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INSTALLATION OF WATER- AND GAS-SAMPLING WELLS IN LOW-LEVEL RADIOACTIVE-WASTE BURIAL TRENCHES, WEST VALLEY, NEW YORK

by David E. Prudic

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CONVERSION FACTORS AND ABBREVIATIONS

The following factors may be used to convert U.S. customary units of measurement in this report to International System (SI) units.

U.S. customary units	Multiply by	To obtain SI units
	Length	
inches (in.)	2.540	centimeters (cm)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)
	Area	
square inches (in^2)	6.452	square centimeters (cm^2)
square feet (ft^2)	929.03	square centimeters (cm^2)
acres	2.137	hectares (ha)
	Volume	
cubic feet (ft^3)	28.31	liters (L)
gallons (gal)	3.785	liters (L)
cubic feet (ft^3)	0.02827	cubic meters (m^3)
	Weight	
pounds (lb)	453.59	grams
	Discharge	
gallons per minute (gal/min)	3.785	liters per minute (L/min)
	Pressure	
pounds per square inch (lb/in^2)	6.894×10^3	pascal (Pa)

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ABSTRACT

A low-level radioactive-waste burial site, operated from 1963-75, contains 12 refuse-filled trenches about 20 feet deep in till. Twenty-eight wells, 1¼ inch in diameter, were driven to selected depths in 11 of the 12 trenches to obtain gas and water samples for chemical and radiochemical analysis, water-level measurements for evaluation of trench hydrology, and trench-gas pressure measurements for evaluation of trench-cover permeability. Gas from unsaturated refuse above the trench water level was detected in nearly all wells. Rapid water-level response in most wells to pumping of water from trench sumps 20 to 275 feet distant showed the refuse to be highly permeable. Described in detail are the methods and equipment used to (1) install the wells, (2) collect gas and water samples, and (3) monitor radiation and methane concentrations while driving wells into trenches. A record of each well driven into the burial trenches is included.

INTRODUCTION

Low-level radioactive waste was buried in trenches in till from 1963-75 at West Valley, Cattaraugus County, New York. Interrelated studies of radioisotope migration at the site were begun in 1975 by the U.S. Geological Survey and by the New York State Geological Survey. The U.S. Geological Survey is investigating several low-level radioactive-waste burial grounds within the nation to determine what factors control the subsurface movement of radioisotopes, and the New York State Geological Survey, as the lead agency under a contract with the U.S. Environmental Protection Agency, is evaluating all processes of radioisotope migration at the West Valley site. Many aspects of the two studies require the same information, and several parts of the work were planned jointly by the two Surveys and completed under cooperative financial agreements.

Site Description

The burial site is about 30 miles south of Buffalo, N.Y. at an altitude of about 1,400 feet. The site includes 22 acres and contains 12 trenches--5 at the north end and 7 at the south end. Trenches 1 and 2 lie end to end and are covered as a unit. Wastes were buried in the north trenches from November 1963 to February 1969 and in the south trenches from February 1969 to May 1975. Near the southwest edge of trench 5 is an area where a series of individual holes were excavated to bury special wastes such as commercial stainless-steel reactor components and parts. This area is commonly referred to as trench 6. Another special burial area, referred to as trench 7, just west of trench 6, was used to bury waste in a concrete vault. Detailed information on trench location and burial practices is given in Kelleher (1973 and 1977). The location and major features of the burial site are shown in figure 1.

Wells driven into the burial trenches during 1976-77 and described in this report were assigned two numbers separated by a hyphen and followed by a letter, for example, 5-3C. The first number indicates the trench; the second indicates the well's relative location along the trench axis, and the letter identifies closely spaced wells at a given location (figs. 2-3). Test holes drilled near or between the burial trenches in 1975-76 were assigned letters A-S.

Purpose and Scope

A thorough understanding of the radiochemical composition of water and gas within the burial trenches, and of the factors controlling movement of these substances, is needed to define the transport of radionuclides from the trenches. The types of information described below were needed for both the U.S. Geological Survey and the N.Y. State Geological Survey investigations:

(1) Chemical and radiochemical analyses of trench water from different depths and locations along the trench axes, to evaluate spatial variation in quality of trench water.
(2) Measurements of head at different depths and positions, particularly when water was being pumped from the trenches, to evaluate continuity of the water body within each trench and permeability of the buried refuse.
(3) Chemical and radiochemical analyses of the gas within the refuse above the trench water level, to help evaluate the magnitude of gas transport of radioisotopes through the trench-cover material.
(4) Measurements of gas-pressure fluctuation within the trenches, for comparison with concurrent fluctuations in atmospheric pressure to estimate a bulk permeability of the trench cover.

To obtain this information, a system of wells tapping both the saturated and unsaturated refuse layers in the trenches was needed. Before 1976, the only access to the interior of each burial trench was through a single sump pipe, which had been installed at the time each trench was completed (except trench 1, where a 2-inch pipe was driven through the cover in 1975). Most sump pipes were 8 inches in diameter and extended from about 3 feet above land surface to the bottom of a gravel-filled sump about 3 feet below the lowest point of the trench bottom. Perforations in the lower part of the pipe allowed trench water to enter, and the pipes were open at the top. Near the sump pipes, trench water may have been subject to dilution and oxidation from rain and gas diffusion, and these effects may have been augmented by the small-scale alternating flux of water in response to fluctuations in atmospheric pressure (Prudic and Randall, 1977). The trench water may also have been subject to cross-contamination by transfer of pumps and other equipment from one sump to another. To meet information needs, 28 small-diameter wells were driven into the burial trenches during the summers of 1976 and 1977.

This report describes in detail the methods and equipment used to (1) install the wells, (2) collect gas and water samples, and (3) monitor radiation and methane concentrations while driving wells into trenches. A record of each well driven into the burial trenches is included.

Acknowledgments

Installation of the wells was funded mostly by the New York State Geological Survey-Museum under Grant 68-01-3543, from the U.S. Environmental Protection Agency. The New York State Department of Health, Radiological Sciences Laboratory, collected and analyzed all gas samples and provided much assistance in driving the wells in 1976 and 1977. The New York State Geological Survey collected the initial water samples from the north trenches in 1976, provided information on burial records of most trenches, and helped to drive some of the wells into the north trenches.

The site operator, Nuclear Fuel Services, Inc., provided personnel to monitor radiation levels while the wells were driven into the trenches and while gas and water samples were collected for chemical and radiochemical analysis.

The U.S. Department of Labor, Mine Safety and Health Administration, monitored methane concentrations in wells as they were driven into the trench refuse, collected gas samples for hydrocarbon analysis, and provided advice on safety while wells were driven into the burial trenches.

GENERAL WORK PLANS

General work plans consisted of two different approaches. Plans for the north trenches (1 through 5) were designed to accommodate the high water levels in trenches 3, 4, and 5, where water was close to the trench cover. Plans for the south trenches (8 through 14), where water levels were near the bottom of the trenches, required a different approach. Additional details on trench-water levels are given in Prudic and Randall (1977), p. 9-15.

The general plan for north trenches (1 through 5), where water levels were high, was to drive two or three wells at appropriate sites within each trench. A gas sample was to be collected from each of four trenches while the well point was within the waste but still above the trench-water level. At each sampling site, one well point would be driven to the trench bottom, one to halfway between the bottom and the trench-water surface, and one to just below the trench-water surface. If the first well point could not be driven to the trench bottom, that well would become one of the shallower sampling points, and another attempt to reach the trench bottom would be made a few feet away. If a well could not be driven to the water level, it would be plugged as described in the section "Well-abandonment procedures." Trench 5 had four sampling sites, one of which was close to the sump. At that site only one well point was to be used and would be driven to a few feet below the trench-water level. The sump was considered the deepest sample-collection point at that site. The remaining trenches were assigned one well site each.

The plan for south trenches (8 through 14), where the water levels were near the trench bottoms, was to drive one well to a few feet below the water level in all but trench 12 and to collect a gas sample as each well was driven through the unsaturated part of the trench. No attempt was made to drive a well to water in trench 12 because most of the water had been removed by the site operator in September 1976. If a well could not be driven any deeper before a gas sample could be collected, another well would be driven close by. If a well could not be driven deeper after a gas sample had been collected but before water was reached, another attempt would be made to reach water after wells had been driven in the remaining trenches and all gas samples had been collected. No more than two wells were attempted in each trench, and no well was closer than 50 feet from a trench sump.

Selection of Well Sites

North Trenches

Trenches 2, 3, and 4 were assigned one site each; trench 5 was assigned four sites for detailed study of lateral variation in chemical and radiochemical quality and to define any variation in water level (head). Trench 5 received special attention because (1) it had a history of rapid water-level rise and overflow; (2) it was the only north trench on which adequate burial records had been kept so that concrete and "special nuclear material"1/ could be avoided; (3) any head variation in trench 5 could be compared with head in several piezometers finished in till a few feet west of trench 5 in test holes that had been drilled in 1975.

Trench 2 was selected for sampling because (1) it was the second-oldest trench; (2) it had a lower water level than trenches 3, 4, and 5, which left more space for gas; and (3) it could be used for comparison with head in piezometers in nearby test holes.

At trench 3, the site was placed near a proposed test hole between trenches 2 and 3 to measure the water-pressure gradient beneath the northend trenches. The site at trench 4 was set near the cross-section line through test holes G, H, D, I, and J (fig. 2) to compare head in trench 4 with head in test wells along the cross section.

Sixteen wells were completed within the north trenches 2-5, and one well was abandoned. Since completion of the wells in 1976, Nuclear Fuel Services, Inc., the site operator, has pumped most of the water from each trench. As of 1977, the trench water levels were below the bottom of several wells in trenches 3, 4, and 5. Locations of all wells driven into the north trenches are shown in figure 2.

South Trenches

At the time well installation in the south trenches was being planned, water levels were so low that the north ends of some of the trenches, which slope southward, were probably dry. Well sites intended for water sampling were placed as far north of each sump as possible where the saturated thickness of refuse would be at least 2 feet. Longitudinal sections along the center of each trench were drawn from information on sump design and trench depth supplied by the site operators. According to the site operators (A. G. Bockelman, oral commun; 1977), land surface in the south burial area had been graded to a 2-percent southward slope by removal of the upper soil zone before construction of the trenches, and, because the trench depth had been maintained constant, the trench

1/ Waste containing ^{238}Pu, ^{239}Pu, ^{235}U, and ^{233}U were generally buried in concrete casks (Kelleher, 1973).

floors would have approximately the same slope as land surface. However, geologic logs from test holes drilled nearby, and the bare sloping surface west of trench 14, suggest a smaller land-surface slope. The longitudinal trench sections (figs. 4-7) were revised to correspond to the drilling and topographic data and were then used to determine the maximum distance from each sump where 2 or more feet of water could be expected in each trench. In trench 12, this point was less than 50 feet from the sump; therefore, no attempt was made to drive a pipe to water level. Sites selected in this manner were shifted as necessary to avoid the recorded locations of "special nuclear materials."

Trenches 9, 11, 12, and 14 were selected as permanent gas-sampling points. Trench 9 was selected because it was one of the oldest south trenches; trench 14 because it was the newest. Trench 11 was chosen because burial records indicate a substantial amount of carbon-14 within it. Trench 12, was selected to study air movement through the trench-cover material because it has only one sump pipe that could be plugged easily.

In all, 12 wells were driven into the south trenches; six were finished in the unsaturated zone. Their locations are shown in figure 3.

Materials

In the north trenches (2-5), several types of well points were used and gave varying degrees of success. All well points were 1.5 to 3 feet long, with 60- to 80-mesh screens as described in the well logs at the end of this report (table 3). The least successful were the wirewound well points. Only two of this type were used; one is known to have broken off at the top of the screened interval because when the string of pipe was pulled up and inspected the well point was missing; the pipe was then dropped back into the hole. The second is assumed to have broken off because the measured inside well depth was 1.5 feet less than the depth driven. No further attempts were made to drive the wirewound well points into the trenches because they were evidently not strong enough to withstand the driving forces.

Brass outside-screened and inside-screened well points were used with some success. One of two outside-screened well points is assumed to have collapsed because the measured well depth was about 2 feet less than the depth driven. Problems with the inside-screen well points included clogged screens and snagging of weights within the screened interval during measurement of water levels. The inside-screen well points did not have an enlarged drive head, which may explain why they clogged more readily. The snagging may have been due to the slight collapse of points or the deflection of weights off the vertical. Best results were obtained from button well points, which had half-inch holes drilled into the pipe with disks of a 60-mesh gauze either pressed or glued into the holes. The only disadvantage was that the drive head was larger than the pipe

which could increase the chance of water movement along the outside of the pipe. These well points were the only type used in the south trenches (8-14). A button well point is illustrated in figure 8.

During the driving of the well points, standard-weight 1¼-inch galvanized pipe was added in 5- to 5½-foot lengths. The pipes were connected by drive couplings; threads were coated with a pipe dope compound before connection. A coupling was placed 2 to 3 feet below land surface to facilitate the eventual abandonment of the wells by varying the lengths of the uppermost one to two pieces of pipe in each hole. (See section "Well-abandonment procedures.")

Well-Installation Technique

At each site, a 2- or 3-inch-diameter hole was hand augered to a depth of 3 feet to provide a starting hole for the well point. Heavy weights were dropped 1½ to 5 feet onto the pipe, and well points were driven from an aluminum tripod and motorized cathead as shown in figure 9.

Procedures at North Trenches

Two different weights were used to drive the pipe and well points into the north trenches. (1) A 100-pound weight, about 3 feet long and guided by a sleeve over the pipe, was dropped directly onto a drive cap on top of the pipe (fig. 7); (2) an 80-pound weight slipped over the pipe and dropped onto a 3/4-inch-thick steel plate that rested on a drive coupling between two sections of pipe.

If a gas sample was to be collected, once the well point had been driven through the trench cover, a bentonite-water mixture was tamped into the augered hole around the pipe to prevent the entry of air into the unsaturated zone during sample collection. After the sample had been collected, the pipe and well point were driven to a predetermined depth or until the pipe could not be driven further, whichever came first. If a gas sample was not to be collected, the pipe and well point were driven continuously, and the bentonite-water mixture was added after completion of the hole to prevent the movement of rainwater down the outside of the pipe into the trench.

Procedures at South Trenches

In the south trenches, 100-pound and 140-pound weights were used to drive the pipe and well points. The 100-pound weight was the same as that used at the north trenches, whereas the 140-pound weight used a stub of pipe, a drive coupling, and a 1-inch flat plate atop the pipe. The 140-pound weight was too heavy for the pipe because the first two pipes driven (8-1A and 9-1A, fig. 1) bent or possibly telescoped or broke off

at a coupling several feet above the well point. A steel tape lowered down the hole could not be maneuvered past the point of failure. Only the 100-pound weight was used thereafter, and no similar problems arose.

Once the pipe was driven to a depth of 8 to 10 feet (14 feet at well 8-1A), the augered hole around the pipe was filled with dry bentonite; more was added as needed as the pipe was driven deeper.

Water levels in the south trenches were near the limit of suction lift from land surface; therefore, a coupling was placed just above land surface (in addition to one about 2 feet below land surface) to facilitate water sampling. Each well pipe extends several feet above land surface for visibility, but the upper length of pipe and lowest visible coupling are removed for water-level measurements and water sampling.

On the average, 75 feet of pipe could be driven in 10 hours by a two-man crew. This time includes tripod setup and augering of pilot holes. The location description and notes taken as each well was driven into the trenches are given in records of wells at the end of this report (table 3).

Well-Abandonment Procedures

If a well is to be abandoned, a procedure was developed to minimize the future impact on trench integrity. The well point and pipe would be sealed to ensure that rainwater would not move down the pipe into the trench once the well was abandoned. First, the screen would be filled with sand, and then the pipe filled with a cement-bentonite grout to the coupling placed 2 to 3 feet below land surface. That uppermost length of pipe would be removed so that it would not interfere with trench maintenance, and the remaining 2 to 3 feet of hole backfilled with a till-and-bentonite mixture. Only one well (5-3B) has been abandoned to date; this procedure will be used to fill the other pipes at the end of the investigation.

GAS SAMPLING

Initial plans on how to collect gas samples from the low-level radioactive burial trenches were developed on the assumption that the gases generated in the burial trenches were similar to those generated in a landfill. Generally, anaerobic decay in landfills generate large volumes of gases, mainly methane and carbon dioxide (Zaroni, 1971, p. 6). Both Tritium and Carbon-14 incorporated in wastes buried in the trenches might be escaping from the trenches in the form of methane or carbon dioxide by upward migration through the trench cover. Gas samples were collected with a compressor, hose, and perforated cap temporarily attached to the string of pipe (fig. 10) to provide a preliminary evaluation to the possibility of radionuclide migration through the cover. Analyses of gas sample collected in the north-end trenches have been presented by Husain and others (1978).

Gas Sampling in North Trenches

Gas samples in the north trenches were collected from wells 2-1A, 3-1A, 5-1A, and 5-3A as soon as gas was detected escaping from the well, which began when the bottom of the screens reached depths of 16, 14, 9.5, and 11.5 feet, respectively. The gas samples were pumped for 20 to 40 minutes into previously evacuated 4.2 gallon stainless-steel spheres that when filled were pressurized to 1,000 pounds per square inch. In addition to these samples, one sample was taken atop the trench cover over a collapse feature on trench 3. The center of the feature was about 15 feet south of wells 3-1A and 3-1B and was first observed in April 1976. The site operator filled the collapse feature in May 1976, and by June 1976 it was again a notable depression about 8 feet wide by 12 feet long and bounded by large concentric cracks (the largest cracks were 1 inch wide at the surface.) The collapse feature was about 1 foot deep at the center. A plastic tarpaulin 20 feet square was placed over the collapse feature, and the edges were set in shallow ditches and covered with soil to seal it. Trapped air was pumped from beneath the tarpaulin, and the tarpaulin was then left overnight. The next day, the gas under the tarpaulin was pumped into a 4.2 gallon stainless-steel sphere. Two "whole air" samples from above the burial trenches were pumped into the evacuated 4.2 gallon spheres for comparison.

Gas Sampling in South Trenches

In the south trenches, gas samples were collected when the bottoms of the 2-foot screens reached the depths indicated below:

Well	Screen depth (feet)	Well	Screen depth (feet)	Well	Screen depth (feet)
8-1A	17	11-1A	17	13-1A	17
9-1A	11	11-2A	20	14-1A	12
9-1B	23	12-1A	14.9	14-2A	13

The gas sample from well 9-1B was not collected when gas was first detected in the well; instead, a sample was taken 12 feet below the sampling depth in well 9-1A to determine if there was a vertical difference in the gas composition within trench 9. Generally, no escape of gas from the wells was detected, so when wells had been driven to a depth of 10 feet, an attempt was made to collect a gas sample. If pumping gas from the well created a vacuum on the system, the well point was assumed not to be in the trench refuse, and the pipe and well point were driven another 1 to 3 feet. This process was repeated until no vacuum could be detected. In wells 8-1A, 9-1A, and 10-1A, samples were collected after 2 to 4 minutes of pumping, which was long enough to ensure that no appreciable vacuum had been created in the pipe. The remaining samples were collected after 10 minutes of pumping so that any air that may have been introduced into the well or trench during the driving of the well would be purged. Three "whole air" samples were collected over the south-end trenches while the wells were driven into the trenches.

