

## Area 18

### Deer Creek Mine 2nd through 7th Right Longwall Panels

Longwall mining in this area was completed in May, 1992 with the extraction of six adjacent longwall panels (figure 60). The 3rd and 4th Right panels were terminated short of the entire panel due to geologic complications. The land surface in the area of these panels contains steep slopes covered by conifer and aspen trees, and sagebrush. The longwall panels have overburden ranging from 1,800 feet on the west end of the panels to 2,000 feet on the east side of the panels.

Subsidence in this area has reached a maximum of seven (7) feet (Figures 61, 62, and 63) and has been stable since 1992. The subsidence zone is a broad trough running in a north - south direction. This area is overlain by several springs. Monitoring of these springs has shown no change in the quality or quantity of water discharged from them (see appendix and the 1995 Hydrologic Monitoring report).

E 2,092,000

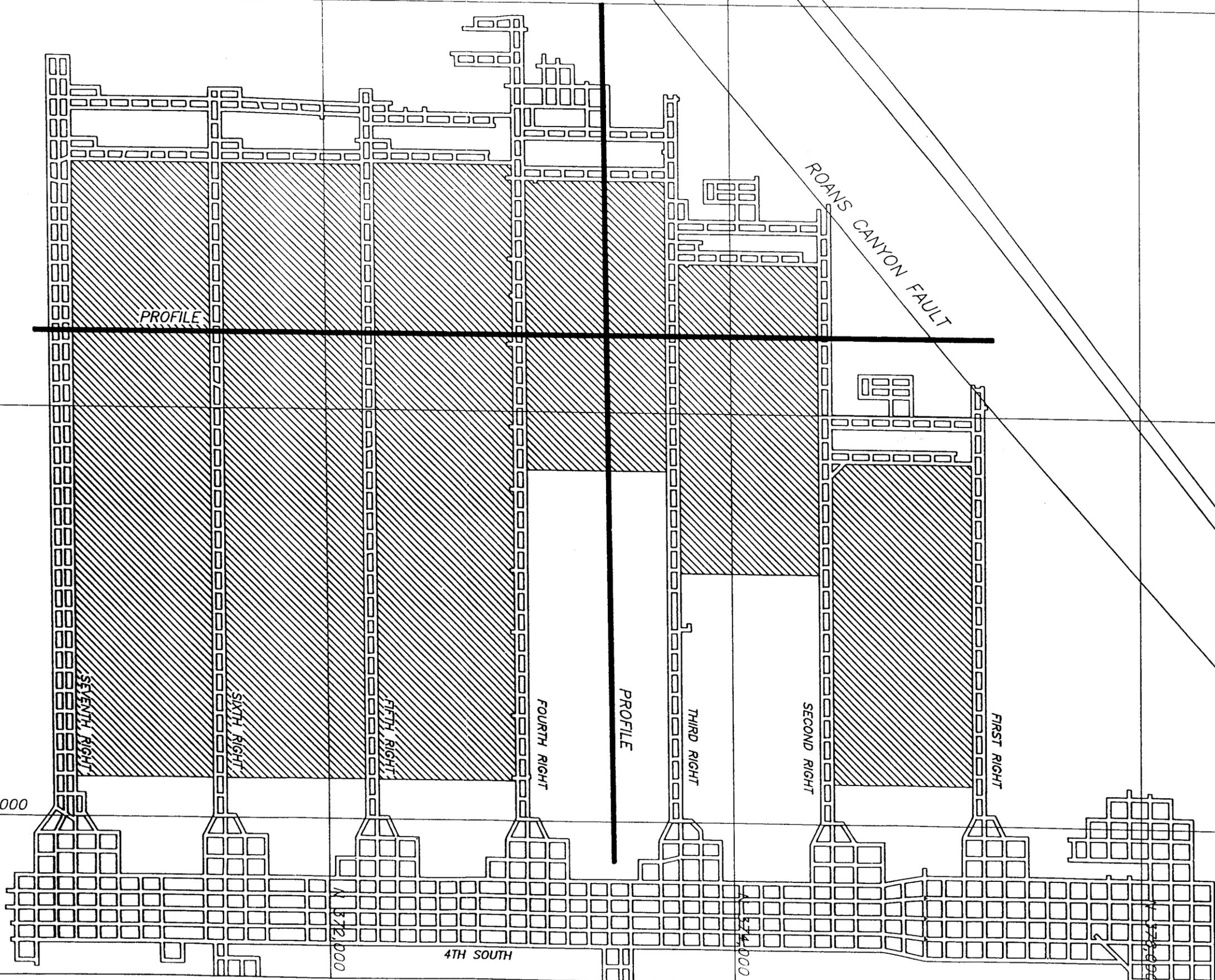
E 2,094,000

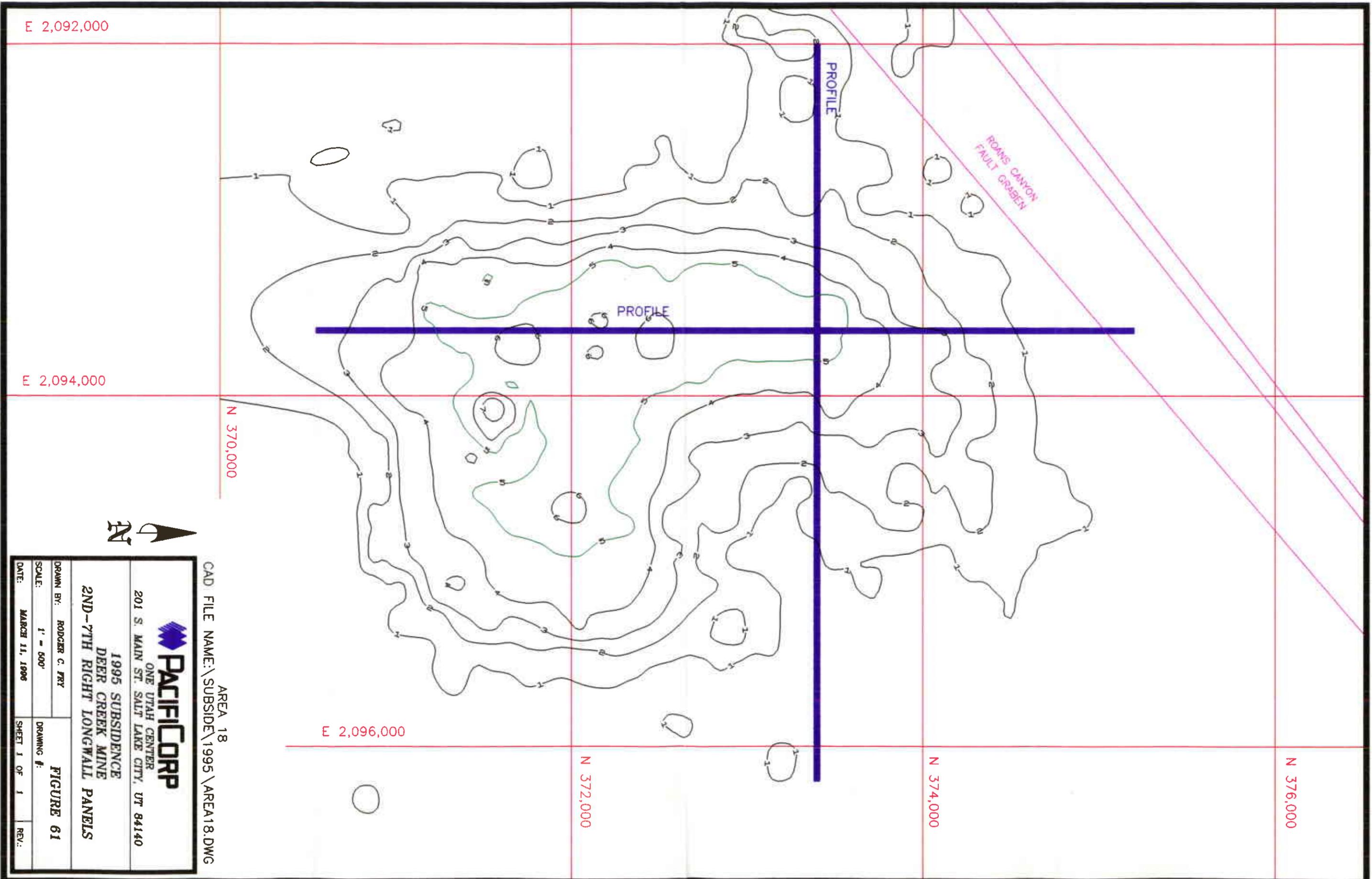


PACIFICORP ELECTRIC OPERATIONS FUEL RESOURCES DEPARTMENT <small>P.O. BOX 26128 SALT LAKE CITY, UTAH 84126-0128</small>		AREA 18 OLD FILE NAME/DISK# 915UB7R
DEER CREEK MINE 2nd-7th RIGHT LONGWALL PANELS		
DRAWN BY: J. GARRETT SCALE: 1"=500' DATE: MARCH 16, 1993	DRAWING #: SHEET 1 OF 1	FIGURE 60 REV.

E 2,096,000

N 370,000





AREA 18  
 CAD FILE NAME: \SUBSIDE\1995\AREA18.DWG



ONE UTAH CENTER  
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

1995 SUBSIDENCE  
 DEER CREEK MINE  
 2ND-7TH RIGHT LONGWALL PANELS

DRAWN BY: RODGER C. FRY	DRAWING #:	FIGURE 61	REV.:
SCALE: 1" = 500'	SHEET 1 OF 1		
DATE: MARCH 11, 1996			

FIGURE 62  
AREA 18 SUBSIDENCE PROFILE  
NORTH-SOUTH

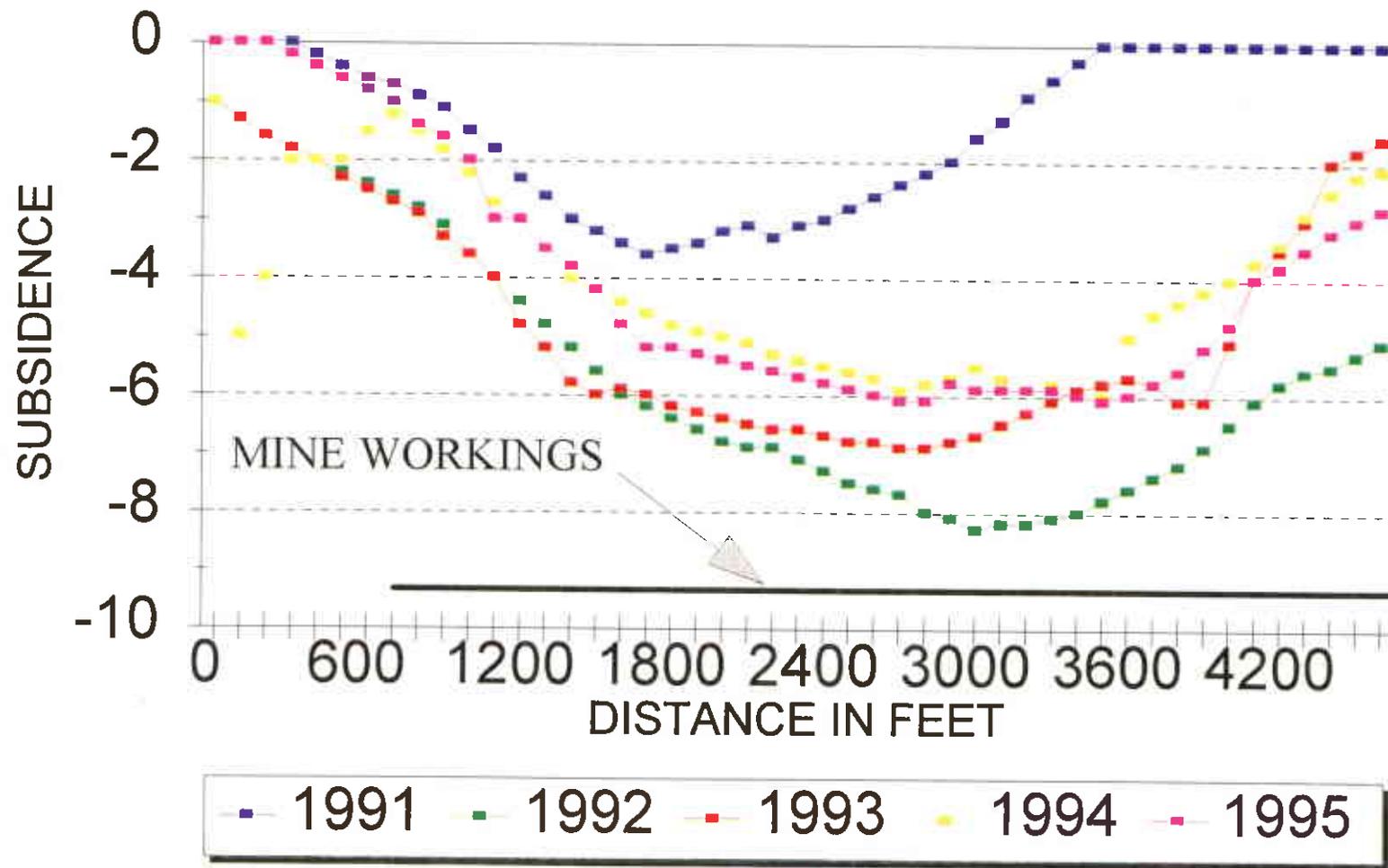
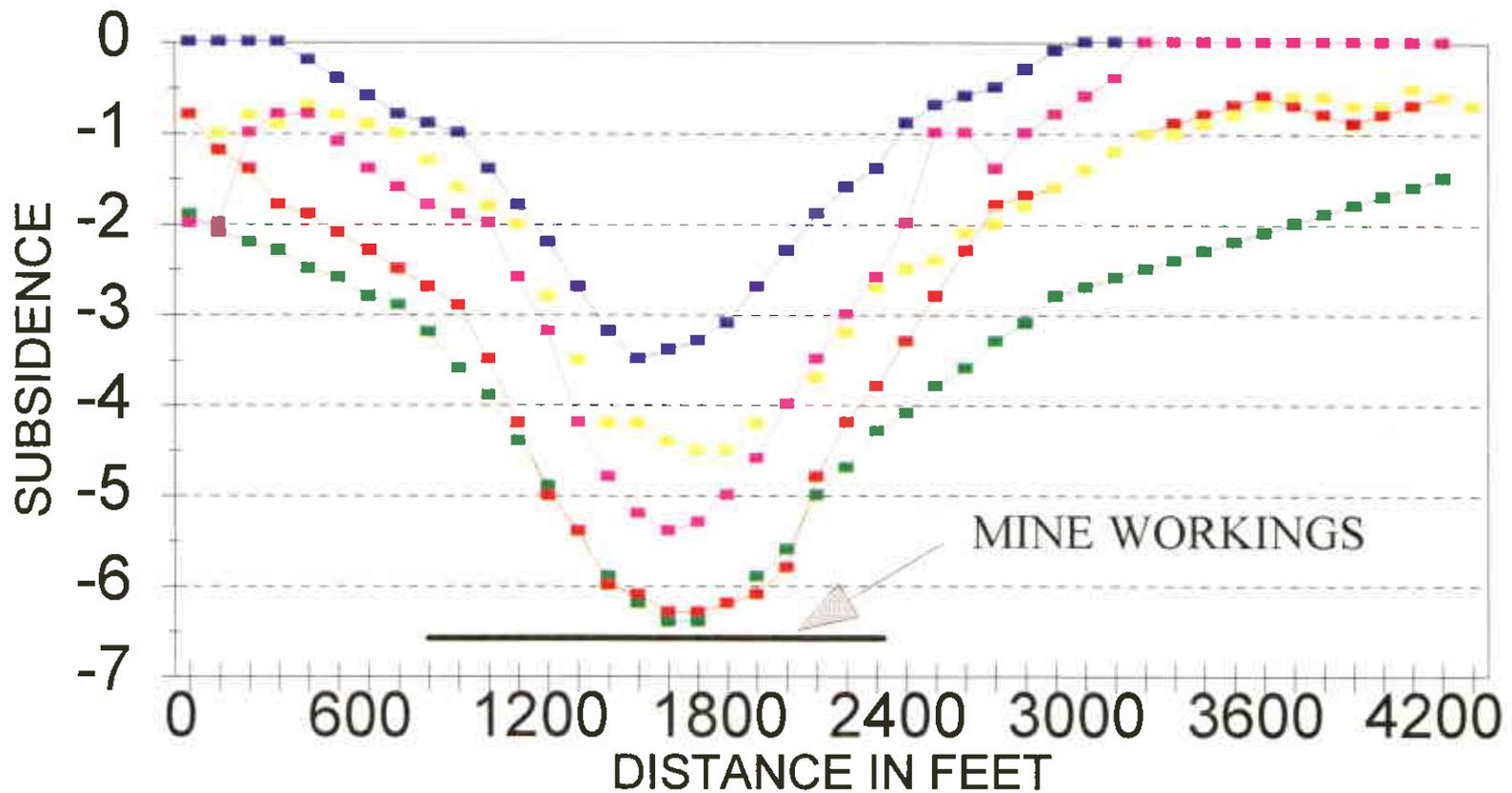


FIGURE 63  
**AREA 18 SUBSIDENCE PROFILE**  
WEST-EAST



■ 1991   ■ 1992   ■ 1993   ■ 1994   ■ 1995

## Area 19

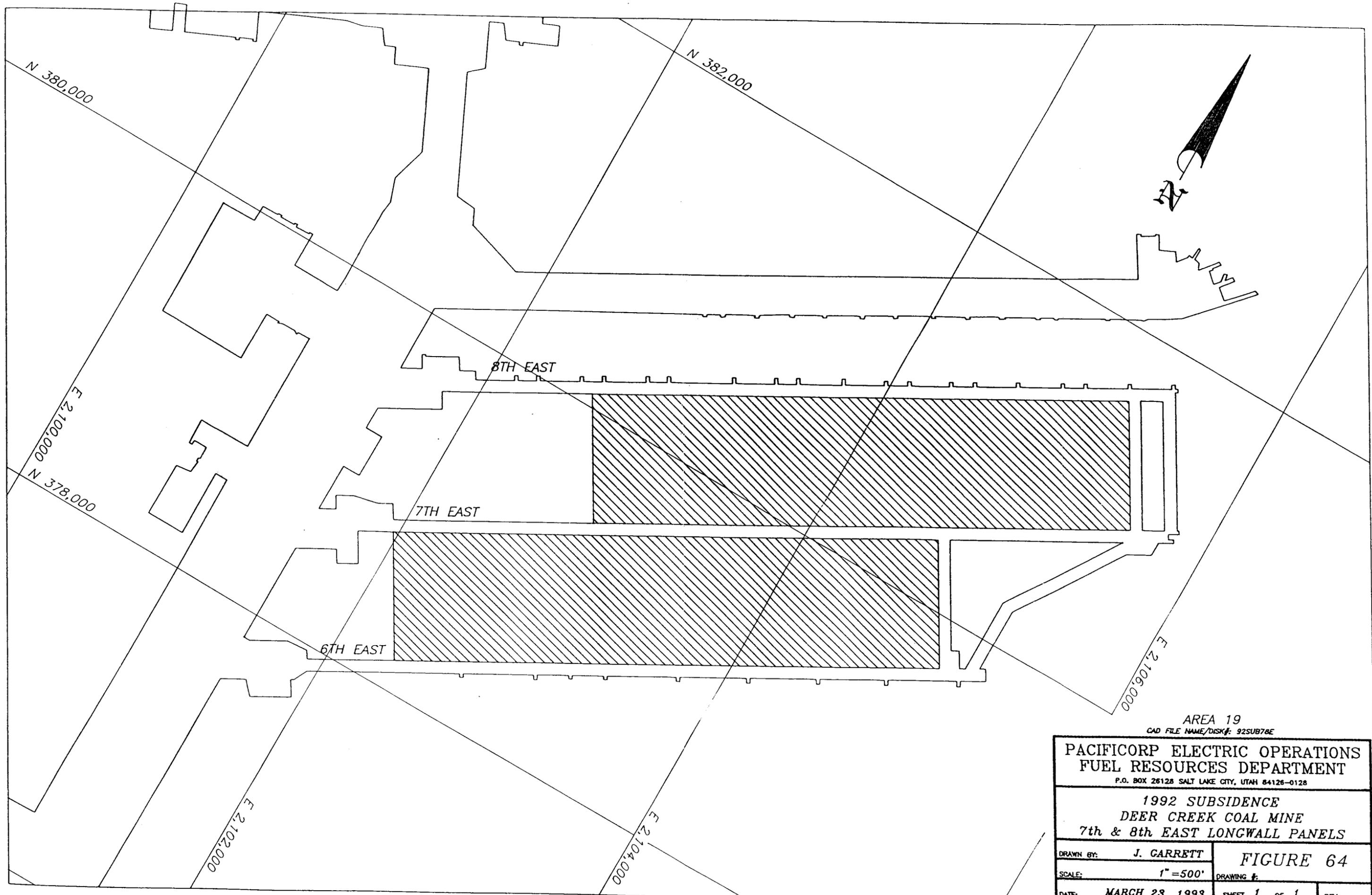
### Deer Creek 7th and 8th East Longwall Panels off 3rd North

Mining in the 7th East Longwall Panel began in May, 1992 and by January 1993 mining was completed in the 8th East Longwall Panel (Figure 64).

