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Preliminary Investigation
Jet Fuel Spill - White Street
Marine Corps Air Station
Camp Lejeune, North Carolina
Atec Job No. 35-63481

01.02-06/20/86-02078



Prepared For:

Mr. Bob Alexander
USMC
Asst. Chief of Staff Facilities
Camp Lejeune, N.C. 28542-5001



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Monitoring Well Details



PROJECT INFORMATION

This study was verbally authorized on April 25, 1986 by Master Sergeant R. L. Dingle of the Contracting Division as Purchase Order M67001-86-M1355. General project information has been provided by Mr. Bob Alexander, Environmental Engineer, and Mr. Fritz Acosta, Facilities Coordinator. We understand that a quantity of JP-5 jet fuel accumulated in a recently-installed communications manhole on the east side of White Street at the Marine Corps Air Station. The fuel is known to have leaked from a pipeline, located 3 to 6 ft below grade on the west side of White Street, prior to its replacement in 1983 (Soils & Materials Engineers reports 051-83-354-A and 057-83-128). Several hand auger borings, performed in 1983, indicated that part of the study area was contaminated with JP-5 jet fuel. Up to 1.0 ft of fuel entered the hand auger borings (Figure 1).

FIELD TESTING

Monitoring Well Installation

A system of 15 monitoring wells was installed during May 6-11, 1986 (Figure 2). The wells are 15 ft deep, with a 10 ft 0.01 inch slotted PVC screen at the base, and 7 ft of standpipe. Wells were installed with 6-1/2 inch O. D. diameter augers, and soil samples were obtained at 5 ft intervals using a split-spoon sampler. Sand was used as backfill to 2 ft above the screen, followed by 1 ft of bentonite and up to 2 ft of cement.

Water Level and Fuel Thickness Determination

Water levels and the thicknesses of the JP-5 fuel layer were measured in each well using both water-sensitive and oil-sensitive pastes (Kolor Kut Water Finding Paste and Kolor Kut Gasoline Gauging Past) and a weighted fiberglass tape. The pastes were applied to opposite sides of the tape and lowered into the well casing. The use of both pastes allowed an accurate determination of the depth to water and the thickness of any JP-5 fuel present.

Locations and Elevations

Locations and elevations for the wells were determined using a theodolite and an electronic distance measuring device (EDM). A temporary benchmark level of El 20.00 was assigned the top cap of fire hydrant 1-72-18 located on the east side of White Street, immediately south of the exit drive of Building 4141. Elevations for the tops of the metal protective well casings were obtained using this temporary benchmark.



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FINDINGS

Subsurface Soil Conditions

Three soil units were encountered. The surface layer is a 0.0 ft to 10.5 ft thick layer of very loose to firm, black to brown, dry to moist, silty (0-40%), fine- to medium-grained SAND (SM or SP). Beneath this granular soil is a 6.0 ft or thicker, very soft to firm, gray to mottled brown and gray, moist to wet, silty CLAY (CH/CL). In boreholes W-2, W-3, W-8, W-9, W-10, and W-11 this cohesive soil unit extended to termination depths of 15.0 ft. At the base of the borings in the remainder of the boreholes is a very loose to firm, gray, wet to saturated, silty (0-15%) fine- to coarse-grained SAND (SM or SP). Details of subsurface soil conditions are included on the Monitoring Well Details Diagrams in the Appendix. Two cross sections showing subsurface conditions are included as Figures 6 and 7.

Fluid Levels

Fluid levels in the wells ranged from 7.0 ft to 13.5 ft below grade two to six days after installation. A contour map of the composite potentiometric surface is included as Figure 3. The fluid level in W-5 has been corrected for the effects of the 0.8 specific gravity of the JP-5 fuel.

The higher potentiometric surfaces noted in wells W-2, W-7, W-9, and W-10 may have been influenced by perched water in the near-surface silty SAND. Other factors which indicate water may be perched, at least temporarily are the relatively high water level in the drainage ditch located to the east and the high water levels encountered in shallow soil borings performed in late 1983. During drilling operations, however, no free water was encountered in the upper silty SAND, probably due to the relatively dry winter and spring months. The occasional presence of fluid in the upper silty SAND suggests that some combination of percolation, evaporation, or drainage will remove perched fluids. Some amount of fluid transfer across the silty CLAY is present since fuel tended to occur in both upper and lower granular soils whenever contamination was detected.

Fuel Thickness

Fuel thicknesses ranged from 0.0 ft to 8.9 ft with fuel being detected in two areas: at the northern edge of the study area (W-3 and W-11) and in the center of the study area near the communications manhole and W-5. Only observation wells W-11, W-4, and W-5 had measurable amounts of fuel (0.18 ft, 0.16 ft, and 8.9 ft respectively), while W-3 and W-15 had only a trace of fuel. Wells W-2 and W-6 had detectable fuel odors in split-spoon samples obtained during drilling operations, but showed no detectable accumulation of fuel in the observation well. A fuel thickness map is included as Figure 4.



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Thickness of fuel within the aquifer is less than the thickness measured in the observation well. Published studies (De Pastrovich, et al., 1979, and Kramer, 1982) report that fuel thickness measured in a well is two to four times greater than the thicknesses in the aquifer due to capillary action.

RECOMMENDED RECOVERY STRATEGY

The presence of 8.9 ft of fuel in W-5 and relatively minor amounts or no fuel in nearby wells indicates a severe, but localized, contamination problem. A major goal of most aquifer restoration programs is to concentrate the pollutant to facilitate its removal. Apparently natural processes have already achieved this goal. The recovery procedure will therefore be largely concerned with the removal of the JP-5, rather than containment of a spreading plume.

The fuel can be removed safely and efficiently by the use of recovery wells. The number of recovery wells required, their location, and the well design can be properly defined only after performing permeability tests to determine the aquifer characteristics. These tests will also enable an evaluation of the relationship between the upper and lower sands. Only at the conclusion of the aquifer tests can the recovery system be properly designed.

Two possible recovery well systems are proposed: A single-pump system utilizing single recovery wells, and a two-pump system utilizing single recovery wells.

