



UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
Water Resources Division  
1201 Pacific Avenue - Suite 600  
Tacoma, Washington 98402

A Record File 10111	
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WMPI	..... WMNL
WMHT.M.A.	..... WMNL
WMUR	..... Others

November 16, 1982

Mr. Mark Logsdon  
U.S. Nuclear Regulatory Commission  
Mail Stop 623 SS  
Washington, D.C. 20555

WM Record File

WM Project WM-10

Docket No. ....

PDR ☒

LPDR ☒

Distribution: .....

Dear Mr. Logsdon:

(Return to WM, 623-SS) .....

In response to your telephone call of yesterday, enclosed are the data  
you requested on DC-1.

Sincerely yours,

*William Meyer*

William Meyer  
Assistant District Chief -  
Hydrologic Investigations

Enclosure

8307260012 821116  
PDR WASTE  
WM-10 PDR

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UNITED STATES  
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY  
Water Resources Division  
P.O. Box 036, TBUSCH  
550 W. Fort Street  
Boise, Idaho 83702

July 16, 1973

Mr. O. E. Elgert, Director  
Production and Waste Management  
Programs Division  
Richland Operations Office  
U.S. Atomic Energy Commission  
Box 550  
Richland, Wash. 99352

Dear Mr. Elgert:

Included herewith for your information and file is a summary record of water-level measurements made in the deep piezometers on and near the Hanford Reservation.

The Geological Survey took responsibility for measuring water levels in these piezometers in connection with the deep mine storage program for the purpose of obtaining static heads at specific depths in the basaltic rocks. These data were needed to compare with data obtained during the drilling and testing at well ARH-DC-1 to evaluate the effects of drilling and pumping on short term packer tests.

In examining the data, please note the following pertinent points:

- (1) Piezometer 4 in ARH-DC-1 shows a consistent decline in head for the period of measurement indicating that the effects of drilling are very long-lived or that the piezometer is poorly connected, hydraulically, with the aquifer (partially plugged screen or sand pack).
- (2) Piezometer DII-4 water-level measurements are anomalously high and have declined for the period of record, suggesting that this piezometer is plugged.
- (3) Water level trends in ARH-DC-1 piezometers (except number 4) and piezometer DDH-3 have been generally similar since January 1973.
- (4) Head in ARH-DC-1 piezometers apparently increases with depth. The opposite trend was obtained from water-level measurements made during drilling.

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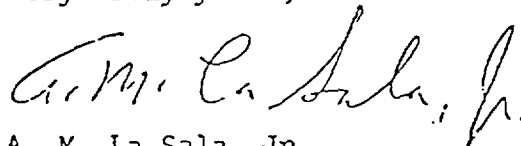
OF R. E. ISACSON

July 16, 1973

The U.S. Geological Survey measurement of water levels in these piezometers terminated with the closing of our Richland office in June, 1973, and the following recommendations are therefore made:

- (1) Water-level measurements should be continued in these piezometers at not longer than monthly intervals for the next two years to verify that natural conditions obtain and to observe the trends at water levels at depth in the basalt on and near the Hanford Reservation.
- (2) Well development procedures (swabbing, pumping) be instituted as quickly as possible in piezometer DH-4 and in ARHDC-1 piezometer 4 in one year, if the historical trend in water-level change continues.
- (3) At intervals of approximately 5 years, suitable testing be done to ascertain that piezometers are open only to the zones in which they have been completed.

Very truly yours,



A. M. La Sala, Jr.  
Research Hydrologist

cc: Regional Hydrologist, WR, Menlo Park, Calif.

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A. E. C. R. L. OFFICE  
PROD. PRGMS. DIV.

Table.--Summary record of depths to water, below land surface in feet,  
for piezometers on and near the Hanford Reservation, Washington.