The land surface above these two panels is very rugged. The longwall panels are located beneath a ridge located between the left and right forks of Meetinghouse Canyon. The area is covered by sagebrush on the south facing slopes and dense stands of spruce trees on the north facing slopes. The overburden in the area of these panels ranges from 400 feet on the north to over 1,800 feet on the south.

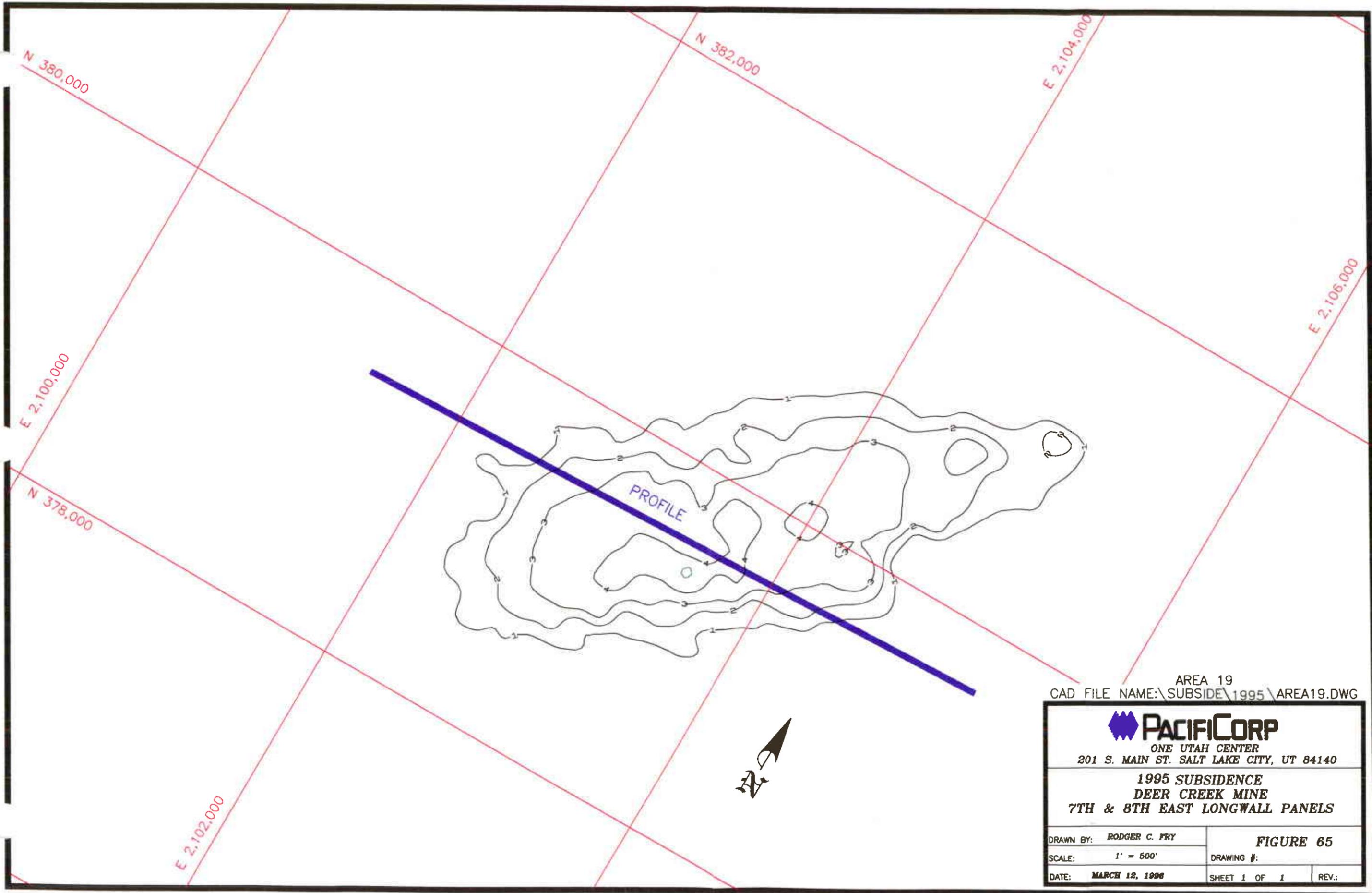
Subsidence in this area has increased from slightly over one foot in 1992 to over three feet in 1993 but has been stable between 1993 and 1995 (Figures 65 and 66).

This area is overlain by a few springs. Monitoring of these springs has shown no change in the quality or quantity of water discharged from them (see appendix and the 1995 Hydrologic Monitoring Report).



AREA 19  
 CAD FILE NAME/DISK#: 92SUB78E

<b>PACIFICORP ELECTRIC OPERATIONS</b> <b>FUEL RESOURCES DEPARTMENT</b> <small>P.O. BOX 26128 SALT LAKE CITY, UTAH 84126-0128</small>	
1992 SUBSIDENCE DEER CREEK COAL MINE 7th & 8th EAST LONGWALL PANELS	
DRAWN BY: J. GARRETT	<b>FIGURE 64</b>
SCALE: 1" = 500'	DRAWING #:
DATE: MARCH 23, 1993	SHEET 1 OF 1 REV.



AREA 19  
 CAD FILE NAME: \SUBSIDE\1995\AREA19.DWG

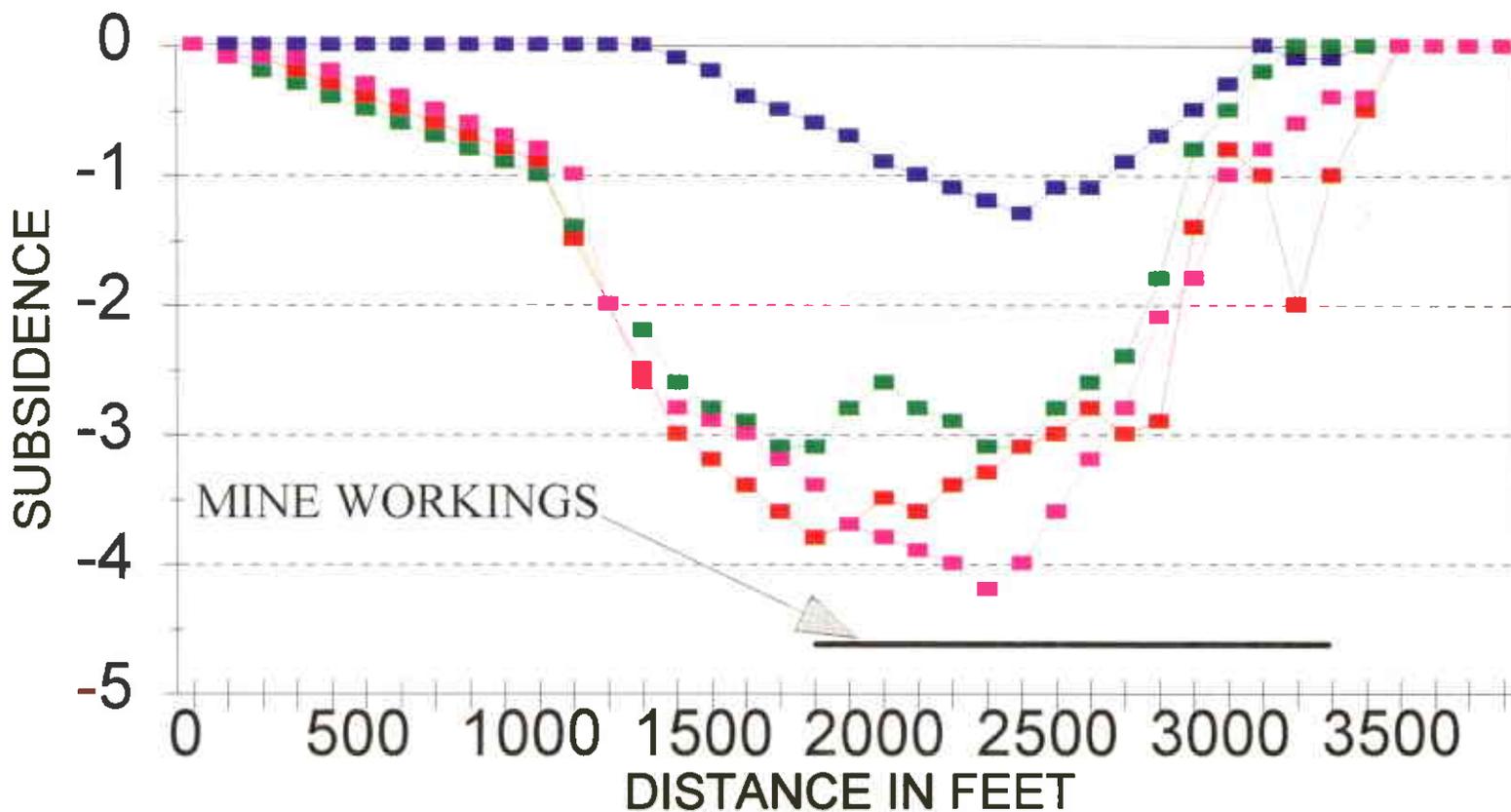


ONE UTAH CENTER  
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

**1995 SUBSIDENCE  
 DEER CREEK MINE  
 7TH & 8TH EAST LONGWALL PANELS**

DRAWN BY: <b>RODGER C. FRY</b>		<b>FIGURE 65</b>	
SCALE: <b>1' = 500'</b>		DRAWING #:	
DATE: <b>MARCH 12, 1998</b>	SHEET <b>1</b> OF <b>1</b>	REV.:	

FIGURE 66  
**AREA 19 SUBSIDENCE PROFILE**  
WEST-EAST



■ 1992   ■ 1993   ■ 1994   ■ 1995

## Area 20

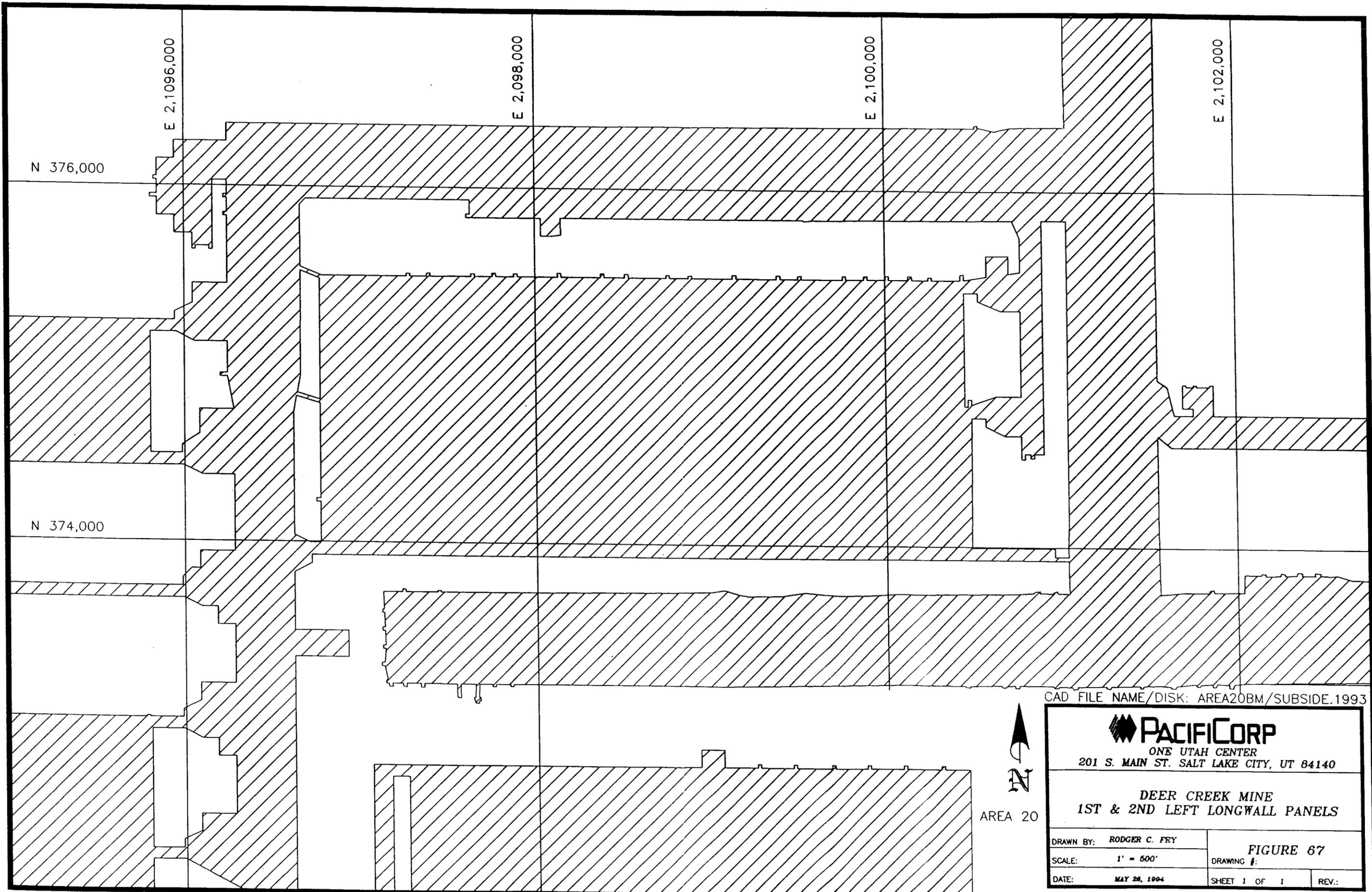
### Deer Creek 1st & 2nd Left Longwall Panels off 3 ½ South

Mining in the 2nd Left Longwall Panel began in February 1993 and was completed in June 1993. Mining then started in the 1st Left Longwall Panel in July 1993 and was completed in November of 1993 (Figure 67).

These longwall panels are overlain by moderately steep slopes that are heavily covered with aspen and spruce trees. The overburden above these panels range from 1,400 feet at their east end to over 2,000 feet above their west end.

The monitoring detected a maximum of slightly over four (4) feet of subsidence above the 2nd Left Longwall Panel. The measurements made in 1995 showed an average of a foot less subsidence than the measurements made in 1994 (Figures 68 and 69). It is believed that subsidence in this area is substantially complete. All of the subsidence detected falls within the bounds of the longwall area. Therefore; the angle of draw in this area is considered to be steeper than 10°.

These longwall panels are overlain by several springs. Monitoring of the springs revealed no impacts due to the subsidence.



CAD FILE NAME/DISK: AREA20BM/SUBSIDE.1993



AREA 20

 <b>PACIFICORP</b> ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140	
<b>DEER CREEK MINE</b> <b>1ST &amp; 2ND LEFT LONGWALL PANELS</b>	
DRAWN BY: RODGER C. FEY	<b>FIGURE 67</b>
SCALE: 1" = 500'	DRAWING #:
DATE: MAY 28, 1994	SHEET 1 OF 1    REV.:

N 376,000

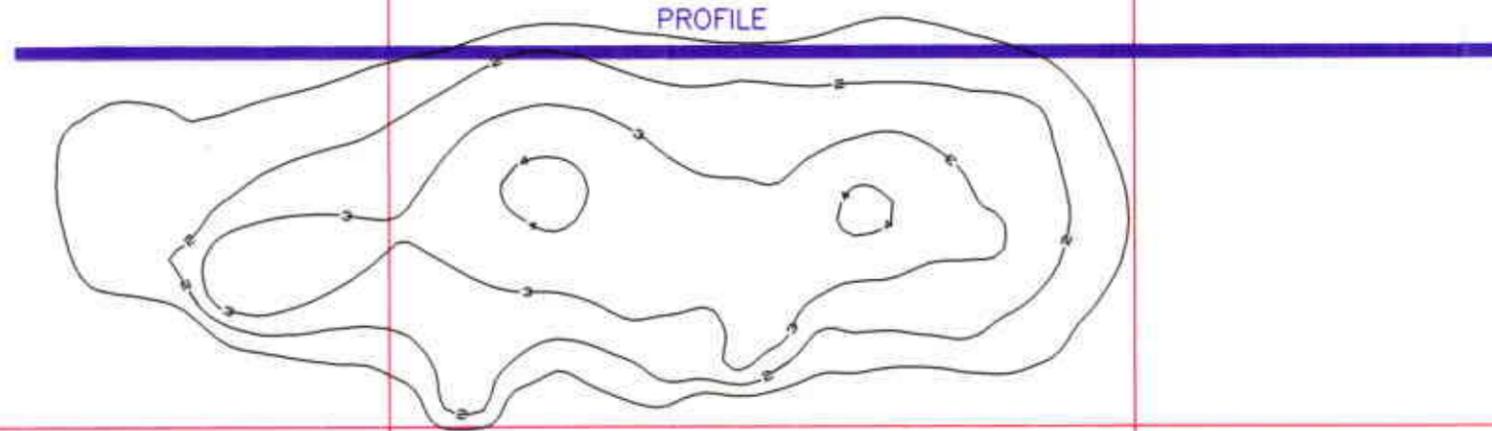
N 374,000

E 2,096,000

E 2,098,000

E 2,100,000

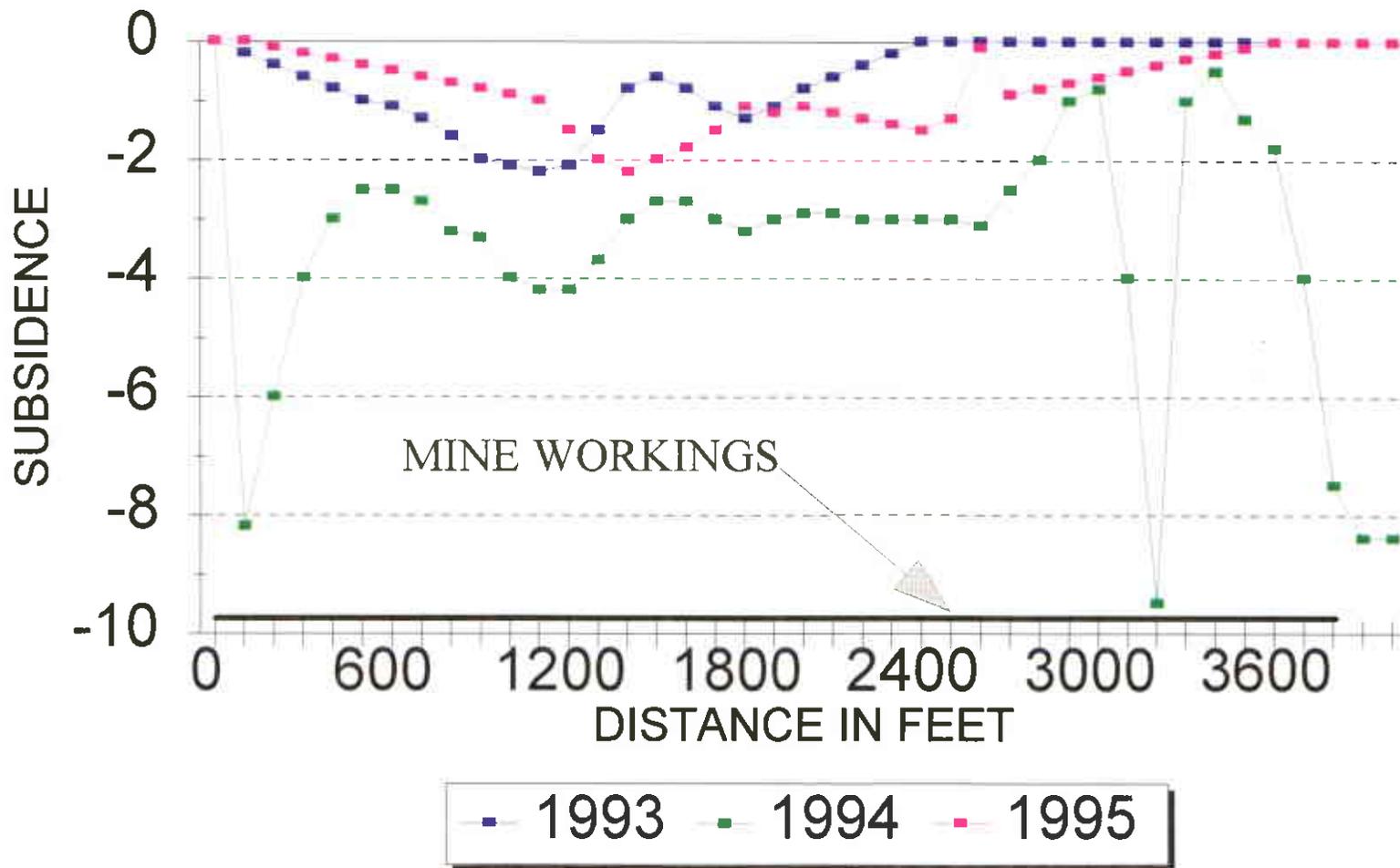
E 2,102,000



AREA 20  
CAD FILE NAME: \SUBSIDE\1995\AREA20.DWG

 <b>PACIFICORP</b> ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140		
<b>1995 SUBSIDENCE DEER CREEK MINE 1ST &amp; 2ND LEFT LONGWALL PANELS</b>		
DRAWN BY: RODGER C. FRY	<b>FIGURE 68</b>	
SCALE: 1" = 500'	DRAWING #:	
DATE: MARCH 12, 1998	SHEET 1 OF 1	REV.:

FIGURE 69  
**AREA 20 SUBSIDENCE PROFILE**  
WEST-EAST



## Area 21

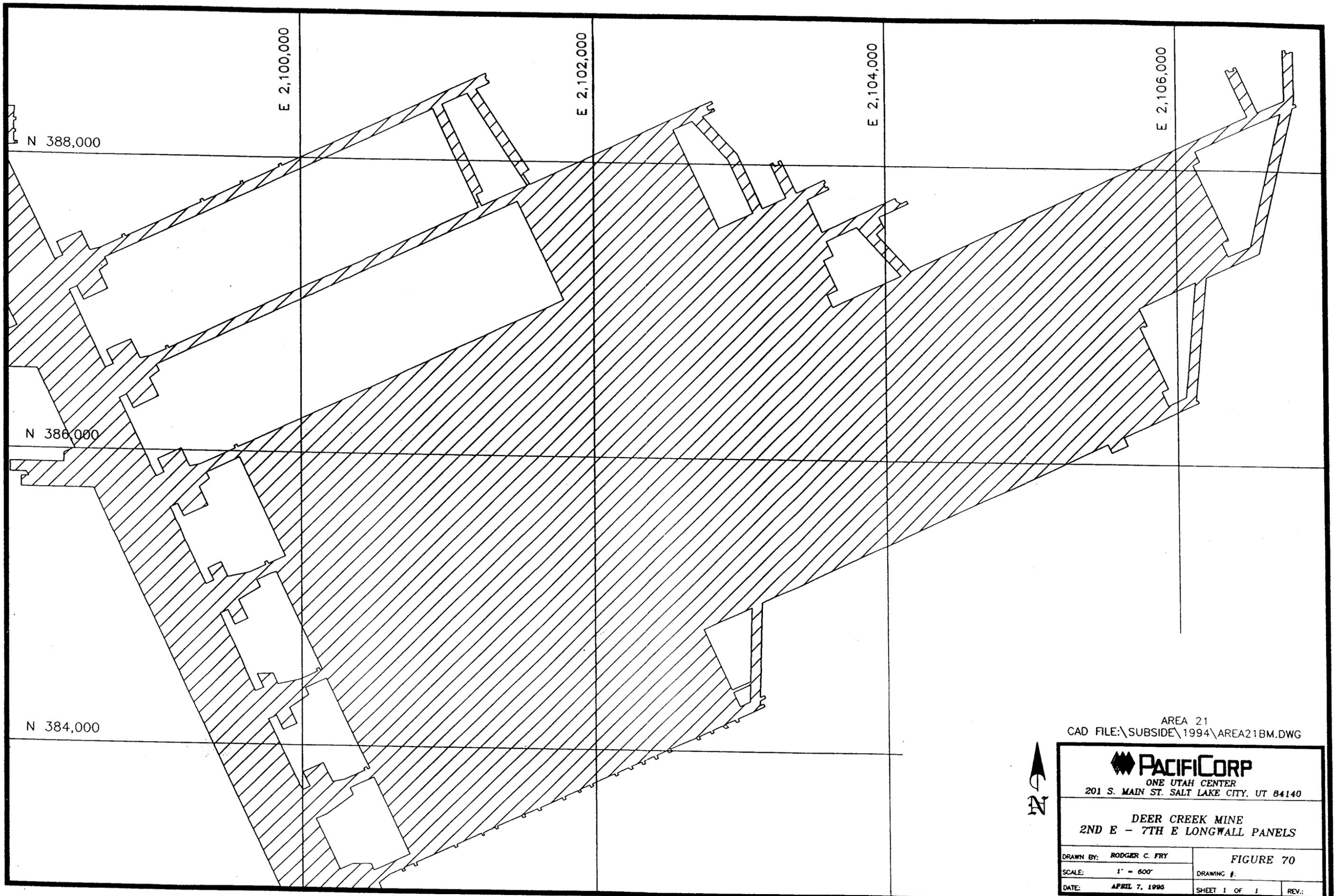
### Deer Creek Mine 2nd East Through 7th East Longwall Panels

Mining in the 2nd East Longwall panel began in November of 1993 and by the End of August 1995 longwall mining had removed all of the 2nd through 5th East Longwall Panels and the eastern 1,100 feet of the 6th East Longwall Panel (Figure 70). Mining in this area, including the remainder of the 6th East and all of the 7th East Longwall Panels, was completed in January 1996.

The topography in this area is fairly rugged. A ridge along the south side of Rilda Canyon is located through the center of the area. The slopes leading down from this ridge to Rilda Canyon on the north are heavily vegetated with conifer trees. Overburden in this area ranges from less than 200 feet in the north to greater than 1,800 feet beneath the ridge top.

Subsidence detected in 1994 had reached a maximum of over four (4) feet above the 2nd East Longwall Panel (Figures 71, 72 and 73). Subsidence over the 3rd East longwall panel was not detected because this panel is longer than the 2nd East panel and subsidence doesn't usually occur until two panel widths have been mined. In 1995, subsidence had progressed to where most of the areas underlain by the 2nd through 6th East Longwall Panels had subsided between 5 and 6 feet. Because subsidence is not complete in this area, no angle of draw was calculated.

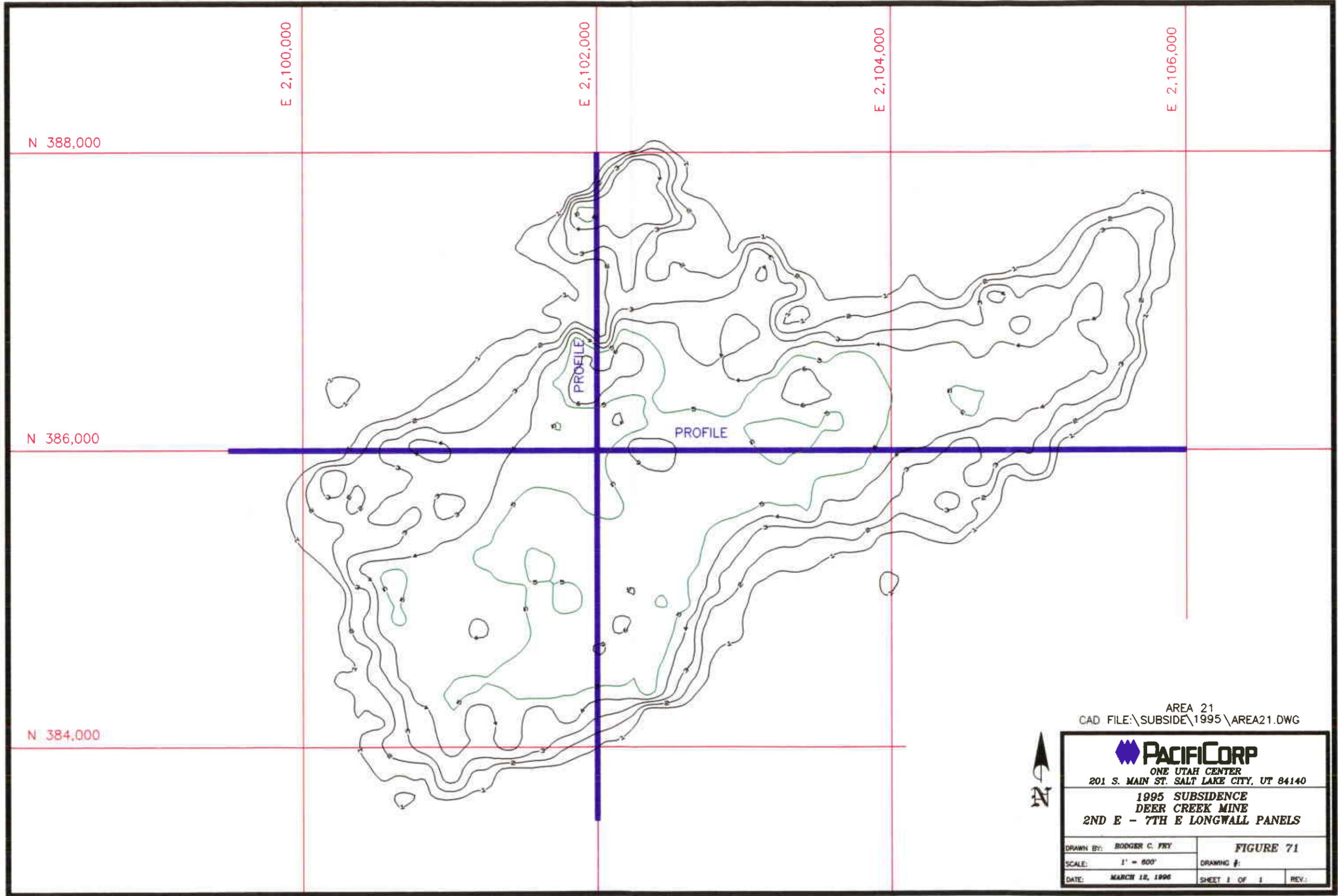
Several springs are located above these longwall panel. However, hydrologic monitoring has not detected any change to the spring flow that is attributable to mining (see 1995 Hydrologic Monitoring Report).



AREA 21  
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 <b>PACIFICORP</b> ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140		
<b>DEER CREEK MINE</b> <b>2ND E - 7TH E LONGWALL PANELS</b>		
DRAWN BY: <b>RODGER C. FRY</b>	<b>FIGURE 70</b>	
SCALE: <b>1" = 600'</b>	DRAWING #	
DATE: <b>APRIL 7, 1995</b>	SHEET 1 OF 1	REV.:



AREA 21  
 CAD FILE:\SUBSIDE\1995\AREA21.DWG



**PACIFICORP**

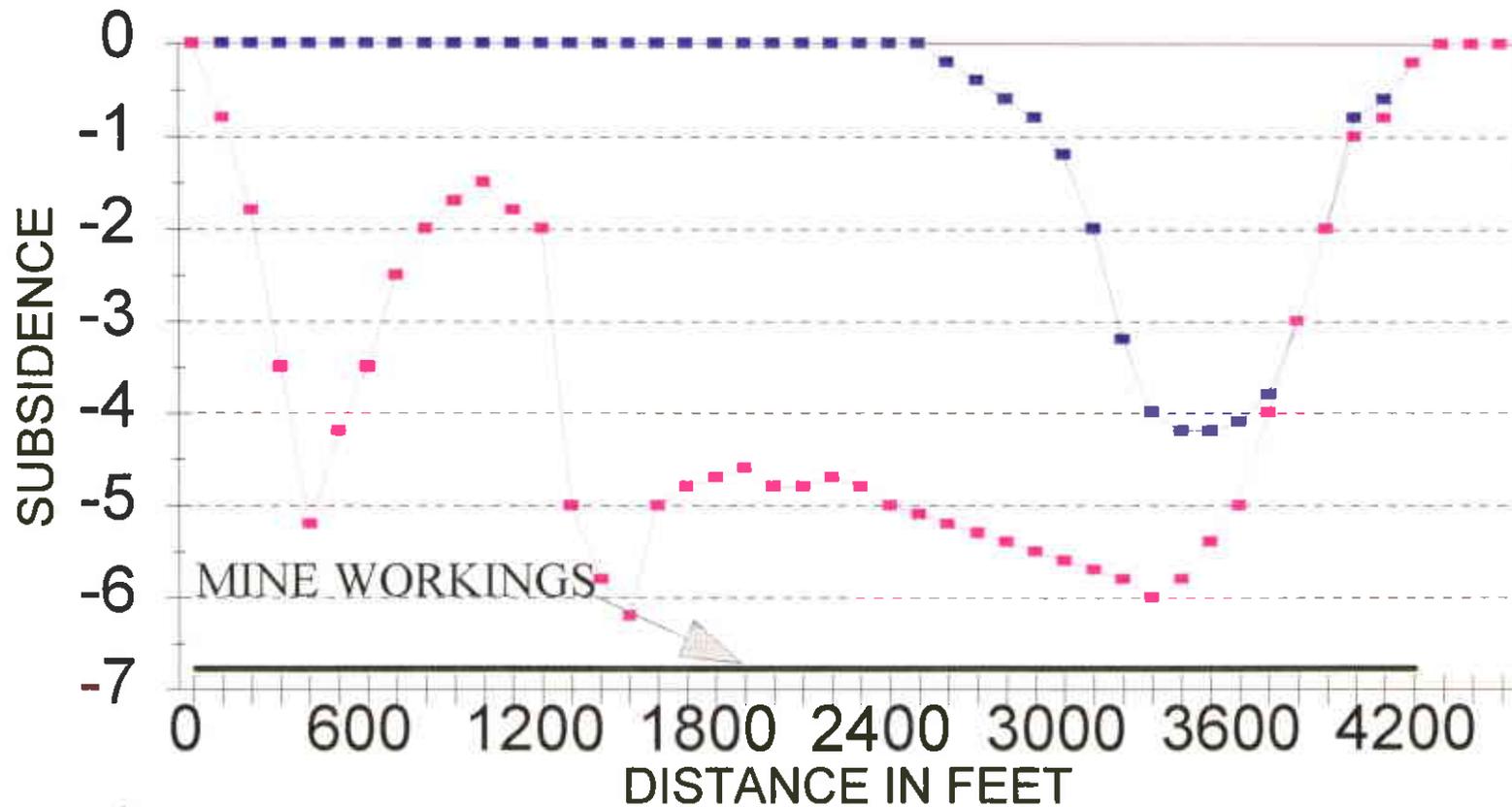
ONE UTAH CENTER  
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

1995 SUBSIDENCE  
 DEER CREEK MINE  
 2ND E - 7TH E LONGWALL PANELS

DRAWN BY: RODGER C. FRY	FIGURE 71	
SCALE: 1" = 600'	DRAWING #:	
DATE: MARCH 12, 1996	SHEET 1 OF 1	REV.:

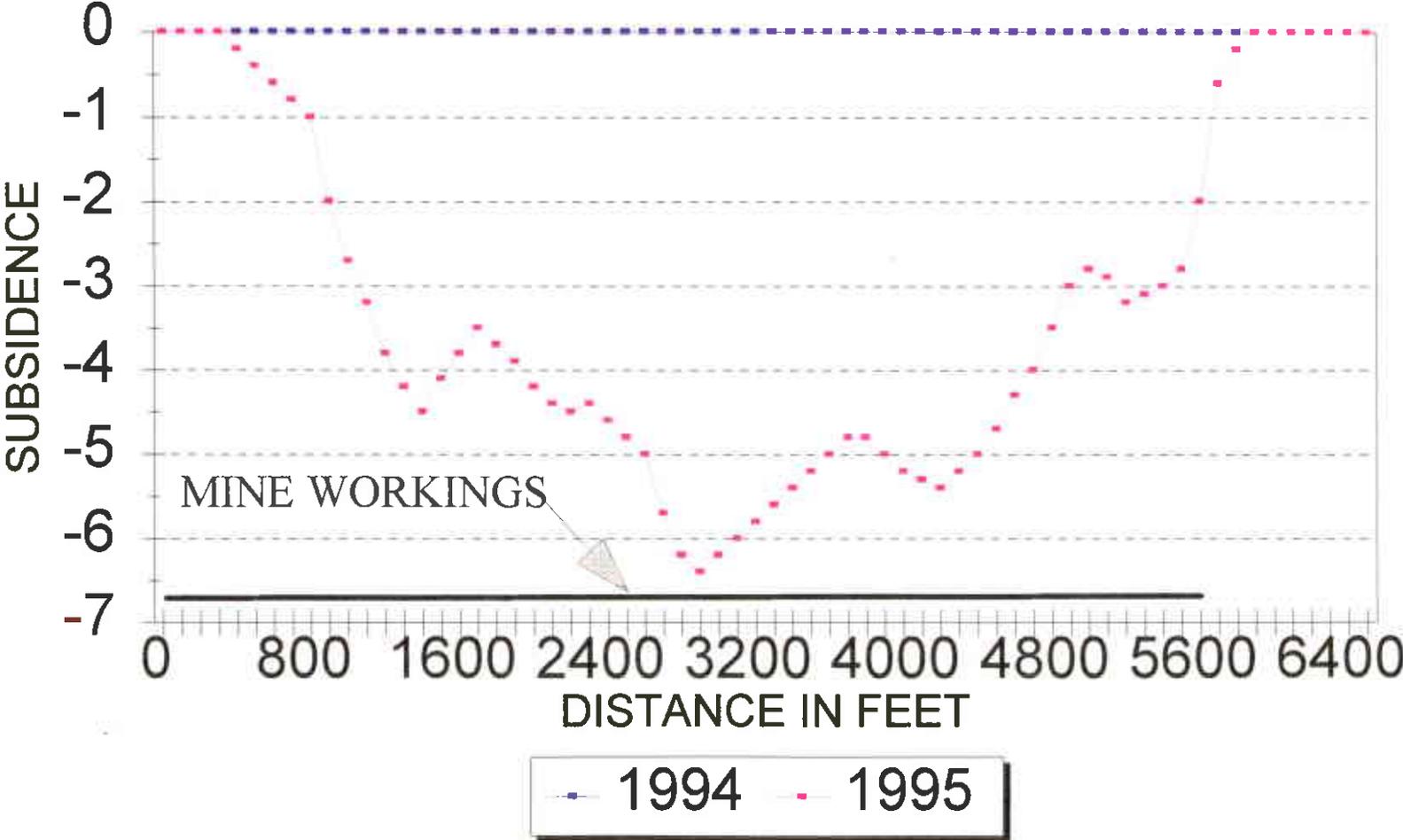
FIGURE 72

# AREA 21 SUBSIDENCE PROFILE NORTH-SOUTH



■ 1994 ■ 1995

FIGURE 73  
**AREA 21 SUBSIDENCE PROFILE**  
WEST-EAST



### Predicted Maximum Subsidence

A comparison between observed and predicted maximum subsidence for the various areas on PacifiCorp's property has been made using a method developed by the British National Coal Board (NCB). The NCB method utilizes graphs compiled from numerous field observations and takes into consideration the length and width of the mined-out area, thickness of coal extracted, and depth of cover. The method is claimed to be correct to  $\pm 10\%$  in the majority of cases, assuming certain limiting conditions are met. The table below compares predicted maximum subsidence with observed subsidence for areas on East Mountain.