A single-pump system can utilize a small (i.e. less than 8 inch) diameter well (Figure 8). It is generally less expensive to construct due to the smaller diameter of the well, the use of a single pump, and the use of a simple mechanical float switch. Disadvantages of the system include the necessity of a surface product/water separator and associated emulsification of product due to fluid agitation.

A two-pump system utilizes a large (26+ inch) diameter well (Figure 9). This system is generally the most desirable recovery arrangement due to the continuous isolation of product from water and the automation of the system. The disadvantages include the higher cost of well installation, expensive pumps, and potential problems with the complex automation system.

SITE PRECAUTIONS

Buried cable housings, particularly those utilizing petroleum-soluble PVC cements, will be susceptible to damage in the contaminated area even after the majority of the fuel has been removed. Kramer (1982) states that buried telephone cables are even susceptible to damage from petroleum vapors.



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A recovery system is designed to remove fuel which has migrated into the wellbore. It should be noted that a volume of fuel equal to approximately 15 percent of the total porosity of the soil will be retained by saturated soil (API, 1982). This residual fuel will be concentrated and mobilized during water table fluctuations, thereby creating a hazard to any buried cables within the fluctuation (vadose) zone. It is therefore important that any utilities installed in the area be designed to withstand exposure to fuel.

CLOSURE

These analyses and recommendations are, of necessity, based on the concepts made available to us at the time of the writing of this report and on the assumption that site and subsurface conditions which existed at the time of the subsurface exploration are representative of general conditions across the site.

We have appreciated being of service to you in the subsurface exploration phase of this project and are prepared to assist you during the construction phases as well. If you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact this office.

Very truly yours,

ATEC ASSOCIATES, INC.

Gary D. Rogers
Senior Geologist

Gary P. Alexander, P.E.
Engineering Department Manager

GDR/GPA/mr



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BIBLIOGRAPHY

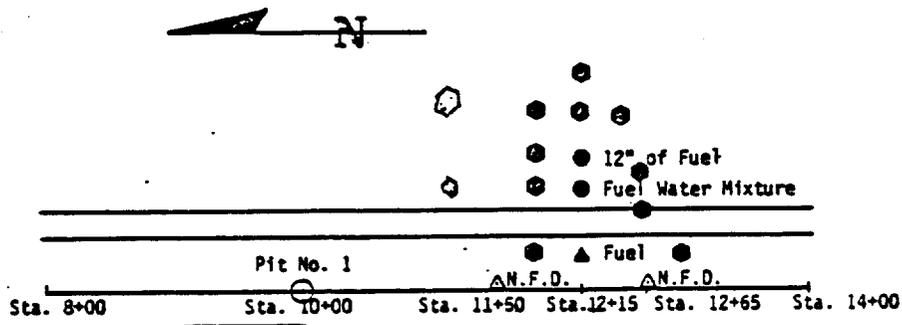
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Blake, Steven B., and R. W. Lewis, 1983, Underground Oil Recovery, Groundwater Monitoring Review, Spring Issue, p. 40-46.

Kramer, William H., 1982, Groundwater Pollution from Gasoline, Groundwater Monitoring Review, Spring Issue, p. 18-22.

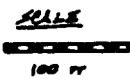
Soil and Materials Engineers, 1983, JP-5 Fuel Line Investigation, S&ME Job # 057-83-128.

Soil and Materials Engineers, 1983, Leaked Fuel Inventory, S&ME Job # 051-83-354-A.



Ground Support
AS 4146

Avionics
AS 4141



LEGEND

- △ Old Hand Auger Probe
- New Hand Auger Probe
- Proposed Hand Auger Probe
- N.F.D. - No Fuel Detected

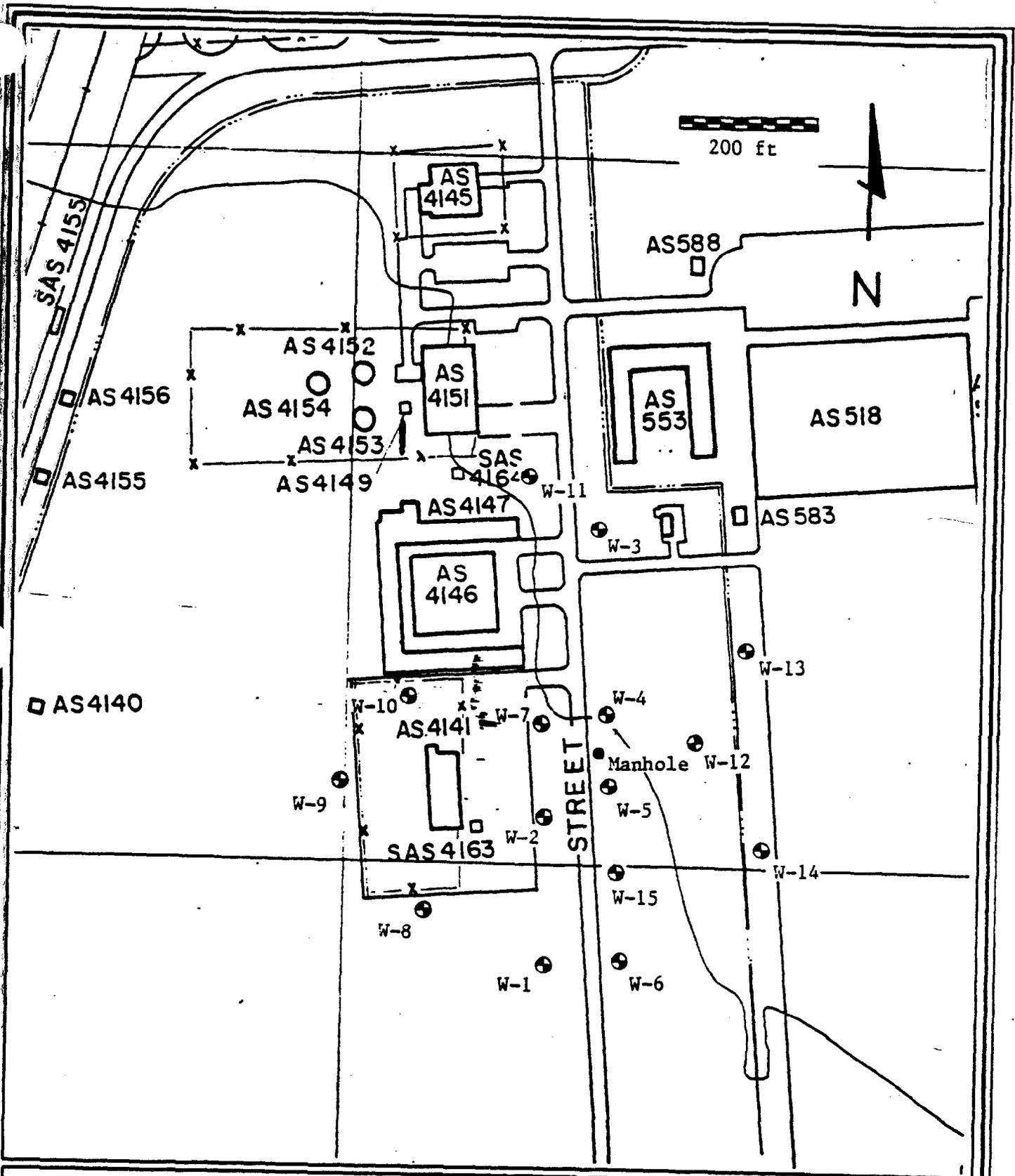
NOTE: Darkened Circles or Triangles Indicate Presence of Fuel.