SAFETY MONITORING

Technicians from the site management monitored radiation at all times during the well driving and gas sampling to ensure that persons on the site would receive minimal exposure to radiation and to detect any release of radioactive materials to the environment.

Before wells were driven into the trenches, little was known about the composition of gases above the water in each trench. It was considered possible that the gases might include potentially explosive mixtures of methane and oxygen, which could be ignited by a spark from a well point striking concrete or steel. Therefore, an inspector from the U.S. Department of Labor, Mine Safety and Health Administration, was invited to monitor the methane content of the trench gas as wells were driven through the refuse.

As a well point was driven into each trench, methane was monitored with a hand-held methanometer, which can detect methane concentrations as high as 5 percent of the total volume of gas. Generally, methane in air is considered explosive if its concentration is between 5 and 15 percent of the total volume; concentrations above 15 percent will usually not explode because the oxygen in the air is insufficient to sustain combustion unless the methane has been mixed with oxygen from an outside source. In the north trenches, atmospheric pressure was declining during most of the time that the wells were driven, which caused a net outward flow of trench gas to the environment through the pipe. The methanometer was placed at the top of the pipe to monitor the methane content of the gas. Methane concentrations exceeded 5 percent in a few wells; however, the well was thought to be nonhazardous for several reasons:

(1) At most sites, gas came out of the well in a way that prevented atmospheric oxygen from mixing with trench gas near the well point.

(2) The gas-filled part of the trenches was only 3 to 4 feet thick.

(3) The gas-filled part of each trench had been previously saturated with trench water, which probably left enough moisture to suppress spark production.

(4) The pipe was usually capped during driving so that air could not enter the well in large quantities even during periods of increasing atmospheric pressure.

In the south trenches, wells were driven mainly during periods of stable or increasing atmospheric pressures, which produced a net inward flow of air through the pipe. In these trenches, methane content was monitored by connecting the methanometer to a hose and lowering it down the pipe, as shown in figure 11, and collecting samples only after gas was encountered, as indicated by readings at the outlet of the gas compressor. Generally, readings from the hose connected to the methanometer indicated concentrations of less than 1 percent, whereas methane concentrations at

the outlet of the gas compressor ranged from 2 to 4 percent. The technique of monitoring methane with the hose down the pipe gave unsatisfactory readings, probably because air entered the pipe during measurement. Methane concentrations at the outlet hose of the compressor were probably more representative of methane concentrations within the trench because the pipe was sealed to prevent the entrance of air.

Driving wells in the south trenches was presumed to be nonhazardous because (1) methane concentrations at the outlet hose of the compressor were generally below 5 percent, and (2) most pipes were capped while wells were being driven. Additional gas samples were collected periodically in a vacuum bottle by the Mine Safety and Health Administration (fig. 12). In this method, the vacuum bottle was held in the stream of gas issuing from the top of the pipe (trench 5) or from the 3/8-inch outlet of the compressor while pumping trench gas (trenches 8-14). To collect a sample, the top of the bottle was broken off within the stream so that gas would be drawn into the bottle. In only one sample did methane concentration exceed 5 percent; its concentration was 49 percent. Other samples did not indicate high methane concentrations (table 1). It is possible that the vacuum bottles drew in some air, particularly at trenches 8-14. A mixture with air was much less likely in samples collected in the 16-liter and 1-liter containers. Results of gas-sample analyses collected by the Mine Safety and Health Administration are presented in table 1.

TRENCH-WATER SAMPLING

Most wells were driven to collect trench-water samples for chemical and radiochemical analyses. Trench-water samples have been collected several times since 1976; those collected most recently were obtained without introducing air to the trench water (Columbo and others, 1977). The purpose of this section is not to describe each water-sampling technique used but to evaluate the performance of each well while trench water was being pumped out. Some analyses of trench water collected at the site are presented in Husain and others (in press).

Wells in North Trenches

Water was pumped from the 15 successful wells in trenches 2-5 in June and July 1976 with a peristaltic pump and 3/8-inch inside-diameter silicone rubber tubing at the surface connected to 3/8-inch polyethylene or polyvinyl chloride (PVC) tubing down the pipe. Pumping rate was 1/5 to ½ gallon per minute. Of the 15 wells, 6 did not yield entirely adequate amounts of trench water. Wells 5-1A, 5-1B, 5-1C, and 5-2A were found to have inadequate yields to collect representative samples, and wells 5-2B and 4-1A yielded less than 1/10 gallon at 5-minute intervals.

Table 1.--Analyses of gas samples collected by U.S. Department of Labor, Mine Safety and Health Administration

[Analyses by sample-collecting agency; all values are in percent of total gas volume]

Well No.	Date	Eastern time	Constituent 1/								
			Carbon dioxide	Oxygen	Methane	Carbon monoxide	Ethylene	Ethane	Acetylene	Propane	Butane
5-3B	06-07-76	1715	0.04	20.92	0.002	0.0000	0.000	0.000	0.000	0.000	--
5-3A	06-07-76	1530	3.18	4.85	49.01	.0000	.34	.023	.000	.007	--
8-1A	06-14-77	--	2.55	15.76	2.23	.0000	--	--	--	--	0.18
9-1A	06-14-77	1045	1.03	19.16	.23	.0000	--	--	--	--	--
11-1A	06-15-77	1030	1.08	17.52	.06	.0001	--	--	--	--	--
12-1A	06-15-77	1330	1.72	16.94	.18	.0000	--	--	--	--	--
13-1A	06-16-77	1445	5.65	6.22	.23	.0046	--	0.01	--	--	--
14-1A	06-16-77	0930	2.99	15.37	.13	.0025	--	0.00	--	--	--
14-2A	06-16-77	1115	4.87	8.88	.25	.0001	--	--	--	--	--
11-2A	06-16-77	1400	2.03	10.31	.34	.0003	--	--	--	--	--

1/ Percentage of nitrogen can be determined by subtracting the sum of the reported values at a given time from 100.00.

Nitrogen was injected into each of these wells (except 4-1A) in an attempt to dislodge any soft material that may have been smeared against the screens. One large nitrogen tank was emptied into wells 5-1A, 5-1B, and 5-1C. After nitrogen had been injected, water entered well 5-2A, which had previously been dry, but the performance of the other four wells did not improve. The low yields of these wells may be attributed to several possible causes: (1) The screens may have ended inside a metal barrel filled with vermiculite; (2) the screens may have become plugged by paper or plastic or other debris; and (3) the points were driven into backfilled or slumped material just above the trench bottom or into soft clay till underlying the trench bottom.

Wells 5-2C and 5-3C were found to be almost 2 feet less in depth than the length of pipe driven into the trench, so 1 or 2 gallons of water was poured into each well to determine whether it was in communication with the trench. In well 5-3C, water was added twice, once before the pipe was pulled back a few feet and once after. A moderately slow recovery during the initial "slug test" showed that the point was partly in communication with the trench, but after the pipe was pulled back, the water level returned to normal immediately. No change in water level could be detected after water was added to well 5-2C. It is assumed that dumping water into the wells had little effect on chemical quality of water collected later because at least 5 gallons was pumped to waste from each well before samples were collected.

Only the samples collected in June and July 1976 represent all responsive wells in the north trenches because, during the next 3 months, the site operator pumped most of the water out of trenches 3, 4, and 5. As of 1977, water levels in these trenches were below the bottom of most wells.

Wells in South Trenches

During July 1977, soon after the well points were installed in the south trenches, an attempt was made to collect water samples from several wells with a peristaltic pump and 3/8-inch inside-diameter laboratory-grade flexible PVC tubing. Wells 14-1A and 8-1B were pumped for 8 to 15 minutes at about ½ gallon per minute, but the remaining wells were not as productive. Well 9-1B had only 0.1 foot of water in the screen, and well 10-1B was dry at the time water samples were being collected, although water gradually seeped in over the next few weeks. Two weights were lost in well 13-1A during measurement of depth before pumping so that the flexible PVC tubing could not be inserted to the bottom. All water above the base of the tubing was pumped out in less than a minute, and no more could be pumped 5 minutes later. Well 11-1A was pumped intermittently at an average rate of 1/5 gallon every 7 minutes. Both wells 11-1A and 13-1A may have penetrated the trench floor.

WELL RESPONSE TO TRENCH PUMPOUTS

Water was pumped from most of the burial trenches at several times in 1976 and 1977. In the north trenches (2 through 5), 9 of 15 wells exhibited water-level declines that were virtually identical to those measured in the sump pipes from which trench water was pumped. This prompt response indicates that the nine wells were in good communication with the trenches and that the refuse generally has a high permeability. Three wells showed delayed responses, and three did not respond at all to the pumpdowns, as shown by graphs in figures 13-20. In the south trenches (8 through 14), four trenches were pumped (9, 10, 11, and 14), but only in trenches 11 and 14 did the wells show a response to the pumpdowns (figs. 21-22). Table 2 lists all wells and their response to trench pumpdowns.

Wells that responded slowly or not at all to trench pumpdowns were probably either driven through the trench floor or into collapsed or caved-in backfill near the trench floor that reduced the connection with the trench, or were finished in zones within a trench where local inhomogeneities either slowed or blocked the movement of trench water. Detailed interpretations of individual wells that did not show a good continuous response to the trench pumpdowns are presented in the following paragraphs.

Wells in North Trenches

Wells 5-1A, 5-1B, and 5-1C.--Wells 5-1A, 5-1B, and 5-1C, near the north end of trench 5, did not respond to the pumping of trench water from the sump (about 130 feet south of the wells, fig. 1), and water levels differed from well to well both during and after the pumpdown. (See fig. 15.) Gas was detected at a depth of 6 to 8 feet below land surface in at least two wells (5-1A and 5-1C) while the wells were being driven into the refuse; a gas sample was taken from well 5-1A. The release of gas suggests good communication between the well and the rest of the trench at the 6- to 8-foot depth or at least greater permeability laterally through the refuse than through the cap above. Water communication at this depth may have been possible during the period of peak trench-water levels in 1975.

These wells at final depth (13-20 ft) showed no evidence of communication with the trench. Attempts to collect water samples from wells 5-1A and 5-1B failed because the points could be pumped dry in seconds and did not refill for hours. Well 5-1C was dry before the pumpout, and water did not begin to percolate into the point until July 13, 1976, 1 week later. The pattern of deeper water levels in successively deeper wells at this location and the slow water-level rise for several weeks after well installation are typical of till.

The type of well construction used may have allowed water levels in these wells to reflect average head at and somewhat above the screened intervals; nevertheless, it is reasonable to infer from water-level

Table 2.--Well response to trench-water pumpdowns

Well no.	Depth of point (feet below land surface)	Dates pumped (months/year)	Remarks
NORTH TRENCHES:			
2-1A	29.8	7-9/77	Water level generally within 0.3 ft of sump water level.
3-1A	23.7	7-10/76 10/77	Do.
3-1B	17.9	7-10/76 10/77	Do.
4-1A	28.2	7-10/76 10/77	Response lagged; water level generally more than 0.3 ft from sump water level.
4-1B	18.4	7-10/76 10/77	Water level generally within 0.3 ft of sump water level.
5-1A	13.5	7-9/76 10/77	No response to trench pumpdown.
5-1B	20.1	7-9/76 10/77	Do.
5-1C	16.6	7-9/76 10/77	Do.
5-2A	14.9	7-9/76 10/77	Response lagged; water level generally more than 0.3 ft from sump water level.
5-2B	29.3	7-9/76 10/77	Do.
5-2C	17.5	7-9/76 10/77	Water level generally within 0.3 ft of sump water level.
5-3A	30.0	7-9/76 10/77	Do.
5-3B	--	--	Well was abandoned.

Table 2.--Well response to trench-water pumpdowns (Continued)

Well no.	Depth of point (feet below land surface)	Dates pumped (months/year)	Remarks
NORTH TRENCHES (Continued)			
5-3C	15.9	7-9/76 10/77	Water level generally within 0.3 ft of sump water level.
5-3D	24.1	7-9/76 10/77	Do.
5-4A	13.9	7-9/76 10/77	Do.
SOUTH TRENCHES:			
8-1A	29±	--	Trench not pumped; well collapsed several feet above screen.
8-1B	30.0	--	Trench not pumped.
9-1A	26.5	11/77	Well collapsed several feet above screen.
9-1B	29.5	11/77	Well was dry at the time water was pumped from trench.
10-1A	19.7	11/77	Screen above trench water level.
10-1B	27.5	11/77	No response to trench pumpdown.
11-1A	29.5	9-10/77	Well responded; insufficient data to classify.
11-2A	20.0	9-10/77	Screen above trench water level.
12-1A	14.9	9/76	Screen above trench water level.
13-1A	30.2	--	Trench not pumped.
14-1A	27.3	11/77	Well responded; insufficient data to classify.
14-2A	13.0	11/77	Screen above trench water level.

behavior that wells 5-1C and 5-1B are finished in till beneath or beyond the trench, where ground-water movement is predominantly downward. It may be that the trench is shallower than normal at wells 5-1B and 5-1C because of a ramp at the north end for bulldozer access. (See figs. 2-5.) Blow counts recorded during the driving of wells 5-1B and 5-1C suggest that the trench floor may be near a depth of 16 feet below land surface, below which the number of blows to the pipe uniformly increased with depth. This would place well point 5-1B about 4 feet below the trench floor and point 5-1C less than 1 foot below it. The method of determining the trench floor from blow counts is imprecise because the trench floor might be soft mud or very wet plastic till.

Well 5-2A.--Well 5-2A had a limited response to the pumpdown of trench water. It is a shallow well, finished about 15 feet above the trench floor and about 2 feet below trench-water level at the time it was completed. At first, no water entered the well. After 14 days, pressurized nitrogen was injected into the pipe and probably dislodged some material that was clogging the screen, because water rose in the well thereafter. When pumping of trench 5 began, the water level in well 5-2A was still rising. The long period of water-level rise (fig. 16) probably cannot be attributed solely to the plugged screen, inasmuch as the water level continued to rise after trench 5 had been pumped far below the screen in well 5-2A and ultimately rose above the initial water level in the trench (indicated by sump 5 and 5-2C, fig. 16).

About 2 weeks after the pumping began in trench 5, the water level in well 5-2A began to decline slowly. By April 1977, the water level was at an altitude of 1,371.4 feet1/, or 14.1 feet below land surface, but then rose gradually to 1,372.0 feet until October 1977. All of this suggests that well 5-2A is finished in a body of poorly permeable material (probably reworked till used as cover) that formed a saturated mound in 1976 and formed or controlled a perched saturated zone in 1977.

Wells 5-2B and 4-1A.--Well 5-2B also had a limited response to pumpdown. It was driven to a depth of 29 feet, just above the estimated bottom of trench 5. In December 1977, cores were collected a few feet away between depths of 27 and 38 feet, and geophysical logs were run in the hole. The logs suggest that well 5-2B was finished in a mass of soft disturbed till (presumably caved or backfilled material) just above the trench floor and may have penetrated a foot into undisturbed till or layered silt and clay beneath the trench floor. This would explain why well 5-2B was not very responsive to changes in the water level within trench 5 and also explains the slow infiltration rate into the pipe when pumping was attempted. (See section "Trench-Water Sampling.") The gently declining water level in well 5-2B in August and early September 1976, despite a higher and rising water level in

1/ All altitudes given hereafter are in feet above mean sea level.

the trench at sump 5 (fig. 16), could be interpreted as reflecting a downward gradient through the disturbed till, which became more evident as the disturbed till above the screen settled against the pipe. Well 4-1A in trench 4 exhibited similar water-level behavior (fig. 14) and is therefore assumed to be finished in similar material at or just beneath the trench floor. Water was pumped from well 4-1A at about 1/10 gallon every 10 minutes, but radiochemical analyses of water from well 4-1A are similar to those from well 4-1B and sump 4 (Husain and others, 1978), which suggests that trench water does infiltrate into well 4-1A.

Well 5-3A.--Near the south end of trench 5, all wells responded to the pumpdown almost immediately, which indicates excellent movement of water from the south end of trench 5 to the sump (figs. 17 and 18). Well 5-3A, finished near the estimated trench floor, responded to the pumpdown until September 13, 1976, when the water level was near 1,361 feet in altitude. Continued removal of water from sump 5 did not affect the water level in well 5-3A, which stayed nearly constant until January 1977, when water in sump 5 rose to nearly 1,361 feet, and water in well 5-3A began to rise in response. The lack of correspondence in water levels between well 5-3A and sump 5 from September 1976 to January 1977 may be caused by a barrier or by a saddle in trench floor with a minimum altitude of 1,361 feet somewhere between the sump and well 5-3A, which would prevent northward drainage of trench water trapped below that altitude near well 5-3A.

Well 2-1A.--The response of well 2-1A to the pumpdown of trench 2 in July 1977 (fig. 11) was similar to the behavior of well 5-3A. At first, drawdown in well 2-1A matched that of sump 2, but once the water level in well 2-1A reached an altitude of 1,360 feet, the well no longer responded to further removal of water from sump 2. Presumably this was caused by a barrier, or saddle, in the trench floor at or near the altitude of 1,360 feet.

Wells in South Trenches

Wells 10-1B, 11-1A, and 14-1A.--During October and November 1977, four trenches in the south part of the burial ground were pumped. Well 10-1B did not respond to pumping in sump 10N, probably because of a reported barrier of undisturbed till (A. G. Brockelman, oral commun., 1977) between the well and sump 10N (fig. 20). However, well 10-1B had a lower water level than sump 10S and a continuous, slow water-level rise as though it were finished in material of low permeability (fig. 20). Water levels in wells 11-1A and 14-1A were almost identical to those in the respective sumps both before and after trench pumpdown (fig. 21), although not enough measurements were made, particularly in 11-1A, to prove a nearly simultaneous response to the removal of water.

SUMMARY

Twenty-eight wells were driven into 11 of 12 waste-burial trenches to provide information on trench-water composition, trench-gas composition and pressure, and trench hydrology. Water levels in the north trenches were high within a few feet of the trench cover; south trenches were partly dry. Of the 28 wells that were driven into the burial trenches, 3 were unusable, 9 had small yields, and 16 yielded adequate water and gas samples. The wells provided access points for water and gas sampling and for information on burial-trench hydrology. The technique used for driving wells into the burial trenches produced little risk of exposure to radiation to individuals doing the work. The technique seems to have maintained trench integrity during emplacement, and wells that were abandoned or that will be abandoned in the future should have a minimal impact on trench integrity.

