GL01107

Union Oil Company of California
Geothermal Division
United States Department of Energy
Contract No. DE-AC08-79 ET 27012 (Phase II)
Geothermal Reservoir Assessment Case Study
Northern Basin and Range Province

TECHNICAL REPORT
WELL RICHARD WEISHAUPT #1
STILLWATER PROSPECT
CHURCHILL COUNTY, NEVADA

Prepared By:

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NV/STR/UOC-4

TABLE OF CONTENTS

INTRODUCTION

Well Richard Weishaupt #1, Stillwater Geothermal Prospect, Churchill County, Nevada was drilled to further evaluate the geothermal potential of the Stillwater Prospect. Phase II of Contract No. DE-AC08-79 ET 27012, between Union Oil Company of California and the United States Department of Energy, applies to the drilling of this well. Maps showing the location of the Stillwater Prospect and the location of Richard Weishaupt #1 well are found in Figures 1 and 2, respectively.

Discussion and presentation of technical data are organized in three catagories. These are drilling, geologic, and reservoir summaries. All depths are measured from the drilling rig Kelly bushing datum, unless otherwise stated.

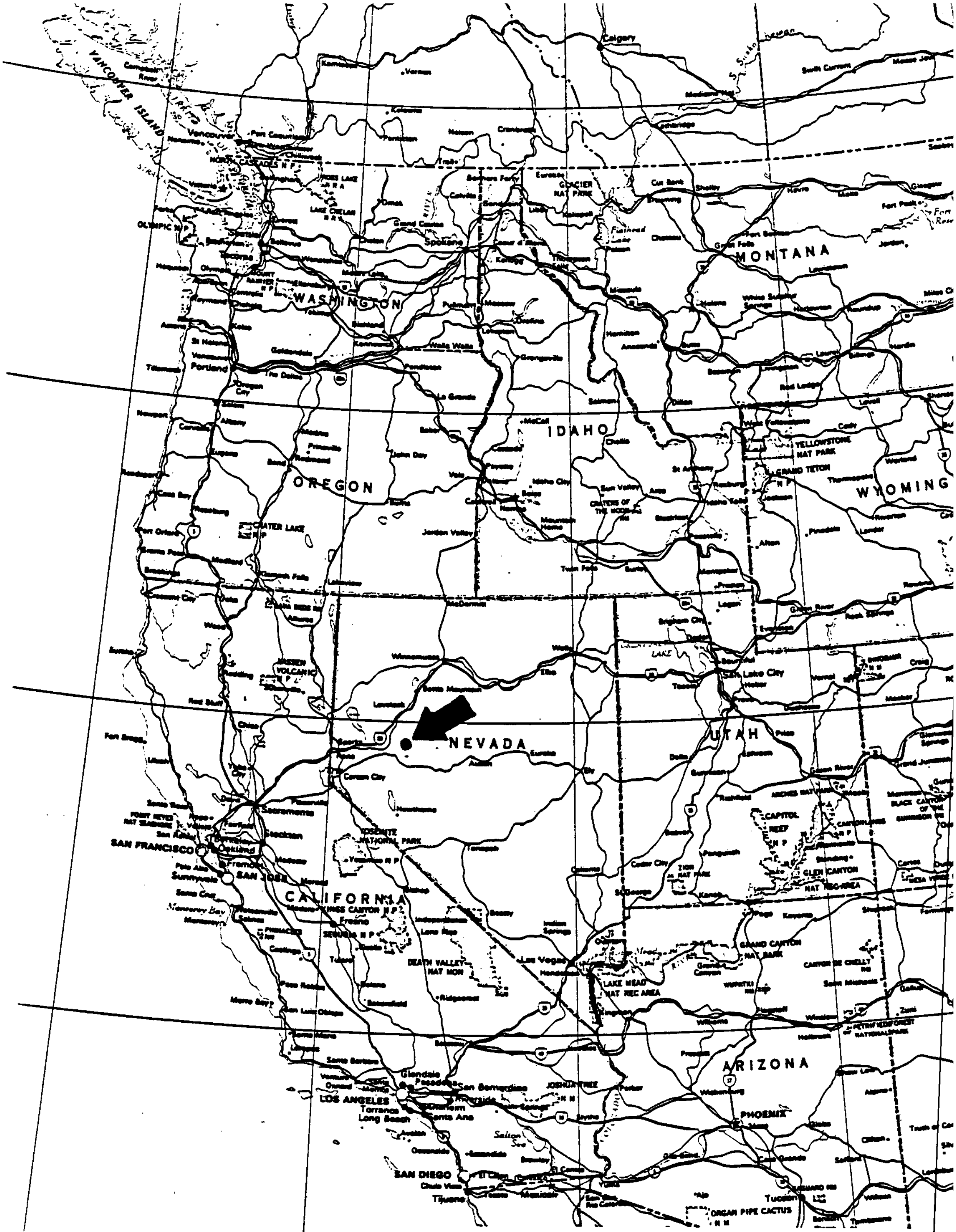


FIGURE 1
MAP SHOWING LOCATION OF
STILLWATER PROSPECT AREA
CHURCHILL COUNTY, NEVADA

(INDICATED BY ➡)

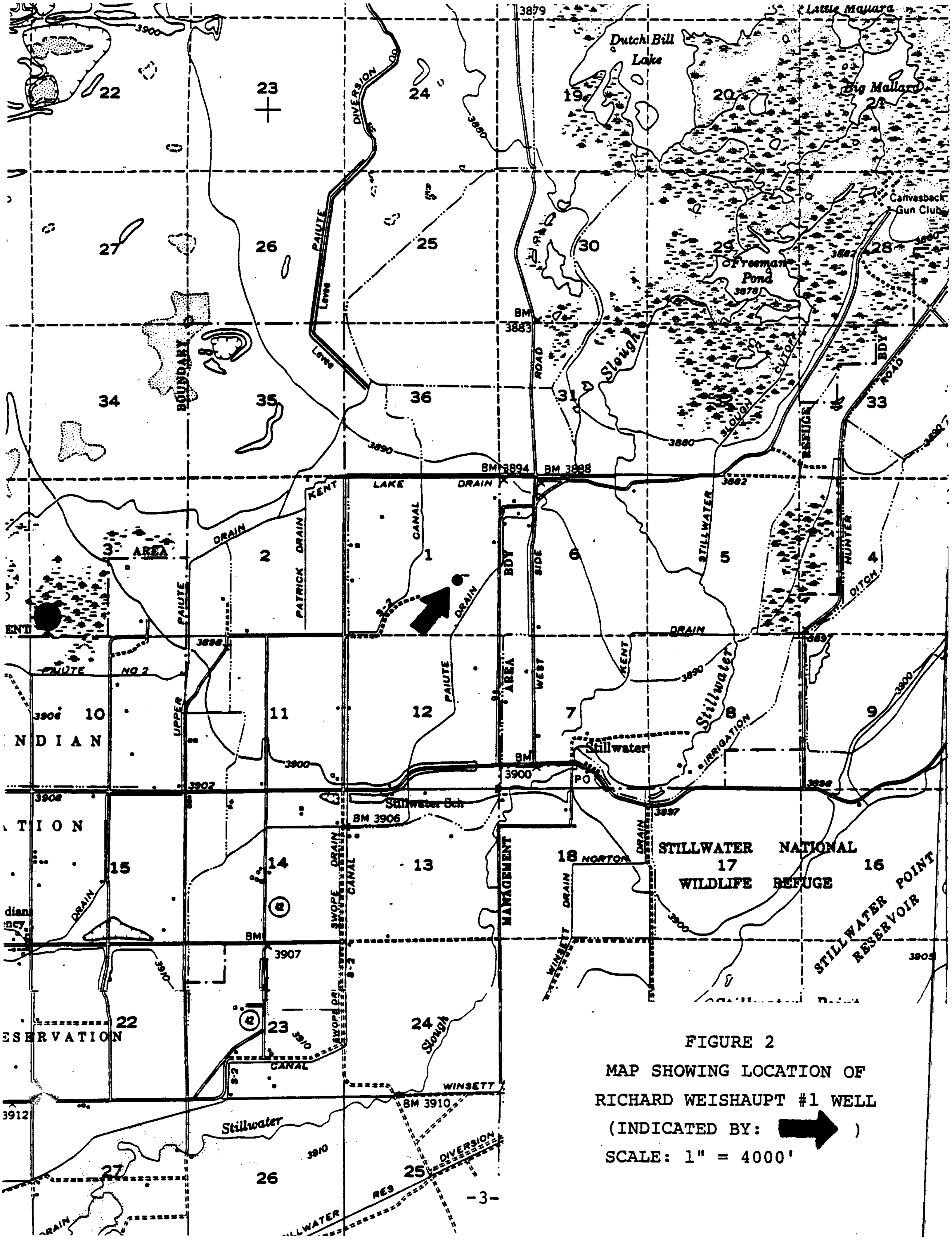


FIGURE 2

MAP SHOWING LOCATION OF

RICHARD WEISHAUPT #1 WELL

(INDICATED BY: ➡)

SCALE: 1" = 4000'

DISCUSSION OF DRILLING OPERATIONS
RICHARD WEISHAUPT #1
STILLWATER PROSPECT
CHURCHILL COUNTY, NEVADA

I. LOCATION PREPARATION AND CONDUCTOR PIPE INSTALLATION

The drill site was constructed prior to moving the drilling rig on location. A one-mile long gravel access road, a gravel covered location, and drilling sump were built. A 36" hole was drilled to 59' below ground level by Dick Howell's Hole-Drilling Service. The 30" conductor pipe was run to 59' below ground level and cemented to surface using ready mix cement.

II. 26" HOLE SECTION - 315' (20" Casing - 299')

Brinkerhoff-Signal Rig #2 was moved in and rigged up. The rig went on day rate at 0800 hours, 5/14/81. Richard Weishaupt #1 was spudded at 1600 hours, 5/14/81. A 17-1/2" hole was drilled to 315'. (Note: All depths are measured from kelly bushing unless otherwise stated.) The hole was opened from 17-1/2" to 26" using a hole opener. A 20" casing string was set at 299' and cemented to surface.

II. 26" Hole Section (Cont'd)

The 20" casing was cut off and a 20" wellhead was welded on. Blowout prevention equipment, consisting of a 20" single-gate preventer dressed with blind rams and a 20" bag-type preventer, was installed and function tested. No problems were encountered in the 26" hole section.

III. 17-1/2" HOLE SECTION - 1404' (13-3/8" Casing - 1390')

A 17-1/2" hole was drilled to 1404'. Electric logs were run. The well began flowing water while preparing to run casing. In order to kill the water flow, the bit was run to bottom and the drilling fluid density was increased from 67 lbs/ft^3 to 72 lbs/ft^3. After killing the water flow, a 13-3/8" casing string was set at 1390' and cemented to surface.

The 13-3/8" casing was cut off and a 12"-900# casing head was welded on. The weld was pressure tested to 1000 psi. Blowout prevention equipment, consisting of a 12"-900# double-gate preventer dressed with blind rams and pipe rams, a 12"-900# bag-type preventer, and a 12" rotating head, was installed.

III. 17-1/2" Hole Section (Cont'd)

The cement level in the 13-3/8" x 20" annulus had dropped to 22' below ground level. A top off cement job was performed to bring the cement level to surface. The B.O.P.'s and casing were successfully pressure tested to 1250 psi.

IV. 12-1/4" HOLE SECTION - 5095' (9-5/8" Liner: 1181'-5078')

A 12-1/4" hole was drilled to 2964'. (Directional drilling operations were commenced at this point. The target objective was to be 2400' due west from the surface location when the true vertical depth reached 9500'.) A turbodrill and bent sub were used to kick the well off from vertical and direct it on a due west course. Three bit runs using the turbodrill were required in order to obtain the desired well course.

An angle building bottom hole assembly was used to complete drilling of the 12-1/4" hole to 5095'. At this point the inclination angle had been built to 22° from vertical and the well course was approximately due west. Inclination and well course were to be maintained at these values until total depth in order to reach the desired target.

IV. 12-1/4" Hole Section (Cont'd)

Electric logs were run over the 12-1/4" hole section. An equipment failure in the logging unit resulted in obtaining only a portion of the planned suite of logs. The 9-5/8" liner was hung from 1182' to 5078' and cemented over its entire length.

Approximately eight hours after the liner cement job was completed, the well began flowing water from the 9-5/8" x 13-3/8" liner lap. In order to kill the water flow, the bit was run to the liner hanger and drilling fluid was mixed to a density of 72 lbs/ft^3 and circulated around. After killing the water flow, a cement squeeze job was performed across the 9-5/8" x 13-3/8" liner lap. The cement was drilled out and the liner lap was successfully pressure tested to a 1.0 psi/ft equivalent gradient.

V. 8-3/4" HOLE SECTION - 10,014' (7" Slotted Liner: 4972'-9995')

An 8-3/4" hole was drilled to 10,014'. A locked bottom hole assembly was used to maintain inclination angle and well course during most of the 8-3/4" hole section. Two bit runs using a pendulum bottom hole assembly were necessary to drop inclination angle. At completion the well was 2306' west and 357' south of the surface location at 9569' true vertical depth.

Three washouts occurred in the 4-1/2" drill pipe while drilling the 8-3/4" hole section. These washouts occurred in spite of Tuboscope inspecting the 4-1/2" drill pipe as a precaution prior to spudding the well. Although no twist-offs resulted from the washouts, three days of rig time were lost in finding and removing the washed-out pipe.

8-3/4" Hole Section (Cont'd)

Due to the rig depth rating for 4-1/2" drill pipe of 8500', drill pipe was changed out at 8541'. Approximately 5000' of 4-1/2" drill pipe was laid down and replaced with 5000' of 3-1/2" rental drill pipe. The 3-1/2" drill pipe was run between the 4-1/2" drill pipe and the bottom hole assembly. Connections were made using 4-1/2" drill pipe to complete drilling to total depth.

While drilling at 9544', the drill string became stuck. A pill of Pipe-Lax and diesel was spotted around the bottom hole assembly, but the pipe did not come free. A free-point indicator was run inside the drill string and indicated the string to be stuck in the 3-1/2" drill pipe approximately 160' above the bottom hole assembly. The Pipe-Lax and diesel pill was pumped up across the stuck point, and the drill string became free. Differential sticking appeared to be the cause of the stuck pipe. In order to prevent further sticking problems 2% diesel was added to the mud.

8-3/4" Hole Section (Cont'd)

Electric logs were run over the 8-3/4" hole section. Several equipment and logging tool failures resulted in obtaining only a portion of the planned suite of logs. A combination blank, slotted, and drilled-hole 7" liner was hung from 4972' to 9995'. This liner was not cemented in place.

A retrievable bridge plug was set in the 9-5/8" liner, and the 9-5/8" x 13-3/8" liner lap was successfully pressure tested to a 0.9 psi/ft gradient. A casing caliper inspection log was run over the entire length of the 13-3/8" casing. The log indicated the 13-3/8" casing to be in excellent condition. A 10"-600# master valve and 10"-600# x 12"-900# crossover spool were installed between the wellhead and B.O.P.E. and successfully pressure tested to 500 psi. The bridge plug was retrieved.

8-3/4" Hole Section (Cont'd)

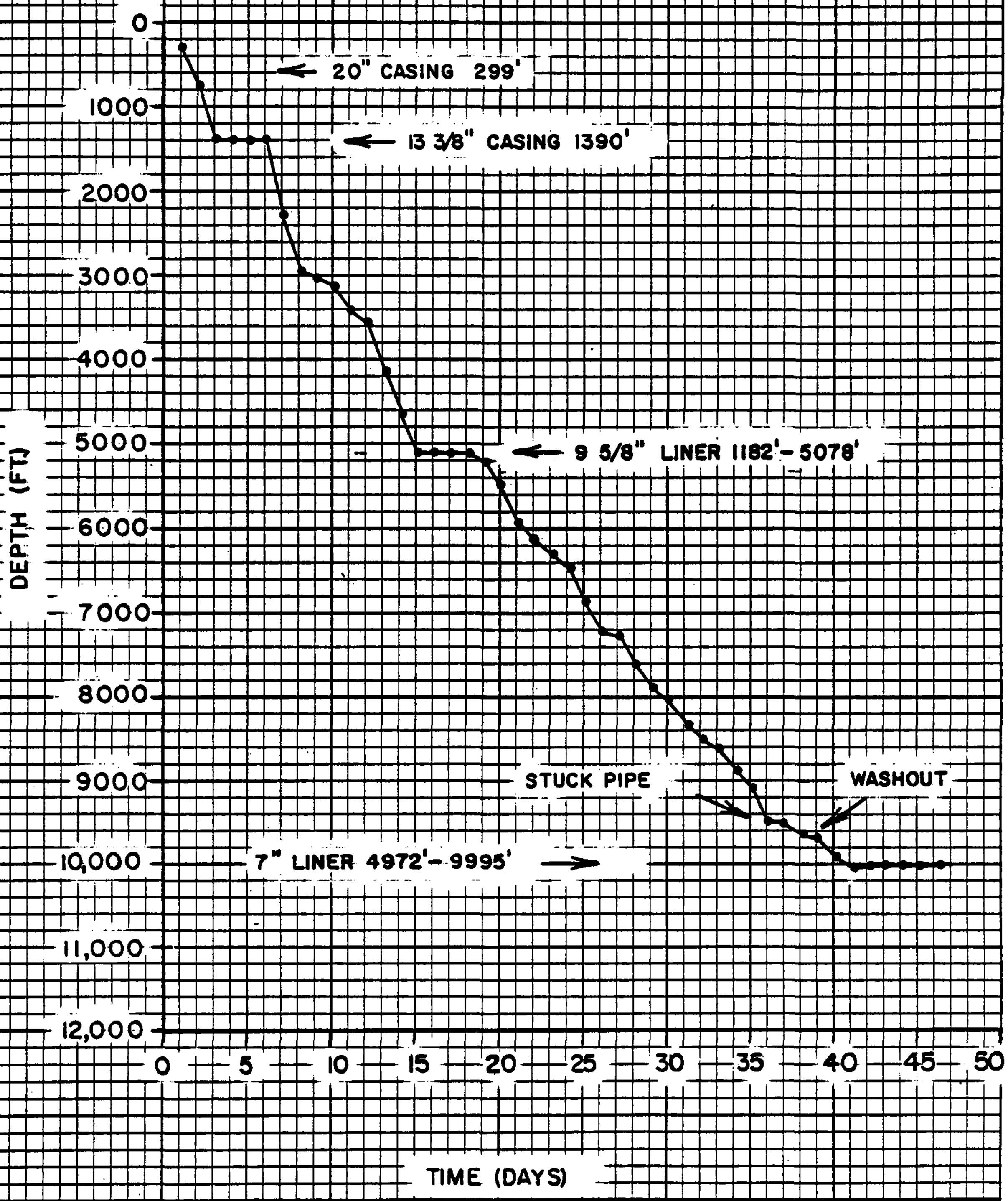
A perforation washing tool was run to the bottom of the 7" liner. The drilling fluid was displaced with fresh water and the hole was flushed clean. The wash tool was used to flush drilling fluid in 7" x 8-3/4" annulus clean as the drill pipe was pulled out of the hole and laid down.

After laying down drill pipe, the master valve was closed and the B.O.P.E. was removed. The rig went on moving rate at 0800 hours, 6/29/81. Rig equipment was torn out and ready for move at the end of the working day, 6/30/81.

TIME vs. DEPTH PROGRESS CURVE

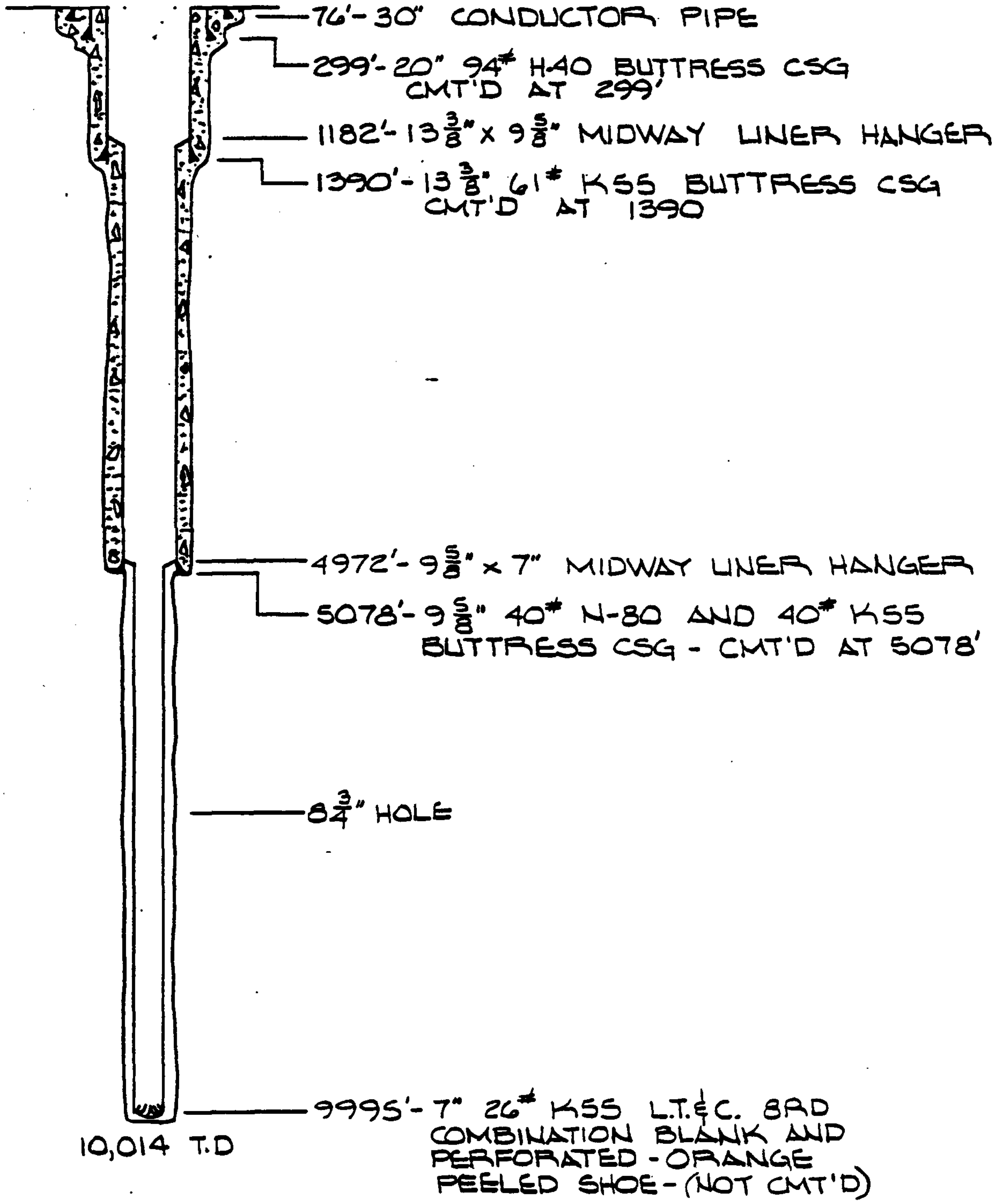
RICHARD WEISHAUPT NO. I

STILLWATER PROSPECT — CHURCHILL COUNTY, NEVADA



WELL COMPLETION SCHEMATIC
RICHARD WEISHAUPT - 1

KELLY BUSHING 27'
GROUND ELEVATION 3895'



7" PERFORATIONS

4972' TO 5062'- BLANK
5062' TO 5219'-16-2-6-80
5347' TO 7344'-18-2-6-150 } APPROX. EVERY OTHER JOINT BLANK
7344' TO 9995'-20-1.5-¼-R.H. }

UNION OIL CO. OF CALIFORNIA
GEOTHERMAL DIVISION

WELL RECORD

LEASE Richard Weishaupt
WELL # 1
FIELD Stillwater Prospect
LOCATION 1800' North and 1400' West of SE
Corner of Section 1, T 19N, R 30E,
Churchill County, Nevada

B.H.L. 357' South and 2306' West of Surf. Loc.
DEPTH: T.D. 10014 T.V.D. 9569 E.T.D. 9995

COMPANY ENGINEER Griebling/Bray

SPUD DATE 5-14-81 COMP. DATE 6-29-81
CONTRACTOR Brinkerhoff-Signal Drilling Co
RIG # 2
ELEVATIONS: GROUND 3895'
K.B. TO GROUND 27'
K.B. TO LOWER CASING HEAD 27'

TYPE WELL: EXPL. X DEV. ____
STM ____ HOT WTR X INJ ____
DRY HOLE X
APPROVED

CASING RECORD

SIZE	WEIGHT	GRADE	THREAD	TOP	BOTTOM	REMARKS
30"	106#/ft	Line pipe	Plain end	Surf.	76'	Cemented to surface
20"	94#/ft	H-40	Buttress	Surf.	299'	Cemented to surface
13-3/8"	61#/ft	K-55	Buttress	Surf.	1390'	Cemented to surface
9-5/8"	40#/ft	N-80 & K-55	Buttress	1182'	5078'	Cemented from 1182-5078'
7"	26#/ft	K-55	8-Rd. LT&C	4972'	9995'	Combination blank, slotte and drilled hole liner, not cemented.

