the flood insurance program. The objectives of this project are to conduct the necessary hydrologic and hydraulic evaluations and studies of areas assigned by FEMA and to present the results in an appropriate format.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The Southern Pines and McDowell County reports were approved by the regional office and transmitted to FEMA. Field data collection was completed in Ashe County and Louisburg, and office computations are underway; field data collection in Stokes County and Duplin County is nearing completion, and preliminary office computations have begun. Time and cost-estimate meetings were held with officials of Columbus County and Bladen County to determine study areas in the unincorporated areas of these counties.

PLANS FOR NEXT QUARTER: There are six flood insurance studies to be completed and plans are to complete these next quarter. Field data collection is approximately 80 percent complete, and office computations are approximately 30 percent complete.

REPORT STATUS: The reports, "Flood Insurance Study, Town of Southern Pines, North Carolina" and "Flood Insurance Study, McDowell County, North Carolina," were transmitted to FEMA. Reports for Ashe County, Louisburg, Duplin County, Scotland County, Stokes County, and Jones County are pending.

PUBLISHED REPORTS:

Eddins, W. H., 1978, Flood Insurance Study, City of Charlotte-Mecklenburg County, N. C.: U. S. Geological Survey, HUD Type 15 report.

Jackson, N. M., Jr., 1978, Flood Insurance Study, Town of Blowing Rock, N. C.: U. S. Geological Survey, HUD Type 15 report.

U. S. Geological Survey, 1978, Flood Insurance Study, Town of Boone, N. C.: U. S. Geological Survey, HUD Type 15 report.

PUBLISHED REPORTS, continued:

U. S. Geological Survey, 1978, Flood Insurance Study, Watauga County, N. C.: U. S. Geological Survey, HUD Type 15 report.

REPORTS TRANSMITTED TO FEMA:

U. S. Geological Survey, 1985, Flood Insurance Study, Town of Mars Hill, N. C.: U. S. Geological Survey, FEMA limited-detail-study report.

U. S. Geological Survey, 1986, Flood Insurance Study, Unincorporated Areas of McDowell County, N. C.: U. S. Geological Survey, FEMA limited-detail study report.

U. S. Geological Survey, 1986, Flood Insurance Study City of Southern Pines, N. C.: U. S. Geological Survey, FEMA limited-detail-study report.

PROJECT HIGHLIGHTS:

A. Project stage: Continuing.
B. Cooperator contacts: Discussed time and cost estimates for Columbus and Bladen Counties with Bill Massey. Scope of these studies was expanded at the community meeting and cost estimates are being revised.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: None.

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INVESTIGATION NC 00-007: Water-Use Data Program in North Carolina

PERIOD OF INVESTIGATION: 1978 - continuing

INVESTIGATION CHIEF: M. W. Treece, Jr.

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD)

OBJECTIVE: The water-use program is part of a nationwide program to provide comprehensive water-use data that will serve as a valuable tool for the development and management of water resources. Major categories of water withdrawals include public water supplies and self-supplied industrial, commercial, electric-power generation, irrigation, and other rural uses, mining, and waste-water treatment plant uses. Estimates of the amount of water returned to the environment are also included in the program. The program also includes provisions for evaluating existing methods of determining water use and developing ways of improving accuracy of water-use information.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Continued compilation of site-specific information on major water users in North Carolina and processed these data using the State Water Use Data System (SWUDS) software. Processed all agricultural, industrial, municipal, and power generation water-use information for the Hiwassee and Little Tennessee River basins. Generated special data retrievals for NRCD modelers on agricultural irrigation in the Roanoke and Chowan River basins.

PLANS FOR NEXT QUARTER: Continue to assemble site-specific water-use information from records maintained by NRCD and other State and Federal agencies. Conduct field surveys as needed to collect additional water-use data and enter data into SWUDS.

REPORT STATUS: None in progress at present time.

PUBLISHED REPORTS:

North Carolina Department of Natural Resources and Community Development, 1983, Self Supplied Industrial Water-Use Summary For 1981: Use of Water in North Carolina, 42 p.

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PROJECT HIGHLIGHTS:

A. Project stage: Ongoing.
B. Cooperator contacts: Conversed with NRCD staff almost on a daily basis and exchanged data periodically. Met with Allan Dietemann and Dexter Langley to discuss progress of the project and to examine objectives for FY 1986.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: None.

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INVESTIGATION NC 76-053: Effects of Channelization on the Hydrology of Chicod Creek Watershed, North Carolina

PERIOD OF INVESTIGATION: 1976-87

INVESTIGATION CHIEF: Robert R. Mason

COOPERATOR: U. S. Department of Agriculture, Soil Conservation Service (SCS)

OBJECTIVE: To determine the effects of channel excavation on the hydrology of the Chicod Creek watershed, including streamflow, surface-water quality, and shallow ground-water conditions.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The collection of data to document post-construction conditions continued. Monthly and quarterly stream-quality samples were collected as scheduled.

PLANS FOR NEXT QUARTER: Continue collection and processing of post-construction data. Present summary of post-construction data collected to date to cooperator at a meeting in May or June.

REPORT STATUS: Collection of data for final report is continuing.

PUBLISHED REPORTS:

Simmons, C. E., and Aldridge, M. S., 1980, Hydrology of the Chicod Creek Basin, North Carolina, Prior to Channel Improvement: U. S. Geological Survey Open-File Report 80-680, 27 p.

Watkins, S. A., and Simmons, C. E., 1984, Hydrologic conditions in the Chicod Creek Basin, North Carolina, before and during channel modifications, 1975-81: U. S. Geological Survey Water Resources Investigations Report 84-4025, 36 p.

