NAWS-CL TP 006

Coso Monitoring Program

October 1993 Through September 1994

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CHINA LAKE, CA 93555-6001

Naval Air Weapons Station

FOREWORD

This report presents the status of the Coso Monitoring Program conducted for the period October 1993 through September 1994 by the Naval Air Weapons Station (NAWS), China Lake, Calif. The investigation, funded under the NAWS Coso Geothermal Development Program, is being conducted to provide baseline information on hydrology and surface geothermal activity in the Coso Hot Springs area.

Comarco personnel aided in the successful completion of the 1993-94 Coso Monitoring Program under contract N60530-88-D-0019 for the Public Works Department.

This report was reviewed for technical accuracy by Allan M. Katzenstein and Andrew E. Sabin.

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(U) The Coso Monitoring Program is a continuing effort in support of the Navy's geothermal resources within the Known Geothermal Resource Area (KGRA). Data are presented on the monitoring of steam flow rates and temperatures, water levels in ponds and wells, water chemistry, and rainfall in the Coso Hot Springs Resort Area. A monthly photographic essay of the mudfields and pools shows the variation of the surface water levels throughout the year.

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INTRODUCTION

The Coso Monitoring Program was initiated in 1978 to gather baseline data on the surface and near-surface geothermal activity at Devils Kitchen and Coso Hot Springs, the main thermal sites within the Coso Known Geothermal Resource Area (KGRA). This report represents the seventeenth year of continuous data collection.

Numerous changes in activity were noted again at the Coso Hot Springs thermal sites since the last report, particularly at the South Pool. These and other activities will be detailed in the individual site discussions.

New digital recording equipment, ITT Barton Automated Data Scanning System (ADSCAN) was installed at the Schober's site to record steam flow and temperature. Additional digital recording equipment has been placed on order for 4H-4 and Devils Kitchen steam wells. A Handar digital weather station was installed near well OB-1. The station records wind direction and velocity, temperature, barometric pressure, and relative humidity. This system replaces the analog microbarograph, meteorgraph, and hygrothermograph used previously.

Monitoring sites of the Coso Hot Springs area and type of data collected at each site are presented in Table 1. The location of each site is shown in Figure 1.

TABLE 1. Monitoring Functions and Locations.

Monitored Sites	Continuous steam flow	Continuous steam temperature	Well head pressure	Periodic water level	Periodic water temperature	Water level photography	Water chemistry	Ambient temperature	Barometric pressure	Relative humidity	Wind speed and direction
Schober's Resort (Wells 4A-2, 3)	X	X									
Well 4A-4				X[b]	X						
Well 4H-4	X					X					
Well 4P-1				X[a]	X		X				
Well 4K-1				X[b]	X		X				
Well 4H-8			X[c]								
Devils Kitchen	X					X					
Observation Well No. 1				X[a]	X		X				
Observation Well No. 2				X[a]	X						
Observation Well No. 3				X[a]	X						
South Pool				X[b]	X	X	X				
Weather Station No. 1								X	X	X	X

[a] Weekly monitoring.

[b] Less than weekly monitoring.

[c] Weekly shut-in well head pressures.

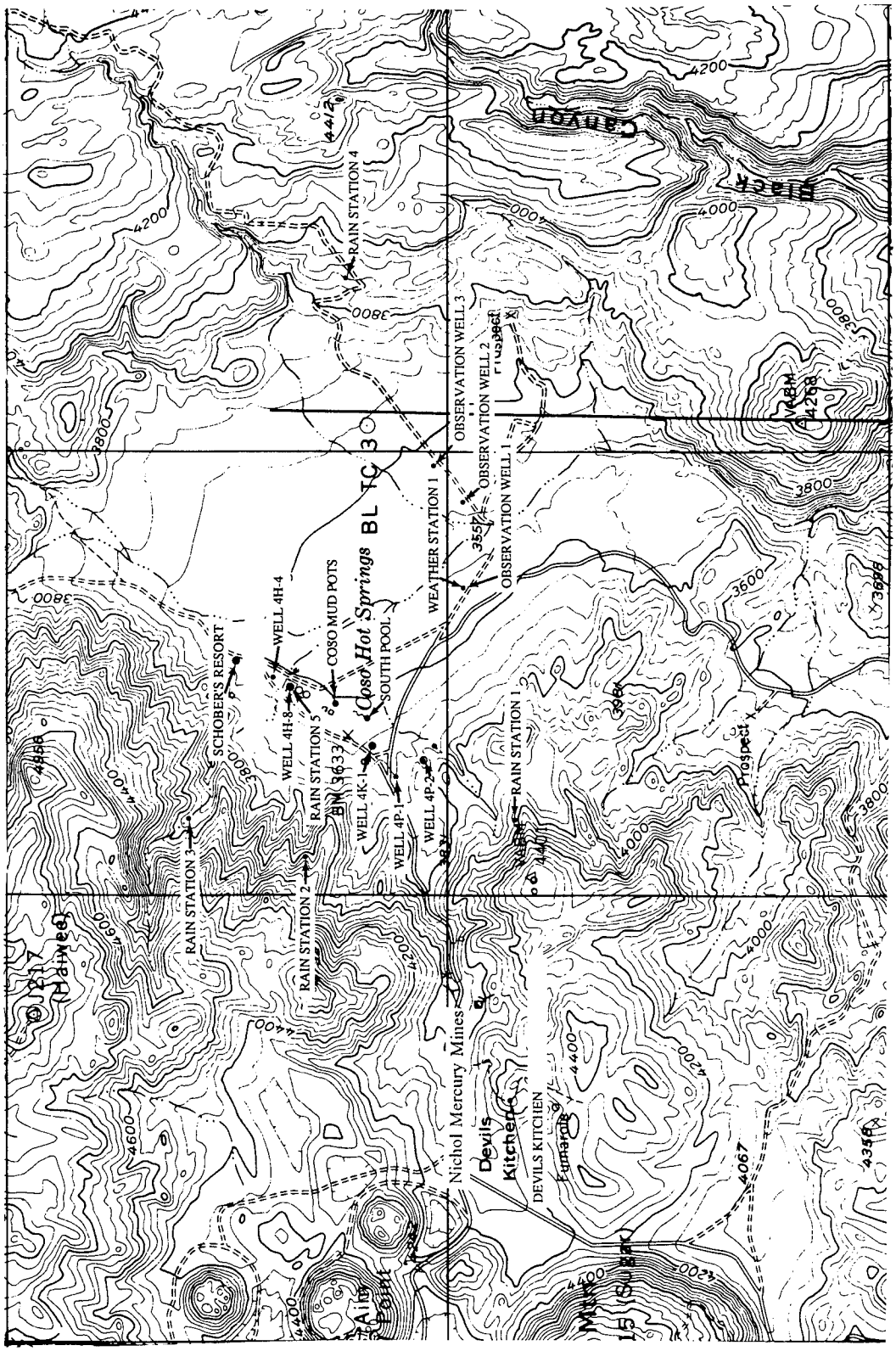


FIGURE 1. Coso Known Geothermal Resource Area Monitoring Sites.

STEAM FLOW AND TEMPERATURE MONITORING

Steam flow and steam temperature have been gauged at several shallow wells since the program was first initiated. While the measured steam flow from these wells represents an unknown fraction of the total steam flow from the Coso thermal area, it does serve to monitor the relative thermal activity in the area over time. Several sites have been included in the study: Devils Kitchen, the Two-Inch Steam Well (4P-2), the Corrosion Array wells (4H-1, 2, 3, and 7), the Eight-Inch Stove-Pipe Well (4H-4), and Schober's Resort (4A-2 and 3). Monitoring of the steam flow from the Corrosion Array ceased in June 1989 after two of the four wells blew out. Monitoring of the steam flow from the Two-Inch Well ceased in October 1991 because of an influx of liquid into the well that stopped the steam flow.

Steam flow is presently measured at three well sites (Schober's Resort, Devils Kitchen, and 4H-4) with steam temperature also monitored at the Schober's well site. One site is located within Devils Kitchen, and the other sites are along the Coso Hot Springs-Airport Lake Fault. Temperature data are used as collected, and the steam flow data are converted from graph units to steam flow in pounds per hour. The conversion factors for steam flow data are calculated using the standard orifice equation for gas flow. The Barton differential pressure recorders are calibrated monthly. Periodic differential pressure manometer readings are taken at each steam site to ensure the recorded data are accurate.

At the Schober's Resort site an ADSCAN was installed on 6 April 1994 for collecting data. The ADSCAN unit was installed with no modifications on the existing Barton recorder. Collected data are down-loaded to a pocket-size flash memory card. The information stored in the flash memory card is then read onto a PC using the Barton card reader. Once read to the PC, the data can be viewed and flow calculations can be performed using Scanbase PC software. The present recording charts will be retained to provide a backup data system and for comparison studies. Two additional ADSCAN units are on order for the other sites (4H-4 and Devils Kitchen). ITT Barton, Inc. representatives recommended that we install condensation collection pots and reconfigure the plumbing from the condensation collection pots to the differential pressure units (DPU) and recorders to comply with current metering standards developed by their research and development branch. These modifications should further increase the accuracy of collected data. Materials for the modifications are presently being procured. The targeted completion date for the modifications is 30 November 1994.

A periodic maintenance schedule (PMS) has been established to ensure that the units are consistently maintained at peak efficiency and reliability. An instructional manual was assembled that describes the inspection, calibration, and maintenance intervals and requirements.

DEVILS KITCHEN

Steam flow at Devils Kitchen is monitored using a 25-inch water column Barton DPU and recorder. The conversion factor, based on an orifice size of 1.387 inches, is 40.23. Daily high and low steam-flow data collected at Devils Kitchen for the period of this report are presented in Appendix A, Table A-1. These data are shown graphically in Figure 2.

Throughout the reporting period the Barton charts have been reading at 95 to 100% of scale. The meter has been calibrated and the readings verified using the Dwyer slack-tube manometer. To keep the recordings on-scale (ideally at about 75%) the steam-flow orifice was enlarged in October 1994. This enlargement will reduce the differential pressure across the orifice while maintaining the same flow rate from the well. The new readings will be a smaller percentage of total scale, and a conversion factor for the new orifice will be calculated and applied to the data to reflect the true flow rate.

In addition to resizing the orifice, some meter repiping will be done in conjunction with installation of the ADSCAN that occurred during the last quarter of 1994. According to the meter manufacturer, these changes and additions will increase the accuracy of the data and simplify data handling.

Figure 3 shows a summary graph of Devils Kitchen steam-flow activity from 1978 to the present. These data are presented as a 2-day moving average on a logarithmic scale to smooth the curve and accent changes in the flow trend. Overall, the steam-flow trend at this site is the most constant of all the sites monitored.

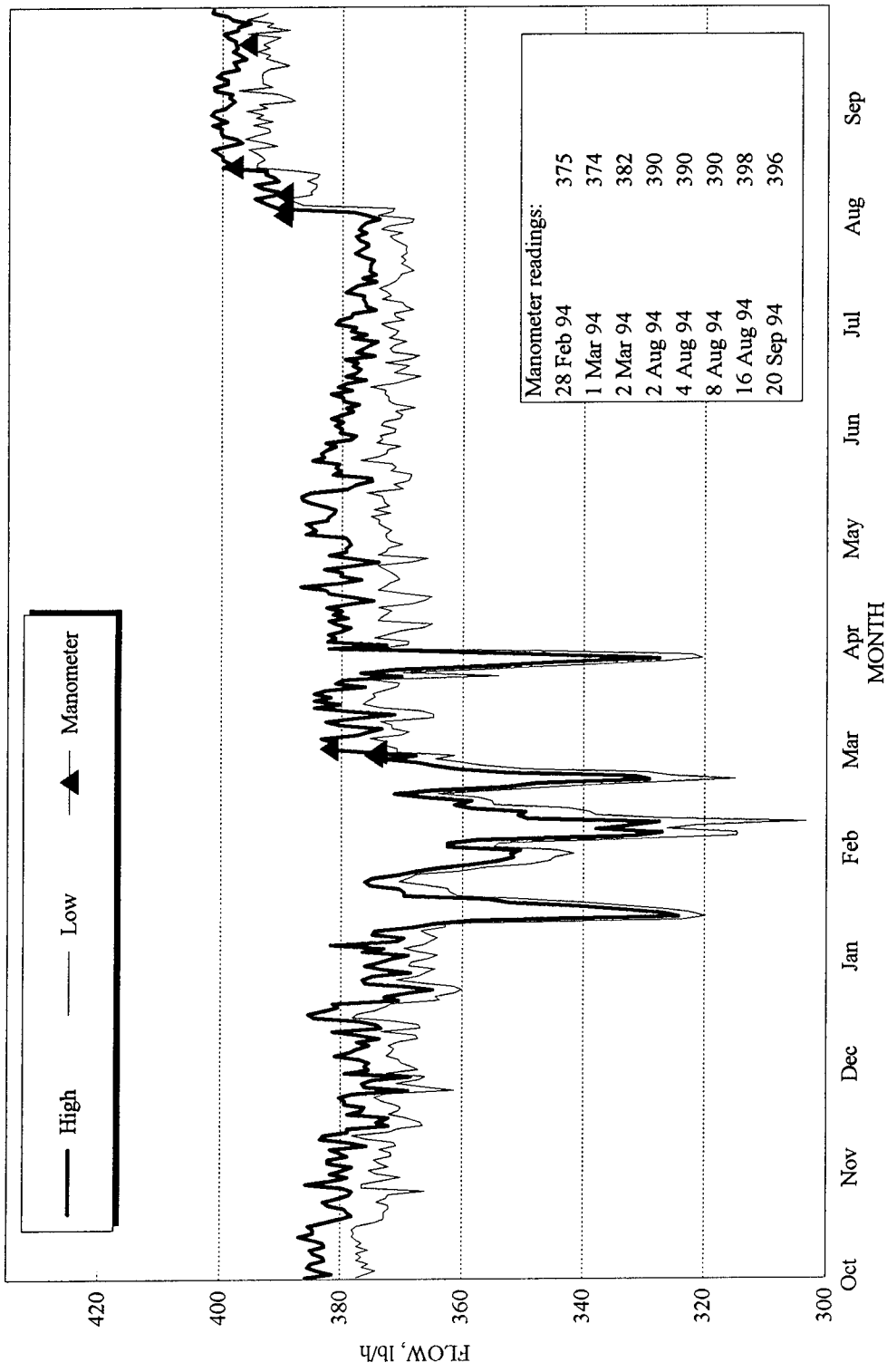


FIGURE 2. Devils Kitchen Steam Flow, 1 October 1993 Through 30 September 1994.

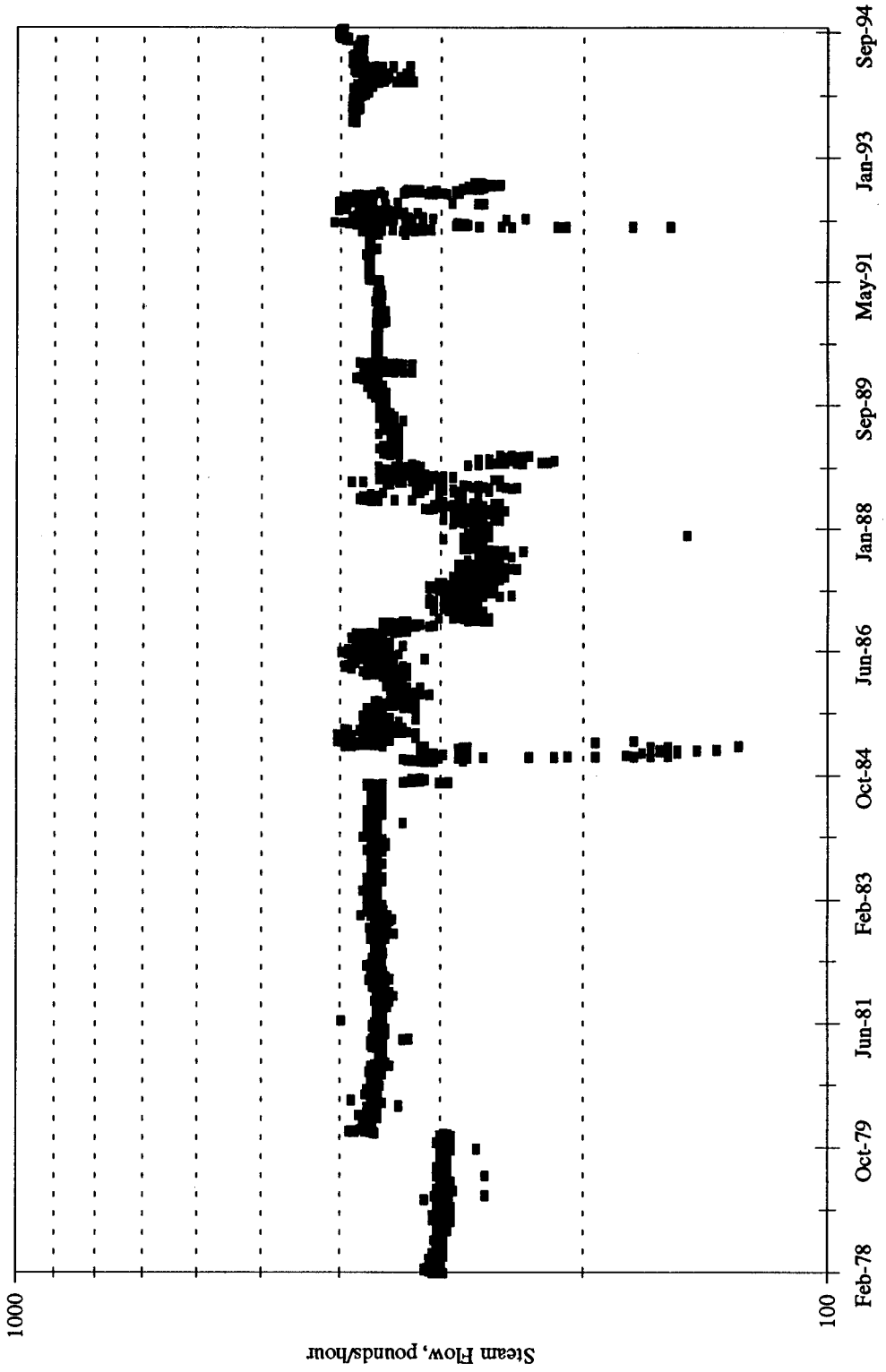


FIGURE 3. Devils Kitchen Steam Flow, January 1978 Through September 1994.

WELL 4H-4 (Eight-Inch Steam Well)

Daily steam flow data for 4H-4 are presented in Appendix A, Table A-2. These data are shown graphically in Figure 4.

This site was equipped with a 25-inch water column DPU and recorder, and has a conversion factor of 20.56. Historically, this site has had the most erratic data recording of all the monitored sites. This site was the first to be incorporated into the new PMS cycle. After the maintenance was completed, the steam flow exceeded the range of the 25-inch water column DPU. This increase is shown graphically in Figure 4. The data were verified with numerous manometer readings using both a digital readout and a Dwyer slack-tube manometer. After thorough investigation of the accuracy of the data, the 25-inch water column DPU was replaced with a 50-inch water column DPU and recorder on 22 July 1994. The conversion factor changed to 46.58. Incorporation of the 50-inch water column also may serve to dampen considerably the erratic readings recorded in the past. Figure 5 shows a summary graph of well 4H-4 steam-flow activity from 1980 to the present. These data are presented on a logarithmic scale to smooth the curve and accent changes in the flow trend.

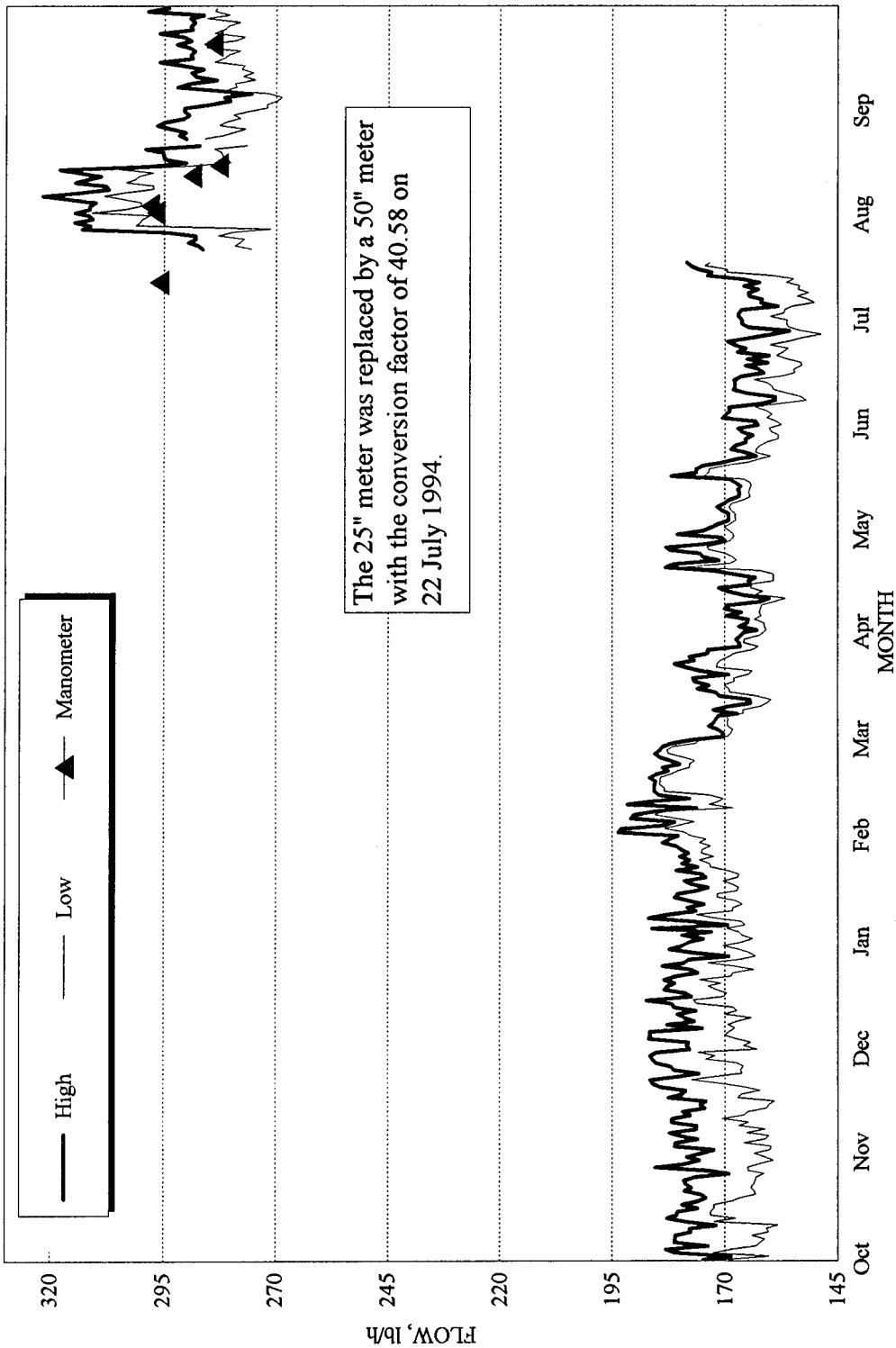


FIGURE 4. Well 4H-4 Steam Flow, 1 October 1993 Through 30 September 1994.

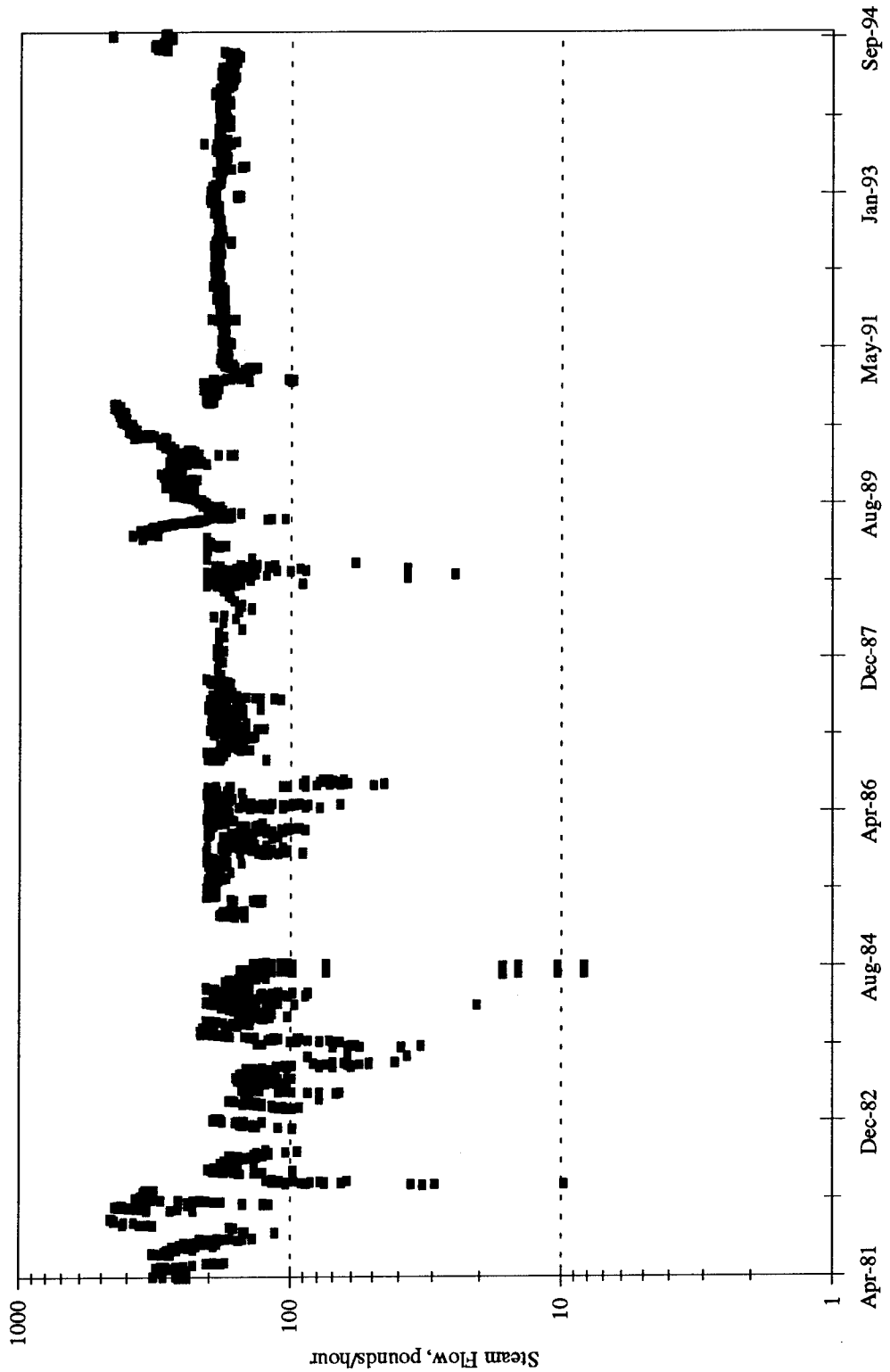


FIGURE 5. Daily High Steam Flow for 4H-4, April 1981 Through September 1994.

SCHOBER'S WELLS (4A-2 AND 4A-3)

The daily steam flow and temperature data for wells 4A-2 and 4A-3 at Schober's Resort are presented in Appendixes A and B, Tables A-3 and B-1. Data are shown graphically in Figures 6 and 7. Steam flow is recorded using a 50-inch water column DPU and recorder. The conversion factor is 150.8.

The ADSCAN system was installed at this site on 6 April 1994 by ITT Barton representatives who recommended replumbing the installation of condensate pots on all the steam wells. They also recommended that we install the condensation collection system and replumb the system to the DPU in accordance with their present requirements for increased reliability and accuracy of data being collected. Replumbing with the incorporation of the condensation collection system was completed on 30 November 1994.

Figure 8 shows a summary graph of Schober's Resort steam flow activity from 1978 to the present. These data are presented as a 2-day moving average on a logarithmic scale to smooth the curve and accent changes in the flow trend. The steam-flow rate began to change at Schober's Resort in the last quarter of 1987, first dropping slightly then rapidly increasing until the original well blew out. The current Schober's steam wells were rehabilitated and put into service in 1989. Steam flow is slowly decreasing at Schober's Resort, apparently because of an influx of rainfall runoff flowing directly into shallow open holes next to the monitored wells.

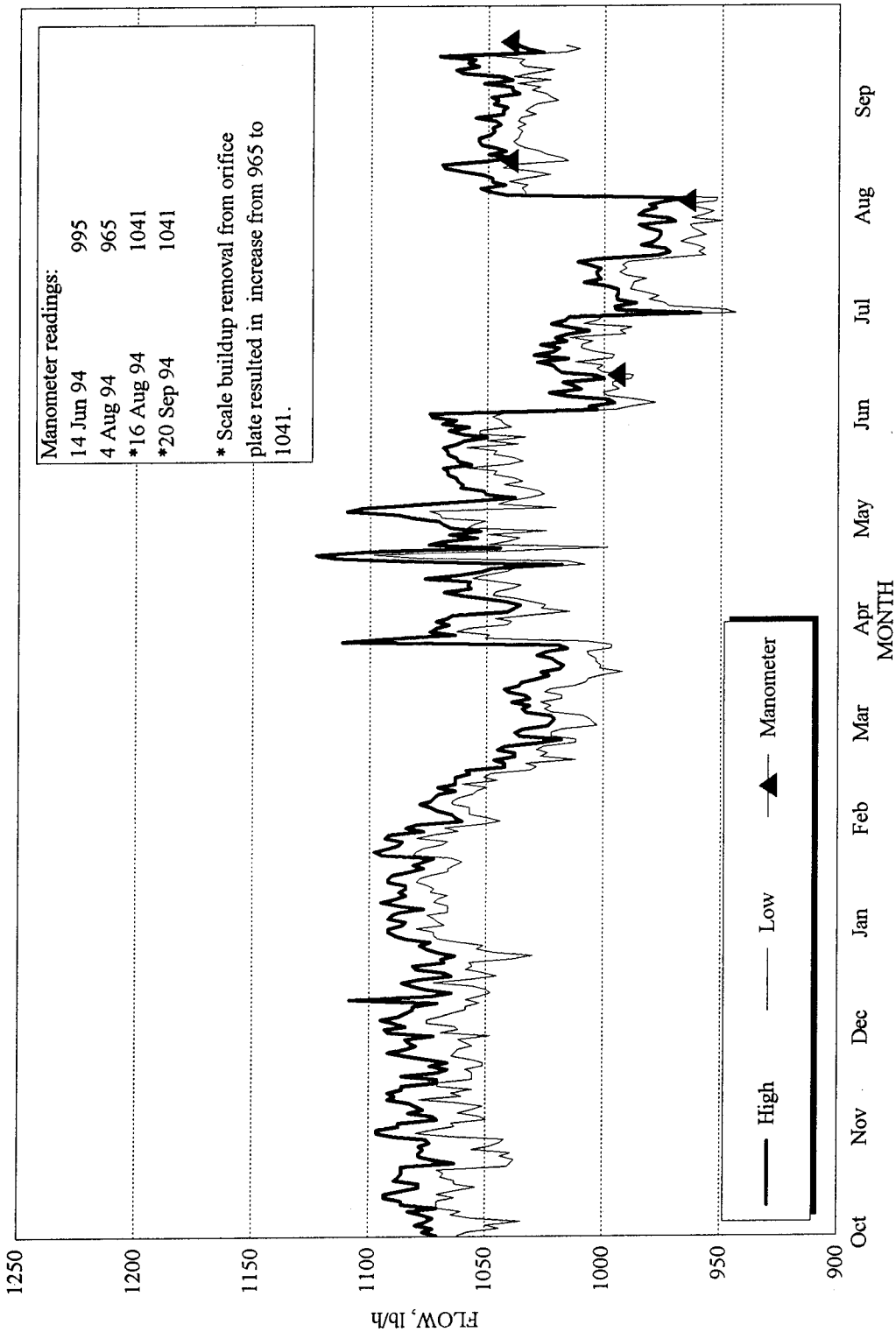


FIGURE 6. Wells 4A-2 and 4A-3 Steam Flow, 1 October 1993 Through 30 September 1994.