Area	Subsidence (feet)		
	Predicted Maximum	Observed	% of Predicted
1* DC 9E/W 1R	15.2	28.0	184
2 DC 5-8E/W, 3-13R	13.8	13.1	95
3 DC 1N Area 7.7	7.7	5.5	71
4 DC 2-17R	13.6	13.5	99
5 DC 2-5L	7.6	5.8	76
6 W 1-2W	5.0	4.5	90
7 Bee 2N off 8W	6.6	5.5	83
8 Bee/Des E&W Sections	6.8	4.8	71
9 LD 1N	4.3	3.5	81
10 Old American Fuel Mine	7.0	6.1	87
11 DC C&D N	5.9	4.5	76
12 W 2L	1.5	0.0	0

Area	Subsidence (feet)		
	Predicted Maximum	Observed	% of Predicted
13 Des-Bee-Dove Southern Areas	2.0	1.8	90
14 Cottonwood 6-7E	7.6	9.0	118
15 Cottonwood 9-12W	7.2	5.0	69
16 Cottonwood 8-11E	8.1	11.0	135
17 Cottonwood 16-15 W	8.1	7.2	89
18 Deer Creek 2nd-7th R	7.7	8.0	104
19 Deer Creek 7th & 8th E	7.9	1.2	15
20 Deer Creek 1st & 2nd L	7.8	4.1	52
21 Deer Creek 2nd - 7th E	7.5	6.0	80

\* This area does not fit the NCB prediction model.

In most areas subsidence is less than the maximum predicted by the NCB model. The observed subsidence shown here represents the actual maximum subsidence for the particular geologic conditions -- probably the case in some areas since subsidence appears to have ceased in several areas where the NCB predicted maxima were not reached. In areas showing greater than expected subsidence, chain pillars or barriers between sections are probably crushing so that strata above the working caves as it would if a wider zone had been mined.

## Mitigation of Surface Effects

Prior to mining in an area, we notify the land owner that mining will be in progress beneath his property. The land owners within our permit boundary are as follows:

Karl A. Seely, Inc.

LDS Church

US Forest Service

US Bureau of Land Management

Elk Springs Property Users Assn.

Kent Barton

We will continue to notify those owners prior to undermining their properties.

Over most areas where subsidence has been observed on East Mountain, present land use has not been affected in any way. Areas 2, 5, 6, 8, 9, 10, 12, 13, 15, 16, 17, 18, 19, 20 and 21 are good examples of subsidence without visible surface disturbance or adverse hydrologic effects. In such areas no mitigation is necessary.

In a few areas, such as Areas 1, 3, 4, 7, 10, 11, and 14, surface fractures have been detected. In order to protect livestock PacifiCorp has erected a fence around Area 1 where fractures are of sufficient magnitude to pose a threat to wandering cattle. In Area 4, the small tension fractures that formed were reclaimed by filling in the fractures using a motor-grader and reseeding the area. In Area 14, where cracks have also been observed, the U.S. Forest Service has determined that no fencing or other measures are needed unless "significant change" occurs in the area. This area

has stabilized and the fractures have closed off. PacifiCorp will submit a reclamation proposal to the Forest Service regarding the Fractures that formed in Area 1. After an approved plan has been formulated it will be reclaimed.

In Areas 3, 7, 10 and 11, where only minor fracturing has occurred on remote ridges and/or where land use has not been affected, more damage would be done by gaining access to and repairing or fencing fractures than can be justified; therefore, mitigation is counterproductive in those areas and is not planned.

## Summary

As of August 1995 PacifiCorp has identified twenty-one (21) areas of mining-induced subsidence on the East Mountain property. Terrain in the subsidence areas ranges from relatively flat mountain tops with thick overburden of up to 2,100 feet to steep slopes and cliffs with overburden of less than 200 feet. The most noticeable subsidence effects occur in the steep cliff areas and where mining next to burned coal appears to have caused crushing of the clinker beds. Most of the fractures observed over mined areas have occurred under these conditions, especially where the Castlegate Sandstone (or similar lithologic unit) crops out or is near the surface. The sandstones yield to stress by brittle deformation (fracturing). The remaining fractures which have been discovered are reactivated surface traces of the Bear Creek Canyon or Deer Creek faults.

In areas where overburden is thicker and other, more clay-rich formations crop out, longwall and room-and-pillar mining methods have allowed the multiple seam mining of large quantities of coal without apparent impact on the environment because the overburden yields through plastic deformation. Areas such as the Beehive-Deseret east and west room-and-pillar sections (Areas 8 and 13) and the Deer Creek 4th through 8th East-Wilberg 3rd through 13th Right longwall panels (Area 2) have demonstrated that subsidence can occur over a broad area with no visible or hydrologic effects. In excess of eighty percent (80%) of the East Mountain property has conditions similar to those areas; therefore, the mining methods being utilized are well suited to the geologic conditions, allowing subsidence to occur without impacting the hydrology or present land use of the area.

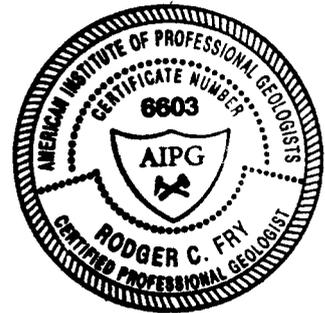
An effort was made again this year to predict maximum possible subsidence for the various areas where subsidence has been detected. The prediction was then compared with observed

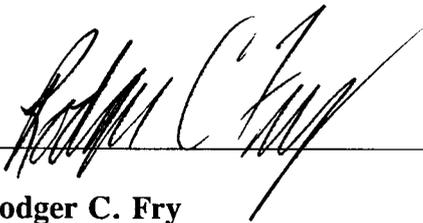
subsidence for each area. It appears that the actual subsidence occurring on East Mountain is slightly less than that predicted by the NCB model.

## Professional Certification of Subsidence Data

I, Rodger C. Fry being a Certified Professional Geologist, with significant experience in subsidence monitoring, certify that the subsidence data contained in this document was collected under my direction, and the attached subsidence materials were prepared by me using industry-accepted methods. I further certify that the interpretations contained herein are an accurate representation of the subsidence that has occurred.

Dated this 30<sup>TH</sup> day of April, 1996.