Adapted from S&ME Report 051-83-354-A

Extent of Contamination Shown by Hand Auger Borings, 1983
White Street
Camp Lejeune, North Carolina

ATEC Associates, Inc.
of North Carolina
6814 Davis Circle
Raleigh, North Carolina 27612
919-782-2832 Raleigh
919-223-3519 Newport

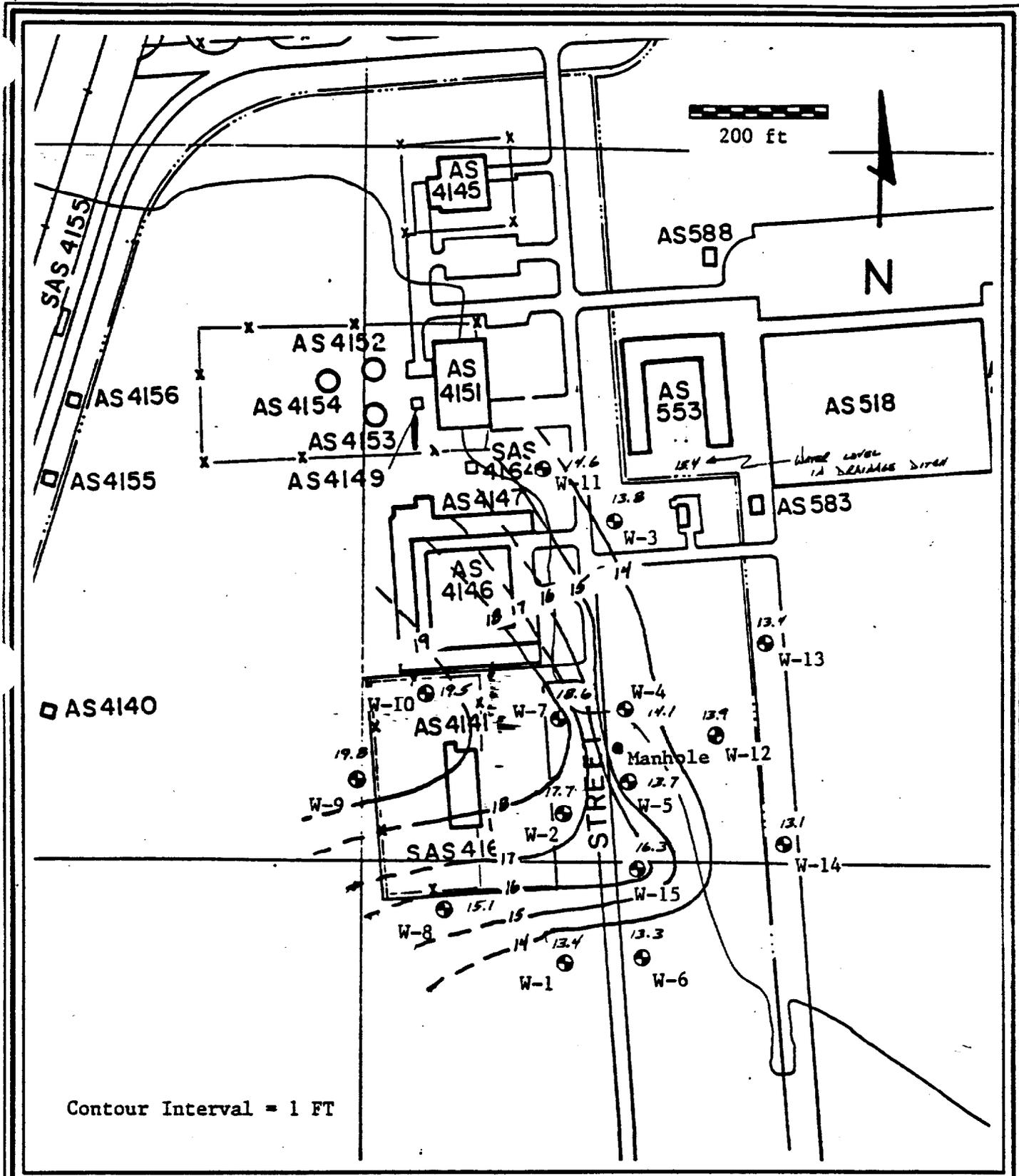
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Monitoring Well Location Diagram
 White Street
 Camp Lejeune, North Carolina

ATEC Associates, Inc.
of North Carolina
 6814 Davis Circle
 Raleigh, North Carolina 27612
 919-782-2832 Raleigh
 919-223-3519 Newport