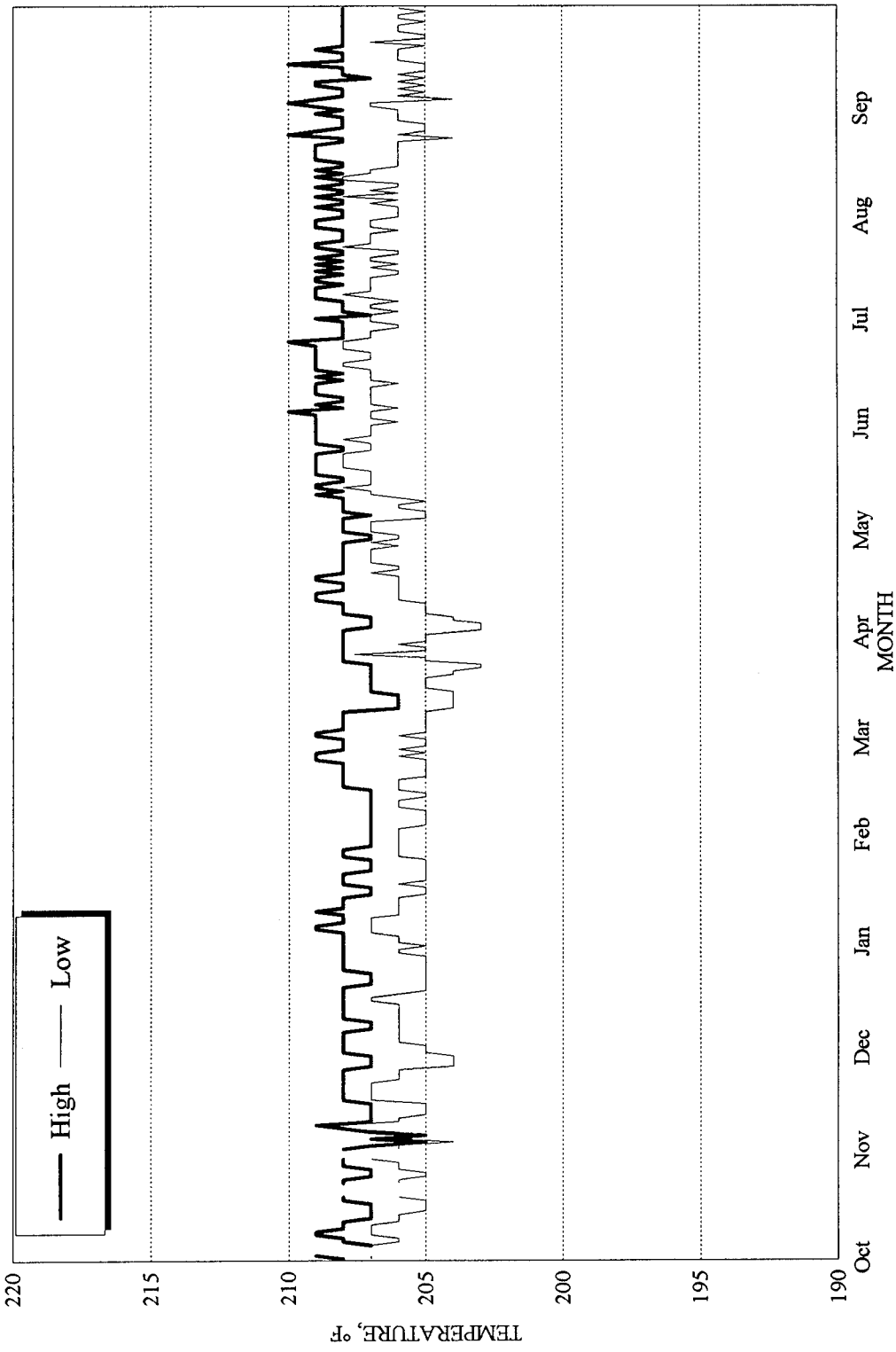


FIGURE 7. Wells 4A-2 and 4A-3 Steam Temperature, 1 October 1993 Through 30 September 1994.

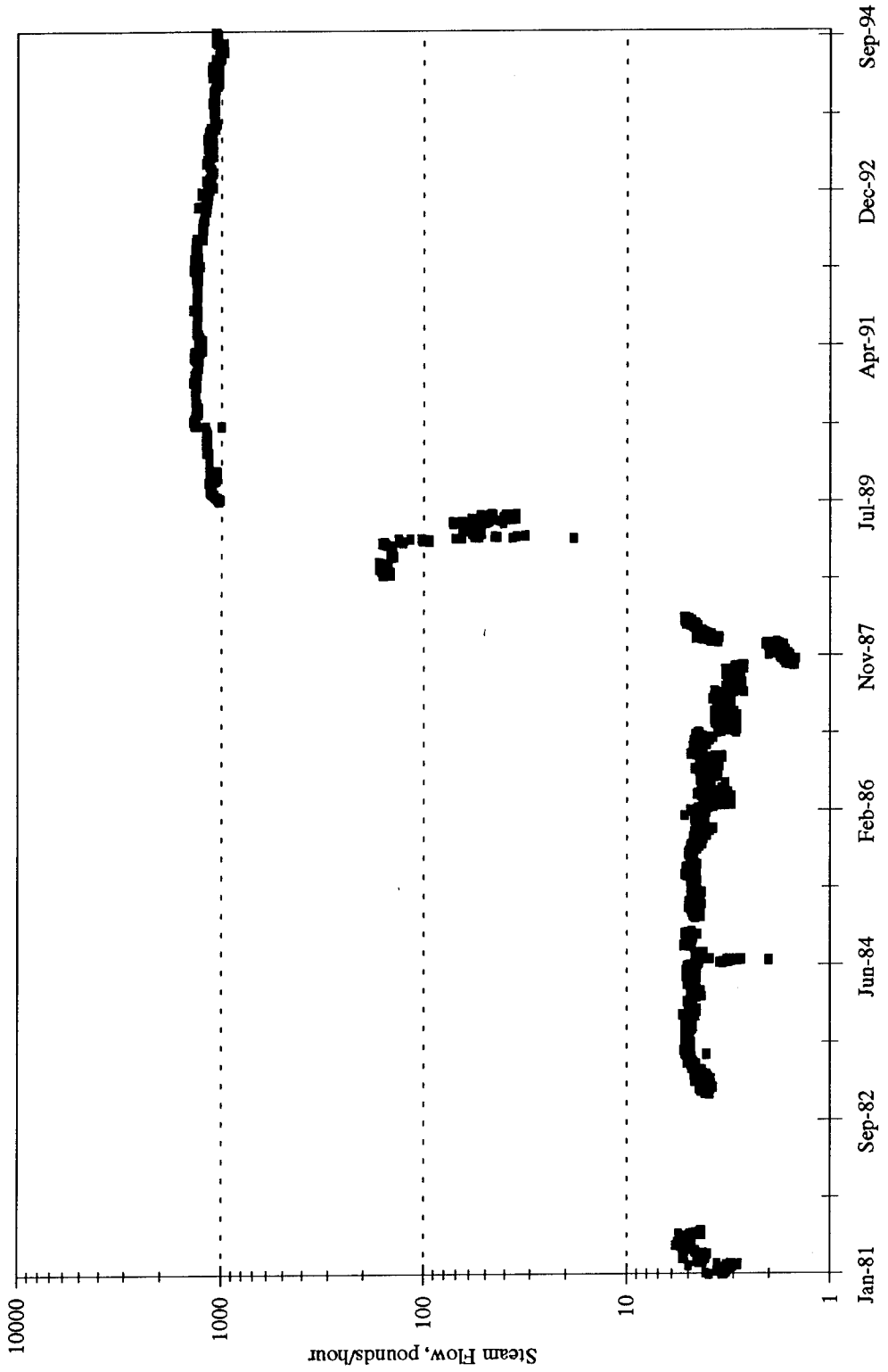


FIGURE 8. Daily High Steam Flow for Schobers Resort, February 1981 Through September 1994.

COSO HOT SPRINGS MUDFIELD PHOTOGRAPHIC RECORD

A weekly photographic record was initiated in January 1978 to document the fluctuation in fluid levels in several of the more prominent mud pots in the Coso KGRA. This project has continued into the steam-production and power-generation stages of the geothermal development.

Steam and weather conditions often combine to partially obscure the Coso Resort area. To counter these effects, nine photo sites are distributed in and around the resort area so photographs can be taken each week that clearly show the physical status of the thermal activity. The Coso Resort sites are listed in Table 2 and shown in Figure 9. Figures 10 through 21 illustrate seasonal variations at several Coso Resort sites.

TABLE 2. Photographic Sites and Views.

Site number	Primary view from each site
1	South Pool looking north
2	Overall Resort mudfield looking southwest and northwest
3	Overall Resort mudfield looking southwest, west, north, and northeast
4	Mudfield looking west, north, and northwest
5	Mudfield looking south, southwest, and west
6	Mudfield looking south, southeast, and east
7	North side of mudfield looking south
8	Crater 4KC-8 looking south, southeast, and east
9	Crater 4KC-8 looking northeast

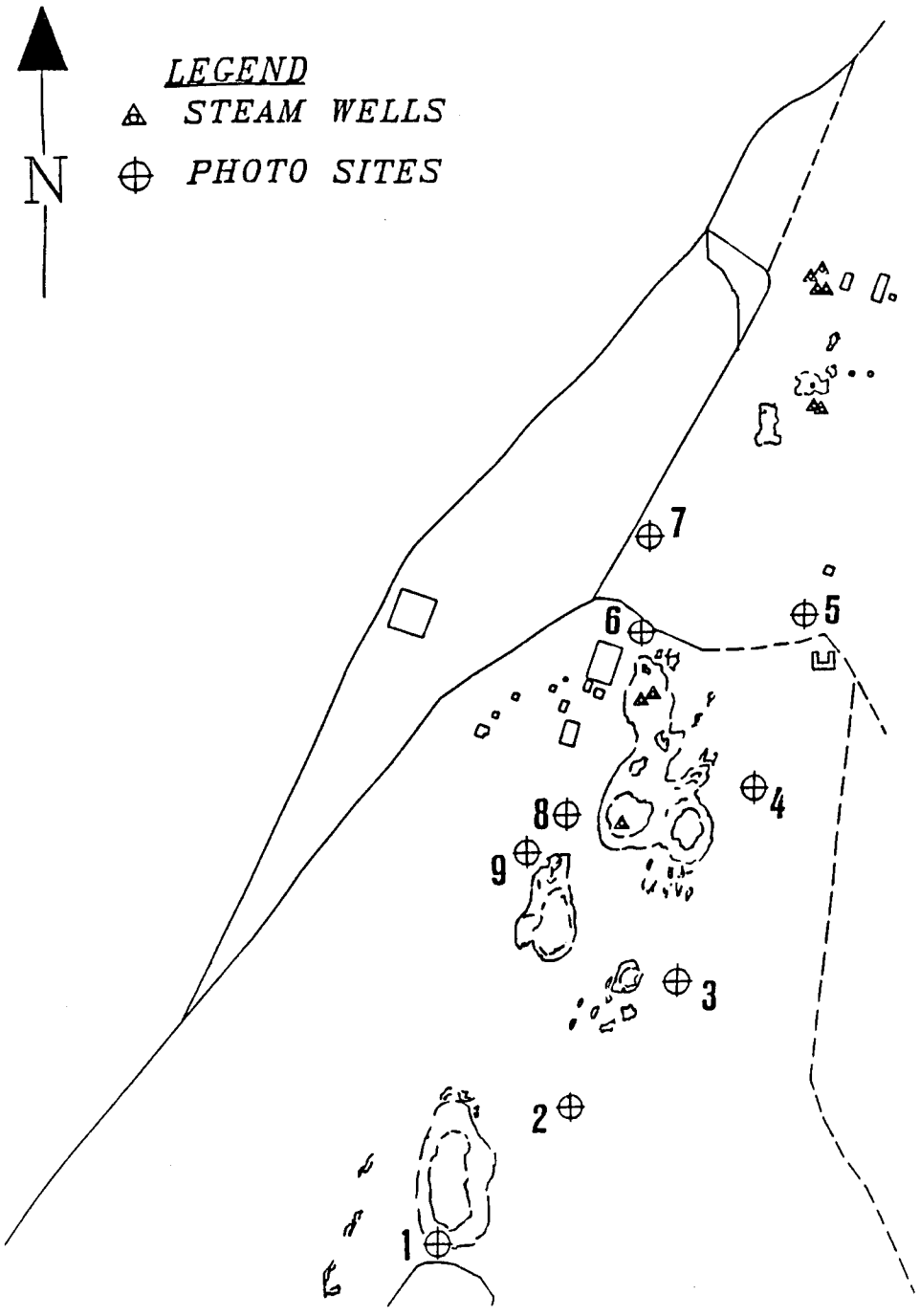
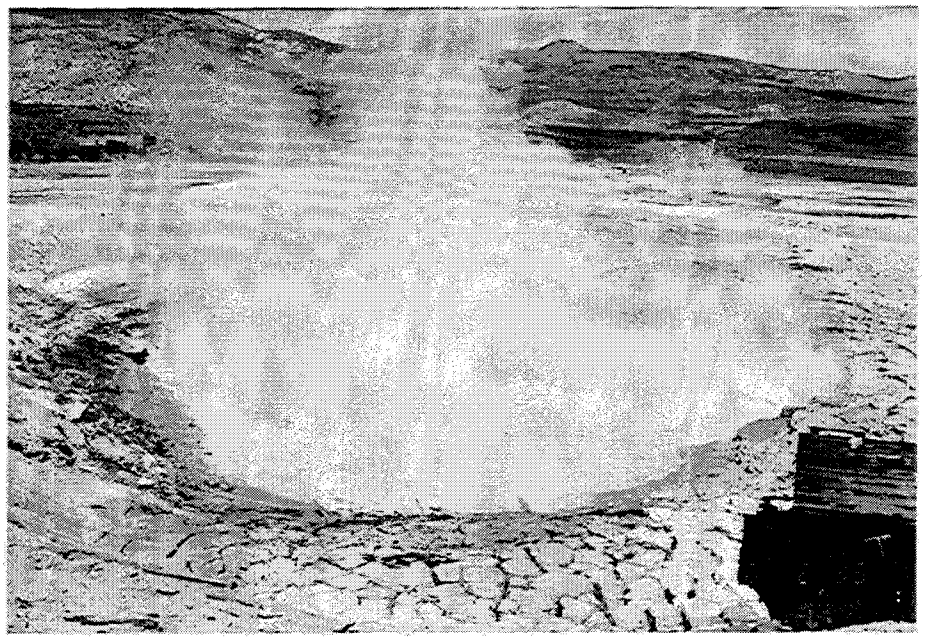


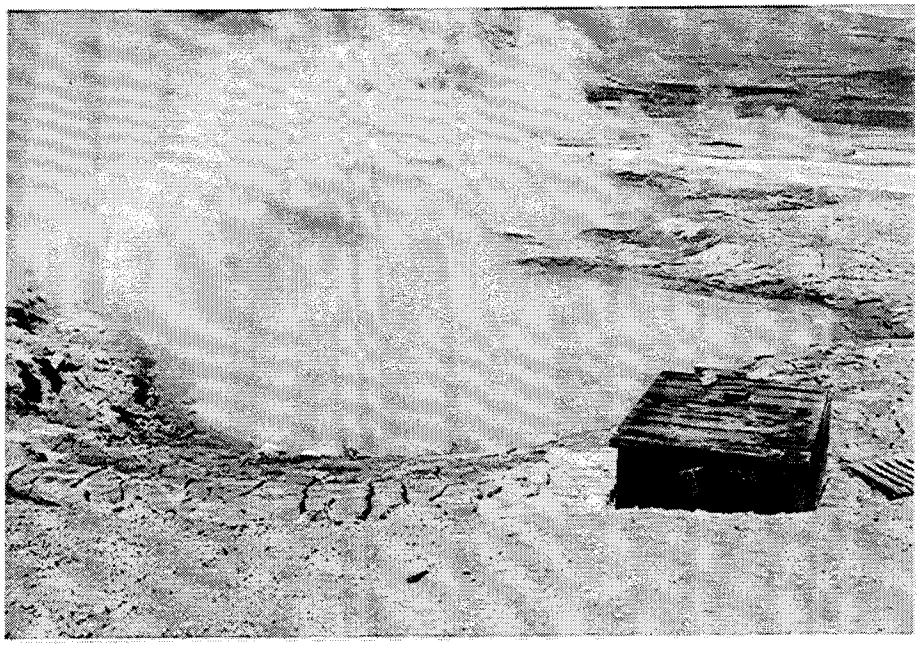
FIGURE 9. Photographic Locations.



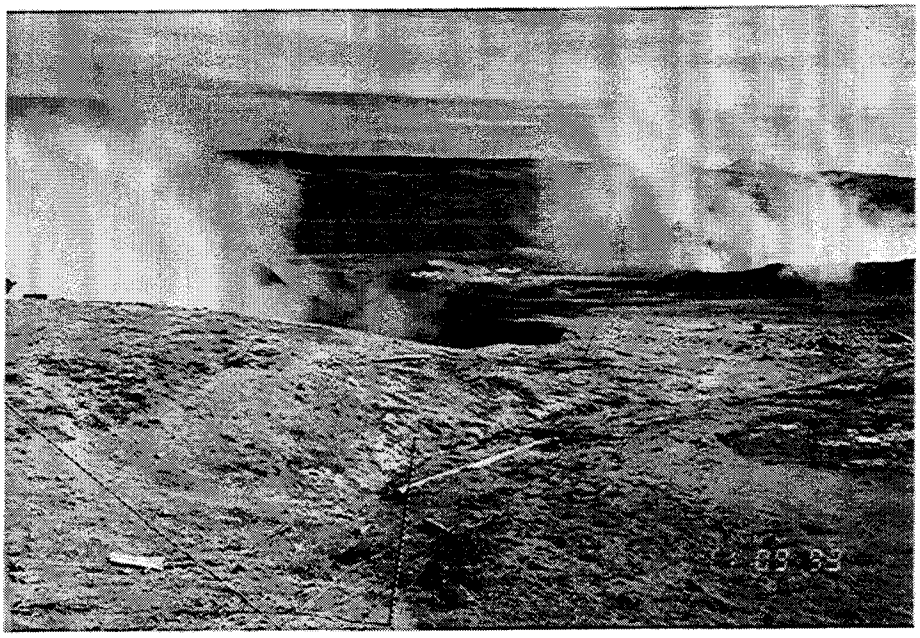
(a) Site 1 looking north.

(b) Site 3 looking northwest.

FIGURE 10. Coso Hot Springs, 12 October 1993.

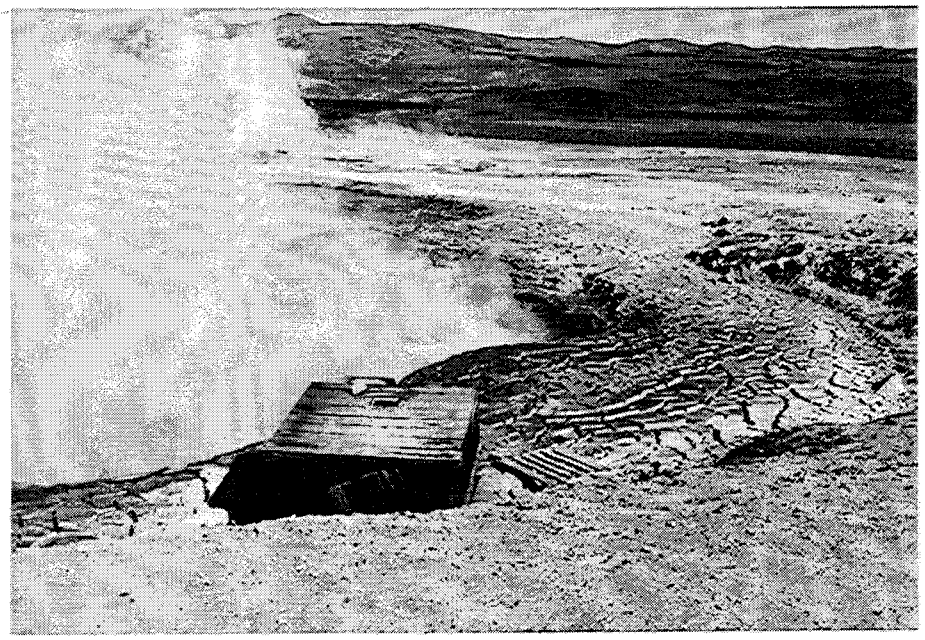


(a) Site 1 looking north.



(b) Site 8 looking southeast.

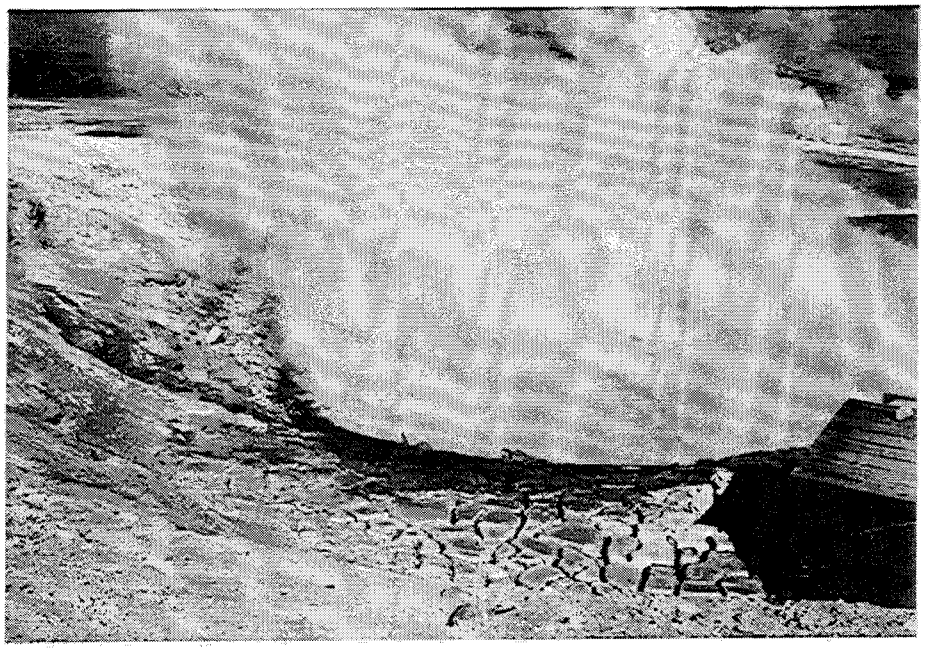
FIGURE 11. Coso Hot Springs, 9 November 1993.



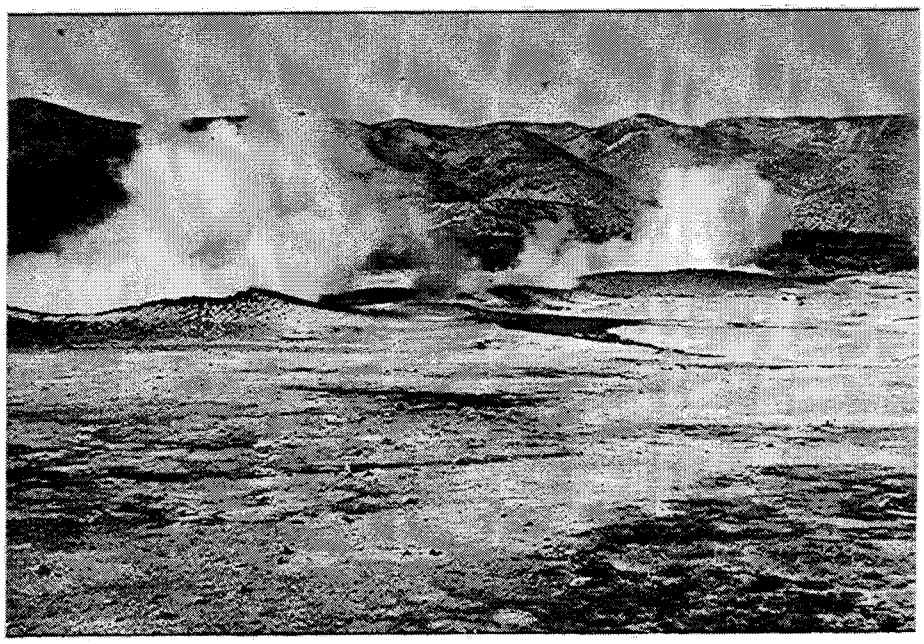
(a) Site 1 looking north.

(b) Site 2 looking north.

FIGURE 12. Coso Hot Springs, 21 December 1993.

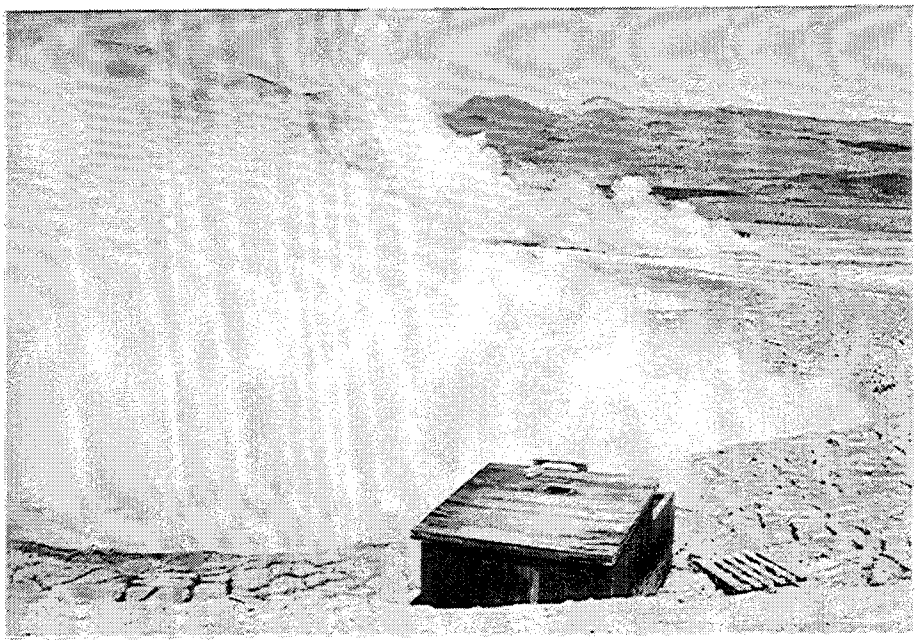


(a) Site 1 looking north.

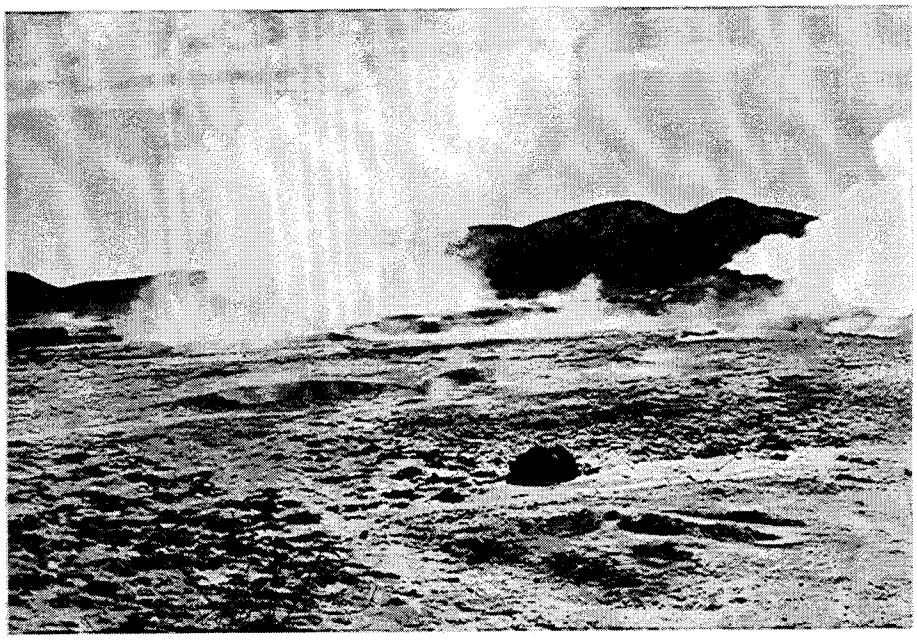


(b) Site 3 looking northwest.

FIGURE 13. Coso Hot Springs, 11 January 1994.

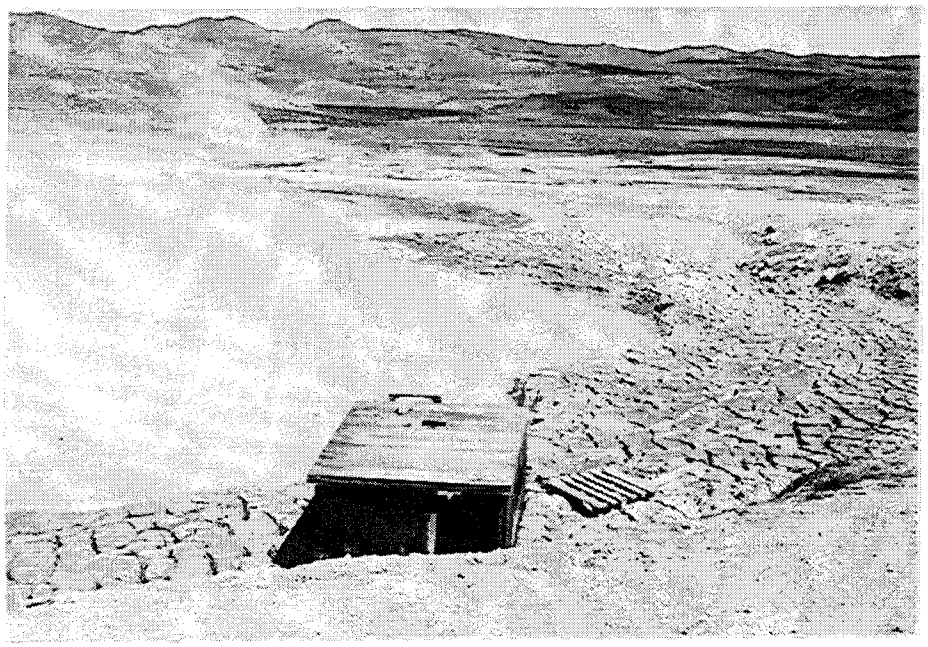


(a) Site 1 looking north.

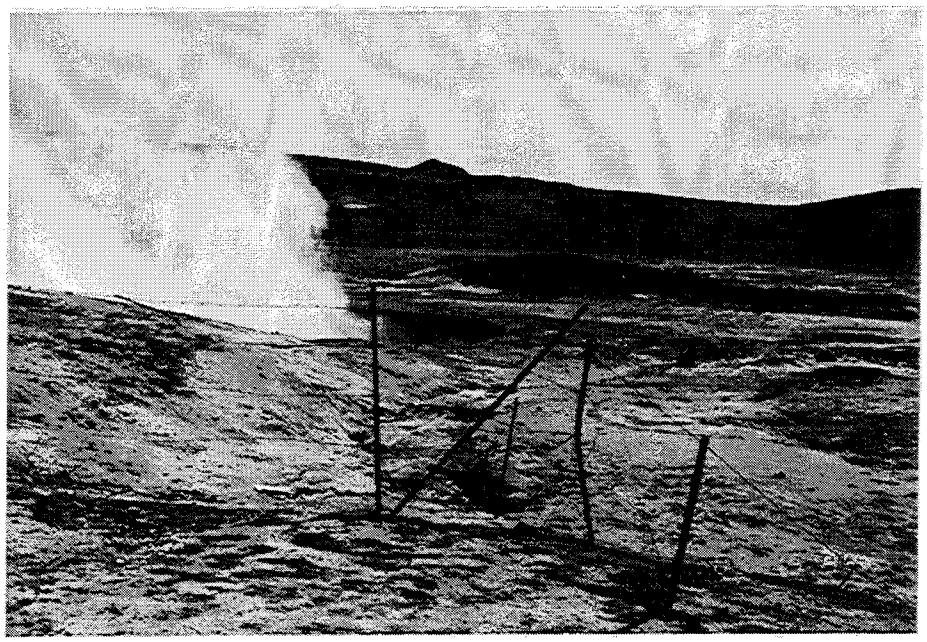


(b) Site 8 looking southeast.