WELL HEAD ASSEMBLY

	MAKE	TYPE	SIZE	PRESSURE RATING
CASING HEAD SPOOL	WKM	S.O.W.	12"	3,000#
~~EXPANSION~~ SPOOL	WKM	Crossover	12"x10"	3,000# x 2,000#
MASTER VALVE(S)	WKM	Gate	10"	2,000#
CASING HEAD VALVES 2X	WKM	Gate	3"	2,000#
~~EXPANSION SPOOL VALVES~~		-		
SWAB VALVE	WKM	Gate	3"	2,000#

STEAM ENTRIES:	DEPTH	LBS. INCREASE
None		

SLOTTED LINER	SLOTS FROM	SLOTS TO	BLANK FROM	BLANK TO

Approximately every other joint slotted (or drilled holes) over entire length (see casing detail).

TEST DATA

ORIFICE SIZE ____

RIG TEST DATE	WHP	FLP	TEMP	POUNDS/HOUR
None				

REMARKS:

Well History

Union Oil Company of California

UNION

TYPE WELL Geothermal

COMPANY Union Oil Co. of California

SEC 1 T 19N R 30E M

LEASE Richard Weishaupt

WELL NO. 1

COUNTY Churchill

LOCATION 1800' North and 1400' West of SE Corner of Section 1, T 19N, R30E, Churchill County, NV

AREA Stillwater Prospect

ELEVATION	SPUD	COMP.	ABAND.	TOTAL DEPTH	PLUG	RECOMP.
3895'	5/14/81	6/29/81		10,014'		

HOLE DEVIATION ☐

B.H.L. 357' South and 2306' West of Surface Location

CASING RECORD

SIZE	CEM. LBS.	DEPTH	SAX	W.S.O. - PERFS. - REMARKS
30"		76'		
20"		299'		
13-3/8"		1390'		
9-5/8"		5078'		
7"		9995'		

WELL DATA

ELEC. LOG

DIPMETER

CORE RECORD

HISTORY

CORE ANALYSIS

PALEO. LETTER

MARKERS - HORIZONS

DATE	DEPTH	PROGRESS HISTORY
5-14-81		Moved in and rigged up Brinkerhoff-Signal Rig #2. Rig on day rate at 0800 hours, 05-14-81. Mixed mud. Drilled and set rathole. Made up 17-1/2" bit. RIH to 30'. Spudded well at 1600 hours, 05-14-81. Drilled cement from 30' to 76'. Drilled 17-1/2" hole from 76' to 315'. Circulated to clean hole at 2400 hours.
5-15-81		POH. Picked up 26" hole opener. Cleaned out cement from 30' to 76'. Opened 17-1/2" hole to 26" from 76' to 315'. Circulated hole clean. Made short trip. No fill. Circulated hole - POH. Ran 7 joints 20" 94# H-40 butt casing with HOWCO 20" stab-in float shoe at 299' (total 300'). Stabbed into float shoe with 4-1/2" drill pipe. Circulated. Pumped 850 cubic feet "G" cement with 40% SSA-1, 1:1 Perlite, 3% Gel, 0.5% CFR-2 and 2% $CaCl_2$, followed by 150 cubic ft. "G" cement with 2% $CaCl_2$. Displaced with 15 cubic ft. water. CIP at 2100 hours. Good cement returns. Circulated 250 cubic feet, good cement returns to surface. Staged tail in slurry. POH with drill pipe. WOC.
5-16-81		WOC. Cut off 30" and 20" casing. Cement at 3' below ground. Welded on 20" SOW casing head. Installed 20" Shaffer single gate with CSO and 20" Hydril. Installed pitcher nipple and flow line. Rigged accumulator. Tested BOP, OK. Made up 17-1/2" drill assembly. RIH to 290'. Drilled cement and shoe. Cleaned out rat hole. Drilled 17-1/2" hole from 315' to 750'.

05-17-81	Drilled 17-1/2" hole from 750' to 1404'/ Rigged up Schlumberger. Ran temp. log from surface to 1396', wire line measure. Max 173°F indicated on log run. Schlumberger lost 4 hours repairing equipment. Ran Sonic log from 1390' to 298', 209°F. Ran DIL from 1388' to 298', 218°F. Ran CNL-FDC from 1386' to 298', 231°F.
05-18-81	Ran Dipmeter from 1386' to 298', maximum temperature 242°F. Rigged down Schlumberger RIH with 17-1/2" bit to 1374'. Cleaned out fill to 1404. Circulated and conditioned mud. POH. Rigged up casing tools. Made up shoe joint. Well flowed due to Artesian water flow. Rigged down casing crew. RIH with 17-1/2" bit to 1404'. Built mud wt. to 72# cu ft. Water flow ceased. POH Prepared to run casing.
05-19-81	Ran 34 joints 13-3/8" 61# K-55 butt casing, landed with HOWCO float shoe at 1390' and float collar at 1350' (-total 1391.81') Rigged down casing tools. RIH with stab-in assembly. Engaged float collar. Circulated, prepared to cement. HOWCO mixed and pumped 1470 cu ft. "G" cement with 1:1 Perlite, 40% SSA-1, 3% Gel and 0.5% CFR-2, followed by 150 cu. ft. "G" cement with 40% SSA-1 and 0.5% CFR-2. Displaced with 80 cu. ft. water. CIP at 1030 hours. Good cement returns (300 cu ft) to surface. POH with 4-1/2" drill pipe. WOC. Cut off 13-3/8" casing. Removed 20" BOE.
05-20-81	Installed 12"-900 SOW casing head. Tested to 1000 psi - OK. Installed 12"-900 Cameron BOP with 12"-900 Hydril. Cement dropped to 22'. HOWCO topped cement from 22' to surface. Installed rotating head and flow line. Tested BOE and casing to 1250 psi, OK.
05-21-81	Drilled 12-1/4" hole from 1404' to 2317'.
05-22-81	Drilled 12-1/4" hole from 2317' to 2964'
05-23-81	Turbodrilled 12-1/4" hole from 2964' to 3036'
05-24-81	Turbodrilled 12-1/4" hole from 3036' to 3143'.
05-25-81	Drilled 12-1/4" hole from 3143' to 3428'
05-26-81	Drilled 12-1/4" hole from 3428' to 3474'. Turbodrilled 12-1/4" hole from 3474' to 3549'.

05-27-81	Reamed 12-1/4" hole from 3429' to 3549'. Drilled 12-1/4" hole from 3549' to 4139' with angle building assembly.
05-28-81	Drilled 12-1/4" hole from 4139' to 4664'.
05-29-81	Drilled 12-1/4" hole from 4664' to 5095'. Conditioned hole. Rigged up Schlumberger.
05-30-81	Ran DIL log from 1390' to 5090'. Schlumberger log (sonic) failed during run. Conditioned hole for casing. POH. Ran casing.
05-31-81	Ran 19 joints 9-5/8" 40# N80 butt and 79 joints 9-5/8" 40# K-55 butt casing with Midway 13-3/8" x 9-5/8" liner hanger, with HOWCO float shoe at 5078' and HOWCO float collar at 4989.74', and hanger at 1182.20'. (Total with accessories 3895.80'). Cooled hole prior to cementing. Cemented with HOWCO as follows: 100 cu ft. water, 112 cu ft Sepiolite flush, followed by 1961 cu ft "G" cement with 1:1 Perlite, 40% SSA-1, 3% Gel, 0.5% CFR-2, and 0.5% HR-7. Followed by 200 cu ft "G" cement, with 40% SSA-1, 0.5% CFR-2, displaced with 1719 cu ft mud. Bumped plug with 1800 psi. Good returns during job. CIP 0900 hours. Pulled out of seal receptacle. Circulated out Perlite and cement cut mud. POH. RIH with 12-1/2" bit to 1182'. Circulated. POH. Laid down 8" drill collars. Picked up 6-1/2" drill collars. Well began to blow while handling tools.
06-01-81	RIH with 12-1/4" bit to 1180'. Well flashed on bottoms up. Mixed mud. Raised mud weight to 72 lbs per cu. ft. Controlled water flow. POH. RIH with HOWCO 13-3/8" RTTS tool at 1136'. Tested casing above RTTS to 1200 psi and BOPs with pipe rams. HOWCO pumped 56 cu ft mud into liner lap, with good psi breakdown to 400 psi pumping rate. Pumped 200 cu ft "G" cement with 40% SSA-1 and 0.5% CFR-2 into lap at 20 cu. ft.minimum at 400 psi. Displaced with 100 cu ft mud to a 200 psi final pressure. No bleed back, well static. Waited 15 minutes, no flow. Released RTTS. POH. Closed CSO rams. WOC 6 hours. RIH with 12-1/4" bit while picking up 6-1/2" drill collars.

06-02-81	Drilled cement from 1136' to 1182'. Circulated. POH. RIH with 8-3/4" bit #8 to 1182'. Drilled cement and seal receptacle. Tested liner lap to a 1.0 gradient, OK. POH. RIH with 8-3/4" bit on locked drilling assembly. Drilled cement, float collar and shoe. Drilled 8-3/4" hole from 5095' to 5210'.
06-03-81	Drilled 8-3/4" hole from 5210' to 5526'.
06-04-81	Drilled 8-3/4" hole from 5526' to 5960'.
06-05-81	Drilled 8-3/4" hole from 5960' to 6159'.
06-06-81	Drilled 8-3/4" hole from 6159' to 6324'.
06-07-81	Drilled 8-3/4" hole from 6324' to 6474'.
06-08-81	Drilled 8-3/4" hole from 6474' to 6864'.
06-09-81	Drilled 8-3/4" hole from 6864' to 7212'.
06-10-81	Drilled 8-3/4" hole from 7212' to 7314'. POH. Retrieved survey instruments. Changed bit and BHA to reduce torque. Magna-Glo'd all tools and drill collars. Laid down 2 bad drill collars. RIH to tight spot at 5826'. Reamed to 5886'. RIH.
06-11-81	RIH to 7224'. Reamed from 7224' to 7314'. Drilled 8-3/4" hole from 7314' to 7357'. Lost 150 psi pump pressure. Pumped softline. Chained out of hole. Found washout 9 stands and one single out. (Wash out in tube one foot below box.) Laid down washed out joint. RIH. Drilled 8-3/4" hole from 7357' to 7626' with bit #13 at 2400 hours.
06-12-81	Drilled 8-3/4" hole from 7626' to 7920'.
06-13-81	Drilled 8-3/4" hole from 7920' to 8040'.
06-14-81	Drilled 8-3/4" hole from 8040' to 8386'. Drilling break from 8064' to 8072' with no fluid loss.
06-15-81	Drilled 8-3/4" hole from 8386' to 8541'. POH.
06-16-81	Drilled 8-3/4" hole from 8541' to 8635'.

06-17-81	Drilled 8-3/4" hole from 8635' to 8914'.
06-18-81	Drilled 8-3/4" hole from 8914' to 9121'.
06-19-81	Drilled 8-3/4" hole from 9121' to 9517'.
06-20-81	Drilled 8-3/4" hole from 9517' to 9544'. Stuck pipe at 9544' while making connection. (Driller slowed down pump and stopped rotary to grease swivel). Worked stuck pipe with full circulation. Spotted 30 bbl "Pipe Lax" diesel pill. Worked stuck pipe and moved pipe-lax pill at 20-minute intervals. Rigged up McCullough Wipeline & Free Point. Found pipe 100% free at 8880'. Worked stuck pipe and move Pipe-Lax to 8850' Pipe pulled free. Circulated out Pipe-Lax and conditioned mud.
06-21-81	Continued conditining mud. Drilled 8-3/4" hole from 9544' to 9615'.Lost 200 psi pump pressure. POH. Did not find wash-out. Drilled 8-3/4" hole from 9615' to 9649'. Lost 350 psi pump pressure. POH. wet, looking for leak
06-22-81	Drilled 8-3/4" hole from 9649' to 9668'. Lost 200 psi pump pressure. POH. Found wash out in 4-1/2" drill pipe 33 stands down, in tube 6" above pin. RIH.
06-23-81	Broke circulation. Lost 200 bbls of mud. Drilled 8-3/4" hole from 9668' to 9932'.
06-24-81	Drilled 8-3/4" hole from 9932' to 10,014'. Circulated. POH. Rigged up Schlumberger. Ran DIL sonic logging tool. Tool failed on bottom. Maximum temperature=290°F. Attempted to run DIL temperature Log. Tool failed on surface. Lost five hours attempting to log. Ran DIL from 10,002' to 5080'. Maximum temperature=305°F. Prepared to run sonic log.
06-25-81	Made 2 unsuccessful attempts to run sonic log. Tool failed twice on bottom. Maximum temperature =305°F after 18 hours static. Lost additional 6 hours. Total 11 hours lost. RIH with CNL-FDC log from 10,002' to 1300'. Maximum temperature=321°F, after 22 hours static. Made several unsuccessful attempts to run temperature log. Tool failed. 7 more hours lost. Total 18 hours lost. Rigged down Schlumberger. RIH to condition mud.

06-26-81	Circulated at shoe. RIH to 10,014', no fill. Circulated and conditioned mud with full returns, after losing 300 bbls of mud. POH. Laid down drill collars. Rigged up and ran 124 joints of blank, drilled and slotted 7" 26# K-55 8-round LT&C casing with orange-peeled shoe. Picked up 7"x9-5/8" Midway liner hanger.
06-27-81	Made up hanger. RIH with liner. Hung liner with hanger at 4972' and shoe at 9995'. Released hanger. POH. Made up Baker Model C retrievable bridge plug. RIH and set same at 1400'. Spotted 200' gel pill above bridge plug. Tested 9-5/8"x13-3/8" liner lap to 500 psi. Held OK. Rigged up Dialog and ran casing caliper over 13-3/8" casing from 1182' to surface. Log showed excellent condition. Rigged down Dialog. Removed BOE. Installed 10"-600 WKM valve, 2 crossover spools, spacer spool. Re-installed BOE.
06-28-81	Tested BOE and master valve to 500 psi. Held OK. RIH with retrieving tool. Cleaned out gel pill, retrieved bridge plug. POH. Picked up perforation washer. RIH. Displaced mud with water. POH, washing liner slots and holes. Laid down drill pipe. All returns at completion of washing were clear of drilling mud. Had 100% returns throughout washing operations.
06-29-81	Completed laying down drill pipe. Closed master valve. Removed BOPE. Released rig at 0800 hours.

R. Weishaupt #1

CASING DETAIL

NO. JTS.	DESCRIPTION	LENGTH	TOP	BOTTOM
	20" CASING DETAIL			
	20" HOWCO stab-in float shoe	2.65	296.35	299.00
7	20" 94# H-40 buttress casing Landed above KB = 1.00'	297.35	-1.00	296.35
	13-3/8" CASING			
	13-3/8" HOWCO Down Jet Float Shoe	2.07	1388.24	1390.31
1	13-3/8" 61# K-55 buttress casing	37.22	1351.02	1388.24
	13-3/8" HOWCO stab-in float collar	1.45	1349.57	1351.02
33	13-3/8" 61# K-55 buttress casing Landed above KB = 1.50'	1351.07	-1.50	1349.57
	9-5/8" CASING			
	9-5/8" HOWCO Super Seal Float Shoe	2.00	5076	5078
2	9-5/8" 40# N-80 & K-55 buttress casing	84.51	4991.49	5076
	9-5/8" HOWCO Super Seal Float Collar	1.75	4989.74	4991.49
96	9-5/8" 40# N-80 & K-55 buttress casing	3800.54	1189.20	4989.74
	13-3/8"x9-5/8" Midway liner hanger	7.00	1182.20	1189.20
	Total	3895.80		
	Hung below KB	1182.20		
		5078.00		

R. Weishaupt-1
Casing Detail page 2

Note: All casing is 7" 26# K-55 8-round LT&C

NO. JTS.	DESCRIPTION	LENGTH	TOP	BOTTOM
	7" LINER			
1	Blank with Orange Peeled shoe	43.01	9951.99	9995.00
2	Drilled holes 20-1.5-1/4RH	84.50	9867.49	9951.99
1	Blank	39.86	9827.63	9867.49
1	Drilled holes 20-1.5-1/4RH	42.23	9785.40	9827.63
1	Blank	36.94	9748.46	9785.40
1	Drilled holes 20-1.5-1/4RH	38.54	9709.92	9748.46
1	Blank	40.89	9669.03	9709.92
1	Drilled holes 20-1.5-1/4RH	42.96	9626.07	9669.03
1	Blank	38.97	9587.10	9626.07
1	Drilled holes 20-1.5-1/4RH	42.10	9545.00	9587.10
1	Blank	38.41	9506.59	9545.00
1	Drilled holes 20-1.5-1/4RH	42.14	9464.45	9506.59
1	Blank	40.13	9424.32	9464.45
1	Drilled holes 20-1.5-1/4RH	34.82	9389.50	9424.32
1	Blank	42.79	9346.71	9389.50
1	Drilled holes 20-1.5-1/4RH	39.98	9306.73	9346.71
1	Blank	41.94	9264.79	9306.73
1	Drilled holes 20-1.5-1/4RH	35.64	9229.15	9264.79
1	Blank	40.93	9188.22	9229.15
1	Drilled holes 20-1.5-1/4RH	42.50	9145.72	9188.22
1	Blank	40.01	9105.71	9145.72
1	Drilled holes 20-1.5-1/4RH	43.14	9062.57	9105.71
1	Blank	36.38	9026.19	9062.57
1	Drilled holes 20-1.5-1/4RH	42.11	8984.08	9026.19
1	Blank	40.44	8943.64	8984.08

PERFORATION DESCRIPTION

20-1.5-.25 RH = 20 rows per foot - 1.5 inch centers - .25 inch diameter round hole - 160 holes per foot.