SCALE: 1"=200'	DRAWN BY: GDR	CHECKED BY: GPA	DATE: 5/20/86	PROJECT NO. 35-63481	DRAWING NO. 2
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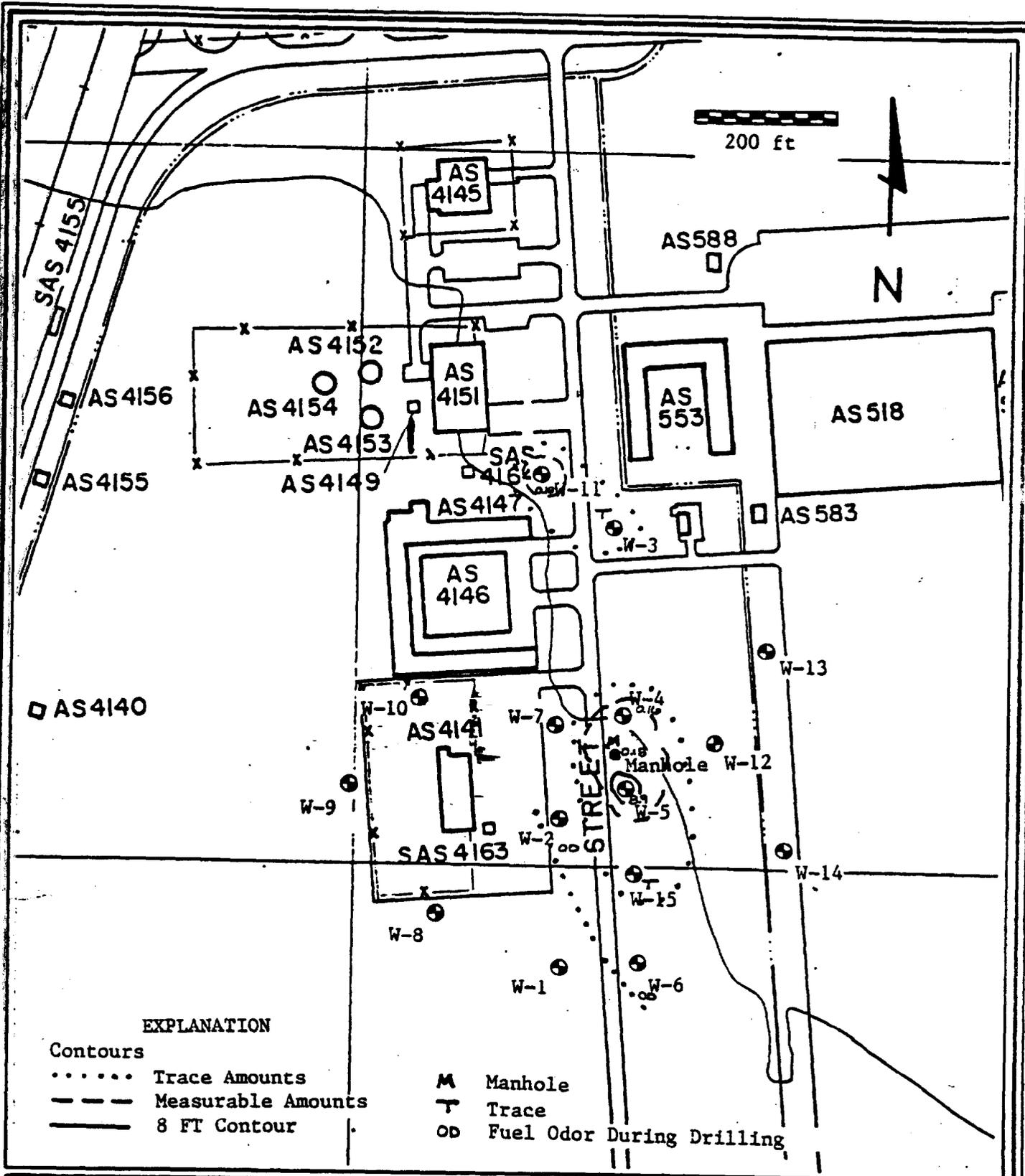


Contour Interval = 1 FT

Composite Potentiometric Surface Map
 White Street
 Camp Lejeune, North Carolina

ATEC Associates, Inc.
 of North Carolina
 6814 Davis Circle
 Raleigh, North Carolina 27612
 919-782-2832 Raleigh
 919-223-3519 Newport