FIGURE 14. Coso Hot Springs, 22 February 1994.



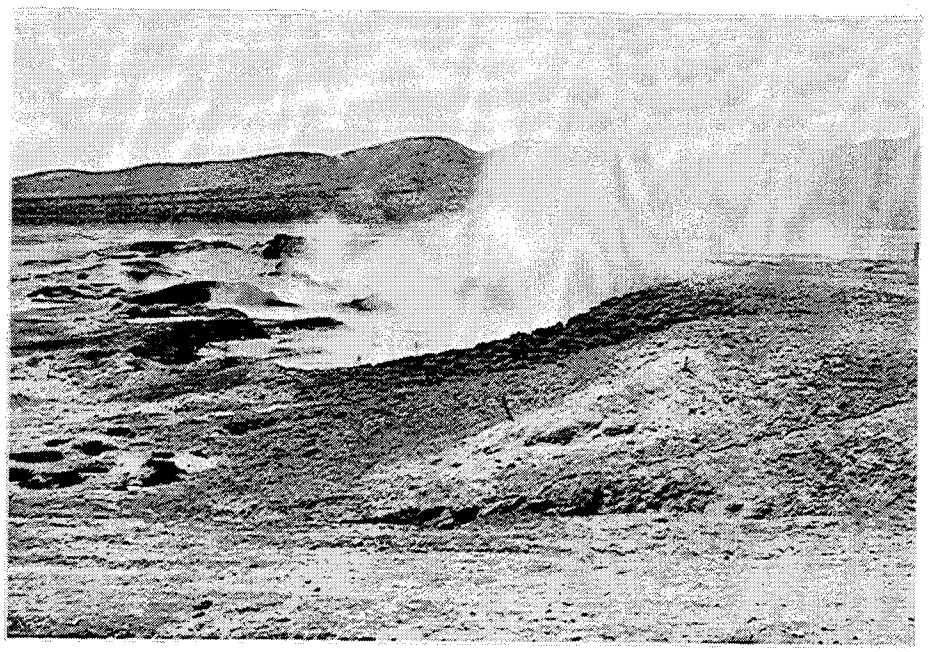
(a) Site 1 looking north.



(b) Site 8 looking southeast.

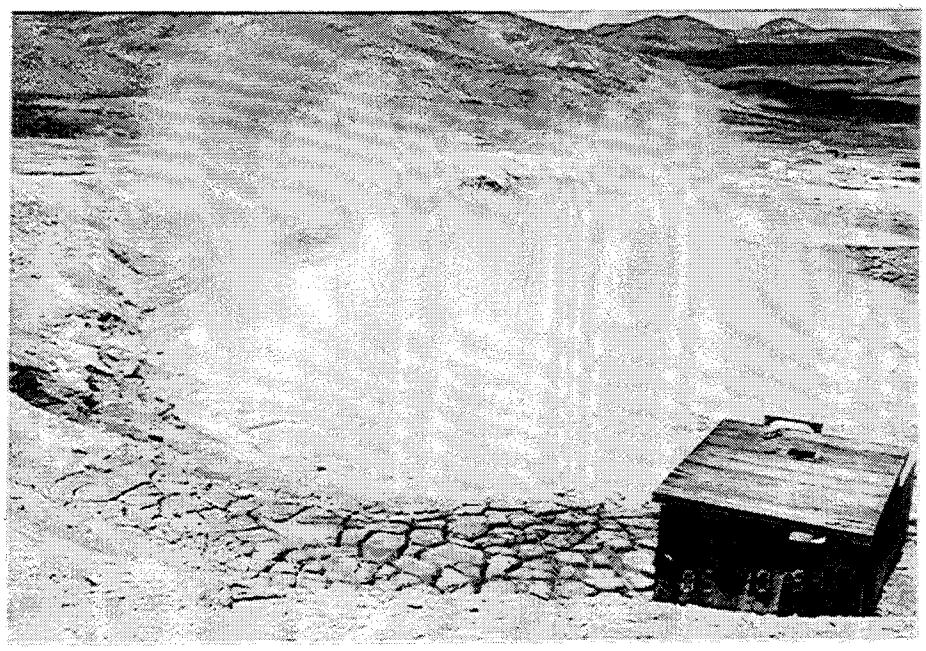
FIGURE 15. Coso Hot Springs, 15 March 1994.

(a) Site 1 looking northeast.

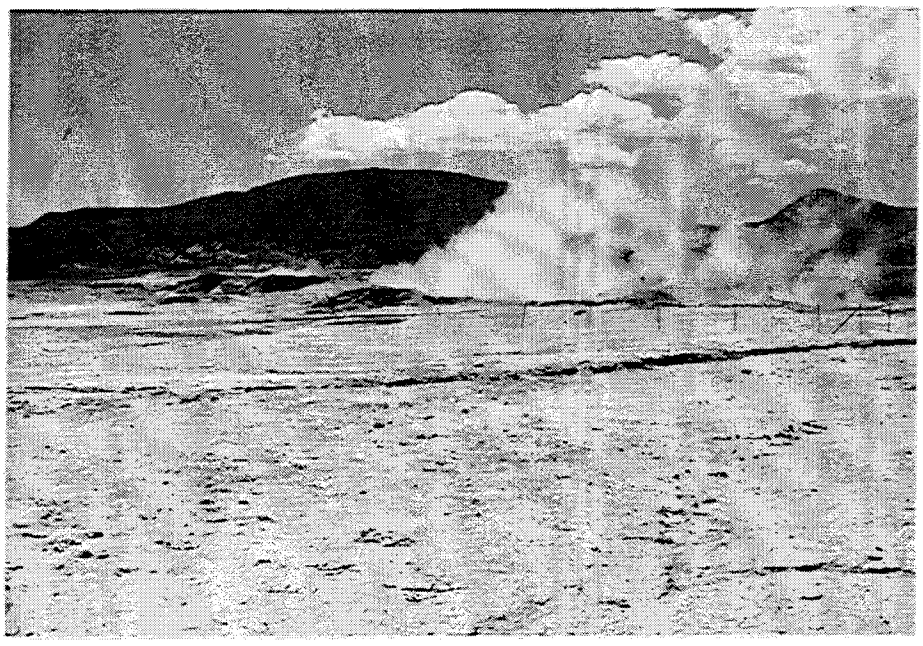


(b) Site 6 looking south.

FIGURE 16. Coso Hot Springs, 20 April 1994.

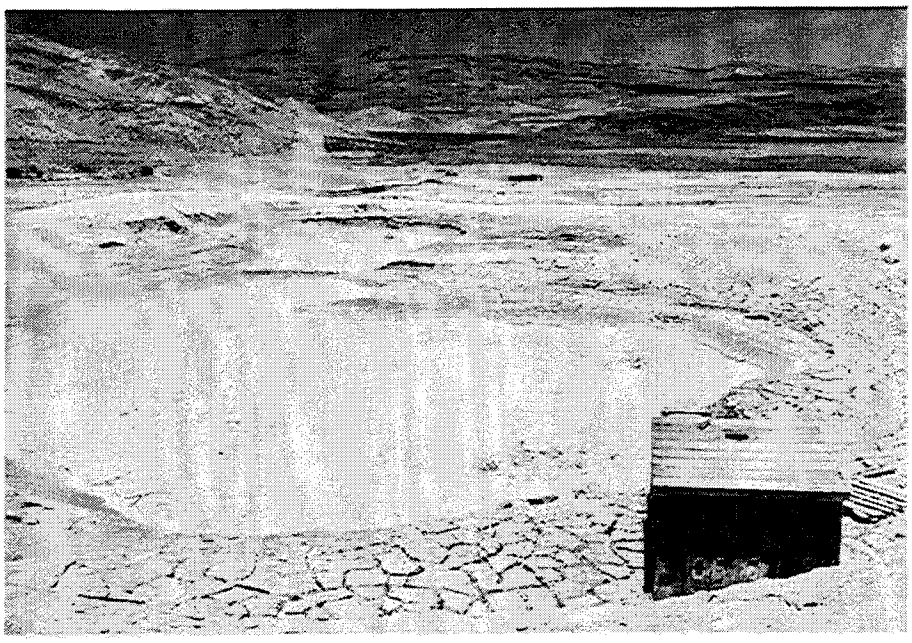


(a) Site 1 looking west.

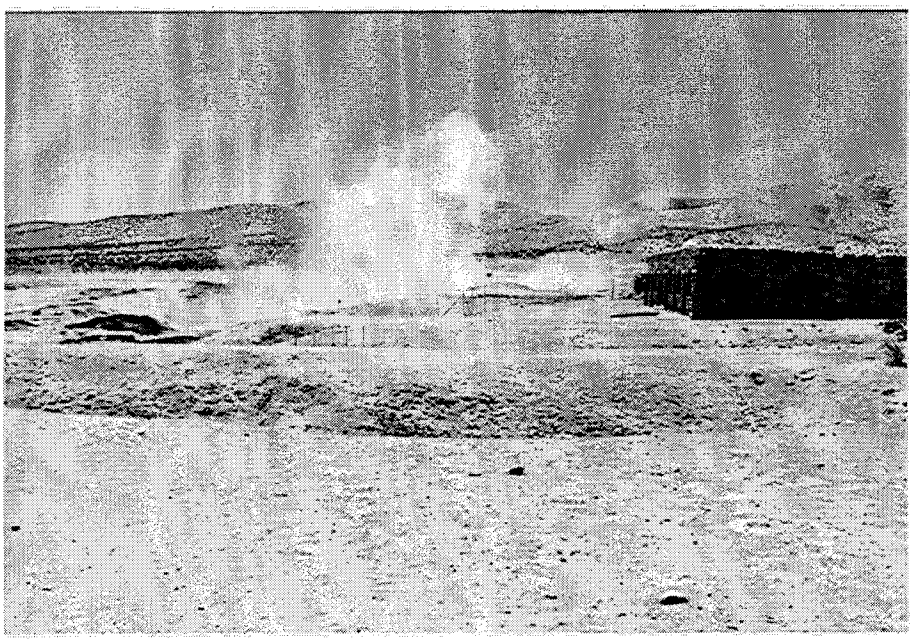


(b) Site 5 looking southwest.

FIGURE 17. Coso Hot Springs, 10 May 1994.

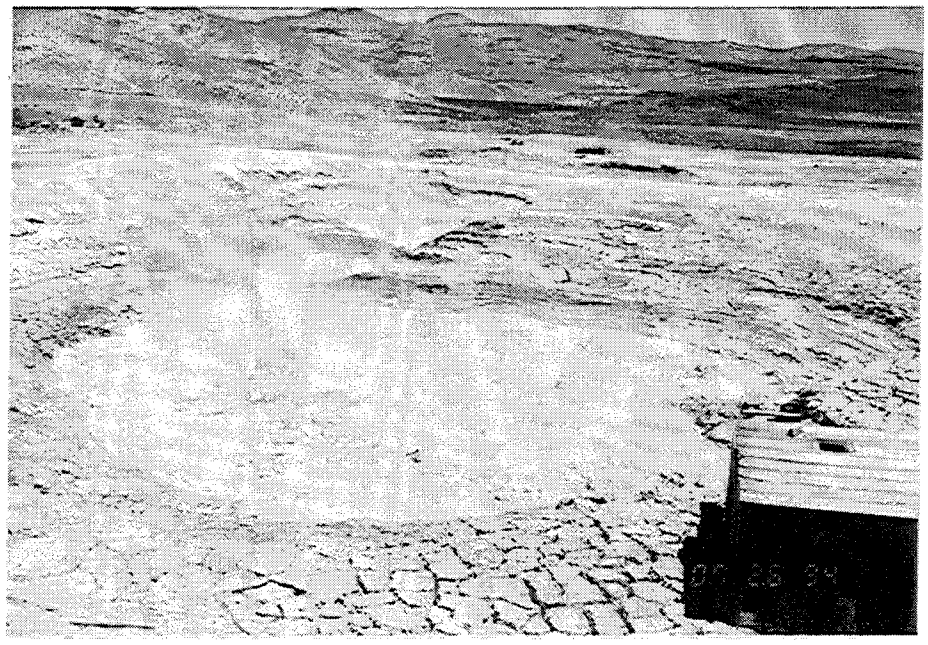


(a) Site 1 looking north.

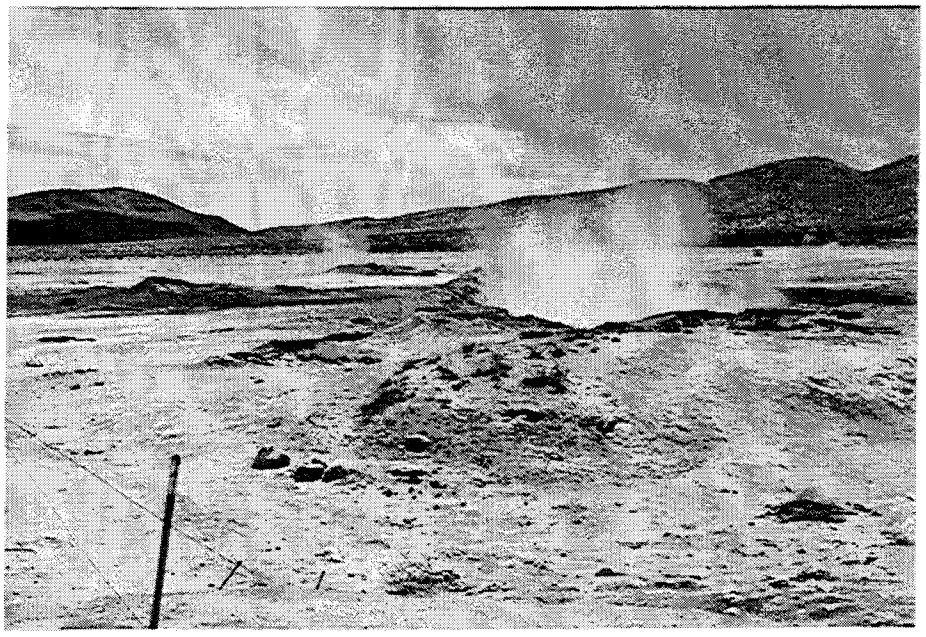


(b) Site 7 looking south.

FIGURE 18. Coso Hot Springs, 21 June 1994.

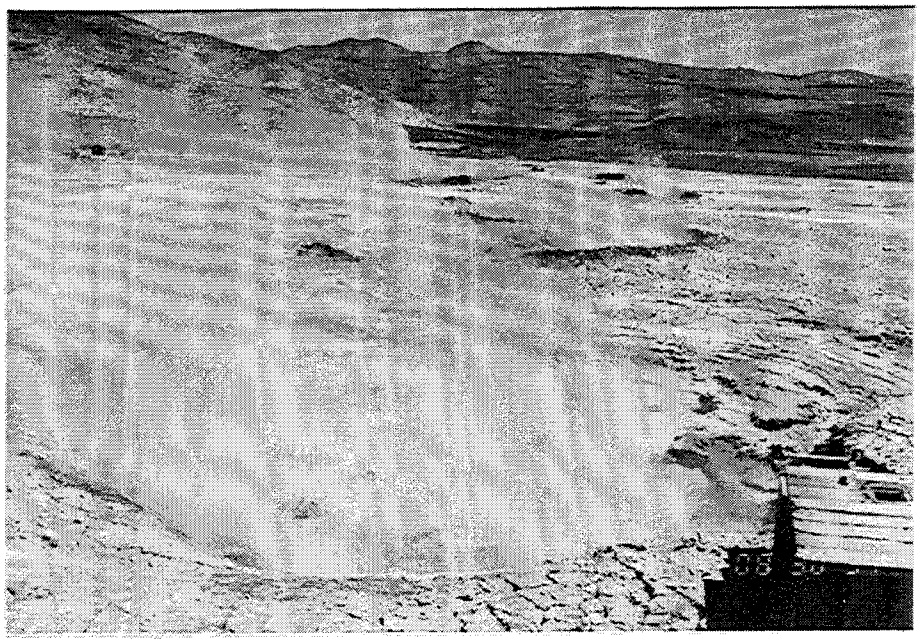


(a) Site 1 looking north.

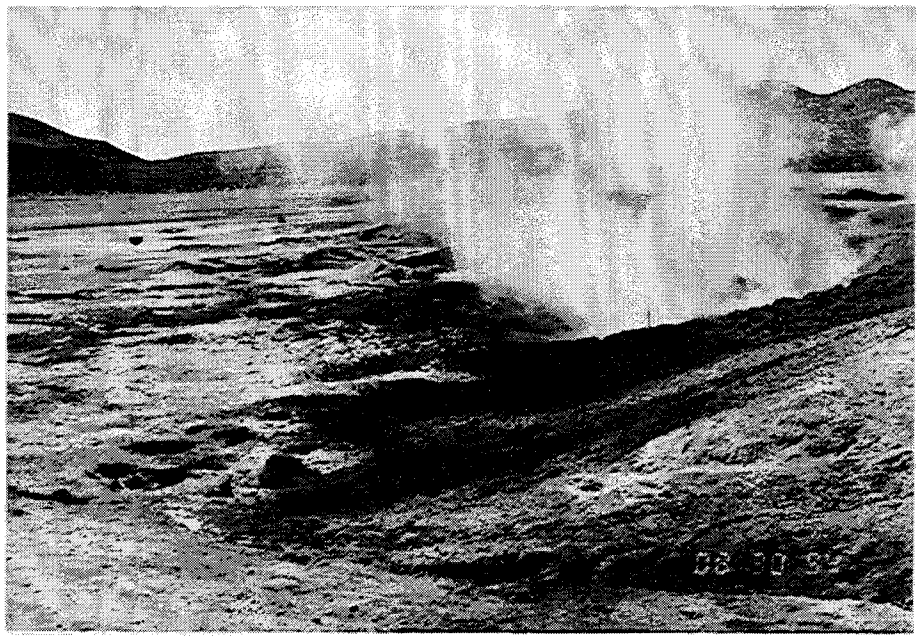


(b) Site 8 looking southeast.

FIGURE 19. Coso Hot Springs, 26 July 1994.

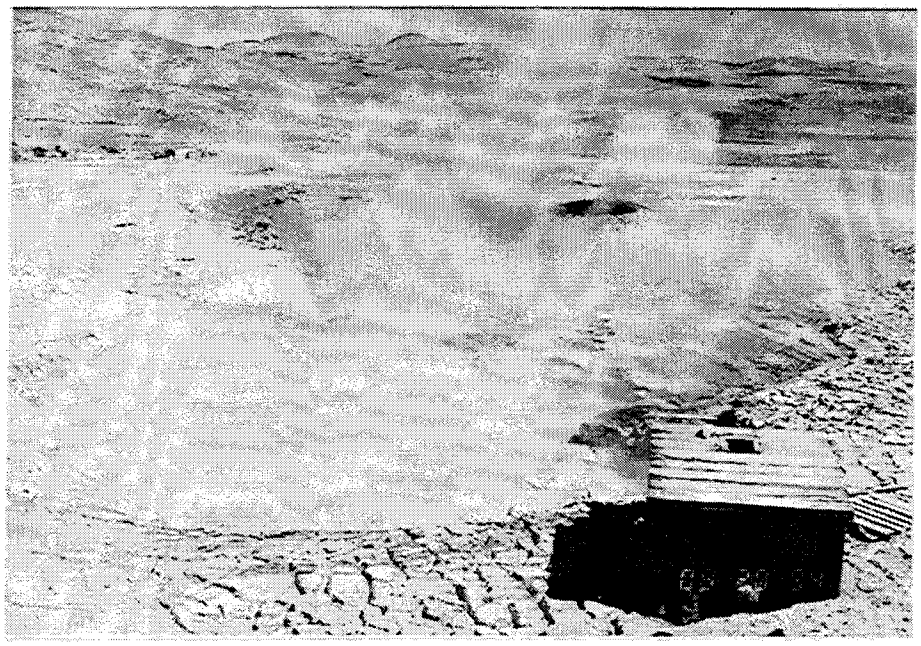


(a) Site 1 looking north.

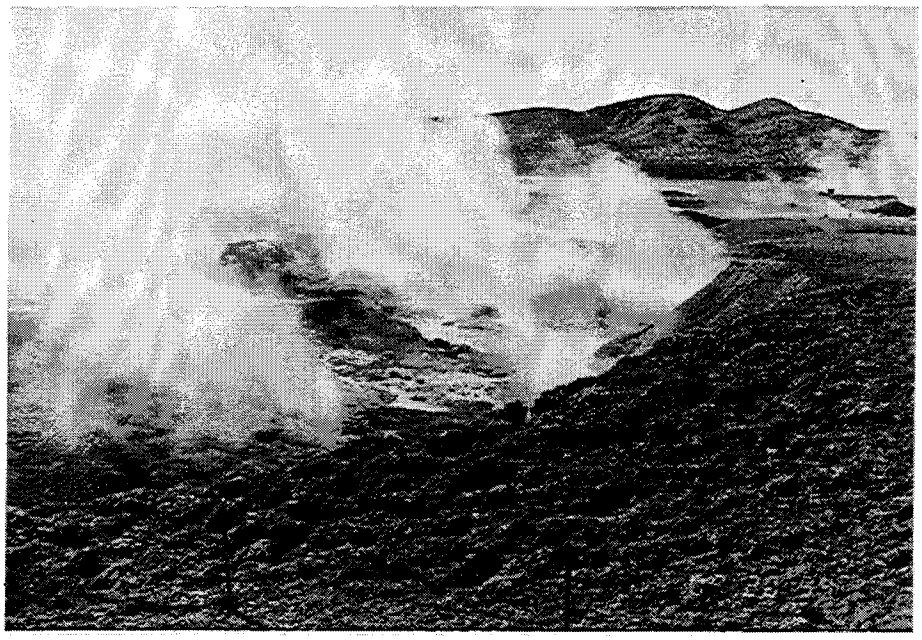


(b) Site 6 looking south.

FIGURE 20. Coso Hot Springs, 30 August 1994.



(a) Site 1 looking north.



(b) Site 6 looking south.

FIGURE 21. Coso Hot Springs, 20 September 1994.

WATER LEVEL MONITORING

OBSERVATION WELLS

Groundwater levels are currently monitored in six wells. Measurements are taken weekly at wells 4P-1; Observation wells (OB) 1, 2, and 3; and periodically at 4K-1 and 4A-4. Water levels are measured in 4P-1, OB-2, and OB-3 using the water-filled pipe and gage method. Water levels are measured in 4K-1, 4A-4, and OB-1 using a modified Fisher electric water-level meter. These data can be seen in Figure 22 and Table 3. Water levels of OB-1 were originally measured using the water-filled pipe and gage method until the water had fallen below the level of the pipe inserted in the well. Early in the next fiscal year an additional 31-feet of pipe will be installed in this well so that the water-filled pipe and gage method can again be used.

Figure 23 shows a summary graph of observation well-water levels from 1980 to the present. Depth to water data have been translated to true elevation. Changes in the levels of the wells at the hot springs are compared to the levels in Coso No. 1 and three observation water wells in the Upper Coso Basin (OB-1, OB-2, and OB-3).

The fluid-level elevation in well 4P-1 (a steam condensate) has risen slightly since 1989. The fluid-level elevation in OB-1 (total depth 300 feet) has declined from +3422-feet ASL in 1988 to +3392-feet ASL in September of 1993. However, the fluid level in OB-2 (total depth 500 feet) has risen during that time. OB-2 is on the northeast side of a wash that bisects the Upper Coso Basin, while OB-1 is on the southwest. The wash may reflect a groundwater divide and place OB-1 and OB-2 in different hydraulic regimes. The fluid-level elevation of a third observation well, OB-3 (total depth 500 feet), has remained relatively unchanged at +3240-feet ASL since it was initially measured in 1989. Although OB-3 is in the Upper Coso Basin alluvium, it is apparently not in hydraulic communication with OB-1 or OB-2.

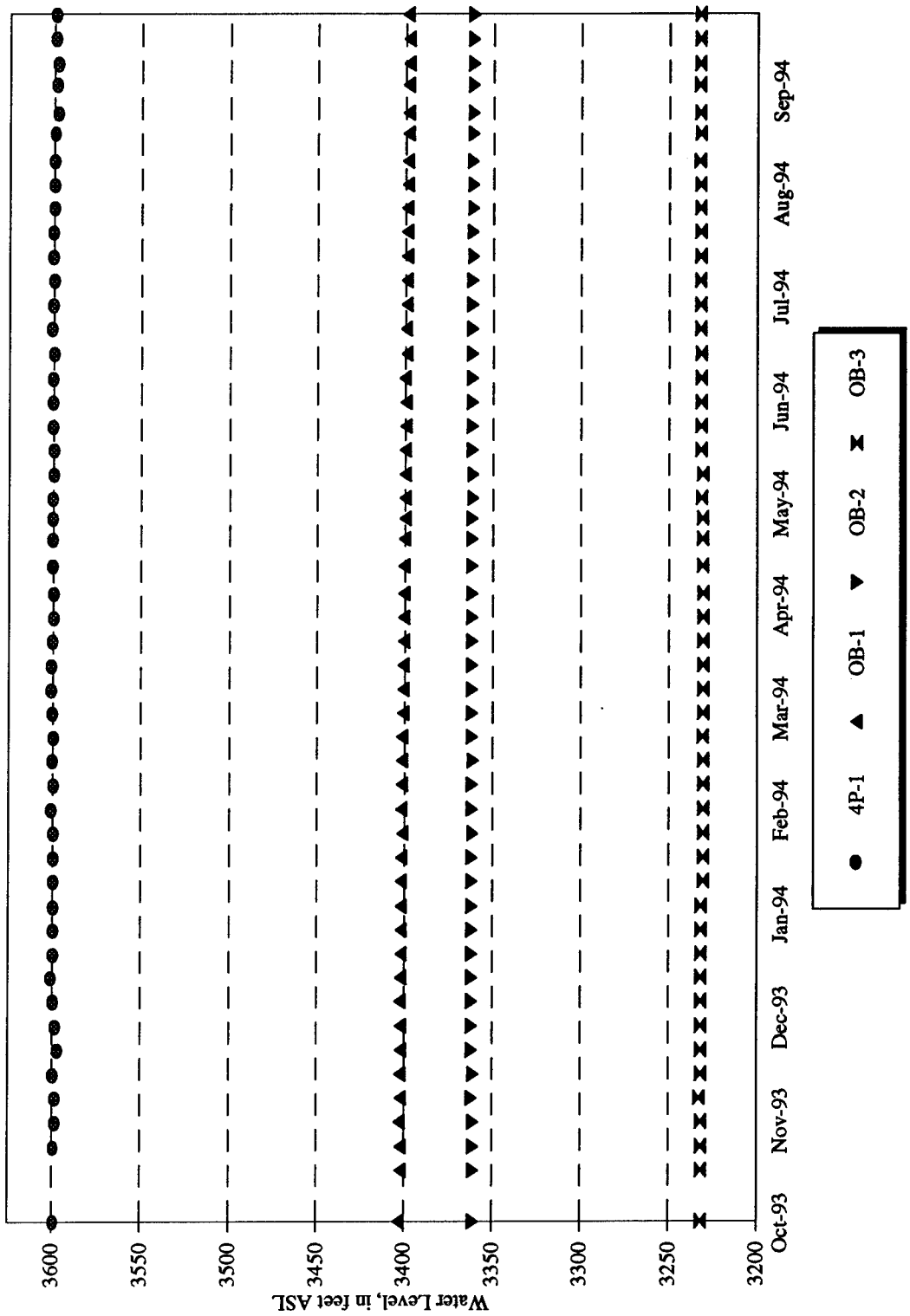


FIGURE 22. Water Levels in Coso Observation Wells, October 1993 Through September 1994.

TABLE 3. Observation Well Water Level Data.

Date	Well depth to water, ft					Date	Well depth to water, ft				
	4P-1	4K-1	OB-1	OB-2	OB-3		4P-1	4K-1	OB-1	OB-2	OB-3
4 Oct 93						5 Apr 94	62.4	50.2	169.2	197.7	384.4
11 Oct 93	62.7		166.7	198.8	383.3	12 Apr 94	62.4		169.3	197.7	384.4
26 Oct 93			167.4	198.8	383.3	20 Apr 94	61.9		169.3	197.7	384.03
2 Nov 93	62.9		167.4	198.8	383.3	28 Apr 94	61.9		169.5	197.7	84.0
9 Nov 93	63.6	50.5	166.9	198.8	383.3	4 May 94	61.9	50.0	169.7	197.7	384.0
16 Nov 93	63.6		167.5	198.8	382.1	10 May 94	61.9		169.7	198.4	383.7
23 Nov 93	62.4	50.2	167.2	197.7	383.3	17 May 94	62.2	50.2	169.8	198.4	384.0
30 Nov 93	64.8		167.4	198.8	383.3	24 May 94	62.4		169.8	197.7	383.3
7 Dec 93	63.6		167.4	197.7	383.3	31 May 94	61.7	49.9	170.0	197.7	383.3
14 Dec 93	62.4		167.2	197.7	383.3	7 Jun 94	61.9		170.1	197.7	383.3
21 Dec 93	61.2		167.5	197.7	383.3	14 Jun 94	61.9		169.6	197.7	383.3
28 Dec 93	62.4		167.8	197.7	383.3	21 Jun 94	62.2	50.2	170.5	197.7	383.3
4 Jan 94	62.4	50.0	167.7	197.7	383.3	28 Jun 94	61.2		170.4	197.7	383.0
11 Jan 94	62.4		167.8	197.7	383.3	5 Jul 94	61.9	50.1	170.5	197.7	383.0
18 Jan 94	62.4		167.8	197.7	384.4	12 Jul 94	62.2		170.6	197.7	382.6
25 Jan 94	62.4		168.0	197.7	384.4	19 Jul 94	61.9		170.8	198.4	383.0
1 Feb 94	62.4		168.5	198.4	384.4	26 Jul 94	61.9	51.0	170.8	198.2	383.0
8 Feb 94	61.2		168.2	197.7	384.4	2 Aug 94	62.4		171.0	198.4	382.8
15 Feb 94	62.4		168.4	197.7	384.4	9 Aug 94	62.4	50.4	171.2	198.4	382.6
22 Feb 94	61.9		168.4	198.6	384.4	16 Aug 94	62.4		171.2	198.2	382.1
1 Mar 94	62.2		168.4	197.7	384.2	24 Aug 94	62.9		171.4	198.4	382.6
8 Mar 94	61.9		168.8	197.7	384.4	30 Aug 94	64.6	50.8	171.4	198.4	382.4
15 Mar 94	61.2		168.8	197.7	384.4	7 Sep 94	63.6		171.5	198.4	382.1
22 Mar 94	61.2	49.0	168.8	197.7	384.4	13 Sep 94	64.6	50.5	171.7	198.6	382.4
29 Mar 94	61.9		169.2	197.7	384.4	20 Sep 94	63.4		171.6	198.4	382.4
						27 Sep 94	63.4	50.5	171.1	198.6	382.4

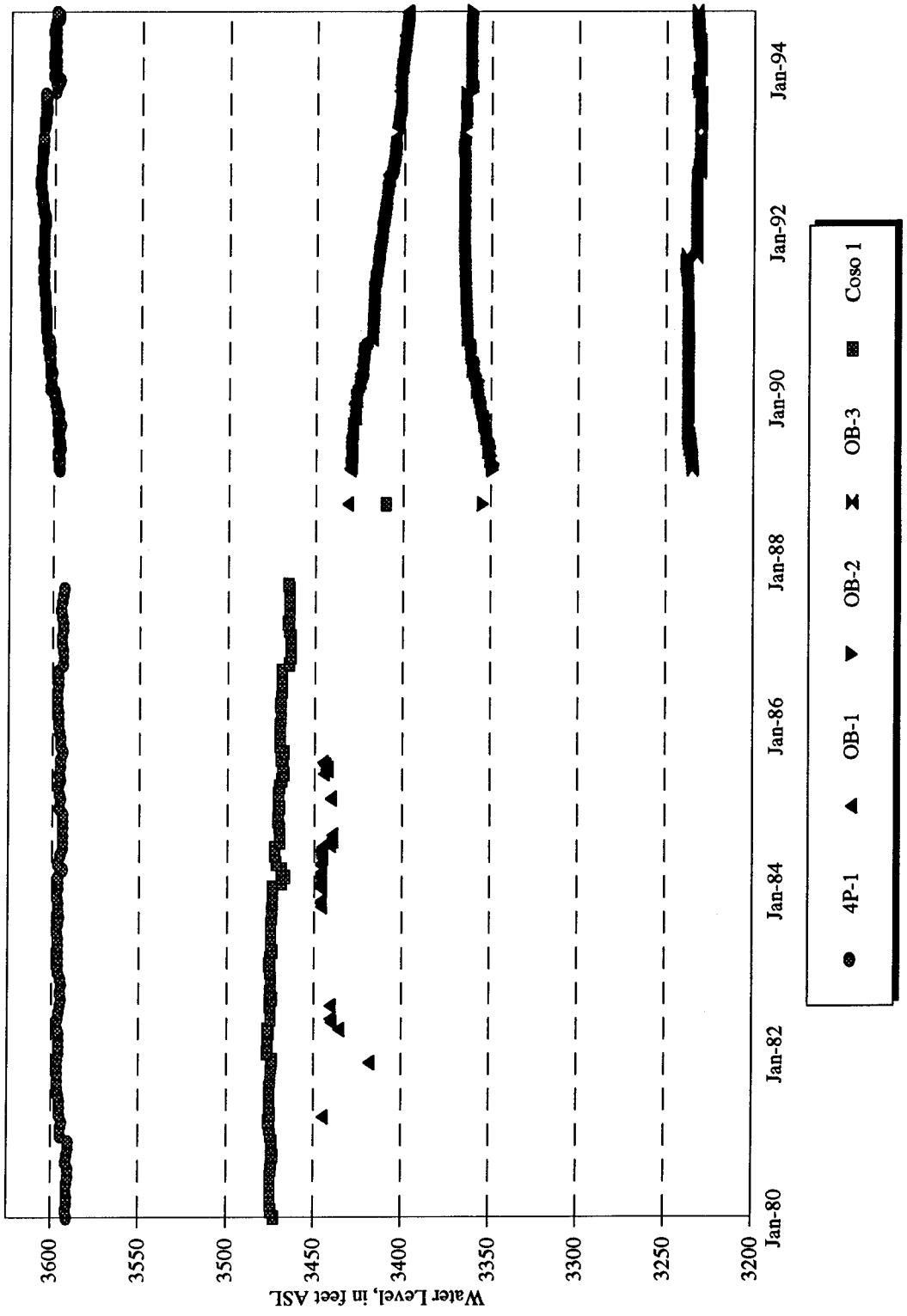


FIGURE 23. Water Levels in Coso Observation Wells, January 1980 Through September 1994.