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PROJECT HIGHLIGHTS:

A. Project Stage: Prior-to- and during-construction phases are complete; second interim report describing findings has been published. Project in final phase of data collection; approximately 1 year of post-construction monitoring remains.
B. Cooperator contacts: None.
C. Changes affecting project elements: Robert Mason assumed duties as project leader replacing Kent Crawford who headed project since early 1985.
D. Problems associated with project: The stream-gaging and sampling operations at Creeping Swamp near Vanceboro (Station 02091970) were discontinued December 31. Chemical sampling accompanied by manual discharge measurements will continue at the 4 Chicod project sites.
E. Hydrologic data released: None.

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INVESTIGATION SR 77-056: Appalachian Basin Waste-Storage Project

PERIOD OF INVESTIGATION: 1977-83

INVESTIGATION CHIEF: O. B. Lloyd, Jr.

COOPERATOR: Federal Research Program - USGS

OBJECTIVE: To determine the presence, thickness, lateral extent and composition of rocks that have potential as reservoirs and reservoir seals for the emplacement and storage of liquid waste in the deep subsurface in segments of the Appalachian basin. The area includes eastern Kentucky, western Maryland, eastern Ohio, southwestern Pennsylvania, east-central Tennessee, southwestern Virginia, and central and western West Virginia (about 60,000 sq. mi.).

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The past quarter has been spent correcting the final report manuscript, illustrations, and tables. The report has been sent to Southeast Region with request for Director's approval for publication.

PLANS FOR NEXT QUARTER: Obtain Director's approval for publication.

REPORT STATUS: Lloyd, O. B., Jr., and Reid, M. S., 1985, Evaluation of liquid waste-storage potential based on porosity distribution in the Paleozoic rocks in central and southern parts of the Appalachian Basin: (in review).

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

A. Project stage: Final report in review.
B. Cooperator contacts: None; this study is part of the Federal program.
C. Changes affecting project elements: None.
D. Problems associated with project: No funds remain to correct and process report and illustrations.
E. Hydrologic data released: None.

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INVESTIGATION NC 78-063: Sediment Characteristics of Streams in North Carolina

PERIOD OF INVESTIGATION: 1978-84

INVESTIGATION CHIEF: C. E. Simmons

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD)

OBJECTIVE: The objective of this investigation is to determine the sediment characteristics, such as sediment yield and effects of land use, of streams in North Carolina.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Comments, changes, and suggestions of preliminary review have been incorporated into report. Rough draft is in typing phase and will be ready for colleague review by end of quarter.

PLANS FOR NEXT QUARTER: Forward report to outside colleague reviewers and continue with review process.

REPORT STATUS:

Simmons, C. E., Sediment Characteristics of Streams in North Carolina, 1970-79: U. S. Geological Survey Water-Supply Paper (in review).

PUBLISHED REPORTS:

Simmons, C. E., 1976, Sediment Characteristics of Streams in the Eastern Piedmont and Western Coastal Plain Regions of North Carolina: U. S. Geological Survey Water-Supply Paper 1798-O, 32 p.

Data collected during 1984 are published in the report, "Water-Resources Data for North Carolina, Water Year 1984." Similar reports are available for previous years.

PROJECT HIGHLIGHTS:

A. Project stage: Initial draft of report and intra-District review of report completed.
B. Cooperator contacts: None.
C. Changes affecting project elements: None.
D. Problems associated with project: Project is complete except for final report.
E. Hydrologic data released: None.

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INVESTIGATION NC 79-067: Ground-Water Development Potential in the Piedmont and Mountain Areas of North Carolina

PERIOD OF INVESTIGATION: 1979-84

INVESTIGATION CHIEF: C. C. Daniel, III

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD) and Town of Cary

OBJECTIVE: The objectives of this investigation are as follows:

A. Investigate and describe the most favorable hydrogeologic settings for developing large ground-water supplies;
B. Develop and describe techniques for locating favorable areas for large ground-water supplies, including locating fractures; and,
C. Develop techniques for efficient development and management of large ground-water supplies in favorable areas, both as sole sources, and as supplements to reservoir supplies.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: At the recommendation of reviewers, the final report is being divided into several shorter reports covering individual topics, which include: (1) statistical analysis of well data, (2) well pumping rates and scheduling techniques used to increase supply-system production, (3) well-site selection techniques, and (4) hydrogeologic units. The first two of these reports have been written and are in review.

PLANS FOR NEXT QUARTER: Complete District and colleague reviews of the first two reports, revise them in accordance with review comments, and submit for approval for publication.

REPORT STATUS:

Daniel, III, C. C., 1986, Statistical analysis relating well yield to construction practices and siting of wells in the Piedmont and Blue Ridge provinces of North Carolina: U. S. Geological Survey Water-Resources Investigations Report (returned from colleague review).

Daniel, III, C. C., 1986, Evaluation of site-selection criteria, well design, monitoring techniques, and costs for a ground-water supply in Piedmont crystalline rocks, Cary, North Carolina: U. S. Geological Survey Water-Resources Investigations Report (in review).

Daniel, III, C. C., and Sharpless, N. B., 1986, Ground-water supply potential and procedures for well-site selection in the upper Cape Fear River basin, North Carolina--Revised 1986: U. S. Geological Survey Water-Resources Investigations Report (previously approved report published by cooperator; revision in progress).

Daniel, III, C. C., 1986, Hydrogeologic unit map of the Piedmont and Blue Ridge physiographic provinces of North Carolina: U. S. Geological Survey Open-File Report (in preparation).

PUBLISHED REPORTS:

Heath, R. C. and Giese, G. L., 1979, What About Groundwater in the Piedmont and Mountains of North Carolina--Are Large Supplies Feasible?: U. S. Geological Survey Leaflet series, 12 p.

Daniel, III, Charles C. and Sharpless, N. Bonar, 1983, Ground-water supply potential and procedures for well-site selection in the upper Cape Fear River basin, North Carolina: North Carolina Department of Natural Resources and Community Development, 73 p.