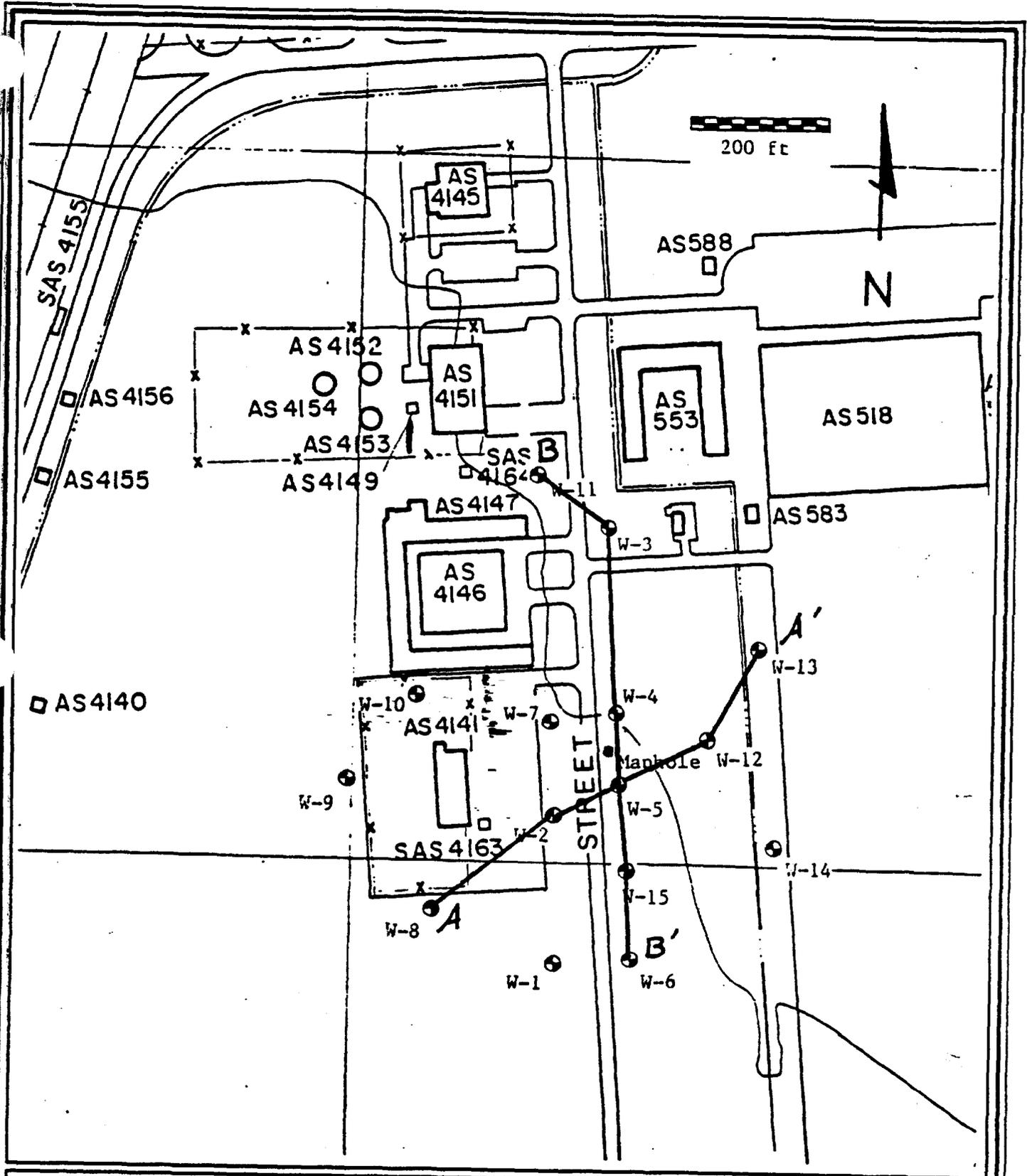
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Fuel Thickness Map
 White Street
 Camp Lejeune, North Carolina

ATEC Associates, Inc.
 of North Carolina
 6814 Davis Circle
 Raleigh, North Carolina 27612
 919-782-2832 Raleigh
 919-223-3519 Newport

SCALE: 1"=200'	DRAWN BY: GDR	CHECKED BY: GPA	DATE: 5/20/86	PROJECT NO. 35-63481	DRAWING NO. 4
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Cross Section Location Map
 White Street
 Camp Lejeune, North Carolina

ATEC Associates, Inc.

of North Carolina
 6814 Davis Circle
 Raleigh, North Carolina 27612
 919-782-2832 Raleigh
 919-223-3519 Newport

SCALE:
 1"=200'

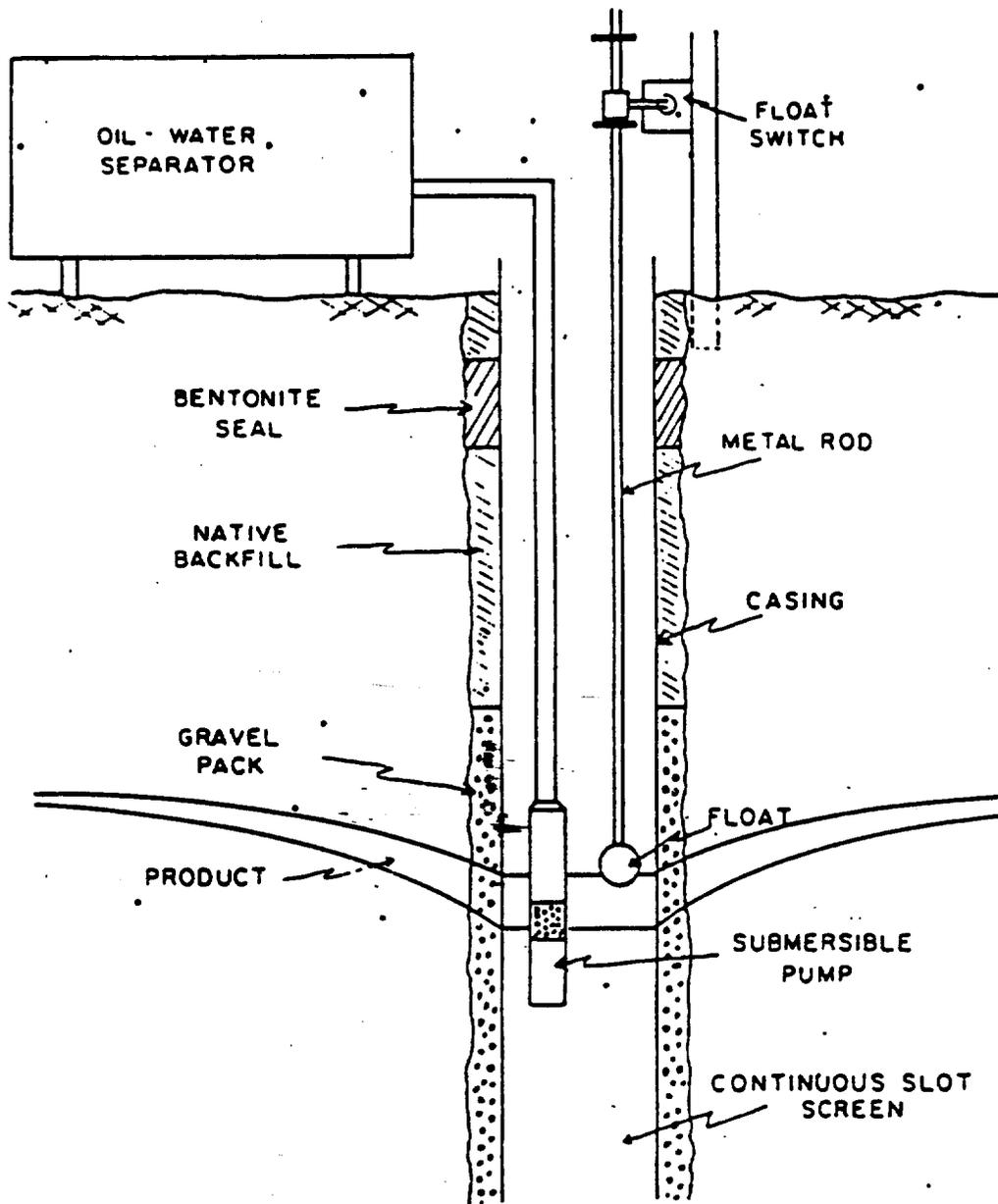
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DATE:
 5/20/86