  
\_\_\_\_\_

Rodger C. Fry

No. 6603

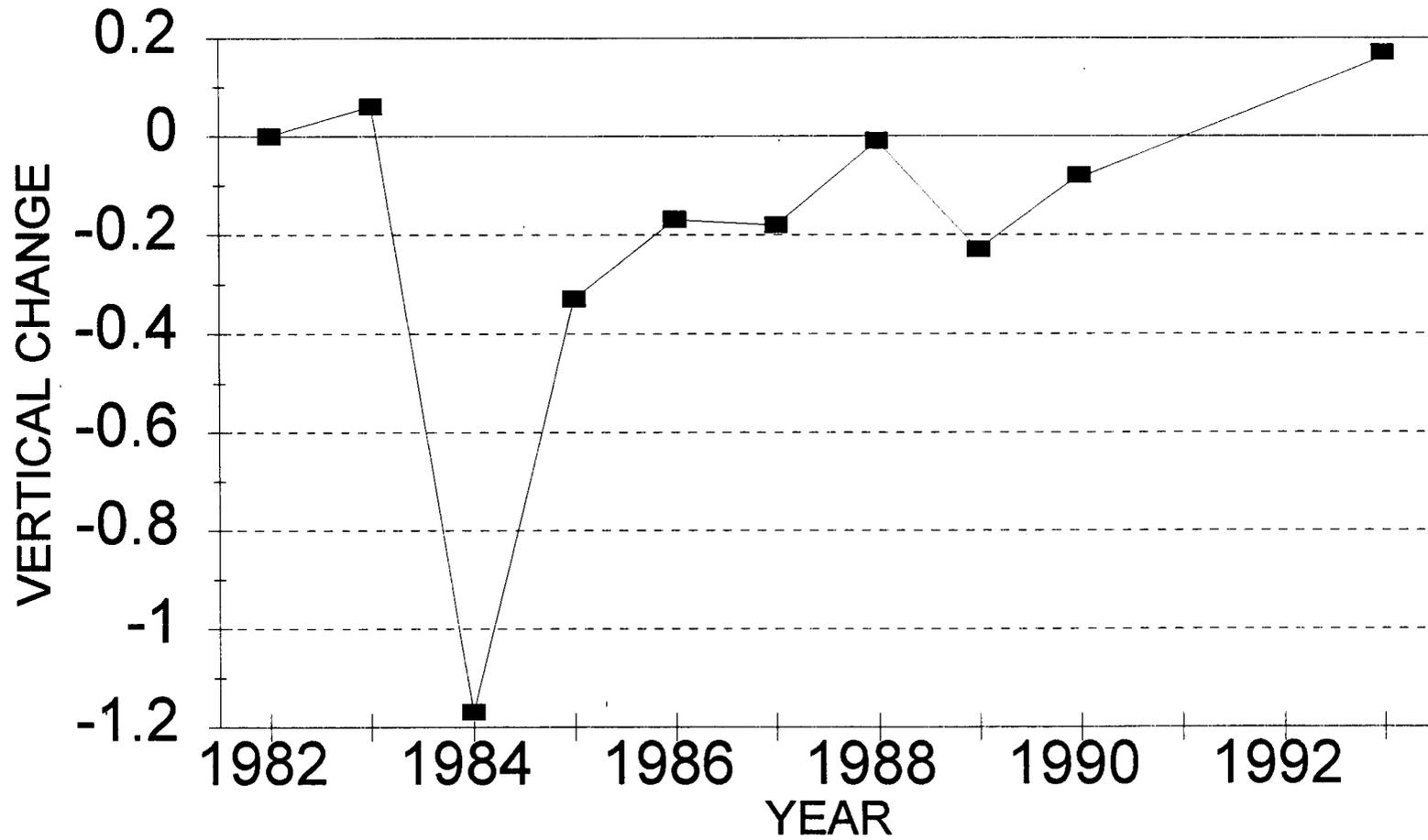
## **APPENDICES**

## **SUBSIDENCE MAP**

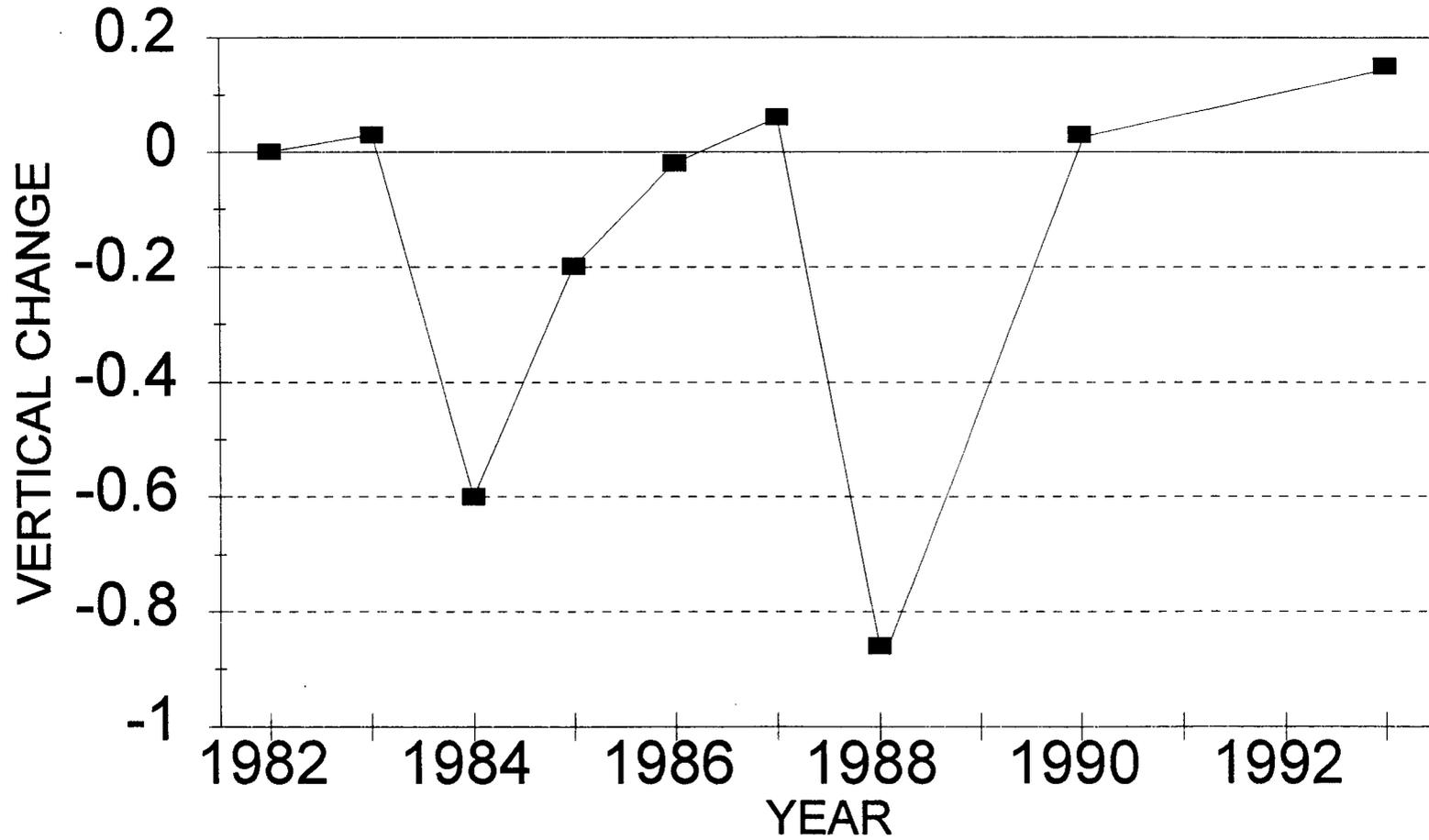
## **Cliff Stability Survey Targets**

# GRIMES WASH

PRISM 1

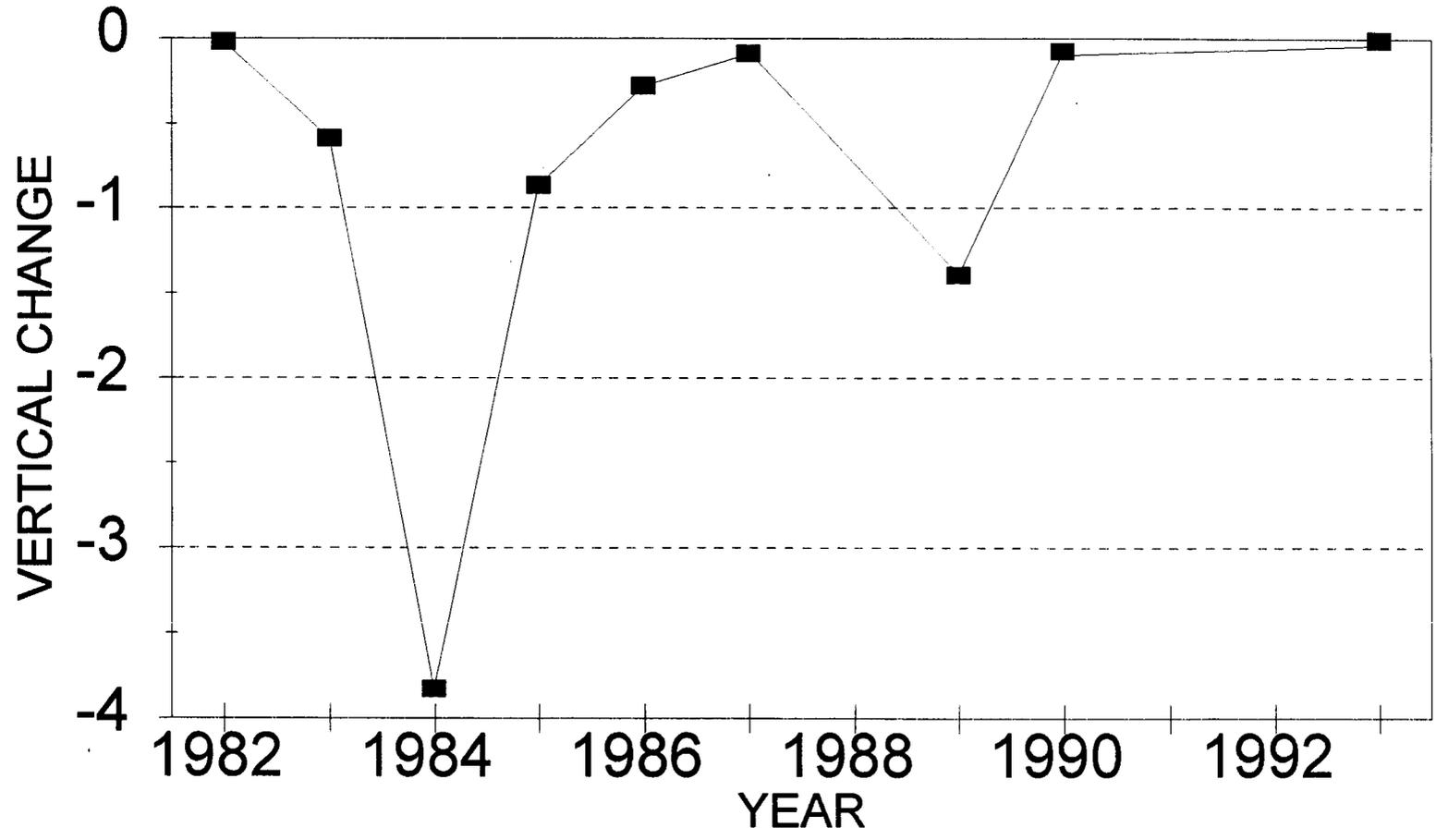


# GRIMES WASH PRISM 2



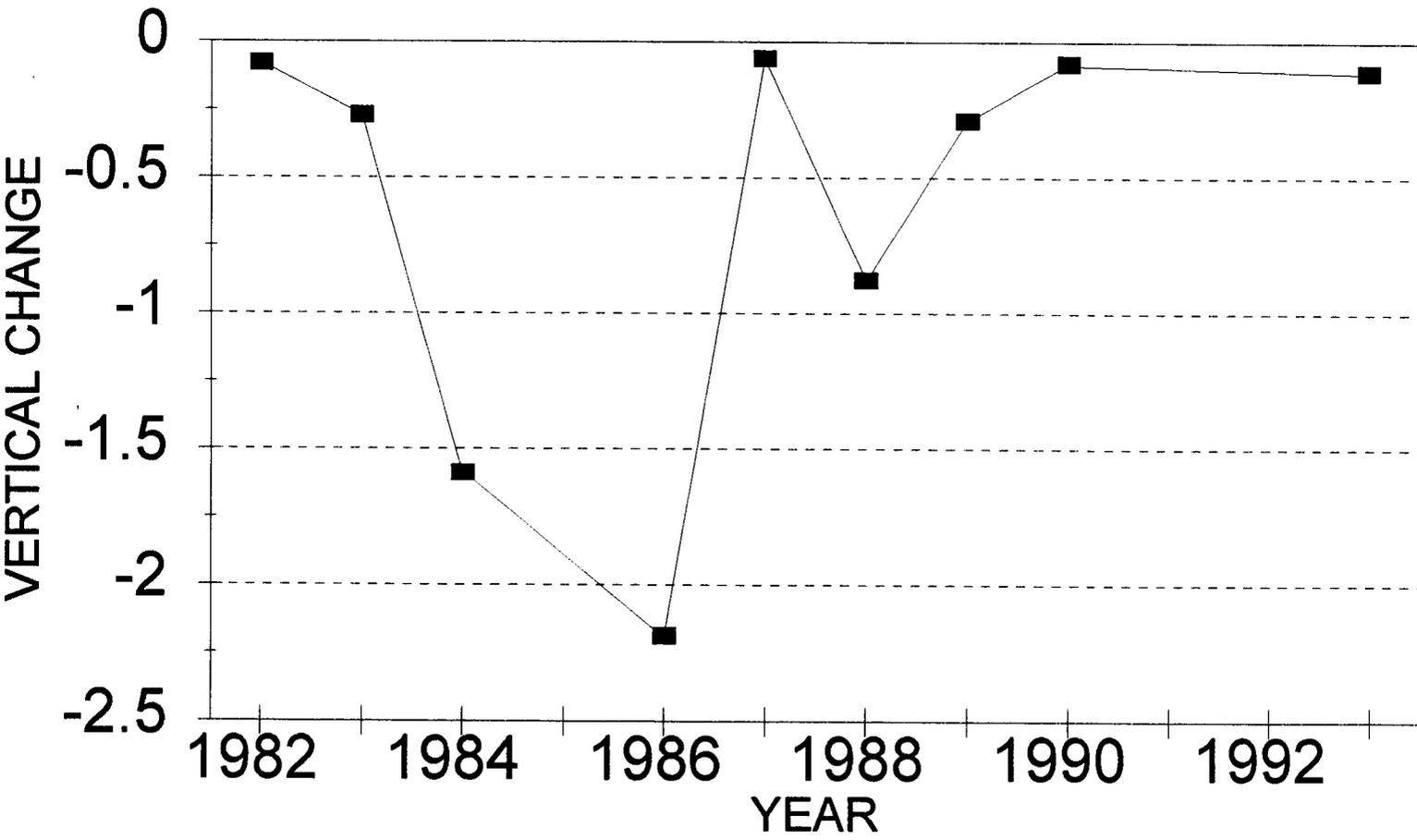
# GRIMES WASH

PRISM 3

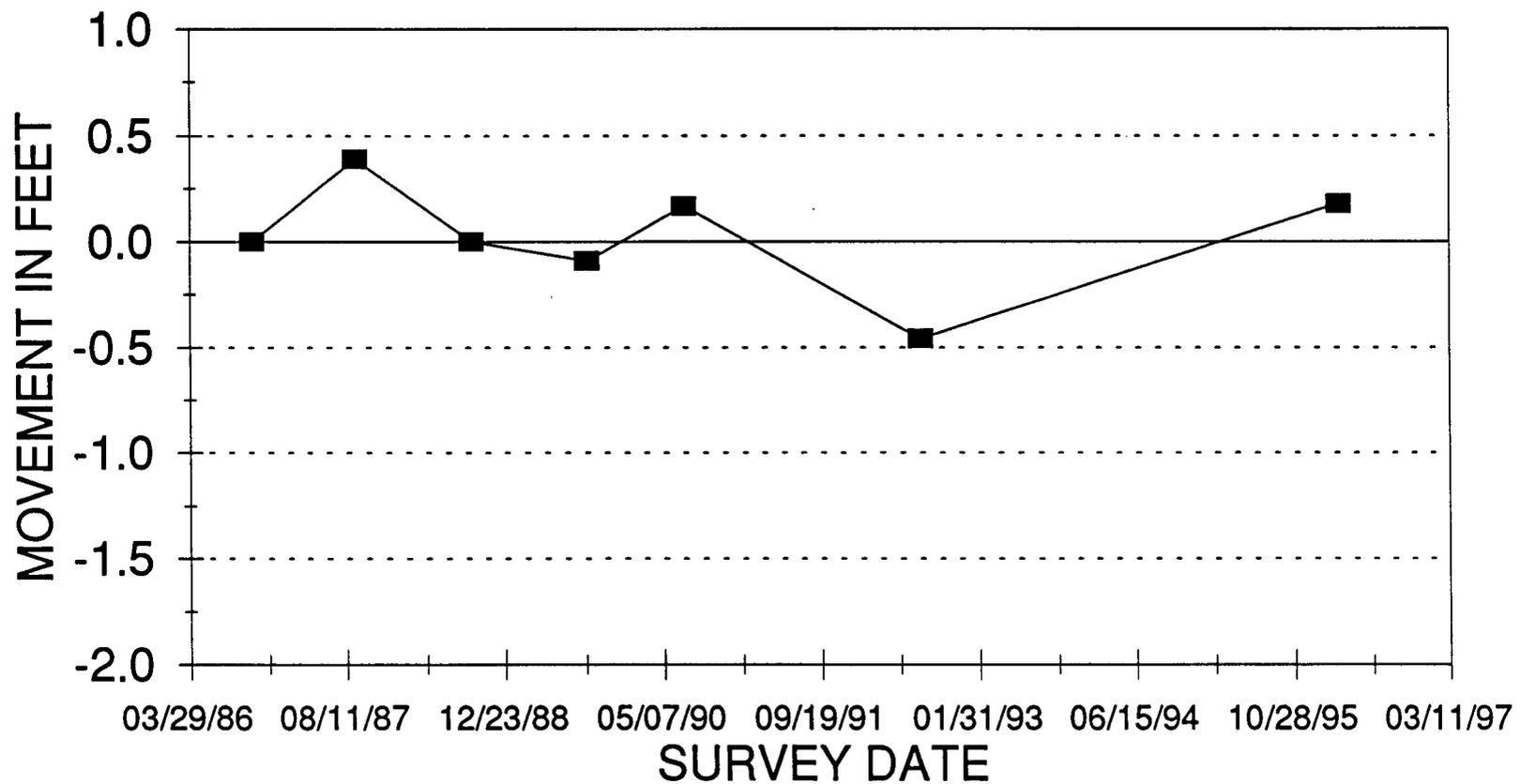


# GRIMES WASH

## PRISM 4

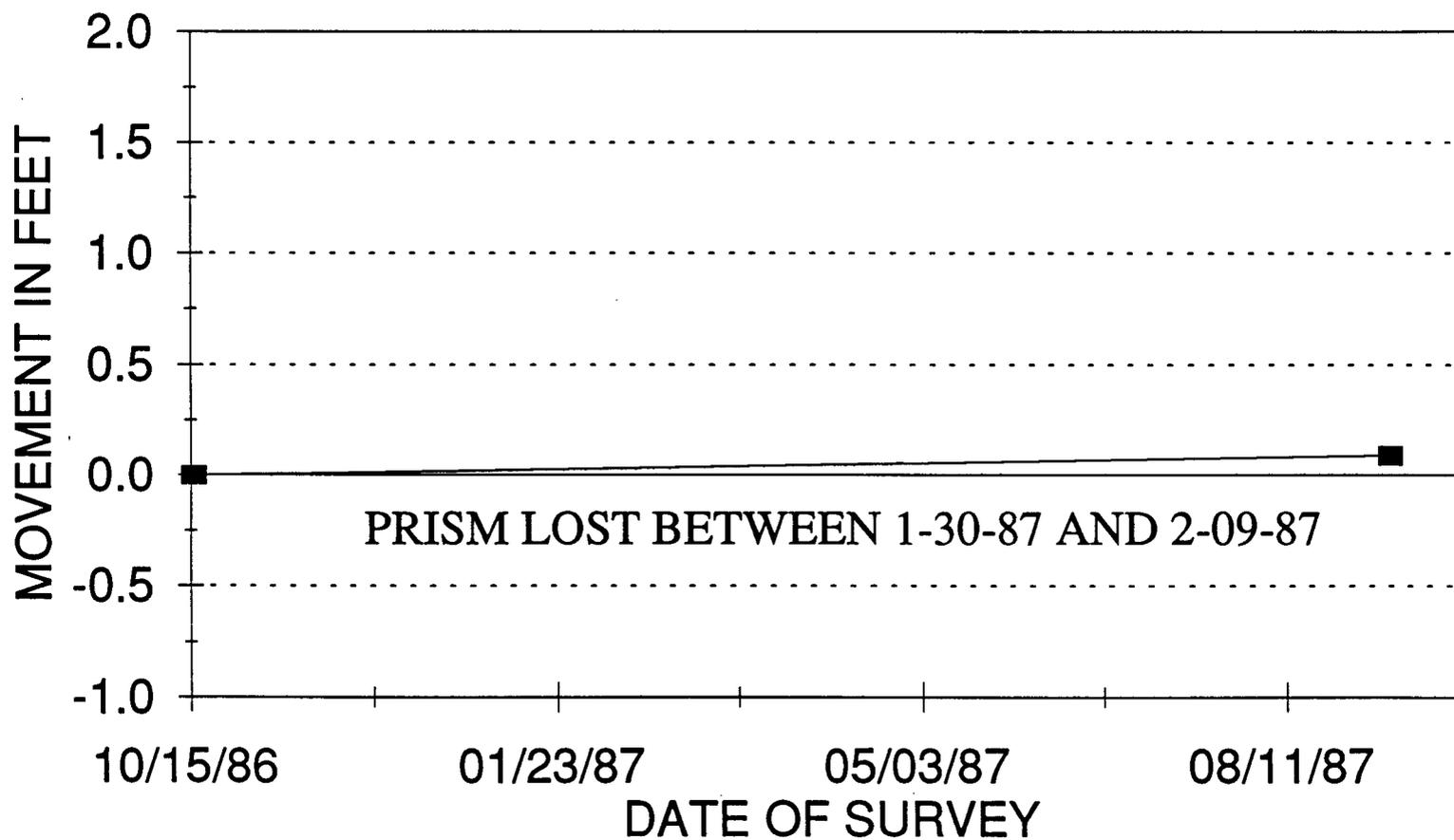


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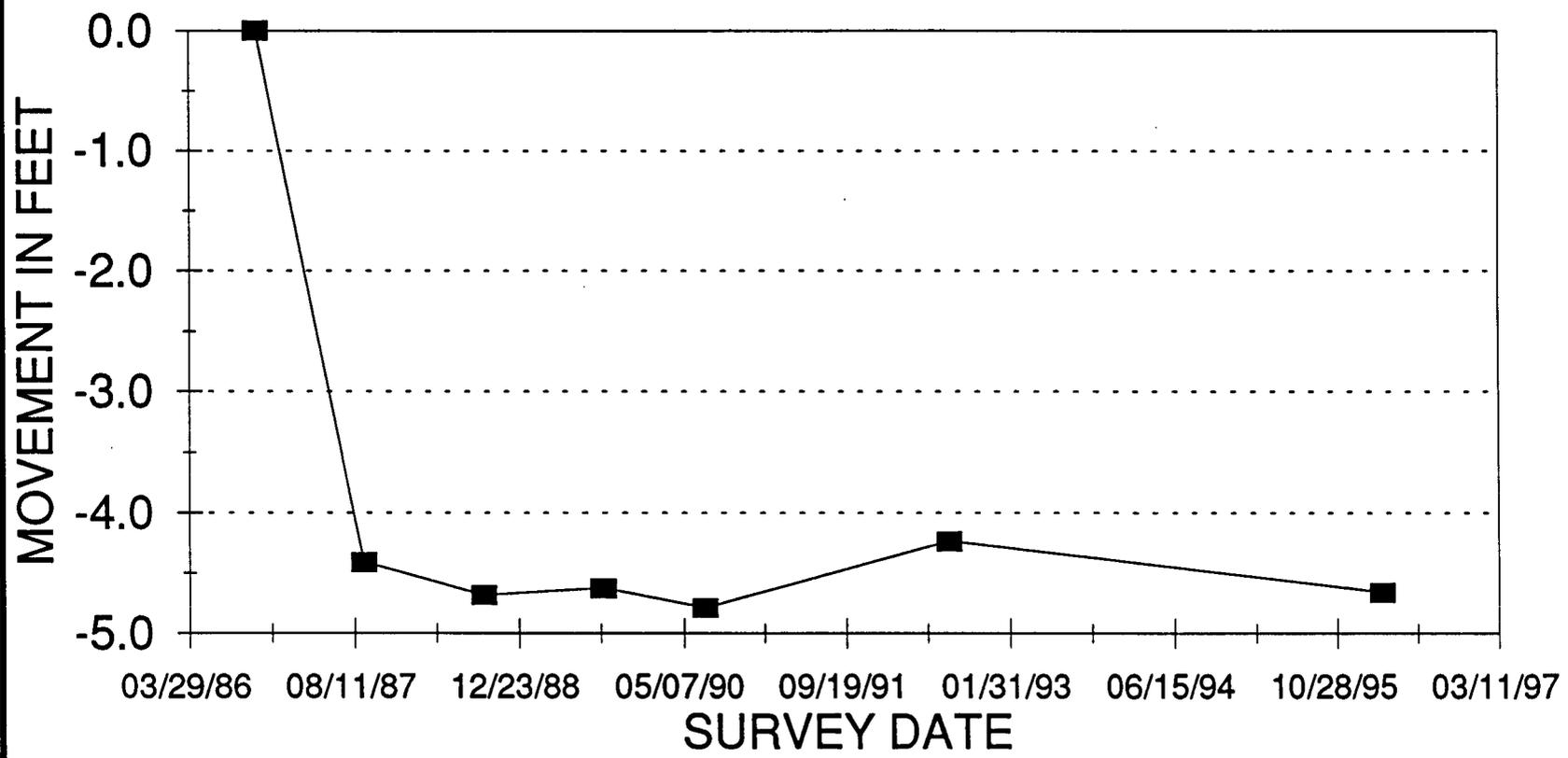