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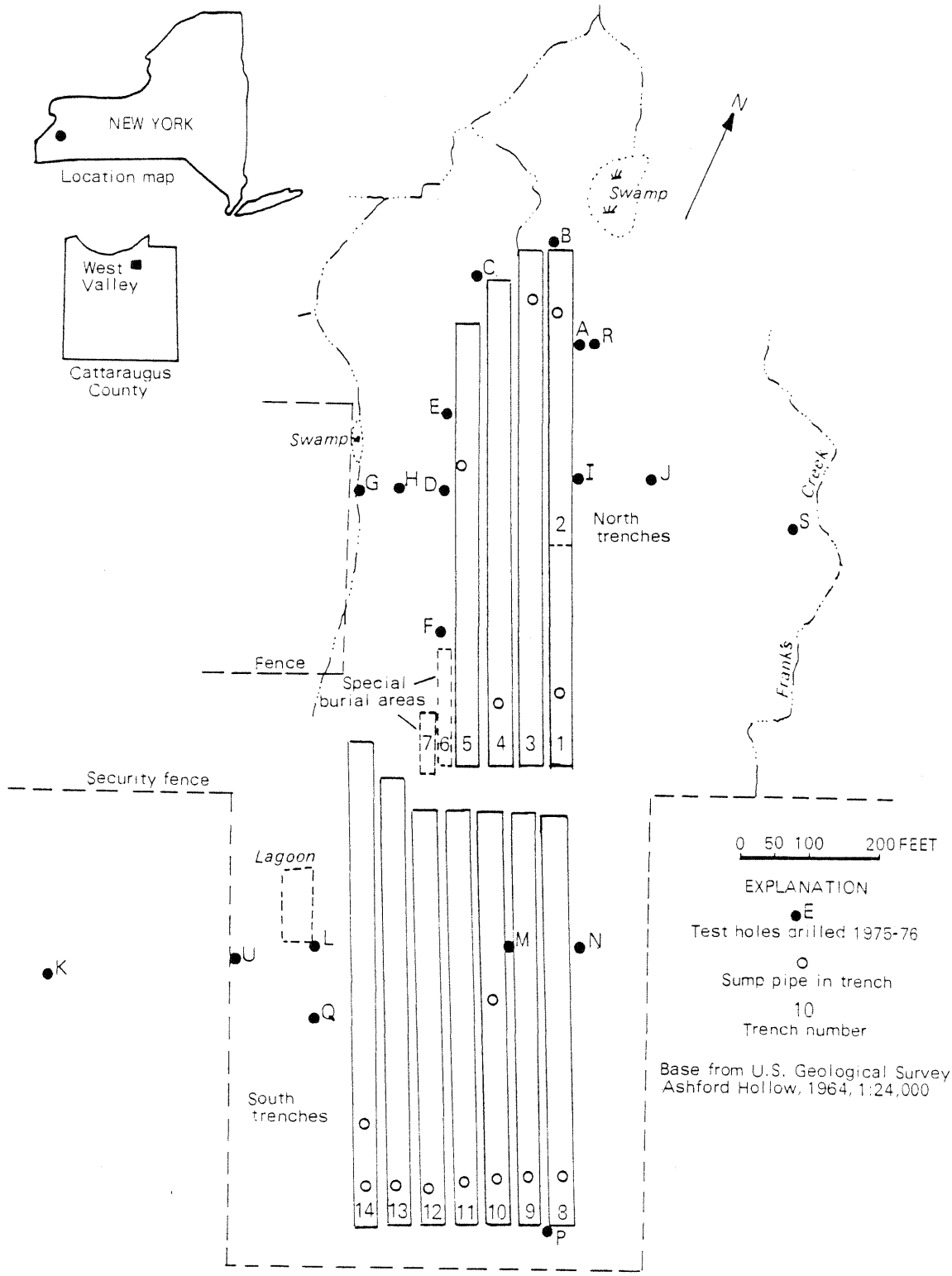


NOTE: Map based on plane-table survey by R.J. Martin, U.S. Geological Survey,1975-78.

Figure 1.--Locations of low-level radioactive-waste burial trenches, West Valley, N.Y.

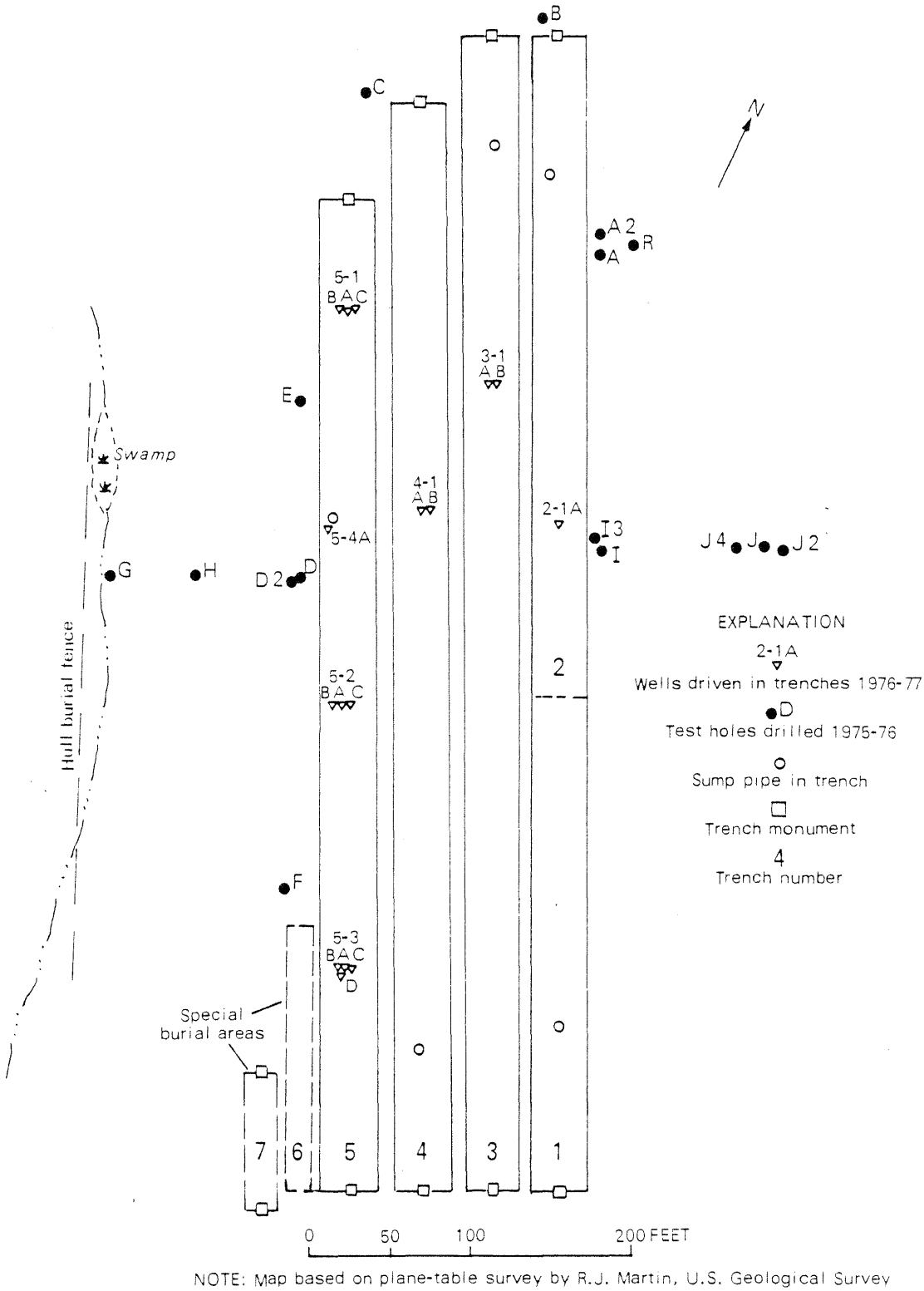
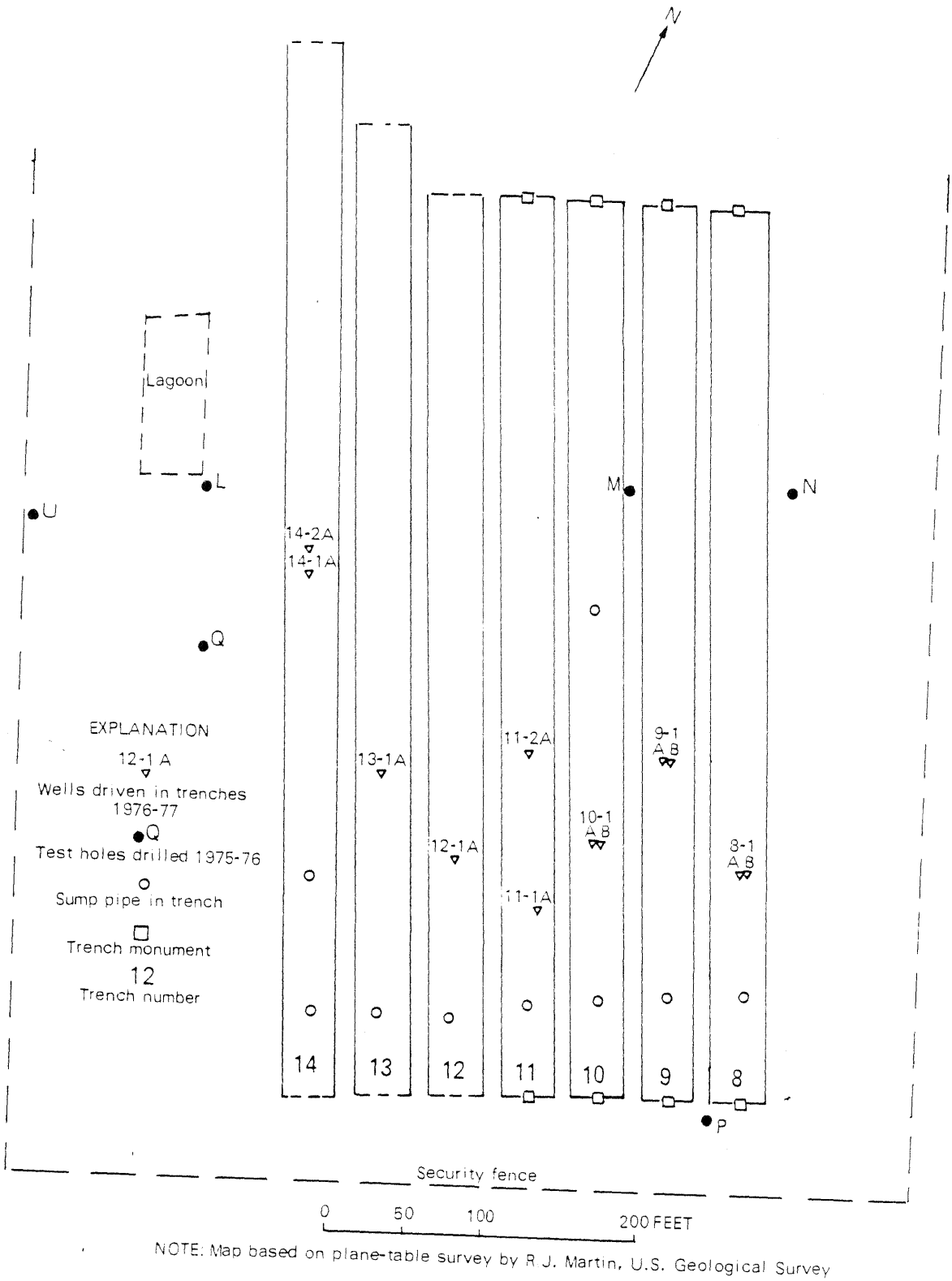


Figure 2.--Locations of driven wells, test holes, sump pipes, and trench monuments in north burial trenches.



NOTE: Map based on plane-table survey by R J. Martin, U.S. Geological Survey

Figure 3.--Locations of driven wells, test holes, sump pipes, and trench monuments in south burial trenches.

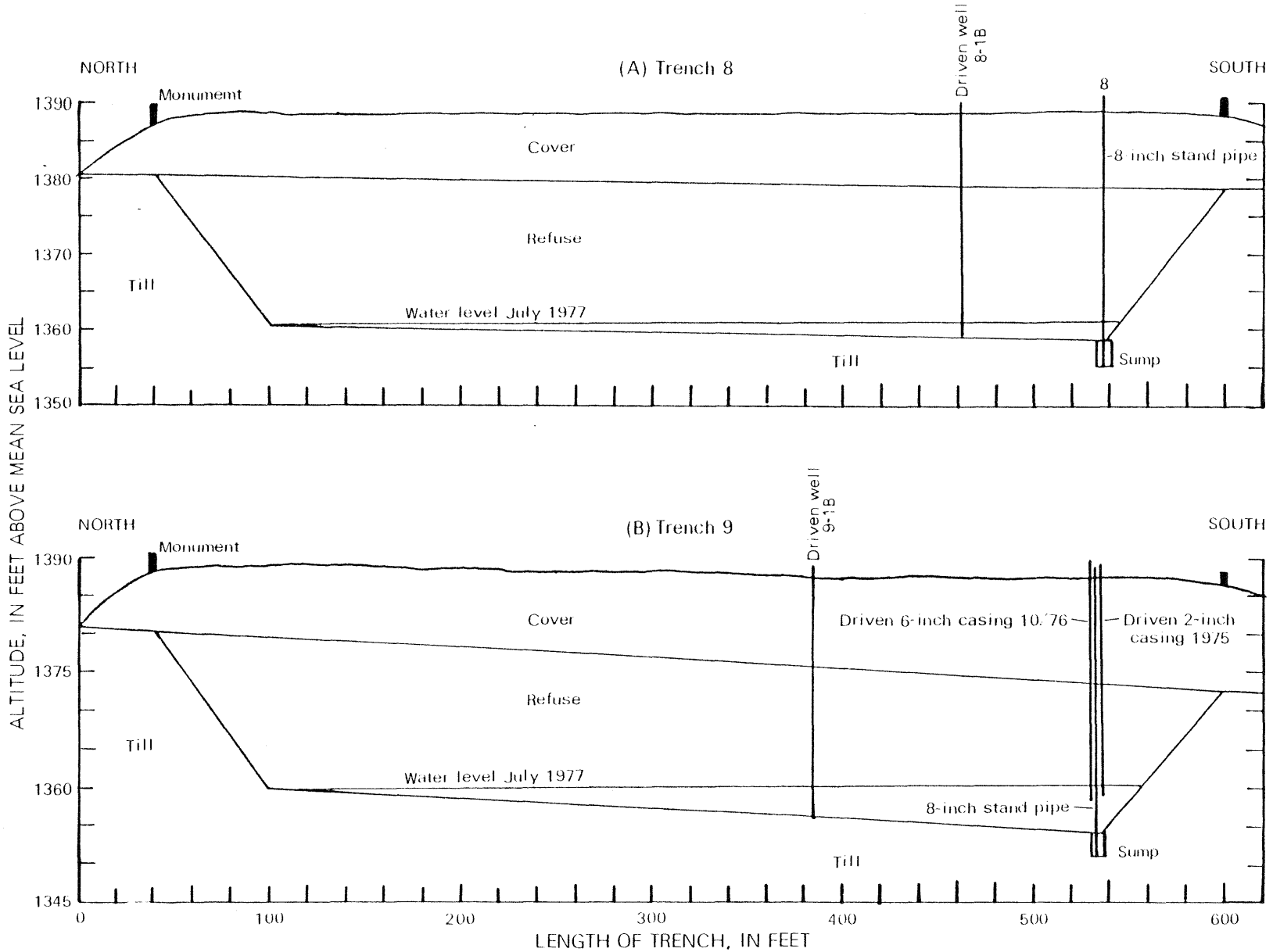


Figure 4.--Longitudinal section of south trenches 8 and 9.
(Locations of trenches are shown in figure 1.)

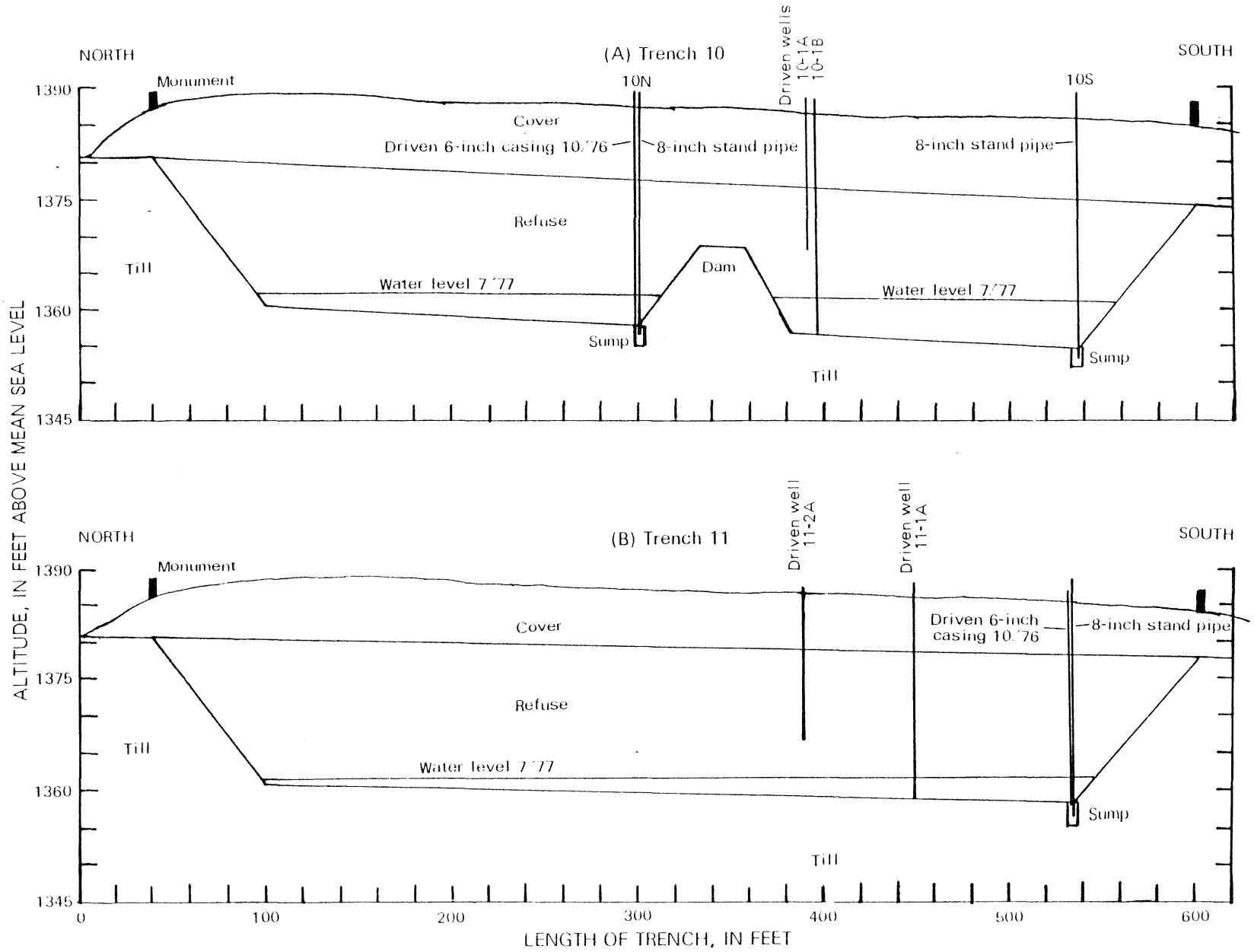


Figure 5.--Longitudinal section of south trenches 10 and 11.
(Locations of trenches are shown in figure 1.)