PROJECT NO.
 35-63481

DRAWING NO.
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Adapted from Blake and Lewis, 1983

Schematic of One-Pump, One-Well
Recovery System

ATEC Associates, Inc.

of North Carolina
6814 Davis Circle
Raleigh, North Carolina 27612
919-782-2832 Raleigh
919-223-3519 Newport

SCALE:
NTS

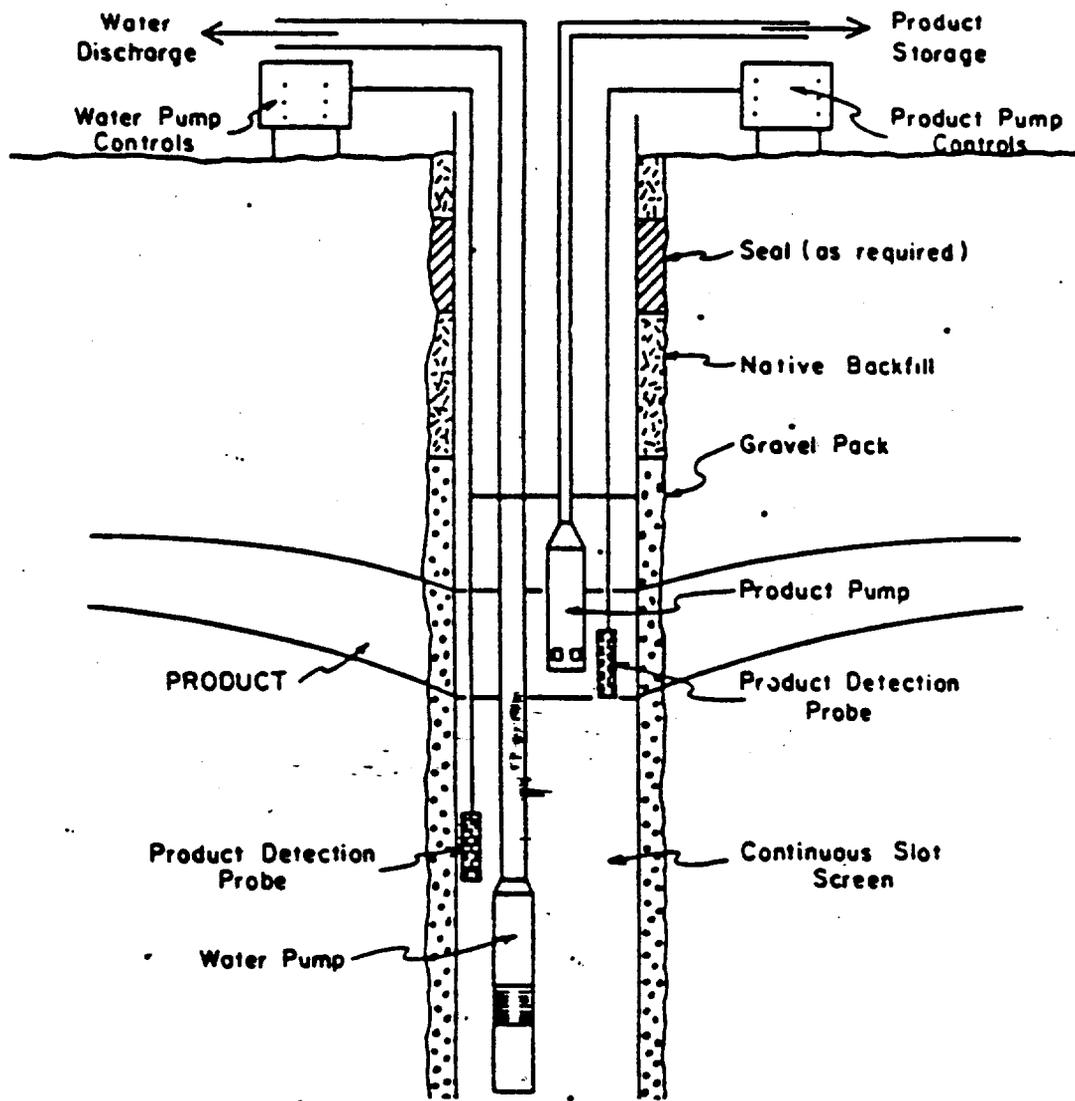
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CHECKED BY:
GPA

DATE:
5/20/86

PROJECT NO.
35-63481

DRAWING NO.
8



Adapted from Blake and Lewis, 1983

Schematic of Two-Pump, One-Well
Recovery System

ATEC Associates, Inc.

of North Carolina
6814 Davis Circle
Raleigh, North Carolina 27612
919-782-2832 Raleigh
919-223-3519 Newport