Daniel, III, C. C., 1985, Statistical analysis of water-well records from the Piedmont and Blue Ridge of North Carolina: Implications for well-site selection and well design (abs.): Geological Society of America Abstracts with programs, v. 17, no. 2, p. 86-87.

PROJECT HIGHLIGHTS:

A. Project stage: The project is complete except for final reports.
B. Cooperator contacts: None.
C. Changes affecting project elements: Final report is being divided into several reports covering individual topics.
D. Problems associated with project: Project is complete except for final reports.
E. Hydrologic data released: None.

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INVESTIGATION NC 80-068: Charlotte-Mecklenburg County Urban Hydrology (Water Quality) Study

PERIOD OF INVESTIGATION: 1980-86

INVESTIGATION CHIEF: W. H. Eddins

COOPERATOR: City of Charlotte and Mecklenburg County

OBJECTIVE: The objective of this investigation is to evaluate the effects of urbanization and other developments on water quality. A reconnaissance study of the Charlotte-Mecklenburg County area to determine the quality of surface water, as it relates to land use, has been completed. These data will assist in locating areas where specialized studies will be needed, including chemical-quality characteristics and movement of water pollutants at solid waste-disposal sites and in inner-city and suburban areas.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Ground-water and surface-water chemical analysis records were reviewed. Compilation of data for the water-quality data report continued. Samples were collected at the following landfill sites:

	Observation wells	Privately owned wells	Surface Water sites
Holbrooks Road	2	3	2
Statesville Ave.	3	1	3
York Road	4	0	3
Harrisburg Road	9	1	3
Total	18	5	11

Inorganic and biological constituents were analyzed by Mecklenburg County Environmental Health Department. Organic constituents were analyzed by USGS laboratory in Denver, Colorado.

Samples from the following sites were analyzed for priority pollutants, herbicides, and pesticides:

1. Holbrooks Road Landfill — HRW # 3, 2
2. Statesville Avenue Landfill — SRW # 22
3. Harrisburg Road Landfill — HRW # 10, HRW # 2006
4. York Road Landfill — YRSW # 9

Four ground-water samples were collected at landfills for analysis of dissolved gases by the USGS Chemical Section in Reston, Virginia, and the results were reviewed in the District. Completed preliminary review of borehole geophysical logs collected at York Road and Harrisburg Road landfills in November-December 1985.

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Reviewed all inorganic and organic water-quality data collected from all sites in Mecklenburg County through June 1985.

PLANS FOR NEXT QUARTER: Continue network operations and sampling at study sites to monitor concentrations of selected organic and inorganic constituents. Continue collection of water samples at landfill and stream sites and give high priority to preparation of the water-quality data report.

Prepare for placement of a nest of monitor wells to be completed at various depths in saprolite at York Road landfill. Ground-water water-quality samples will be collected from these well sites.

Begin Eh (Redox Potential) measurements at selected observation wells. Complete interpretation of inorganic and organic water-quality data collected in and around landfill sites in Mecklenburg County.

Begin mineralogical and geochemical evaluation of the saprolite samples collected at York Road and Harrisburg Road landfills in November 1985.

REPORT STATUS: The reconnaissance report on water quality of streams was published and distributed in June 1985. The following report is being prepared:

Cardinell, A. P., 1986, Assessment of Water-Quality Characteristics of Ground Water and Surface Water at Selected Landfill and Urban Sites in Mecklenburg County, North Carolina: U.S. Geological Survey Water Resources Investigations Report (in process).

Eddins, W. H., 1986, Chemical-quality data for the urban hydrology study of Mecklenburg County, North Carolina, 1980-85: U. S. Geological Survey Water-Resources Investigations Report (in process).

PUBLISHED REPORTS:

Eddins, W. H., and Crawford, J. K., 1984, Reconnaissance of water-quality characteristics of streams in the City of Charlotte, Mecklenburg County, North Carolina: U. S. Geological Survey Water-Resources Investigations Report 84-4308, 105 p., 45 figs., 26 tables.

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PROJECT HIGHLIGHTS:

A. Project stage: Study is 92 percent complete.
B. Cooperator contacts: Daily contact. Meetings were held on March 27, 1986, in Raleigh to apprise City and County cooperators of progress on the water-quality study. Perry Nelson, Director of Groundwater Section of NRCD, and several members of his staff and Michael Babuin, of the Solid and Hazardous Waste Management Branch, Division of Health Services, attended.
C. Changes affecting project elements: Alex Cardinell has assumed responsibility for part of the study concentrating on data analysis and interpretation.
D. Problems associated with project: None.
E. Hydrologic data released: Data are supplied on request to cooperating agencies and others.

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INVESTIGATION NC 80-070: Urban Hydrology of the Coastal Plain

PERIOD OF INVESTIGATION: 1980 - continuing

INVESTIGATION CHIEF: H. C. Gunter

COOPERATOR: North Carolina Department of Transportation (DOT)

OBJECTIVE: The objectives of this investigation are to evaluate the effects of urban development on flood magnitude and frequency in the Coastal Plain province and update regional flood relations for North Carolina

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Long-term records of peak discharges were simulated for each of the five modeled basins. First draft of report was completed.

PLANS FOR NEXT QUARTER: Complete in-house review of report and begin colleague review.

REPORT STATUS: Preparation of the final report is continuing.

Gunter, H. C., 1986, Regional flood-frequency relations for urban and rural basins in North Carolina: U. S. Geological Survey Water-Resources Investigations Report (in preparation).

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

A. Project stage: First draft of report complete.
B. Cooperator contacts: None.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: None.