R. Weishaupt-1
Casing Detail page 3

Note: All casing is 7" 26# K-55 8-round LT&C

NO. JTS.	DESCRIPTION	LENGTH	TOP	BOTTOM
	7" LINER (Cont'd.)			
1	Drilled holes 20-1.5-1/4RH	41.96	8901.68	8943.64
1	Blank	41.97	8859.71	8901.68
1	Drilled holes 20-1.5-1/4RH	42.35	8817.36	8859.71
1	Blank	40.91	8776.45	8817.36
1	Drilled holes 20-1.5-1/4RH	40.83	8735.62	8776.45
1	Blank	42.56	8693.06	8735.62
1	Drilled holes 20-1.5-1/4RH	42.40	8650.66	8693.06
1	Blank	40.33	8610.33	8650.66
1	Drilled holes 20-1.5-1/4RH	34.76	8575.57	8610.33
1	Blank	40.91	8534.66	8575.57
1	Drilled holes 20-1.5-1/4RH	42.63	8492.03	8534.66
1	Blank	40.13	8451.90	8492.03
1	Drilled holes 20-1.5-1/4RH	40.82	8411.08	8451.90
1	Blank	40.12	8370.96	8411.08
1	Drilled holes 20-1.5-1/4RH	40.00	8330.96	8370.96
1	Blank	44.33	8286.63	8330.96
1	Drilled holes 20-1.5-1/4RH	34.30	8252.33	8286.63
1	Blank	41.85	8210.48	8252.33
1	Drilled holes 20-1/5-1/4RH	41.70	8168.78	8210.48
1	Blank	43.45	8125.33	8168.78
6	Drilled holes 20-1.5-1/4RH	249.12	7876.21	8125.33
1	Blank	40.48	7835.73	7876.21
1	Drilled holes	42.38	7793.35	7835.73
1	Blank	39.27	7754.08	7793.35
1	Drilled holes	40.93	7713.15	7754.08
1	Blank	43.74	7669.41	7713.15
1	Drilled Holes 20-1.5-1/4RH	40.65	7628.7	7669.41

R. Weishaupt-1
Casing Detail page 4

Note: All casing is 7" 26# K-55 8-round LT&C

NO. JTS.	DESCRIPTION	LENGTH	TOP	BOTTOM
	7" LINER (Cont'd.)			
1	Blank	42.84	7585.92	7628.76
1	Drilled holes 20-1.5-1/4RH	41.00	7544.92	7585.92
1	Blank	41.15	7503.77	7544.92
4	Drilled holes 20-1.5-1/4RH	159.79	7343.98	7503.77
2	Slotted 18-2-6-150	77.20	7266.78	7343.98
1	Blank	40.80	7225.98	7266.78
1	Slotted 18-2-6-150	42.16	7183.82	7225.98
1	Blank	40.88	7142.94	7183.82
1	Slotted 18-2-6-150	41.51	7101.43	7142.94
3	Blank	122.33	6979.10	7101.43
1	Slotted 18-2-6-150	38.97	6940.13	6979.10
1	Blank	39.38	6900.75	6940.13
1	Slotted 18-2-6-150	40.91	6859.84	6900.75
1	Blank	40.55	6819.29	6859.84
1	Slotted 18-2-6-150	38.57	6780.72	6819.29
1	Blank	42.31	6738.41	6780.72
1	Slotted 18-2-6-150	41.24	6697.17	6738.41
1	Blank	43.72	6653.45	6697.17
1	Slotted 18-2-6-150	38.35	6615.10	6653.45
1	Blank	40.93	6574.17	6615.10
1	Slotted 18-2-6-150	40.78	6533.39	6574.17
1	Blank	40.80	6492.59	6533.39
1	Slotted 18-2-6-150	41.70	6450.89	6492.59
1	Blank	40.99	6409.90	6450.89
1	Slotted 18-2-6-150	38.08	6371.82	6409.90

PERFORATION DESCRIPTION

18-2-6-150 = 18 rows per foot - length of slot = 2 inches - 6-inch centers - 150 mesh slot

16-2-6-80 = 16 rows per foot - length of slot = 2 inches - 6-inch centers - 80 mesh slot

R. Weishaupt-1
Casing Detail page 5

Note: All casing is 7" 26# K-55 8-round LT&C

NO. JTS.	DESCRIPTION	LENGTH	TOP	BOTTOM
	7" LINER (Cont'd.)			
1	Blank	40.78	6331.04	6371.82
1	Slotted 18-2-6-150	38.45	6292.59	6331.04
1	Blank	39.86	6252.73	6292.59
1	Slotted 18-2-6-150	41.78	6210.95	6252.73
1	Blank	40.95	6170.00	6210.95
1	Slotted 18-2-6-150	39.16	6130.84	6170.00
1	Blank	36.67	6094.17	6130.84
1	Slotted 18-2-6-150	39.29	6054.88	6094.17
1	Blank	36.63	6018.25	6054.88
1	Slotted 18-2-6-150	38.71	5979.54	6018.25
1	Blank	41.16	5938.38	5979.54
1	Slotted 18-2-6-150	38.82	5899.56	5938.39
5	Blank	196.48	5703.08	5899.56
1	Slotted 18-2-6-150	38.21	5664.87	5703.08
1	Blank	41.10	5623.77	5664.87
1	Slotted 18-2-6-150	38.85	5584.92	5623.77
1	Blank	37.69	5547.23	5584.92
1	Slotted 18-2-6-150	38.89	5508.34	5547.23
1	Blank	39.28	5469.06	5508.34
1	Slotted 18-2-6-150	39.65	5429.41	5469.06
1	Blank	40.76	5388.65	5429.41
1	Slotted 18-2-6-150	41.29	5347.36	5388.65
3	Slotted 16-2-6-250	128.14	5219.22	5347.36
4	Slotted 16-2-6-80	156.83	5062.39	5219.22
2	Blank	81.90	4980.49	5062.39
	Midway 7"x9-5/8" Liner Hanger and Tie-back receptacle	8.50	4971.99	4980.49

DIRECTIONAL SURVEY LIST - RICHARD WEISHAUPT #1
STILLWATER PROSPECT - CHURCHILL COUNTY, NEVADA

STA	MEAS. DEPTH	VERT. DEPTH	DRIFT ANGLE	DRIFT BEARING	CUMULATIVE COORDINATES N S(-)	CUMULATIVE COORDINATES E W(-)
1	0	0	0.00	N37E	0	0
2	1800	1800	0.50	N37E	6	5
3	2241	2241	0.25	N71W	9	4
4	2619	2619	0.50	N47W	10	2
5	2932	2932	0.50	N27W	12	0
6	2972	2972	0.75	N75W	13	0
7	3003	3003	2.00	N87W	13	-1
8	3035	3035	2.50	S73W	13	-2
9	3066	3066	3.50	S60W	12	-4
10	3097	3097	4.50	S60W	11	-6
11	3198	3197	7.50	S54W	5	-14
12	3322	3320	8.50	S56W	-5	-29
13	3449	3446	9.25	S52W	-16	-44
14	3506	3502	8.00	S65W	-21	-52
15	3636	3631	7.00	N82W	-23	-69
16	3763	3757	7.00	N87W	-21	-84
17	3857	3850	7.00	N87W	-21	-95
18	3951	3943	7.75	N87W	-20	-107
19	4075	4066	9.50	S85W	-21	-126
20	4264	4252	12.00	N86W	-21	-161
21	4418	4402	14.00	S83W	-20	-196
22	4607	4584	17.25	S85W	-23	-247
23	4977	4932	22.00	S83W	-36	-370
24	5183	5122	23.00	S84W	-45	-449
25	5275	5207	23.00	S84W	-49	-484
26	5462	5379	23.00	S82W	-58	-557
27	5850	5735	24.00	S84W	-77	-710
28	5967	5842	24.75	S80W	-84	-758
29	6064	5930	24.75	S89W	-87	-799
30	6222	6074	23.25	S89W	-89	-863
31	6411	6249	21.75	S84W	-93	-935
32	6560	6388	20.75	S83W	-99	-999
33	6686	6505	21.25	S84W	-104	-1034
34	6811	6622	21.25	S84W	-109	-1079
35	6937	6739	21.75	S83W	-114	-1125
36	7062	6855	22.25	S83W	-120	-1171
37	7157	6943	22.00	S82W	-124	-1207
38	7283	7060	22.25	S84W	-130	-1254
39	7427	7193	22.50	S79W	-138	-1308
40	7521	7280	22.00	S79W	-145	-1343
41	7614	7366	22.25	S79W	-152	-1377
42	7801	7539	22.25	S79W	-165	-1447
43	7897	7628	22.25	S79W	-172	-1482
44	8054	7773	23.00	S78W	-184	-1542
45	8212	7918	23.00	S77W	-198	-1602
46	8337	8033	23.50	S78W	-208	-1650
47	8462	8148	23.25	S78W	-219	-1699
48	8541	8220	23.00	S77W	-225	-1729
49	8725	8389	23.75	S73W	-241	-1800
50	8883	8534	23.75	S77W	-255	-1862

Station 51 is extrapolated assuming station 50 survey remains constant

51	10014	9569	23.75	S77W	-357	-2306

DRILLING RIG SPECIFICATIONS

RICHARD WEISHAUPT #1

STILLWATER PROSPECT

CHURCHILL COUNTY, NEVADA

RIG:	Brinkerhoff-Signal Drilling Co. rig #2 Unit U-36A 600 HP with 2-engine compound, 22" Parkersburg hydromatic brake, 1-1/8" drilling line
RIG POWER:	2 AC 25,000 diesel engines on compound 1 Detroit 16 V71 on #1 pump 1 AC 25,000 on #2 pump
DERRICK:	127' Lee C. Moore 450,000# rating with 25' substructure
MUD PUMPS:	2 x EMSCO DA-500 (7-1/2" x 16")
MUD TANKS:	2 steel pits - 700 bbl capacity
WATER TANKS:	1 x 600 bbl skidded, 1 x 500 bbl skidded
LIGHT PLANTS:	2 x 60 KW
BOP EQUIPMENT:	12" 3000 #WP double gate and spherical, 80 gal Hydril accumulator with remote controls
MUD MAINTENANCE EQUIPMENT:	Milchem EVS 24 shaker, Milchem Mud Cleaner
TRAVELING EQUIPMENT:	Oilwell 66 - 250 ton block, Byron Jackson BJ-4125 125 ton hook. Oilwell PC225-225 ton swivel
DRILL STRING:	4-1/2" 16.60 Grade "E" drill pipe 8" O.D. and 6-1/2" O.D. drill collars
ROTARY TABLE:	27-1/2"
FUEL TANKS:	1 x 8000 gal skidded, 1 x 6000 gal skidded

DRILLING FLUID SUMMARY
RICHARD WEISHAUPT #1
STILLWATER PROSPECT
CHURCHILL COUNTY, NEVADA

The mud system used in drilling Richard Weishaupt #1 consisted mainly of bentonite, water, caustic, and lignite. As problems were encountered during the drilling operation, other mud products were added.

Two water flows, one in the 17-1/2" hole section and one from the 9-5/8" x 13-3/8" liner lap, occurred when the mud weight was less than approximately 67 lbs/ft^3. The water flows were easily killed by increasing the mud weight with barite to 72 lbs/ft^3. The fact that the well did not flow from the 8-3/4" hole section after the mud was displaced with water indicates that over-pressured zones must have been isolated by the 13-3/8" and 9-5/8" casing strings.

Rotating torque in the 8-3/4" hole section was above average. Drilling detergent, walnut hulls, and mica were added in attempts to reduce torque. Although these additions did not noticeably reduce rotary torque, there was no increase in torque with depth after additions were begun.

A Pipe-Lax and diesel pill successfully freed differentially stuck pipe in the 8-3/4" hole section. After the pipe was freed, 2% diesel was added to the mud. This had the effect of reducing filtration rate and producing a thinner, slicker, tougher filter cake.

Only negligible amounts of lost circulation occurred while drilling. On two occasions, on trips at 9668' and 10,014', surge pressures while running in the hole caused the formation to break down. At 9668' lost circulation material was added and circulation was regained after pumping 200 bbls. At 10,014' lost circulation material was not added and circulation was regained after pumping a total of 300 bbls.

Drill pipe corrosion was not noticeable. Three corrosion rings were run indicating corrosion rates of 5.6, 0.6, and 2.1 $lbs/ft^2/yr$. The ring which indicated a rate of 5.6 $lbs/ft^2/yr$ was run for too short a time period for its results to be significant.

DRILLING FLUID PROPERTIES DETAIL

RICHARD WEISHAUPT #1

STILLWATER PROSPECT - CHURCHILL COUNTY, NEVADA

Date	Depth (ft)	Mud Weight (lb/ft^3)	Funnel Viscosity (sec/qt)API	Plastic Viscosity (cps)	Yield Point (lb/100ft^2)	Gel Strength (lb/100 ft^2) 10sec/10min	pH
05-14-81	315	67	35	5	11	5/8	9.4
05-15-81	315	66	33	4	6	1/3	9.4
05-16-81	683	68	33	5	14	4/9	11.3
05-17-81	1404	67	30	4	8	5/10	9.2
05-18-81	1404	72	42	8	16	5/12	9.1
05-19-81	-	-	-	-	-	-	-
05-20-81	-	-	-	-	-	-	-
05-21-81	2273	72	45	15	10	3/12	9.2
05-22-81	2964	77	39	14	12	2/15	8.8
05-23-81	3017	70	36	12	9	3/17	9.9
05-24-81	3132	70	37	10	7	1/7	9.8
05-25-81	3347	72	35	13	9	1/6	9.8
05-26-81	3550	68	27	4	1	0/0	9.4
05-27-81	4038	72	44	14	8	4/16	10.8
05-28-81	4599	70	38	13	4	3/22	10.3
05-29-81	4933	70	42	15	9	3/13	9.9
05-30-81	-	-	-	-	-	-	-
05-31-81	5095	68	32	10	20	3/16	9.0
06-01-81	5095	64	28	2	1	0/0	8.0
06-02-81	5230	67	38	11	6	1/12	10.2
06-03-81	5485	68	40	11	6	1/12	10.2
06-04-81	5902	69	42	14	9	2/11	10.4
06-05-81	6160	71	50	20	16	4/18	10.1
06-06-81	6300	69	45	15	10	2/6	10.9
06-07-81	6460	68	42	16	9	1/4	10.4
06-08-81	6811	68	38	10	6	0/3	10.2
06-09-81	7175	70	43	22	11	2/6	10.2
06-10-81	7314	68	38	10	6	0/2	10.0
06-11-81	7603	68	40	16	4	1/2	10.0
06-12-81	7920	69	42	15	6	1/3	10.3
06-13-81	7935	69	42	12	5	1/2	9.8
06-14-81	8374	69	41	19	5	1/2	9.9
06-15-81	8541	69	40	15	6	1/3	10.3
06-16-81	8604	68	40	18	6	1/3	10.1
06-17-81	8914	68	40	16	8	2/3	10.1
06-18-81	9121	68	38	15	7	1/2	10.0
06-19-81	9469	68	39	11	5	0/2	10.5
06-20-81	9544	68	41	12	6	0/2	10.6
06-21-81	9626	68	40	13	6	0/2	10.0
06-22-81	9668	68	40	14	5	0/2	10.5
06-23-81	9890	68	41	17	6	0/3	10.0
06-24-81	10014	68	40	16	6	1/2	10.4
06-25-81	10014	68	40	16	6	1/2	10.4

DRILLING FLUID PROPERTIES DETAIL

RICHARD WEISHAUPT #1

STILLWATER PROSPECT - CHURCHILL COUNTY, NEVADA

DATE	DEPTH (ft)	FILTRATE (ml/30 min.) API	CAKE THICKNESS (32nd in)API	ALKALINITY OF MUD (pm)	ALKALINITY OF FILTRATE (Pf/Mf)	CHLORIDES (ppm)
05-14-81	315	NC	2	1.0	.2/.25	600
05-15-81	315	NC	2	1.1	.2/.25	600
05-16-81	683	NC	2	1.5	.3/.3	1000
05-17-81	1404	NC	2	.05	TR/TR	1400
05-18-81	1404	18.8	2	.1	.05/.1	1425
05-19-81	-	-	-	-	-	-
05-20-81	-	-	-	-	-	-
05-21-81	2273	19.6	2	.25	.1/.1	1200
05-22-81	2074	20.0	3	.1	TR/.05	1400
05-23-81	3017	19.2	2	.3	.3/1.0	1600
05-24-81	3132	19.2	2	.3	.3/1.0	1500
05-25-81	3347	18.6	2	.35	.3/1.1	1450
05-26-81	3550	20.0	2	.15	TR/.6	1000
05-27-81	4038	15.6	2	.7	.5/1.2	800
05-28-81	4599	13.6	2	.6	.4/1.1	850
05-29-81	4933	12.0	2	.3	.2/.8	850
05-30-81	-	-	-	-	-	-
05-31-81	5095	NC	2	.1	.1/.5	1600
06-01-81	5095	NC	2	TR	TR/TR	600
06-02-81	5230	21.6	2	.65	.15/.25	500
06-03-81	5485	20.8	2	.7	.15/.25	500
06-04-81	5902	17.6	2	.7	.2/.4	550
06-05-81	6160	14.6	1	.45	.15/.3	550
06-06-81	6300	13.6	1	.9	.3/.5	550
06-07-81	6460	14.6	1	.45	.2/.4	500
06-08-81	6811	14.6	1	.3	.15/.5	500
06-09-81	7175	14.4	1	.35	.15/.35	450
06-10-81	7314	14.0	1	.25	.1/.4	450
06-11-81	7603	14.4	1	.35	.15/.55	450
06-12-81	7920	13.2	1	.5	.25/.75	650
06-13-81	7935	15.2	1	.2	.1/.55	400
06-14-81	8374	14.4	1	.25	.1/.55	350
06-15-81	8541	15.2	1	.3	.15/.55	350
06-16-81	8604	16.0	1	.25	.1/ .5	350
06-17-81	8914	15.6	1	.25	.1/.45	350
06-18-81	9121	15.6	1	.2	.1/.4	350
06-19-81	9469	16.4	1	.5	.3/.8	350
06-20-81	9544	14.0	1	.6	.4/.9	350
06-21-81	9626	12.8	1	.2	.15/.5	300
06-22-81	9668	12.0	1	.45	.3/.7	300
06-23-81	9890	12.0	1	.3	.2/.6	275
06-24-81	10014	11.6	1	.4	.3/.7	275
06-25-81	10014	11.6	1	.4	.3/.7	275

DRILLING FLUID PROPERTIES DETAIL

RICHARD WEISHAUPT #1

STILLWATER PROSPECT - CHURCHILL COUNTY, NEVADA

DATE	DEPTH (ft)	CALCIUM (ppm)	SOLIDS (% by Vol.)	SAND (% by Vol)	OIL (% by Vol.)	METHYLENE BLUE CAPACITY (ml/ml/mud)
05-14-81	315	TR	5	1.5	0	-
05-15-81	315	TR	3.5	.25	0	-
05-16-81	683	120	5	1	0	-
05-17-81	1404	400	5	.75	0	-
05-18-81	1404	140	9	TR	0	-
05-19-81	-	-	-	-	-	-
05-20-81	-	-	-	-	-	-
05-21-81	2273	60	9	.75	0	-
05-22-81	2964	240	14	1.75	0	-
05-23-81	3017	200	7	1.25	0	-
05-24-81	3132	260	7	1	0	-
05-25-81	3347	100	9	1.5	0	18.5
05-26-81	3550	40	5	.25	0	16
05-27-81	4038	40	9	1.5	0	20
05-28-81	4599	40	7.7-	1	0	18.5
05-29-81	4933	160	7.7	.25	0	18
05-30-81	-	-	-	-	-	-
05-31-81	5095	80	5	TR	0	15
06-01-81	5095	0	2	0	0	12
06-02-81	5230	20	4	.75	0	19.5
06-03-81	5485	180	5.5	1	0	21
06-04-81	5902	40	6.5	.25	0	22.5
06-05-81	6160	20	7.5	TR	0	23.5
06-06-81	6300	60	6.5	.5	0	22.5
06-07-81	6460	40	5.5	.25	0	22
06-08-81	6811	20	5.5	TR	0	22
06-09-81	7175	20	7	.25	0	22
06-10-81	7314	80	5.5	TR	0	23
06-11-81	7603	80	5.5	.25	0	22
06-12-81	7920	20	6	.25	0	23
06-13-81	7935	20	6	.25	0	21.5
06-14-81	8374	20	6	TR	0	22.5
06-15-81	8541	20	6	.25	0	22.5
06-16-81	8604	20	5.5	TR	0	22
06-17-81	8914	20	5.5	TR	0	22
06-18-81	9121	20	5.5	TR	0	20.5
06-19-81	9469	40	5.5	TR	0	21.5
06-20-81	9544	20	5.5	TR	0	22
06-21-81	9626	TR	5	TR	1.5	22
06-22-81	9668	20	5	TR	1.5	21.5
06-23-81	9890	20	5	.25	2.0	22.5
06-24-81	10014	20	5	.25	2.0	22
06-25-81	10014	20	5	.25	2.0	22

BIT NO.	BIT SIZE	BIT MFGR.	BIT TYPE	SERIAL NO. OF BIT	JET SIZE			DEPTH OUT	FTGE	HOURS RUN	ACC. HOURS	FT/HR	WEIGHT 1000 LBS.	ROTARY R.P.M.	VERT. DEV.	PUMP PRESS	PUMPS			MUD		DULL CODE			REMARKS FORMATION, CIRC. FLUID, ETC.
					1	2	3										No.	Liner	SPM	Wt.	Vis.	T	B	G	
1	17½	STC	DSJ	AV4671	14	14	16	1404	1328	26.5	26.5	50	7	110	.25°	1200	½	5½	2X 60	67	35	2	3	I	
2	12¼	REED	S11J	906172	14	14	14	2964	1560	32.5	59	48	22	90	.5°	800	1	5½	60	77	39	5	6	I	
3	12¼	REED	Y12J	931995	O	U	T	3036	72	8.5	67.5	8	10	TURBO	2°	1200	½	5½	87	70	36	7	7	I	
4	12¼	STC	DGJ	BN5194	O	U	T	3143	107	10	77.5	11	10	TURBO	4°	1200	½	5½	84	70	37	7	7	I	
5	12¼	STC	DGJ	BN5015	14	14	14	3474	331	18.5	96	18	32	70	9°	700	½	5½	97	70	30	4	4	1/16	
6	12¼	SEC	M44N	942946	O	U	T	3549	75	2	98	38	10	TURBO	9°	1250	½	5½	97	70	30	2	2	I	
7	12¼	REED	HS51J	907001	14	14	14	5095	1546	46.5	144.5	33	35	75	22°	800	1	5½	60	70	42	3	3	1/8	
8	8¾	HTC	OSC1G	HT162	12	12	12	5369	274	9	153.5	30	30	70	23°	700	1	5½	40	68	40	4	2	I	
9	8¾	REED	HS51J	917683	12	12	12	6018	649	30	183.5	22	25	80	24°	700	1	5½	40	71	50	2	2	I	
10	8¾	STC	DGJ	AE1713	12	12	12	6222	204	13.5	197	15	30	80	22°	700	1	5½	40	69	45	5	4	1/16	
11	8¾	REED	HS51J	344303	12	12	12	6474	252	13	210	19	30	80	22°	700	1	5½	40	68	42	1	1	I	
12	8¾	REED	HS51J	928314	11	11	11	7314	840	45.5	255.5	18	35	80	22°	800	1	5½	40	68	38	2	8	I	
13	8¾	STC	F2	BL6055	10	10	10	7920	606	30	285.5	20	30	80	22°	1150	1	5½	40	68	40	2	2	I	
14	8¾	SEC	S84F	979941	10	10	10	8541	621	38	323.5	16	30	75	23°	1150	1	5½	40	68	40	2	7	I	
15	8¾	STC	F2	BR3845	14	14	12	9121	580	42.5	366	14	27	75	23°	1200	1	5½	44	68	40	3	2	I	
16	8¾	HTC	J33	VH259	13	13	13	9615	494	32	398	15	27	75	23°	700	1	5½	44	68	40	2	4	I	
17	8¾	STC	F3	BL4898	14	14	14	10014	399	32.5	430.5	12	25	80	23°	1100	1	5½	44	68	40	3	4	I	

DRILL BIT RECORD

RICHARD WEISHAUPT #1

STILLWATER PROSPECT

CHURCHILL COUNTY, NEVADA

CASING CEMENTING DETAIL

RICHARD WEISHAUPT #1 - STILLWATER PROSPECT - CHURCHILL COUNTY, NEVADA

CASING SIZE	HOLE DIAMETER	SETTING DEPTH	SLURRY VOLUME	SLURRY COMPOSITION	REMARKS
30"	36"	76'	12 yd^3	Ready-mix cement	Set 59' below ground level
20"	26"	299'	1000 ft^3	850 ft^3 of class "G" cement premixed with 1:1 Perlite, 40% silica flour, 3% bentonite, 0.5% CFR-2 and 2% $CaCl_2$ 150 ft^3 of class "G" cement premixed with 2% $CaCl_2$.	Cemented through stab-in float shoe. Circulated 250 ft^3 of good cement to surface
13-3/8"	17-1/2"	1390'	1620 ft^3	1470 ft^3 of class "G" cement premixed with 1:1 Perlite, 40% silica flour, 3% bentonite, and 0.5% CFR-2. 150 ft^3 of class "G" cement premixed with 40% silica flour and 0.5% CFR-2.	Cemented through stab-in float collar. Circulated 300 ft^3 of good cement to surface. Cement level dropped 22' below ground level. A top job was performed using 30 ft^3 of the lead slurry.
9-5/8"	12-1/4"	1182' - 5078'	2161 ft^3	1961 $ft^3$of class "G" cement premixed with 1:1 Perlite, 40% silica flour, 3% bentonite, 0.5% CFR-2 and 0.5% HR-7 (retarder) 200 ft^3 of class "G" cement premixed with 40% silica flour and 0.5% CFR-2.	Cemented through liner hanger. A water flow from the 9-5/8" by 13-3/8" liner lap commenced approximately 8 hours after bumping plug. A squeeze cement job was performed as below.
9-5/8"x13-3/8"	Liner Lap	Squeeze	200 ft^3	Class "G" cement premixed with 40% silica flour and 0.5% CFR-2.	Lap was tested successfully to 1.0 psi/ft equivalent gradient after squeeze job.