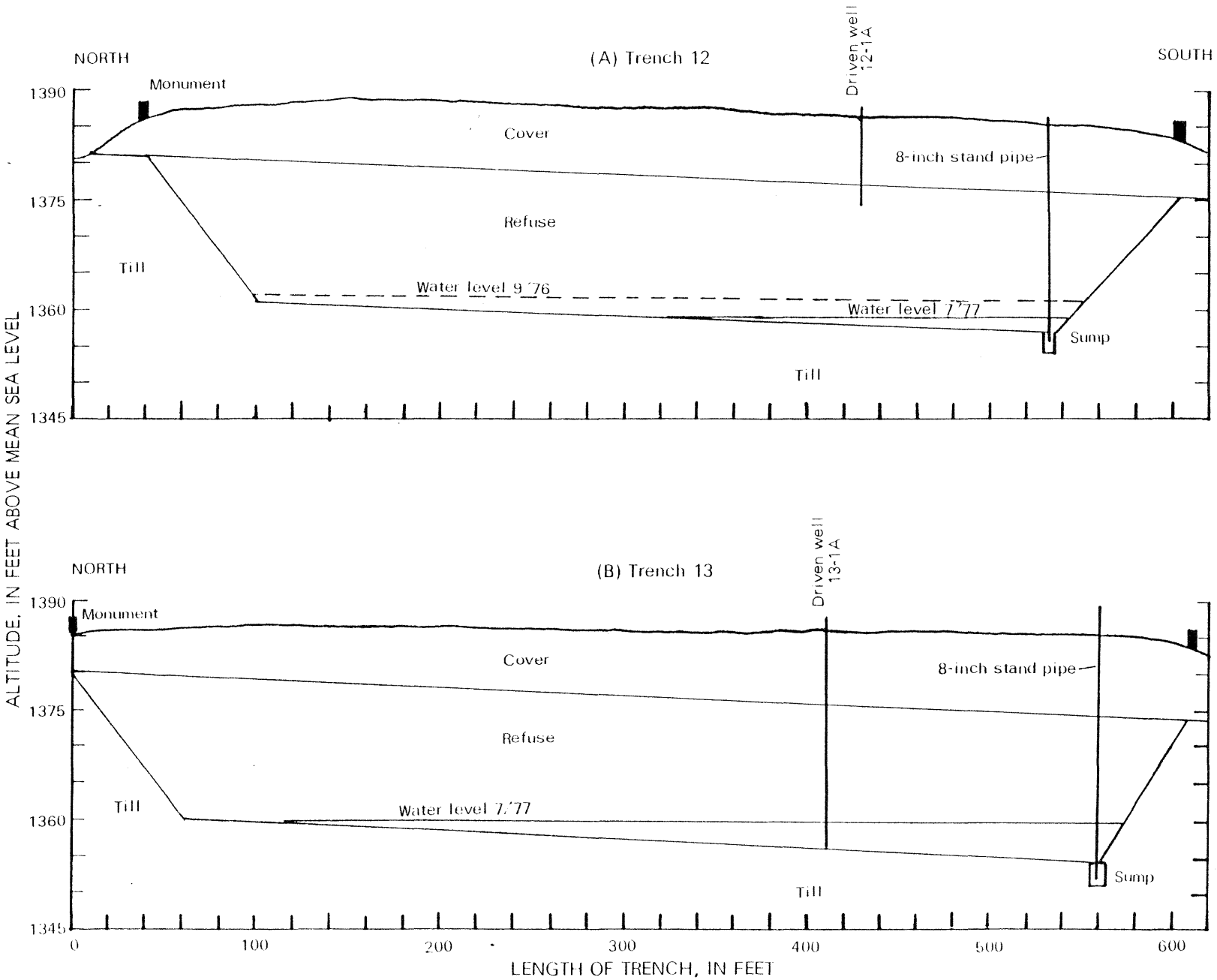


Figure 6.--Longitudinal section of south trenches 12 and 13.
(Locations of trenches are shown in figure 1.)

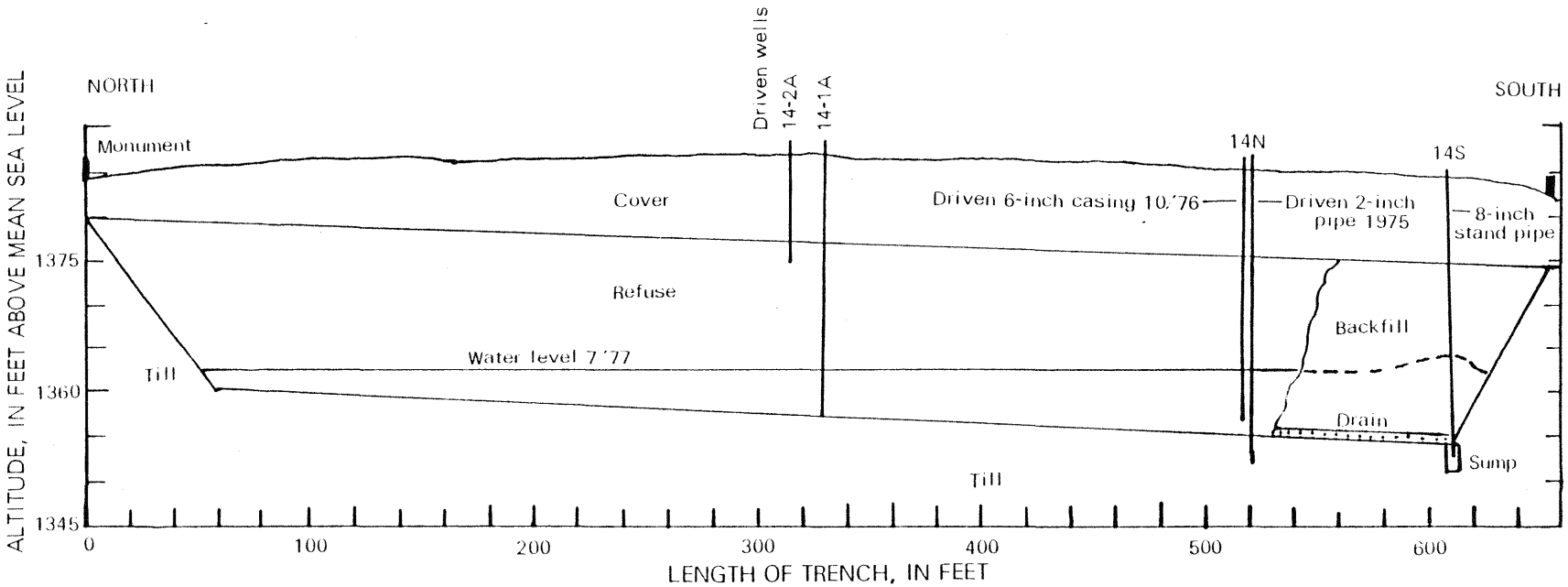


Figure 7.--Longitudinal section of south trench 14. (Location of trench is shown in figure 1.)

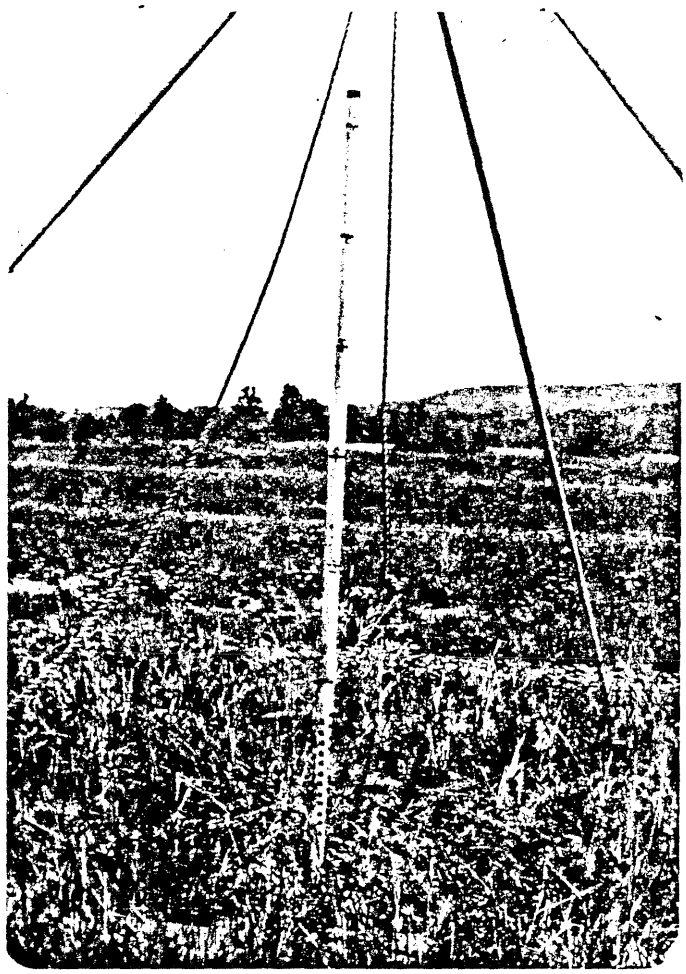


Figure 8.--Button well point attached to first section of 1¼-inch galvanized pipe.

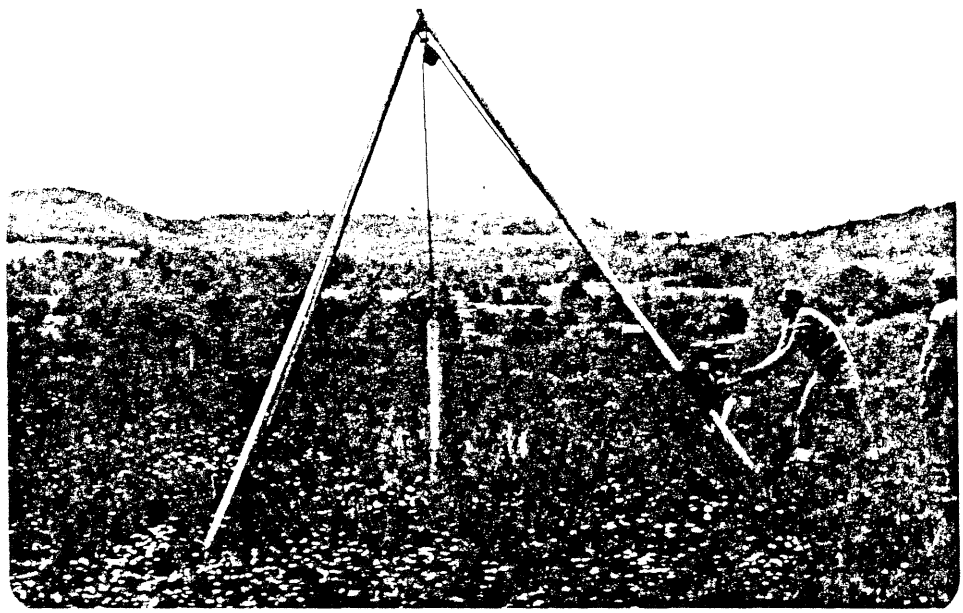


Figure 9.--Arrangement of tripod, cathead, and weight as well point is driven.

Figure 10.--Apparatus used to collect gas samples. A, Compressor; B, Flexible polyvinyl chloride tubing; C, Perforated cap; D, Gas-sampling container.

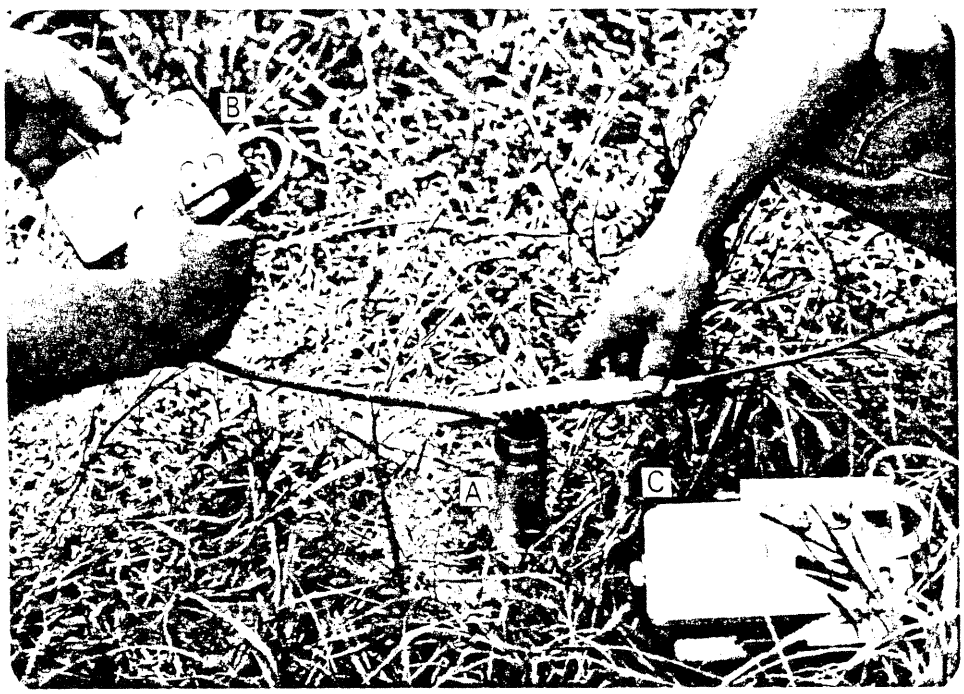


Figure 11.--Equipment used in measuring methane concentrations in wells driven into south trenches. Radiological survey meter was also in use. A, pipe; B, methanometer and attached tubing; C, radiological survey meter.

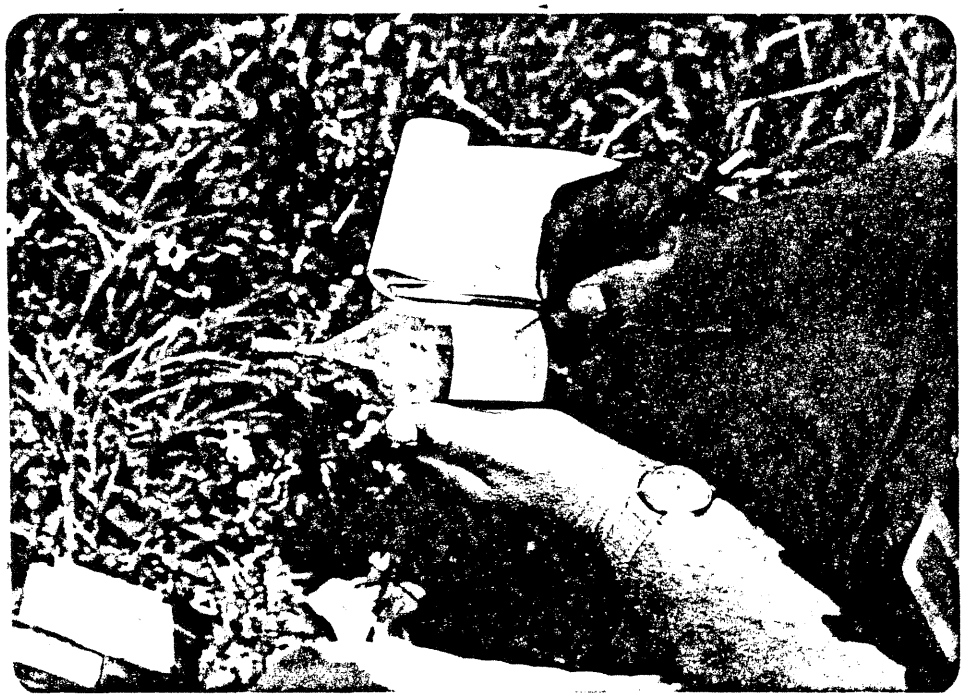


Figure 12.--Bottle used by U.S. Department of Labor, Mine Safety and Health Administration, for hydrocarbon sampling.

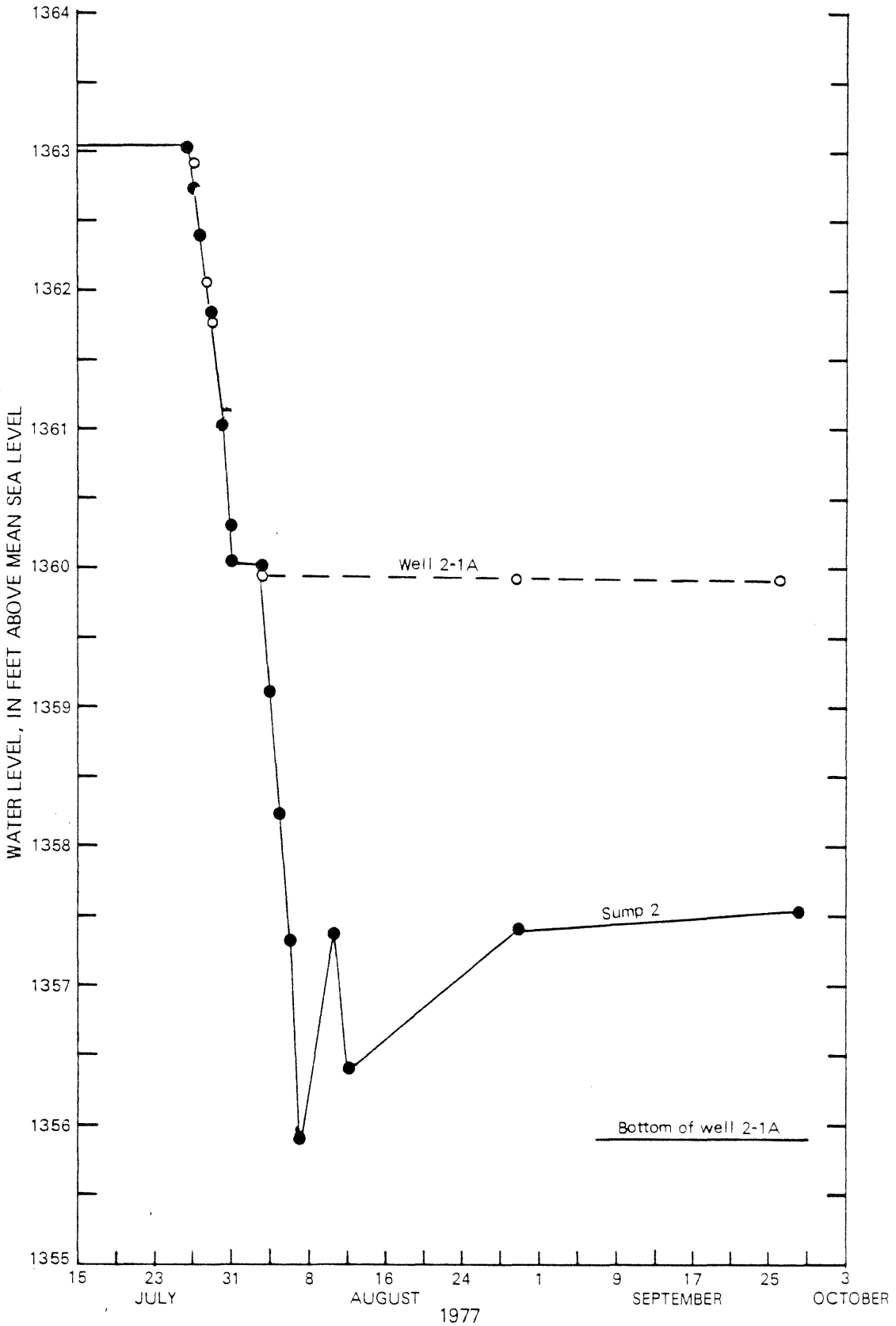


Figure 13.--Response of well 2-1A to trench-water pumpout, July 2 - August 12, 1977.