■ 10/16/86

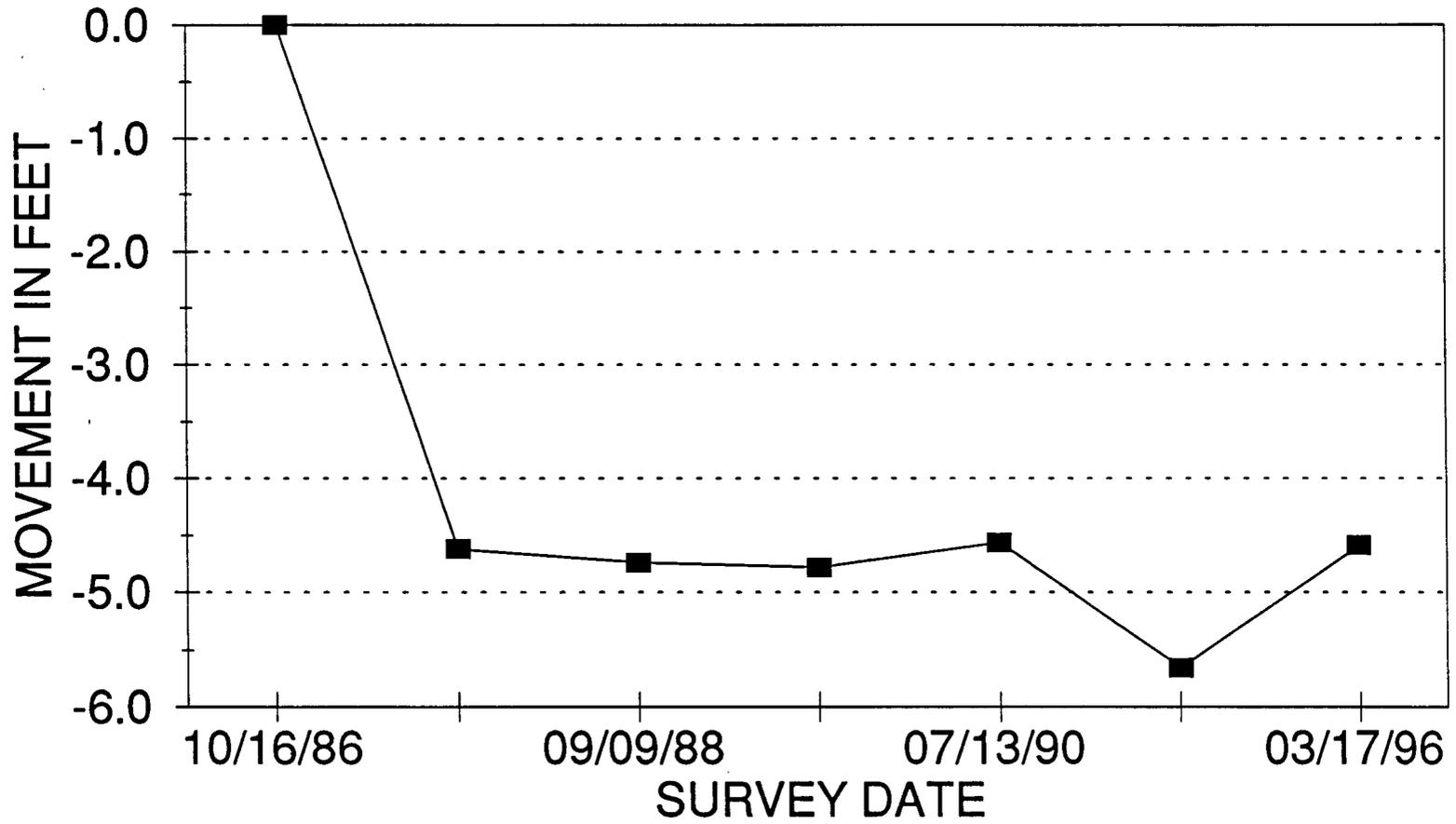
# NEWBERRY CANYON PR-2



# NEWBERRY CANYON PR-3

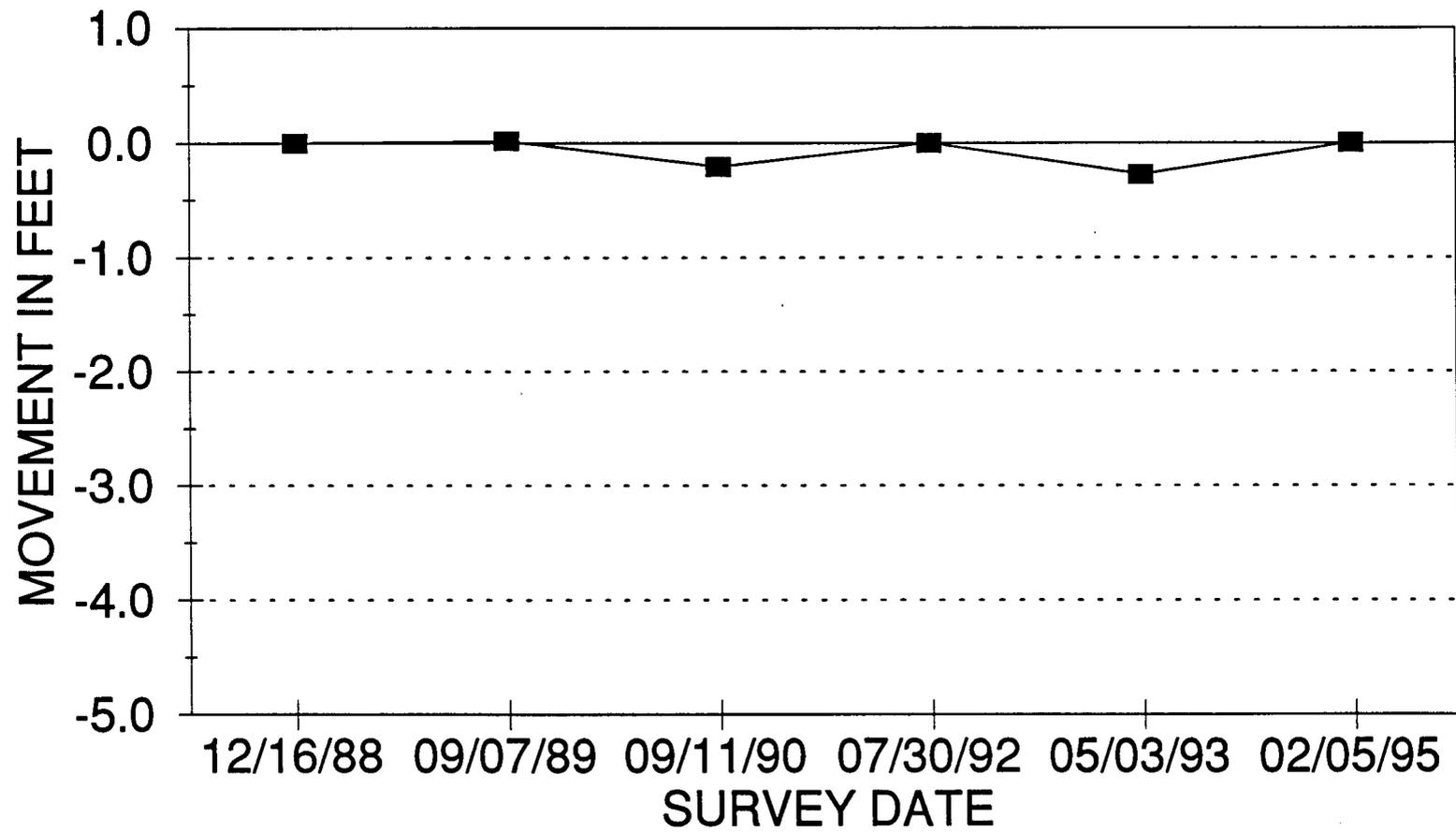


# NEWBERRY CANYON PR-4



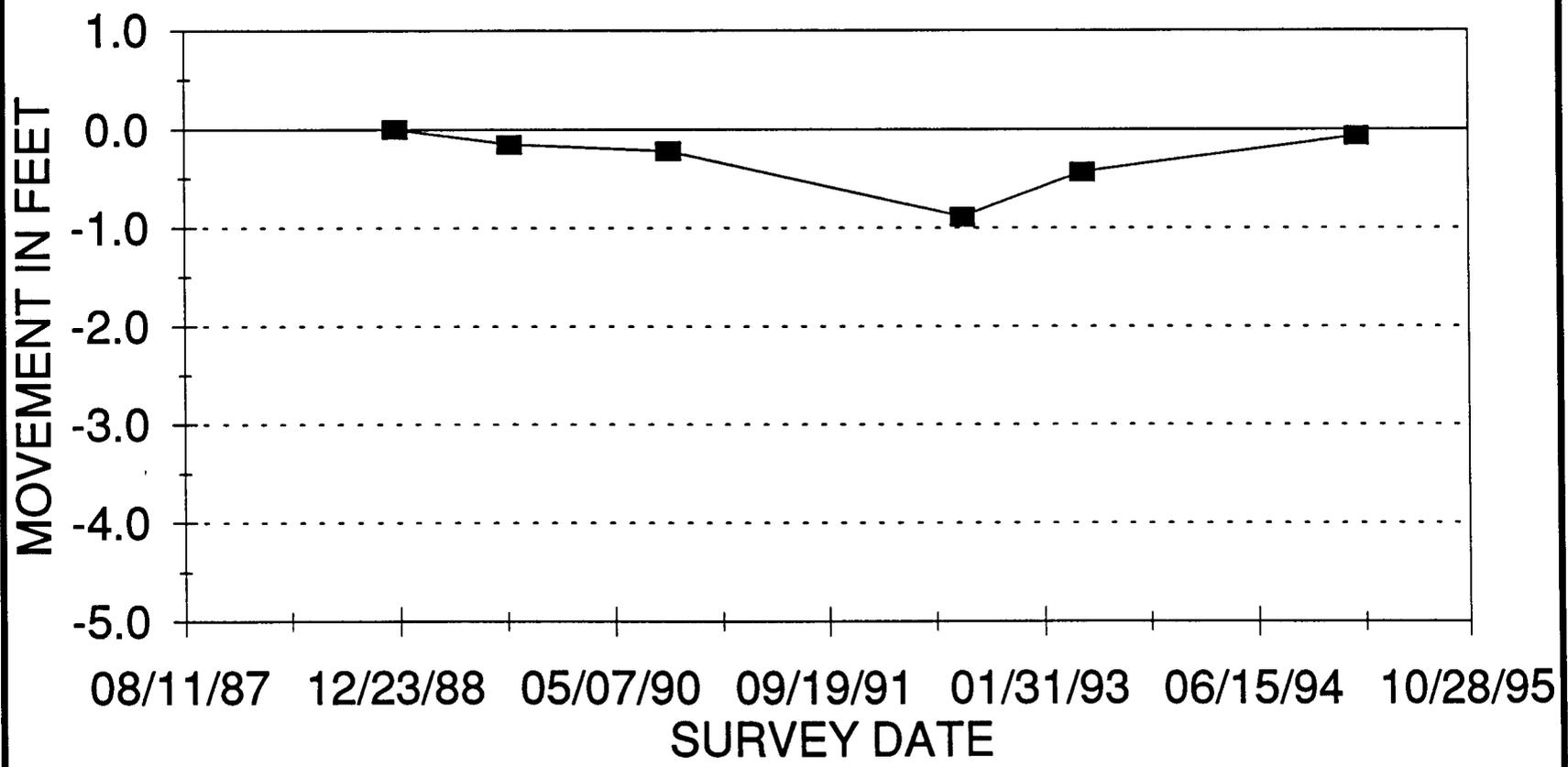
# NEWBERRY CANYON

PR-5

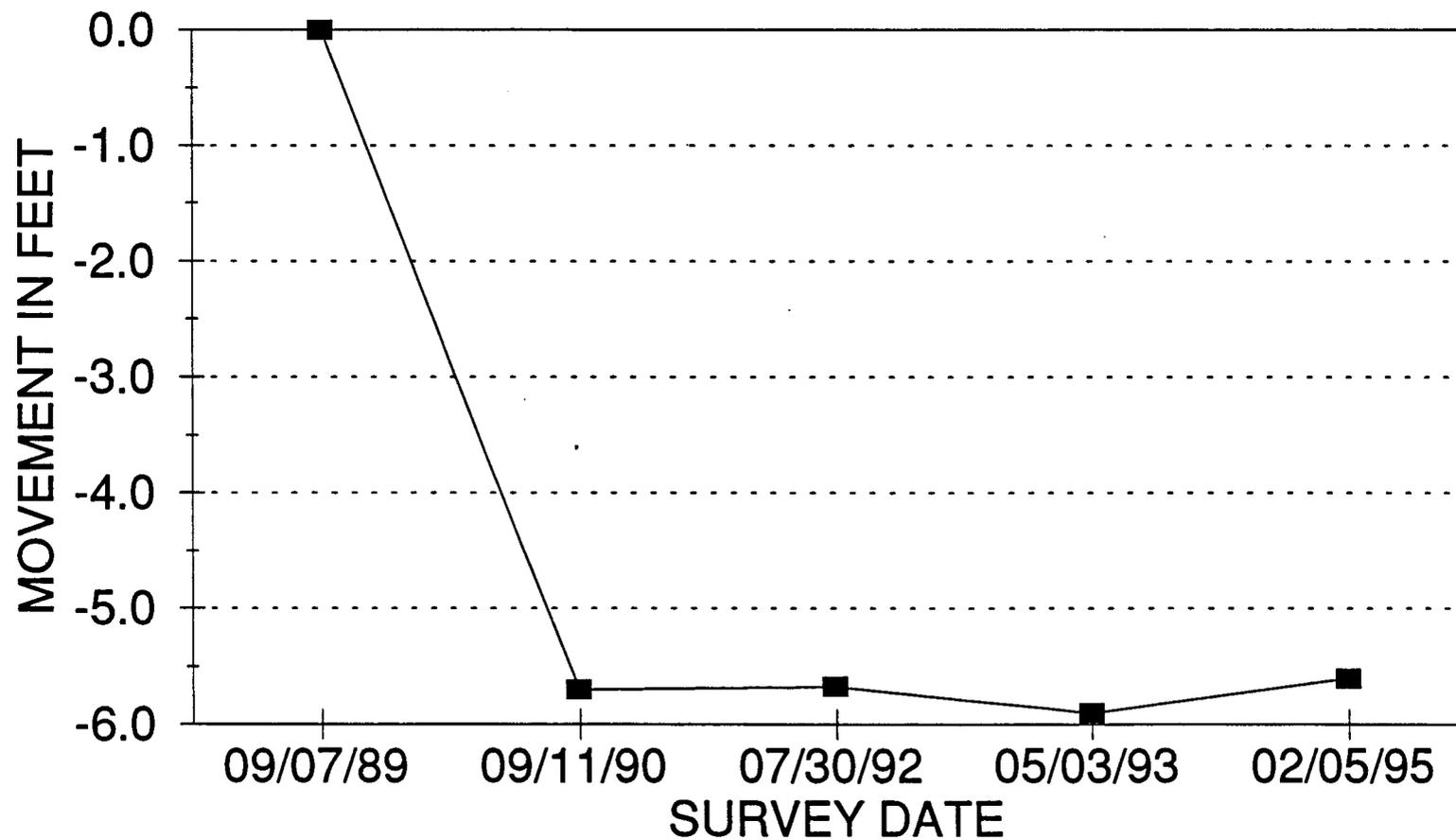


# NEWBERRY CANYON

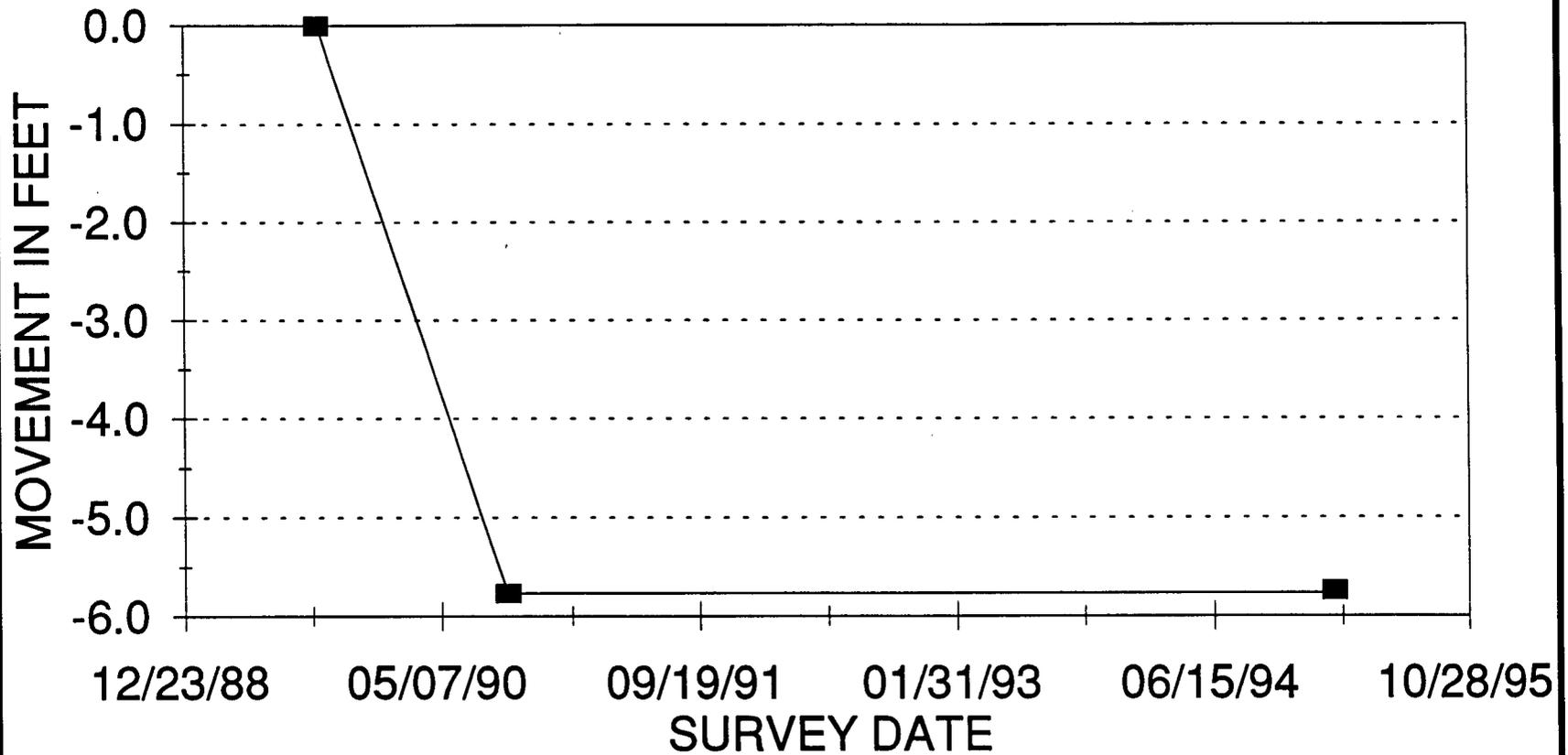
PR-6



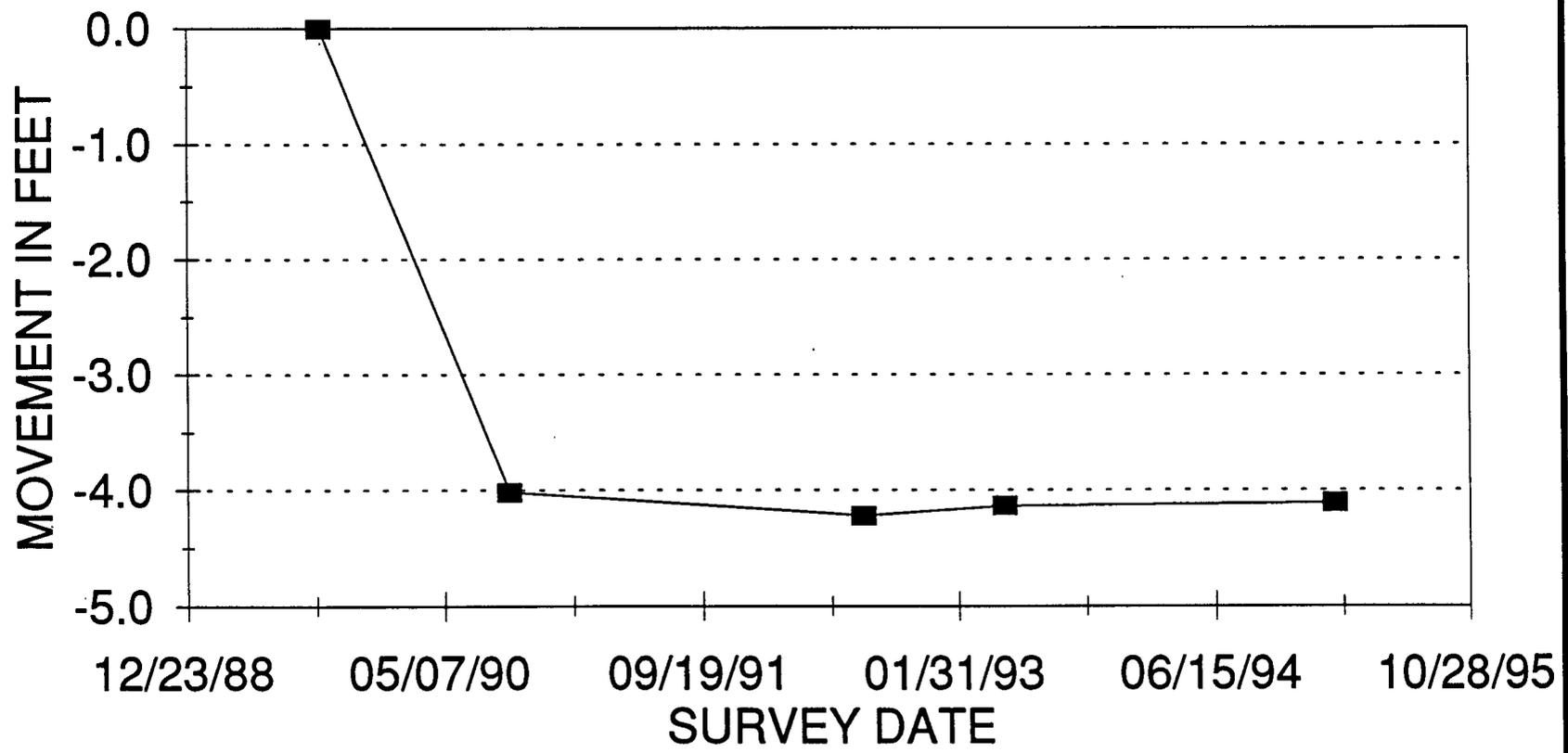
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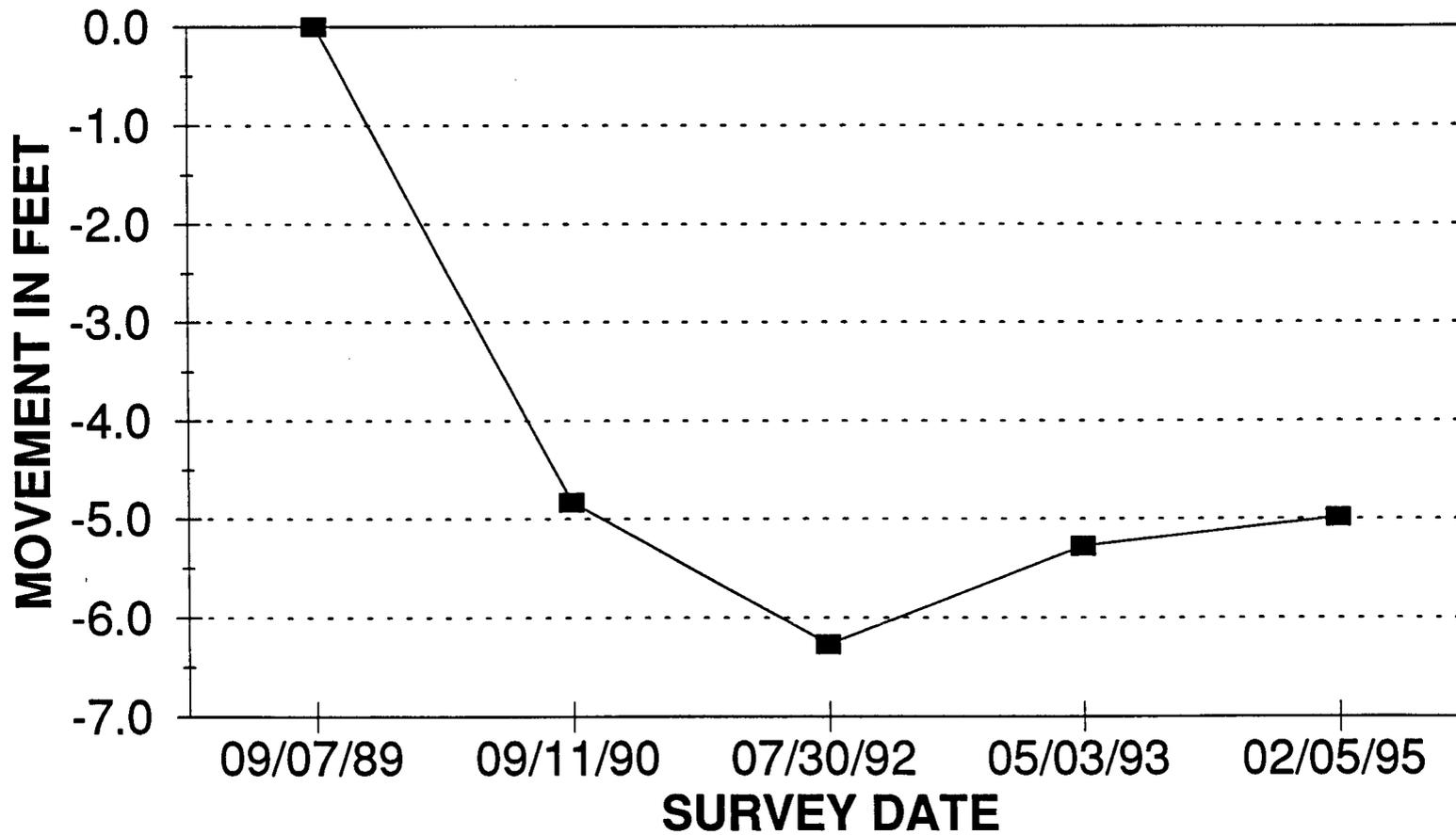
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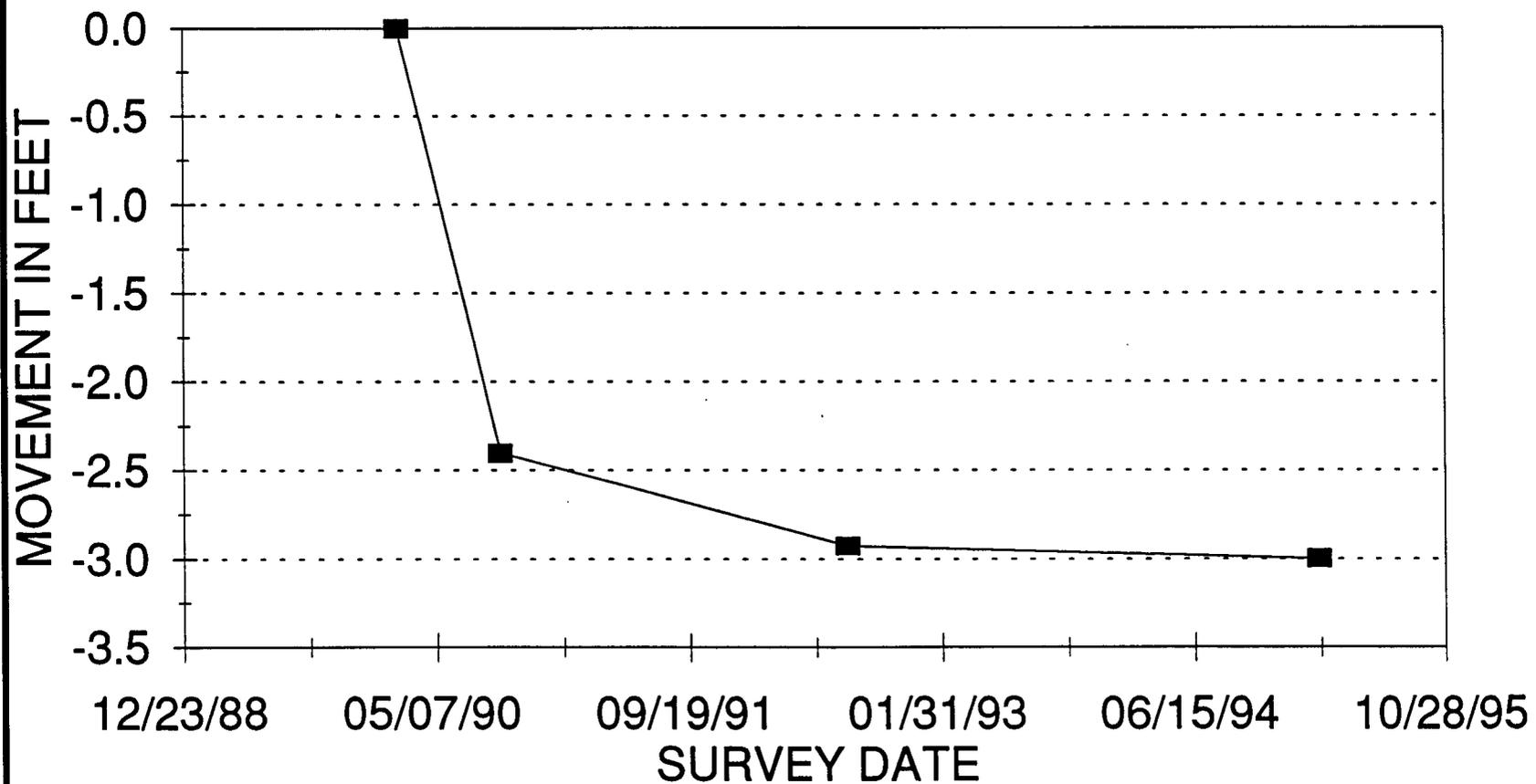
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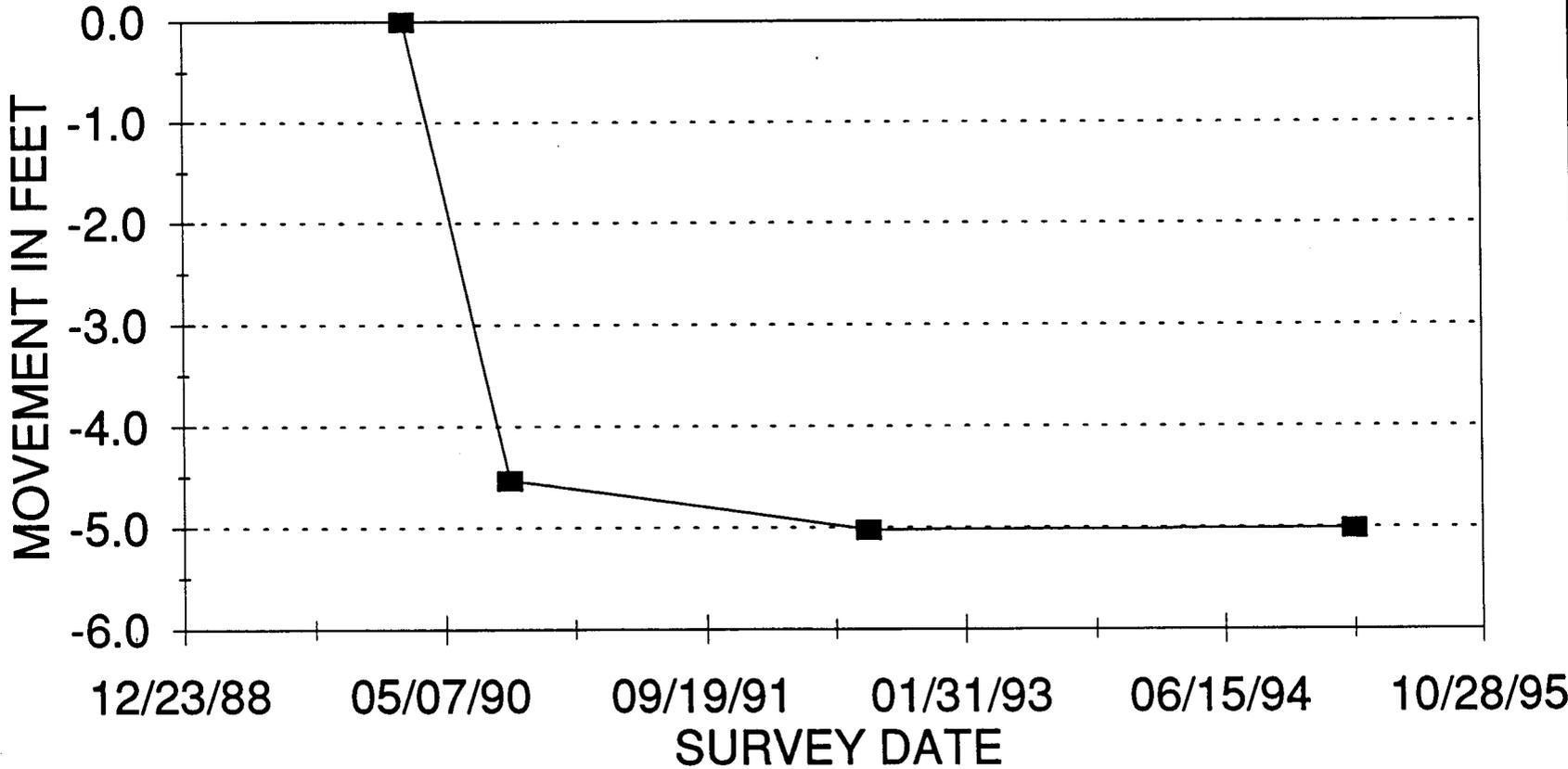