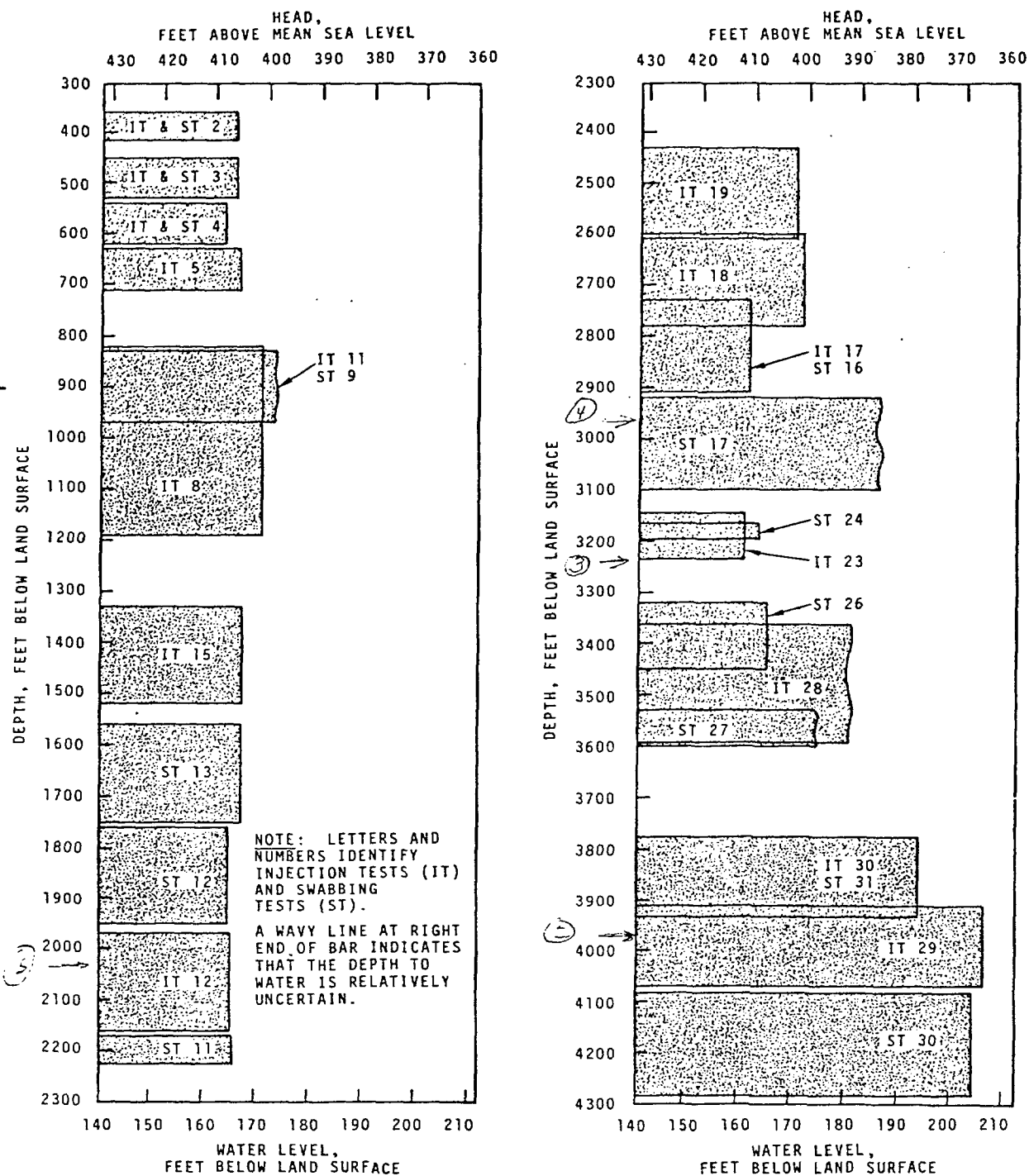
Piezometer designation	DDH-3	DH-4	DH-5	ARHDC-1 #1 open 4750-4849	ARHDC-1 #2 open 3930-4051	ARHDC-1 #3 open 3177-3242	ARHDC-1 #4 open 2913-2987	ARHDC-1 #5 open 1219-2105
Date								
8-24-70	14.61							
9-23-70	14.91							
2-24-71	15.43							
6-8-72	14.47			157.20				
6-22-72	14.46							
6-29-72	14.77			157.33	158.02	158.39	141.37	163.00
7-6-72	14.60			157.05	157.71	158.10	142.33	162.82
7-13-72	14.82			157.02	157.63	158.00	143.40	162.94
7-20-72	14.76	42.00		156.91	157.50	157.90	144.24	163.00
7-26-72	14.77			156.85	157.44	157.83		162.87
8-2-72	14.81	42.03						
8-10-72	14.70			157.07	158.00	158.38	146.42	162.78
8-17-72	14.81	42.10	382.68	157.34	158.21	158.58	147.18	162.88
8-24-72	14.65			157.27	159.00	158.42	147.75	162.82
8-30-72	14.80			157.45	158.17	158.52	148.28	162.30
9-7-72	14.58	42.28	382.57	157.25	157.88	158.25	148.81	162.81
9-21-72	14.38			156.97	157.57	157.94	149.69	162.83
9-28-72	14.65			157.52	157.75	158.07	150.29	163.06
10-5-72	14.82	42.45	382.93	157.36	157.88	158.25	150.80	163.22