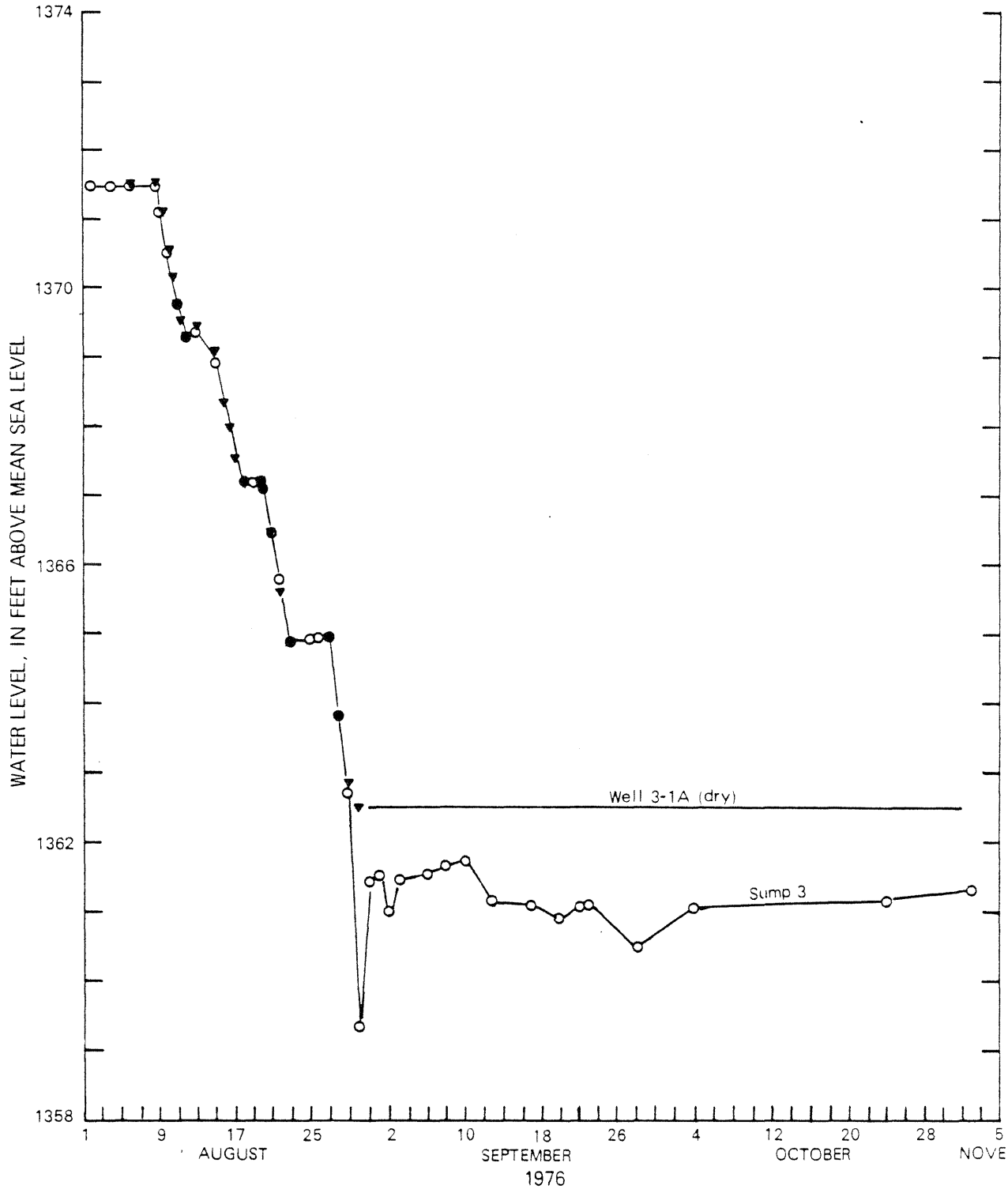


Figure 14.--Response of well 3-1A to trench-water pumpout, August 9 - September 28, 1976.

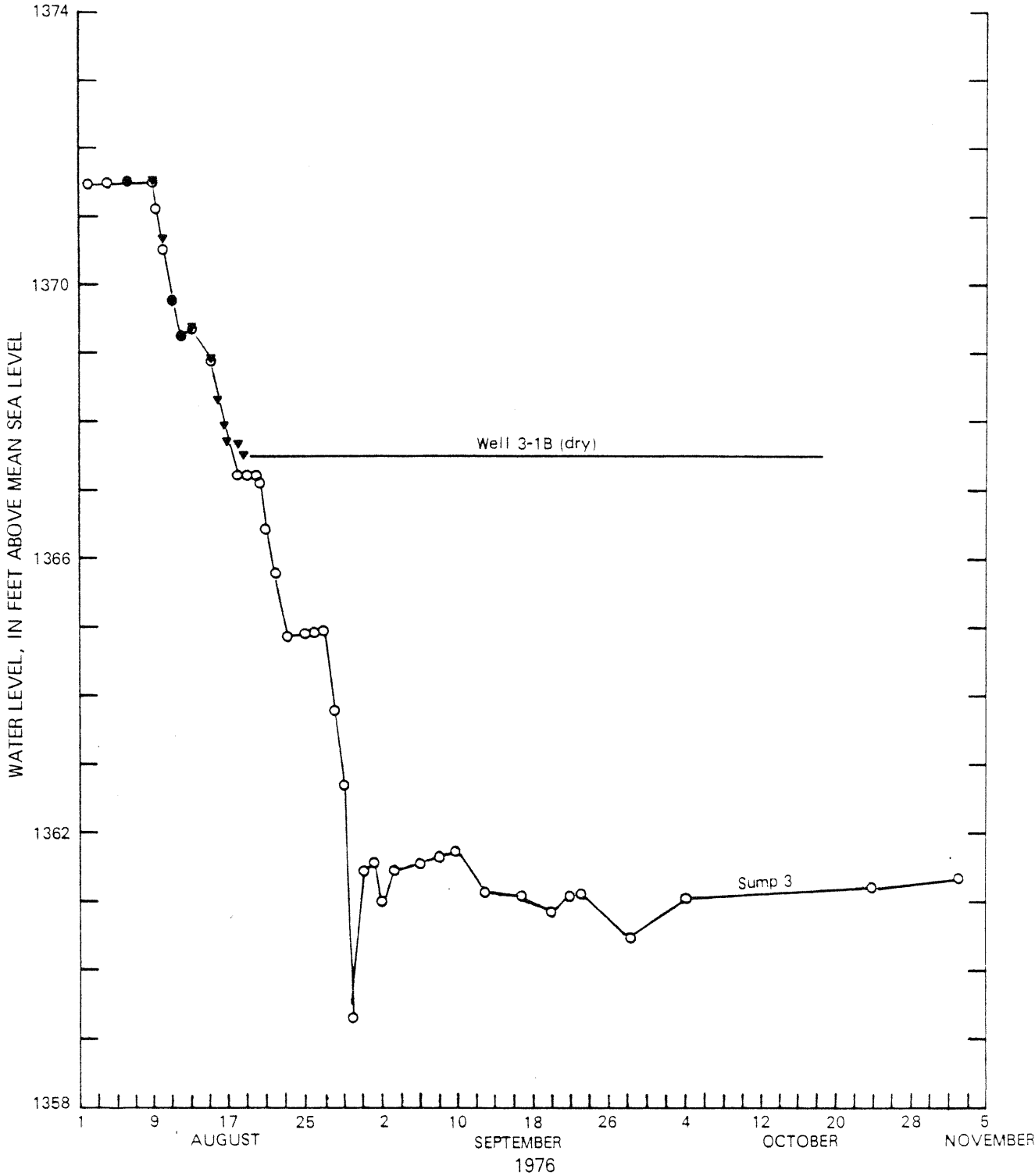


Figure 15.--Response of well 3-1B to trench-water pumpout, August 9 - September 28, 1976.

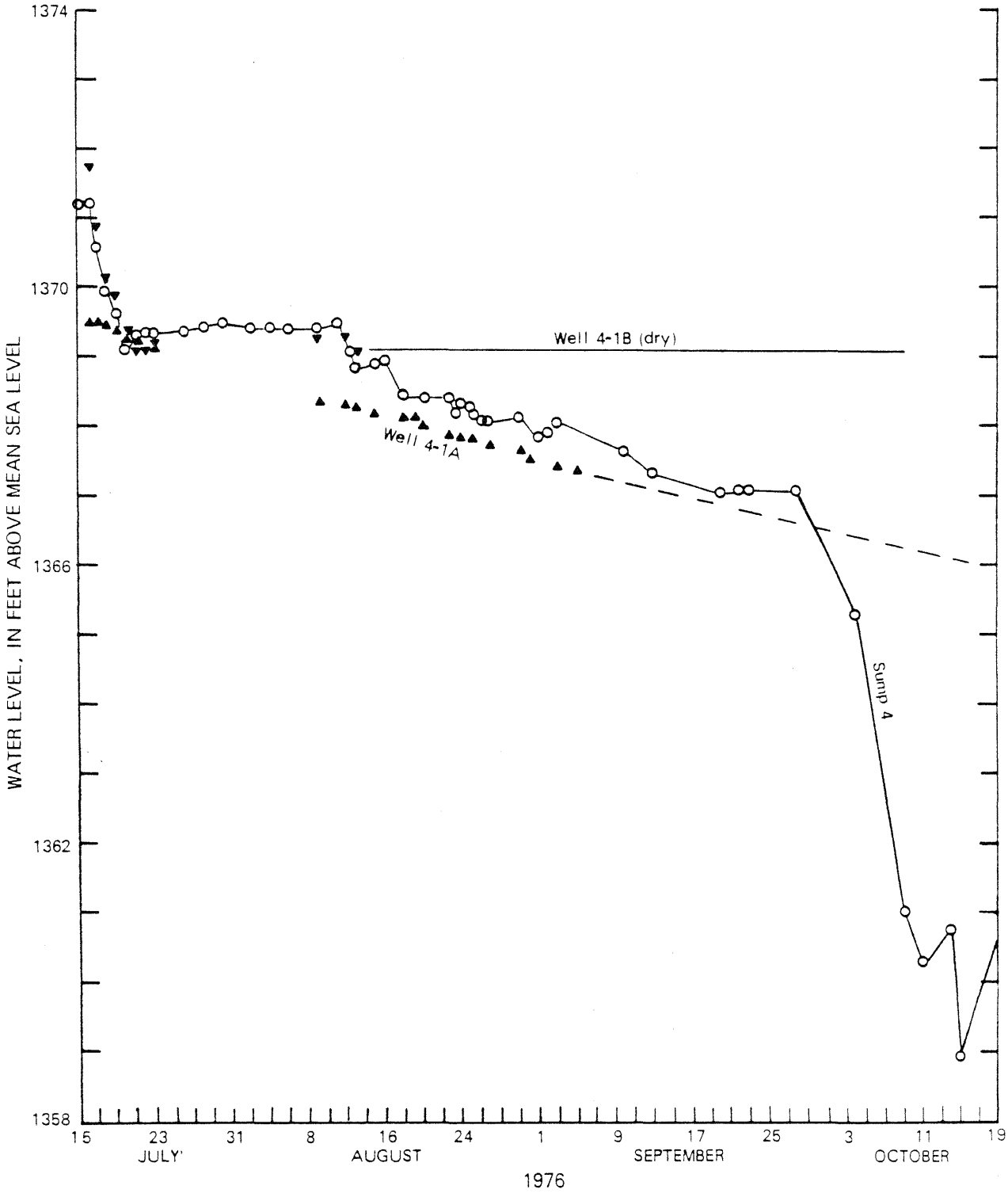


Figure 16.--Response of wells 4-1A and 4-1B to trench-water pumpout, July 17 - October 15, 1976.

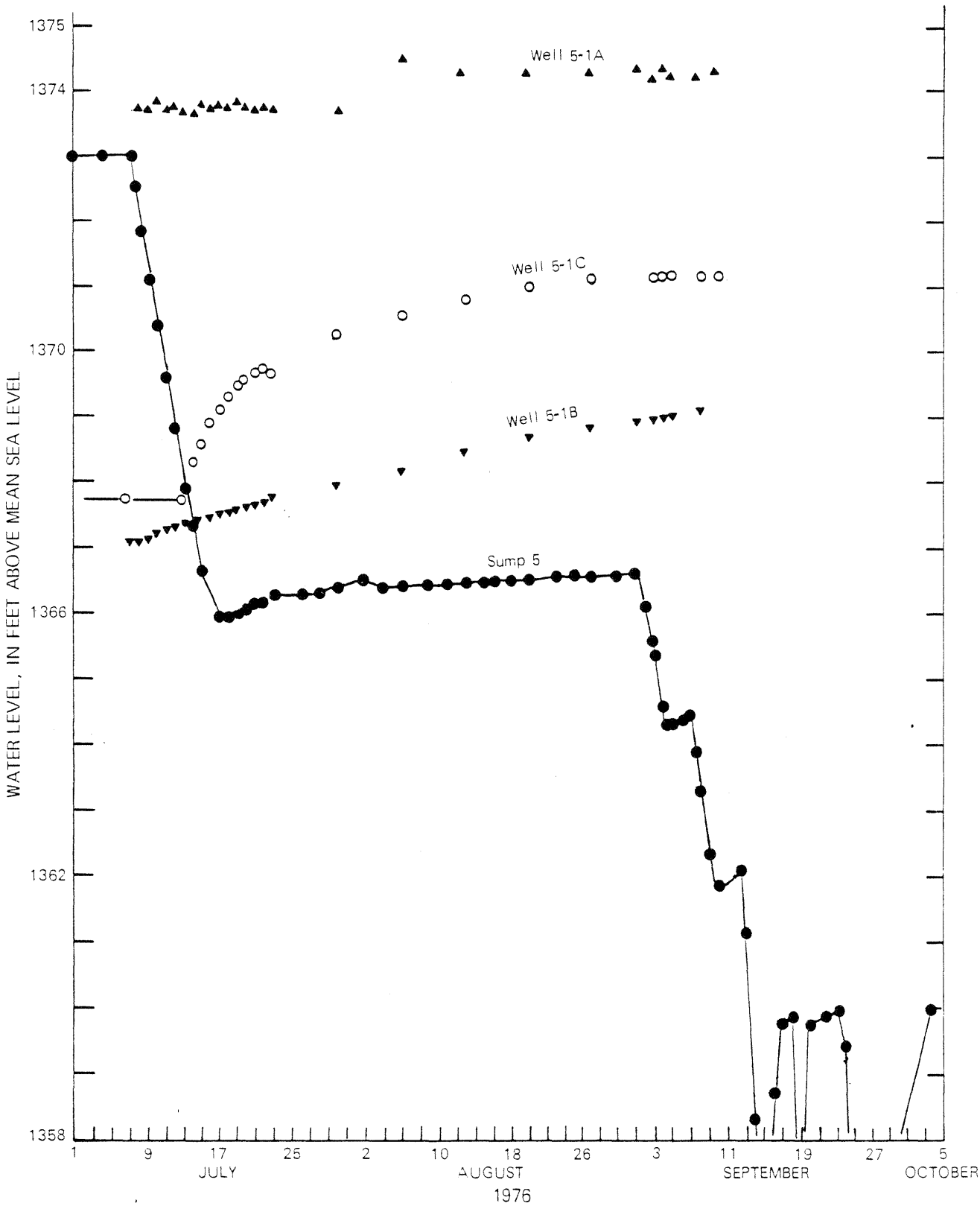


Figure 17.--Response of wells 5-1A, 5-1B, and 5-1C to trench-water pumpout, July 7 - September 25, 1976.

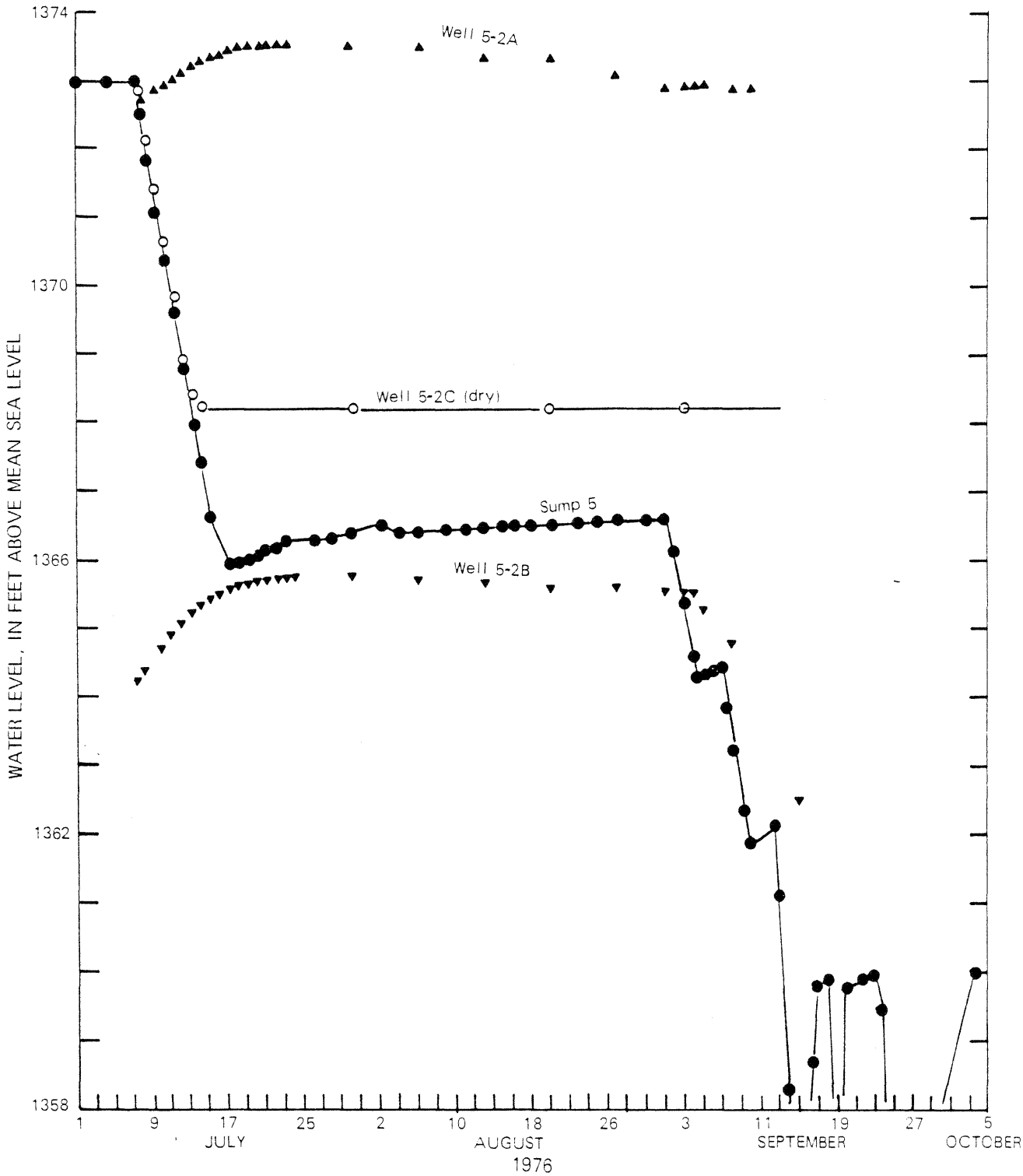


Figure 18.--Response of wells 5-2A, 5-2B, 5-2C to trench-water pumpout, July 7 - September 25, 1976.