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INVESTIGATION NC 80-071: Coastal Plain Aquifer Study

PERIOD OF INVESTIGATION: 1980-86

INVESTIGATION CHIEF: G. L. Giese

COOPERATOR: Federal

OBJECTIVE: The objective of this investigation is to develop the capability to make predictive evaluations of the Coastal Plain aquifer systems under existing and future conditions. A digital model to simulate the response of the multi-layered aquifer system under varying pumping and climatic stresses will require detailed information on the following:

A. Geology and hydrology of the aquifer system;

B. The ground-water flow system and freshwater-saltwater interface before extensive ground-water withdrawals began.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: A first draft of the model report was completed during the quarter. It received supervisory review and is being revised by the authors. The hydrogeologic framework report is being revised following colleague review.

PLANS FOR NEXT QUARTER: Complete revisions to model report following supervisory review, and obtain one or more colleague reviews. Submit hydrogeologic framework report for approval for publication as an Open-File Report pending publication as a U.S. Geological Survey Professional Paper.

REPORT STATUS: As indicated above, a first draft of the model report has been completed and is being revised following supervisory review and prior colleague review. The hydrogeologic framework report is being revised after receiving three colleague reviews prior to submission for approval for publication. Both reports will be prepared for publication as Open-File Reports and later as U.S. Geological Survey Professional Papers.

Winner, M. D., Jr., and Coble, R. W., 1986, A Hydrogeologic Framework of the North Carolina Coastal Plain Aquifer System: U. S. Geological Survey Professional Paper (in review).

Giese, G. L., Eimers, J. L., and Coble, R. W., 1986, A digital-model simulation of the North Carolina Coastal Plain aquifer system: U. S. Geological Survey Professional Paper (in preparation).

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

A. Project stage: Both framework and modeling phases of the study are complete except for report processing.
B. Cooperator contacts: None.
C. Changes affecting project elements: None.
D. Problems associated with project: FY 86 funding has been reduced from $54,000 to $45,000. Also, since an extension of the project for another year seems unlikely, additional effort must be made to complete the project this fiscal year. The total shortfall in project funds for FY 86 due to these causes is about $15,000 to $20,000.
E. Hydrologic data released: None.

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INVESTIGATION NC 83-073: Water Quality of Inflow to Falls and Jordan Lakes, North Carolina

PERIOD OF INVESTIGATION: October 1982-86

INVESTIGATION CHIEF: R. G. Garrett

COOPERATOR: U. S. Army Corps of Engineers

OBJECTIVE: The 12,500-acre Falls Lake was filled in June 1983, and the 13,900-acre Jordan Lake was filled in February 1982. Few data are available on the quality of inflow to the lakes; however, several cities plan to use the lakes for public water supply. The objective of this project is to collect hydrologic data for evaluating chemical-quality characteristics of inflow under existing and future development conditions.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The collection and processing of water-quality data at the Falls project stations continued. All water-quality monitoring equipment was removed from the Jordan Lake station.

PLANS FOR NEXT QUARTER: Continue collection, processing, and storage of data in the WATSTORE system for the Falls project sites.

REPORT STATUS: No interpretive reports in progress at this time; however, all basic data collected as part of this project will be published in annual reports, "Water-Resources Data for North Carolina."

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

A. Project stage: Data-collection phase.
B. Cooperator contacts: Data, program funding, and objectives for FY 86 were discussed with Corps personnel.
C. Changes affecting project elements: The water-quality data collection for the sites located at Jordan Lake were discontinued in November 1985.
D. Problems associated with project: None.
E. Hydrologic data released: Provisional water-quality data available as of March 3 were released to the cooperator. Preliminary computations of nitrogen and phosphorus influx into Jordan Lake during the 1985 WY were transmitted to the cooperator, also.

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INVESTIGATION NC 83-074: Effects of Stream Restoration on the Hydrology of the Grove Creek Watershed near Kenansville, North Carolina

PERIOD OF INVESTIGATION: October 1982-87

INVESTIGATION CHIEF: T. C. Stamey

COOPERATOR: North Carolina Department of Human Resources (DHR)

OBJECTIVE: The objective of this investigation is to define the hydrology of Grove Creek watershed before, during, and after channel restoration and to evaluate the impact of channel restoration on frequency and duration of overbank floodings, ground water, and water quality. The project was expanded to define ground-water and surface-water characteristics on open-marsh water-management projects at Hobucken and West Onslow Beach.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Data collection continued at network stations in the Grove Creek watershed and at Hobucken and West Onslow Beach Marshes. The surface-water, ground-water, and water-quality data for these sites have been finalized for publication in the annual data report.

PLANS FOR NEXT QUARTER: Continue collection, processing, and storage of streamflow, ground-water, and water-quality data in the WATSTORE files. Correlate water levels in the breeding pools with those for the observation wells (as the data are received from cooperator).

REPORT STATUS: None in progress.

PUBLISHED REPORTS:

Stamey, T. C., 1986, Frequency and duration of flooding of Grove Creek near Kenansville, North Carolina, for present and proposed restored channel conditions: U. S. Geological Survey Water-Resources Investigations Report 85-4298.

PROJECT HIGHLIGHTS:

A. Project stage: Data collection and analysis.
B. Cooperator contacts: Numerous contacts were made with DHR to discuss plans and progress at project sites.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: None.

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INVESTIGATION NC 83-075: Central Coastal Plain Aquifer Study

PERIOD OF INVESTIGATION: 1983-88

INVESTIGATION CHIEF: M. D. Winner, Jr.

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD); the cities and towns of Ayden, Farmville, Jacksonville, Kinston, La Grange, New Bern, Pinetops, Snow Hill, and Stantonsburg; Greene, Jones, and Onslow Counties; Greenville Utilities; and North Lenoir Water Corporation.

OBJECTIVE: The objectives of the study are to evaluate: (1) ground-water supply potential of the Central Coastal Plain; and, (2) effects of alternative ground-water development schemes, especially with regard to maximum-development potential, declines in regional water levels, and saltwater intrusion. To accomplish these objectives, the study will include construction of a detailed hydrogeologic framework for the 3,600 mi^2 area and development of steady-state and transient digital models to analyze the ground-water flow system.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The project area has now expanded by about 600 square miles to include Jones and Onslow Counties and has caused a re-evaluation of the central Coastal Plain model. The number of computational blocks, or nodes, added to the model is now greater than the capacity of the model to handle in its present form, so that a new model format is required to operate the increased numbers of data. Testing of the new model format has begun.