DISCUSSION OF GEOLOGY

RICHARD WEISHAUPT #1

STILLWATER PROSPECT, CHURCHILL COUNTY, NEVADA

REGIONAL SETTING

The Stillwater Prospect is located in a complex graben which formed in response to the regional extensional tectonic regime that characterized the Basin and Range Province from the Miocene to Holocene. The thermal anomaly and faulting associated with the graben structure both have north-northeast trends suggesting that near-surface ascent of thermal fluids is controlled by aspects of regional structure. The stratigraphy of the graben consists of: 1) Quaternary clays, siltstone, sandstone deposited in Pleistocene Lake Lahonton; 2) Late Tertiary volcanics/sediments which were deposited while horst and graben structure developed; and 3) Mesozoic basement complex (metasedimentary/metavolcanic rocks and gabbroic to granitic intrusions).

WELL STRATIGRAPHY

The R. Weishaupt-1 well penetrated Cenozoic rocks to total depth (10,014 ft.). Based on examination of cuttings using a binocular microscope and petrographic study of 6 thin sections (2200-2300'; 3000-3100'; 3400-3500'; 3700-3800'; 3900-4000'; 4400-4500'), the well stratigraphy has been informally subdivided into the following intervals:

Quaternary

- Lahonton Valley Group Sediments

Quaternary to Late Tertiary

- Pre-Lahonton Valley Group Sediment Volcanics
- Mafic Hypabyssal Intrusion

Late Tertiary

- Intercalated Sediments and Volcanics
- Amygdular Basaltic to Andesitic Volcanics
- Basaltic to Andesitic Volcanics
- Andesitic Tuff
- Basaltic to Andesitic Volcanics
- Andesitic Tuff
- Basaltic to Andesitic Volcanics
- Felsic Volcanics
- Basaltic to Andesitic Tuff/Volcanics

as described below (see also Stratigraphic Column). Tops and bases of the aforementioned intervals were determined from Schlumberger logs. Thicknesses have been corrected for hole deviation by assuming that the orientation of all strata is nearly horizontal (which is corroborated by dipmeter logs).

QUATERNARY ROCKS

Lahonton Valley Group Sediments

The Lahonton Valley Group is composed of 1090 ft. of interbedded shale, siltstone and sandstone which reflect a period of Quaternary lake sedimentation. These strata are poorly to moderately indurated and are characterized by a low sandstone/shale ratio. The fine-grained sediments are primarily composed of phyllosilicate minerals (chlorite, montmorillonite, illite, muscovite) along with variable proportions of quartz and calcite. Hydrothermal alteration of framework clasts and fine-grained clays to pyrite ± calcite is common. Sandstone is generally fine-grained (< 1.0 mm) and consists primarily of subrounded to subangular quartz along with lesser amounts of feldspar + biotite + clay which are poorly cemented with calcite.

The entire section is characterized by relatively high electrical conductivity, fast (but variable) travel time (sonic log), and low density/high porosity which are attributed to the large amount of clay, absence of fracturing, and poor consolidation, respectively.

QUATERNARY TO LATE TERTIARY

Pre-Lahonton Valley Group Sediments/Volcanics

The transition from Lahonton Valley group to Pre-Lahonton Valley group rocks is gradational and obscured by hydrothermal metamorphism associated with the geothermal system. This contact is distinguished by a higher sandstone/shale ratio and higher degree of induration in the Pre-Lahonton Valley group rocks. This unit has been informally subdivided into an upper and lower which have a combined thickness of 1690 ft. The upper section (1090' to about 2540') is dominated by sandstone + siltstone along with minor amounts of shale and volcanics (the proportion of volcanics may be underestimated due to the fine-grained nature of most lithologies) whereas the lower section contains a significant (20-80%) amount of intercalated volcanics.

The sedimentary rocks are quartz-rich (subrounded; grain size 0.1 to 1.0 mm quartz overgrowths locally common), but also contain lithic and feldspar clasts. The sediments appear to be cemented with clay + variable amounts of calcite. The volcanics are composed primarily of fine-grained mafic lavas (?) and mafic to silicic tuff. The mafic rocks contain abundant microlites of plagioclase set in a fine-grained chlorite-rich matrix, where as the tuffaceous strata are dominated by plagioclase and quartz crystals, and altered glass.

These strata reflect the transition from a period of volcanism to alluvial fan and lake sedimentation. The entire section is characterized on electric logs by relatively high conductivity and high porosity which are probably related to the dominance of sedimentary/tuffaceous sedimentary rocks.

Mafic Hypabyssal Intrusion

The late Tertiary sediments/volcanics are underlain by mafic igneous rocks which have an aggregate thickness of about 750 ft. Variations in lithologies of ditch cuttings and electric logs suggest that the lower portion of this section contains some late Tertiary tuff/tuffaceous sediments. Features of the mafic rocks include slow drilling rate (105-150 ft./hr), dark green color, coarse grain size (0.5-2.0 mm), and an olivine (15%), clinopyroxene (15%), magnetite (5-10%) and plagioclase (60-65%) mineralogy which exhibit hypidiomorphic granular and locally subophitic textures. Low conductivity and low radioactivity of these rocks (from Schlumberger logs) reflect the lack of fractures/low porosity and the mafic composition of these rocks. The absence of vesicles and a fine-grained matrix along with the coarse grain size, taken together, indicate that these rocks are part of an intrusive complex. Local seismic data along with stratigraphy of adjacent wells suggest that this intrusion has a near-horizontal orientation.

LATE TERTIARY

Intercalated Sediments and Volcanics

The upper portion of the late Tertiary section is composed of about 420 ft. of fine-grained tuff and tuffaceous sediment. These rocks have a white to cream color, are well indurated, locally laminated, and are composed of fine grained lithic clasts, quartz crystals and plagioclase crystals (clasts?) set in a matrix of altered glass shards. These tuffaceous rocks are locally intercalated with pumice-rich horizons and mafic flows (?). The mafic flows (?) are composed of minor vesicles and abundant plagioclase microlites set in a glassy matrix. Glassy material is locally replaced by chlorite ± plagioclase (albite) ± pyrite ± opague minerals.

Amygdular Basaltic to Andesitic Volcanics

The fine-grained pyroclastic strata are conformably underlain by a thick (about 2,525 ft.) unit of basaltic to andesitic flows or coarse-grained volcaniclastics which locally contains minor tuffaceous strata. These volcanics are typified by the presence of abundant (up to 40 volume %) vesicles which are variably filled with zeolite, chlorite, copper minerals (?), quartz chalcedony and calcite.

Phenocrysts of plagioclase ± pyroxene are rare to absent. The matrix is composed primarily of plagioclase microlites which are set in glass that has been altered to a very fine-grained hematite + chlorite assemblage. These strata are characterized by an extremely variable density, porosity and conductivity which probably reflect differences in alteration and vesicularity between the tops/bottoms and central portions of individual flows.

Basaltic to Andesite Volcanics

An interval of basaltic to andesitic (composition uncertain) volcanics was penetrated between 6560' ± 20' to 7310' ± 20' (thickness ∿690 ft.) and distinguished from the amygdular basaltic to andesitic volcanics by the paucity of vesicles and hematitic alteration, and the presence of abundant pyroxence, plagioclase, and olivine (?) phenocrysts. The matrix is fine-grained, but granular and consists primarily of plagioclase and chloritized mafics. The absence of clastic textures in the sand-size cuttings suggests that these rocks are lava flows or coarse pyroclastics. Cuttings from this interval ubiquitously contain 10-40% amygdular basaltic to andesitic volcanics which, owing to the distinctly different alteration and phenocryst mineralogy is tentatively interpreted to be due to sloughing from the upper portion of the hole (caliper log indicates hole enlargement). This interval is also characterized by variable density and porosity which probably reflect differences between tops/bottoms and the central portions of individual flows.

Andesitic Tuff

The basaltic to andesitic volcanics are conformably underlain by a ∿170 ft. (7210' ± 20' to 7490' ± 20') layer of andesitic pumice/tuff. The horizon has a variable green to tan/brown color that appears to reflect chlorite-rich and biotite-rich mineralogies, and is composed of very fine-grained well-bedded tuff and coarser-grained lithic tuff. The lithic fragments are often flatened, range in size to 4mm, and characterized by abundant vesicles (filled with chlorite). Plagioclase and rare quartz (?) microphenocrysts are present in both lithic clasts and in the fine-grained ash. Pyrite is a ubiguitous accessory mineral. Electrical features of these rocks include high conductivity, high porosity and low density.

Basaltic to Andesitic Volcanics

A third zone of basaltic to andesitic volcanics was penetrated from 7490' ± to 7900' ± 20' (thickness 390 ft.). This interval is composed of variable proportions of : 1) vesicular (filled with chlorite and quartz), hematite-stained aphanitic volcanics; and 2) fine-grained plagioclase-pyroxene-olivine (?) porphyritic volcanics which contain only minor vesicles. These rocks are similar to the basaltic to andesitic volcanic section at 6560' to 7310', but distinguished by the absence of copper minerals (?) as vesicle fillings. This section is also typified by relatively low conductivity and variable density which reflect either the absence of clays or permeability, and differences between bottoms/tops and central portion of flows, respectively.

Andesitic Tuff

A second layer of andesitic tuff was encountered at 7906'-8043' (thickness of ∿130 ft.). These strata are identical to the tuff/pumice described previously but only exhibit a chlorite-rich alteration assemblage. In addition, calcite and pyrite are abundant secondary phases.

Basaltic to Andesitic Volcanics

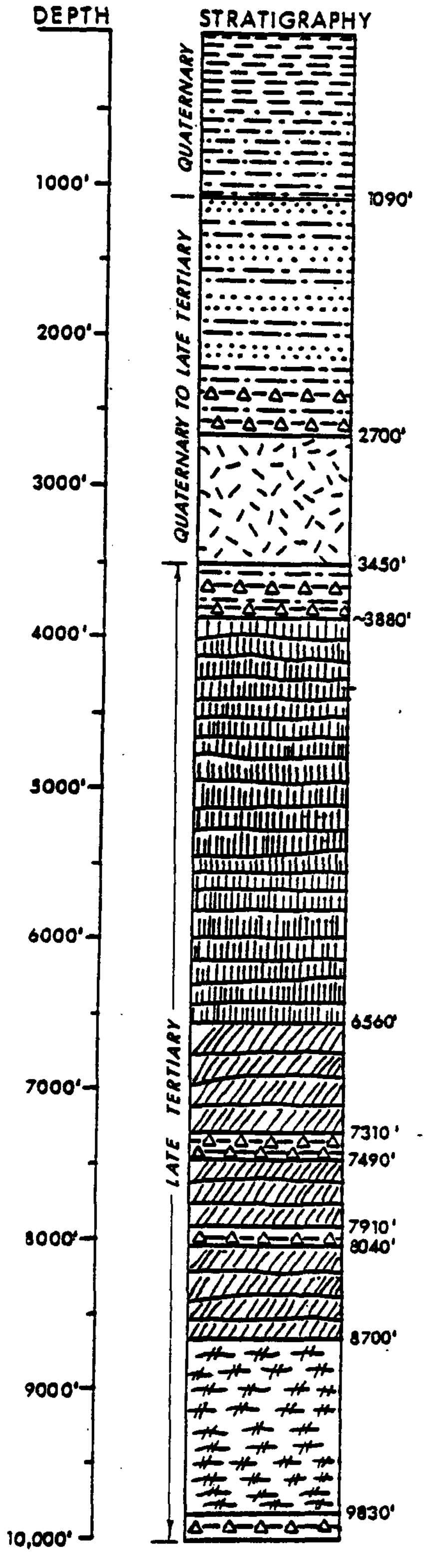
The andesitic tuff horizon (7910'-8040') is underlain by a third zone of basaltic to andesitic volcanics. This ∿620' thick interval (8040' ± 20' to 8700' ± 20') is very similar to previously described basaltic to andesitic volcanics and consists of both highly vesicular (filled with quartz and chlorite) and fine-grained (with minor vesicles) rocks. The highly vesicular rocks lack phenocrysts and contain a hematite-stained aphanitic matrix which is locally rich in plagioclase microlites. The less-vesicular volcanics contain plagioclase, pyroxene (chloritized) and olivine (?) phenocrysts set in a matrix of granular plagioclase + chloritized mafics. Pyrite and chlorite are common secondary minerals.

Felsic Volcanics

A zone of light green to light grey, hard felsic (dacitic to rhyolitic composition) volcanics was encountered from 8700' ± to 9830' ± 20' (thickness of ~1,050 ft.). These rocks are composed of plagioclase, magnetite, hornblende and rare quartz (?) phenocrysts (1 to 2 mm) set in an aphanitic matrix. Microphenocrysts of plagioclase and hornblende are locally present in the matrix. Perlitic texture is common. Alteration features include veining and replacement of the matrix with quartz, chlorite, pyrite (rare) clacite and epidote (glassy lemon yellow mineral; may be carnotite?).

Basaltic to Andesitic Tuft/Volcanics

The felsic volcanics are conformably underlain by a mixture of variable proportions of andesitic volcanics. The andesitic tuff is composed of abundant pumice fragments (vesicles filled with chlorite) whereas the basaltic to andesitic volcanics contain plagioclase phenocrysts which are set in a fine-grained matrix. Calcite, pyrite, and chlorite veining and replacement are common. These strata are characterized by relatively high conductivity and porosity which probably reflect a high clay (altered ash) content.



STRATIGRAPHIC COLUMN - R. WEISHAUPT-1 WELL

LAHONTON VALLEY GROUP (thickness = 1090')- interbedded clay, siltstone and minor sandstone; poorly consolidated; coarser sediments are quartz-rich and fine-grained (< 1.6mm);calcite cement is common; pyrite and chlorite are secondary minerals.

PRE-LAHONTON VALLEY GROUP (thickness = 1610') - interbedded sandstone, siltstone and minor clay; moderately well consolidated; coarse-grained sediments are quartz-rich; quartz overgrowths are locally abundant; intercalated with tuffaceous sediment and tuff near the base of this unit.

BASALTIC HYPABYSSAL SILL (thickness = 750') - hydromorphic granular and ophitic texture; fine-grained (1-2mm); composed of plagioclase, pyroxene, olivine and magnetite.

INTERBEDDED TUFFACEOUS SEDIMENTS AND VOLCANICS - (thickness = 420') - v. fine grained tuff which is locally rich in quartz + plagioclase fragments; volcanics have a mafic composition, are aphanitic, and do not have a clastic texture.

AMYGDULAR BASALTIC TO ANDESITIC VOLCANICS - (thickness = 2,530') - very vesicular (filled with quartz, chlorite, cu-minerals (?), and calcite); rare plagioclase phenocrysts; matrix locally contains abundant plagioclase microlites, is very fine-grained, and always hematite-stained.

BASALTIC TO ANDESITIC VOLCANICS (thickness = 690') - fine-grained, minor vesicles (filled with quartz + chlorite); plagioclase, pyroxene and olivine phenocrysts set in a matrix of granular plagioclase + chloritized mafics.

ANDESITIC TUFF (thickness = 170') - very fine-grained, well-bedded tuff and lithic-rich (pumice clasts) tuff.

BASALTIC TO ANDESITIC VOLCANICS (thickness = 390') - Same as above

ANDESITIC TUFF (thickness = 130') - Same as above

BASALTIC TO ANDESITIC VOLCANICS (thickness = 625') - Same as above

FELSIC VOLCANICS (thickness = 1,050') - plagioclase, hornblende and rare quartz phenocrysts set in very fine-grained matrix; plagioclase microphenocrysts locally present in matrix; perlitic cracks are abundant; epidote (?)- calcite-quartz-chlorite veins are common.

MIXTURE OF ANDESITIC TUFF AND BASALTIC TO ANDESITIC VOLCANICS (thickness = 170')- Same as above

LIST OF ELECTRICAL LOGS

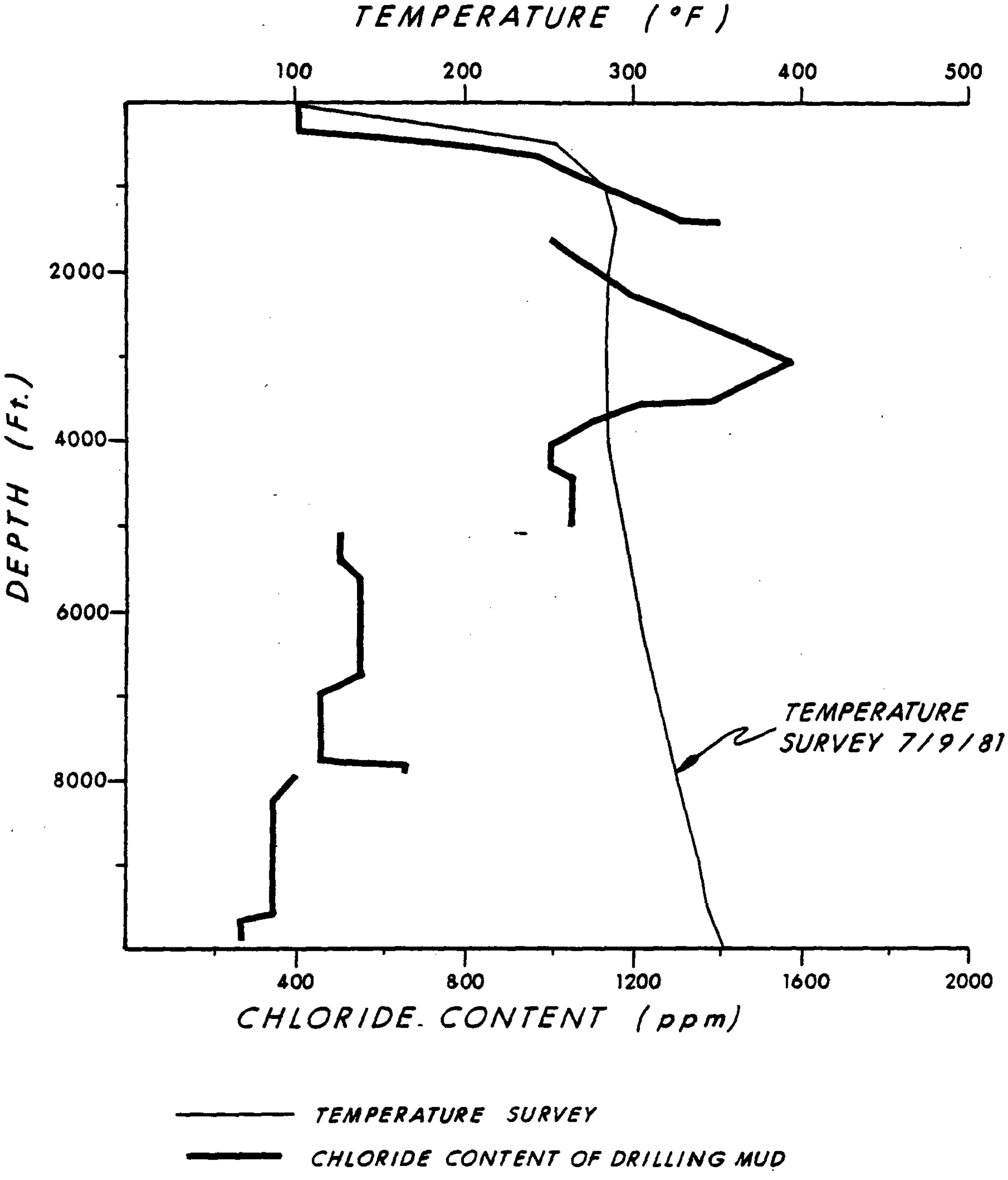
All of the following electrical logging data were obtained using Schlumberger tools and methods:

DATE	TYPE OF LOG	LOGGED INTERVAL	TOTAL DEPTH
17 May 81	Temperature Log	298-1396'	1404'
17 May 81	Sonic Log with Caliper and S-P	298-1390'	1404'
17 May 81	DIL-SFL with Linear Correlation log	298-1388'	1404'
17 May 81	CNL-FD with Gamma Ray and Caliper	298-1386'	1404'
18 May 81	Continous Dipmeter	298-1386'	1404'
29 May 81	DIL-SFL with Linear Correlation log and S-P	1389-5090'	5092'
29 May 81	Sonic Log with Caliper and Gamma Ray (computer failed at 3500')	3500-5089'	5092'
24 June 81	DIL-SFL and Sonic Log with S-P, Gamma Ray and Caliper	Both tools failed at depth of 9500-10,000'	10,014'
24 June 81	Temperature Log	Tool could not be calibrated	10,014'
24 June 81	DIL-SFL with S-P	5080-10,000'	10,014'
25 June 81	Sonic Log with Caliper and Gamma Ray	Tool failed at depth of 9500-10,000'	10,014'
25 June 81	Sonic Log with Caliper and Gamma Ray	Tool failed at depth of 9500-10,000'	10,014'

25 June 81	CNL with Gamma Ray	1306-5080'	10,014'
25 June 81	CNL-FD with Gamma Ray	5080-9997'	10,014
25 June 81	Temperature Log	Tool failed at about 2500'	10,014
25 June 81	Temperature Log	Tool failed at about 1500'	10,014

CORRELATION OF CHLORIDE CONTENT OF DRILLING MUD WITH TEMPERATURE DATA

Since thermal fluids are rich in chloride, the interrelationship between temperature data and chloride content of drilling mud was evaluated to determine if either zones of permeability or characteristics of the thermal structure of the prospect could be predicted. Chloride content of drilling mud in the upper part of the hole exhibits a reversal with a maxima at about 1400' to 3100' (of ∿1600 ppm) despite a relatively constant mud weight (68-72 lbs/ft^3) from 1000' to T.D. (mud gradient was 0.45-0.49 psi/ft. while pressure gradient of the formation is 0.37-0.40 psi/ft; significant lost circulation did not occur during drilling). Below ∿4000', chloride content of drilling mud is uniformly low. In comparison, the thermal framework of this well is characterized by a slight reversal to nearly isothermal zone at about 1500' to about 4000', and a positive gradient about 1.0-1.4 $^0F/100ft.$) from 4000' to T.D. Although the trends are not identical, the similarity of the location of maxima and overall shape strongly suggest that the two trends are related. These reversals are interpreted to be the result of lateral flow of thermal fluid (some of which flows into the wellbore) within a relatively permeable zone which is located at a depth of 1000' to 2000'. The uniformly low chloride content of drilling mud from 4000' to T. D. suggests that the rocks of this portion of R. Weishaupt-1 have less permeability.