SCALE:
NTS

DRAWN BY:
GDR

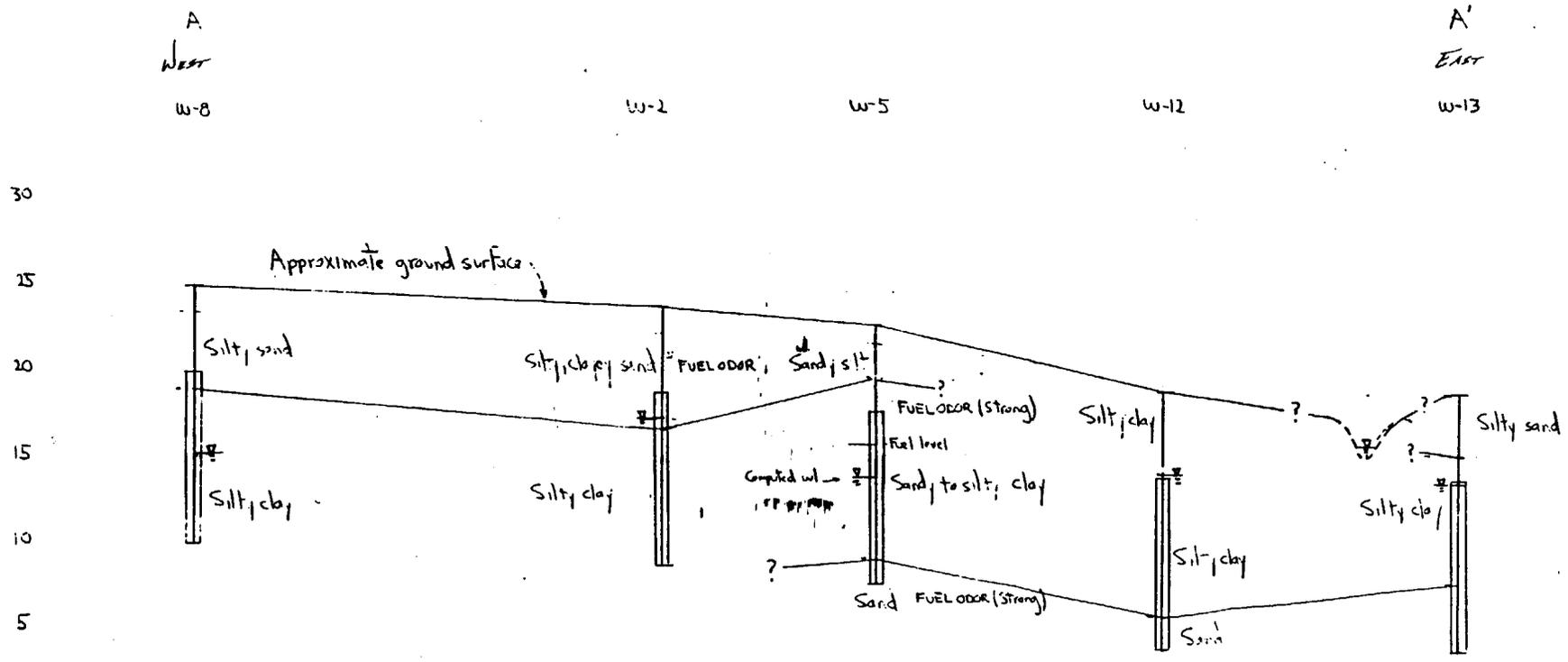
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5/20/86

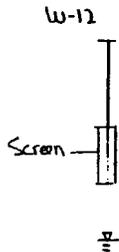
PROJECT NO.
35063481

DRAWING NO.
9

Altitude, in feet above arbitrary datum



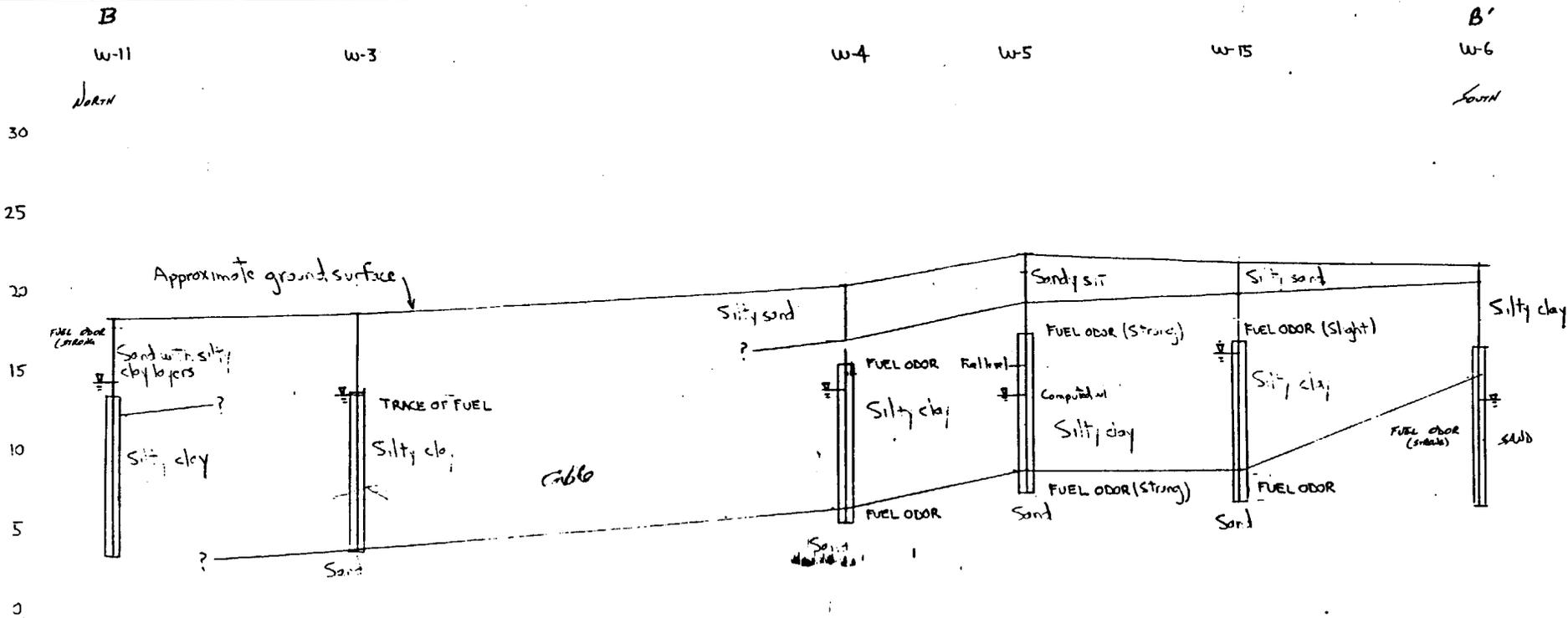
EXPLANATION:



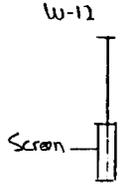
Monitoring well and number. Shows location of screened interval.