The assemblage of additional hydrogeologic data for the expansion area was begun, and five hydrogeologic cross sections were completed. Work on correlating the logs of these sections with the existing hydrogeologic framework of the study area was also begun.

Test drilling by NRCD continued at the Chicod Research Station in Pitt County and at the Jacksonville Highway 258 well-field site in Onslow County. At the latter site, bedrock was found at a depth of 1224 feet, and a saltwater head about 20 feet above land surface was measured in a test interval about 400 feet below the freshwater production zone at this site.

Revisions to the pumpage report were made and the report was submitted for colleague review.

PLANS FOR NEXT QUARTER: Test-hole and observation-well construction by NRCD should be completed. Aquifer and confining-unit maps should be completed for the expanded study area. Tests for the new model format should be finished and a new grid designed for model input data. Model boundary flux scheme will be finalized.

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REPORT STATUS: The following reports have been completed and are in review:

Lyke, William L., and Winner, M. D., Jr., 198-, Altitude of basement surface in the central Coastal Plain of North Carolina: U. S. Geological Survey Open-File Report.

Winner, M. D., Jr., and Lyke, William L., 198-, History of ground-water pumpage from Cretaceous aquifers of the central Coastal Plain of North Carolina, and the decline of water levels: U. S. Geological Survey Open-File Report.

The following report is in preparation:

Winner, M. D., Jr., and Lyke, William L., 198-, The hydrogeologic framework of the central Coastal Plain, North Carolina: U. S. Geological Survey Water-Resources Investigations Report.

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

A. Project stage: Data-collection and evaluation stage of the study overlaps with the report preparation stage. A number of reports will be prepared at various stages of the investigation.
B. Cooperator contacts: Several contacts were made with NRCD on test drilling and other aspects of the study.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: None.

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INVESTIGATION NC 83-075: Central Coastal Plain Aquifer Study

PERIOD OF INVESTIGATION: 1983-88

INVESTIGATION CHIEF: M. D. Winner, Jr.

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD); the cities and towns of Ayden, Farmville, Jacksonville, Kinston, La Grange, New Bern, Pinetops, Snow Hill, and Stantonsburg; Greene, Jones, and Onslow Counties; Greenville Utilities; and North Lenoir Water Corporation.

OBJECTIVE: The objectives of the study are to evaluate: (1) ground-water supply potential of the Central Coastal Plain; and, (2) effects of alternative ground-water development schemes, especially with regard to maximum-development potential, declines in regional water levels, and saltwater intrusion. To accomplish these objectives, the study will include construction of a detailed hydrogeologic framework for the 3,600 mi^2 area and development of steady-state and transient digital models to analyze the ground-water flow system.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: The project area has now expanded by about 600 square miles to include Jones and Onslow Counties and has caused a re-evaluation of the central Coastal Plain model. The number of computational blocks, or nodes, added to the model is now greater than the capacity of the model to handle in its present form, so that a new model format is required to operate the increased numbers of data. Testing of the new model format has begun.

The assemblage of additional hydrogeologic data for the expansion area was begun, and five hydrogeologic cross sections were completed. Work on correlating the logs of these sections with the existing hydrogeologic framework of the study area was also begun.

Test drilling by NRCD continued at the Chicod Research Station in Pitt County and at the Jacksonville Highway 258 well-field site in Onslow County. At the latter site, bedrock was found at a depth of 1224 feet, and a saltwater head about 20 feet above land surface was measured in a test interval about 400 feet below the freshwater production zone at this site.

Revisions to the pumpage report were made and the report was submitted for colleague review.

PLANS FOR NEXT QUARTER: Test-hole and observation-well construction by NRCD should be completed. Aquifer and confining-unit maps should be completed for the expanded study area. Tests for the new model format should be finished and a new grid designed for model input data. Model boundary flux scheme will be finalized.

Quarterly Report - January-March 1986

REPORT STATUS: The following reports have been completed and are in review:

Lyke, William L., and Winner, M. D., Jr., 198-, Altitude of basement surface in the central Coastal Plain of North Carolina: U. S. Geological Survey Open-File Report.

Winner, M. D., Jr., and Lyke, William L., 198-, History of ground-water pumpage from Cretaceous aquifers of the central Coastal Plain of North Carolina, and the decline of water levels: U. S. Geological Survey Open-File Report.

The following report is in preparation:

Winner, M. D., Jr., and Lyke, William L., 198-, The hydrogeologic framework of the central Coastal Plain, North Carolina: U. S. Geological Survey Water-Resources Investigations Report.

PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

A. Project stage: Data-collection and evaluation stage of the study overlaps with the report preparation stage. A number of reports will be prepared at various stages of the investigation.
B. Cooperator contacts: Several contacts were made with NRCD on test drilling and other aspects of the study.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: None.

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INVESTIGATION NC 84-076: Effects of Land Use on the Biological Environment of Streams in Piedmont North Carolina

PERIOD OF INVESTIGATION: 1984-86

INVESTIGATION CHIEF: J. Kent Crawford

COOPERATOR: North Carolina Department of Natural Resources and Community Development (NRCD)

OBJECTIVE: This investigation examines the effects of three land uses (forests, agriculture, and urban) on stream environments. The objectives are to:

1. Monitor the chemical characteristics of the water column including transport in solution and transport associated with suspended sediment;

2. Monitor the chemical and physical characteristics of bed material including both sediments and interstitial water;

3. Characterize the aquatic invertebrate communities of each of the study streams; and,

4. Relate biotic degradation found during the study to water quality, sediment quality, and land-use activities.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: A second survey of fish populations and community structure was conducted during the quarter. All data from the USGS Atlanta laboratory were returned to the project chief this quarter except that interstitial water samples were lost at the lab and cannot be recovered or analyzed.