Piezometer designation	DH-3	DH-4	DH-5	ARHDC-1 #1 open 4750-4542	ARHDC-1 #2 open 3330-4051	ARHDC-1 #3 open 3177-3242	ARHDC-1 #4 open 2913-2987	ARHDC-1 #5 open 1219-2105
10-12-72	14.77			157.27	157.78	158.14	151.13	163.26
10-19-72	14.45			156.88	157.40	157.79	151.25	163.05
10-26-72	14.29			156.67	157.20	157.56	151.44	162.94
11-2-72	14.42			156.74	157.30	157.69	151.80	163.08
11-9-72	14.32			156.62	157.17	157.52	151.93	163.04
11-16-72	14.17			156.45	157.00	157.35	151.99	162.88
11-30-72	14.38			156.60	157.13	157.51	152.65	163.23
12-20-72	14.21							
1-3-73	14.11			156.37	156.88	157.30	153.19	163.08
1-19-73	13.95			156.08	156.63	157.02	153.23	162.83
2-22-73	13.84			156.19	156.78	157.17	153.95	163.06
3-15-73	13.77			156.13	156.70	157.11	154.15	163.05
3-30-73	13.49			155.87	156.42	156.85	154.27	162.89
4-12-73	13.44			155.81	156.37	156.80	154.50	162.88
4-26-73	13.50			155.86	156.43	156.86	154.73	162.98
5-10-73	13.62			155.98	156.55	157.00	154.98	163.03
5-24-73	13.16			155.46	156.06	156.51	154.90	162.71
6-4-73	13.49			155.75	156.32	156.78	155.21	162.91
12-30-74				155.73	156.26	156.67	158.90	162.56
4-18-75				155.28	155.60	156.35	163.70	162.24
4-24-75							163.71	

NOTE: Reference elevation for land surface  
for ARHDC-1 is 572.18 ', United States Coast  
& Geodetic datum.

On September 8, 1982 a head measurement  
was obtained from the DDH-3 piezometer

Depth below land surface was 14.29 feet.



**FIGURE 3.** Approximate Undisturbed Ground-Water Head for Isolated Water-Bearing Zones in Well ARH-DC-1

# Difference Between HEADS Estimated For DC 1 DURING DRILLING AND HEADS MEASURED By Piezometers

Piez.	Drilling	Now	Δ
1	365		
2	365+	415+	+ 50
3	410+	415+	+ 5
4	385+	410+	+ 25
5	405+	410+	+ 5

Drilling heads indicated downward  
 movement of water + piezometered heads

Show upward movement of water.  
TOP TO BOTTOM

INITIAL HEAD Difference 365+ To 410+  $\approx -45'$   
 Final HEAD Difference 410+ To 415+  $\approx +5'$

Fig 3

Fig 6



## APPENDIX A

### ARH-DC-1 HOLE HISTORY

Moved in Calvert Western Exploration Company Rig #28 on 4-17-69 and started rigging up. During rigging up operations 20" O.D. conductor casing was cemented in a 30" hole at 23' G.L. with 270 ft.<sup>3</sup> of ready mix concrete.