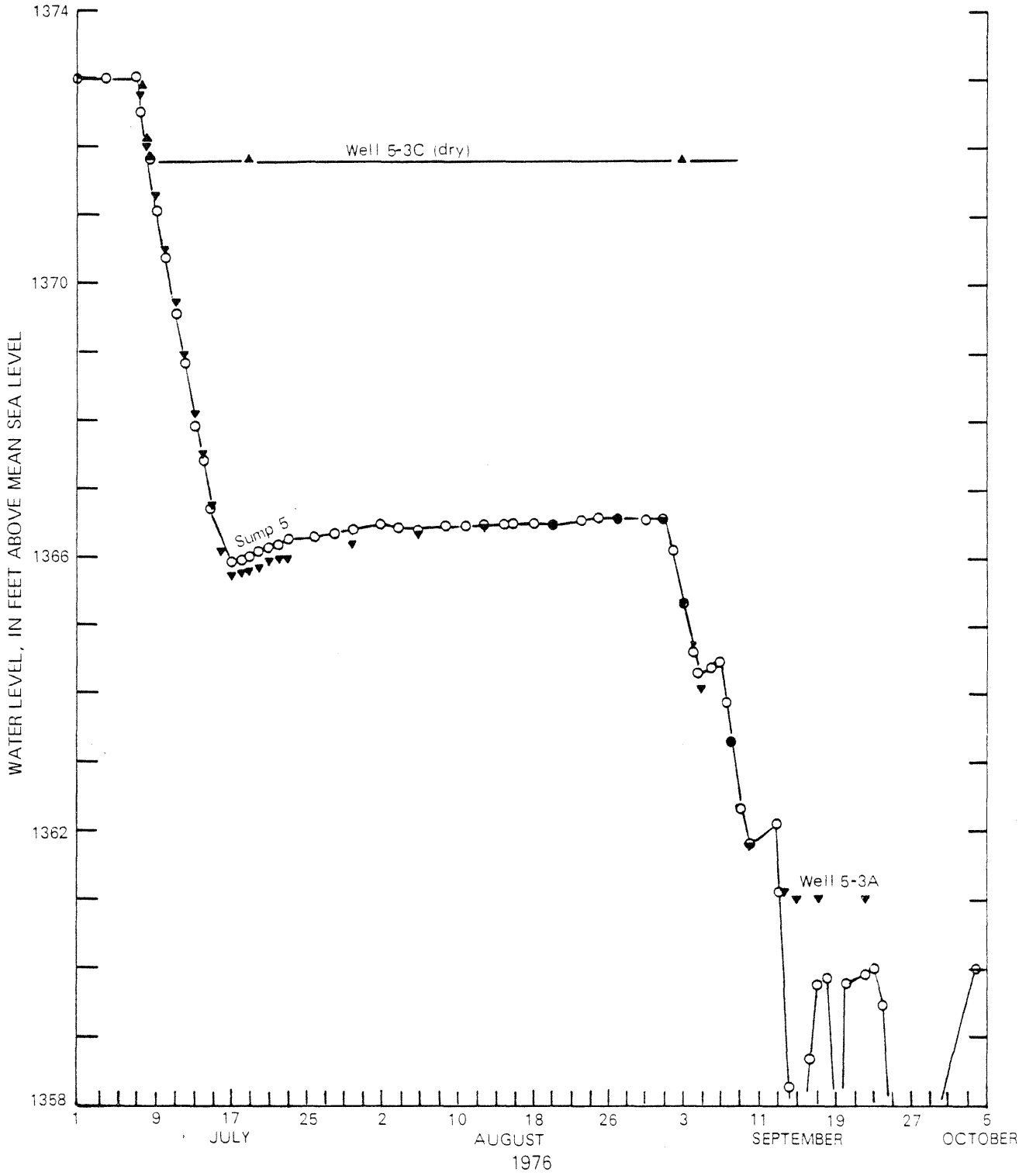


Figure 19.--Response of wells 5-3A and 5-3C to trench-water pumpout, July 7 - September 25, 1976.

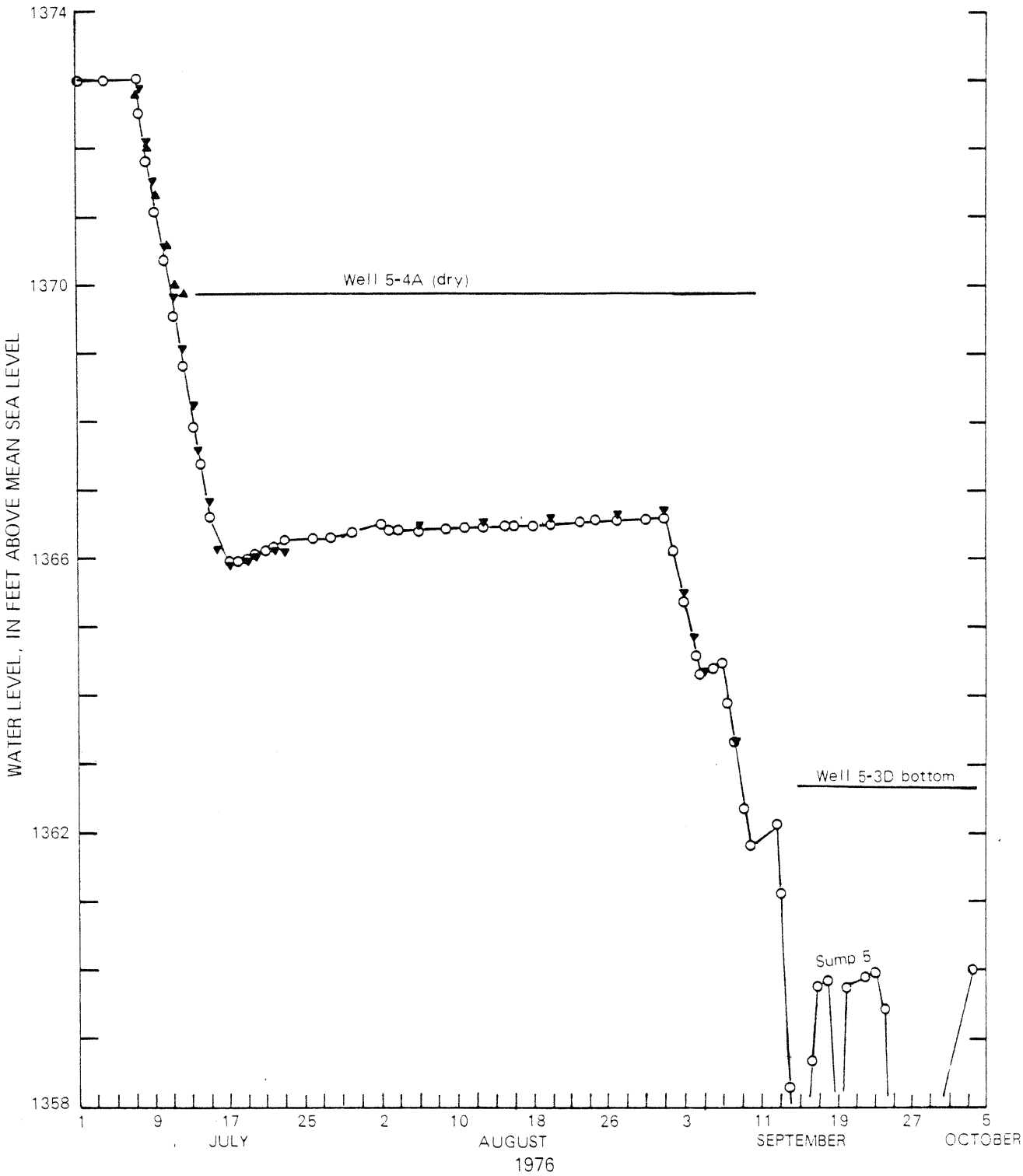


Figure 20.--Response of wells 5-3D and 5-4A to trench-water pumpout, July 7 - September 25, 1976.

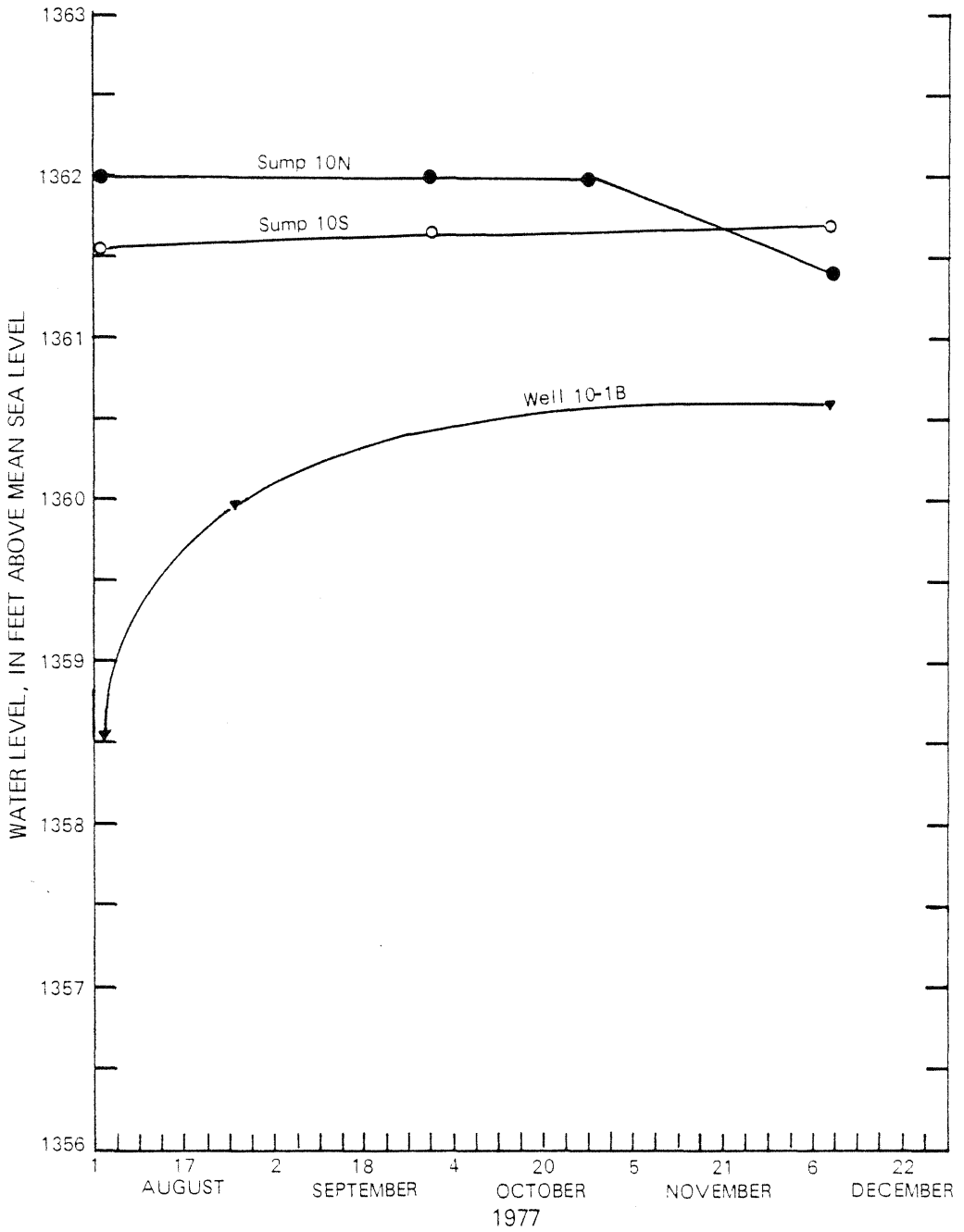


Figure 21.--Response of well 10-1B to trench-water pumpout, November 1-20, 1977.

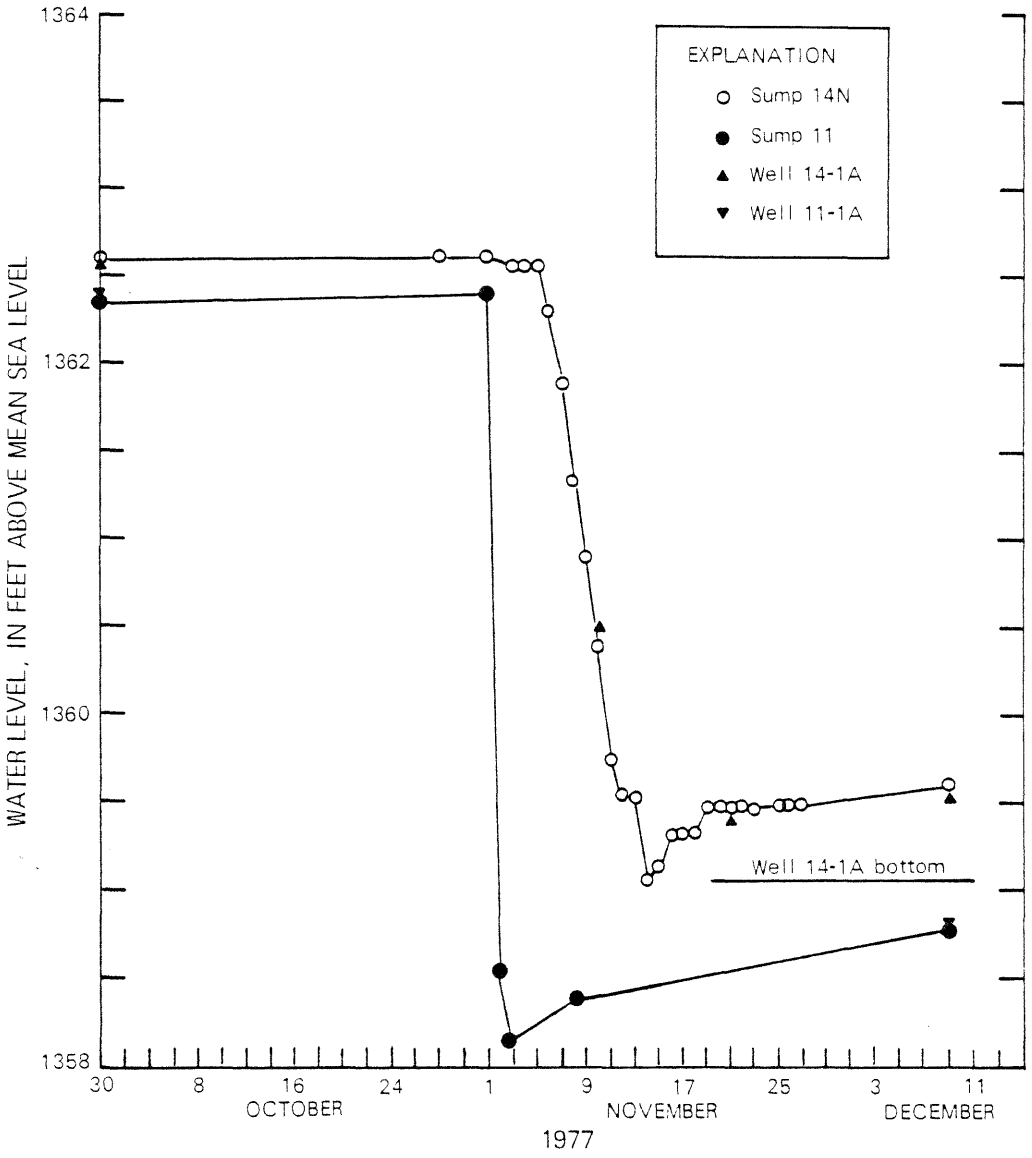


Figure 22.--Response of wells 11-1A and 14-1A to trench-water pumpout, November 1-17, 1977.

Table 3

Records of wells in trenches, Western New York Nuclear Service Center low-level radioactive-waste burial site, West Valley, New York

Altitudes are in feet above mean sea level; depths are in feet below land surface.

NYDH, New York State Department of Health;
MSHA, U.S. Department of Labor, Mine Safety and Health Administration

WELL 2-1A

Date completed: June 8, 1976

Location: 300 feet south of north monument in trench 2 and approximately on center line of trenches 1 and 2.

Site and well-construction data (values are in feet):

Altitude of land surface.....1385.74
Altitude of measuring point.....1387.95
Water-level altitude June 1976.....1362.70
Depth to bottom of screen from land surface.....29.84

Type of well point: 60-mesh, 24-inch button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch-diameter hole
3 - 4	18	100	2.5	
4 - 5	16	100	2.5	
5 - 6	25	80	4	
6 - 7	29	80	4	
7 - 8	20	80	4	
8 - 9	21	100	2.5	
9 - 10	18	100	2.5	
10 - 11	20	80	4	
11 - 12	23	80	4	
12 - 13	21	80	4	
13 - 14	20	100	2.5	Gas flowing from well
14 - 15	16	100	2.5	NYDH collected gas sample
15 - 16	14	100	2.5	
16 - 17	28	80	4	
17 - 18	13	80	4	
18 - 19	13	80	4	
19 - 20	16	100	2	
20 - 21	19	100	2	
21 - 22	26	80	2.5	
22 - 23	33	80	2.5	
23 - 24	24	80	2.5	
24 - 25	47	80	2.5	
25 - 26	20	80	2.5	
26 - 27	27	80	2.5	
27 - 28	30	100	2.5	
28 - 29	24	100	2.5	
29 - 29.8	40	100	2.5	Hole completed

WELL 3-1A

Date completed: June 9, 1976

Location: 216 feet south of north monument on trench 3 and approximately on center line of trench 3.

Site and well-construction data (values are in feet):

Altitude of land surface.....1385.49
Altitude of measuring point.....1388.18
Water-level altitude June 1977.....1371.4
Depth of bottom of screen from land surface.....23.7

Type of well point: 60-mesh, 24-inch button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	9	100	2.5	
4 - 5	17	100	2.5	
5 - 6	14	80	4	
6 - 7	15	80	4	
7 - 8	17	80	4	
8 - 9	14	100	2.5	
9 - 10	15	100	2.5	
10 - 11	12	80	4	
11 - 12	12	80	4	Failed to collect gas sample
12 - 13	15	80	4	No gas detected
13 - 14	20	80	4	Gas flowing from well NYDH collected gas sample
14 - 15	16	100	2.5	
15 - 16	18	100	2.5	Water bubbling into screen 6-08-76; altitude of water was 1370.1 feet. 6-09-76; altitude of water was 1370.5 feet
16 - 17	33	80	3	
17 - 18	28	80	3	
18 - 19	28	80	3	
19 - 20	21	80	2.5	
20 - 21	24	80	2.5	
21 - 22	19	80	2.5	
22 - 23	14	80	2.5	
23 - 23.8	14	80	4	Met refusal at 23.8-foot depth, pipe was pulled and last section replaced; pipe redriven to 23.8-foot depth; hole completed

WELL 3-1B

Date completed: June 9, 1976

Location: 216 feet south of north monument on trench 3 and approximately 5 feet east of 3-1A.