PLANS FOR NEXT QUARTER: All data to be interpreted are on hand. Report preparation will occupy a significant part of the coming quarter.

REPORT STATUS: One interpretive report and a journal article are planned. Data were prepared for publication in "Water-Resources Data for North Carolina." Draft of interpretive report is due July 15, 1986.

PUBLISHED REPORTS: None.

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PROJECT HIGHLIGHTS:

A. Project stage: Data collection complete. Data analysis and report preparation underway.
B. Cooperator contacts: Telephone contact was maintained during the quarter with Dave Lenat, NRCD.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: None.

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INVESTIGATION NC 84-077: The Effects of Land Use on Ground-Water Quality in the Piedmont Province, North Carolina.

PERIOD OF INVESTIGATION: 1984-86

INVESTIGATION CHIEF: Douglas A. Harned

COOPERATOR: Federal

OBJECTIVE: The objective of this investigation is to study the quality of ground water of the combined-regolith and fractured-rock ground-water system and to assess the current status of contamination in the system under typical land uses. This will be a two-phase study. The first, and current phase, is the analysis of existing data. The second phase will be monitoring and hypothesis testing based on findings of the first study phase.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER: Editing of the Piedmont ground-water quality data set was completed for data obtained from NRCD during their 208 Study and the county ground-water reconnaissance study reports. A revised version of the Phase I report was sent out for colleague review. Funding for Phase II was cancelled.

PLANS FOR NEXT QUARTER: None. If new funding is not obtained, however, plans involve merging the edited data file; areal characteristics, including LUDA land use, geology, and soils data will continue to be added to the file. Preparation of the data report will begin.

REPORT STATUS: Completion of the following data report is planned if new funding is obtained.

Harned, D. A., 1986, Ground-water quality data for the Piedmont of North Carolina: U. S. Geological Survey Water-Resources Investigations Report (in process).

Review and revision of the following interpretive report continues:

Harned, D. A., 1986, The effect of land use on ground-water quality in the Piedmont province, North Carolina: U. S. Geological Survey Water-Supply Paper.

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PUBLISHED REPORTS: None.

PROJECT HIGHLIGHTS:

A. Project stage: Phase I nearly complete.
B. Cooperator contacts: Federal program - no local cooperators.
C. Changes affecting project elements: Funding for this study has been canceled. The second phase will not be initiated. Preparation of reports covering the first phase will resume if new funding is allocated.
D. Problems associated with the project: No funding.
E. Hydrologic data released: None.

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INVESTIGATION NC 85-081: Effects of Land-Management Practices on Sediment and Chemical Transport in Guilford County

PERIOD OF INVESTIGATION: 1984-91

INVESTIGATION CHIEF: C. L. Hill

COOPERATOR: Guilford County Soil and Water Conservation District and U. S. Soil Conservation Service (SCS)

OBJECTIVE: Runoff from agricultural lands is a major contributor of sediment, nutrients, and toxics to surface and ground waters in North Carolina. The full impact of agricultural runoff is unknown and large-scale improvements cannot be accomplished until further knowledge is gained regarding pollutant sources and levels, transport and assimilative mechanisms, degradation and alteration of pollutants, and methods of improvements. Primary objectives are as follows:

A. Quantify fluvial sediments and associated chemical constituents transported from a basin using good land management techniques and compare with similar variables from a basin where accepted soil-conservation practices are not currently used;

B. Define changes in quantities of sediment and selected nutrients and pesticides following implementation of soil conservation practices in a rural, mixed, land-use basin.

SIGNIFICANT FINDINGS AND PROGRESS DURING THE QUARTER:

1. Hill met with SCS officials to discuss progress and problems during the first year of the project.
2. SCS completed a survey of 1985 crop-year land use in the Candy Creek (mixed land-use) basin.
3. Project site was visited and water-quality sampling methods were reviewed by Water-Quality Branch and Southeast Region review team.
4. Second recording rain gage was installed in the upper (poor) tobacco field.
5. Data was finalized for annual report publication.

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PLANS FOR NEXT QUARTER:

1. Begin intensive water-quality sampling of all four sites if weather permits;
2. Bury rain gage in lower (good) tobacco field;
3. Install erosion pins above runoff gage in upper tobacco field;
4. Run levels at the two tobacco fields to check reference gages at runoff sites; and
5. Meet with SCS officials in June at the project site.

REPORT STATUS: No interpretive reports currently in progress; data will be published in the annual data report, "Water-Resources Data for North Carolina," beginning with the 1985 report.

PROJECT HIGHLIGHTS:

A. Project stage: Data collection.
B. Cooperator contacts: Numerous contacts with SCS personnel in Raleigh and Guilford County.
C. Changes affecting project elements: None.
D. Problems associated with project: None.
E. Hydrologic data released: None.

OTHER PROGRAM ACTIVITIES

1. On January 9, 1986, Turner and McGeary, USGS, met with Tom Tarrant, City of Asheville, to discuss implementation of a proposed urban runoff study for the City of Asheville. Tarrant indicated that final approval of the USGS study was anticipated within several weeks and that the city wanted to study Nasty Branch, one of the most heavily polluted streams in North Carolina.

In a separate meeting, Bill Mull, Director of the Municipal Sewage District, indicated interest in establishing a monitoring program for the French Broad River.

2. On January 12, 1986, Turner and Daniel, North Carolina, and Byron Prugh, Virginia, USGS, attended a meeting at the U.S. Army Corps of Engineers Headquarters, Norfolk, Virginia, on hydrology of the Great Dismal Swamp. The relation between hydrologic conditions in the Great Dismal Swamp National Wildlike Refuge and water requirements for operating lockages in the Dismal Swamp Canal were the major items of discussion. The meeting was attended by representatives of Federal, Federal, State, and local agencies from North Carolina and Virginia and private individuals from Elizabeth City. The Corps requested USGS assistance in compiling available ground-water information on the area for inclusion in their report scheduled for completion in September 1986.