- 4-27-69 Completed rigging up at 0800 hours and drilled 17-1/2" hole from 23' to 77' using mud as a drilling fluid. Hole caving, lost returns at 77', mixed mud and lost circulation materials.
- 4-28-69 Drilled 17-1/2" hole from 77' to 207', hole caving. Deviation surveys: 1/4° at 60', 1/4° at 202'.
- 4-29-69 Drilled 17-1/2" hole from 207' to 339', made trip for bit and cleaned out bridges and fill from 190' to 339' and drilled to 364'. Deviation survey: 1/2° at 260'.
- 4-30-69 Ran Birdwell 3-D, Density, Electric, Caliper and Temperature logs. Ran 12 joints (385.97') of 13-3/8" O.D., J-55, 54.50#, 8 round short thread and collar casing. Landed casing at 362.37' G.L. HOWCO guide shoe and float collar on bottom joint. Centralizers ran on top of joint #2, #4, #6, and #8. Started cementing casing.
- 5-1-69 Completed cementing casing to surface using Halliburton with 400 sacks of neat cement plus 2% calcium chloride. CIP at 0010 hours. Waited on cement.
- 5-2-69 Waited on cement and nipped up.
- 5-3-69 Rigged up for air-mist drilling. Dried up hole with air and drilled cement and float equipment from 323' to 364' with 9-7/8" bit and new hole to 372'.
- 5-4-69 Drilled 9-7/8" hole from 372' to 575'. Hole wet at 394', started air-foam drilling at 406'. Deviation surveys: 1° at 425', 3/4° at 480'.
- 5-5-69 Drilled 9-7/8" hole from 575' to 706'. Deviation surveys: 1-1/4° at 536', 1-1/4° at 610'.
- 5-6-69 Cut core #1 with 6-1/8" Williams diamond bit from 706' to 712', cored 6', recovered 6'. Reamed 6-1/8" core hole to 712'. Ran Birdwell Caliper, Electric, Density, Temperature, 3-D and Radio-active Tracer logs.

- 7-69 Started hydrological testing.
- 8-69 Completed hydrological testing, cleaned out 20' of fill and drilled 9-7/8" hole from 712' to 765'.
- 9-69 Drilled 9-7/8" hole from 765' to 781'. Attempted to cut core #2, cleaned out fill and damaged bit. Ran 9-7/8" bit in hole and cleaned out bridges and fill from 700' to 781' and drilled to 783'. Made 2 short trips into 13-3/8" O.D. casing, hole caved to 700' each trip, cleaned out to bottom.
- 10-69 Started hydrological testing. Water level before test was 165'. Ran Birdwell Temperature and Radioactive Tracer logs.
- 11-69 Completed hydrological testing. Cleaned out fill and set cement plug #1 at 710' using Halliburton with 100 sacks of cement plus 2% calcium chloride. CIP at 1200 hours. Waited on cement until 2045 hours and tagged top of plug #1 at 675'. Set plug #2 at 672' with 100 sacks of cement plus 2% calcium chloride. CIP at 2115 hours. Waited on cement.
- 12-69 Waited on cement until 0530 hours, tagged top of plug #2 at 619'. Set plug #3 at 619' with 200 sacks of type 2 cement plus 2% calcium chloride. CIP at 0630 hours. Waited on cement until 1530 hours and tagged top of plug #3 at 488'. Set plug #4 at 484' with 100 sacks of neat cement plus 2% calcium chloride. CIP 1700 hours.
- 13-69 Waited on cement until 0115 hours and tagged top of plug #4 at 486'. Set plug #5 with 100 sacks of neat cement plus 2% calcium chloride. CIP at 0130 hours. Waited on cement until 0930 hours and tagged top of plug #5 at 485'. Set plug #6 with 100 sacks of neat cement plus 2% calcium chloride. CIP at 0937 hours. Waited on cement until 1545 hours and tagged top of plug #6 at 484'. Set plug #7 with 100 sacks of neat cement plus 2% calcium chloride. CIP at 1545 hours. Waited on cement until 2200 hours and tagged top of plug #7 at 310'.
- 5-14-69 Waited on cement until 0630 hours and drilled out cement inside the 13-3/8" O.D. casing with a 12-1/4" bit from 310' to 360'. Ran 9-7/8 bit, tagged cement at 358', drilled cement to 581'.
- 5-15-69 Drilled cement from 581' to 701', cleaned out fill from 701' to 783'. Hole started to make water at 637', had void in cement from 668' to 677'. Cut core #3 from 783' to 784', cored 1', recovered 1/2'. Cleaned out 2' of fill, reamed 6-1/8" core hole with 9-7/8" bit to 784'.
- 5-16-69 Drilled 9-7/8" hole from 784' to 980' then came out of hole to repair Shaffer drilling head. Ran in hole, cleaned out 40' of fill and drilled 9-7/8" hole from 980' to 1048'. Deviation surveys: 1-1/2° at 753', 1-1/4° at 870', 1-1/4° at 964'.
- 5-17-69 Drilled 9-7/8" hole from 1048' to 1188'. Cut core #4 from 1188' to 1190', cored 2', recovered 2'. Ran in hole with caliper tool,

hit bridge at 890'. Came out of hole then ran in with bit. Reamed out bridges and cleaned out 80' of fill on bottom. Circulated for logging.