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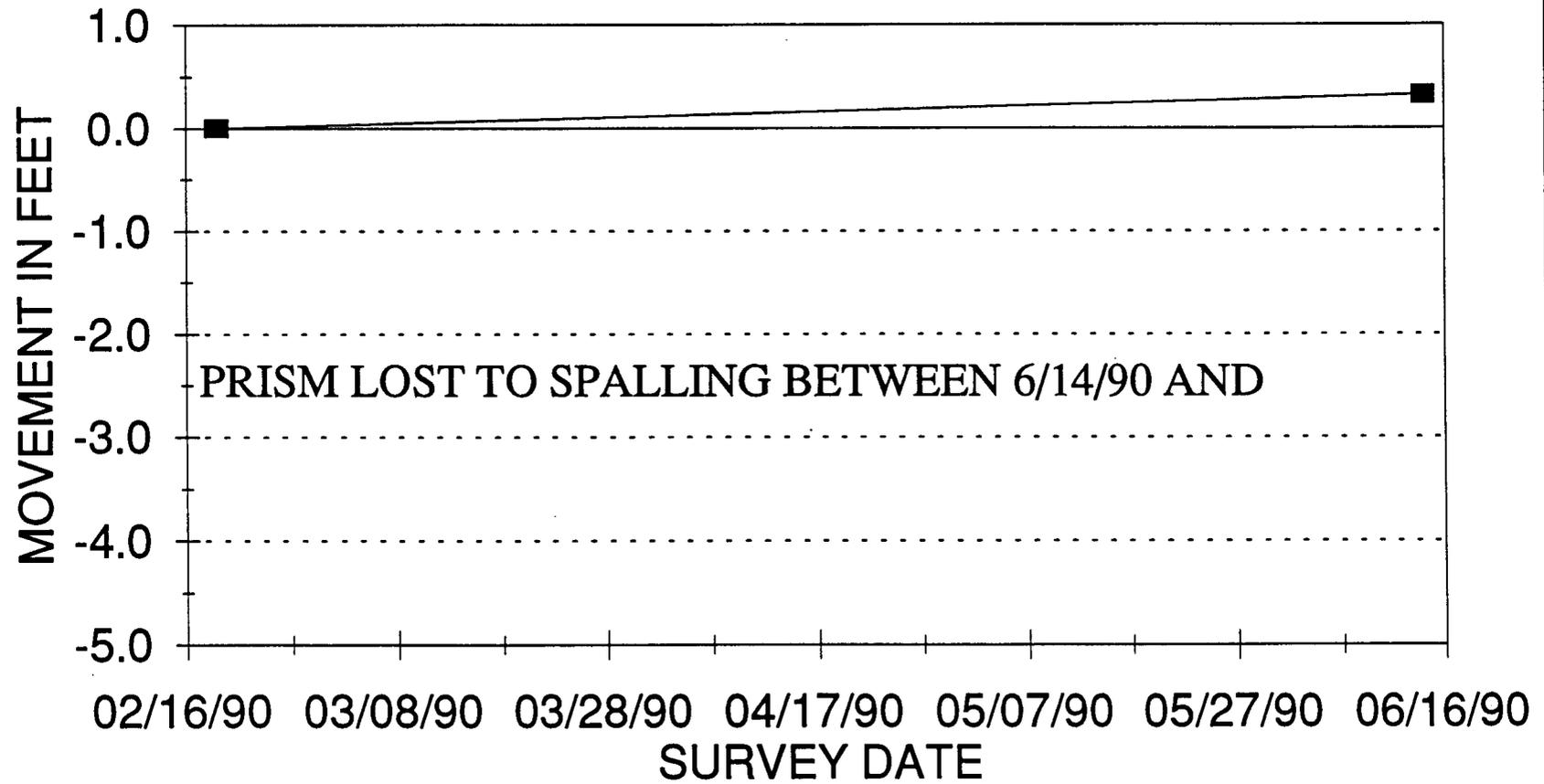
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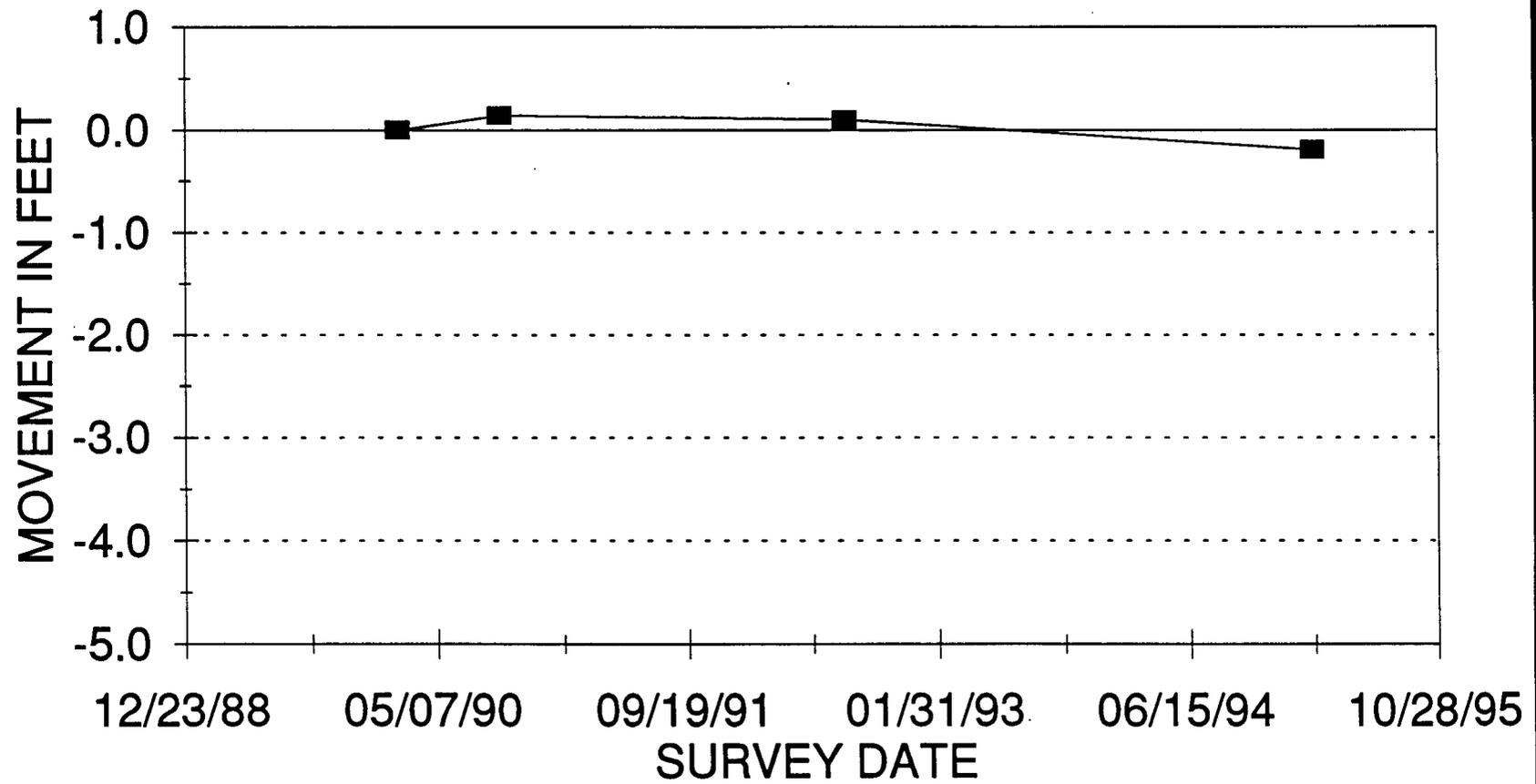
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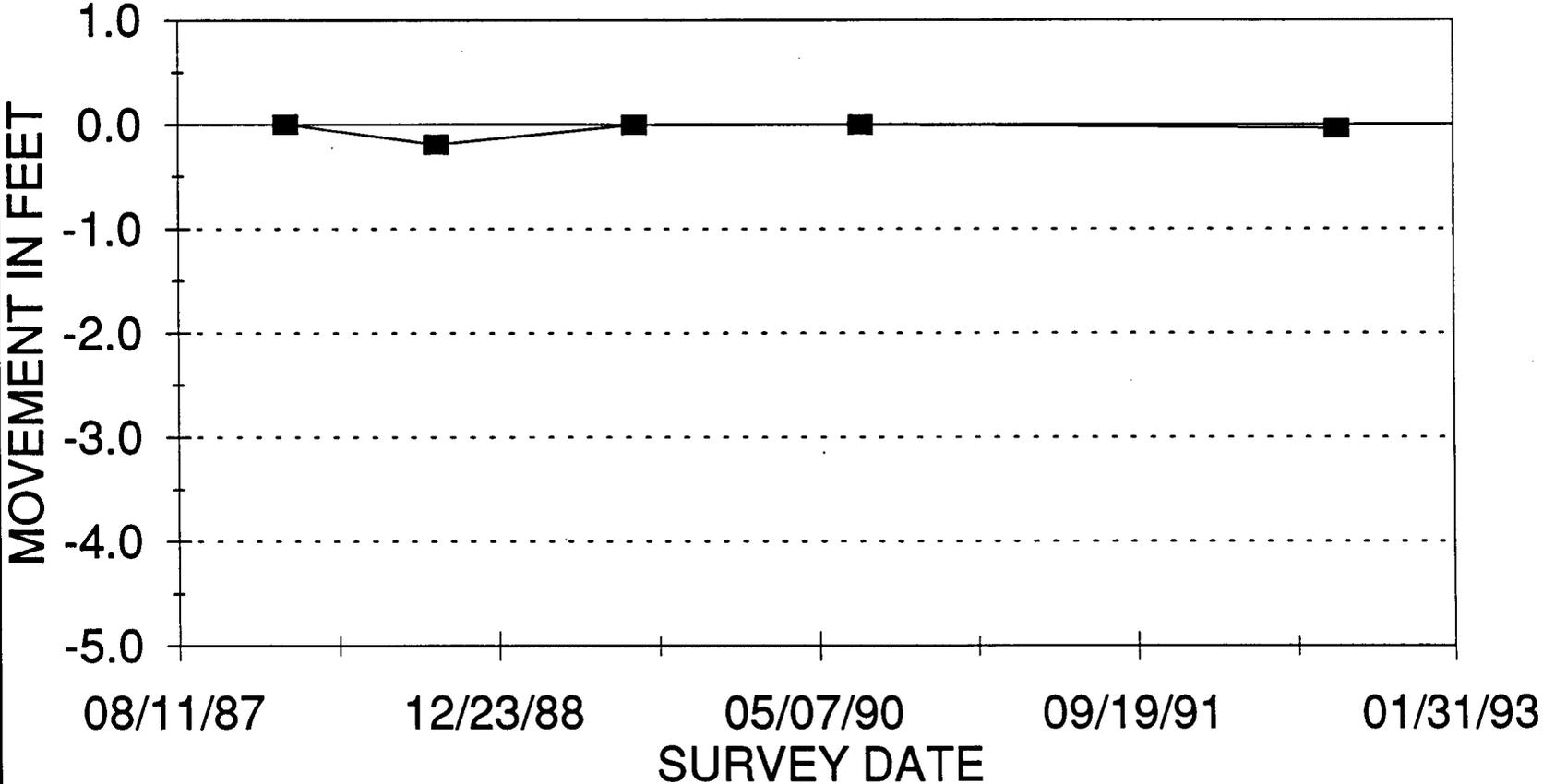
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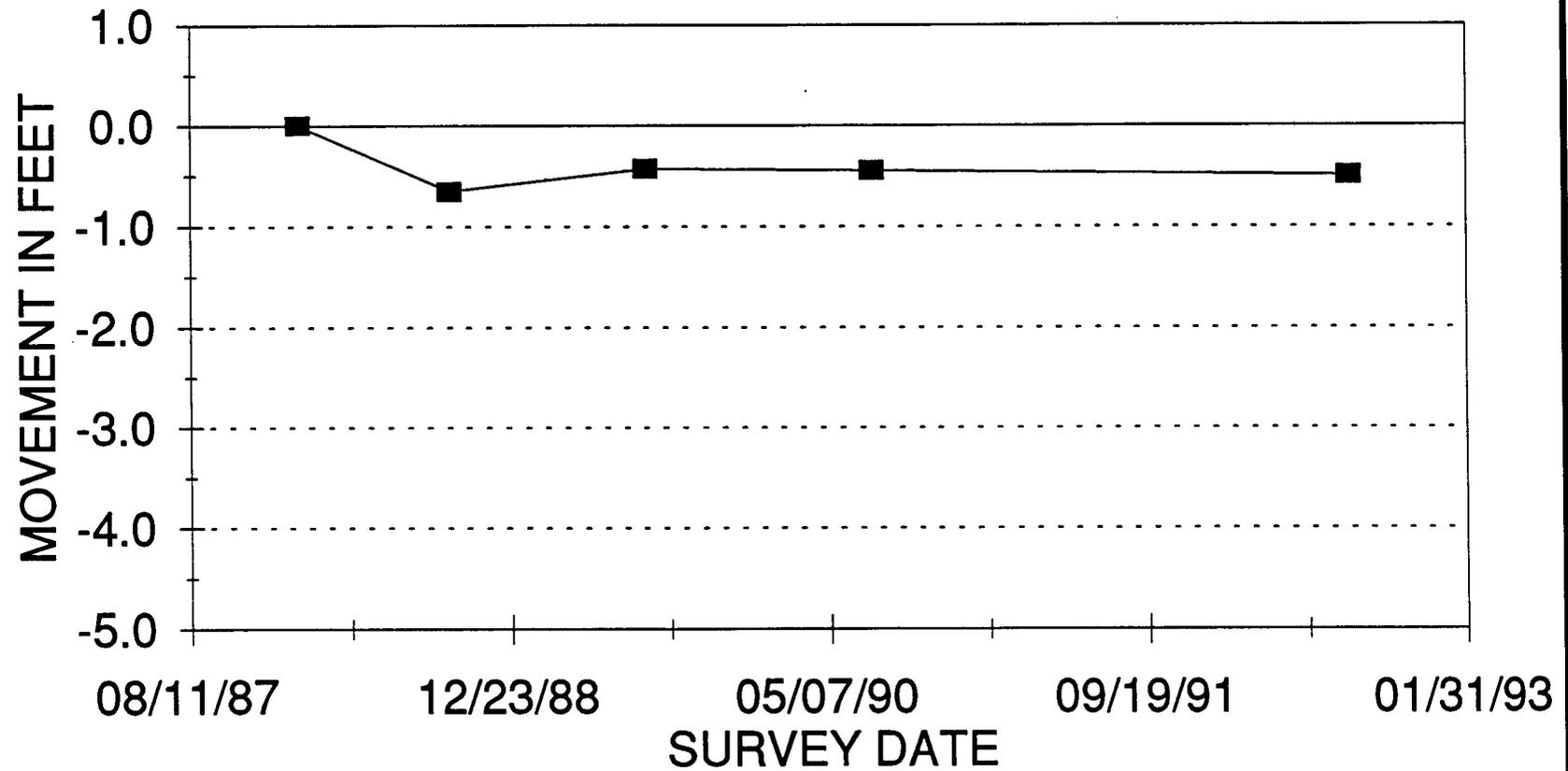
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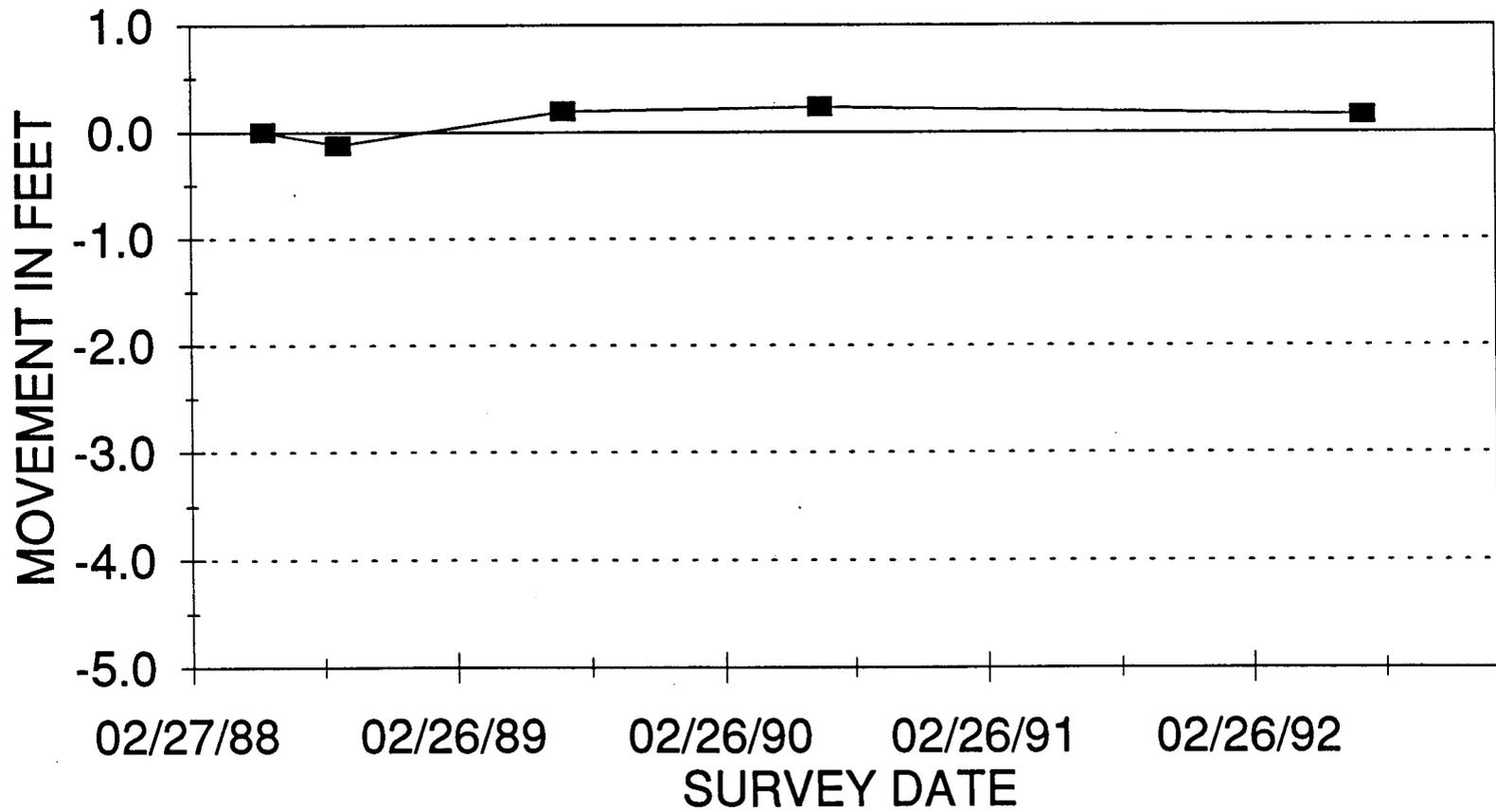
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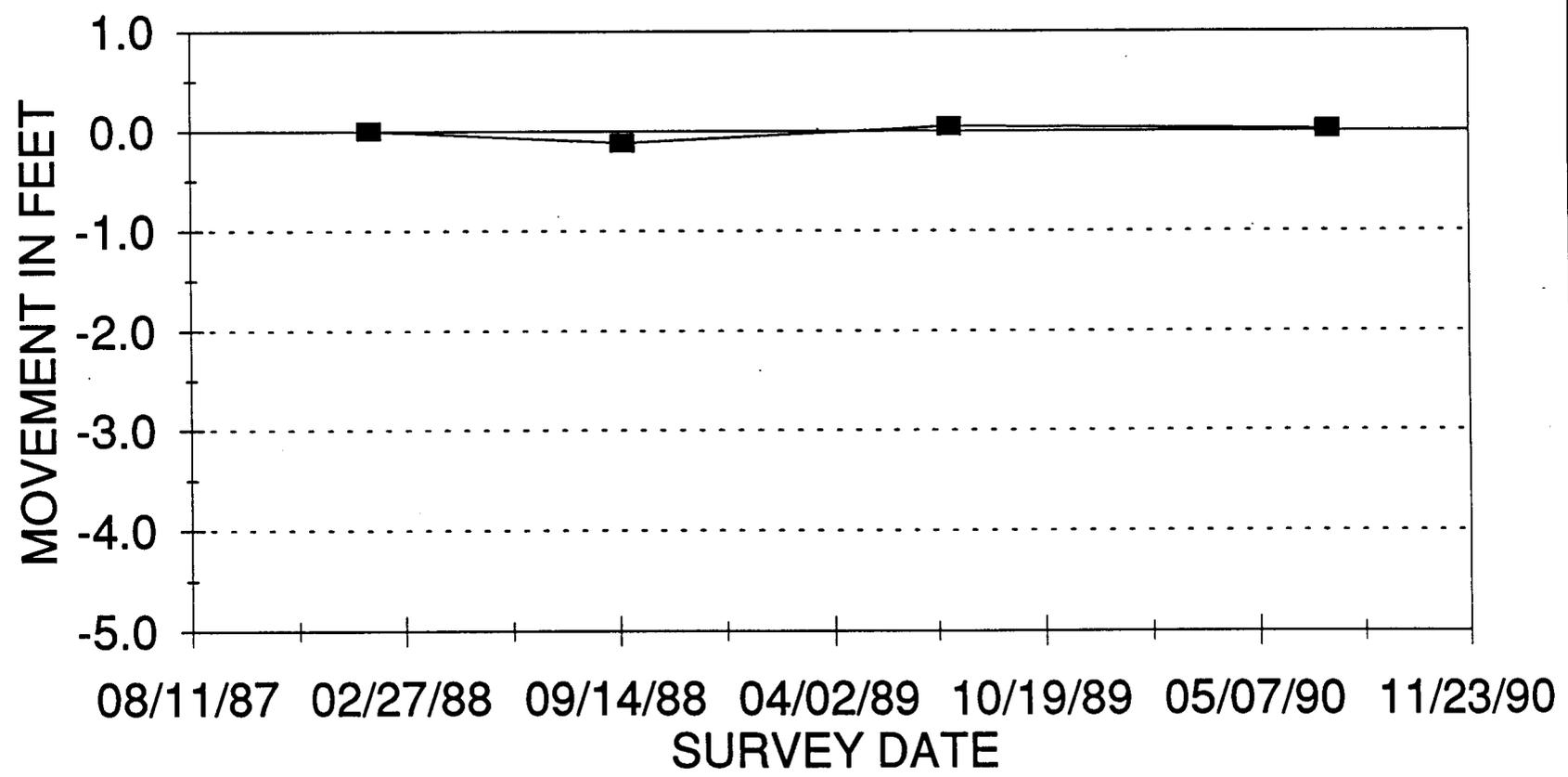
# MILLER CANYON PR-2