3. The Guilford County Land Management project was reviewed January 14, 1986. U.S. Soil Conservation Service (SCS) and Guilford County Soil and Water Conservation District representatives included Clary, Williams, Waller, Evans, Smith, and Andrews. Cathy Hill represented the USGS. Progress and problems during the first year of the project, 1985, were discussed. A decision was made to extend data collection at the two tobacco sites through 1988, to allow monitoring the results of strip cropping. A field meeting was tentatively scheduled for June 1986.

4. On January 21, 1986, Ed Simmons, USGS, gave a presentation to Carolina Power and Light Company's Environmental Section on USGS water-quality programs in North Carolina. The technical staff was extremely interested in USGS quality-assurance programs, sample-collecting and processing techniques, and reservoir studies. A number of questions were directed at funding of new projects, availability of USGS reports, and cooperative programs in the State.

5. Jim Turner, USGS, met with John Wray, Division of Water Resources, North Carolina Department of Natural Resources and Community Development on January 22, 1986, to discuss plans for the cooperative program for FY 87. A number of possible new studies were discussed, including water resources of Dismal Swamp, statewide low-flow relations, reservoir sedimentation, and interstate ground-water modeling.

OTHER PROGRAM ACTIVITIES, Cont'd.

6. On January 22, 1986, Kent Crawford, Marjorie Davenport, and Cathy Hill met at the Southeast Regional office with Charlie Demus, Louisiana District; Art Horowitz and Jim McConnell, Georgia District; Gary Pederson, Water Quality Spcialist, Atlanta; and Ralph White, Denver Central Laboratory, to discuss the technical aspects of a proposal for studying surface water toxics in the City of Greensboro, North Carolina and surrounding area. Major suggestions included sampling of bottom material for synthetic organic compounds, lower detection limits in the SOC analyses, and NBS library searches for compounds in addition to the 129 primary pollutants. On January 30, Crawford, Jackson, and Davenport met with Ray Shaw, Assistant Director of Public Works for the City of Greensboro to finalize plans for the project.

7. Ron Coble, USGS, attended a meeting on January 30, 1986, at the North Carolina Department of Natural Resources and Community Development to review progress on the research project, "An expert system for North Carolina ground-water quality and management needs," a Water Resources Research Institute study being conducted by Professors Miguel Medina and Carlos Marin of Duke University. Their goal is to develop a computerized system of data selection and input that will aid in selecting and operating ground-water flow and solute models for landfill and hazardous-waste site evaluation for the permitting process and leachate movement. Representatives from the Institute, University of North Carolina at Chapel Hill, and the North Carolina Division of Environmental Management also attended.

8. The North Carolina District ground-water program and overall District programs were reviewed February 3-7, 1986, by representatives of the Office of Ground Water and Southeast Region. Participating in the review were: Lehn Franke, Office of Ground Water, Harold Meisler, North Atlantic Coastal Plain RASA Chief, and John George, Bob Faye, Mike Yurewicz, and Perry Olcott, Southeast Region. Problem of interfacing of large- and small-scale ground-water models in areas with varying head-boundary conditions were considered in detail. Suggested alternative approaches are presently being evaluated.

9. Plans are being made to begin ground-water contamination studies at the Cherry Point Marine Air Station, and at the Camp Lejeune Marine Base. Discussions are also being held with the Elizabeth City Coast Guard Station to study ground-water contamination problems. These programs are to evaluate extent and movement of contamination plumes and to develop plans for management of ground-water resources pertaining to use as water supplies. Moderate levels of drilling and sampling in various water bearing zones will be required for these programs. Flow and solute-transport models of the sites are planned.

OTHER PROGRAM ACTIVITIES, Cont'd.

10. On February 11, 1986, a proposed USGS urban runoff study was approved by the City of Asheville. The 4-year study is to evaluate applicability of urban runoff models in steep gradient, mountainous terrane of western North Carolina and effects of landuse changes on water-quality characteristics. The study will be a demonstration project for the Geographic Information System (GIS) and will provide information for verification of statewide urban flood relations.

11. On February 18, 1986, Turner, Meeks, Eddins, and Cardinell, USGS, met with Ken Hoffman, County Engineer, Mecklenburg County, and Clark Readling, City Engineer, City of Charlotte, and their staffs to review the cooperative program and consider plans for studying flow and leachate movement from selected landfill sites in Mecklenburg County. A comprehensive and detailed data base for ground-water levels, streamflow, and water quality has been developed for the Mecklenburg County area. The USGS is to present findings of ongoing studies to State regulatory agencies in late March 1986.

12. On February 19, 1986, Turner, Meeks, Winner, and Giese, USGS, met with John Meshaw and Porter Morgan, Corps of Engineers, Wilmington, and Carl Bailey, Groundwater Section, North Carolina Department of Natural Resources and Community Development (NRCD) to discuss ground-water problems and needs of the 17-county area of the Coastal Plain north of Cape Lookout. The meeting was held, pursuant to a recent State request for the Corps of Engineers to reactivate a flood study of the area, but to shift emphasis to ground-water resource needs and problems. Interstate ground-water declines, effects of peat mining and phosphate mining, potential for saltwater intrusion, and effects of freshwater withdrawals on the Albemarle Pamlico Sound Estuarine System were discussed. The Corps was particularly interested in ground-water flow and water-quality models and a comprehensive integrated, ground-water data base and data-management system for the area.