SOUTH POOL

The South Pool water level continued the pattern of seasonal fluctuations during this reporting period, ranging from a high of 3619 feet on 5 April 1994 to a low of 3612.33 feet on 27 September 1994 (Table 4 and Figure 24). The average level continued to be above historic levels recorded prior to 1988 until July 1994 when the rate of water evaporation in the pool exceeded steam influx from below, causing a rapid decrease in fluid level (Figure 25). During this reporting period, prior to 16 August 1994, water levels were extrapolated to the nearest quarter foot using photographic comparisons with known elevations. On 4 August 1994 water-level-monitoring steps were surveyed by Steve Bjornstad and Gary Whitnack using a Wild N2 theodolite and stadia rod (Figure 26). Step elevations were taken relative to survey monument BM 3635 1905 13B (3633.052 feet ASL). A water-level measuring fixture was locally fabricated to measure the water level relative to these surveyed steps. The fixture was tested and found to have a repeatability of approximately 1 inch. The fixture has been in use since 16 August 1994, with the water level being measured weekly.

Station	Elevation +0.02 feet	For photo records use
Site 0	3629.22	3629.2 feet
Site Rox	3626.36	3626.4 feet
Step 1 (bottom)	3619.66	3619.7 feet
Step 2	3620.60	3620.6 feet
Step 3	3622.67	3622.7 feet
Step 4 (top)	3624.52	3624.5 feet

Water temperatures of the South Pool were normally measured biweekly as conditions permitted. Water temperatures averaged above 200°F.

As with previous years, activity within South Pool consisted of three to four prominent boiling areas. As summer progressed and the water level declined, three separate pools were formed within the confines of the South Pool perimeter. These pools, separated by mud dikes, consisted of a large northern pool, a smaller central pool, and a large southern pool. In early September, as the water level further declined, the northern pool began blowing mud, forming a crater with walls higher than the original confines of South Pool. This activity has continued in varying degrees throughout September. The small central pool and the southernmost pool continued to exhibit boiling water. By the end of September, a small island of mud surrounded by boiling water was exhibited by the large southernmost pool. The west bank of this area is where water temperatures and water levels are taken. Figure 27 is a photo of the pool and steam hut showing the effects of the pronounced water-level decline. The photo was taken at the water level survey site.

TABLE 4. South Pool Elevation and Temperature Changes.

Date	Elevation*, ft	Water temperature, °F	Date	Elevation*, ft	Water temperature, °F
5 Oct 93	3616.00		5 Apr 94	3619.00	202
12 Oct 93	3616.00		12 Apr 94	3619.00	
21 Oct 93	3616.00		20 Apr 94	3618.85	200
2 Nov 93	3616.00		28 Apr 94	3618.50	
9 Nov 93	3616.00		4 May 94	3618.25	204
16 Nov 93	3616.00	206	10 May 94	3618.00	
23 Nov 93	3616.25	204	17 May 94	3617.75	207
30 Nov 93	3616.25		31 May 94	3617.50	197
7 Dec 93	3616.50		7 Jun 94	3617.25	
14 Dec 93	3616.50		14 Jun 94	3617.00	208
21 Dec 93	3616.50		21 Jun 94	3616.75	
28 Dec 93	3616.50		28 Jun 94	3516.25	198
4 Jan 94	3616.75		5 Jul 94	3615.75	
11 Jan 94	3617.00	205	12 Jul 94	3615.25	206
18 Jan 94	3617.25		19 Jul 94	3615.00	
25 Jan 94	3617.50		26 Jul 94	3614.75	203
1 Feb 94	3617.75	198	2 Aug 94	3614.50	
8 Feb 94	3618.00		9 Aug 94	3614.25	
15 Feb 94	3618.25		16 Aug 94	3614.00	
22 Feb 94	3618.75		24 Aug 94	3613.63	208
1 Mar 94	3618.50	201	30 Aug 94	3613.24	211
8 Mar 94	3618.50		7 Sep 94	3612.93	212
15 Mar 94	3618.50		13 Sep 94	3612.89	
22 Mar 94	3618.75	198	20 Sep 94	3612.59	210
28 Mar 94	3618.75		27 Sep 94	3612.33	

* Estimated until 16 August 1993.

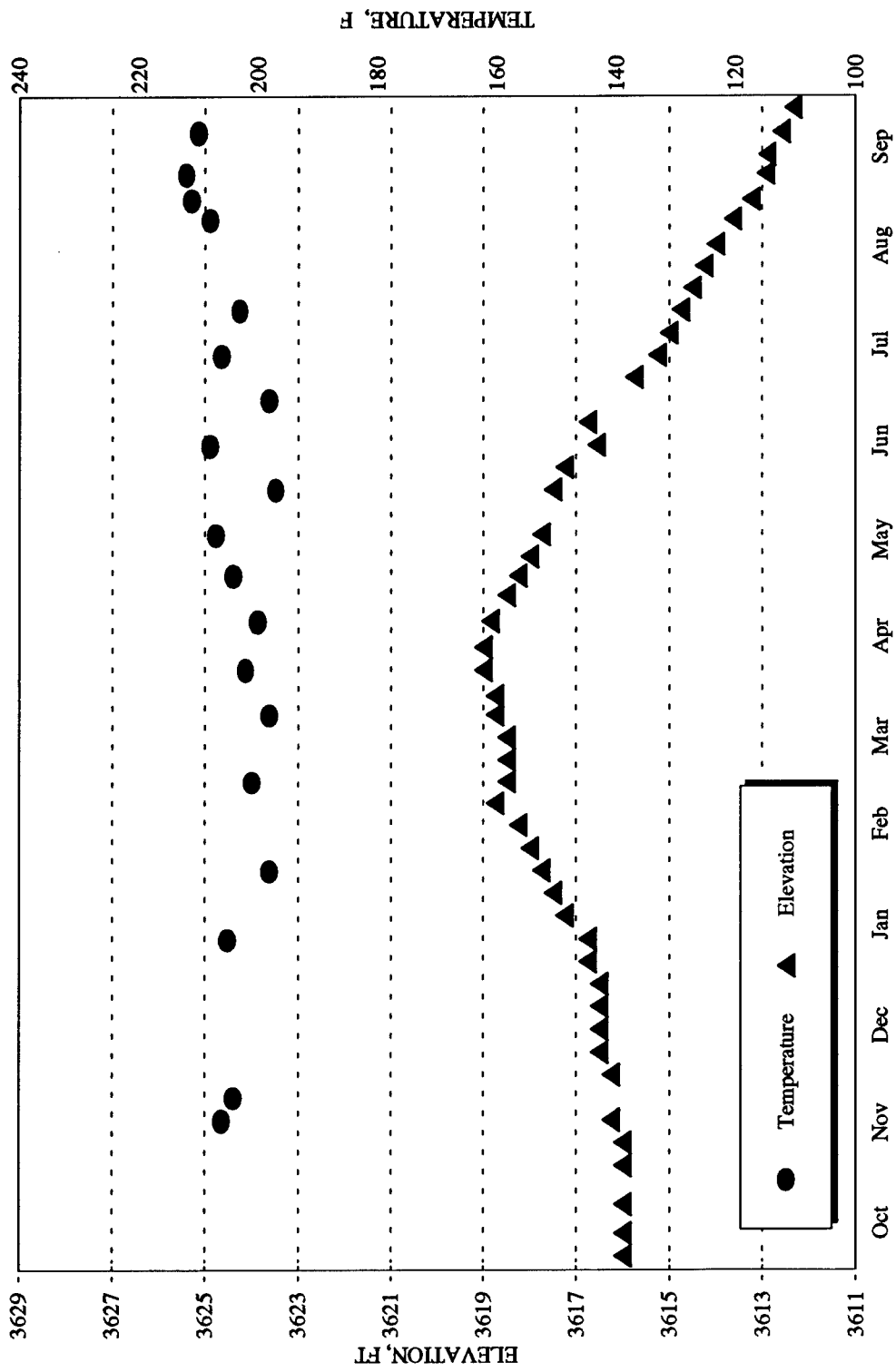


FIGURE 24. South Pool Elevation and Temperature, 1 October 1993 Through 30 September 1994.

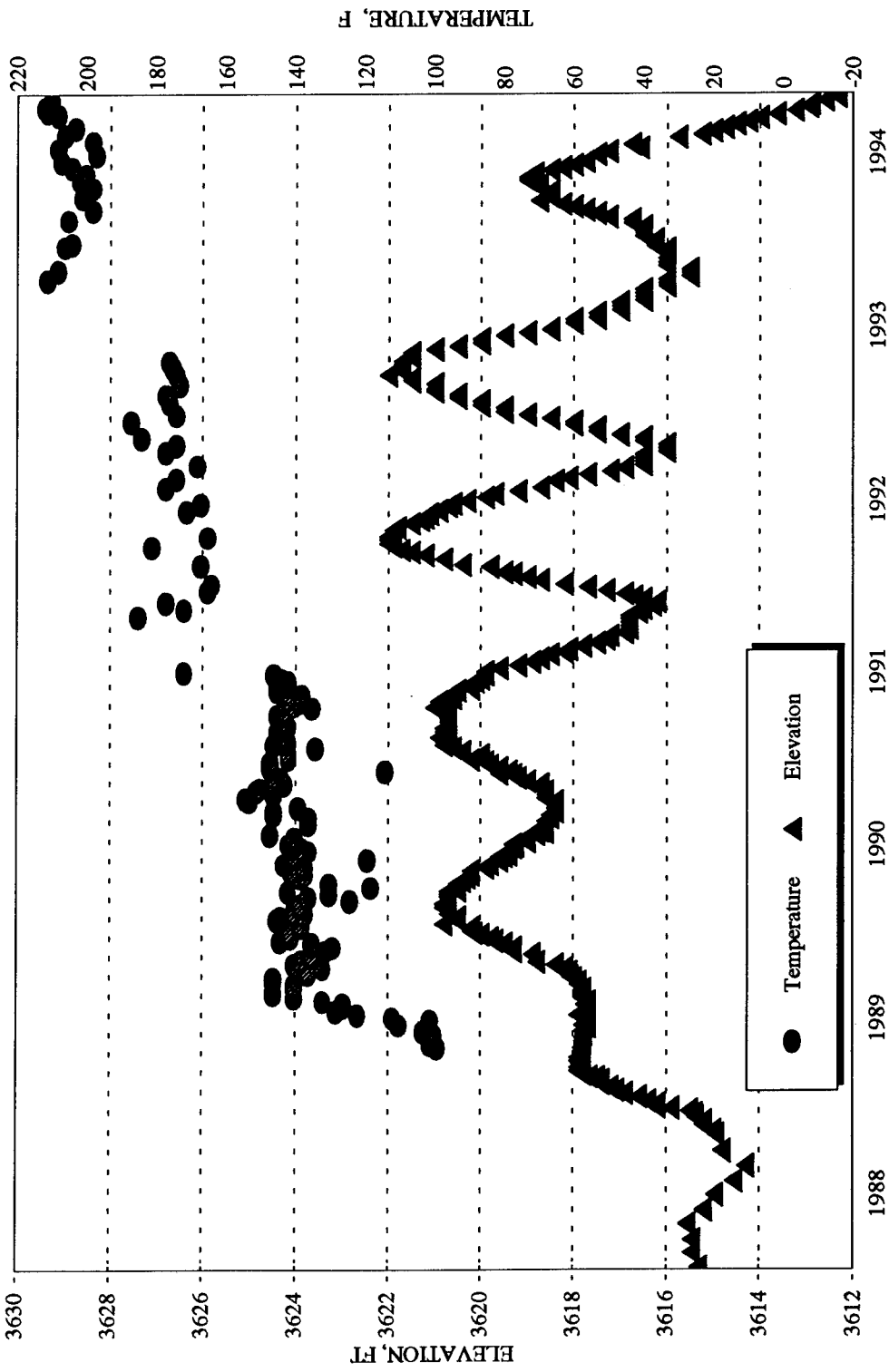


FIGURE 25. South Pool Elevation and Temperature, January 1988 Through September 1994.

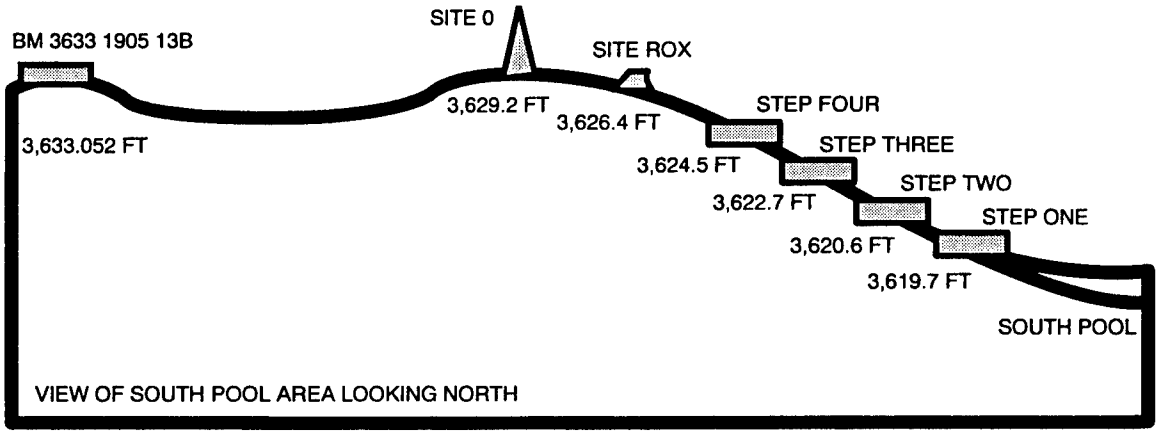


FIGURE 26. Level Survey of South Pool Water Level Monitor "Steps".

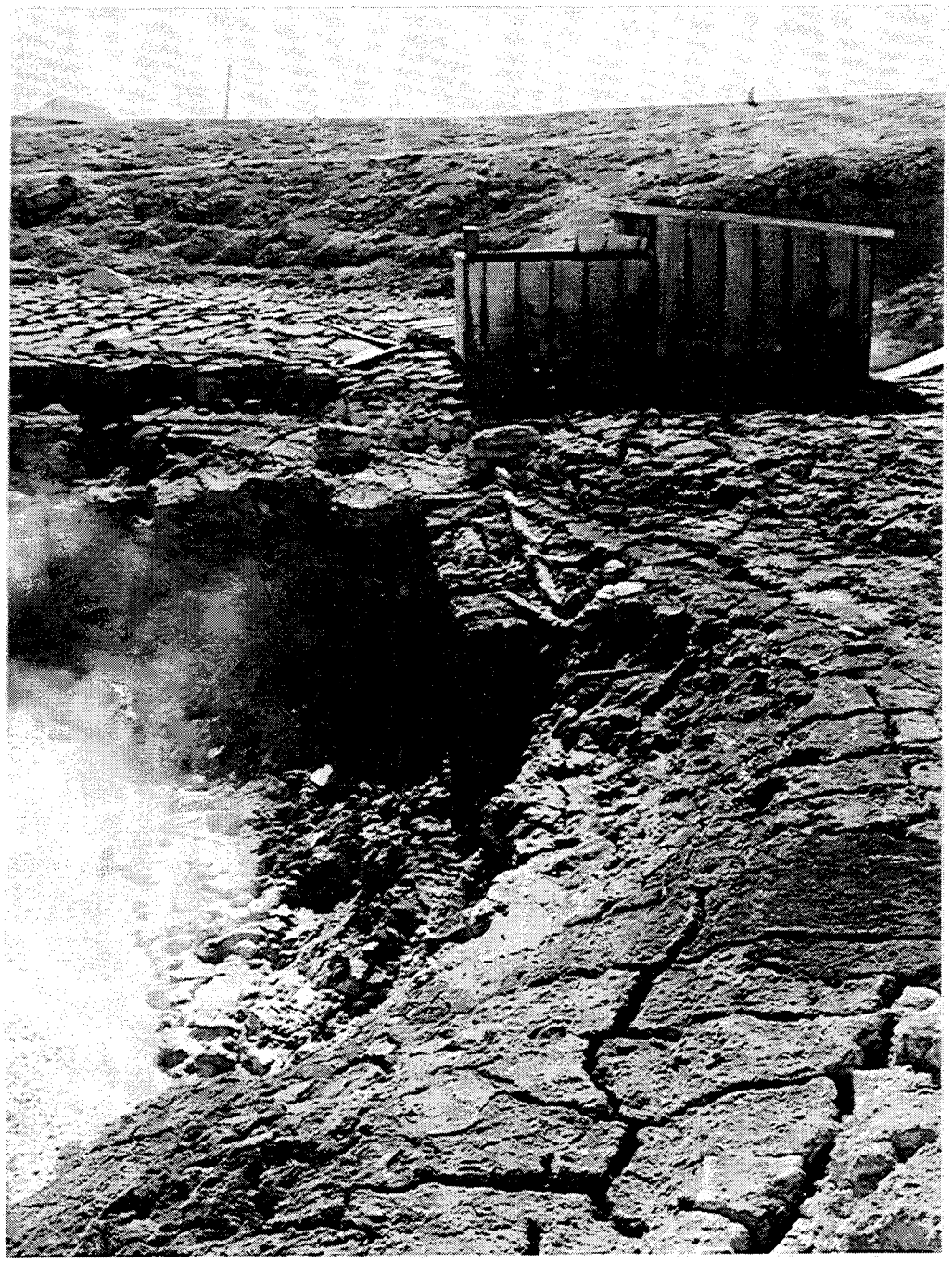


FIGURE 27. South Pool and Steam Hut.

RAINFALL AT COSO RESORT AREA AND ROSE VALLEY

Rainfall in the Coso Hot Springs basin is monitored at five rain station sites, as shown in Figure 1. Instrumentation at each site consists of a battery-operated long-term strip recorder that is triggered by a tipping bucket. This year no interruptions in rainfall data collection occurred. Rain stations are checked every 6 weeks for proper operation. Although the battery packs are changed at 6-week intervals, ensuring continuous operation of the system, they are also checked prior to any major weather front that may possibly bring rain to the area.

Data from the Coso stations presented in Table 5 show daily and cumulative rainfall. The Rose Valley data (Table 6) are collected at the Los Angeles Department of Water and Power Haiwee Reservoir Plant. The yearly cumulative rainfall for the Coso stations is averaged and compared to the yearly Rose Valley cumulative numbers in Figure 28. The Coso area generally receives less annual rainfall than Rose Valley. This significant difference in rainfall between two such closely situated areas is not unusual given the nature of high desert storms.

Comparative rainfall data for Coso Basin, Rose Valley, and Indian Wells Valley (IWV) can be found in Table 7 and seen in Figure 29. The IWV data were gathered at Armitage Field, Naval Air Warfare Center Weapons Division (NAWCWPNS), and provided by a NAWCWPNS meteorologist.

TABLE 5. Rainfall Recorded at Coso Monitoring Stations.

Date	Tipping bucket stations (rainfall, in.)				
	1	2	3	4	5
12 Nov 93	0.06	0.05	0.05	—	—
15 Nov 93	0.07	—	—	—	—
12 Dec 93	0.06	0.04	0.03	—	—
4 Feb 94	0.30	0.28	0.12	—	—
7 Feb 94	0.40	0.30	0.19	—	—
17 Feb 94	0.09	0.06	0.06	—	—
20 Feb 94	0.33	0.14	0.15	—	—
6 Mar 94	0.01	—	—	—	—
19 Mar 94	Ran	0.15	0.13	—	—
20 Mar 94	out	—	—	—	0.06
23 Mar 94	of	0.05	—	—	—
24 Mar 94	paper	0.14	0.04	—	0.08
25 Mar 94	3/19	—	—	—	0.01
26 Apr 94	—	0.02	0.02	—	0.02
27 Apr 94	0.14	0.44	0.60	—	0.26
6 May 94	—	—	0.03	—	0.01
7 May 94	0.02	—	0.01	0.04	—
30 May 94	—	—	—	0.01	—
20 Sep 94	0.01	—	—	—	—
29 Sep 94	0.04	—	0.02	0.02	0.01
30 Sep 94	—	0.02	—	—	—
TOTAL	1.53	1.69	1.45	0.07	0.45

TABLE 6. Rose Valley Cumulative Rainfall, October 1993 Through September 1994.

Date	Daily, in.	Cumulative, in.
11 Oct 93	0.13	0.13
11 Nov 93	0.04	0.17
30 Nov 93	0.03	0.20
12 Dec 93	0.05	0.25
27 Jan 94	0.12	0.37
4 Feb 94	0.30	0.67
7 Feb 94	0.01	0.68
8 Feb 94	0.37	1.05
17 Feb 94	0.10	1.15
18 Feb 94	0.10	1.25
20 Feb 94	0.15	1.4
7 Mar 94	0.08	1.48
20 Mar 94	0.14	1.62
25 Mar 94	0.44	2.06
26 Mar 94	0.07	2.13
27 Apr 94	0.32	2.45
28 Apr 94	0.02	2.47
8 May 94	0.11	2.58
9 May 94	0.11	2.69
31 May 94	0.01	2.70
24 Sep 94	0.07	2.77
28 Sep 94	0.08	2.83

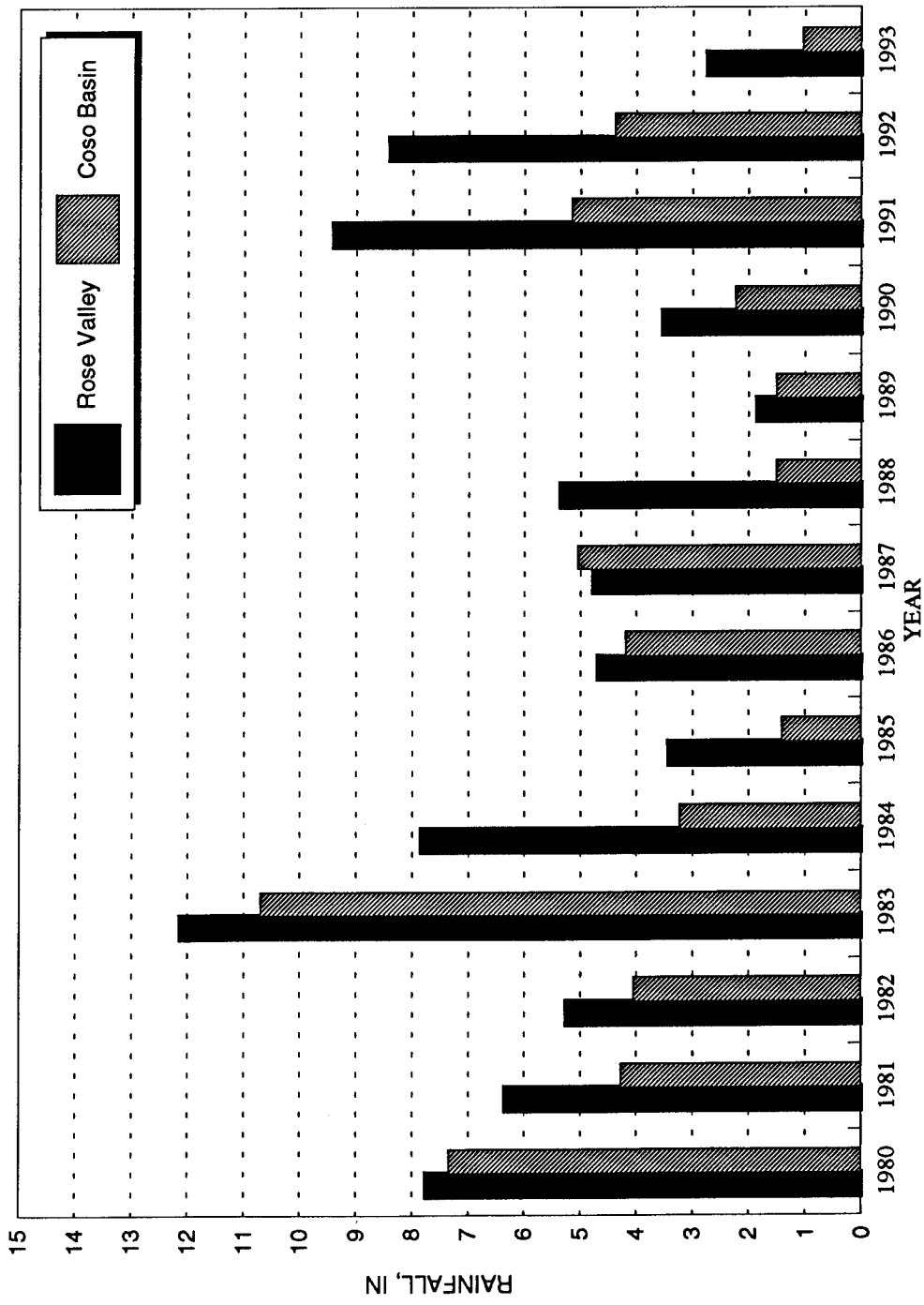


FIGURE 28. Comparison of Total Rainfall at Coso Basin and Rose Valley Sites, by Year.

TABLE 7. IWV, Rose Valley, and Coso Basin Rainfall Comparison, 1947 Through 1993.

Year	Rainfall, in.			Year	Rainfall, in.		
	IWV	Rose Valley	Coso Basin		IWV	Rose Valley	Coso Basin
1947	2.03	—	—	1977	4.67	8.34	—
1948	0.87	—	—	1978	10.68	12.61	—
1949	1.30	—	—	1979	5.65	4.97	2.67
1950	1.28	—	—	1980	6.31	7.75	7.34
1951	0.84	—	—	1981	4.49	6.34	4.28
1952	5.88	—	—	1982	4.73	5.26	4.05
1953	0.14	—	—	1983	10.56	12.14	10.70
1954	4.07	—	—	1984	5.95	7.84	3.23
1955	0.56	—	—	1985	1.29	3.42	1.42
1956	1.73	—	—	1986	3.68	4.68	4.19
1957	2.68	—	—	1987	4.43	4.77	5.04
1958	3.70	—	—	1988	3.76	5.36	1.51
1959	2.98	—	—	1989	0.94	1.85	1.51
1960	3.01	—	—	1990	1.78	3.53	2.24
1961	2.46	—	—	1991	7.83	9.41	5.15
1962	2.31	—	—	1992	8.10	8.40	4.38
1963	5.45	8.30	—	1993	0.94	2.83	1.04
1964	0.78	2.49	—				
1965	9.15	8.66	—				
1966	1.31	6.13	—				
1967	4.28	4.32	—				
1968	3.16	3.26	—				
1969	5.55	8.80	—				
1970	3.74	6.45	—				
1971	1.47	2.87	—				
1972	1.24	1.90	—				
1973	2.58	4.56	—				
1974	7.48	9.19	—				
1975	1.64	2.79	—				
1976	3.74	8.50	—				

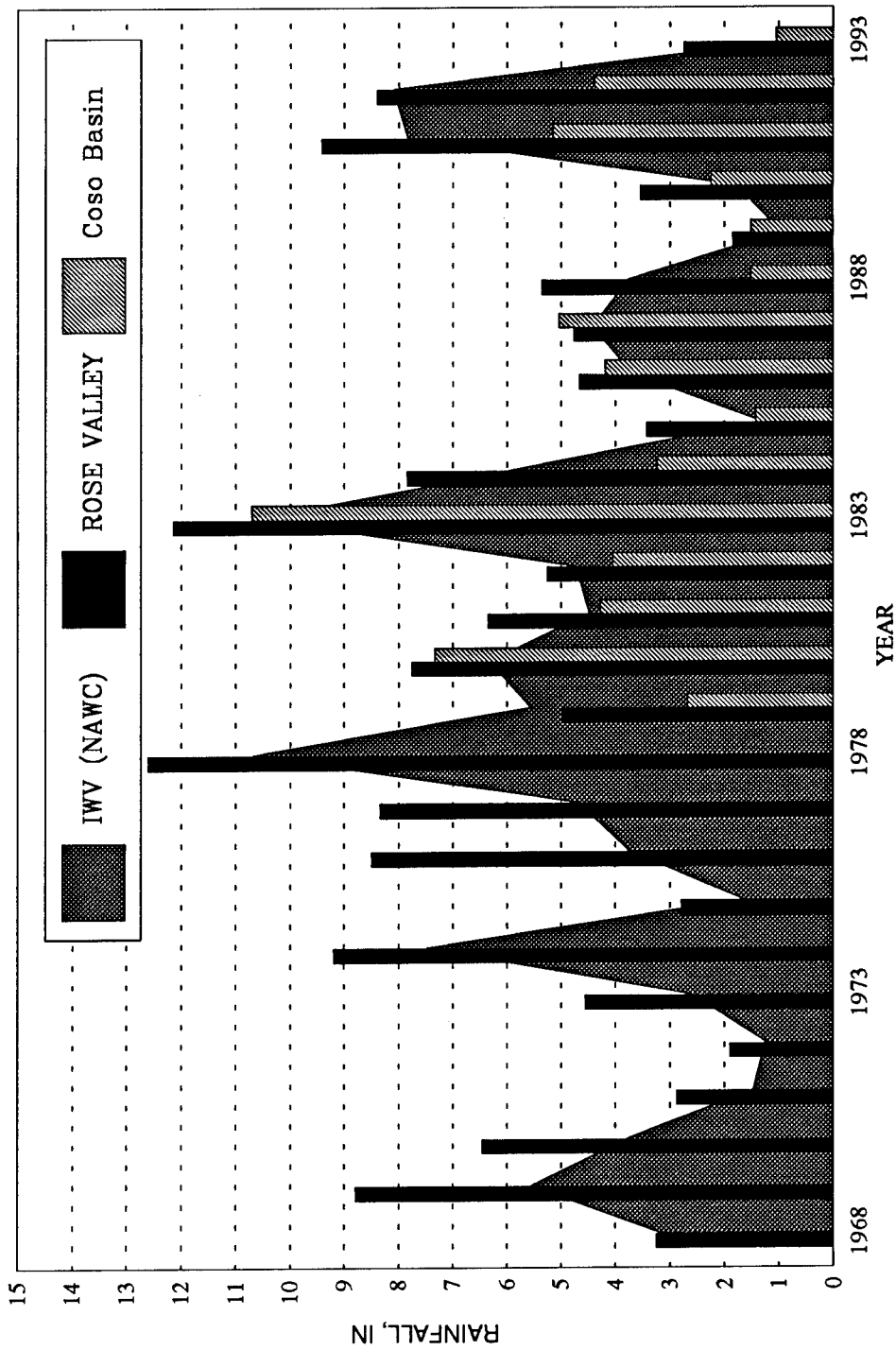


FIGURE 29. Comparison of Total Rainfall at Rose Valley, NAWC Sites, and Coso Basin by Year, from 1968 to 1993.