CORRELATION OF CHLORIDE CONTENT OF DRILLING MUD WITH TEMPERATURE DATA

CONSTRAINTS ON THE GEOLOGICAL/GEOTHERMAL FRAMEWORK OF THE STILLWATER PROSPECT DETERMINED FROM THE R. WEISHAUPT-1 WELL

Stratigraphic, thermal and chemical data provide the following constraints on the geologic/geothermal framework of the Stillwater prospect:

1) The host for the geothermal reservoir is late Tertiary volcanics; the volcanics dominate the straigraphic section from +2000 ft. (sea level is datum) to depths of -5700 ft. In contrast the top of the volcanic section is located at -1150 ft. in the northern part of the Fallon Basin (Hastings, 1979), and at +2060 to +2690 ft. in the Soda Lake area (Sibbett, 1979). The depth of the base of the late Tertiary section is unknown in the Stillwater area.

2) The very high thermal gradient in the upper portion of the R. Weishaupt-1 well along with the impermeable nature of the Quaternary clays which comprise this section, taken together, suggest that the Quaternary clays act as a "caprock" over the thermal anomaly.

3) Chemistry of drilling mud along with drilling characteristics and the result of the flow test suggest that the highest permeability in the R. Weishaupt-1 well is located between 1000 to 3500 ft.

DISCUSSION OF RESERVOIR ENGINEERING

RICHARD WEISHAUPT #1

STILLWATER PROSPECT

Richard Weishaupt-1 flowtest no. 1 was conducted on July 15, 1981. The amount of fluid flowed, fluid chemistry and the sump liquid level following the flowtest indicated that the fluid produced was from the well bore. This suggests permeability is quite low, in fact, well bore fillup is on the order of 21 hours.The inferred flow rate from this wellbore fillup time is 25 gallons per minute. Pressure and temperature surveys indicate bottom hole pressure and temperature of 3845 psig and 350 degrees F. The greatest gradient is within the first 1000 ft, from surface temperature to about 285°F. Below this, the temperature gradient is approximately .01 °F/ft from 1000 ft to total depth. The pressure gradient, approximately .38 psi/ft, indicates a liquid column.

INTRODUCTION

The piping used in the flowtest, shown in Figure 3, is similar to the test apparatus used by Union in other geothermal resource areas. A weir was used as a flowmeter due to the low flow rates expected. The measured parameters, wellhead pressure and temperature, line pressure, pressure drop across the orifice, and liquid flow from the flash tank, are enough to calculate total mass flow rate using Murdock's equation.

Chemical sampling ports were placed on the flowline near the wellhead as indicated in Figure 3. Samples of the condensate were also taken at the outlet from the flash tank.

BACKGROUND

Richard Weishaupt-1 was completed on June 29, 1981 to a total depth at 10,000 ft. The drilling report states that one lost circulation zone was encountered below the 9-5/8 inch liner shoe, from 9615 ft to 9649 ft.

One 8 ft drilling break was reported, from 8064 to 8072. There was no loss of drilling fluid during the drilling break.

A pressure and temperature survey was taken on July 9; after the well had been shut in for 10 days. Seven days later the flow test was conducted. One day after the flowtest, a second pressure and temperature survey was taken.

FLOWTEST #1

During the first survey, a liquid flow rate of approximately 6 gallons per minute was noted. The results of this survey can be seen in Figures 4 and 5. The maximum temperature increase is in the first 1000 ft with the rest of the well exhibiting an approximate gradient of .01 °F/ft. The pressure gradient suggests a column of liquid in the well bore.

The flowtest conducted on Richard Weishaupt-1 suggested that the flow into the well bore is not great enough to allow the well to flow on its own. Appendix A contains a chronological list of events, as well as the various parameters measured.

The well bore seemed to start emptying at approximately 1345; by 1440 the well had unloaded and no liquid flow could be detected from the wellhead. Using sump calculations, the liquid emptied from the well bore into the sump was approximately 310 barrels. Well bore capacity is approximately 700 barrels. The discrepancy between well bore capacity and increase in sump volume could be caused by a combination of factors: porus sump walls, flashing and irregularity in the shape of the sump.

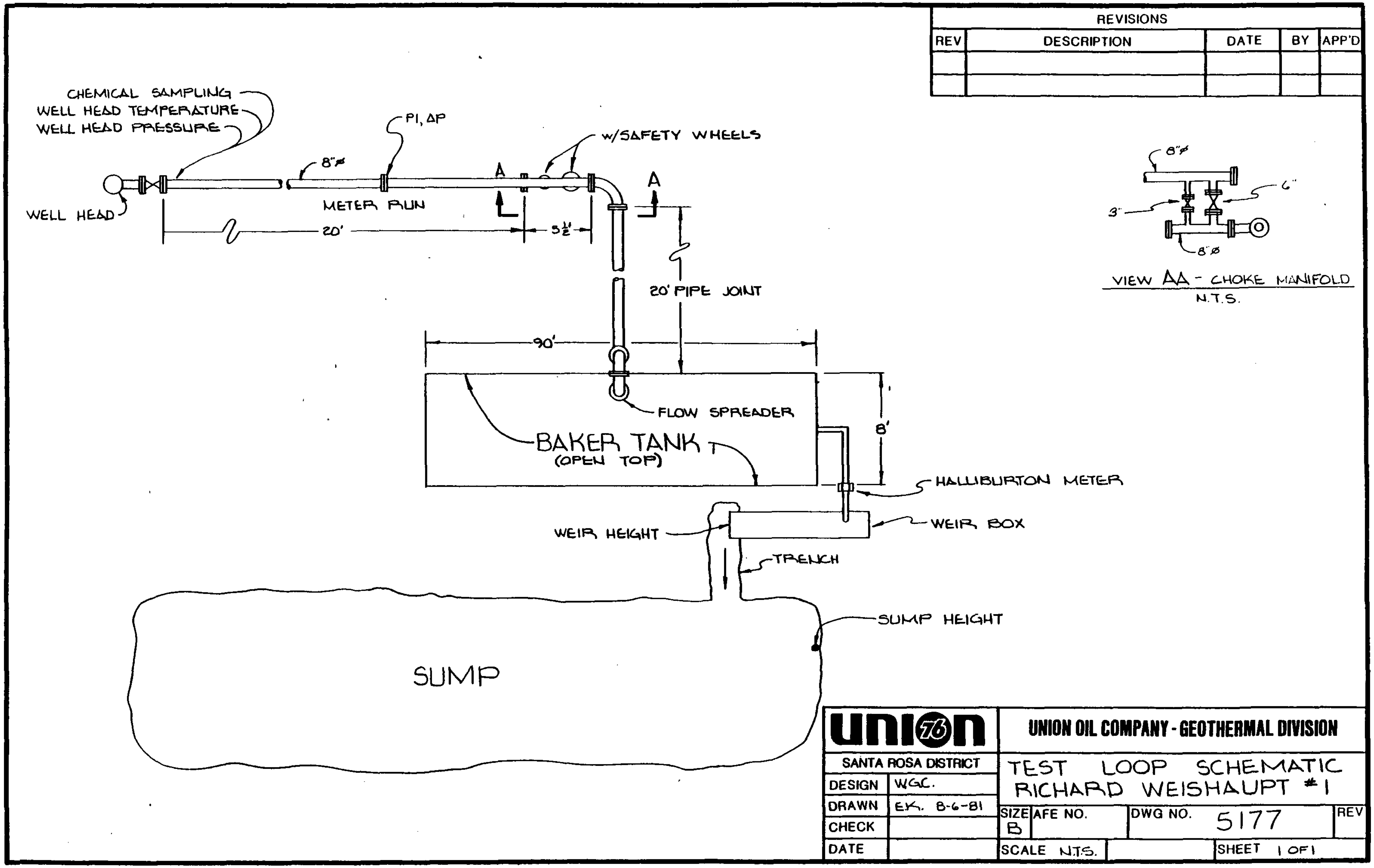
Approximately 3 hours after no liquid was observed flowing from the well, the liquid level was located with a sinker bar at 9200 ft, 800 ft off the bottom. If the well bore was emptied 3 hours prior, this would indicate flow into the well of 12 gallons per minute. The liquid level was located about 18 hours after the sinker bar run at the wellhead; this suggests a flow into the well of 25 gallons per minute.After the nitrogen injection tubing was pulled, a slug of liquid was observed coming out of the well bore. This could have possibly emptied the wellbore, suggesting that flow into the open well bore is closer to 25 gallons per minute.

Survey number 2, taken 18 hours after the conclusion of the flowtest, is graphically presented in Figures 4 and 5. Appendix B contains the data for both survey number 1 and survey number 2. From Figures 4 and 5, it can be seen that the pressure and temperature gradients of survey number 2 were almost the same as survey number 1 taken prior to the flowtest. The change in the pressure gradient below 9000 ft for survey number 2 was most likely due to the pressure instrument being plugged.

A complete chemical analysis of the water was to be done, but due to the limited amount of flow, only PH and chloride concentration were analyzed. The PH ranged from 9.25 to 9.57. The chlorides varied between 350 ppm and 460 ppm except for the reading taken from the wellhead. It was 40 ppm. The variation in the chloride level could be due to contamination in the Baker tank.

REFERENCES

Murdock, J.W.; "Two-Phase Flow Measurement with Orifices," Journal of Basic Engineering; Transactions of the ASME; December, 1962.



REVISIONS				
REV	DESCRIPTION	DATE	BY	APP'D

UNION OIL COMPANY - GEOTHERMAL DIVISION

SANTA ROSA DISTRICT

TEST LOOP SCHEMATIC
RICHARD WEISHAUPT #1

DESIGN	WGC.
DRAWN	EK. 8-6-81
CHECK	
DATE	

SIZE B
AFE NO.
DWG NO. 5177
REV
SCALE N.T.S.
SHEET 1 OF 1

FIGURE 3

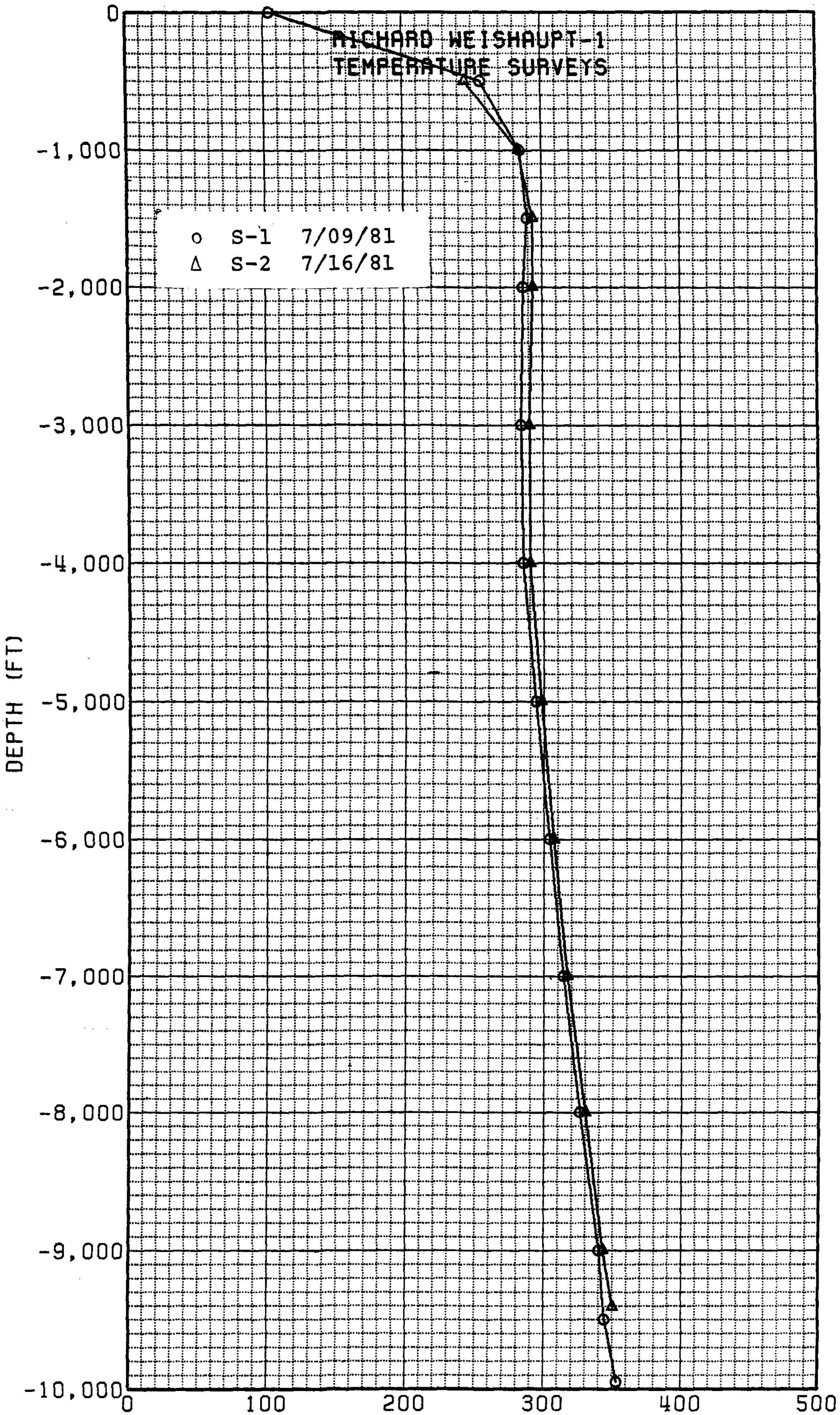

RICHARD WEISHAUPT-1
TEMPERATURE SURVEYS
o S-1 7/09/81
Δ S-2 7/16/81
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
-7,000
-8,000
-9,000
-10,000
DEPTH (FT)
0
100
200
300
400
500
TEMPERATURE (DEG. F)

FIGURE 4

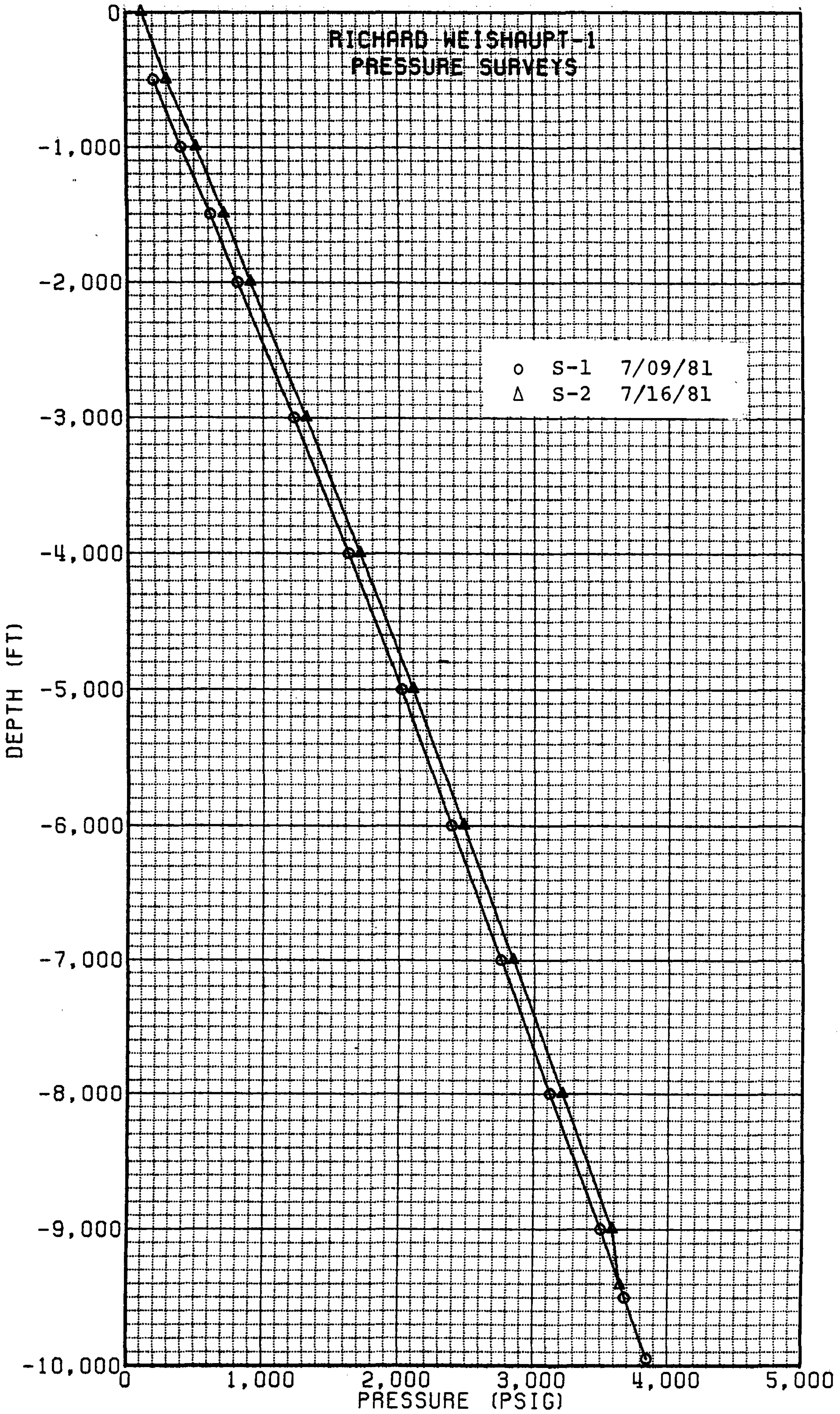

RICHARD WEISHAUPT-1
PRESSURE SURVEYS
o S-1 7/09/81
Δ S-2 7/16/81
DEPTH (FT)
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
-7,000
-8,000
-9,000
-10,000
0
1,000
2,000
3,000
4,000
5,000
PRESSURE (PSIG)

FIGURE 5

APPENDIX A

RICHARD WEISHAUPT #1 FLOW TEST

7-15-81

					WEIR		SUMP		TUBING				
TIME	WHP PSIG	WHT °F	P1 PSIG	ΔP PSI	FT	FT^3/Min	FT	FT^3	DEPTH (FT)	N_2 RATE SCF/M	N_2 PRESS PSIG	N_2 TEMP °F	REMARKS
1145	0	NA	NA	NA	0	0	3.75	0	0	0	0	0	NOWSCO on site - starting to run tubing in
1206	0	NA	NA	NA	0	0	3.75	0	340	200	500	180	Stopped running in with tubing; blowing hole dry
1215	3	NA	NA	NA	.65	4.95	3.75	0	340	200	800	180	Started running in hole with 1" tubing at ± 30 FPM
1230	0	180	NA	NA	.80	8.10	3.65	360	618	200	900	180	Encountered obstruction at 618'
1240	4	NR	NA	NA	NLFIT	-	3.65	360	618	450	900	180	Working tubing. Increased nitrogen injection rate
1243	0	180	NA	NA	NLFIT	-	3.65	360	620	200	900	180	Worked tubing past obstruction
1248	3	180	NA	NA	NLFIT	-	3.65	360	895	300	900	180	Increased nitrogen injection rate
1250	0	180	NA	NA	NLFIT	-	3.65	360	1020	300	1200	180	Stopped running in with tubing; blowing hole dry
1255	0	180	NA	NA	NLFIT	-	3.65	360	1020	1000	2000	180	Increased nitrogen injection rate
1300	0	180	NA	NA	NLFIT	-	3.65	360	1020	300	2700	180	Started running tubing in hole at ± 30 FPM
1315	0	180	NA	NA	.55	3.31	3.60	540	1370	300	2150	180	Liquid started flowing into tank
1322	6	180	NA	NA	.85	9.46	3.55	720	1505	300	2150	180	Working tubing
1330	8	215	NA	NA	.95	12.41	3.55	720	1320	500	2200	180	Increased nitrogen rate

RICHARD WEISHAUPT #1 FLOW TEST
Page 2

	WHP	WHT	P1	ΔP	WEIR		SUMP		TUBING DEPTH	N_2 RATE	N_2 PRESS	N_2 TEMP	
TIME	PSIG	°F	PSIG	PSI	FT	FT^3/MIN	FT	FT^3	(FT)	SCF/M	PSIG	°F	REMARKS
1333	0	200	NA	NA	NLFIT	-	3.55	720	1760	500	2200	180	
1340	0	180	NA	NA	NLFIT	-	3.55	720	2025	1050	2750	180	Stopped running in with tubing; blowing hole dry
1345	5	200	NA	NA	.95	12.41	3.50	900	2025	1050	3650	180	Well unloaded - slugging
1350	15	230	NA	NA	1.00	14.00	3.50	900	2025	1050	4300	180	Continued slugging
1355	12	230	NA	NA	1.00	14.00	3.50	900	2025	1000	4600	180	Chemical sample taken at 13:55 from tank - Results: PH=9.25 Cl^-=350 ppm Well started to die
1400	10	225	10	1.84	.95	12.41	3.50	900	2025	1000	4800	180	Started pulling tubing out of hole
1410	19	235	25	3.36	1.00	14.00	3.35	1440	1495	1000	4200	180	Pulling out of hole
1414	20	230	10	1.99	.90	10.81	3.35	1440	1476	1200	3500	180	Increased nitrogen rate; because no returns; stopped pulling tubing
1420	3	180	5	1.26	.75	6.98	3.35	1440	1615	1200	3500	180	Started running tubing back in hole
1430	3	180	3	.90	.50	2.59	NR	1440	2220	1200	3200	180	Chemical sample taken at 14:27 from tank - Results: PH=9.57 Cl^-=460 ppm
1440	0	180	0	0	NLFIT	-	NR	1440	2570	1200	2800	180	
1447	0	180	0	0	NLFIT	-	NR	1440	3195	600	1600	180	Suspect emptied well bore. Decreased nitrogen flow rate
1500	0	175	0	0	NLFIT	-	NR	1440	4208	400	1300	180	Chemical sample taken at 15:10 from W.H. Results: PH=9.45 Cl^-=40 ppm. Decrease nitrogen flow rate. *

TIME	WHP PSIG	WHT °F	P1 PSIG	ΔP PSI	WEIR		SUMP		TUBING DEPTH (FT)	N_2 RATE SCF/M	N_2 PRESS PSIG	N_2 TEMP °F	REMARKS
					FT	FT^3/MIN	FT	FT^3					
1520	0	180	0	0	NLFIT	-	NR	1440	5122	400	1400	180	Hit obstruction; trying to work tubing past it
1530	0	180	0	0	NLFIT	-	3.27	1728	5122	400	1400	180	Started to pull tubing out of hole
1540	0	180	0	0	NLFIT	-	3.27	1728	4520	400	1200	180	Stopped nitrogen flow
1745													When tubing all pulled out, 589' was broken off the bottom. Liquid slug was observed flowing from well after nitrogen injection was stopped. Fluid level = 9200' Located by sinker bar.
7/16/81 1155													Fluid level = Surface

Notes: N.A. - Not available.
N.L.F.I.T. - No liquid flow into tank
N.R. - No reading taken

Depth is corrected to K.B.
Sump dimensions: 45' x 80' (approximately)

Line size : 7.625 inch
Orifice size: 5.25 inch
WHP (initial) = 148 psig

* Sample is probably from liquid standing in pipeline upstream of orifice.