Water level on May 12, 1986.

Cross Section A-A' White Street Camp Lejeune, North Carolina				ATEC Associates, Inc. of North Carolina 4814 Davis Circle Raleigh, North Carolina 27612 919-282-2632 through 919-282-2619 telexgram	
SCALE:	DRAWN BY:	CHECKED BY:	DATE:	PROJECT NO.	DRAWING NO.
Graphic	BM	GDR	5-20-86	35-63481	6

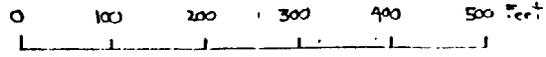


EXPLANATION:



Monitoring well and number. Shows location of screened interval.

Water level on May 12, 1986.



Cross Section B-B' White Street Camp Lejeune, North Carolina				ATEC Associates, Inc. <small>41 North Center 6814 Davis Circle Raleigh, North Carolina 27612 919-822-2822 (telex) 919-822-2819 (mail)</small>	
SCALE:	DRAWN BY:	CHECKED BY:	DATE:	PROJECT NO.	DRAWING NO.
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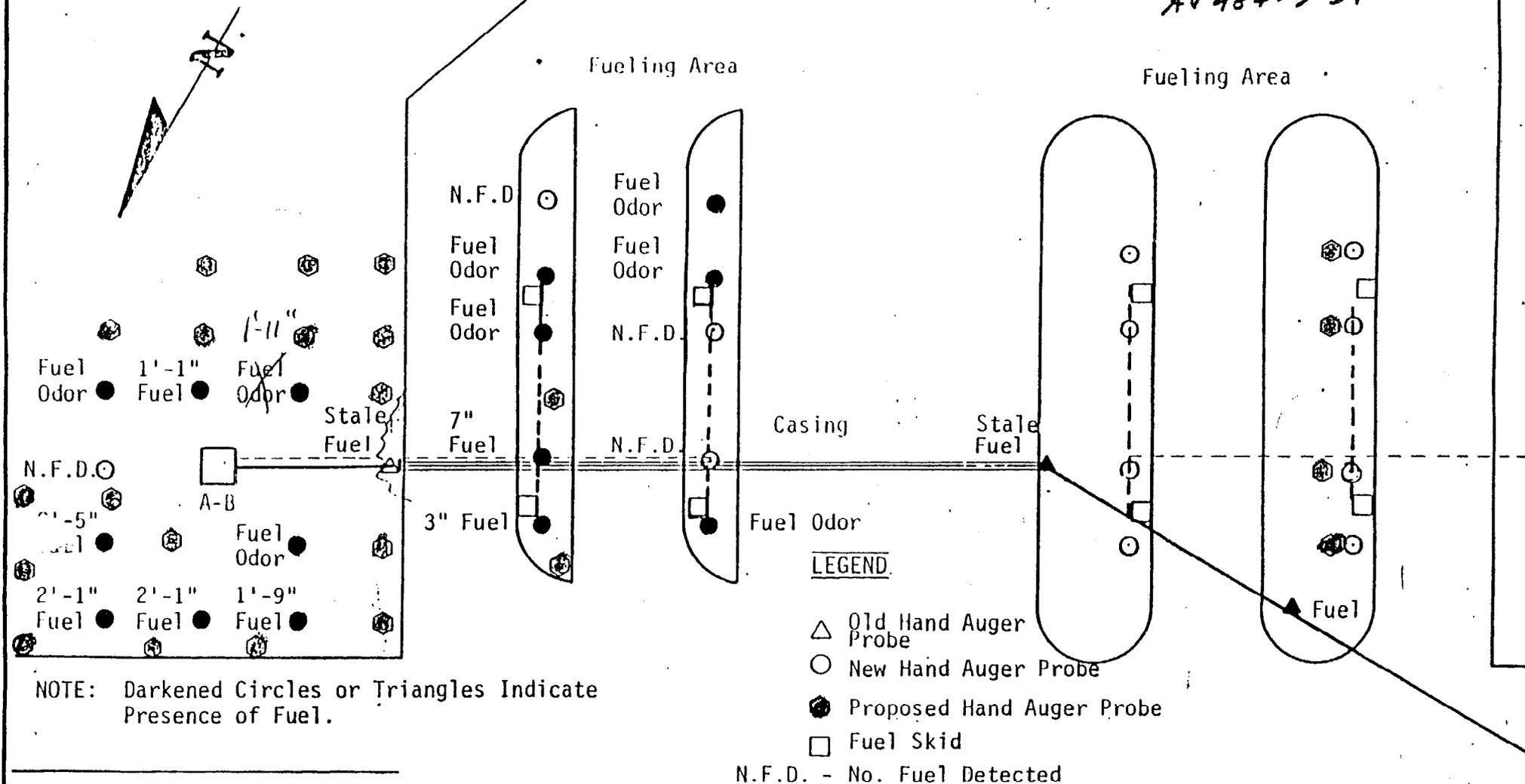
SCOPE OF WORK FOR ADDITIONAL SOIL BORINGS,
MCAS (H) NEW RIVER FUEL PIPELINE INVESTIGATION

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.

23 BORINGS
AS SHOWN BELOW

BoHA 4/30/85

AV 484-3034



NOTE: Darkened Circles or Triangles Indicate Presence of Fuel.

PROJECT Fuel Pipeline Investigation Camp LeJeune Jacksonville, North Carolina	SOIL & MATERIAL ENGINEERS, INC. RALEIGH, NORTH CAROLINA	SCALE: 1" = 100'
		JOB NO: 051-83-354-A
		FIG NO: 8