13. On February 24, 1986, Turner, Meeks, Simmons, and Coble, USGS, met with John Morris, Director, Division of Water Resources, Perry Nelson, Chief, Groundwater Section, Division of Environmental Management, and Charles Gardner, Director, Division of Soil and Water, and their staffs to review the 1986 cooperative program and proposals for the 1987 program. Because of changes in the State waste permitting criteria, NRCD officials expressed interest in development of statewide relations for estimating low-flow characteristics required for their permitting programs and in a statewide study of sedimentation of reservoirs and water quality.

OTHER PROGRAM ACTIVITIES, Cont'd.

14. A management advisory team, sponsored by the National Park Service (NPS) convened at Manteo, North Carolina, March 2-3, 1986, to formulate and prioritize research needs for the seashore. A number of research areas were explored, and most related in some way to the hydrology of the barrier island setting. Participants included: Vincent Bellis, East Carolina University; Susan Bratton, University of Georgia; David Browers, University of North Carolina; Joan Ehsenfeld, Rutgers University (team coordinator); William Odum, University of Virginia; Richard Stevenson, East Carolina University; Kent Turner, NPS; and Mike Winner, USGS.

15. The North Carolina water-quality program was reviewed during the week of March 3-7, 1986. The review team consisted of Bob Schoen, Rich Alexander, and Dick Smith of the Office of Water Quality, Reston, Virginia, and Gary Pederson, Southeast Region. The review emphasized interpretive studies rather than field activities. The team encouraged the District to take advantage of opportunities for further scientific contributions by becoming more involved in research activities at local universities.

16. On March 12, 1986, Jim Turner, Ed Simmons, and Kent Crawford, USGS, attended a presentation by university researchers on studies of algal problems in the lower Neuse River, particularly the role of phosphorus in recent algal blooms. Dr. Hans Paerl, University of North Carolina, Dr. Wu-Seng Lung, University of Virginia, and Dr. Nicholas Clesceri, Rensselaer Polytechnic Institute, Troy, New York, each gave presentations on their research including modeling activities.

17. On March 14, 1986, Jim Turner, Wanda Meeks, and Charles Daniel, USGS, met with Commander Dennis Shaw, Coast Guard Air Station at Elizabeth City, to discuss ground-water contamination problems at the facility. The Coast Guard facility for rebuilding and repairing air craft has been in operation since about 1960. Shaw requested a proposal for evaluating extent and movement of contaminant plumes in the impacted area for assessment plan.

18. On March 25, 1986, Rick Treece and Bruce Lloyd, USGS, met with Dexter Langley and Allan Dietemann, North Carolina Department of Natural Resources and Community Development, to discuss progress of the water-use program during FY 86; priorities and budgeting for FY 87 were also discussed. FY 87 funding will remain at about the same level as FY 86; efforts will be made to update water-use information on major industrial facilities statewide.

OTHER PROGRAM ACTIVITIES, Cont'd.

19. On March 27, 1986, Jim Turner, Wanda Meeks, Ron Coble, Harold Eddins, and Alex Cardinell, USGS, met with representatives of Charlotte and Mecklenburg County and the North Carolina Departments of Natural Resources and Community Development and Human Resources to review status and results of USGS landfill studies in Mecklenburg County. Data-collection activities and water-quality studies pertaining to impacts of leachate from landfills on ground water and streams were discussed. USGS information on flow and chemical transport were of particular interest.

MEETINGS AND COORDINATION ACTIVITIES

1. On January 9, 1986, the North Carolina Water Resources Association (NCWRA) held their annual conference and banquet on the campus of Duke University in Durham, North Carolina. The conference focused on the impacts of proposed peat mining on the water resources of coastal North Carolina. During the business session, Doug Harned, USGS, was elected Secretary of the group for 1986. Ron Coble, Kent Crawford, Jody Eimers, Robert Mason, Wanda Meeks, and Jim Turner of the USGS staff attended.

2. The North Carolina Water Resources Research Institute Program was reviewed on January 27 and 28, 1986. The review team consisted of Jerry Parker, District Chief, Mississippi; Madge Ertel, USGS Research Program, Reston, Virginia; Dr. George Everett, Division of Environmental Management, North Carolina Department of Natural Resources and Community Development; Byers Gordan, WRRI, University of New Hampshire; Dr. Ron North, Institute of Natural Resources, University of Georgia; and Mr. Lucius Pullen, Vice-President for Law and Communications, Texasgulf Chemicals Company, Raleigh, North Carolina. Jim Turner, USGS, participated in discussions of the review team with the Institute Advisory Committee on January 28 covering relevancy of the Institute's programs to needs of the State.

3. On February 5 and 6, 1986, Jim Turner and Bob Baker, USGS, visited with key faculty members of North Carolina State University, Raleigh, N.C. and University of North Carolina, Chapel Hill, N.C. to discuss the Water Resources Division Staffing Plan for 1986. Turner discussed organizational aspects of the Division and District programs and prospective recruitment goals. Baker discussed various aspects of the Division's research programs across the country. David Moreau, Director of the North Carolina Water Resources Research Institute, arranged the meetings and participated in the discussions.

MEETINGS AND COORDINATION ACTIVITIES, Cont'd.

4. On March 12, 1986, Dr. James Stewart, Associate Director of the North Carolina Water Resources Research Institute, visited with Jim Turner, Wanda Meeks, and Ed Simmons, USGS, to discuss plans for conducting a ground-water seminar for State, Federal, local agencies, and individuals from local universities and consulting firms in late fall, 1986. The North Carolina District will participate in both the planning and development of seminars. The proposed format is selected ground-water topics with invited speakers for a two-day period.

5. Cathy Hill, USGS, spoke at the fourth annual meeting of the Weed Science Society of North Carolina on March 6, 1986. The program focused on ground-water contamination from pesticides. Hill discussed monitoring of pesticides in the saturated and unsaturated zones in Guilford County soils. Other speakers included professors from North Carolina State University; Perry Nelson, North Carolina Department of Natural Resources and Community Development; and representatives of Ciba Geigy and Union Carbide.