APPENDIX B

union

RW 1 - S1 - PT Grad.

GEOTHERMAL DIVISION

SUBSURFACE SURVEY
Field Work Sheet

OWNER Union Oil Company
FIELD Stillwater
WELL NAME R. Weishaupt #1
CASING
ELEV. ± 3400'
DATE: 7-9-81
LINER DESCRIPTION: Slotted 7" csg 9995' to 4900'
9-5/8 csg 5000 to surface
ZERO POINT Swab Gate (+7')
DEPTH ± 10000
TUBING DETAIL:
PURPOSE
REMARKS: Fluid level @ surface

ELEMENT Temp SERIAL NO. 10172 CLOCK 17499 TURN
Press 12833 17498
STABILIZATION PERIOD
WELL HEAD
PICKUP @ 9980 TIME ON BOTTOM MAX. °F
WELL STATUS
SHUT IN:
ON PRODUCTION: 0800 - 1550
RATE 6 GPM - Temp. 168° F

Temp - Press

TIME	DEPTH	DEFL.	← T	GRAD.	/D	TIME	DEPTH	DEFL.	P ←	GRAD.	/D	TIME	DEPTH	DEFL.	P - T	GRAD.	/D
	0		104						-								
	500		256						204								
	1000		284						407								
	1500		289						613								
	2000		286						814								
	3000		284						1225								
	4000		285						1624								
	5000		294						2016								
	6000		304						2385								
	7000		314						2753								
	8000		326						3120								
	9000		340						3500								
	9500		344						3682								
	9950		353						3845								

COMMENTS:

BY: Sam Timmons

UNION

RW 1 - S2 - PT Grad.

GEOTHERMAL DIVISION

SUBSURFACE SURVEY
Field Work Sheet

OWNER Union Oil Company FIELD Stillwater WELL NAME R. Weishaupt #1
CASING ELEV. ± 3400' DATE: 7-16-81
LINER DESCRIPTION: Slotted 7" csg 9995' to 4900' ZERO POINT Swab Gate (+7')
9-5/8 csg 5000 to surface DEPTH ± 10000'
TUBING DETAIL:
PURPOSE
REMARKS: Well filled with debris @ ± 9410 cannot pass.
Fluid to surface @ end of survey.
ELEMENT Press SERIAL NO. 12833 CLOCK 17498 TURN
Temp 10172 17499
STABILIZATION PERIOD
WELL HEAD
PICKUP @ 9410 TIME ON BOTTOM MAX. °F
WELL STATUS
SHUT IN: 7/15/81 ON PRODUCTION:
RATE

Time Off Bottom	1155
Open Swab Gate	0918
Close Swab Gate	1217

			Temp						Press								
TIME	DEPTH	DEFL.	T	GRAD.	/D	TIME	DEPTH	DEFL.	P	GRAD.	/D	TIME	DEPTH	DEFL.	P-T	GRAD.	/D
	0		-						122								
	500		245						302								
	1000		283						513								
	1500		293						713								
	2000		293						912								
	3000		290						1314								
	4000		290						1709								
	5000		298						2101								
	6000		307						2475								
	7000		317						2846								
	8000		330						3214								
	9000		343						3585								
	9410		350						3645								

COMMENTS:

BY: Sam Timmons

GEOTHERMAL RESERVOIR ASSESSMENT
CASE STUDY
NORTHERN BASIN AND RANGE PROVINCE
STILLWATER PROSPECT
CHURCHILL COUNTY, NEVADA

FINAL REPORT
FOR THE PERIOD
APRIL 1979 - JULY 1981

D.L. ASH, R.F. DONDANVILLE, AND M.S. GULATI
AUGUST, 1981

WORK PERFORMED UNDER CONTRACT
DE-AC08-79 ET-27012

UNION OIL COMPANY OF CALIFORNIA
GEOTHERMAL DIVISION
UNION OIL CENTER
461 S. BOYLSTON STREET
LOS ANGELES, CALIFORNIA 90017

ABSTRACT

During 1979 and 1981 Union Oil Company of California drilled two exploratory geothermal wells in the Stillwater geothermal prospect area in northwestern Nevada to obtain new subsurface data for inclusion in the U. S. Department of Energy's geothermal reservoir assessment program. Existing data from prior investigations, which included the drilling of four earlier deep temperature gradient wells in the Stillwater area, was also provided.

The two wells were drilled to total depths of 6946' and 10,014' with no significant drilling problems. A maximum reservoir temperature of 353°F was measured at 9950'. The most productive well flow tested at a rate of 152,000 lbs/hr with a wellhead temperature of 252°F and pressure of 20 psig. Based upon current economics, the Stillwater geothermal prospect is considered to be subcommercial for the generation of electrical power.

This report is a synopsis of the exploratory drilling activities and results, and it contains summary drilling, geologic, and reservoir information from two exploratory geothermal wells. Detailed information and data for each of the wells is available through the University of Utah Research Institute Earth Science Laboratory (UURI/ESL), Salt Lake City, Utah.

DOE/ET/27012-1
Distribution Category UC-66a

GEOTHERMAL RESERVOIR ASSESSMENT
CASE STUDY
NORTHERN BASIN AND RANGE PROVINCE
STILLWATER PROSPECT
CHURCHILL COUNTY, NEVADA

FINAL REPORT
FOR THE PERIOD
APRIL 1979 - JULY 1981

D.L. ASH, R.F. DONDANVILLE, AND M.S. GULATI

UNION OIL COMPANY OF CALIFORNIA
GEOTHERMAL DIVISION
UNION OIL CENTER
461 S. BOYLSTON STREET
LOS ANGELES, CALIFORNIA 90017

U.S. DEPARTMENT OF ENERGY
DIVISION OF ENERGY TECHNOLOGY
NEVADA OPERATIONS OFFICE
UNDER CONTRACT DE-AC08-79 ET-27012

TABLE OF CONTENTS

INTRODUCTION

The Stillwater Prospect Final Report has been prepared to summarize results from two exploratory geothermal wells drilled on the prospect, DeBraga #2 and Richard Weishaupt #1. The general location of the Stillwater Prospect area is shown in Figure 1. Specific well locations are shown in Figure 2.

Prior to drilling the two geothermal exploratory wells described in this report, existing data was delivered which included:

1. Dipole-dipole resistivity survey - four lines covering about 20 miles.

2. Telluric survey - four lines covering about 23 miles.

3. Gravity measurements - 48 stations observed resulting in a Bouguer gravity map and a number of computed depth estimates of Valley fill.

4. Temperature data from 16 temperature gradient holes with an average depth of about 275 feet each.

5. Complete drilling history including all subsurface data such as lithological, temperature, wireline, and penetration logs from four existing deep temperature gradient wells, Weishaupt #1 and #2, DeBraga #1 and Wisnefski #1. Total depths of these wells are 3450', 5532', 2672', and 3637' respectively.

All depths are measured from the drilling rig kelly bushing datum unless otherwise specified.

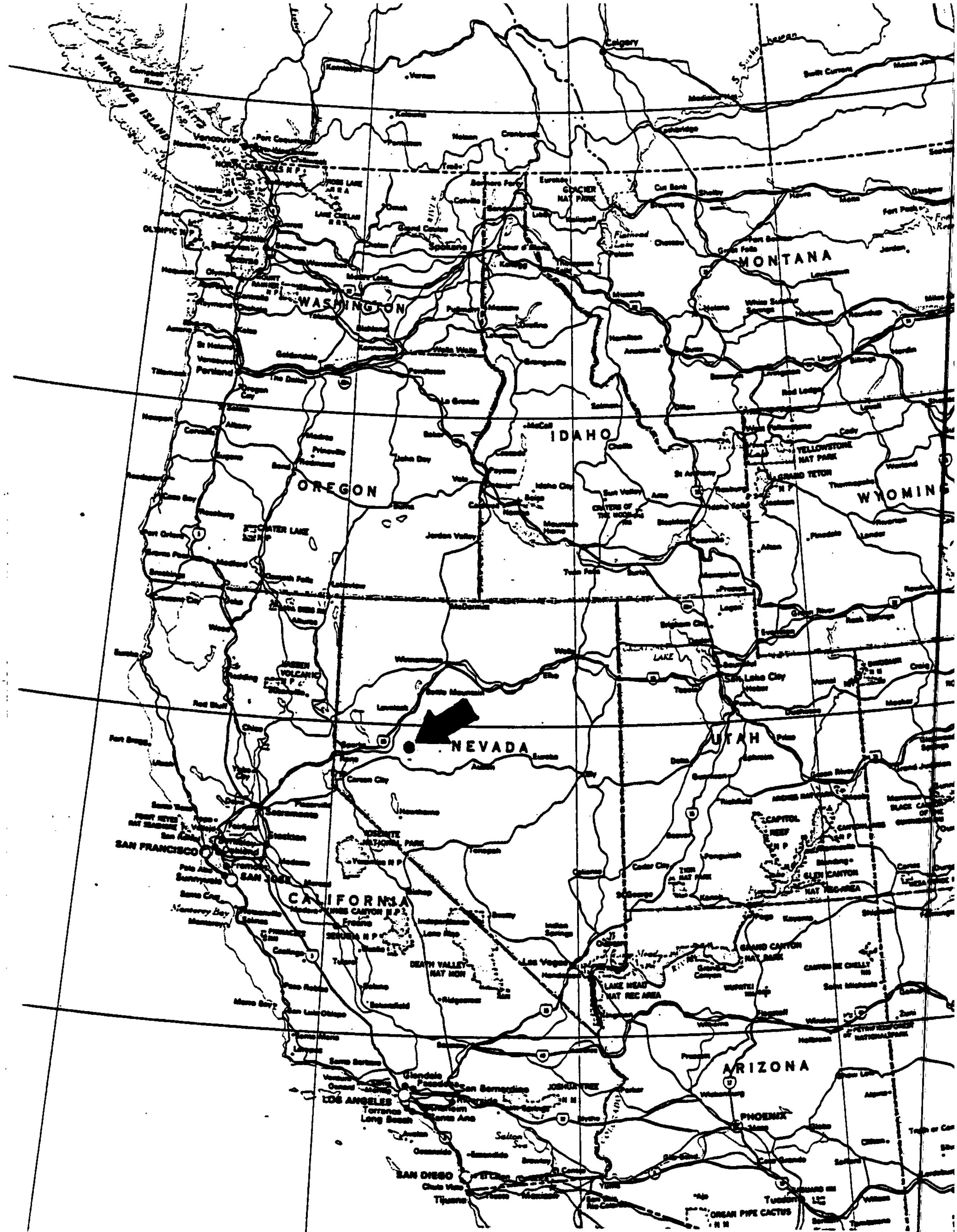


FIGURE 1
MAP SHOWING LOCATION OF
STILLWATER PROSPECT AREA
CHURCHILL COUNTY, NEVADA

(INDICATED BY ➡)

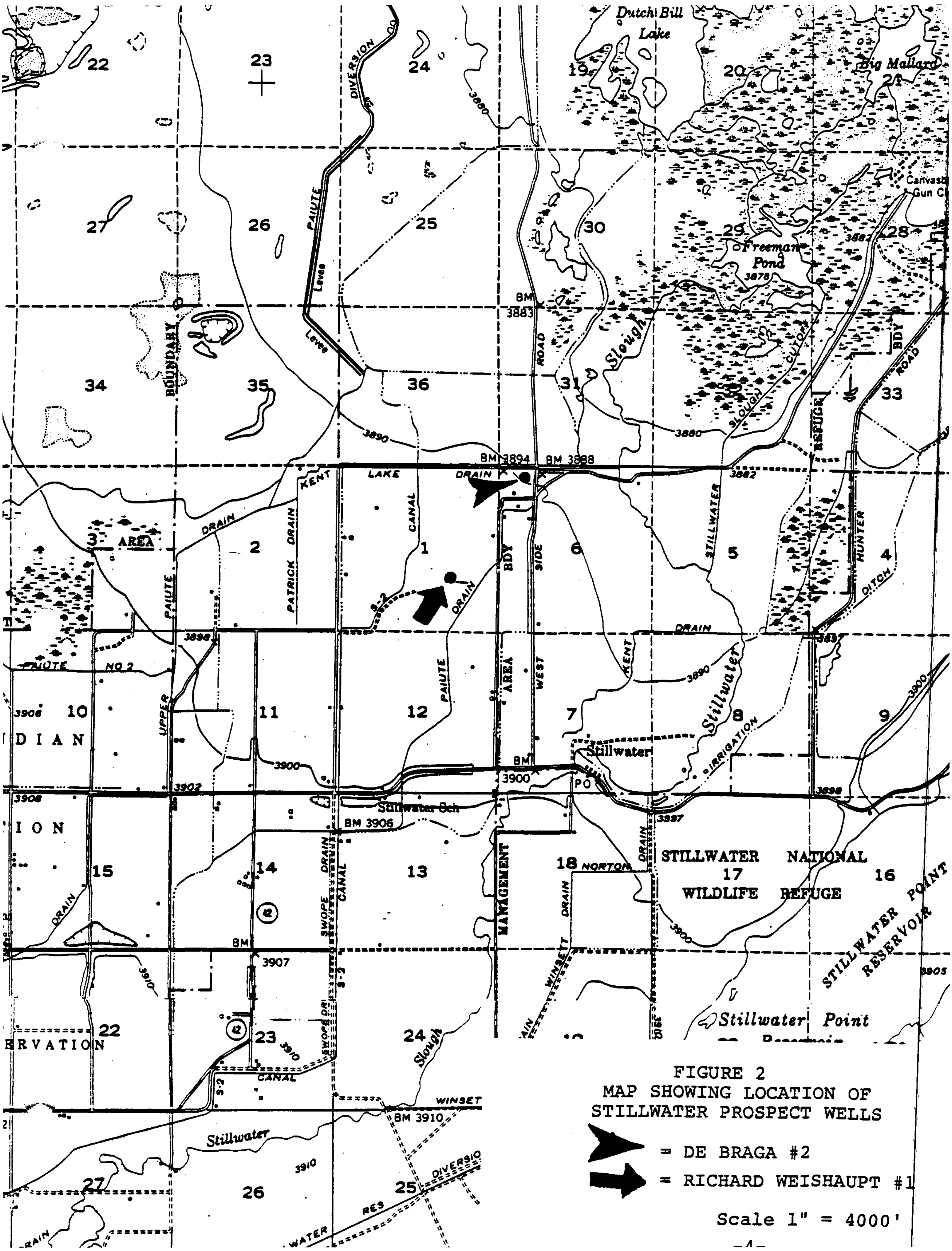


FIGURE 2
MAP SHOWING LOCATION OF
STILLWATER PROSPECT WELLS

➤ = DE BRAGA #2

➡ = RICHARD WEISHAUPT #1

Scale 1" = 4000'

DISCUSSION OF DRILLING OPERATIONS

EXPLORATORY WELLS - STILLWATER PROSPECT

CHURCHILL COUNTY, NEVADA

Each of the Stillwater prospect geothermal exploratory wells was drilled and completed with relatively few problems. Thirty-two days and $568,000 were required to complete DeBraga #2 at 6946'. Forty-six days and $1,230,000 were required to complete Richard Weishaupt #1 at 10,014'.

Casing Program

DeBraga #2 was drilled to evaluate the reservoir to a total depth of 6946'. The casing program was implemented with 20" conductor at 94', 13-3/8" surface casing at 310', 9-5/8" intermediate casing at 1194', and a 7" slotted liner from 987' to 6940'. Richard Weishaupt #1 was drilled to evaluate a deeper portion of the reservoir to a total depth of 10,014'. Because it was deeper, an additional string of casing (cemented blank liner) was required. Each casing size had to be increased in order that a 7" slotted liner could still be run at total depth. The casing program was implemented with 30" conductor at 76', 20" surface casing at 299', 13-3/8" intermediate casing casing at 1390', a cemented blank liner from 1182' to 5078', and a 7" slotted liner from 4972' to 9995'.

Cementing

With the exception of the slotted liners, all casing strings were cemented over their entire length. In most cases the slurry volume was selected by adding 100% excess to the theoretical calculated volume. Casing strings were usually cemented with a low density lead slurry of class "G" cement with 1:1 perlite, 40% silica flour, 3% bentonite, 0.5% CFR-2 and accelerators or retarders as required. The lead slurry was followed by a small volume of higher density tail slurry of class "G" cement with 40% silica flour, 0.5% CFR-2 and accelerators or retarders as required. Water spacers and sepiolite mud flushes were normally pumped ahead of the cement slurries.

In Richard Weishaupt #1 a cement squeeze was required to seal off a water flow from the 9-5/8" x 13-3/8" liner lap. Slurry composition was the same as the tail slurries used on casing cement jobs.

In DeBraga #2 six cement plugs were required to seal off lost circulation. Slurry composition for five of these plugs was the same as the lead slurries used on casing cement jobs with the exception that class "B" cement replaced class "G" cement. The fifth plug used two slurries, the second of which was class "B" cement with 25 lbs/sack gilsonite and 0.75% CFR-2. The sixth plug was mixed with class "G" cement and 0.75% CFR-2.

Drilling Fluid

Both wells were drilled with a drilling fluid consisting mainly of bentonite, water, caustic, and lignite. As problems were encountered during the drilling operation, other mud products were added.

Four water flows occurred, two in each well, when the mud weight was less than approximately 67 lbs/ft^3. The water flows were easily killed by increasing the mud weight with barite to 72 lbs/ft^3.

Lost circulation occurred in DeBraga #2 while killing a water flow. Lost circulation material was added with little effect and six cement plugs were required to seal off losses. No lost circulation occurred while drilling Richard Weishaupt #1, although surge pressures developed while running in the hole caused the formation to break down twice. Each time 200 to 300 bbls of mud were pumped before the hole filled and full returns were regained. Lost circulation material was added on the first occasion but not on the second.

Rotating torque in Richard Weishaupt #1 in the 8-3/4" hole section was above average. Drilling detergent, walnut hulls, and mica were added in attempts to reduce rotary torque. Although these additions did not noticeably reduce rotary torque, there was no increase in torque with depth after additions were begun.

Differentially stuck pipe in Richard Weishaupt #1 was successfully freed with a Pipe-Lax and diesel pill. In order to prevent further sticking problems, 2% diesel was added to the mud.

Drill pipe corrosion was not significant while drilling the Stillwater Prospect wells. H_2S was not encountered in either well.

Directional Drilling

DeBraga #2 was drilled as a straight hole. No problems were encountered in keeping the drift angle to within 4° of vertical.

Richard Weishaupt #1 was directionally drilled toward a target objective 2400' due west of the surface location at 9500' true vertical depth. The bottom hole location reached was 357' south and 2306' west of the surface location at 9569' true vertical depth. A turbodrill and bent sub were used to kick the well off. Three bit runs using the turbodrill were required to obtain the desired well course. Rotating bottom hole assemblies were then adjusted as necessary to build the drift angle to 22° from vertical and maintain it at that value until total depth was reached. The maximum drift angle reached was 24.75°.