- 5-18-69 Pulled out of hole to run caliper log. Ran in hole with logging tool and hit bridge at 870'. Cleaned up bridges after two attempts then ran Birdwell Caliper Log.
- 5-19-69 Picked up Lynes test tools for hydrological testing. Ran USGS water probe and found static fluid level at 168.55' G.L.
- 5-20-69 Hydrological testing. Ran Birdwell Radioactive log. Completed testing. Ran in hole with 9-7/8" bit to 875'. No bridges, then came out of hole. Ran in hole with 5" open ended drill pipe. Bridge at 901'. Started plug back #2, cemented stage #1 with 100 sacks of type 2 cement, 2% calcium chloride, 2% gel. CIP at 2200 hours.
- 5-21-69 Waited on cement. Tagged top of stage #1 at 892'. Cemented stage #2 with 100 sacks, type #2, 2% calcium chloride, 2% gel. CIP at 0515 hours. Tagged top of stage #2 at 890'. Cemented stage #3 with 200 sacks, type #2, 2% calcium chloride, 2% gel. Tagged top of cement for stage #3 at 887'. Cemented stage #4 with 200 sacks cement. CIP at 2100 hours.
- 5-22-69 Waited on cement. Tagged top of stage #4 at 871'. Cemented stage #5 with 100 sacks cement. CIP at 0530 hours. Waited on cement. Tagged top of stage #5 at 868'. Cemented stage #6 with 100 sacks, type #2, 2% calcium chloride, 2% prehydrated gel. CIP at 1400 hours. Waited on cement. Tagged top of cement for stage #6 at 836'. Cement not set. Waited on cement.
- 5-23-69 Waited on cement. Ran in hole with bit and drilled out cement from 836' to 901'. Cleaned out hole to bottom and reamed from 1188' to 1190'. Circulated and conditioned hole for logging. Ran Birdwell Caliper log from 350' to 916', hit bridge at 916'. Came out of hole with logging tool and then ran in with bit to clean out bridge.
- 5-24-69 Ran caliper log to 916'. Plug back #3, set cement plug at 916' with 200 sacks, type #2, 3% calcium chloride and 2% gel. CIP at 0230 hours. Waited on cement. Tagged top of cement at 892'.
- 5-25-69 Ran in hole with bit and drilled out cement plug from 892' to 938'. Pulled out of hole to check bit. Ran back in hole and drilled out plug from 938' to 950'. Cleaned out bridges from 950' to 959'. Came out of hole and ran caliper log from 947' to 350'. Ran in hole with bit and reamed from 960' to 1190'. Circulated and conditioned hole for logs. Ran logging tool and hit bridge at 527'.
- 5-26-69 Ran in hole with bit and cleaned out bridges. Ran Birdwell Caliper, Electric, Density, Temperature, 3-D and Radioactive Tracer logs. Started hydrological testing.

5-27-69 Hydrological testing.

5-28-69 Completed hydrological testing. Ran in hole with 9-7/8" bit and cleaned out 10' of fill. Drilled 9-7/8" hole from 1190' to 1315'. Deviation survey: 2° at 1272'.

5-29-69 Drilled 9-7/8" hole from 1315' to 1587'. Deviation surveys: 2° at 1334', 2-3/4° at 1457', 2° at 1520', 1-3/4° at 1552'.

5-30-69 Drilled 9-7/8" hole from 1587' to 1708'. Circulated and conditioned hole to core. Came out of hole for core barrel then ran in and cut core #5 from 1708' to 1711-1/2', cored 3-1/2', recovered 3-1/2'. Ran in hole with 9-7/8" bit and reamed from 1708' to 1711-1/2' then drilled from 1711-1/2' to 1756'. Deviation surveys: 1-3/4° at 1644'.

5-31-69 Drilled 9-7/8" hole from 1756' to 2042'. Deviation surveys: 2-1/2° at 1741', 2° at 1800', 2-1/4° at 1887', 2° at 1920', 1-3/4° at 1990'.

6-1-69 Drilled 9-7/8" hole from 2042' to 2242'. Circulated to run logs. Came out of hole then ran in with logging tool, hit bridge at 890'. Came out of hole with logging tool then ran in with bit to clean out bridges. Deviation surveys: 2° at 2050', 1-1/2° at 2147', 1-1/4° at 2209'.