COSO HOT SPRINGS MINI-WEATHER RECORDING STATION

Weather Station 1 was upgraded during the second quarter of this reporting period with the installation of a weather tower and digital recording system manufactured by the Handar Corporation, Sunnyvale, California. The system, brought on-line on 19 January 1994, is solar/battery powered. The system's recording capabilities include barometric pressure, ambient temperature, relative humidity, and wind speed and direction. This new station has several advantages over the existing set of mechanical/analog recorders, including no need to change weekly strip charts and pens, no lost data due to battery or clock failures, and fewer calibration problems. Both the accuracy and continuity of the data are superior to that recovered with the old equipment. Quarterly equipment calibration at the weather station is conducted by China Lake Range Support Branch personnel.

Although the weather station now has the capability of storing up to 5 months of data, the data are recovered quarterly using an IBM-compatible portable computer. The data are then imported directly into a spreadsheet program for manipulation and comparison with other hot springs data. The weather data from 19 January through 30 September 1994 are presented in Figures 30 and 31. These hourly data are expansive, but are available on request.

Worldwide, all surface thermal activity is affected by natural forces, such as weather, earthquakes, and tides. Coso Hot Springs is no exception, although the magnitude of these effects had been unclear.

Of all surface thermal features throughout the world, geysers are by far the most studied. While no geysers exist at Coso, knowledge gained from geyser observation can be applied to investigations of potential effects at Coso. A number of natural forces are known to affect the flow of gases, including steam and hot water in the earth. According to Rhinehart (1980) and Grant (1982) these forces include

Barometric pressure - pushing against the surface of the earth.
Tectonic motion - ebb and flow of stress, up to and including earthquake activity.
Variable gravitational pull - tides, particularly lunar tides.
Atmospheric temperature - diurnal and seasonal variation.

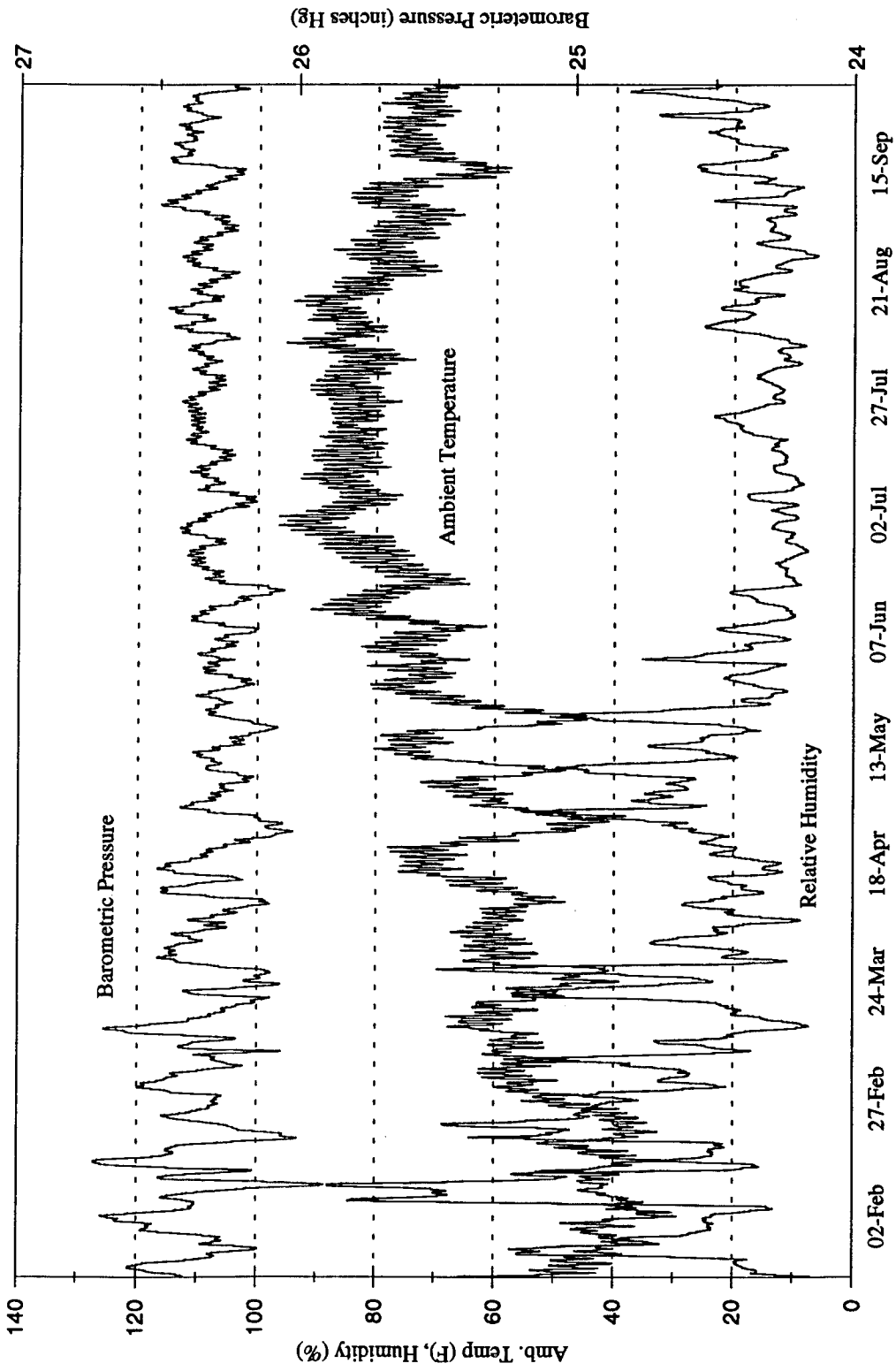


FIGURE 30. Coso Hot Springs Weather Station One, Hourly Data, 19 January Through 30 September 1994.

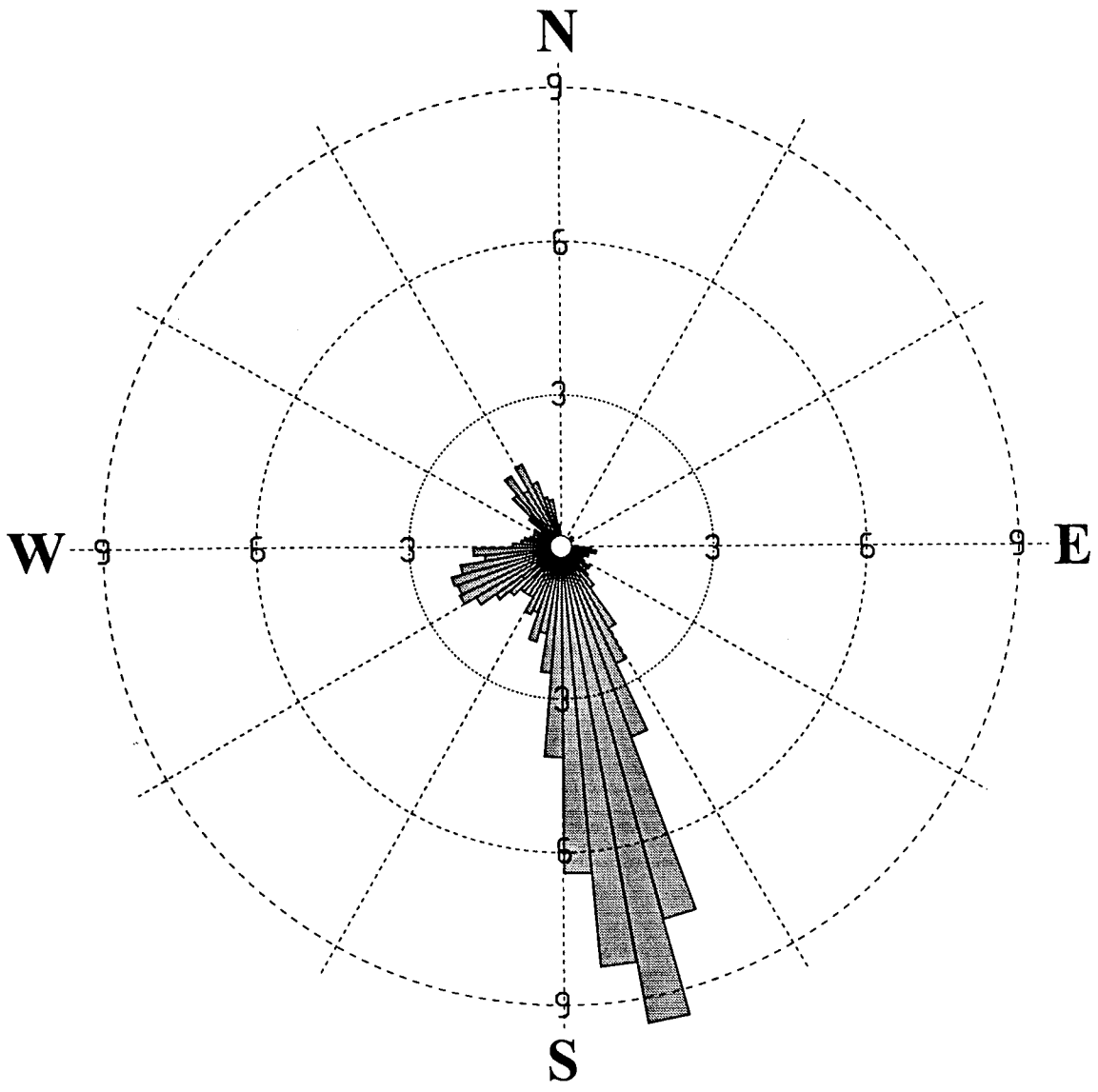


FIGURE 31. Frequency Distribution, Hourly Average Wind Direction, Weather Station 1, 19 January Through 30 September 1994.

Changes in barometric pressure have a noticeable effect on geyser and hot spring activity. Rhinehart and Murphy (1969) noted that several geysers at Yellowstone and Old Faithful of California at Calistoga all respond to pressure variations, primarily changing the interval between eruptions. At Coso, short-term irregular fluctuations in measured steam flow have been shown to be related to barometric pressure (Erskine and Lofgren, 1989). An example of this relationship, as well as that of steam flow versus atmospheric temperature, and humidity, are shown in Figure 32. The figure is a graph of these data for the period 19 January through 6 April 1994.

Rhinehart (1980) felt that thermal features are not affected by weather, with the exception of very near surface phenomena such as mud pots and those deeper-seated features directly recharged by meteoric runoff. However, as seen in Figure 33, steam flow from these shallow wells is slightly affected by the diurnal fluctuation of air temperature.

The rate of flow, both gas and liquid, from surface features changes in response to tectonic stresses preceding, during, and following earthquake activity. In fact, geyser activity has been observed to be affected by increasing stress up to 2 or 3 years prior to an earthquake. (Rhinehart and Murphy, 1969). The relationship of changes in the levels of thermal activity at Coso Hot Springs to earthquakes in the region has not been studied in detail and is unclear.

Finally, tidal forces have a strong regulatory effect on thermal, particularly geyser, activity. This effect is especially true for fortnightly (lunar) tides rather than the diurnal and semidiurnal tides. Earth tides have been shown to affect geysering intervals at Yellowstone. Rhinehart (1980) speculated that this effect indicates that, while the earth reacts elastically to tides on a global scale, at the scale of individual spring and geyser systems the rock mass must react inelastically. As with barometric changes, tides primarily affect the interval between geyser eruptions. The long-term steam-flow trends at the Corrosion Array and the Two-Inch Steam (4P-2) wells exhibit a cyclic nature which, though irregular, appears to have an average periodicity of about 18 months (Figure 34). This cyclic behavior is not observed in any of the water well data.

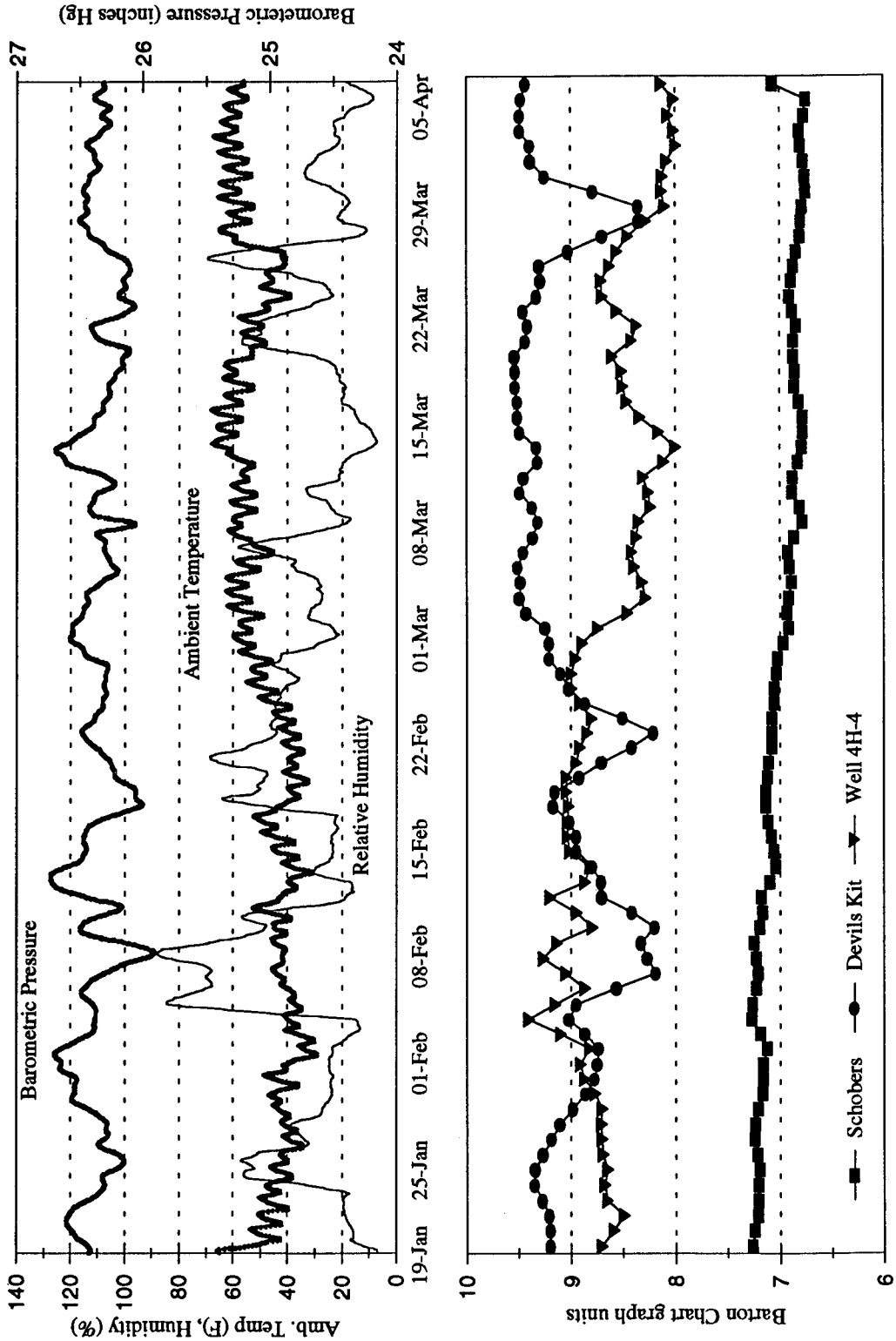


FIGURE 32. Steam Flow Versus Weather Indicators, 19 January Through 6 April 1994.

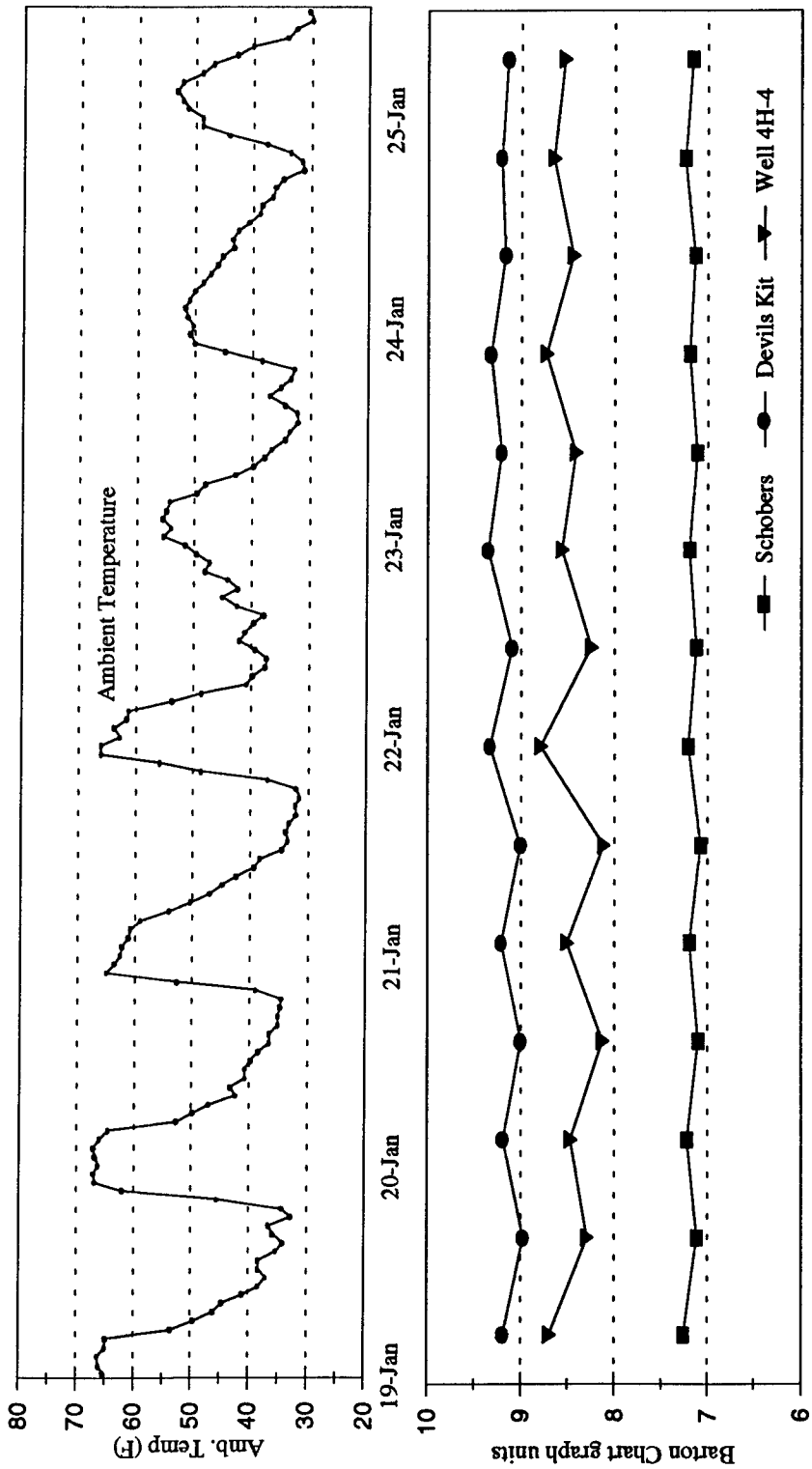


FIGURE 33. Steam Flow Versus Ambient Temperature, 19 January Through 24 January 1994.

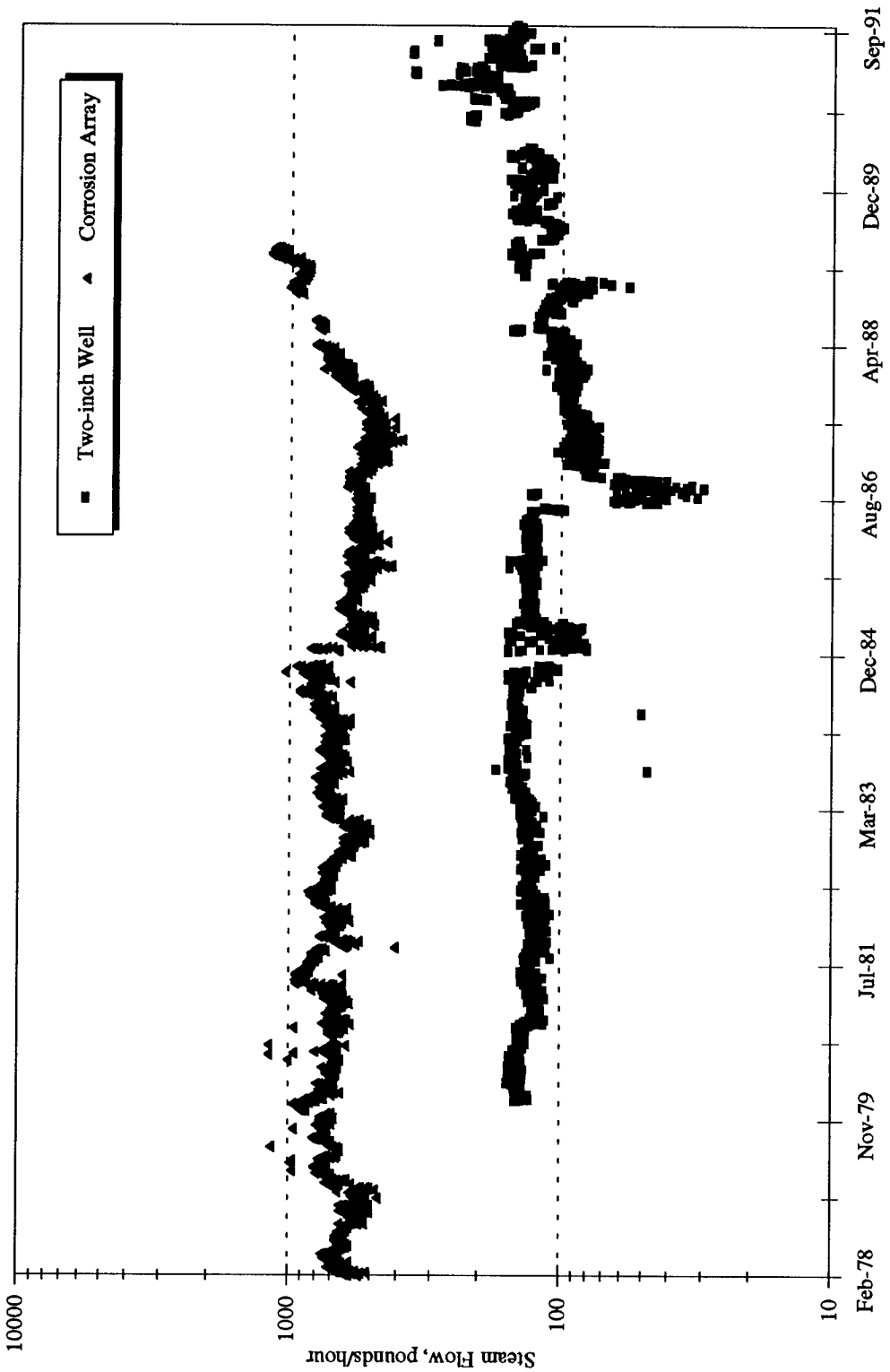


FIGURE 34. Daily High Steam Flow for Two Coso Wells, February 1978 Through September 1991.

WATER ANALYSIS OF COSO HOT SPRINGS AREA

Water samples were collected from several sites in the Coso Hot Springs area. These samples were analyzed for a suite of geothermal constituents by B.C. Laboratories, Inc., Bakersfield, California. The results are provided in Tables 8 through 15.

Wells 4H-4, 4K-1, 4P-1, Devils Kitchen, Observation Well No. 1, Schober's Resort Well (4A-4), and the South Pool are the sites regularly analyzed. Other sites are occasionally analyzed for comparison studies of the area's water.

Waters present at Coso Hot Springs consist of a relatively shallow geothermal brine overlain by a layer of water condensed from steam. Samples previously collected from Coso No. 1 showed that the brine was present in the well at about 140 feet below the surface, as late as 1988. Other wells in the area of Coso Hot Springs (4K-1, 4P-1, and Schober's Resort) tap only the condensate layer. Near, and at the surface, the oxidation of H_2S in the gas and steam flowing up through the mud pots and the conduits feeding them has resulted in a strong acid-sulfate character to the surface thermal features. None of the water samples from the area of Coso Hot Springs indicate the presence of a groundwater derived from rainfall. Water produced from the observation well OB-1 is a mixture of geothermal fluids and a nongeothermal groundwater, probably derived from local and regional runoff upstream of Coso basin.

Coso water samples will no longer be analyzed for the nitrogen constituents ammonia, nitrate, or nitrite. These constituents are not considered geothermal indicator compounds and have limited utility to the current monitoring program. In addition, because carbonate and bicarbonate are not stable in acidic waters, these constituents will no longer be analyzed in water samples with a field pH of less than 5.5.

TABLE 8. Chemical Analysis of Devils Kitchen.

Constituent	Units	29 Dec 93	13 Apr 94	30 Aug 94
Calcium	mg/L	44.0	49.0	62.0
Magnesium	mg/L	17.9	24.0	22.0
Sodium	mg/L	31.0	36.0	41.0
Potassium	mg/L	25.0	27.0	33.0
Carbonate	mg/L	*a*	*a*	*a*
Bicarbonate	mg/L	*a*	*a*	*a*
Chloride	mg/L	*a*	*a*	*a*
Sulfate	mg/L	1020.0	1020.0	1220.0
Nitrate as NO_3	mg/L	*a*	*a*	*a*
Fluoride	mg/L	0.35	0.38	0.4
Bromide	mg/L	*a*	*a*	*a*
pH	pH	2.4	2.4	2.1
Electrical conductivity	umhos/cm	4480.0	4200.0	4800.0
Total dissolved solids	mg/L	1270.0	1300.0	1600.0
Acidity as H ion	mg/L	15.0	19.8	*a*
Aluminum	mg/L	12700.0	12000.0	16000.0
Antimony	mg/L	*a*	*a*	*a*
Arsenic	mg/L	9.6	11.0	15.0
Boron	mg/L	3.5	3.7	4.6
Copper	mg/L	*a*	*a*	10.0
Lithium	mg/L	58.0	56.0	73.0
Manganese	mg/L	1290.0	1580.0	1830.0
Mercury	mg/L	45.0	2.2	0.25
Selenium	mg/L	*a*	*a*	*a*
Si as SiO_2	mg/L	343.0	330.0	320.0
Strontium	mg/L	82.0	91.0	100.0
Thallium	mg/L	*a*	*a*	*a*
Zinc	mg/L	48.0	79.0	65.0
Total iron	mg/L	36000.0	42000.0	50100.0

[a] None detected.

TABLE 9. Chemical Analysis of Observation Well No. 1.

Constituent	Units	19 May 94	30 Aug 94
Calcium	mg/L	21.0	30.0
Magnesium	mg/L	2.3	2.9
Sodium	mg/L	917.0	1090.0
Potassium	mg/L	87.0	93.0
Carbonate	mg/L	*a*	*a*
Bicarbonate	mg/L	204.0	218.0
Chloride	mg/L	1310.0	1600.0
Sulfate	mg/L	100.0	80.0
Nitrate as NO_3	mg/L	6.2	*a*
Fluoride	mg/L	6.7	5.2
Bromide	mg/L	2.6	3.0
pH	pH	7.0	7.0
Electrical conductivity	umhos/cm	4800.0	6140.0
Total dissolved solids	mg/L	2770.0	3300.0
Acidity as H ion	mg/L	*a*	*a*
Aluminum	mg/L	*a*	*a*
Antimony	mg/L	*a*	*a*
Arsenic	mg/L	6200.0	5160.0
Boron	mg/L	36.0	39.0
Copper	mg/L	*a*	12.0
Lithium	mg/L	8260.0	8880.0
Manganese	mg/L	97.0	86.0
Mercury	mg/L	2.2	2.5
Selenium	mg/L	6.2	4.2
Si as SiO_2	mg/L	95.0	91.0
Strontium	mg/L	1310.0	1570.0
Thallium	mg/L	*a*	*a*
Zinc	mg/L	990.0	960.0
Total iron	mg/L	520.0	300.0

[a] None detected.

TABLE 10. Chemical Analysis of 4P-1.

Constituent	Units	29 Dec 93	13 Apr 94	30 Aug 94
Calcium	mg/L	37.0	35.0	43.0
Magnesium	mg/L	0.53	15.6	0.52
Sodium	mg/L	102.0	111.0	119.0
Potassium	mg/L	45.0	48.0	50.0
Carbonate	mg/L	*a*	*a*	*a*
Bicarbonate	mg/L	116.0	112.0	102.0
Chloride	mg/L	7.1	6.5	8.7
Sulfate	mg/L	269.0	281.0	323.0
Nitrate as NO_3	mg/L	0.4	*a*	*a*
Fluoride	mg/L	0.37	0.39	0.38
Bromide	mg/L	0.17	0.34	0.07
pH	pH	7.7	8.1	7.3
Electrical conductivity	umhos/cm	860.0	862.0	980.0
Total dissolved solids	mg/L	950.0	980.0	1020.0
Acidity as H ion	mg/L	*a*	*a*	*a*
Aluminum	mg/L	248.0	80.0	330.0
Antimony	mg/L	*a*	*a*	*a*
Arsenic	mg/L	3.0	*a*	15.0
Boron	mg/L	0.11	0.11	0.15
Copper	mg/L	28.0	*a*	24.0
Lithium	mg/L	52.0	52.0	69.0
Manganese	mg/L	432.0	243.0	250.0
Mercury	mg/L	283.0	4.3	22.0
Selenium	mg/L	*a*	*a*	*a*
Si as SiO_2	mg/L	425.0	408.0	360.0
Strontium	mg/L	578.0	618.0	650.0
Thallium	mg/L	*a*	*a*	*a*
Zinc	mg/L	1150.0	758.0	1760.0
Total iron	mg/L	2900.0	300.0	240.0

[a] None detected.

TABLE 11. Chemical Analysis of 4K-1.