DRILLING DATA TABLE

EXPLORATORY WELLS - STILLWATER PROSPECT

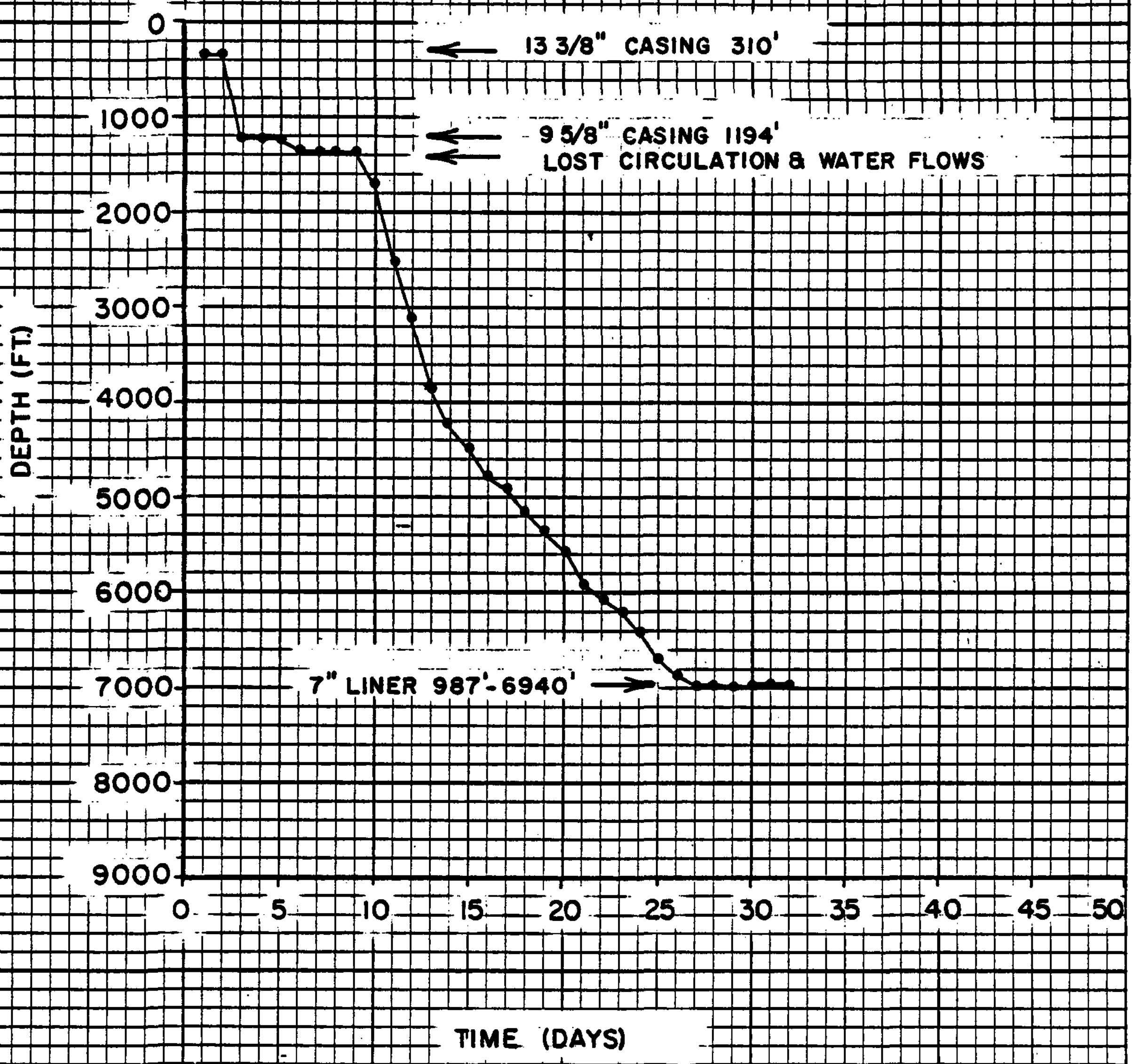
CHURCHILL COUNTY, NEVADA

	De Braga #2	Richard Weishaupt #1
Spud Date	04-06-79	05-14-81
Completion Date	05-07-79	06-29-81
Rig	Coastal Drlg Rig #2	Brinkerhoof-Signal Rig #2
Total Depth	6,946'	10,014'
Total Days	32	46
Total Cost	$568,000	$1,230,000
Water Flows	1205', 1309' to 1355'	1404', 9-5/8" x 13-3/8" liner lap (1390')
Lost Circulation	1309' - 1450' (6 cement plugs)	None
Differential Sticking	None	8850' (Bit at 9544') Freed with PipeLax Diesel
Fishing Jobs	Twist Off at 6946' Recovered fish on first attempt	None
Bottom Hole Location	31' South and 240' East of Surface Location	357' South and 2306' West of Surface Location
True Vertical Depth	6940'	9569'
Maximum Drift Angle	4°	24.75°

TIME vs. DEPTH PROGRESS CURVE

DE BRAGA NO. 2

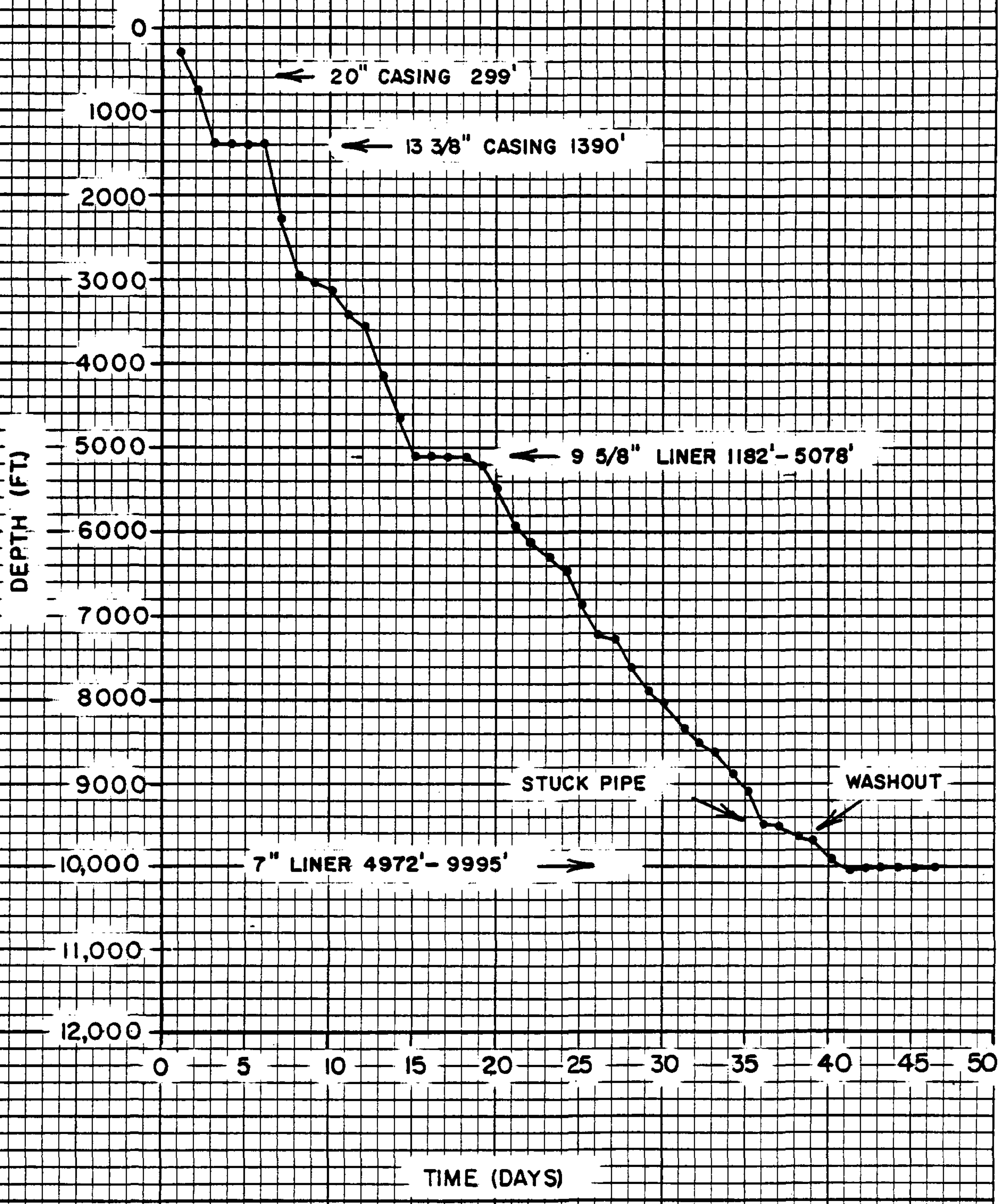
STILLWATER PROSPECT, CHURCHILL COUNTY, NEVADA



TIME vs. DEPTH PROGRESS CURVE

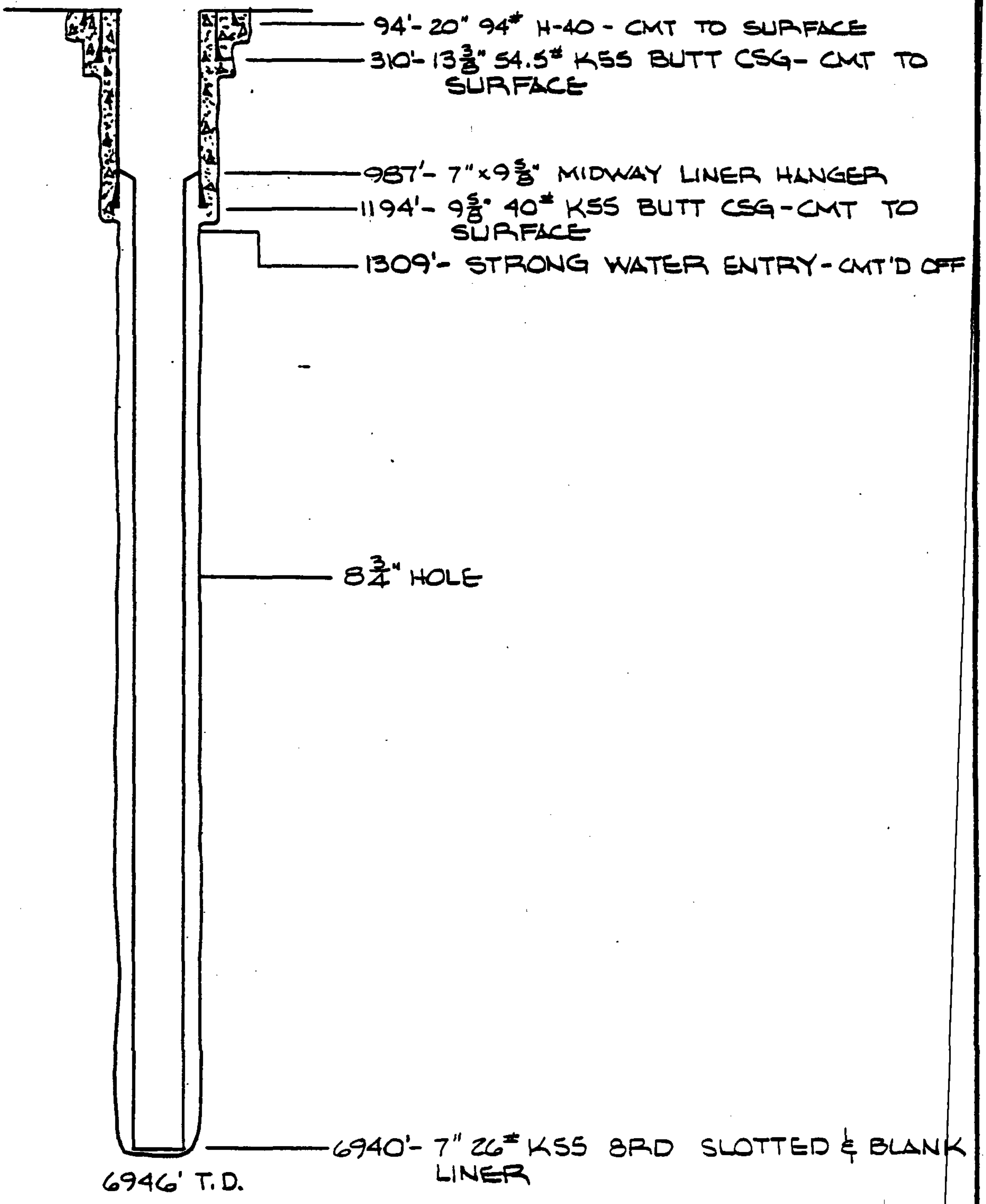
RICHARD WEISHAUPT NO. 1

STILLWATER PROSPECT — CHURCHILL COUNTY, NEVADA



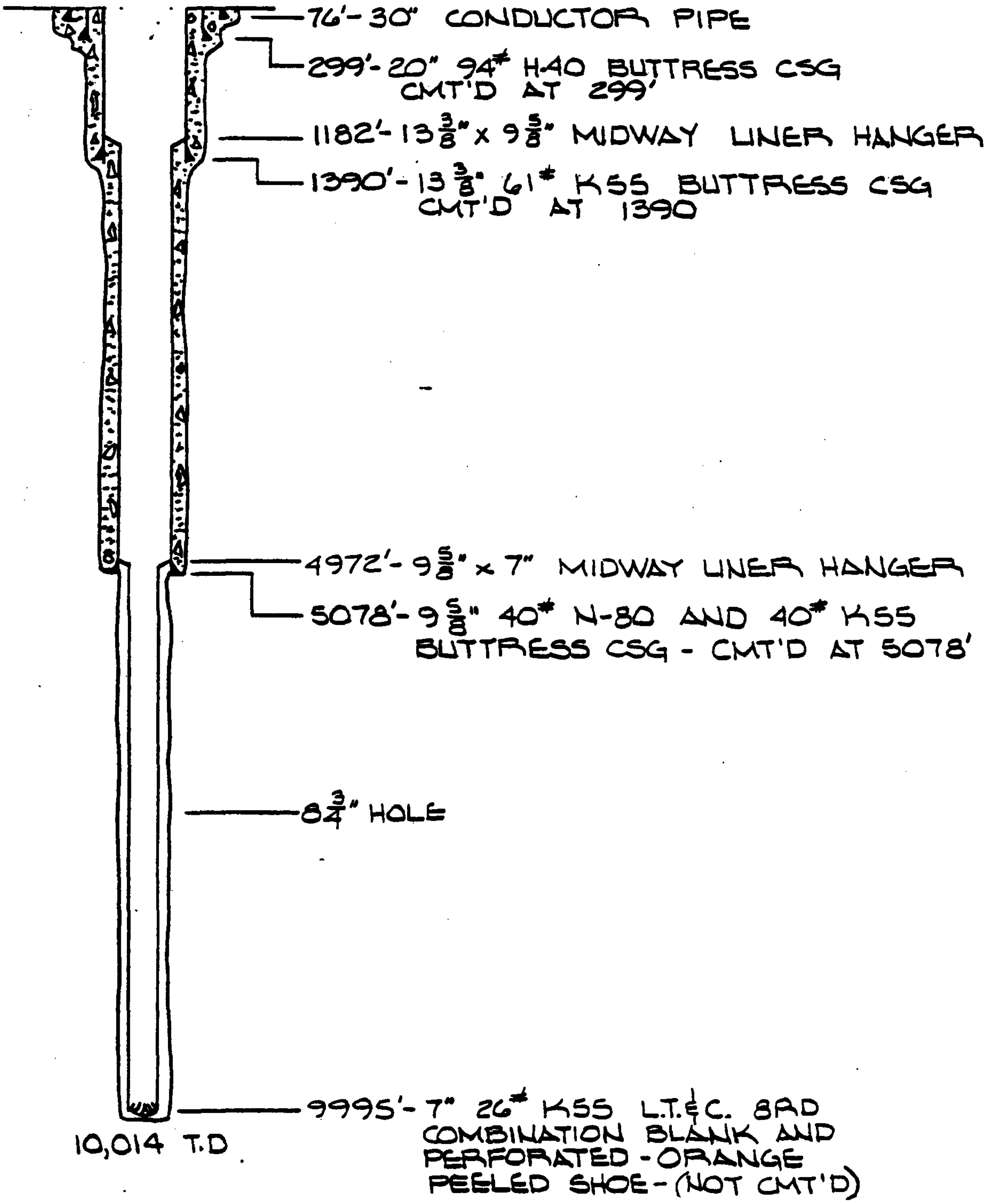
WELL COMPLETION SCHEMATIC
DE BRAGA NO. 2

KELLY BUSHING 11'
GROUND ELEVATION 3885'



WELL COMPLETION SCHEMATIC
RICHARD WEISHAUPT - 1

KELLY BUSHING 27'
GROUND ELEVATION 3895'



7" PERFORATIONS

4972' TO 5062'- BLANK
5062' TO 5219'-16-2-6-80
5219' TO 5347'-16-2-6-250
5347' TO 7344'-18-2-6-150
7344' TO 9995'-20-1.5-1/4-R.H.

} APPROX. EVERY OTHER JOINT BLANK

CASING PROGRAM

EXPLORATORY WELLS - STILLWATER PROSPECT

CHURCHILL COUNTY, NEVADA

	DeBraga #2	Richard Weishaupt #1
Conductor Casing	26" Hole to 94' 20" 94# K-55 Buttress at 94' Cemented to Surface	36" Hole to 76' 30" 106# Plain End @ 76' Cemented to Surface
Surface Casing	17-1/2" Hole to 312' 13-3/8" 54.5# K-55 Buttress @ 310' Cemented to Surface	26" Hole to 315' 20" 94# K-55 Buttress @ 299' Cemented to Surface
Intermediate Casing	12-1/4" Hole to 1205' 9-5/8" 40# K-55 Buttress @ 1194' Cemented to Surface	17-1/2" Hole to 1404' 13-3/8" 61# K-55 Buttress @ 1390' Cemented to Surface
Liner		12-1/4" Hole to 5095' 9-5/8" 40# N-80 and K-55 Buttress from 1182' to 5078'. Cemented over Entire Length
Slotted Liner	8-3/4" Hole to 6946' 7" 26# K-55 8-round LT&C From 987' to 6940' Not Cemented	8-3/4" Hole to 10,014' 7" 26# K-55 8-round LT&C From 4972' to 9995' Not Cemented

GEOLOGIC SUMMARY OF THE STILLWATER PROSPECT

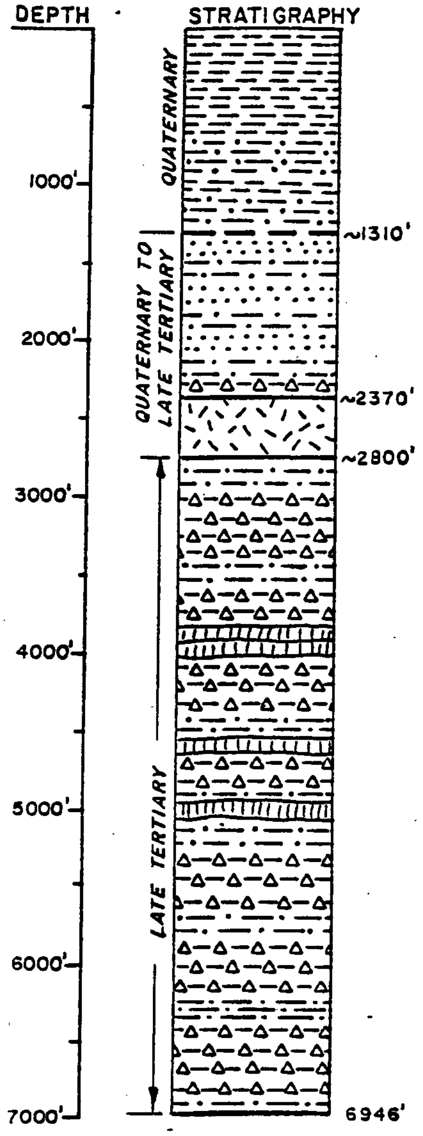
The two deep production wells, DeBraga-2 and R. Weishaupt-1, defined features of the geological and geothermal framework of the Stillwater Prospect, but failed to establish the existence of an electrical resource base. Both wells penetrated Cenozoic rocks to total depth (stratigraphy summarized in the stratigraphic columns). The upper portion of the stratigraphic section is composed primarily of Quaternary clay along with minor interbedded sandstone and siltstone. These Quaternary strata are poorly consolidated and generally characterized by high conductivity, high porosity, and low density (logging data summarized in the logging tables). Conformably underlying these strata is an interval of early Quaternary to late Tertiary interbedded sandstone, siltstone and clay. These rocks are distinguished from the Quaternary strata by a higher sandstone + siltstone/shale ratio, better induration and the presence of tuffaceous horizons in the lower part of this interval. The sedimentary strata are underlain by late Tertiary (possibly to early Quaternary) igneous rocks which consist of (in descending stratigraphic order) a mafic sill complex, basaltic to andesitic volcanics, and felsic volcanics. The depth to the top of the Mesozoic basement complex was not determined. Furthermore, the presence of a shallow intrusive complex which is characterized by high density and susceptibility precludes defining deep structural complexities of the basin using gravity and magnetic modeling techniques.

Characteristics of the thermal profiles of DeBraga-2 and

R. Weishaupt-1 are summarized in the profile of geothermal framework. Both wells contain temperature reversals at about 1400 to 1500 ft. with the upper portions of the reversals typified by gradients of ∿50-60°F/100 ft. Since these high thermal gradients generally occur within the unconsolidated clays of the Lahontan Valley Group, it seems likely that these strata are relatively impermeable and act as a caprock over the reservoir. The occurrence of lost circulation and evidence for the incursion of thermal fluids into the well bore suggests that the highest permeability is located at depths of ∿1300-3000 ft. As this permeable zone occurs at nearly the identical depths in both wells, this permeable zone is probably a stratigraphic interval. Therefore, the temperature reversals probably reflect lateral flow of thermal fluids. Negative to nearly isothermal gradients occur from ∿3500-4500 ft. while the lower portions of both wells have positive gradients of 0.4-1.6°F/100 ft. The maximum temperatures recorded in both wells (336-353°F) are comparable to the lower range of estimates of formation temperature using chemical geothermometry techniques.

The productivity and temperature of both DeBraga-2 and R. Weishaupt-1 are insufficient for electrical power generation. However, the presence of >300°F fluids and high permeability at ∿1300-3000 ft. perhaps indicates that this prospect could be utilized in a direct-heat project.

STRATIGRAPHIC COLUMN-DE BRAGA #2 WELL



LAHONTAN VALLEY GROUP (thickness = 1310') - composed primarily of unconsolidated shale along with minor amounts of siltstone + sandstone; coarser sediments are quartz-rich and fine-grained (<1.0mm); calcite cement is common.