Site and well-construction data (values are in feet):

Altitude of land surface.....1386.00
Altitude of measuring point.....1387.28
Water-level altitude June 1977.....1371.3
Depth to bottom of screen from land surface.....17.9

Type of well point: 60-mesh, 30-inch inside screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	13	100	2.5	
4 - 5	21	100	2.5	
5 - 6	24	75	4	
6 - 7	30	75	4	
7 - 8	23	75	4	
8 - 9	27	100	2.5	
9 - 10	21	100	2.5	
10 - 11	24	100	2.5	
11 - 12	25	100	2.5	
12 - 13	26	100	2.5	Gas flowing from well Driving character changed at 12.7 feet
13 - 14	30	75	2.5	
14 - 15	19	75	2.5	
15 - 16	23	75	2.5	Water entering well
16 - 17	24	75	2.5	
17 - 18	39	75	1.5	
18 - 19	40	75	1.5	
19 - 20	25	75	2.5	
20 - 20.8	15	75	2.5	Met refusal; brought well point back to 17.9-foot depth; hole completed

WELL 4-1A

Date completed: June 11, 1976

Location: 256 feet south of north monument on trench 4 and approximately on center line of trench 4.

Site and well-construction data (values are in feet):

Altitude of land surface.....1387.3
Altitude of measuring point.....1389.25
Water-level altitude June 1976.....1370.2
Depth to bottom of screen from land surface.....28.2

Type of well point: 60-mesh, 30-inch inside screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	23	80	4.5	
4 - 5	32	80	4.5	
5 - 6	34	80	4.5	
6 - 7	37	80	4.5	
7 - 8	32	80	4.5	Driving easier at 7.6-foot depth
8 - 9	48	99*	2.5	Hard object at 8.1-foot depth
9 - 10	31	80	2.5	
10 - 11	24	80	2.5	
11 - 12	62	80	1.5	
12 - 13	40	80	2	
13 - 14	34	80	5	
14 - 15	22	99*	5	Gas flowing from well
15 - 16	12	99*	5	
16 - 17	16	99*	3	
17 - 18	22	80	3	
18 - 19	18	80	3	
19 - 20	17	80	3	
20 - 21	23	80	3	
21 - 22	11	80	3	6-11-76; water-level altitude at 10:55 was 1370.3 feet
22 - 23	17	80	3.5	
23 - 24	21	80	3.5	
24 - 25	20	80	3.5	
25 - 26	30	80	3.5	Hard object at 25.6-foot depth
26 - 27	30	80	4.5	
27 - 28	33	80	4.5	Hole completed

* Two 24-inch pipe wrenches added to weight.

WELL 4-1B

Date completed: June 22, 1976

Location: 256 feet south of north monument on trench 4 and approximately 3 feet east of 4-1A.

Site and well-construction data (values are in feet):

Altitude of land surface.....1387.25
Altitude of measuring point.....1389.06
Water-level altitude June 1976.....1370.2
Depth to bottom of screen from land surface.....18.4

Type of well point: 60-mesh, 30-inch inside screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	13	80	4	
4 - 5	17	80	4	
5 - 6	18	80	4	
6 - 7	20	80	4	
7 - 8	20	80	4	
8 - 8.6	7	80	4	
8.6 - 9	24	80	1.5	
9 - 10	61	80	1.5	
10 - 10.3	34	80	1.5	
10.3 - 11	17	80	5	
11 - 12	23	80	5	
12 - 13	31	80	5	
13 - 13.4	11	80	5	Gas flowing from well
13.4 - 14.9	47	80	4	Trace of water in well
14.9 - 16	30	100	2.5	
16 - 17.2	24	100	2.5	Water trickling into well 6-22-76; water-level altitude at 16:00 was 1370.9 feet
17.2 - 17.8	6	100	2	
17.8 - 18.2	15	100	2	
18.2 - 18.4	5	100	2	Water bubbling into well; hole complete

WELL 5-1A

Date completed: June 3, 1976

Location: 65 feet south of north monument on trench 5 and approximately on center line of trench 5.

Site and well construction data (values are in feet):

Altitude of land surface.....1384.43
Altitude of measuring point.....1384.63
Water-level altitude June 1976.....1373.0
Depth to bottom of screen from land surface.....13.5

Type of well point: 80-mesh, 30-inch inside screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 2.9	--	--	--	Augered 3-inch diameter hole
2.9 - 4.5	12	100	2.5	
4.5 - 5.5	25	80	4	
5.5 - 6.5	31	80	4	
6.5 - 7.5	26	80	4	
7.5 - 8.5	39	100	2.5	Possibly struck barrel at 8-foot depth
8.5 - 9.5	22	100	2.5	Gas flowing from well NYDH collected a gas sample
9.5 - 10.5	38	80	4	
10.5 - 11.5	28	80	4	
11.5 - 12.5	30	100	2.5	Hard object at 12.3-foot depth
12.5 - 13.5	35	100	2.5	Hole completed

Note: June 24, 1976
Forty cubic feet of compressed nitrogen was injected into the well at 45 pounds per square inch without any return flow when the tubing to the well was removed.

WELL 5-1B

Date completed: June 3, 1976

Location: 65 feet south of north monument on trench 5 and approximately 5 feet west of 5-1A.

Site and well construction data (values are in feet):

Altitude of land surface.....1384.08
Altitude of measuring point.....1386.02
Water-level altitude June 1976.....1366.8
Depth to bottom of screen from land surface.....20.1

Type of well point: 60-mesh, 18-inch inside screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3.2	--	--	--	Augered 3-inch diameter hole
3.2 - 4	5	80	4	
4 - 5	20	80	4	
5 - 6	28	80	4	
6 - 7	29	80	4	
7 - 8	19	100	2.5	Possibly entered trench at 7.5-foot depth
8 - 9	11	100	2.5	
9 - 10	17	80	4	Hard object at 9-foot depth; 9 blows to break through
10 - 11	13	80	4	
11 - 12	21	80	4	Hard object at 11.8-foot depth
12 - 13	25	100	2.5	
13 - 14	29	100	2.5	
14 - 15	35	80	4	
15 - 16	38	80	4	
16 - 17	56	80	4	Driving more difficult below 16.5-foot depth
17 - 18	64	100	2.5	
18 - 19	71	100	2.5	
19 - 19.6	70	80	4	
19.6 - 20	22	100	2.5	Hole completed

Note: June 24, 1976
The well has possibly penetrated through the trench at or near the depth of 16.5 feet because driving became more difficult with depth below. Compressed nitrogen was injected into the well at 80 pounds per square inch. The pressure held momentarily, then dropped. There was no detectable change in water level.

WELL 5-1C

Date completed: June 24, 1976

Location: 65 feet south of north monument on trench 5 and approximately 5 feet east of 5-1A.

Site and well construction data (values are in feet):

Altitude of land surface.....1384.30
Altitude of measuring point.....1386.35
Water-level altitude June 1976.....dry
Depth to bottom of screen from land surface.....16.65

Type of well point: 60-mesh, 18-inch inside screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 2.9	--	--	—	Augered 3-inch diameter hole
2.9 - 4	22	80	4	
4 - 5	24	80	4	
5 - 6	26	80	4	
6 - 7	12	80	4	Gas flowing from well
7 - 8	9	80	4	
8 - 9	7	80	4	
9 - 10	10	80	4	
10 - 11.2	11	80	4	
11.2 - 12	11	100	2.5	
12 - 13	15	100	2.5	
13 - 13.6	13	100	2.5	
13.6 - 15	30	80	4	
15 - 16	30	80	4	
16 - 16.5	19	80	4	
16.5 - 18	43	100	2.5	
18 - 18.8	28	100	2.5	
18.8 - 20	49	80	4	
20 - 21	62	80	4	
21 - 21.7	58	80	4	
21.7 - 23	123	100	2.5	
23 - 23.8	108	100	2.5	Refusal?

Note: June 24, 1976
The well has possibly penetrated through the trench at or near the depth of 20 feet. Compressed nitrogen was added to the well under pressure to determine if the well point was clogged. The well would not hold pressure and there was a large decrease in the volume of nitrogen left in the tank, indicating the screen at the bottom of the well was open. There was no change in the water level before and after the addition of the nitrogen. The well point was then pulled back to an altitude of 1366.75 feet. Remeasurement of the well showed that no water was left. Nitrogen was again added to the well. Pressure would not build up in the well. The well remained dry after the injection of nitrogen.

WELL 5-2A

Date completed: June 9, 1976

Location: 310 feet south of north monument on trench 5 and approximately 8 feet west of center line on trench 5.

Site and well construction data (values are in feet):

Altitude of land surface.....1385.52
Altitude of measuring point.....1388.10
Water-level altitude June 1976.....1372.0
Depth to bottom of screen from land surface.....14.9

Type of well point: 60-mesh, 30-inch inside screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 3-inch diameter hole
3 - 4	20	80	3	
4 - 5	29	80	3	
5 - 6	36	80	3	
6 - 7	48	80	3	
7 - 8.5	52	80	3	
8.5 - 10	27	80	4.5	
10 - 11	12	80	4.5	
11 - 12	22	80	4.5	
12 - 12.7	19	80	4.5	
12.7 - 14	40	100	2.5	
14 - 14.5	18	100	2.5	
14.5 - 15	19	80	2	No water in well; screen must be plugged; no gas was detected; hole completed

Note: June 23, 1976
Compressed nitrogen injected into well. Water-level altitude after injection was 1372.0 feet; well was dry before injecting nitrogen.

WELL 5-2B

Date completed: June 10, 1976

Location: 310 feet south of north monument on trench 5 and approximately 5 feet west of 5-2A.

Site and well construction data (values are in feet):

Altitude of land surface.....1384.94
Altitude of measuring point.....1388.34
Water-level altitude June 1976.....1370.6
Depth to bottom of screen from land surface.....29.3

Type of well point: 60-mesh, 24-inch outside brass screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 3-inch diameter hole
3 - 4	11	80	4	
4 - 5	19	80	4	
5 - 6	18	80	4	
6 - 7	17	80	4	
7 - 7.8	8	80	4	Possibly entered trench at 7 feet
7.8 - 9	11	100	2.5	
9 - 10	10	100	2.5	
10 - 11	11	80	4	
11 - 12	12	80	4	
12 - 13	15	80	4	
13 - 14	19	80	2.5	
14 - 15	19	80	2.5	
15 - 16	25	80	2.5	
16 - 17	30	80	2.5	
17 - 18	33	80	4	
18 - 19	25	80	4	
19 - 20	23	80	4	
20 - 21	25	100	2.5	
21 - 22	33	100	2.5	6-04-76; water-level altitude was 1372.8 feet
22 - 23	52	80	1.5	
23 - 24	49	80	1.5	
24 - 25	37	80	1.5	Driving was below 24.6-foot depth; about 0.1 foot per blow
25 - 25.5	26	80	1.5	
25.5 - 27	26	80	4.5	
27 - 27.7	7	80	4.5	
27.7 - 29	28	100	2.5	
29 - 29.3	16	75	2.5	Into bottom of trench? No gas was detected flowing from well; hole completed

Note: June 23, 1976
Compressed nitrogen was injected into the well. Water level in well did not change.

WELL 5-2C

Date completed: June 4, 1976

Location: 310 feet south of north monument on trench 5 and approximately 5 feet east of 5-2A.

Site and well construction data (values are in feet):

Altitude of land surface.....1385.88
Altitude of measuring point.....1388.69
Water-level altitude.....1372.8
Depth to bottom of screen from land surface.....17.5

Type of well point: 60-mesh, 24-inch outside brass screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3.2	--	--	--	Augered 3-inch diameter hole
3.2 - 4	13	80	4	
4 - 5	27	80	4	
5 - 6	30	80	4	
6 - 7	21	80	4	
7 - 7.8	11	80	4	
7.8 - 9	14	100	2.5	
9 - 10	6	100	2.5	
10 - 11.5	28	80	2	Stopped to collect gas sample; gas was not flowing from well; pumping created vacuum
11.5 - 13	13	80	4.5	
13 - 14	10	100	2.5	
14 - 15	10	100	2.5	0.2 foot of water in pipe
15 - 16	20	80	4.5	
16 - 17	37	80	4.5	Hard object at 16.5-foot depth
17 - 18.4	36	80	4.5	
18.4 - 18.8	68	100	2.5	Met refusal; tried to pull back 4 feet, but could only pull back 0.8 foot. Redrove to 18.8-foot depth
18.8 - 20	137	99*	5	Broke through something at 19.8-foot depth; could only measure 17.5 feet of pipe below land surface, apparently the screen collapsed or broke off. Added 1.5 gallons of water; no change in water level could be detected; hole completed

* Two 24-inch pipe wrenches added to weight.

WELL 5-3A

Date completed: June 8, 1976

Location: 470 feet south of north monument on trench 5 and approximately 8 feet west of center line on trench 5.

Site and well construction data (values are in feet):

Altitude of land surface.....1387.03
Altitude of measuring point.....1390.16
Water-level altitude June 1976.....1372.6
Depth to botoom of screen from land surface.....30.0

Type of well point: 60-mesh, 24-inch button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	—	—	—	Augered 2-inch diameter hole
3 - 4	8	100	3	
4 - 5	9	100	3	
5 - 6	9	80	4.5	
6 - 7	25	80	4.5	Hard object at 6.7-foot depth
7 - 8.3	30	80	4.5	
8.3 - 9	14	100	3	
9 - 9.5	4	100	3	Driving very easy below 9-foot depth
9.5 - 10.4	56	100	3	Hard object at 9.5 feet
10.4 - 11.5	11	80	4	Gas flowing from well; methanometer detected between 2-5% methane; NYDH and MSHA collected gas samples
11.5 - 12	7	80	4	
12 - 13	27	80	4	
13 - 14	14	100	2.5	
14 - 15	10	100	2.5	
15 - 16	23	80	4	
16 - 17	8	80	4	
17 - 18	9	80	4	
18 - 18.8	8	80	4	
18.8 - 20	13	80	4	
20 - 21	8	80	4	
21 - 22	14	80	4	
22 - 22.8	22	80	4	
22.8 - 24	88	80	3	
24 -25	37	80	3	
25 - 26	48	80	3	
26 - 27.2	74	80	3	6-8-76; water-level altitude at 08:15 was 1,372.7 feet
27.2 - 28	38	100	2.5	
28 - 29	44	100	2.5	
29 - 30	47	100	2.5	Hole completed

WELL 5-3B

Date completed: June 7, 1976

Location: 470 feet south of north monument on trench 5 and approximately 3 feet west of 5-3A.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.61
Altitude of measuring point.....-------
Water-level altitude.....-------
Depth to bottom of screen from land surface.....-------

Type of well point: 60-mesh, 18-inch wire wound screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3.5	--	--	--	Augered 2-inch diameter hole
3.5 - 5	10	80	5	
5 - 6	15	80	5	
6 - 7	26	80	5	
7 - 8	27	80	5	
8 - 9	40	100	2.5	
9 - 10	27	100	2.5	
10 - 11	42	80	5	
11 - 12	44	80	5	
12 - 13	22+	80	5	Met refusal; MSHA inspector collected gas sample; pulled pipe out of ground, well point was missing; pipe went back into ground immediately; hole abandoned

WELL 5-3C

Date completed: June 10, 1976

Location: 470 feet south of north monument on trench 5 and approximately 5 feet east of well 5-3A.

Site and well construction data (values are in feet):

Altitude of land surface.....1387.44
Altitude of measuring point.....1389.08
Water-level altitude June 1976.....1372.8
Depth to bottom of screen from land surface.....15.9

Type of well point: 60-mesh, 18-inch wire wound screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	9	100	3	
4 - 5	16	100	3	
5 - 6	32	100	1.5	
6 - 7	39	100	2	
7 - 8	33	100	2	
8 - 9	37	100	2.5	
9 - 10	20	100	2.5	
10 - 11	20	80	3.5	
11 - 12	17	80	3.5	
12 - 13	16	80	3.5	
13 - 14	15	100	2.5	
14 - 15	17	100	2.5	
15 - 16	35	80	2.5	
16 - 17	23	100	2.5	
17 - 18	23	100	2.5	
18 - 19	32	80	3.5	
19 - 19.5	86+	85 & 100	3	Hard object at 19.5 foot depth; met refusal. Poured about 1 gallon of water into well at 10:55 on 6-08-76:

Time	Water-level altitude
10:45	1373.1 feet
11:00	1388.3
12:05	1386.3
17:25	1380.3

Tried to pull pipe back to change last length but failed; tried to redrive pipe but failed; measured 15.9-foot depth, 2 feet less than expected. Apparently the screen broke off or became bent. Poured 1 gallon of water into well at 15:12 on 6-10-76:

Time	Water-level altitude
15:05	1373.0
15:10	1372.8
15:15	1372.9

Hole completed

WELL 5-3D

Date completed: June 10, 1976

Location: 475 feet south of north monument on trench 5 and approximately 3 feet south of well 5-3B.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.55
Altitude of measuring point.....1387.65
Water-level altitude June 1976.....1372.6
Depth to bottom of screen from land surface.....24.1

Type of well point: 60-mesh, 30-inch inside screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 2.5	--	--	--	Augered 2-inch diameter hole
2.5 - 4	22	100	2.5	
4 - 5.3	25	100	2.5	
5.3 - 6	28	80	4	
6 - 7	54	80	4	
7 - 8	40	80	4	
8 - 8.5	9	80	4	
8.5 - 9	31	100	2.5	
9 - 10.4	75	100	2.5	Gas flowing from well
10.4 - 11	27	80	4	
11 - 12	40	80	4	
12 - 13	54	99*	4.5	Hard object at 12.1-foot depth
13 - 14	19	99*	4.5	
14 - 15	15	99*	4.5	
15 - 16	10	99*	4.5	
16 - 17	18	99*	4.5	
17 - 18	22	99*	4.5	
18 - 19	22	99*	4	
19 - 20	20	99*	4	
20 - 21	19	99*	4	
21 - 22	14	99*	4	
22 - 23	31	99*	4	
23 - 24	28	99*	4	Hole completed

* Two 24-inch pipe wrenches added to drive weight.

WELL 5-4A

Date completed: June 9, 1976

Location: 200 feet south of north monument on trench 5 and approximately 10 feet southwest of sump 5.

Site and well construction data (values are in feet):

Altitude of land surface.....1383.44
Altitude of measuring point.....1386.23
Water-level altitude June 1976.....1372.5
Depth to bottom of screen from land surface.....13.9

Type of well point: 60-mesh, 30-inch inside screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	18	80	2.5	
4 - 5	13	80	2.5	
5 - 6	12	80	2.5	
6 - 7	19	80	2.5	
7 - 8	10	80	2.5	
8 - 9	8	80	4.5	
9 - 10	5	80	4.5	
10 - 11	5	80	4.5	
11 - 11.5	7	80	4.5	
11.5 - 12	7	100	2.5	
12 - 13	9	100	2.5	
13 - 13.8	7	100	2.5	No gas was detected; hole completed

WELL 8-1A

Date completed: June 14, 1977

Location: 75 feet north of sump 8, 415 feet south of north monument on trench 8, and approximately on center line of trench 8.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.5
Altitude of measuring point.....1386.86
Water-level altitude June 1977.....--------
Depth to bottom of screen from land surface.....29 (estimated)

Type of well point: 60-mesh, 24-inch washer or button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole 1/
3 - 4	10	100	2.5	
4 - 5	15	100	2.5	
5 - 6	23	100	2.5	
6 - 7	29	100	2.5	No methane detected
7 - 8	18	100	2.5	
8 - 9	18	100	2.5	No methane detected
9 - 10	23	100	2.5	
10 - 11	25	100	2.5	No methane detected
11 - 12	27	100	2.5	
12 - 13	29	100	2.5	
13 - 14	30	100	2.5	No methane detected; tried to collect a gas sample, vacuum after 2 minutes
14 - 15	15	140	3	
15 - 16	23	140	3	
16 - 17	31	140	3	NYDH and MSHA collected gas samples; 5 percent methane detected from outlet of compressor while gas was pumped from well
17 - 18	70	100	2.5	
18 - 19	54	100	2.5	
19 - 20	66	100	2.5	
20 - 21	56	100	2.5	
21 - 22	51	100	2.5	No methane detected
22 - 23	35	100	2.5	
24 - 24	39	100	2.5	No methane detected
24 - 25	55	100	2.5	
25 - 26	64	100	2.5	
26 - 26.5	50	100	2.5	
26.5 - 27	34	140	2	
27 - 28	108	100	2.5	
28 - 29	106	140	2	Pumped gas from well; 4 percent methane detected at outlet hose of compressor. Measured depth of well was several feet less than the length of pipe driven. Presumably the pipe either bent or broke off at a coupling.