Constituent	Units	29 Dec 93	13 Apr 94	30 Aug 94
Calcium	mg/L	3.2	3.2	3.8
Magnesium	mg/L	0.15	1.5	0.15
Sodium	mg/L	39.0	43.0	43.0
Potassium	mg/L	7.6	8.0	8.3
Carbonate	mg/L	*a*	*a*	*a*
Bicarbonate	mg/L	64.3	67.8	61.7
Chloride	mg/L	3.5	4.4	4.7
Sulfate	mg/L	45.0	50.0	52.0
Nitrate as NO_3	mg/L	0.4	0.9	*a*
Fluoride	mg/L	0.96	1.0	1.1
Bromide	mg/L	0.18	0.22	0.26
pH	pH	7.1	7.4	7.3
Electrical conductivity	umhos/cm	240.0	261.0	262.0
Total dissolved solids	mg/L	415.0	410.0	440.0
Acidity as H ion	mg/L	*a*	*a*	*a*
Aluminum	mg/L	316.0	82.0	140.0
Antimony	mg/L	*a*	*a*	*a*
Arsenic	mg/L	2.0	*a*	4.2
Boron	mg/L	0.29	0.25	0.33
Copper	mg/L	*a*	12.0	32.0
Lithium	mg/L	43.0	44.0	54.0
Manganese	mg/L	47.0	47.0	48.0
Mercury	mg/L	267.0	30.0	21.0
Selenium	mg/L	*a*	*a*	*a*
Si as SiO_2	mg/L	289.0	279.0	272.0
Strontium	mg/L	39.0	50.0	54.0
Thallium	mg/L	*a*	*a*	*a*
Zinc	mg/L	833.0	214.0	480.0
Total iron	mg/L	4290.0	735.0	1070.0

[a] None detected.

TABLE 12. Chemical Analysis of Schober's (4A-4).

Constituent	Units	29 Dec 93	13 Apr 94	30 Aug 94
Calcium	mg/L	16.4	14.9	18.4
Magnesium	mg/L	0.26	0.14	0.15
Sodium	mg/L	41.0	42.0	44.0
Potassium	mg/L	1.6	1.6	2.2
Carbonate	mg/L	*a*	2.6	2.6
Bicarbonate	mg/L	73.9	74.8	70.4
Chloride	mg/L	*a*	*a*	*a*
Sulfate	mg/L	66.0	66.0	79.0
Nitrate as NO_3	mg/L	*a*	0.4	*a*
Fluoride	mg/L	0.23	0.27	0.27
Bromide	mg/L	0.11	0.06	*a*
pH	pH	7.8	8.2	8.2
Electrical conductivity	umhos/cm	290.0	283.0	310.0
Total dissolved solids	mg/L	240.0	230.0	290.0
Acidity as H ion	mg/L	*a*	*a*	*a*
Aluminum	mg/L	*a*	1240.0	13600.0
Antimony	mg/L	*a*	*a*	*a*
Arsenic	mg/L	10.0	9.2	14.0
Boron	mg/L	*a*	*a*	*a*
Copper	mg/L	*a*	*a*	16.0
Lithium	mg/L	*a*	*a*	*a*
Manganese	mg/L	46.0	134.0	220.0
Mercury	mg/L	6.9	22.0	516.0
Selenium	mg/L	*a*	*a*	*a*
Si as SiO_2	mg/L	108.0	109.0	150.0
Strontium	mg/L	213.0	326.0	370.0
Thallium	mg/L	*a*	*a*	*a*
Zinc	mg/L	*a*	24.0	110.0
Total iron	mg/L	241.0	1100.0	20900.0

[a] None detected.

TABLE 13. Chemical Analysis of South Pool.

Constituent	Units	29 Dec 93	13 Apr 94	30 Aug 94
Calcium	mg/L	147.0	85.0	259.0
Magnesium	mg/L	80.0	42.0	131.0
Sodium	mg/L	31.0	24.0	50.0
Potassium	mg/L	37.0	30.0	73.0
Carbonate	mg/L	*a*	*a*	*a*
Bicarbonate	mg/L	*a*	*a*	*a*
Chloride	mg/L	6.6	*a*	5.5
Sulfate	mg/L	2330.0	1420.0	2890.0
Nitrate as NO_3	mg/L	0.4	0.4	*a*
Fluoride	mg/L	0.09	0.07	0.28
Bromide	mg/L	*a*	*a*	*a*
pH	pH	3.3	3.3	3.4
Electrical conductivity	umhos/cm	4370.0	2930.0	5270.0
Total dissolved solids	mg/L	3960.0	2490.0	3400.0
Acidity as H ion	mg/L	20.0	9.2	*a*
Aluminum	mg/L	2280.0	1330.0	3310.0
Antimony	mg/L	*a*	*a*	*a*
Arsenic	mg/L	82.0	54.0	31.0
Boron	mg/L	38.0	33.0	66.0
Copper	mg/L	*a*	*a*	*a*
Lithium	mg/L	149.0	125.0	218.0
Manganese	mg/L	4920.0	3460.0	9550.0
Mercury	mg/L	0.36	1.1	0.68
Selenium	mg/L	*a*	*a*	*a*
Si as SiO_2	mg/L	409.0	361.0	360.0
Strontium	mg/L	25.0	11.0	95.0
Thallium	mg/L	*a*	*a*	*a*
Zinc	mg/L	1170.0	796.0	1390.0
Total iron	mg/L	400000.0	164000.0	120000.0

[a] None detected.

TABLE 14. Chemical Analysis of West Canyon Water.

Constituent	Units	29 Dec 93	13 Apr 94	30 Aug 94
Calcium	mg/L	75.0	80.0	93.0
Magnesium	mg/L	17.0	40.0	17.8
Sodium	mg/L	100.0	110.0	108.0
Potassium	mg/L	27.0	30.0	29.0
Carbonate	mg/L	*a*	*a*	*a*
Bicarbonate	mg/L	*a*	*a*	*a*
Chloride	mg/L	8.6	8.6	8.5
Sulfate	mg/L	680.0	690.0	790.0
Nitrate as NO_3	mg/L	0.4	0.9	0.50
Fluoride	mg/L	0.36	0.45	0.50
Bromide	mg/L	*a*	0.08	*a*
pH	pH	3.0	2.9	2.6
Electrical conductivity	umhos/cm	2000.0	1920.0	2400.0
Total dissolved solids	mg/L	1250.0	1290.0	1400.0
Acidity as H ion	mg/L	2.9	3.9	*a*
Aluminum	mg/L	1150.0	1070.0	4460.0
Antimony	mg/L	*a*	*a*	*a*
Arsenic	mg/L	2.0	*a*	10.0
Boron	mg/L	0.18	0.24	0.28
Copper	mg/L	16.0	14.0	11.0
Lithium	mg/L	26.0	34.0	43.0
Manganese	mg/L	3030.0	3750.0	4190.0
Mercury	mg/L	*a*	3.2	27.0
Selenium	mg/L	*a*	*a*	*a*
Si as SiO_2	mg/L	293.0	302.0	320.0
Strontium	mg/L	186.0	209.0	170.0
Thallium	mg/L	*a*	*a*	*a*
Zinc	mg/L	88.0	79.0	81.0
Total iron	mg/L	2340.0	2160.0	10400.0

[a] None detected.

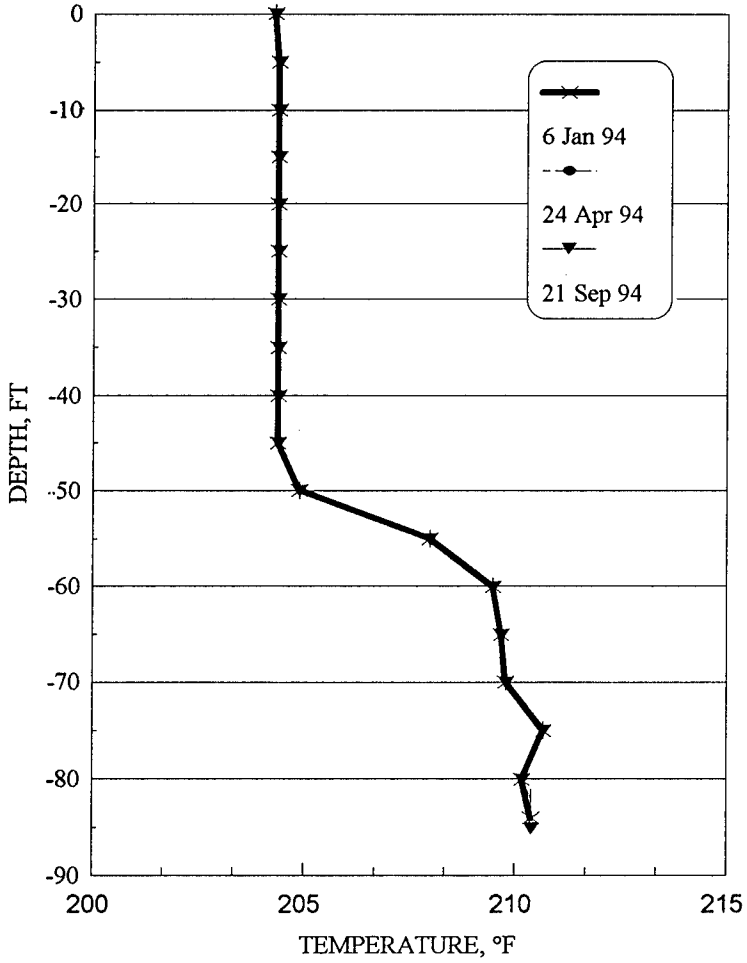
TABLE 15. Chemical Analysis of Nicol Prospect.

Constituent	Units	29 Dec 93	13 Apr 94	30 Aug 94
Calcium	mg/L	44.0	41.0	47.0
Magnesium	mg/L	11.2	10.0	10.2
Sodium	mg/L	707.0	780.0	801.0
Potassium	mg/L	.0	99.0	105.0
Carbonate	mg/L	*a*	*a*	*a*
Bicarbonate	mg/L	*a*	*a*	*a*
Chloride	mg/L	1340.0	1320.0	1400.0
Sulfate	mg/L	410.0	66.0	395.0
Nitrate as NO_3	mg/L	*a*	*a*	*a*
Fluoride	mg/L	0.22	0.21	0.19
Bromide	mg/L	2.5	2.4	2.8
pH	pH	2.7	2.4	2.4
Electrical conductivity	umhos/cm	6480.0	6100.0	6150.0
Total dissolved solids	mg/L	3100.0	3060.0	3150.0
Acidity as H ion	mg/L	8.1	10.1	*a*
Aluminum	mg/L	7090.0	5170.0	4120.0
Antimony	mg/L	*a*	*a*	*a*
Arsenic	mg/L	764.0	768.0	1240.0
Boron	mg/L	28.0	30.0	30.0
Copper	mg/L	*a*	*a*	23.0
Lithium	mg/L	612.0	2590.0	3340.0
Manganese	mg/L	1440.0	1470.0	1310.0
Mercury	mg/L	43.0	4.8	4.5
Selenium	mg/L	*a*	*a*	*a*
Si as SiO_2	mg/L	365.0	366.0	360.0
Strontium	mg/L	76.0	89.0	110.0
Thallium	mg/L	5.7	6.0	6.9
Zinc	mg/L	87.0	76.0	100.0
Total iron	mg/L	31000.0	31000.0	33300.0

[a] None detected.

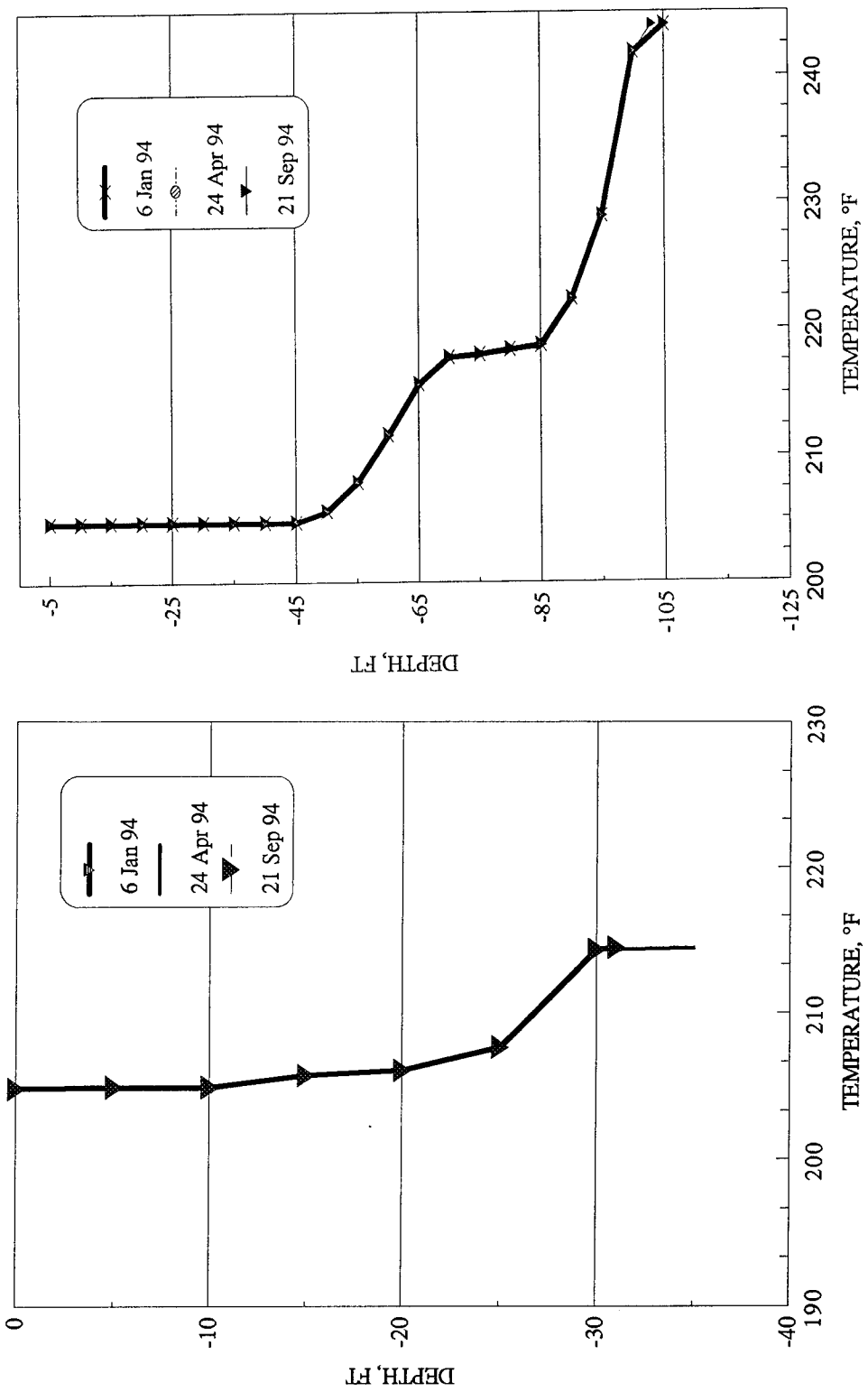
TEMPERATURE RECORDINGS OF THE COSO RESORT AREA WELLS

The temperature logs from wells 4K-1; 4P-1; Schober's Resort (4A-4); and observation wells OB-1, OB-2, and OB-3 are graphed in Figure 35, with the data listed in Appendix D. These data were recorded using the TD probe system, manufactured by Natural Progress Instruments, Dallas, Texas.



(a) Well 4K-1.

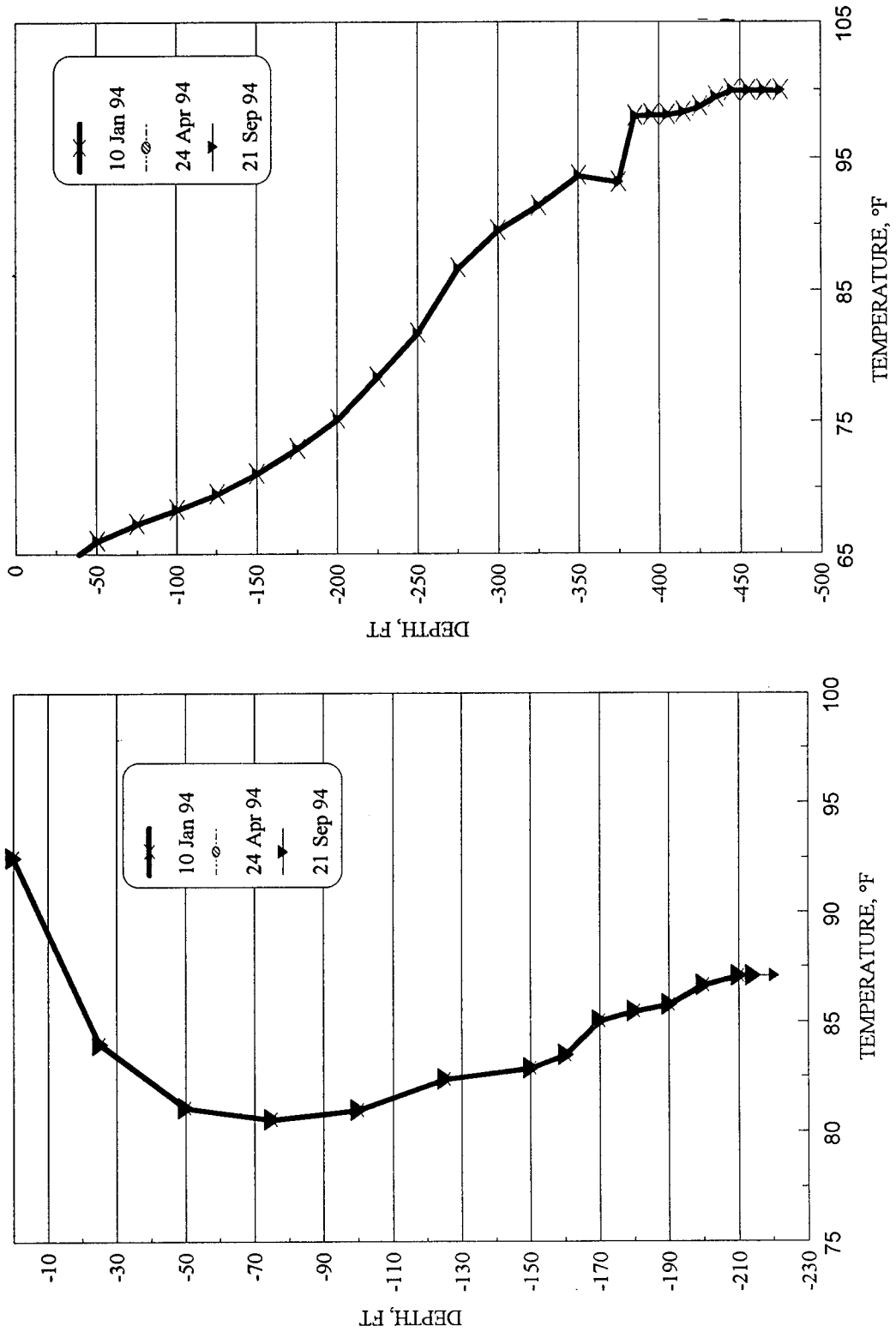
FIGURE 35. Temperature Profiles.



(b) Well 4P-1.

(c) Well 4A-4.

FIGURE 35. (Contd.)



(e) Well OB-3.

(d) Well OB-1.

FIGURE 35. (Contd.)

OTHER GEOTHERMAL ACTIVITY AT COSO HOT SPRINGS

WELL 4H-8 (Coso No. 1)

As reported in last year's summary (NAWS-CL TP 003), Coso Well No. 1 was plugged and required rehabilitation. Welch and Howell, El Centro, California, performed a work over on 10 and 11 January 1994. The wellhead was cleaned and rehabilitated, the 2-inch tubing (338 feet) was pulled, and the 4-inch casing was cleaned to 365 feet. WESTECH, Inc., Ventura and Bakersfield, California (Jeff Whittaker, engineer, and Jack Thompson, technician), provided the video logging service on 13 January 1994. Table 16 is a summary of the video log.

The video log indicated that the 4-inch casing is in good condition. The increase in steam flow and drop in fluid level measured in the well in 1990 reflected a growth of the steam zone near this well rather than the loss of integrity of the casing as previously thought. The well work over was completed without installing the 2 7/8-inch tubing and the well was shut in.

Pressure gauges were installed on both the 4-inch casing and the 7-inch intermediate casing string. These gauges have been read on a weekly basis. The resulting data are presented in Table 17. The 7-inch casing was set to 194 feet at the alluvium/ bedrock interface. Shut-in pressure on this casing (18 to 19.5 psig) reflected the pressure in the steam zone in the bottom alluvium. The 4-inch casing was set to 370 feet and shut-in gauge pressure reflects the steam pressure in the casing. During and immediately following the work-over, the water level in the well was about 336 feet and a gauge pressure of about 30 psig. As the well has sat shut in, the water level has risen—possibly due to a combination of in-flow from the bottom and condensation of steam at the top—and the steam pressure has dropped to between 20 and 22 psig. The fluid level has probably returned to a level of around 200 to 220 feet. Shut-in pressure on both casings are now nearly identical, which indicates a stable condition around the wellbore. Both pressure gauges are now measuring equivalent steam zones. Monitoring of wellhead pressures will continue and water samples and temperature logs will be taken on this well in the future.

TABLE 16. Coso No. 1, Summary of Borehole Video, 12 January, 1994.

Depth, ft	Description
0	Ground level
5 to 8.5	A boiling zone. Condensate dripping off tool and cable and falling back into the well is boiling off the casing at this point.
0 to 90	No significant scale formation. In fast-forward mode one can see the spiral markings from the 3 1/2-inch drill bit that was used to clean the wellbore.
40.5	Casing joint.
61.5	Casing joint.
82.5	Casing joint.
90 to 178	Increasing scale buildup.
178 to 225	Maximum scale thickness. The drill bit cut quite a bit of scale. Appears to be a primary boiling zone.
225	Scale thickness is decreasing here.
285	Scale is becoming smoother at this point. Appears to be well into the water zone at this point. Deposition of scale is still occurring but in a predominantly water environment.
307 to 323	Scale very smooth.
330 to 335	Visible steam swirling counterclockwise in the well.
333	Bottom of a collar. Steam turbulence is clearly visible at this point. From here down, slots are visible in the casing. Unclear whether steam is entering only through the slots or also at the casing joint (probably only through the slots.)
336	Boiling fluid in the wellbore. Very muddy water, which surges from 336 to 338 feet in this video. The video cannot see through the muddy water beyond this point.

TABLE 17. Shut In Wellhead Pressure, Coso No. 1 Well.

Date	7-in. well pressure (PSI)	4-in. well pressure (PSI)	Remarks
16 Nov 93	18	—	
23 Nov 93	18	—	
30 Nov 93	18	—	
7 Dec 93	19	—	
14 Dec 93	19.5	—	
21 Dec 93	19.2	—	
28 Dec 93	19	—	
4 Jan 94	19	—	
11 Jan 94	23.5	—	Well reworked
18 Jan 94	23	30	Gage installed on 4-in. casing
25 Jan 94	23	30	
1 Feb 94	23	30	
8 Feb 94	23	30	
15 Feb 94	23	30	
22 Feb 94	23	gage broken	
1 Mar 94	23	gage broken	
8 Mar 94	23	30	
15 Mar 94	23	28	New 0-300 gage installed on 4-in. casing
22 Mar 94	23	28	
29 Mar 94	23	28	
5 Apr 94	23	28	
12 Apr 94	23	20	New 0-100 gage installed on 4-in. casing
20 Apr 94	23	20	Pressure 4-in. well verified with a 0-30 PSI gage. 0-100 gage reinstalled.
28 Apr 94	23	20	
4 May 94	23	20	
10 May 94	23	20	
17 May 94	23	20	
24 May 94	23	20	
31 May 94	23	20	
7 Jun 94	23	20	
14 Jun 94	23	20	
21 Jun 94	23	20	
28 Jun 94	23	20	
5 Jul 94	23	20	
12 Jul 94	23	22	
19 Jul 94	23	22	
26 Jul 94	23	22	

TABLE. 17. (Contd.)

Date	7-in. well pressure (PSI)	4-in. well - pressure (PSI)	Remarks
2 Aug 94	23	22	
9 Aug 94	23	22	
16 Aug 94	22	23	
24 Aug 94	23	0	Bleed-off valve on 4-inch casing was found open
30 Aug 94	23	22	
7 Sep 94	23	22	
13 Sep 94	23	22	
20 Sep 94	23	22	
27 Sep 94	23	22	

NICOL PROSPECT MINE SHAFT

Late in 1993 California Energy Company wellfield workers noticed steam coming from the mine shaft at the Nicol Prospect. This area is located midway between Devils Kitchen and Coso Hot Springs and was prospected and mined for mercury in the 1920s. The mine shaft is 54 feet deep. Brine reinjection wells (41-8 pad) for the Navy One power plant are located adjacent to this site and have been in use since 1987. The appearance of hot water in this shaft provided an opportunity to add a new, near-surface monitoring site. Since November 1993, depth to water in the shaft and the water temperature have been measured weekly. The site has been stable through the reporting period with a slight rise in the water level and an increase in temperature. These data are listed in Table 18.

TABLE 18. Nicol Prospect Mine Shaft.

Date	Time	Ambient temperature, °F	Water temperature, °F	Depth to water, ft
11 Oct 93	1000	—	202	—
2 Nov 93	—	—	---	Dry
9 Nov 93	1030	—	---	28.5
16 Nov 93	1030	52	138	29.2
23 Nov 93	1015	59	138	29.5
30 Nov 93	1430	58	142	28.5
7 Dec 93	945	55	---	28.6
14 Dec 93	1330	46	142	28.5
21 Dec 93	1045	49	137	28.4
28 Dec 93	1010	51	141	28.7
4 Jan 94	1040	52	142	28.5
11 Jan 94	1020	50	140	28.7
18 Jan 94	1110	64	137	28.2
25 Jan 94	1000	43	143	28.2
1 Feb 94	1030	41	141	28.7

TABLE 18. (Contd.)

Date	Time	Ambient temperature, °F	Water temperature, °F	Depth to water, ft
8 Feb 94	1020	51	141	28.0
15 Feb 94	1015	52	140	28.5
22 Feb 94	1000	49	140	28.4
1 Mar 94	1030	79	141	28.4
8 Mar 94	1030	65	139	28.5
15 Mar 94	1020	76	141	28.5
22 Mar 94	1020	53	141	28.5
29 Mar 94	1030	71	140	28.3
5 Apr 94	1040	66	140	28.5
12 Apr 94	1030	70	140	28.5
20 Apr 94	1010	85	143	28.3
28 Apr 94	1010	63	142	28.4
4 May 94	1040	71	144	28.2
10 May 94	1400	83	146	28.2
17 May 94	1250	59	144	28.2
24 May 94	1035	83	143	28.1
31 May 94	1030	84	147	28.1
7 Jun 94	1430	89	146	28.0
14 Jun 94	1040	88	146	28.2
21 Jun 94	1140	91	147	28.3
28 Jun 94	1010	101	148	28.4
5 Jul 94	1020	87	149	28.2
12 Jul 94	1050	97	149	28.3
19 Jul 94	1500	98	148	28.3
26 Jul 94	1340	102	151	28.3
2 Aug 94	1050	---	---	28.4
9 Aug 94	945	---	---	28.4
16 Aug 94	1030	102	150	28.2
24 Aug 94	930	81	148	28.3
30 Aug 94	1010	87	151	28.3
7 Sep 94	740	71	147	28.4
13 Sep 94	945	63	147	28.3
20 Sep 94	950	78	148	28.3
27 Sep 94	1025	82	150	28.2

WEST CANYONS

These two canyons are located west of the resort and run perpendicular to the strike of the Coso Hot Springs fault.

The southerly canyon is directly below rain station No. 2 and includes both thermal features in the canyon and a wide area of hydrothermal alteration and scattered thermal activity at the mouth of the canyon. Substantial evidence exists of a long history of thermal activity in the canyon, as well as historic utilization of these thermal features. The principle area of activity in the canyon consists of a mildly boiling pool bordered by an active steam vent, which periodically turns into an actively boiling pool. Further up the canyon are two small steam vents and small springs. Activity in these areas is sporadic, depending on climatic conditions. This canyon area and the thermal activity are shown in Figure 36.

The northerly canyon holds a wide area of hydrothermal alteration and fossil hot springs deposits. Current thermal activity is limited to warm to hot ground with a few small steam vents around the ground slump, first noted in NAWS-CL TP-001. Last year's document (NAWS-CL TP 003) reported that the high wall at the top had separated by 3 feet and the toe had moved several feet. Observations over this past year indicate little significant change to this area, possibly due to lack of significant rainfall and record hot summer temperatures. The geology, as well as the geometry, of these two canyons indicates the probability of recurring activities and possible changes, which include hydrothermal alteration and active steam discharge, sharp topography, and desert rainfall and runoff patterns. These areas will continue to be monitored and photographed on a monthly basis.

COSO RESORT MUDFIELD

The mudfield has again been fairly quiet this year. The seasonal cycle of wet and dry was repeated, with drying conditions predominating. In addition, there is significantly less steam and heat flowing from the crater fumeroles. As a result, much of the crater area was dry and accessible in late September, as seen in Figure 37. As the steep-sided crater walls slough, the crater will continue to grow to the west.

ALONG FAULT LINE, BETWEEN THE SOUTH POOL AND THE COSO ROAD

This area consists of a series of small- to moderate-sized mud pots and pools strung along about 300-feet of the down-thrown edge of the Coso Hot Springs fault. There appears to have been a small increase in thermal activity here during the past year and the single large pool has enlarged by growing into the fault hangwall. Overall the area is stable.

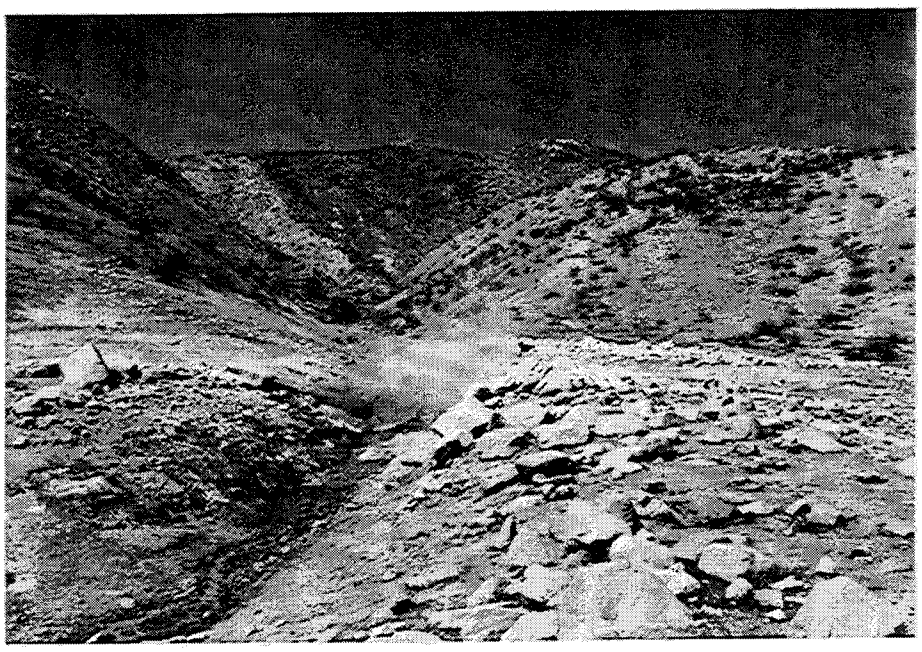


FIGURE 36. West Canyon Thermal Activity.