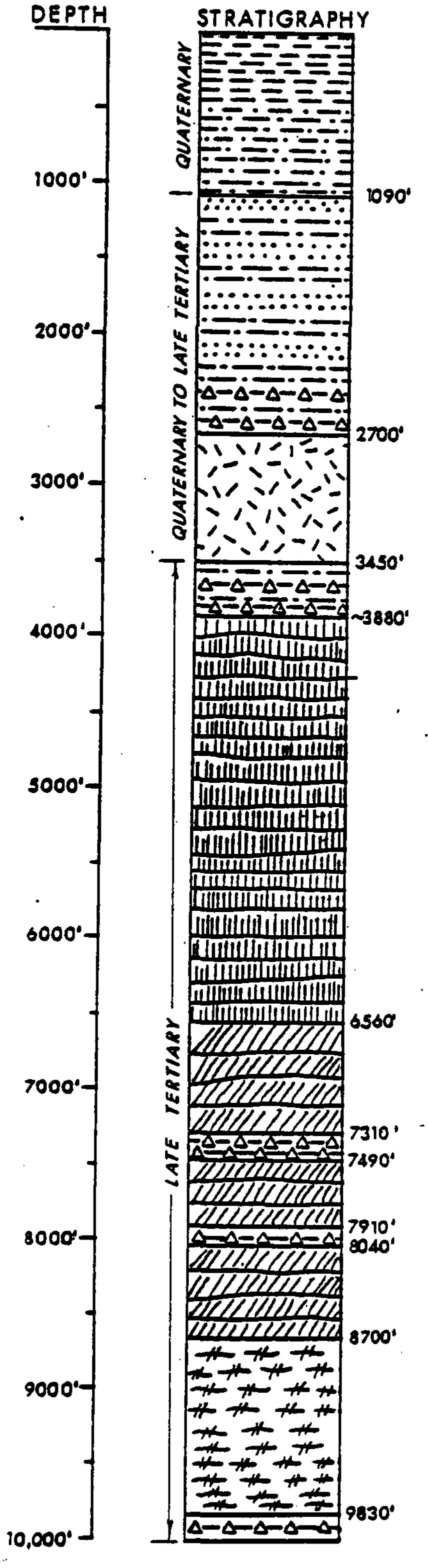
PRE-LAHONTAN VALLEY GROUP (thickness = 1060') - composed primarily of sandstone + siltstone along with minor shale; well-indurated; quartz-rich; locally tuffaceous near base.

BASALTIC HYPABYSSAL SILL (thickness = 430') - medium-grained (1-2mm) hypidiomorphic granular texture; composed of clinopyroxene, magnetite, olivine and plagioclase.

INTERCALATED MAFIC FLOWS, TUFF, TUFFACEOUS SEDIMENT AND SEDIMENTARY STRATA (thickness = ~4140') - includes:

1) basaltic to andesitic flows - plagioclase phenocrysts; vesicles which are filled with calcite + quartz; matrix is very fine-grained.
2) tuff, tuffaceous sediment - very fine-grained; clastic texture; locally calcareous.
3) sedimentary strata - quartz rich; fine-grained.

STRATIGRAPHIC COLUMN - R. WEISHAUPT #1 WELL



LAHONTON VALLEY GROUP (thickness = 1090')- interbedded clay, siltstone and minor sandstone; poorly consolidated; coarser sediments are quartz-rich and fine-grained (< 1.6mm);calcite cement is common; pyrite and chlorite are secondary minerals.

PRE-LAHONTON VALLEY GROUP (thickness = 1610') - interbedded sandstone, siltstone and minor clay; moderately well consolidated; coarse-grained sediments are quartz-rich; quartz overgrowths are locally abundant; intercalated with tuffaceous sediment and tuff near the base of this unit.

BASALTIC HYPABYSSAL SILL (thickness = 750') - hydromorphic granular and ophitic texture; fine-grained (1-2mm); composed of plagioclase, pyroxene, olivine and magnetite.

INTERBEDDED TUFFACEOUS SEDIMENTS AND VOLCANICS - (thickness = 420') - v. fine grained tuff which is locally rich in quartz + plagioclase fragments; volcanics have a mafic composition, are aphanitic, and do not have a clastic texture.

AMYGDULAR BASALTIC TO ANDESITIC VOLCANICS - (thickness = 2,530') - very vesicular (filled with quartz, chlorite, cu-minerals (?), and calcite); rare plagioclase phenocrysts; matrix locally contains abundant plagioclase microlites, is very fine-grained, and always hematite-stained.

BASALTIC TO ANDESITIC VOLCANICS (thickness = 690') - fine-grained, minor vesicles (filled with quartz + chlorite); plagioclase, pyroxene and olivine phenocrysts set in a matrix of granular plagioclase + chloritized mafics.

ANDESITIC TUFF (thickness = 170') - very fine-grained, well-bedded tuff and lithic-rich (pumice clasts) tuff.

BASALTIC TO ANDESITIC VOLCANICS (thickness = 390') - Same as above

ANDESITIC TUFF (thickness = 130') - Same as above

BASALTIC TO ANDESITIC VOLCANICS (thickness = 625') - Same as above

FELSIC VOLCANICS (thickness = 1,050') - plagioclase, hornblende and rare quartz phenocrysts set in very fine-grained matrix; plagioclase microphenocrysts locally present in matrix; perlitic cracks are abundant; epidote (?)- calcite-quartz-chlorite veins are common.

MIXTURE OF ANDESITIC TUFF AND BASALTIC TO ANDESITIC VOLCANICS (thickness = 170')- Same as above

LOGGING TABLES

The following tables summarize logging runs in the
De Braga-2 and R. Weishaupt-1 wells
Logs will be available from:

Rocky Mountain Well Log Service
P.O. Box 3150
Denver, Colorado 80201
(303) 825-2181

DE BRAGA-2 WELL

SCHLUMBERGER LOGGING DATA

DATE	TYPE OF LOG	LOGGED INTERVAL	TOTAL DEPTH
9 April 79	Dual Induction-Laterolog	320-1207'	1205'
9 April 79	Compensated Neutron Log-Formation Density	90-1213'	1205'
9 April 79	Temperature Log	0-1205'	1205'
9 April 79	Dipmeter Log	320-1212'	1205'
3 May 79	Dual Induction-Laterolog	1192-6938'	6946'
3 May 79	Compensated Neutron Log-Formation Density	1192-6944'	6946'
3 May 79	Temperature Log	0-6946'	6946'
3 May 79	Dipmeter Log	1196-6944'	6946

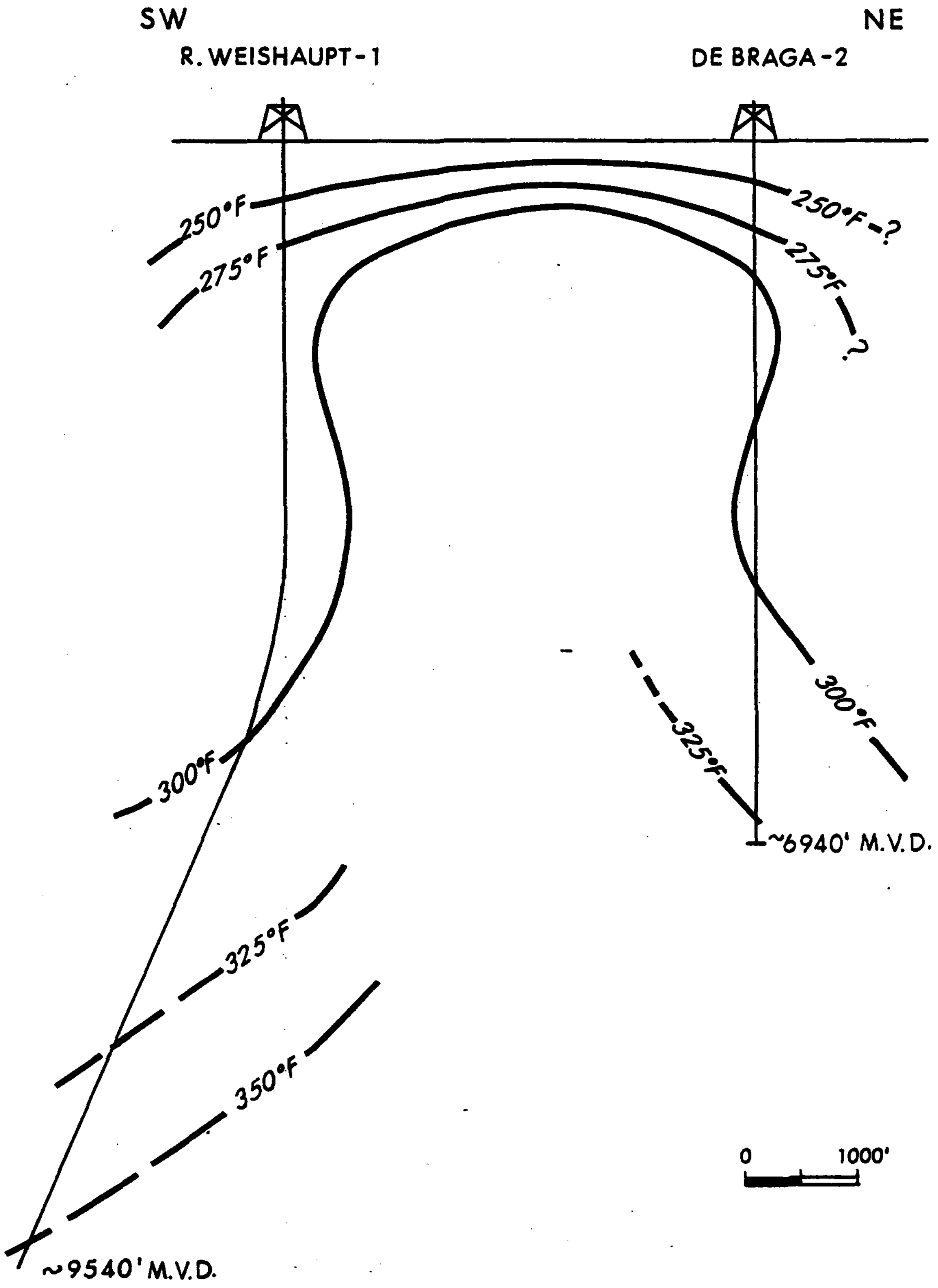
R. WEISHAUPT -1 WELL

SCHLUMBERGER LOGGING DATA

DATE	TYPE OF LOG	LOGGED INTERVAL	TOTAL DEPTH
17 May 81	Temperature Log	298-1396'	1404'
17 May 81	Sonic Log with Caliper and S-P	298-1390'	1404'
17 May 81	DIL-SFL with Linear Correlation log	298-1388'	1404'
17 May 81	CNL-FD with Gamma Ray and Caliper	298-1386'	1404'
18 May 81	Continous Dipmeter	298-1386'	1404'
29 May 81	DIL-SFL with Linear Correlation log and S-P	1389-5090'	5092'
29 May 81	Sonic Log with Caliper and Gamma Ray (computer failed at 3500')	3500-5089'	5092'
24 June 81	DIL-SFL and Sonic Log with S-P, Gamma Ray and Caliper	Both tools failed at depth of 9500-10,000'	10,014'
24 June 81	Temperature Log	Tool could not be calibrated	10,014'
24 June 81	DIL-SFL with S-P	5080-10,000'	10,014'
25 June 81	Sonic Log with Caliper and Gamma Ray	Tool failed at depth of 9500-10,000'	10,014'
25 June 81	Sonic Log with Caliper and Gamma Ray	Tool failed at depth of 9500-10,000'	10,014'

R. WEISHAUPT-1 WELL
continued

25 June 81	CNL with Gamma Ray	1306-5080'	10,014'
25 June 81	CNL-FD with Gamma Ray	5080-9997'	10,014
25 June 81	Temperature Log	Tool failed at about 2500'	10,014
25 June 81	Temperature Log	Tool failed at about 1500'	10,014



PROFILE OF GEOTHERMAL FRAMEWORK
STILLWATER PROSPECT

RESERVOIR SUMMARY

STILLWATER PROSPECT

Pressure and temperature surveys have been conducted in DeBraga-2 and Richard Weishaupt-1. Production tests have also been attempted on both wells. A comparison of the information from these tests is provided in well test data table.

Richard Weishaupt-1 flowtest, conducted on July 15, 1981, indicated mass flow rate into the empty well bore to be 190 pounds per hour. The mass flow was calculated using the assumption that the flowtest emptied the wellbore and approximately 21 hours later it was full again. It should be noted that during drilling one drilling break was encountered. The lack of flow suggests that the fracture is not connected to the reservoir.

The DeBraga flowtest on May 22, 1979 lasted 3-1/2 hours. The average flowrate during the flowtest was indicated to be 150,000 pounds per hour at 5 percent flash, 20 psig wellhead pressure and 252°F.

The pressure buildup following the flowtest on DeBraga-2 indicated a kh of 10,000 md-ft and a skin coefficient of +0.1. The buildup was recorded by gauges at 2,600 ft.

Both wells' temperature profiles are compared in the temperature survey plot. The two wells had temperature reversals between 1500 ft and 3500 ft. The temperature peak at 1500 ft. was slightly higher in DeBraga-2 : 310°F v.s. 290°F. Following the drop in temperature, a temperature gradient in both wells led to bottom hole temperatures of 336°F and 350°F for DeBraga 2 and Richard Weishaupt-1, respectively.

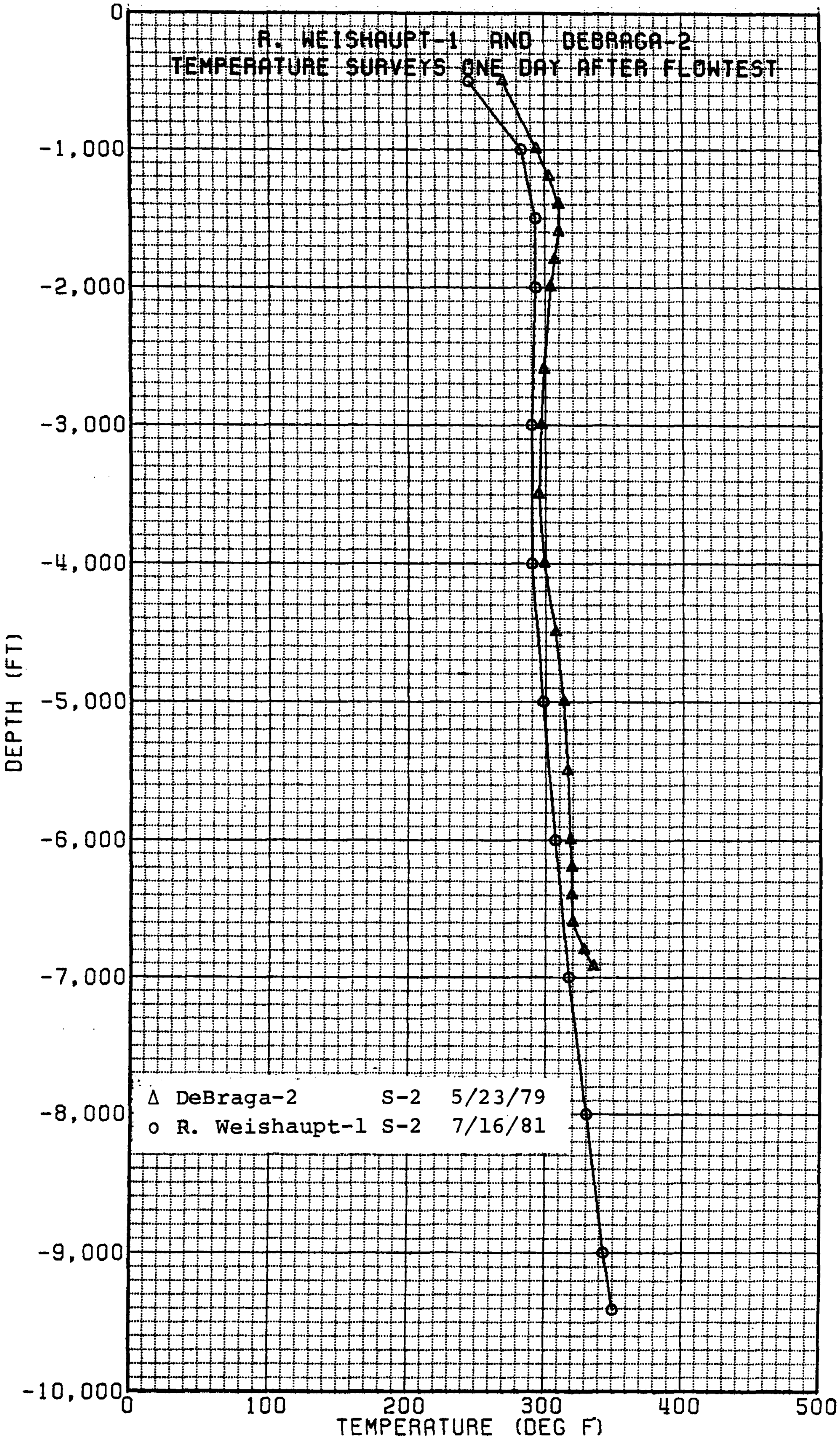
The pressure survey plot illustrates the pressure profiles for DeBraga-2 and Richard Weishaupt-1. Both gradients illustrate a saturated profile with a .4 psi/ft gradient. The saturated profile in both wells indicate that the well bore is full of liquid.

Testing on DeBraga-2 indicates that the fractures encountered during drilling are connected with a permeable region in the resource. Richard Weishaupt-1 did not seem to encounter the same permeable region. The similarity in the temperature profiles indicate that the wells are using the same heat source. Stimulation of Richard Weishaupt-1 might allow the fractures to enter a permeable region similar to DeBraga-2.

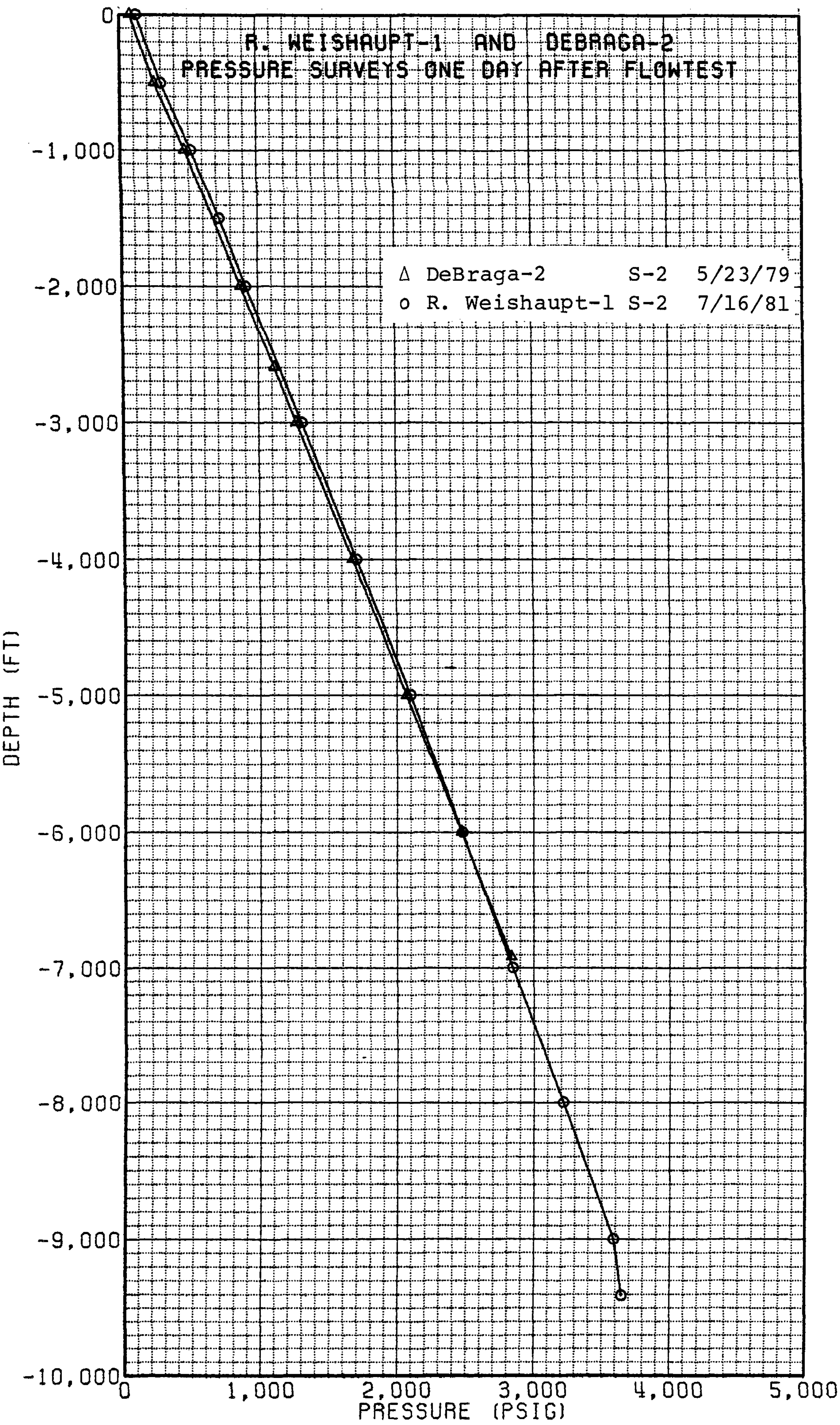
The low temperature profiles would suggest that the Stillwater resource is not feasible for electrical generation.

WELL TEST DATA TABLE
STILLWATER FIELD, NEVADA
COMPARATIVE WELL TEST INFORMATION
AS OF JULY, 1981

	DeBraga No. 2	R. Weishaupt No. 1
DATE COMPLETED	5-08-79	6-29-81
TOTAL DEPTH	6,946	10,000
PRODUCTION STRING	7", 26# liner	7", 26# liner
SLOTTED INTERVAL	2,724-6,940	5,000-10,000
TEMPERATURE ANOMALY		
Max. Temp., °F	310	290
Depth Interval	1,200-1,800	1,000-2,000
FLOW TEST		Unable To Flow
Avg. Rate (lb/hr)	152,000	--
WHP,PSIG	20	--
WHT, °F	252	--
Bottomhole Press, PSIG	925	--
Depth, Feet	2,600	--
% Flash	5%	--
BUILD UP TEST		
Kh, md-ft	10,000	--
S	0	--
Max. Temp., °F	336	350
Depth, Feet	6,920	9,410



TEMPERATURE SURVEY PLOT



PRESSURE SURVEY PLOT