6-2-69 Finished cleaning up hole from 2100' to 2242'. Circulated and conditioned hole for logging. Came out of hole and ran Schlumberger Electric log. Hit bridge at 1098'. Ran in hole with 5" open ended drill pipe and hit bridge at 1100'. Set 5" drill pipe at 951' and started plug back #4, cemented stage #1 with 200 sacks of type #2 cement with 2% calcium chloride. CIP at 1545 hours. Waited on cement.

6-3-69 Tagged top of plug at 895' and then set stage #2 with 200 sacks of type #2 cement with 2% calcium chloride. CIP at 0037 hours. Came out of hole and waited on cement. Ran in hole with 5" drill pipe and tagged top of plug at 888'. Set stage #3 with 200 sacks of type #2 cement, 2% calcium chloride, 2% gel. CIP at 0930 hours. Waited on cement then ran Birdwell Caliper log. Tool stopped at 503'. Ran in hole with 5" drill pipe and tagged top of cement plug at 831'.

6-4-69 Waited on cement then ran in hole with 9-7/8" bit. Drilled out cement from 830' to 950' and cleaned out hole to 2242'. Came out of hole then ran logging tool, hit bridge at 497'. Knocked out bridge then reran logging tool, hit bridge at 672'. Ran in hole with bit and cleaned out 60' of fill. Ran in with logging tool and hit bridge at 497'.

6-5-69 Ran in hole with 5" open ended drill pipe to 525'. Started plug back #5, cemented stage #1 with 200 sacks of type #2 cement, 2% calcium chloride. CIP at 0030 hours. Waited on cement. Ran in hole with drill pipe to 545' and cemented stage #2 with 100 sacks of type #2, 2% calcium chloride, 2% gel. CIP at 0830 hours.

Waited on cement. Ran in hole and tagged top of cement at 549'. Cemented stage #3 with 300 sacks of type #2, 2% calcium chloride, 2% gel. CIP at 1700 hours.

- 6-6-69 Waited on cement then ran in hole and tagged top of cement at 460'. Waited on cement. Ran in hole with bit and drilled out cement from 460' to 545'. Cleaned out to bottom and found bridges at 795', 844', 932', and 2178' to 2242'. Circulated and conditioned hole for logging.
- 6-7-69 Ran Schlumberger Electric, Sonic, Micro-Laterolog, Sidewall Neutron, Density, Bottom Hole TV and Temperature logs.
- 6-8-69 <sup>WSU</sup> Ran University of Washington Temperature, Fluid Resistivity, Electric, and Gamma Ray-Neutron logs. Ran Birdwell Density, Caliper, 3-D Temperature, and Electric logs.
- 6-9-69 Ran Birdwell Radioactive Tracer log and started hydrological testing.
- 6-10-69 Hydrological testing.
- 6-11-69 Hydrological testing.
- 6-12-69 Completed hydrological testing. Ran 9-7/8" bit and junk basket, drilled from 2242' to 2246' and recovered parts from logging tools and straps from B.J. pump used for water testing and some bit bearings. Cleaned out 46' of fill and drilled 9-7/8" hole from 2246' to 2326'.
- 6-13-69 Drilled 9-7/8" hole from 2326' to 2380-1/2'. Ran magnet in hole, no recovery of junk. Cut core #6 from 2380-1/2' to 2387', cored 6-1/2', recovered 5-1/2'. Deviation survey: 1-3/4° at 2360'.
- 6-14-69 Cleaned out 30' of fill, reamed core hole and drilled 9-7/8" hole from 2387' to 2558'. Lost circulation at 2530' and 2547', regained returns. Deviation survey: 1-1/2° at 2453'.
- 6-15-69 Drilled 9-7/8" hole from 2558' to 2695'. Lost circulation and stuck drill pipe at 2600', worked loose and regained returns. Attempted to run Birdwell Caliper log, could not get below 2522'. Hole caving. Deviation surveys: 1-1/2° at 2578', 1-1/4° at 2630'.
- 6-16-69 Drilled 9-7/8" hole from 2695' to 2779'. Cut core #7 from 2779' to 2784-1/2', cored 5-1/2', recovered 5'. Reamed 6-1/8" core hole and drilled 9-7/8" hole from 2784-1/2' to 2840'. Deviation survey: 1-1/4° at 2755'.