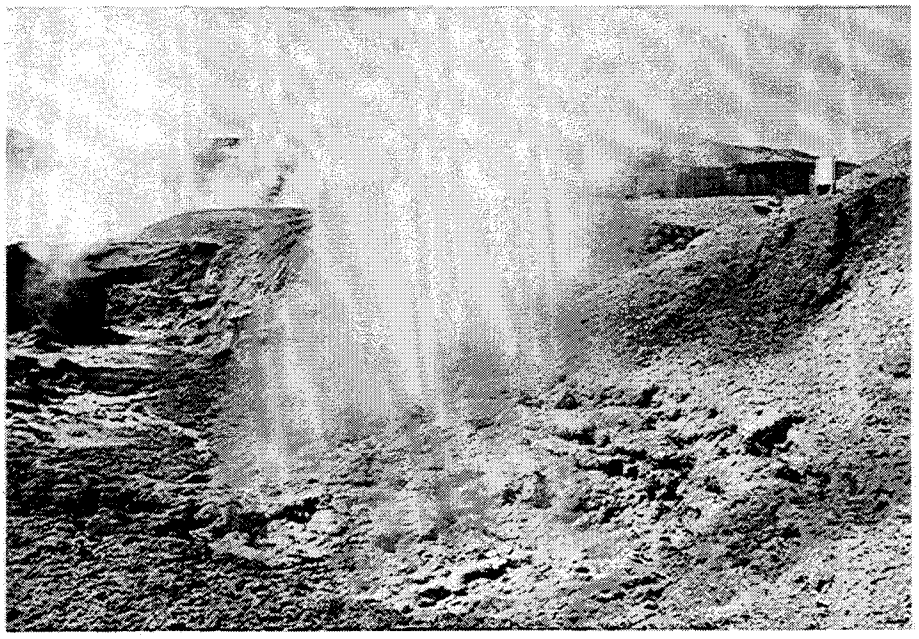


FIGURE 37. Coso Resort Mudfield.

DISCUSSION AND SUMMARY

A number of improvements were made to the monitoring program this year, primarily having to do with the steam-flow sites. A formal periodic maintenance schedule for these sites was established. Also, the metering pipe run at each of these sites was reconfigured, as per the Barton Companies latest specifications, to increase the reliability and accuracy of the differential pressure measurements. In addition, a Barton ADSCAN digital steam flow and temperature recorder was added to the DPU at the Schober's site. Data recorded at this site can now be downloaded directly into the Coso database instead of being entered manually or digitized, as it has been in the past. ADSCAN units have also been purchased for the Devils Kitchen and Eight-Inch Well sites and will be installed during the first quarter of 1995.

A new Handar weather station was installed adjacent to well OB-1 to replace the three analog recorders. The old recorders were high maintenance, short-term, strip-chart units which did not work well in inclement weather. The new station is solar/battery powered. The data are recorded digitally, can be stored on-site for several months, and can be downloaded directly into the Coso database. These new weather data provides for an accurate and detailed comparison of thermal activity and weather factors.

A rework of Coso Well #1 was completed this year. The observation tubing was removed and carbonate scale cleaned from the well bore. A video log was run from the surface to the bottom of the well. The log showed that the well casing was in good condition. Because of a significant drop in fluid level in the well in 1989, we had speculated that the casing had failed at the alluvium/bedrock interface. It now appears that either an increase in temperature or a drop in water level in the formation around the well caused an increase in boiling and precipitation of scale in the well.

The water level of the South Pool is again being measured accurately. The wide fluctuations in water level throughout the year, coupled with the high temperature and acid nature of that water, has made water level measurement difficult and dangerous. This year, surveyed level sites were installed adjacent to the pool and a measuring fixture was fabricated that allows for accurate measurements without endangering personnel.

Finally, a new monitoring site was added to the program this year. The Nicol mine shaft was originally part of a mercury mining operation in the 1920s. Late in 1993, hot, dilute sodium-chloride water entered the shaft. The water level and temperature are now measured weekly and the water chemistry determined monthly. This site provides a monitoring point for near-surface thermal activity adjacent to one of the primary brine and non-condensable gas reinjection pads in the geothermal field.

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Appendix A

DAILY STEAM FLOW DATA

TABLE A-1. Devils Kitchen Steam Flow.

Date	High, F	Low, F	Date	High, F	Low, F
01-Oct-93	385.81	377.36	10-Nov-93	383.39	375.75
02-Oct-93	381.38	375.75	11-Nov-93	382.99	378.16
03-Oct-93	383.79	374.14	12-Nov-93	378.97	372.13
04-Oct-93	385.40	376.55	13-Nov-93	378.97	370.52
05-Oct-93	385.00	375.35	14-Nov-93	372.13	366.50
06-Oct-93	382.59	377.36	15-Nov-93	374.14	366.90
07-Oct-93	382.99	376.55	16-Nov-93	372.13	369.31
08-Oct-93	384.60	377.36	17-Nov-93	378.97	372.13
09-Oct-93	385.00	375.35	18-Nov-93	376.55	370.52
10-Oct-93	382.59	377.36	19-Nov-93	376.15	370.12
11-Oct-93	382.99	376.55	20-Nov-93	379.37	371.32
12-Oct-93	384.60	377.36	21-Nov-93	379.37	373.33
13-Oct-93	387.01	378.16	22-Nov-93	380.17	374.54
14-Oct-93	384.60	377.76	23-Nov-93	378.16	372.53
15-Oct-93	384.60	378.16	24-Nov-93	368.91	361.27
16-Oct-93	385.40	377.36	25-Nov-93	376.15	366.50
17-Oct-93	382.99	374.54	26-Nov-93	376.55	370.92
18-Oct-93	380.58	372.93	27-Nov-93	374.94	367.30
19-Oct-93	378.16	372.93	28-Nov-93	368.51	366.09
20-Oct-93	378.97	372.93	29-Nov-93	379.37	372.53
21-Oct-93	379.37	372.13	30-Nov-93	375.35	367.30
22-Oct-93	382.19	372.13	01-Dec-93	376.15	368.51
23-Oct-93	382.99	374.14	02-Dec-93	375.35	370.12
24-Oct-93	380.58	372.53	03-Dec-93	376.96	370.52
25-Oct-93	378.56	372.13	04-Dec-93	380.98	372.53
26-Oct-93	378.16	366.09	05-Dec-93	378.56	371.73
27-Oct-93	379.77	376.55	06-Dec-93	377.36	371.32
28-Oct-93	385.81	376.55	07-Dec-93	375.35	372.13
29-Oct-93	381.78	373.33	08-Dec-93	377.36	370.52
30-Oct-93	378.97	370.12	09-Dec-93	373.74	367.30
31-Oct-93	381.78	374.14	10-Dec-93	376.96	367.70
01-Nov-93	379.77	375.35	11-Dec-93	381.38	373.33
02-Nov-93	378.16	372.13	12-Dec-93	373.33	366.90
03-Nov-93	382.19	373.74	13-Dec-93	374.14	367.30
04-Nov-93	382.19	374.54	14-Dec-93	376.96	371.32
05-Nov-93	378.97	371.73	15-Dec-93	384.60	378.16
06-Nov-93	380.17	371.73	16-Dec-93	385.40	377.36
07-Nov-93	381.78	373.74	17-Dec-93	382.99	374.54
08-Nov-93	375.75	370.92	18-Dec-93	380.58	372.93
09-Nov-93	378.56	371.32	19-Dec-93	381.38	371.73

TABLE A-1. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
20-Dec-93	370.52	363.68	29-Jan-94	354.02	345.58
21-Dec-93	372.93	364.48	30-Jan-94	351.61	344.77
22-Dec-93	369.31	361.27	31-Jan-94	352.01	341.55
23-Dec-93	364.89	360.06	01-Feb-94	350.40	344.37
24-Dec-93	368.91	361.27	02-Feb-94	362.47	354.83
25-Dec-93	376.15	366.50	03-Feb-94	362.47	354.02
26-Dec-93	376.55	370.92	04-Feb-94	357.24	331.90
27-Dec-93	374.94	367.30	05-Feb-94	331.50	314.60
28-Dec-93	368.51	366.09	06-Feb-94	327.07	314.60
29-Dec-93	373.33	364.48	07-Feb-94	337.93	326.27
30-Dec-93	376.15	368.91	08-Feb-94	332.30	321.04
31-Dec-93	373.74	368.51	09-Feb-94	327.47	303.33
01-Jan-94	371.73	365.69	10-Feb-94	349.20	327.47
02-Jan-94	368.91	364.08	11-Feb-94	350.81	337.93
03-Jan-94	376.55	367.30	12-Feb-94	349.60	339.14
04-Jan-94	372.93	369.71	13-Feb-94	358.45	342.76
05-Jan-94	381.78	366.50	14-Feb-94	361.27	354.83
06-Jan-94	370.92	365.29	15-Feb-94	358.45	355.23
07-Jan-94	369.71	364.08	16-Feb-94	366.09	357.64
08-Jan-94	374.94	365.69	17-Feb-94	371.32	364.08
09-Jan-94	374.54	366.90	18-Feb-94	364.89	352.82
10-Jan-94	368.51	362.87	19-Feb-94	352.41	343.16
11-Jan-94	364.89	362.87	20-Feb-94	347.59	329.08
12-Jan-94	358.05	323.85	21-Feb-94	329.08	315.00
13-Jan-94	324.25	319.83	22-Feb-94	331.50	325.46
14-Jan-94	327.07	322.24	23-Feb-94	352.41	329.48
15-Jan-94	333.51	326.27	24-Feb-94	360.46	350.00
16-Jan-94	341.15	333.51	25-Feb-94	364.48	356.44
17-Jan-94	352.01	340.75	26-Feb-94	367.30	360.06
18-Jan-94	355.63	350.00	27-Feb-94	372.93	364.48
19-Jan-94	369.71	360.86	28-Feb-94	367.70	361.27
20-Jan-94	369.71	362.07	01-Mar-94	375.75	370.92
21-Jan-94	370.52	362.47	02-Mar-94	382.59	370.92
22-Jan-94	375.35	366.09	03-Mar-94	380.98	372.93
23-Jan-94	376.15	370.52	04-Mar-94	381.38	372.53
24-Jan-94	374.94	368.91	05-Mar-94	383.39	375.35
25-Jan-94	370.52	367.70	06-Mar-94	377.36	370.12
26-Jan-94	368.10	360.86	07-Mar-94	375.75	368.91
27-Jan-94	364.08	356.84	08-Mar-94	373.33	371.73
28-Jan-94	358.45	348.79	09-Mar-94	380.17	371.73

TABLE A-1. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
10-Mar-94	382.59	373.74	19-Apr-94	380.23	372.17
11-Mar-94	377.76	364.89	20-Apr-94	376.79	370.55
12-Mar-94	371.32	364.89	21-Apr-94	380.25	371.03
13-Mar-94	378.56	366.90	22-Apr-94	379.98	371.88
14-Mar-94	384.60	373.74	23-Apr-94	382.97	373.23
15-Mar-94	380.17	376.55	24-Apr-94	378.16	374.14
16-Mar-94	384.60	375.75	25-Apr-94	373.99	368.52
17-Mar-94	381.78	374.54	26-Apr-94	378.08	365.81
18-Mar-94	384.60	374.94	27-Apr-94	382.19	374.14
19-Mar-94	382.59	372.93	28-Apr-94	379.23	372.69
20-Mar-94	376.15	370.92	29-Apr-94	379.32	372.43
21-Mar-94	380.98	370.52	30-Apr-94	378.46	370.03
22-Mar-94	379.77	375.35	01-May-94	378.89	372.21
23-Mar-94	370.12	354.02	02-May-94	379.51	372.73
24-Mar-94	376.88	370.01	03-May-94	385.96	372.73
25-Mar-94	370.79	355.01	04-May-94	384.34	371.80
26-Mar-94	354.91	341.01	05-May-94	385.01	373.08
27-Mar-94	344.20	327.18	06-May-94	385.91	374.01
28-Mar-94	327.47	320.38	07-May-94	382.46	373.84
29-Mar-94	344.15	322.14	08-May-94	382.29	375.24
30-Mar-94	362.18	344.60	09-May-94	381.44	371.99
31-Mar-94	382.19	374.14	10-May-94	381.10	374.85
01-Apr-94	372.62	369.15	11-May-94	383.01	372.27
02-Apr-94	382.33	369.02	12-May-94	385.28	373.14
03-Apr-94	381.02	374.77	13-May-94	386.58	373.19
04-Apr-94	382.27	372.43	14-May-94	386.71	373.49
05-Apr-94	380.04	370.47	15-May-94	385.37	375.99
06-Apr-94	378.53	366.47	16-May-94	379.17	369.90
07-Apr-94	380.87	365.10	17-May-94	377.73	371.56
08-Apr-94	382.19	374.14	18-May-94	375.05	369.07
09-Apr-94	378.97	373.60	19-May-94	375.26	368.87
10-Apr-94	381.49	372.69	20-May-94	381.57	368.58
11-Apr-94	379.93	371.82	21-May-94	380.34	372.01
12-Apr-94	382.52	374.05	22-May-94	381.12	371.16
13-Apr-94	378.91	368.47	23-May-94	380.59	371.82
14-Apr-94	374.79	366.45	24-May-94	384.89	377.09
15-Apr-94	378.35	365.19	25-May-94	383.05	374.18
16-Apr-94	382.19	370.12	26-May-94	383.50	372.67
17-Apr-94	382.63	374.16	27-May-94	382.59	372.56
18-Apr-94	386.84	372.93	28-May-94	381.17	370.38

TABLE A-1. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
29-May-94	382.67	374.42	08-Jul-94	376.27	370.14
30-May-94	378.53	373.38	09-Jul-94	376.60	373.58
31-May-94	377.71	373.88	10-Jul-94	376.42	371.97
01-Jun-94	380.51	371.40	11-Jul-94	379.55	372.67
02-Jun-94	380.06	371.27	12-Jul-94	378.63	374.05
03-Jun-94	381.27	373.60	13-Jul-94	377.39	372.60
04-Jun-94	379.91	373.19	14-Jul-94	374.42	371.40
05-Jun-94	381.80	370.51	15-Jul-94	376.68	370.79
06-Jun-94	380.21	370.12	16-Jul-94	374.57	370.36
07-Jun-94	378.25	371.43	17-Jul-94	375.56	368.30
08-Jun-94	379.36	368.10	18-Jul-94	375.43	369.22
09-Jun-94	377.26	371.45	19-Jul-94	375.43	370.42
10-Jun-94	379.85	372.43	20-Jul-94	374.83	369.72
11-Jun-94	379.93	372.43	21-Jul-94	376.60	370.38
12-Jun-94	381.82	373.10	22-Jul-94	377.99	369.44
13-Jun-94	378.44	372.90	23-Jul-94	376.96	369.68
14-Jun-94	380.76	375.50	24-Jul-94	375.82	369.39
15-Jun-94	379.44	371.19	25-Jul-94	375.93	370.55
16-Jun-94	376.10	369.22	26-Jul-94	377.41	371.67
17-Jun-94	379.53	367.17	27-Jul-94	377.91	372.36
18-Jun-94	377.76	371.60	28-Jul-94	376.15	370.12
19-Jun-94	376.94	370.23	29-Jul-94	377.41	373.79
20-Jun-94	378.33	369.04	30-Jul-94	376.90	372.40
21-Jun-94	377.46	373.01	31-Jul-94	376.08	368.60
22-Jun-94	379.64	369.00	01-Aug-94	373.92	368.36
23-Jun-94	374.74	367.35	02-Aug-94	375.95	374.31
24-Jun-94	377.84	371.73	03-Aug-94	378.20	371.90
25-Jun-94	376.58	372.27	04-Aug-94	390.48	371.45
26-Jun-94	375.56	371.38	05-Aug-94	392.03	386.54
27-Jun-94	374.18	369.39	06-Aug-94	393.41	388.13
28-Jun-94	378.44	372.40	07-Aug-94	394.62	388.94
29-Jun-94	376.02	371.23	08-Aug-94	391.33	385.28
30-Jun-94	378.68	370.79	09-Aug-94	390.69	385.31
01-Jul-94	377.84	372.60	10-Aug-94	393.49	384.49
02-Jul-94	381.06	373.62	11-Aug-94	394.58	384.30
03-Jul-94	380.64	369.88	12-Aug-94	390.62	385.98
04-Jul-94	378.59	371.25	13-Aug-94	391.25	384.36
05-Jul-94	378.33	371.58	14-Aug-94	392.77	383.88
06-Jul-94	374.57	368.27	15-Aug-94	392.59	387.57
07-Jul-94	376.08	369.77	16-Aug-94	399.78	394.38

TABLE A-1. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
17-Aug-94	398.74	394.27	11-Sep-94	400.83	393.47
18-Aug-94	399.86	392.96	12-Sep-94	400.16	393.43
19-Aug-94	399.82	393.58	13-Sep-94	397.24	392.32
20-Aug-94	400.73	394.42	14-Sep-94	397.75	388.98
21-Aug-94	401.53	395.59	15-Sep-94	398.11	390.75
22-Aug-94	399.35	390.83	16-Sep-94	396.08	392.88
23-Aug-94	396.73	393.25	17-Sep-94	396.97	392.13
24-Aug-94	396.73	393.25	18-Sep-94	398.16	394.27
25-Aug-94	397.57	396.22	19-Sep-94	397.52	392.18
26-Aug-94	399.94	394.46	20-Sep-94	397.77	393.25
27-Aug-94	400.24	392.13	21-Sep-94	397.73	391.89
28-Aug-94	400.08	392.28	22-Sep-94	399.09	390.42
29-Aug-94	401.56	394.83	23-Sep-94	399.70	395.87
30-Aug-94	399.21	391.64	24-Sep-94	397.38	388.88
31-Aug-94	400.95	394.17	25-Sep-94	397.36	392.67
01-Sep-94	401.23	396.02	26-Sep-94	395.40	391.62
02-Sep-94	399.45	392.63	27-Sep-94	398.36	396.02
03-Sep-94	398.72	393.88	28-Sep-94	399.11	393.66
04-Sep-94	397.93	388.03	29-Sep-94	401.64	392.34
05-Sep-94	398.76	389.13	30-Sep-94	401.35	391.97
06-Sep-94	398.26	391.08			
07-Sep-94	401.21	397.24			
08-Sep-94	401.23	391.66			
09-Sep-94	399.03	393.37			
10-Sep-94	399.07	393.39			

TABLE A-2. 4H-4 Steam Flow.

Date	High, F	Low, F	Date	High, F	Low, F
01-Oct-93	0.00	0.00	10-Nov-93	181.75	164.69
02-Oct-93			11-Nov-93	181.75	170.65
03-Oct-93			12-Nov-93	177.64	165.92
04-Oct-93			13-Nov-93	179.28	164.89
05-Oct-93	173.72	162.97	14-Nov-93	174.35	160.78
06-Oct-93	181.06	162.16	15-Nov-93	175.38	160.37
07-Oct-93	180.88	161.12	16-Nov-93	174.14	158.93
08-Oct-93	180.88	163.95	17-Nov-93	182.57	167.15
09-Oct-93	177.52	160.17	18-Nov-93	179.49	166.33
10-Oct-93	177.77	160.80	19-Nov-93	178.67	162.22
11-Oct-93	171.88	158.29	20-Nov-93	184.22	165.71
12-Oct-93	178.67	172.50	21-Nov-93	186.07	170.85
13-Oct-93	182.78	167.56	22-Nov-93	186.68	177.43
14-Oct-93	180.72	173.12	23-Nov-93	180.93	172.91
15-Oct-93	180.52	173.12	24-Nov-93	175.79	166.12
16-Oct-93	175.99	172.50	25-Nov-93	181.34	166.54
17-Oct-93	179.49	172.29	26-Nov-93	181.96	165.92
18-Oct-93	175.99	168.59	27-Nov-93	185.25	167.36
19-Oct-93	174.14	166.54	28-Nov-93	186.07	174.14
20-Oct-93	175.17	163.25	29-Nov-93	186.48	172.09
21-Oct-93	178.87	163.45	30-Nov-93	185.04	175.99
22-Oct-93	177.43	164.27	01-Dec-93	177.84	162.84
23-Oct-93	178.67	163.66	02-Dec-93	178.46	165.92
24-Oct-93	179.08	163.25	03-Dec-93	178.05	164.27
25-Oct-93	176.82	163.04	04-Dec-93	186.89	167.56
26-Oct-93	169.00	161.19	05-Dec-93	186.68	170.03
27-Oct-93	173.32	164.89	06-Dec-93	186.68	169.00
28-Oct-93	185.45	164.89	07-Dec-93	174.97	167.77
29-Oct-93	178.67	162.22	08-Dec-93	182.78	169.41
30-Oct-93	175.58	159.34	09-Dec-93	176.82	167.15
31-Oct-93	178.46	161.19	10-Dec-93	179.08	164.07
01-Nov-93	175.17	163.45	11-Dec-93	180.52	170.03
02-Nov-93	172.50	159.96	12-Dec-93	176.40	167.36
03-Nov-93	181.13	159.75	13-Dec-93	181.34	168.39
04-Nov-93	180.93	165.71	14-Dec-93	181.75	176.20
05-Nov-93	175.99	160.98	15-Dec-93	187.30	177.02
06-Nov-93	180.11	160.37	16-Dec-93	177.43	170.24
07-Nov-93	182.16	165.10	17-Dec-93	178.67	169.62
08-Nov-93	176.40	160.98	18-Dec-93	183.40	171.88
09-Nov-93	176.20	166.95	19-Dec-93	182.78	173.73

TABLE A-2. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
20-Dec-93	181.13	170.85	29-Jan-94	180.72	173.12
21-Dec-93	183.40	175.58	30-Jan-94	183.81	175.58
22-Dec-93	180.93	168.59	31-Jan-94	182.37	174.14
23-Dec-93	175.99	168.18	01-Feb-94	180.31	177.64
24-Dec-93	177.64	163.66	02-Feb-94	193.68	178.87
25-Dec-93	183.81	168.39	03-Feb-94	193.06	183.40
26-Dec-93	179.08	173.73	04-Feb-94	183.19	180.11
27-Dec-93	178.05	166.74	05-Feb-94	181.13	176.82
28-Dec-93	169.00	163.25	06-Feb-94	190.80	181.13
29-Dec-93	177.02	164.48	07-Feb-94	190.18	185.66
30-Dec-93	182.16	166.95	08-Feb-94	185.45	182.78
31-Dec-93	179.49	170.44	09-Feb-94	176.20	168.18
01-Jan-94	178.05	166.33	10-Feb-94	191.62	173.53
02-Jan-94	174.76	163.86	11-Feb-94	186.48	171.47
03-Jan-94	179.49	166.12	12-Feb-94	177.84	170.44
04-Jan-94	172.91	166.95	13-Feb-94	184.63	173.53
05-Jan-94	186.07	169.62	14-Feb-94	185.66	183.40
06-Jan-94	169.41	165.51	15-Feb-94	185.66	183.40
07-Jan-94	177.02	166.33	16-Feb-94	185.66	184.42
08-Jan-94	186.89	172.29	17-Feb-94	185.25	184.22
09-Jan-94	182.78	176.20	18-Feb-94	186.48	184.22
10-Jan-94	176.40	168.39	19-Feb-94	185.25	181.96
11-Jan-94	178.26	168.18	20-Feb-94	182.57	180.31
12-Jan-94	174.55	166.12	21-Feb-94	183.81	177.84
13-Jan-94	178.05	167.56	22-Feb-94	179.90	177.84
14-Jan-94	181.13	171.68	23-Feb-94	181.96	176.61
15-Jan-94	180.52	171.68	24-Feb-94	184.42	179.28
16-Jan-94	176.40	167.36	25-Feb-94	185.45	182.57
17-Jan-94	173.73	166.95	26-Feb-94	184.42	182.78
18-Jan-94	177.64	168.59	27-Feb-94	183.81	181.54
19-Jan-94	178.87	170.44	28-Feb-94	181.75	176.20
20-Jan-94	174.14	167.15	01-Mar-94	177.43	175.58
21-Jan-94	174.97	166.95	02-Mar-94	170.24	169.41
22-Jan-94	180.72	169.62	03-Mar-94	170.44	168.59
23-Jan-94	175.99	173.12	04-Mar-94	171.47	168.18
24-Jan-94	179.49	173.53	05-Mar-94	173.53	169.41
25-Jan-94	177.84	175.58	06-Mar-94	172.50	169.41
26-Jan-94	179.90	172.50	07-Mar-94	171.88	169.21
27-Jan-94	178.05	175.17	08-Mar-94	171.47	169.62
28-Jan-94	179.69	174.97	09-Mar-94	167.15	165.92

TABLE A-2. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
10-Mar-94	172.29	165.92	19-Apr-94	172.62	162.23
11-Mar-94	169.21	162.22	20-Apr-94	183.11	178.98
12-Mar-94	164.27	160.57	21-Apr-94	181.20	168.94
13-Mar-94	164.48	159.75	22-Apr-94	171.33	167.41
14-Mar-94	171.06	163.04	23-Apr-94	174.82	168.35
15-Mar-94	171.88	168.80	24-Apr-94	175.38	169.99
16-Mar-94	175.99	169.00	25-Apr-94	182.17	173.34
17-Mar-94	173.53	170.03	26-Apr-94	182.98	173.94
18-Mar-94	176.61	167.98	27-Apr-94	175.06	171.03
19-Mar-94	177.02	167.98	28-Apr-94	169.87	168.75
20-Mar-94	169.00	164.69	29-Apr-94	170.59	168.11
21-Mar-94	175.17	163.86	30-Apr-94	180.52	168.08
22-Mar-94	176.40	173.12	01-May-94	175.01	168.88
23-Mar-94	181.20	171.61	02-May-94	173.01	170.23
24-Mar-94	176.82	170.90	03-May-94	171.40	168.69
25-Mar-94	177.84	169.14	04-May-94	169.26	167.56
26-Mar-94	173.80	167.76	05-May-94	169.04	167.67
27-Mar-94	173.74	163.91	06-May-94	169.02	167.70
28-Mar-94	166.49	162.58	07-May-94	170.59	168.55
29-Mar-94	166.73	165.87	08-May-94	171.67	168.96
30-Mar-94	167.47	165.57	09-May-94	170.13	168.30
31-Mar-94	166.52	162.40	10-May-94	169.06	165.85
01-Apr-94	165.70	161.48	11-May-94	166.93	164.38
02-Apr-94	162.88	160.79	12-May-94	166.57	164.54
03-Apr-94	166.75	161.12	13-May-94	167.08	164.51
04-Apr-94	164.99	161.20	14-May-94	166.35	164.08
05-Apr-94	164.66	163.37	15-May-94	167.51	164.38
06-Apr-94	169.62	161.90	16-May-94	168.77	165.66
07-Apr-94	166.24	162.29	17-May-94	181.83	174.52
08-Apr-94	169.89	162.07	18-May-94	176.19	173.60
09-Apr-94	169.47	161.80	19-May-94	176.31	173.42
10-Apr-94	162.31	158.99	20-May-94	174.78	169.42
11-Apr-94	160.16	156.59	21-May-94	170.56	164.66
12-Apr-94	166.22	163.19	22-May-94	167.54	162.24
13-Apr-94	169.29	161.64	23-May-94	163.01	159.77
14-Apr-94	171.23	164.20	24-May-94	165.01	163.10
15-Apr-94	164.24	164.26	25-May-94	168.59	163.00
16-Apr-94	164.69	159.27	26-May-94	167.74	162.14
17-Apr-94	163.24	159.32	27-May-94	165.26	160.67
18-Apr-94	167.91	159.31	28-May-94	165.39	158.07

TABLE A-2. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
29-May-94	163.81	158.04	08-Jul-94	164.43	153.93
30-May-94	166.14	159.69	09-Jul-94	164.70	151.46
31-May-94	167.09	160.08	10-Jul-94	162.65	153.66
01-Jun-94	162.67	157.41	11-Jul-94	165.72	153.32
02-Jun-94	163.06	158.57	12-Jul-94	162.31	156.32
03-Jun-94	170.49	160.67	13-Jul-94	166.01	154.84
04-Jun-94	169.77	159.56	14-Jul-94	173.84	159.81
05-Jun-94	168.74	160.82	15-Jul-94	172.89	169.65
06-Jun-94	169.04	163.19	16-Jul-94	175.75	169.48
07-Jun-94	162.14	158.04	17-Jul-94	177.53	174.40
08-Jun-94	158.83	151.98	18-Jul-94	178.40	173.29
09-Jun-94	158.69	153.14	19-Jul-94	Meter in for maintenance.	
10-Jun-94	165.01	156.24	20-Jul-94	Conversion factor change	
11-Jun-94	168.15	159.03	21-Jul-94	as of 22 July 1994 to 46.5	
12-Jun-94	167.62	159.52	22-Jul-94	286.38	275.49
13-Jun-94	167.66	160.71	23-Jul-94	287.37	279.17
14-Jun-94	167.99	163.68	24-Jul-94	289.62	278.04
15-Jun-94	166.26	157.32	25-Jul-94	287.89	277.14
16-Jun-94	161.22	154.54	26-Jul-94	287.97	283.03
17-Jun-94	162.35	154.60	27-Jul-94	293.82	279.95
18-Jun-94	165.35	153.03	28-Jul-94	313.02	271.29
19-Jun-94	160.43	153.07	29-Jul-94	311.18	301.12
20-Jun-94	165.03	156.22	30-Jul-94	314.75	300.29
21-Jun-94	160.08	158.50	31-Jul-94	310.76	299.67
22-Jun-94	167.21	157.04	01-Aug-94	311.56	298.11
23-Jun-94	165.24	155.85	02-Aug-94	314.58	310.97
24-Jun-94	167.78	159.91	03-Aug-94	311.56	303.52
25-Jun-94	169.38	155.93	04-Aug-94	311.39	300.03
26-Jun-94	164.21	152.91	05-Aug-94	310.10	300.00
27-Jun-94	159.50	148.72	06-Aug-94	315.82	304.06
28-Jun-94	155.61	153.21	07-Aug-94	321.81	308.24
29-Jun-94	164.67	155.78	08-Aug-94	313.51	303.56
30-Jun-94	166.21	156.34	09-Aug-94	307.18	297.42
01-Jul-94	166.19	156.20	10-Aug-94	307.78	297.38
02-Jul-94	166.80	159.83	11-Aug-94	314.58	303.34
03-Jul-94	166.98	156.90	12-Aug-94	312.33	301.41
04-Jul-94	166.27	156.62	13-Aug-94	308.98	300.65
05-Jul-94	158.25	154.90	14-Aug-94	313.54	297.42
06-Jul-94	161.89	150.16	15-Aug-94	318.11	304.77
07-Jul-94	161.69	151.55	16-Aug-94	298.29	289.13

TABLE A-2. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
17-Aug-94	290.03	280.26	11-Sep-94	288.01	277.53
18-Aug-94	294.71	280.99	12-Sep-94	288.95	275.14
19-Aug-94	295.15	281.91	13-Sep-94	286.27	277.88
20-Aug-94	295.11	282.26	14-Sep-94	460.53	450.38
21-Aug-94	298.98	283.76	15-Sep-94	460.95	452.43
22-Aug-94	287.14	276.36	16-Sep-94	458.59	454.89
23-Aug-94	Well shutdown		17-Sep-94	459.63	454.03
24-Aug-94	290.11	285.96	18-Sep-94	461.00	456.51
25-Aug-94	291.56	281.45	19-Sep-94	460.27	454.08
26-Aug-94	290.15	279.36	20-Sep-94	292.12	285.36
27-Aug-94	293.27	276.87	21-Sep-94	288.87	279.09
28-Aug-94	296.47	282.68	22-Sep-94	290.63	277.02
29-Aug-94	294.71	281.26	23-Sep-94	295.92	283.83
30-Aug-94	290.63	278.04	24-Sep-94	288.68	281.65
31-Aug-94	289.36	279.56	25-Sep-94	289.10	280.60
01-Sep-94	290.37	276.20	26-Sep-94	288.12	278.08
02-Sep-94	290.44	272.12	27-Sep-94	289.17	285.51
03-Sep-94	284.79	272.16	28-Sep-94	286.27	280.37
04-Sep-94	280.22	269.68	29-Sep-94	298.55	283.68
05-Sep-94	281.65	268.92	30-Sep-94	294.01	283.22
06-Sep-94	275.57	271.61			
07-Sep-94	283.79	281.38			
08-Sep-94	292.01	278.90			
09-Sep-94	289.43	279.25			
10-Sep-94	283.37	274.78			

TABLE A-3. 4A-2 and 4A-3 (Schober's Resort Wells) Steam Flow.