1/ The MSHA inspector tested for methane in the augered hole. Initially, the methanometer read 1.5 percent methane but subsequent measurements did not detect any methane. Some methane was probably left in the tubing after testing methane content in hole 9-1A, resulting in the high initial reading.

WELL 8-1B

Date completed: July 26, 1977

Location: 415 feet south of north monument on trench 8 and about 5 feet east of 8-1A.

Site and well construction data (values are in feet):

Altitude of land surface.....1388.56
Altitude of measuring point.....1388.96
Water-level altitude July 1977.....1360.98
Depth to bottom of screen from land surface.....30.0

Type of well point: 60-mesh, 24-inch button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3.1	--	--	--	Augered 2-inch diameter hole
3.1 - 4	12	100	2.5	
4 - 5	12	100	2.5	
5 - 6	24	100	2.5	
6 - 7	28	100	2.5	
7 - 8	25	100	2.5	
8 - 9	31	100	2.5	
9 - 10	27	100	2.5	
10 - 11	33	100	2.5	
11 - 12	34	100	2.5	
12 - 13	37	100	2.5	
13 - 14	33	100	2.5	
14 - 15	36	100	2.5	
15 - 16	27	100	2.5	
16 - 17	37	100	2.5	Hard object at 17.3-foot depth
17 - 18	41	100	2.5	
18 - 19	45	100	2.5	
19 - 20	60	100	2.5	
20 - 21	65	100	2.5	
21 - 22	95	100	2.5	Hard object at 21.9-foot depth
22 - 23	95	100	2.5	Driving easier below 22.7-foot depth
23 - 24	216	100	2.5	Hard object at 23.0-foot depth Driving easier below 23.6-foot depth
24 - 25	89	100	2.5	Hard object at 24.8-foot depth
25 - 26	93	100	2.5	Hard object near 26-foot depth
26 - 27	83	100	2.5	
27 - 28	72	100	2.5	Hard object at 27.7-foot depth
28 - 29	43	100	2.5	
29 - 30	69	100	2.5	Hole completed

WELL 9-1A

Date completed: June 14, 1977

Location: 150 feet north of sump 9, 349 feet south of north monument on trench 9, and on center line of trench 9.

Site and well construction data (values are in feet):

Altitude and land surface.....1387.2
Altitude of measuring point.....1387.46
Water-level altitude June 1977.....-------
Depth to bottom of screen from land surface.....26.5

Type of well point: 60-mesh, 24-inch washer or button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	6	100	2.5	
4 - 5	4	140	3	
5 - 6	7	140	3	
6 - 7	11	140	3	No methane detected
7 - 8	21	100	2.5	0.1 percent methane detected
8 - 9	19	100	2.5	0.1 percent methane detected
9 - 10	18	140	4	
10 - 11	13	140	4	No methane detected. NYDH and MSHA collected gas samples; 2 percent methane detected from outlet hose of compressor while gas was pumped from well
11 - 12	9	140	4	
12 - 13	14	100	2.5	
13 - 13.5	9	100	2.5	No methane detected
13.5 - 14	51	140	3	Hard object at 13.5 foot depth
14 - 15	21	140	4	
15 - 16	19	140	4	
16 - 17	19	140	4	0.2 percent methane detected
17 - 18	22	100	2.5	
18 - 19	24	100	2.5	No methane detected
19 - 20	14	140	4	
20 - 21	41	140	4	
21 - 22	32	140	4	0.2 percent methane detected
22 - 23	145	100	2.5	
23 - 23.5	130	100	2.5	0.2 percent methane detected
23.5 - 24	33	140	3	
24 - 25	25	140		
25 - 26	34	140	3	No methane detected
26 - 26.5	100	140	4	Bent top pipe; very difficult if not impossible to drive pipe. Two percent methane detected from outlet hose of compressor while gas was pumped from well. Measured depth of well was several feet less than the length of pipe driven. Presumably the pipe either bent or broke off at a coupling.

WELL 9-1B

Date completed: June 16, 1977

Location: 150 feet north of sump 9, 349 feet south of north monument on trench 9, and 9 feet east of 9-1A.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.2
Altitude of measuring point.....1386.25
Water-level altitude June 1977.....-------
Depth to bottom of screen from land surface.....29.5

Type of well point: 60-mesh, 24-inch button or washer screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 2	--	--	--	Augered 2-inch diameter hole
2 - 3	9	100	2.5	
3 - 4	12	100	2.5	
4 - 5	16	100	2.5	
5 - 6	20	100	2.5	
6 - 7	23	100	2.5	0.5 percent methane detected
7 - 8	29	100	2.5	
8 - 9	29	100	2.5	
9 - 10	43	100	2.5	
10 - 11	29	100	2.5	
11 - 12	28	100	2.5	0.5 percent methane detected for a short time, then no methane detected
12 - 13	26	100	2.5	
13 - 14	96	100	2.5	
14 - 15	49	100	2.5	Gas flowing from well
15 - 16	67	100	2.5	
16 - 17	47	100	2.5	Pegged 2 percent methane scale for a short time, then only 0.3 percent methane was detected
17 - 18	30	100	2.5	
18 - 19	22	100	2.5	
19 - 20	24	100	2.5	
20 - 21	68	100	2.5	
21 - 22	37	100	2.5	
22 - 23	41	100	2.5	1.3 percent methane detected for a short time, then 0.2 percent methane detected. NYDH collected gas sample after pumping for ten minutes; 4 percent methane detected from outlet hose of compressor while gas was pumped from well
23 - 24	52	100	2.5	
24 - 25	54	100	2.5	
25 - 26	49	100	2.5	
26 - 27	66	100	2.5	1 percent methane detected for a short time, then no methane detected
27 - 28	36	100	2.5	
28 - 29	56	100	2.5	
29 - 29.5	12	100	2.5	Well is dry. Gas flowing from well; hole completed

WELL 10-1A

Date completed: June 15, 1977

Location: 100 feet north of sump 10S, 403 feet south of north monument on trench 10, and approximately on center line of trench 10.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.01
Altitude of measuring point.....1388.50
Water-level altitude June 1977.....———
Depth to bottom of screen from land surface.....19.7

Type of well point: 60-mesh, 24-inch washer or button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole 1/
3 - 4	14	100	2.5	
4 - 5	8	100	2.5	
5 - 6	13	100	2.5	
6 - 7	14	100	2.5	
7 - 8	15	100	2.5	
8 - 9	23	100	2.5	
9 - 10	33	100	2.5	
10 - 11	32	100	2.5	
11 - 12	31	100	2.5	
12 - 13	31	100	2.5	
13 - 14	29	100	2.5	Tried to collect a gas sample; vacuum after a few minutes
14 - 15	42	100	2.5	
15 - 16	57	100	2.5	Tried to collect a gas sample; vacuum after a few minutes
16 - 17	53	100	2.5	Tried to collect a gas sample; vacuum after a few minutes
17 - 18	71	100	2.5	
18 - 19	64	100	2.5	NYDH collected a gas sample; after a few minutes of pumping gas from the well
19 - 19.5	300	100	2.5	
19.5 - 19.5	50	140	2.5	Met refusal; detected 0.4 percent methane from outlet hose of compressor while gas was pumped from well; hole completed

1/ Monitored methane content while augering into the trench. Did not detect any methane.

WELL 10-1B

Date completed: July 26, 1977

Location: 403 feet south of north monument on trench 10 and about 7 feet east of 10-1A.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.0
Altitude of measuring point.....1386.06
Water-level altitude July 1977.....dry
Depth to bottom of screen from land surface.....27.5

Type of well point: 60-mesh, 24-inch button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	—	--	—	Augered 2-inch diameter hole
3 - 4	6	100	2.5	
4 - 5	7	100	2.5	
5 - 6	16	100	2.5	
6 - 7	23	100	2.5	
7 - 8	16	100	2.5	
8 - 9	16	100	2.5	
9 - 10	23	100	2.5	
10 - 11	31	100	2.5	
11 - 12	31	100	2.5	
12 - 13	41	100	2.5	
13 - 14	38	100	2.5	
14 - 15	62	100	2.5	
15 - 16	62	100	2.5	Hard object at 15.8-foot depth
16 - 17	181	100	2.5	Driving easier below 16.6-foot depth
17 - 18	54	100	2.5	
18 - 19	152	100	2.5	Hard object at 18.7-foot depth
19 - 20	115	100	2.5	Driving easy below 19.5-foot depth
20 - 21	53	100	2.5	
21 - 22	68	100	2.5	Driving hard below 21.7-foot depth
22 - 23	69	100	2.5	Driving steady
23 - 24	80	100	2.5	
24 - 25	95	100	2.5	Driving steady
25 - 26	93	100	2.5	
26 - 27	145	100	2.5	Hard object at 26.5-foot depth
27 - 27.5	80	100	2.5	Driving steady; mud on tape, no water; hole completed

WELL 11-1A

Date completed: June 15, 1977

Location: 60 feet north of sump 11, 447 feet south of north monument on trench 11, and about 8 feet east of center line on trench 11.

Site and well construction data (values are in feet):

Altitude of land surface.....1385.4
Altitude of measuring point.....1385.59
Water-level altitude June 1977.....1358.7
Depth to bottom of screen from land surface.....29.5

Type of well point: 60-mesh, 24-inch button or washer screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	—	—	—	Augered 2-inch diameter hole; no methane detected
3 - 4	6	100	2.5	
4 - 5	8	100	2.5	
5 - 6	13	100	2.5	
6 - 7	13	100	2.5	No methane detected
7 - 8	8	100	2.5	
8 - 9	12	100	2.5	
9 - 10	21	100	2.5	
10 - 11	27	100	2.5	Tried to collect a gas sample; vacuum after a few minutes; no methane detected
11 - 12	27	100	2.5	
12 - 13	27	100	2.5	Tried to collect a gas sample; vacuum after a few minutes; no methane detected
13 - 14	34	100	2.5	
14 - 15	41	100	2.5	Tried to collect a gas sample; vacuum after a few minutes; no methane detected
15 - 16	33	100	2.5	
16 - 17	41	100	2.5	NYDH and MSHA collected a gas sample at 16.8-foot depth, pumped about 8 minutes before NYDH collected sample. At first, no methane was detected from outlet hose of compressor but later there was a trace
17 - 18	28	100	2.5	
18 - 19	45	100	2.5	
19 - 20	46	100	2.5	
20 - 21	50	100	2.5	
21 - 22	59	100	2.5	0.3 percent methane detected
22 - 23	27	100	2.5	
23 - 24	40	100	2.5	
24 - 25	40	100	2.5	
25 - 26	41	100	2.5	
26 - 27	37	100	2.5	
27 - 28	36	100	2.5	No methane detected; 1.3 feet of water in well
28 - 29	31	100	2.5	
29 - 29.1	4	100	2.5	Driving pipe became very difficult; about 2 feet of water in well; hole completed

WELL 11-2A

Date completed: June 16, 1977

Location: 160 feet north of sump 11, 347 feet south of north monument and approximately 3 feet east of the center line of trench 11.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.43
Altitude of measuring point.....1388.41
Water-level altitude June 1977.....-------
Depth to bottom of screen from land surface.....20

Type of well point: 60-mesh, 24-inch button or washer screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	18	100	2.5	
4 - 5	13	100	2.5	
5 - 6	19	100	2.5	
6 - 7	16	100	2.5	0.5 percent methane detected
7 - 8	16	100	2.5	
8 - 9	18	100	2.5	
9 - 10	20	100	2.5	
10 - 11	35	100	2.5	
11 - 12	29	100	2.5	0.2 percent methane detected. Tried to detect a gas sample; vacuum after a few minutes
12 - 13	29	100	2.5	
13 - 14	30	100	2.5	
14 - 15	41	100	2.5	0.2 percent methane detected. Tried to collect a gas sample; vacuum after a few minutes
15 - 16	54	100	2.5	
16 - 17	53	100	2.5	0.5 percent methane detected
17 - 18	47	100	2.5	
18 - 19	33	100	2.5	
19 - 20	56	100	2.5	NYDH and MSHA collected gas sample after pumping for 10 minutes. Only a trace of methane was detected at the outlet hose on compressor while pumping; hole completed

WELL 12-1A

Date completed: June 15, 1977

Location: 105 feet north of sump 12 and approximately on center line of trench 12.

Site and well construction data (values are in feet):

Altitude of land surface.....1385.7
Altitude of measuring point.....1386.32
Water-level altitude June 1977.....-------
Depth to bottom of screen from land surface.....14.9

Type of well point: 60-mesh, 24-inch washer or button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 2.3	--	--	—	Augered 2-inch diameter hole
2.3 - 3	9	100	2.5	
3 - 4	10	100	2.5	
4 - 5	11	100	2.5	
5 - 6	16	100	2.5	
6 - 7	17	100	2.5	
7 - 8	19	100	2.5	
8 - 9	22	100	2.5	
9 - 10	38	100	2.5	
10 - 11	40	100	2.5	
11 - 12	34	100	2.5	Tried to collect a gas sample; vacuum after a few minutes
12 - 13	32	100	2.5	
13 - 14	48	100	2.5	Tried to collect a gas sample; vacuum after a few minutes
14 14.9	32	100	2.5	NYDH and MSHA collected gas samples; 2 percent methane detected at outlet hose of compressor while pumping from well; hole completed

WELL 13-1A

Date completed: June 15, 1977

Location: 150 feet north of sump 13, 408 feet south of north monument on trench 13, and approximately located on center line of trench 13.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.1
Altitude of measuring point.....1386.32
Water-level altitude June 1977.....1358.25
Depth to bottom of screen from land surface.....30.2

Type of well point: 60-mesh, 24-inch button or washer screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diamater hole
3 - 4	9	100	2.5	
4 - 5	13	100	2.5	
5 - 6	13	100	2.5	
6 - 7	19	100	2.5	No methane detected
7 - 8	13	100	2.5	
8 - 9	20	100	2.5	
9 - 9.5	17	100	2.5	0.1 percent methane detected
9.5 - 10	8	100	2.5	
10 - 11	19	100	2.5	
11 - 12	21	100	2.5	0.15 percent methane detected. Tried to collect a gas sample; vacuum after a few minutes
12 - 13	27	100	2.5	
13 - 14	26	100	2.5	No methane detected. Tried to collect a gas sample; vacuum after a few minutes
14 - 15	38	100	2.5	
15 - 16	44	100	2.5	Tried to collect a gas sample; vacuum after a few minutes. 0.15 percent methane detected
16 - 17	50	100	2.5	0.3 percent methane detected. NYDH and MSHA collected gas samples after pumping ten minutes. 1.7 percent methane detected from outlet hose of compressor while gas was pumped from well
17 - 18	32	100	2.5	
18 - 19	50	100	2.5	
19 - 20	75	100	2.5	Lost weight while measuring depth of well
20 - 21	91	100	2.5	
21 - 22	75	100	2.5	
22 - 23	87	100	2.5	
23 - 24	133	100	2.5	
24 - 25	55	100	2.5	0.5 percent methane detected
25 - 26	93	100	2.5	
26 - 27	143	100	2.5	No methane detected
27 - 28	120	100	2.5	
28 - 29	148	100	2.5	
29 - 30	113	100	2.5	
30 - 30°	30	100	2.5	Hole completed

WELL 14-1A

Date completed: June 16, 1977

Location: 190 feet north of sump 14N, 332 feet south of north monument on trench 14 and approximately on center line of trench 14.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.35
Altitude of measuring point.....1386.35
Water-level altitude June 1977.....1362.0
Depth to bottom of screen from land surface.....27.3

Type of well point: 60-mesh, 24-inch button screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	10	100	2.5	
4 - 5	8	100	2.5	
5 - 6	13	100	2.5	
6 - 7	17	100	2.5	
7 - 8	13	100	2.5	
8 - 9	14	100	2.5	
9 - 10	14	100	2.5	
10 - 11	17	100	2.5	
11 - 12	17	100	2.5	0.5 percent methane detected. NYDH and MSHA collected gas samples; NYDH after pumping well for 12 minutes. 0.5 percent methane detected at outlet hose of compressor while gas was pumped from well
12 - 13	13	100	2.5	
13 - 14	17	100	2.5	
14 - 15	25	100	2.5	0.4 percent methane detected; gas flowing from well
15 - 16	26	100	2.5	
16 - 17	25	100	2.5	
17 - 18	12	100	2.5	
18 - 19	40	100	2.5	
19 - 20	64	100	2.5	
20 - 20.5	11	100	2.5	0.5 percent methane detected
20.5 - 21	124	100	2.5	Hard object at 20.5-foot depth
21 - 22	39	100	2.5	
22 - 23	38	100	2.5	0.5 percent methane detected
23 - 24	21	100	2.5	At first, 0.4 percent methane detected, then no methane was detected. 1.5 feet of water in well
25 - 26	19	100	2.5	
26 - 27	62	100	2.5	No methane detected
27 - 27.3	--	100	2.5	Hole completed

WELL 14-2A

Date completed: June 16, 1977

Location: 205 feet north of sump 14N, 317 feet south of north monument, and approximately on the center line of trench 14.

Site and well construction data (values are in feet):

Altitude of land surface.....1386.38
Altitude of measuring point.....1389.91
Water-level altitude June 1977.....-------
Depth to bottom of screen from land surface.....13

Type of well point: 60-mesh, 24-inch button or washer screen

Depth below land surface (feet)	Blow count	Weight of hammer (pounds)	Distance hammer dropped (feet)	Remarks
0 - 3	--	--	--	Augered 2-inch diameter hole
3 - 4	11	100	2.5	
4 - 5	10	100	2.5	
5 - 6	11	100	2.5	
6 - 7	12	100	2.5	
7 - 8	12	100	2.5	
8 - 9	20	100	2.5	
9 - 10	24	100	2.5	0.3 percent methane detected. Tried to collect a gas sample; vacuum after a few minutes
10 - 11	26	100	2.5	
11 - 12	24	100	2.5	
12 - 13	21	100	2.5	At first, 0.5 percent methane detected, then no methane was detected. NYDH and MSHA collected gas samples. NYDH after pumping for 10 minutes; 4 percent methane detected at outlet hose of compressor while gas was pumped from well; hole completed