- 6-17-69 Drilled 9-7/8" hole from 2840' to 2943'. Cut core #8 from 2943' to 2954', cored 11', recovered 11'. Cleaned out 20' of fill, reamed 6-1/8" core hole and drilled 9-7/8" hole from 2954' to 3009'.  
Deviation surveys: 1-1/2° at 2850', 1-1/2° at 2912'.
- 6-18-69 Drilled 9-7/8" hole from 3009' to 3087'. Cut core #9 from 3087' to 3089', cored 2', recovered 2'. Pulled out of hole and left bottom section of the outer barrel in the hole. Ran 9-3/8" O.D. Bowen overshot and recovered fish. Cleaned out 35' of fill, reamed 6-1/8" core hole and drilled 9-7/8" hole from 3089' to 3100'.  
Deviation survey: 1-3/4° at 3026'.
- 6-19-69 Drilled 9-7/8" hole from 3100' to 3103'. Cut core #10 from 3103' to 3103-1/2'. Pulled out of hole and left bottom section of core barrel in the hole. Recovered fish with Bowen overshot. Core #10, cored 1/2', recovered 0'. Ran Birdwell Caliper, Density, 3-D, and Electric logs.
- 6-20-69 Ran Birdwell Temperature and Radioactive Tracer logs. Ran gas sampler. Started hydrological testing.
- 6-21-69 Hydrological testing.
- 6-22-69 Hydrological testing.
- 6-23-69 Hydrological testing.
- 6-24-69 Completed hydrological testing. Cleaned out 6' of fill and cut core #11 from 3107' to 3117', cored 10', recovered 0'.
- 6-25-69 Reamed 6-1/8" core hole and drilled 9-7/8" hole from 3117' to 3126'. Ran in hole for core #12, could not get bit to core. Pulled out of hole and found bit was worn out. Cut core #13 from 3126' to 3128-1/2', cored 2-1/2', recovered 2-1/2'. Cleaned out 6' of fill, reamed 6-1/8" core hole and drilled 9-7/8" hole from 3128-1/2' to 3163'.  
Deviation survey: 1-3/4° at 3163'.
- 6-26-69 Cut core #14 from 3163' to 3164.8', cored 1.8', recovered 1-1/4'. Reamed 6-1/8" core hole and drilled 9-7/8" hole from 3164.8' to 3171'. Cleaned out 16' of fill and cut core #15 from 3171' to 3173-1/2', cored 2-1/2', recovered 2'. Reamed 6-1/8" core hole and drilled 9-7/8" hole from 3173-1/2' to 3185'.
- 6-27-69 Drilled 9-7/8" hole from 3185' to 3216'. Cut core #16 from 3216' to 3236', cored 20', recovered 9'. Ran Birdwell Caliper log. Started hydrological testing.
- 6-28-69 Completed hydrological testing. Ran Birdwell Temperature log. Reamed 6-1/8" core hole and drilled 9-7/8" hole to 3236'. Cut core #17 from 3236' to 3246' and started out of hole.

6-29-69 Core #17, cored 10', recovered 2'. Started hydrological testing.

6-30-69 Completed testing. Reamed 6-1/8" core hole to 3246' and drilled 9-7/8" hole from 3246' to 3354'.  
Deviation surveys: 2-1/2° at 3235', 2-1/2° at 3307'.

7-1-69 Drilled 9-7/8" hole from 3354' to 3411'. Cut core #18 from 3411' to 3421', cored 10', recovered 7-1/3'. Cleaned out 10' of fill, reamed 6-1/8" core hole and drilled 9-7/8" hole from 3421' to 3451'. Ran Birdwell Caliper log. Started hydrological testing.  
Deviation surveys: 2-1/4° at 3330', 2-3/4° at 3451'.

7-2-69 Hydrological testing.

7-3-69 Completed testing, cut core #19 from 3451' to 3452.8', cored 1.8', recovered 1.8'. Cut core #20 from 3452.8' to 3461', cored 8.2', recovered 0'. Reamed 6-1/8" core hole and drilled 9-7/8" hole from 3461' to 3463'.

7-4-69 Drilled 9-7/8" hole from 3463' to 3491'. Cut core #21 from 3491' to 3495', cored 4', recovered 4'. Reamed 6-1/8" core hole and drilled 9-7/8" hole from 3495' to 3523'. Cut core #22 from 3523' to 3525'.  
Deviation survey: 2-1/4° at 3523'.