Date	High, F	Low, F	Date	High, F	Low, F
01-Oct-93	1085.76	1040.52	10-Nov-93	1088.78	1064.65
02-Oct-93	1070.68	1055.60	11-Nov-93	1096.32	1079.73
03-Oct-93	1070.68	1040.52	12-Nov-93	1096.32	1072.19
04-Oct-93	1070.68	1025.44	13-Nov-93	1087.27	1063.14
05-Oct-93	1067.06	1051.61	14-Nov-93	1087.27	1064.65
06-Oct-93	1074.71	1056.89	15-Nov-93	1070.68	1049.57
07-Oct-93	1069.09	1038.00	16-Nov-93	1072.19	1052.58
08-Oct-93	1070.68	1025.00	17-Nov-93	1082.74	1061.63
09-Oct-93	1070.36	1028.54	18-Nov-93	1076.71	1055.60
10-Oct-93	1065.25	1022.78	19-Nov-93	1079.73	1051.08
11-Oct-93	1066.53	1031.08	20-Nov-93	1082.74	1061.63
12-Oct-93	1070.68	1061.63	21-Nov-93	1091.79	1078.22
13-Oct-93	1076.71	1057.11	22-Nov-93	1088.78	1060.12
14-Oct-93	1072.19	1043.54	23-Nov-93	1091.79	1064.65
15-Oct-93	1079.73	1049.57	24-Nov-93	1085.76	1055.60
16-Oct-93	1075.20	1034.49	25-Nov-93	1085.76	1070.68
17-Oct-93	1072.19	1055.60	26-Nov-93	1070.68	1070.68
18-Oct-93	1076.71	1064.65	27-Nov-93	1070.68	1055.60
19-Oct-93	1082.74	1060.12	28-Nov-93	1085.76	1055.60
20-Oct-93	1070.68	1070.68	29-Nov-93	1070.68	1055.60
21-Oct-93	1085.76	1070.68	30-Nov-93	1066.16	1058.62
22-Oct-93	1085.76	1070.68	01-Dec-93	1073.70	1051.08
23-Oct-93	1093.30	1063.14	02-Dec-93	1066.16	1051.08
24-Oct-93	1093.30	1070.68	03-Dec-93	1075.20	1057.11
25-Oct-93	1085.76	1063.14	04-Dec-93	1084.25	1064.65
26-Oct-93	1078.22	1054.09	05-Dec-93	1091.79	1063.14
27-Oct-93	1078.22	1063.14	06-Dec-93	1084.25	1061.63
28-Oct-93	1088.78	1063.14	07-Dec-93	1079.73	1055.60
29-Oct-93	1087.27	1069.17	08-Dec-93	1082.74	1058.62
30-Oct-93	1085.76	1067.66	09-Dec-93	1084.25	1061.63
31-Oct-93	1085.76	1070.68	10-Dec-93	1072.19	1048.06
01-Nov-93	1085.76	1040.52	11-Dec-93	1091.79	1069.17
02-Nov-93	1063.14	1039.01	12-Dec-93	1093.30	1061.63
03-Nov-93	1072.19	1037.50	13-Dec-93	1084.25	1063.14
04-Nov-93	1078.22	1043.54	14-Dec-93	1088.78	1075.20
05-Nov-93	1078.22	1039.01	15-Dec-93	1094.81	1075.20
06-Nov-93	1076.71	1055.60	16-Dec-93	1087.27	1069.17
07-Nov-93	1078.22	1048.06	17-Dec-93	1084.25	1064.65
08-Nov-93	1073.70	1043.54	18-Dec-93	1081.24	1058.62
09-Nov-93	1075.20	1042.03	19-Dec-93	1081.24	1058.62

TABLE A-3. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
20-Dec-93	1070.68	1052.58	29-Jan-94	1076.71	1066.16
21-Dec-93	1108.38	1058.62	30-Jan-94	1081.24	1063.14
22-Dec-93	1073.70	1052.58	31-Jan-94	1076.71	1060.12
23-Dec-93	1064.65	1048.06	01-Feb-94	1072.19	1064.65
24-Dec-93	1075.20	1049.57	02-Feb-94	1094.81	1081.24
25-Dec-93	1081.24	1055.60	03-Feb-94	1097.82	1079.73
26-Dec-93	1085.76	1072.19	04-Feb-94	1091.79	1076.71
27-Dec-93	1078.22	1057.11	05-Feb-94	1087.27	1069.17
28-Dec-93	1064.65	1045.04	06-Feb-94	1085.76	1066.16
29-Dec-93	1067.66	1051.08	07-Feb-94	1093.30	1079.73
30-Dec-93	1079.73	1058.62	08-Feb-94	1091.79	1072.19
31-Dec-93	1081.24	1055.60	09-Feb-94	1076.71	1061.63
01-Jan-94	1067.66	1057.11	10-Feb-94	1084.25	1067.66
02-Jan-94	1069.17	1039.01	11-Feb-94	1079.73	1052.58
03-Jan-94	1063.14	1029.96	12-Feb-94	1060.12	1043.54
04-Jan-94	1070.68	1046.55	13-Feb-94	1063.14	1049.57
05-Jan-94	1075.20	1054.09	14-Feb-94	1064.65	1057.11
06-Jan-94	1078.22	1051.08	15-Feb-94	1070.68	1057.11
07-Jan-94	1073.70	1061.63	16-Feb-94	1073.70	1057.11
08-Jan-94	1084.25	1070.68	17-Feb-94	1078.22	1064.65
09-Jan-94	1088.78	1072.19	18-Feb-94	1073.70	1064.65
10-Jan-94	1091.79	1072.19	19-Feb-94	1072.19	1061.63
11-Jan-94	1091.79	1079.73	20-Feb-94	1070.68	1055.60
12-Jan-94	1085.76	1067.66	21-Feb-94	1063.14	1054.09
13-Jan-94	1084.25	1070.68	22-Feb-94	1070.68	1049.57
14-Jan-94	1091.79	1072.19	23-Feb-94	1063.14	1060.12
15-Jan-94	1090.28	1075.20	24-Feb-94	1063.14	1045.04
16-Jan-94	1087.27	1066.16	25-Feb-94	1063.14	1051.08
17-Jan-94	1076.71	1066.16	26-Feb-94	1057.11	1048.06
18-Jan-94	1087.27	1066.16	27-Feb-94	1058.62	1031.47
19-Jan-94	1094.81	1072.19	28-Feb-94	1042.03	1028.46
20-Jan-94	1088.78	1070.68	01-Mar-94	1042.03	1032.98
21-Jan-94	1084.25	1066.16	02-Mar-94	1046.55	1011.87
22-Jan-94	1087.27	1073.70	03-Mar-94	1037.50	1026.95
23-Jan-94	1084.25	1072.19	04-Mar-94	1037.50	1023.93
24-Jan-94	1084.25	1075.20	05-Mar-94	1045.04	1028.46
25-Jan-94	1091.79	1079.73	06-Mar-94	1042.03	1025.44
26-Jan-94	1091.79	1078.22	07-Mar-94	1026.95	1011.87
27-Jan-94	1090.28	1073.70	08-Mar-94	1017.90	1011.87
28-Jan-94	1082.74	1066.16	09-Mar-94	1036.00	1022.42

TABLE A-3. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
10-Mar-94	1037.50	1022.42	19-Apr-94	1050.20	1037.13
11-Mar-94	1034.49	1017.90	20-Apr-94	1060.97	1047.16
12-Mar-94	1023.93	1002.82	21-Apr-94	1068.02	1046.51
13-Mar-94	1022.42	1004.33	22-Apr-94	1056.78	1039.21
14-Mar-94	1020.92	1005.84	23-Apr-94	1058.18	1035.15
15-Mar-94	1022.42	1008.85	24-Apr-94	1056.89	1045.86
16-Mar-94	1032.98	1022.42	25-Apr-94	1076.19	1056.35
17-Mar-94	1034.49	1025.44	26-Apr-94	1061.83	1050.31
18-Mar-94	1031.47	1022.42	27-Apr-94	1052.36	1041.50
19-Mar-94	1039.01	1026.95	28-Apr-94	1047.60	1037.46
20-Mar-94	1031.47	1017.90	29-Apr-94	1017.87	1007.88
21-Mar-94	1032.98	1017.90	30-Apr-94	1077.56	1015.75
22-Mar-94	1040.52	1025.44	01-May-94	1114.49	1078.62
23-Mar-94	1042.38	1022.78	02-May-94	1123.03	1098.46
24-Mar-94	1036.14	1012.05	03-May-94	1101.05	1045.64
25-Mar-94	1034.93	1007.43	04-May-94	1044.34	998.02
26-Mar-94	1028.54	1006.41	05-May-94	1074.71	1049.23
27-Mar-94	1023.11	1000.98	06-May-94	1068.34	1040.52
28-Mar-94	1026.55	991.85	07-May-94	1054.20	1035.92
29-Mar-94	1018.54	1001.54	08-May-94	1065.89	1049.44
30-Mar-94	1016.98	1001.20	09-May-94	1052.69	1024.55
31-Mar-94	1020.22	1003.25	10-May-94	1065.25	1058.61
01-Apr-94	1022.00	1003.13	11-May-94	1068.55	1055.71
02-Apr-94	1028.43	1006.19	12-May-94	1070.47	1050.74
03-Apr-94	1024.77	1006.98	13-May-94	1081.46	1069.51
04-Apr-94	1015.41	996.76	14-May-94	1088.17	1070.15
05-Apr-94	1019.21	996.31	15-May-94	1109.69	1074.81
06-Apr-94	1111.63	1007.09	16-May-94	1103.21	1020.44
07-Apr-94	1092.34	1050.63	17-May-94	1079.67	1045.21
08-Apr-94	1063.33	1048.79	18-May-94	1057.00	1040.52
09-Apr-94	1074.18	1063.01	19-May-94	1038.00	1031.74
10-Apr-94	1071.85	1057.54	20-May-94	1050.42	1025.55
11-Apr-94	1066.00	1040.96	21-May-94	1051.39	1027.99
12-Apr-94	1071.64	1039.32	22-May-94	1061.29	1034.71
13-Apr-94	1067.49	1046.51	23-May-94	1060.33	1042.70
14-Apr-94	1064.40	1030.86	24-May-94	1062.47	1034.49
15-Apr-94	1041.07	1014.40	25-May-94	1063.22	1038.77
16-Apr-94	1038.22	1026.66	26-May-94	1066.85	1047.16
17-Apr-94	1035.59	1024.66	27-May-94	1066.96	1045.97
18-Apr-94	1041.72	1031.30	28-May-94	1068.77	1058.83

TABLE A-3. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
29-May-94	1056.68	1040.96	08-Jul-94	1014.52	988.17
30-May-94	1062.47	1034.49	09-Jul-94	1022.44	1008.78
31-May-94	1063.22	1038.77	10-Jul-94	1016.75	1002.45
01-Jun-94	1066.85	1047.16	11-Jul-94	1015.30	1000.86
02-Jun-94	1066.96	1045.97	12-Jul-94	958.86	943.92
03-Jun-94	1068.77	1058.83	13-Jul-94	995.05	948.84
04-Jun-94	1063.22	1036.80	14-Jul-94	995.39	972.51
05-Jun-94	1059.69	1049.88	15-Jul-94	986.33	974.38
06-Jun-94	1049.98	1033.72	16-Jul-94	994.59	981.01
07-Jun-94	1060.97	1053.23	17-Jul-94	994.82	976.71
08-Jun-94	1066.10	1053.12	18-Jul-94	993.91	982.40
09-Jun-94	1057.64	1039.65	19-Jul-94	994.25	988.98
10-Jun-94	1069.30	1043.03	20-Jul-94	999.16	987.94
11-Jun-94	1063.22	1044.23	21-Jul-94	1008.67	987.60
12-Jun-94	1073.54	1047.71	22-Jul-94	1001.43	982.17
13-Jun-94	1074.28	1042.81	23-Jul-94	1003.02	990.93
14-Jun-94	1003.02	995.05	24-Jul-94	1003.36	993.45
15-Jun-94	1006.41	988.29	25-Jul-94	1001.43	990.47
16-Jun-94	995.39	977.88	26-Jul-94	1005.96	992.53
17-Jun-94	997.79	985.98	27-Jul-94	1011.37	989.90
18-Jun-94	1015.64	998.59	28-Jul-94	1003.36	975.43
19-Jun-94	1023.11	1000.41	29-Jul-94	977.18	956.72
20-Jun-94	1009.91	993.45	30-Jul-94	972.28	960.04
21-Jun-94	1013.06	996.42	31-Jul-94	973.68	956.96
22-Jun-94	1017.65	996.42	01-Aug-94	984.02	961.11
23-Jun-94	999.95	988.63	02-Aug-94	978.81	967.83
24-Jun-94	1003.59	987.48	03-Aug-94	977.06	963.71
25-Jun-94	1018.21	1000.75	04-Aug-94	976.13	956.60
26-Jun-94	1020.33	1003.13	05-Aug-94	976.13	959.80
27-Jun-94	1022.00	1000.52	06-Aug-94	981.71	962.41
28-Jun-94	1028.54	1012.50	07-Aug-94	985.18	963.47
29-Jun-94	1015.41	996.76	08-Aug-94	969.59	949.56
30-Jun-94	1029.98	995.62	09-Aug-94	972.75	962.88
01-Jul-94	1021.55	1004.60	10-Aug-94	985.41	957.55
02-Jul-94	1019.10	1009.91	11-Aug-94	983.56	953.03
03-Jul-94	1026.99	1009.57	12-Aug-94	977.99	959.33
04-Jul-94	1016.20	1004.94	13-Aug-94	980.78	965.59
05-Jul-94	1020.88	1014.74	14-Aug-94	974.15	952.31
06-Jul-94	1015.86	991.04	15-Aug-94	964.29	951.71
07-Jul-94	1006.41	993.22	16-Aug-94	1041.83	1033.50

TABLE A-3. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
17-Aug-94	1048.90	1034.16	06-Sep-94	1044.77	1033.83
18-Aug-94	1053.01	1035.37	07-Sep-94	1046.62	1037.13
19-Aug-94	1042.59	1032.84	08-Sep-94	1055.17	1036.14
20-Aug-94	1048.14	1040.96	09-Sep-94	1043.47	1029.64
21-Aug-94	1048.14	1033.28	10-Sep-94	1043.79	1034.05
22-Aug-94	1052.04	1023.33	11-Sep-94	1041.83	1032.29
23-Aug-94	1060.97	1031.08	12-Sep-94	1047.38	1029.42
24-Aug-94	1068.55	1043.79	13-Sep-94	1045.53	1019.99
25-Aug-94	1069.40	1039.43	14-Sep-94	1048.58	1023.22
26-Aug-94	1051.07	1015.75	15-Sep-94	1036.80	1025.33
27-Aug-94	1038.88	1018.54	16-Sep-94	1039.75	1031.41
28-Aug-94	1049.66	1025.00	17-Sep-94	1039.43	1027.66
29-Aug-94	1042.38	1028.10	18-Sep-94	1051.61	1037.89
30-Aug-94	1046.84	1034.27	19-Sep-94	1039.75	1023.11
31-Aug-94	1052.90	1037.35	20-Sep-94	1043.58	1039.10
01-Sep-94	1053.66	1039.10	21-Sep-94	1060.54	1031.19
02-Sep-94	1053.66	1036.91	22-Sep-94	1063.65	1022.00
03-Sep-94	1048.90	1036.58	23-Sep-94	1054.09	1034.71
04-Sep-94	1047.16	1035.26	24-Sep-94	1058.61	1036.69
05-Sep-94	1048.14	1037.35	25-Sep-94	1055.49	1034.49
			26-Sep-94	1070.47	1047.60
			27-Sep-94	1026.44	1016.87
			28-Sep-94	1033.06	1011.03
			29-Sep-94	1037.02	1017.20
			30-Sep-94	1034.60	1017.20

Appendix B

DAILY TEMPERATURE DATA

TABLE B-1. 4A-2 and 4A-3 (Schoeber's Resort Wells) Steam Temperature.

Date	High, F	Low, F	Date	High, F	Low, F
01-Oct-93	208	207	10-Nov-93	207	206
02-Oct-93	209	207	11-Nov-93	207	206
03-Oct-93			12-Nov-93	207	205
04-Oct-93			13-Nov-93	207	205
05-Oct-93	207	207	14-Nov-93	207	205
06-Oct-93	208	206	15-Nov-93	207	205
07-Oct-93	208	206	16-Nov-93	208	207
08-Oct-93	209	207	17-Nov-93	208	207
09-Oct-93	209	207	18-Nov-93	208	207
10-Oct-93	208	207	19-Nov-93	208	207
11-Oct-93	208	207	20-Nov-93	208	207
12-Oct-93	208	206	21-Nov-93	208	207
13-Oct-93	207	206	22-Nov-93	208	206
14-Oct-93	207	206	23-Nov-93	208	206
15-Oct-93	207	205	24-Nov-93	208	206
16-Oct-93	207	205	25-Nov-93	208	206
17-Oct-93	207	205	26-Nov-93	207	204
18-Oct-93	208	205	27-Nov-93	207	204
19-Oct-93	208	206	28-Nov-93	207	204
20-Oct-93			29-Nov-93	207	204
21-Oct-93			30-Nov-93	208	205
22-Oct-93			01-Dec-93	208	205
23-Oct-93	208	206	02-Dec-93	208	205
24-Oct-93	208	206	03-Dec-93	208	206
25-Oct-93	207	205	04-Dec-93	208	206
26-Oct-93	207	205	05-Dec-93	208	206
27-Oct-93	207	206	06-Dec-93	208	206
28-Oct-93	208	206	07-Dec-93	207	206
29-Oct-93	208	206	08-Dec-93	207	206
30-Oct-93	208	207	09-Dec-93	207	206
31-Oct-93			10-Dec-93	208	206
01-Nov-93			11-Dec-93	208	206
02-Nov-93	208	206	12-Dec-93	208	206
03-Nov-93	207	206	13-Dec-93	208	206
04-Nov-93	205	204	14-Dec-93	208	206
05-Nov-93	207	206	15-Dec-93	208	207
06-Nov-93	202	206	16-Dec-93	208	207
07-Nov-93	207	206	17-Dec-93	208	206
08-Nov-93	208	208	18-Dec-93	208	205
09-Nov-93	209	208	19-Dec-93	208	205

TABLE B-1. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
20-Dec-93	207	205	29-Jan-94	207	206
21-Dec-93	207	205	30-Jan-94	207	206
22-Dec-93	207	205	31-Jan-94	207	206
23-Dec-93	207	205	01-Feb-94	207	206
24-Dec-93	208	505	02-Feb-94	207	206
25-Dec-93	208	205	03-Feb-94	207	206
26-Dec-93	208	205	04-Feb-94	207	205
27-Dec-93	208	205	05-Feb-94	207	205
28-Dec-93	208	205	06-Feb-94	207	205
29-Dec-93	208	206	07-Feb-94	207	205
30-Dec-93	208	206	08-Feb-94	207	205
31-Dec-93	208	205	09-Feb-94	207	206
01-Jan-94	208	206	10-Feb-94	207	206
02-Jan-94	208	206	11-Feb-94	207	206
03-Jan-94	208	206	12-Feb-94	207	205
04-Jan-94	208	207	13-Feb-94	207	205
05-Jan-94	209	207	14-Feb-94	207	206
06-Jan-94	209	207	15-Feb-94	208	206
07-Jan-94	208	207	16-Feb-94	208	206
08-Jan-94	208	207	17-Feb-94	208	206
09-Jan-94	208	206	18-Feb-94	208	205
10-Jan-94	209	206	19-Feb-94	208	205
11-Jan-94	208	206	20-Feb-94	208	205
12-Jan-94	208	206	21-Feb-94	208	205
13-Jan-94	208	206	22-Feb-94	208	205
14-Jan-94	208	206	23-Feb-94	209	205
15-Jan-94	207	205	24-Feb-94	209	206
16-Jan-94	207	205	25-Feb-94	209	205
17-Jan-94	207	205	26-Feb-94	208	206
18-Jan-94	208	206	27-Feb-94	208	205
19-Jan-94	208	205	28-Feb-94	208	205
20-Jan-94	208	205	01-Mar-94	208	205
21-Jan-94	208	205	02-Mar-94	209	206
22-Jan-94	207	205	03-Mar-94	209	205
23-Jan-94	207	205	04-Mar-94	208	205
24-Jan-94	207	205	05-Mar-94	208	205
25-Jan-94	207	205	06-Mar-94	208	205
26-Jan-94	208	206	07-Mar-94	208	205
27-Jan-94	208	206	08-Mar-94	208	205
28-Jan-94	208	206	09-Mar-94	208	205

TABLE B-1. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
10-Mar-94	206	204	19-Apr-94	208	207
11-Mar-94	206	204	20-Apr-94	208	206
12-Mar-94	206	204	21-Apr-94	208	206
13-Mar-94	206	204	22-Apr-94	208	207
14-Mar-94	206	204	23-Apr-94	208	207
15-Mar-94	207	204	24-Apr-94	208	207
16-Mar-94	207	205	25-Apr-94	208	207
17-Mar-94	207	205	26-Apr-94	208	207
18-Mar-94	207	205	27-Apr-94	208	206
19-Mar-94	207	205	28-Apr-94	208	207
20-Mar-94	207	204	29-Apr-94	207	206
21-Mar-94	207	204	30-Apr-94	207	206
22-Mar-94	207	203	01-May-94	208	207
23-Mar-94	207	203	02-May-94	208	207
24-Mar-94	208	205	03-May-94	208	207
25-Mar-94	208	205	04-May-94	208	207
26-Mar-94	208	208	05-May-94	208	205
27-Mar-94	208	205	06-May-94	207	205
28-Mar-94	208	205	07-May-94	208	205
29-Mar-94	208	206	08-May-94	208	206
30-Mar-94	208	205	09-May-94	208	206
31-Mar-94	208	205	10-May-94	208	205
01-Apr-94	208	205	11-May-94	208	206
02-Apr-94	208	203	12-May-94	209	207
03-Apr-94	207	203	13-May-94	208	207
04-Apr-94	207	203	14-May-94	209	208
05-Apr-94	207	204	15-May-94	209	207
06-Apr-94	207	204	16-May-94	208	207
07-Apr-94	208	205	17-May-94	208	207
08-Apr-94	208	205	18-May-94	209	207
09-Apr-94	208	205	19-May-94	209	207
10-Apr-94	208	205	20-May-94	209	208
11-Apr-94	209	206	21-May-94	209	208
12-Apr-94	209	206	22-May-94	209	208
13-Apr-94	209	206	23-May-94	209	208
14-Apr-94	208	206	24-May-94	209	208
15-Apr-94	208	206	25-May-94	208	207
16-Apr-94	208	206	26-May-94	208	207
17-Apr-94	209	206	27-May-94	209	207
18-Apr-94	209	206	28-May-94	209	208

TABLE B-1. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
29-May-94	209	207	08-Jul-94	209	207
30-May-94	209	207	09-Jul-94	209	208
31-May-94	209	207	10-Jul-94	209	207
01-Jun-94	209	207	11-Jul-94	209	207
02-Jun-94	209	206	12-Jul-94	208	207
03-Jun-94	209	207	13-Jul-94	209	207
04-Jun-94	209	207	14-Jul-94	209	207
05-Jun-94	210	207	15-Jul-94	208	206
06-Jun-94	208	206	16-Jul-94	209	206
07-Jun-94	209	207	17-Jul-94	208	207
08-Jun-94	208	207	18-Jul-94	209	206
09-Jun-94	208	207	19-Jul-94	208	207
10-Jun-94	209	207	20-Jul-94	209	207
11-Jun-94	209	207	21-Jul-94	208	206
12-Jun-94	209	207	22-Jul-94	208	206
13-Jun-94	209	206	23-Jul-94	209	208
14-Jun-94	208	207	24-Jul-94	209	207
15-Jun-94	209	207	25-Jul-94	208	207
16-Jun-94	208	207	26-Jul-94	208	207
17-Jun-94	209	207	27-Jul-94	208	207
18-Jun-94	209	208	28-Jul-94	208	206
19-Jun-94	209	208	29-Jul-94	209	207
20-Jun-94	209	207	30-Jul-94	209	207
21-Jun-94	209	207	31-Jul-94	209	207
22-Jun-94	209	207	01-Aug-94	208	206
23-Jun-94	209	208	02-Aug-94	208	206
24-Jun-94	209	208	03-Aug-94	208	206
25-Jun-94	210	208	04-Aug-94	209	206
26-Jun-94	208	207	05-Aug-94	208	207
27-Jun-94	208	207	06-Aug-94	208	206
28-Jun-94	208	207	07-Aug-94	209	208
29-Jun-94	208	206	08-Aug-94	208	206
30-Jun-94	208	206	09-Aug-94	208	207
01-Jul-94	208	207	10-Aug-94	209	206
02-Jul-94	209	207	11-Aug-94	208	206
03-Jul-94	207	207	12-Aug-94	208	208
04-Jul-94	208	206	13-Aug-94	209	208
05-Jul-94	208	207	14-Aug-94	208	207
06-Jul-94	208	207	15-Aug-94	209	207
07-Jul-94	208	206	16-Aug-94	208	206

TABLE B-1. (Contd.)

Date	High, F	Low, F	Date	High, F	Low, F
17-Aug-94	208	206	11-Sep-94	208	206
18-Aug-94	209	206	12-Sep-94	208	205
19-Aug-94	209	206	13-Sep-94	208	205
20-Aug-94	209	206	14-Sep-94	210	205
21-Aug-94	209	206	15-Sep-94	208	206
22-Aug-94	209	206	16-Sep-94	208	206
23-Aug-94	208	206	17-Sep-94	208	206
24-Aug-94	208	204	18-Sep-94	209	206
25-Aug-94	210	206	19-Sep-94	208	205
26-Aug-94	209	205	20-Sep-94	208	207
27-Aug-94	208	205	21-Sep-94	208	205
28-Aug-94	208	205	22-Sep-94	208	205
29-Aug-94	208	206	23-Sep-94	208	206
30-Aug-94	208	206	24-Sep-94	208	206
31-Aug-94	209	206	25-Sep-94	208	206
01-Sep-94	208	206	26-Sep-94	208	205
02-Sep-94	209	207	27-Sep-94	208	206
03-Sep-94	210	207	28-Sep-94	208	206
04-Sep-94	209	204	29-Sep-94	208	205
05-Sep-94	208	206	30-Sep-94	208	206
06-Sep-94	208	205			
07-Sep-94	208	206			
08-Sep-94	209	205			
09-Sep-94	209	206			
10-Sep-94	207	205			

Appendix C

WELL TEMPERATURE DATA

TABLE C-1. Well 4K-1 Temperature.

6 Jan 94		24 Apr 94		21 Sep 94	
Depth, ft	Temp, °F	Depth, ft	Temp, °F	Depth, ft	Temp, °F
0	204.3	0	203.7	0	205.3
-5	204.4	-5	203.7	-5	205.3
-10	204.4	-10	203.7	-10	205.3
-15	204.4	-15	203.7	-15	205.3
-20	204.4	-20	203.7	-20	205.3
-25	204.4	-25	203.7	-25	205.3
-30	204.4	-30	203.7	-30	205.3
-35	204.4	-35	203.7	-35	205.3
-40	204.4	-40	203.7	-40	205.3
-45	204.4	-45	203.7	-45	205.3
-50	204.9	-50	208.0	-50	206.4
-55	208.0	-55	208.6	-55	208.8
-60	209.5	-60	209.8	-60	210.6
-65	209.7	-65	209.8	-65	210.7
-70	209.8	-70	210.9	-70	211.5
-75	210.7	-75	210.4	-75	211.5
-80	210.2	-80	210.4	-80	211.3
-84	210.4	-85	210.2	-82	211.5

TABLE C-2. Well 4P-1 Temperature.

6 Jan 94		24 Apr 94		21 Sep 94	
Depth, ft	Temp, °F	Depth, ft	Temp, °F	Depth, ft	Temp, °F
0		0	179.8	0	205.0
-5	204.8	-5	204.4	-5	205.9
-10	204.8	-10	204.4	-10	205.9
-15	204.8	-15	204.6	-15	205.9
-20	204.8	-20	204.6	-20	205.9
-25	204.8	-25	204.6	-25	205.9
-30	204.8	-30	204.6	-30	205.9
-35	204.8	-35	204.6	-35	206.1
-40	204.8	-40	204.6	-40	206.1
-45	204.8	-45	204.8	-45	206.1
-50	205.7	-50	206.1	-50	206.1
-55	208.0	-55	209.8	-55	209.3
-60	211.8	-60	213.1	-60	214.0
-65	215.8	-65	217.0	-65	217.4
-70	217.9	-70	218.7	-70	220.1
-75	218.1	-75	218.8	-75	220.3
-80	218.5	-80	219.2	-80	220.5
-85	218.8	-85	219.7	-85	222.4
-90	222.4	-90	225.1	-90	225.0
-95	228.9	-95	231.1	-95	231.6
-100	241.9	-100	239.9	-100	243.1
-105	244.0	-105	240.1	-103	245.3

TABLE C-3. Well 4A-4 Temperature.

6 Jan 94		24 Apr 94		21 Sep 94	
Depth, ft	Temp, °F	Depth, ft	Temp, °F	Depth, ft	Temp, °F
0	204.8	0	204.6	0	206
-5	204.9	-5	204.6	-5	206
-10	204.9	-10	204.6	-10	206
-15	205.7	-15	204.6	-15	206
-20	206.1	-20	205.7	-20	207
-25	207.7	-25	207.5	-25	207
-30	214.3	-30	211.3	-30	211
-31	214.5	-35	211.5	-31	211

TABLE C-4. Well OB-1 Temperature.

10 Jan 94		24 Apr 94		21 Sep 94	
Depth, ft	Temp, °F	Depth, ft	Temp, °F	Depth, ft	Temp, °F
0	60	0	70.3	0	92.5
-25	67	-25	70.5	-25	84.0
-50	69	-50	72.5	-50	81.1
-75	71	-75	73.8	-75	80.6
-100	73	-100	75.0	-100	81.0
-125	77	-125	76.8	-125	82.4
-150	80	-150	81.5	-150	82.9
-160	81	-160	84.6	-160	83.5
-170	85	-170	84.6	-170	85.1
-180	85	-180	85.1	-180	85.5
-190	86	-190	85.6	-190	85.8
-200	86	-200	86.5	-200	86.7
-210	87	-210	86.7	-210	87.1
		-220	86.7	-214	87.1

TABLE C-5. Well OB-3 Temperature.

10 Jan 94		24 Apr 94		21 Sep 94	
Depth, ft	Temp, °F	Depth, ft	Temp, °F	Depth, ft	Temp, °F
0	61.9	0	63.3	0	93.0
-25	63.7	-25	65.5	-25	75.4
-50	66.0	-50	68.2	-50	70.5
-75	67.3	-75	70.3	-75	72.1
-100	68.4	-100	72.0	-100	72.5
-125	69.6	-125	74.5	-125	73.0
-150	71.1	-150	77.2	-150	73.9
-175	73.0	-175	79.9	-175	75.2
-200	75.2	-200	82.0	-200	76.5
-225	78.4	-225	85.1	-225	78.1
-250	81.7	-250	91.4	-250	80.1
-275	86.7	-275	88.0	-275	85.3
-300	89.6	-300	90.0	-300	88.9
-325	91.4	-325	90.9	-325	90.7
-350	93.7	-350	92.5	-350	92.7
-375	93.2	-375	97.9	-375	98.2
-385	98.1	-385	98.1	-385	98.6
-395	98.2	-395	98.2	-395	98.6
-405	98.2	-405	98.4	-405	98.8
-415	98.4	-415	98.8	-415	99.0
-425	98.8	-425	99.1	-425	99.7
-435	99.5	-435	99.8	-435	100.2
-445	100.0	-445	99.9	-445	101.8
-455	100.0	-455	99.9	-455	100.6
-465	100.0	-465	99.9	-465	100.6
-475	100.0	-475	100.0	-475	100.6
		-485	99.9	-485	100.6

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