7-5-69 Pulled core #22, cored 2', recovered 2'. Reamed 6-1/8" core hole and drilled 9-7/8" hole from 3525' to 3556'. Cut core #23 from 3556' to 3566', cored 10', recovered 5'. Reamed 6-1/8" core hole and drilled 9-7/8" hole from 3566' to 3597'. Started logging.  
Deviation survey: 2-1/2° at 3543'.

7-6-69 Completed running Birdwell Caliper log. Started hydrological testing.

7-7-69 Completed testing. Cut core #24 from 3597' to 3599', cored 2', recovered 0'. Cut core #25 from 3599' to 3602', cored 3', recovered 2'. Reamed 6-1/8" core hole and drilled 9-7/8" hole from 3602' to 3613'.

7-8-69 Drilled 9-7/8" hole from 3613' to 3652'. Cut core #26 from 3652' to 3659', cored 7', recovered 4'. Reamed 6-1/8" core hole and drilled 9-7/8" hole from 3659' to 3723'.  
Deviation surveys: 2-1/4° at 3620', 1-3/4° at 3715'.

7-9-69 Drilled 9-7/8" hole from 3723' to 3932'.  
Deviation surveys: 2-1/4° at 3816', 2-1/4° at 3898'.

7-10-69 Drilled 9-7/8" hole from 3932' to 3935'. Cut core #27 from 3935' to 3938', cored 3', recovered 2'. Reamed 6-1/2" core hole and drilled 9-7/8" hole from 3938' to 4011'.  
Deviation survey: 2-1/4° at 3987'.

7-11-69 Drilled 9-7/8" hole from 4011' to 4237'.  
Deviation surveys: 2° at 4123', 2-1/2° at 4217'.

7-12-69 Drilled 9-7/8" hole from 4237' to 4282'. Ran Birdwell Gamma Ray, Caliper, 3-D, Electric logs.

7-13-69 Ran Birdwell Temperature and Radioactive Tracer logs. Started hydrological testing.

7-14-69 Hydrological testing.

7-15-69 Completed hydrological testing.

7-16-69 Drilled 9-7/8" hole from 4282' to 4285'. Cut core #28 from 4285' to 4292'. Pulled out of hole and left 8 drill collars and coring assembly in the hole. Recovered fish with 9-3/8" O.D. Bowen overshot. Core #28, cored 7', recovered 2'.

7-17-69 Cleaned out 18' of fill, reamed 6-11/16" core hole and drilled 9-7/8" hole from 4292' to 4406'. Deviation surveys: 3° at 4295', 3-3/4° at 4370', 3-1/2° at 4391'.

7-18-69 Drilled 9-7/8" hole from 4406' to 4459'. Ran Schlumberger Temperature log. Deviation survey: 2-3/4° at 4464'.

7-19-69 Ran Schlumberger FDC, SNP Gamma and attempted to run sonic log. Cleaned out 20' of fill and drilled 9-7/8" hole from 4459' to 4491'.

7-20-69 Drilled 9-7/8" hole from 4491' to 4615'. Deviation surveys: 2-3/4° at 4510', 3° at 4540', 2-3/4° at 4600'.

7-21-69 Ran Schlumberger Sonic log. Drilled 9-7/8" hole from 4615' to 4620'.

7-22-69 Drilled 9-7/8" hole from 4620' to 4800'. Deviation surveys: 2-1/4° at 4664', 2° at 4725'.

7-23-69 Drilled 9-7/8" hole from 4800' to 5011'. Deviation surveys: 2° at 4800', 2-1/4° at 4862', 2° at 4910'.

7-24-69 Drilled 9-7/8" hole from 5011' to 5114'. Cleaned out bridge and fill from 4944' to 5114' on trip for new bit. Deviation surveys: 3° at 5018', 3-3/4° at 5079', 3-3/4° at 5707'.

7-25-69 Completed cleaning out fill and drilled 9-7/8" hole from 5114' to 5148'. Cut core #29 from 5148' to 5149', cored 1', recovered 0'. Deviation survey: 4° at 5140'.

7-26-69 Reamed 6-1/2" core hole and drilled 9-7/8" hole from 5149' to 5253'. Lost circulation at 5235' and regained. Deviation surveys: 3° at 5180', 2-3/4° at 5252'.

7-27-69 Cleaned out 40' of fill and drilled 9-7/8" hole from 5253' to 5359'. Lost circulation at 5278' and regained. Deviation survey: 3-1/4° at 5315'.