# MILLER CANYON PR-3



# MILLER CANYON PR-4



# MILLER CANYON PR-5

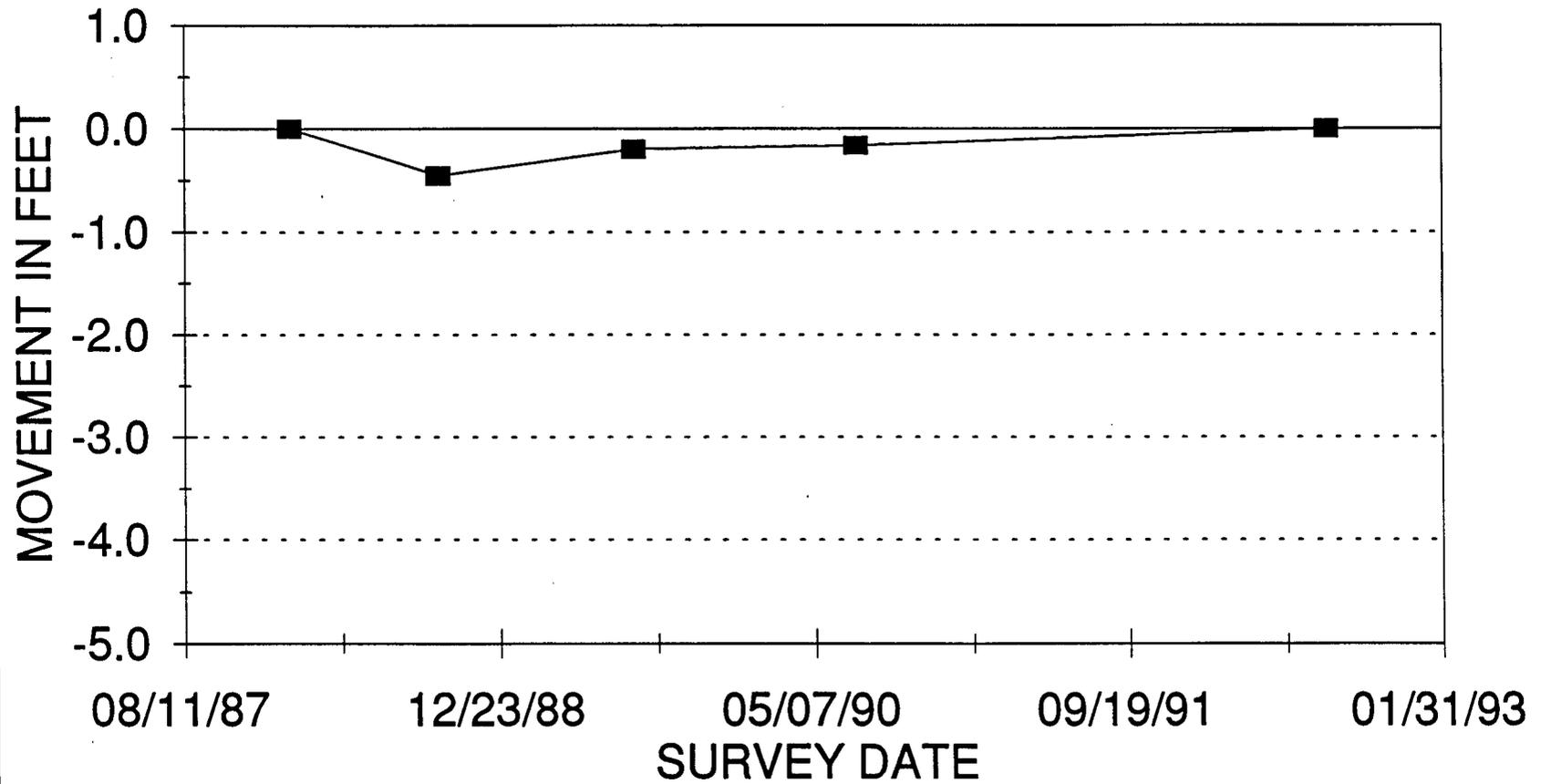


FIGURE 14T  
**AREA 3 TOPOGRAPHIC PROFILE**  
NORTH-SOUTH

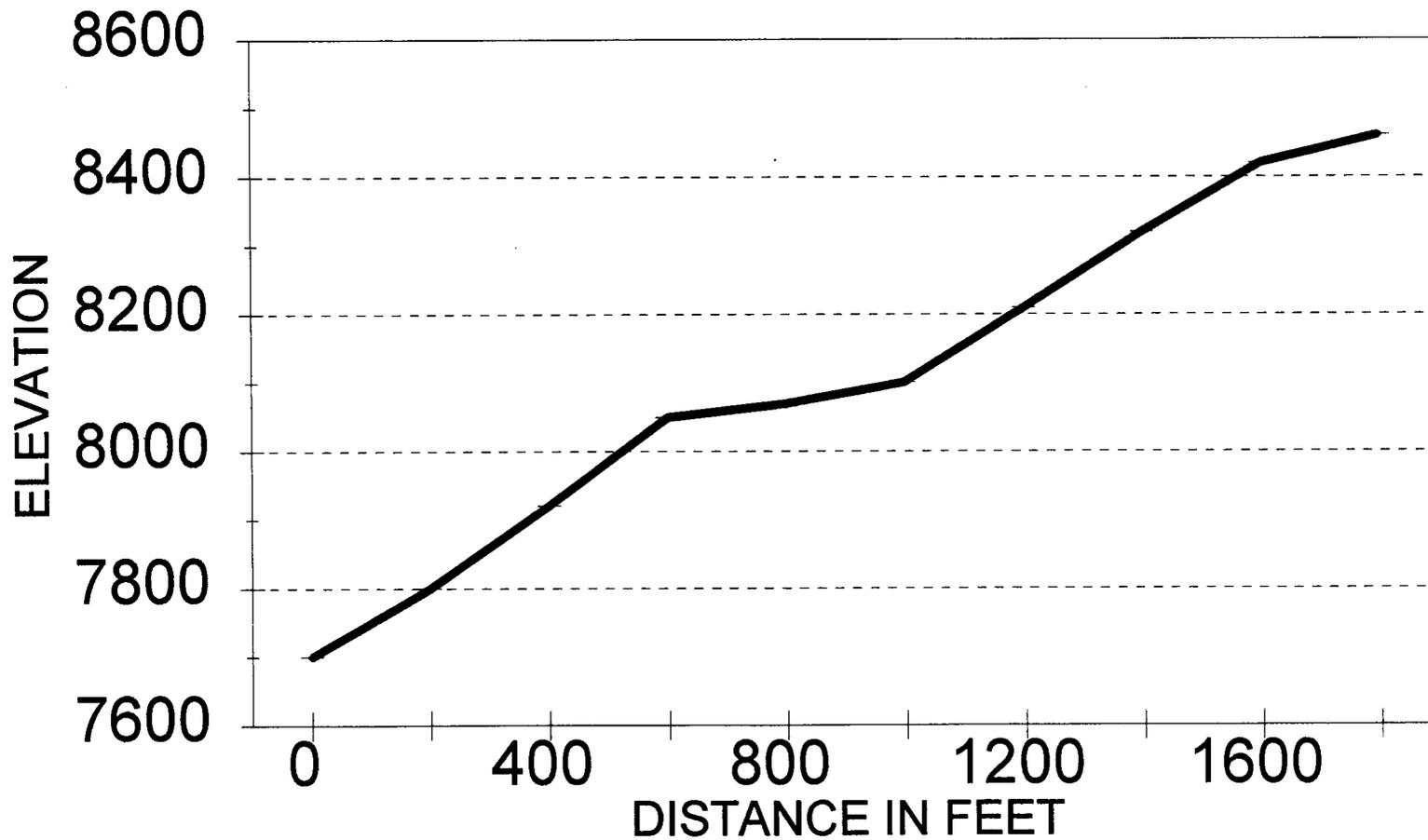


FIGURE 29T

**AREA 7 TOPOGRAPHIC PROFILE**  
SOUTHWEST-NORTHEAST

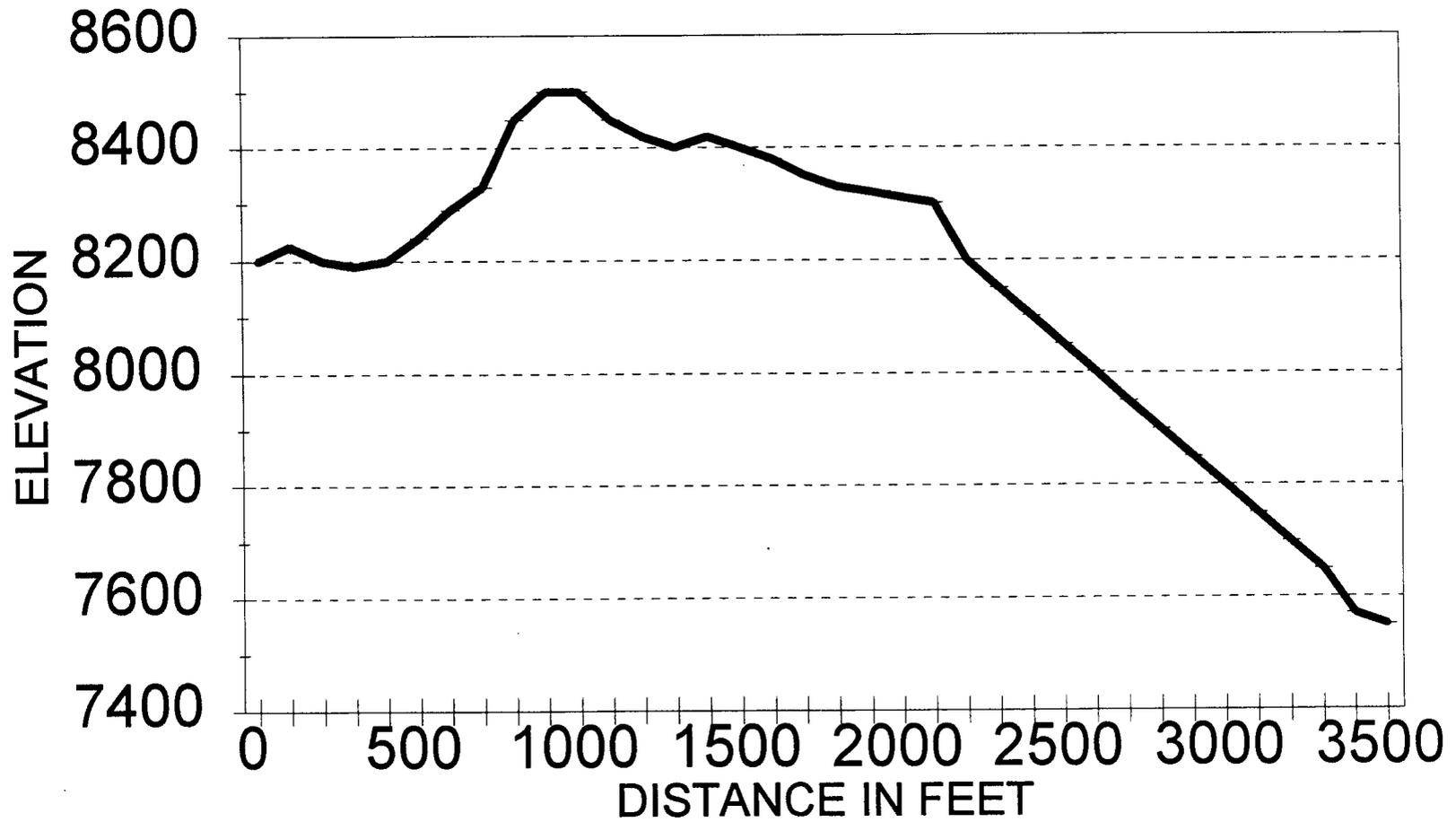


FIGURE 33T  
**AREA 8 TOPOGRAPHIC PROFILE**  
WEST - EAST

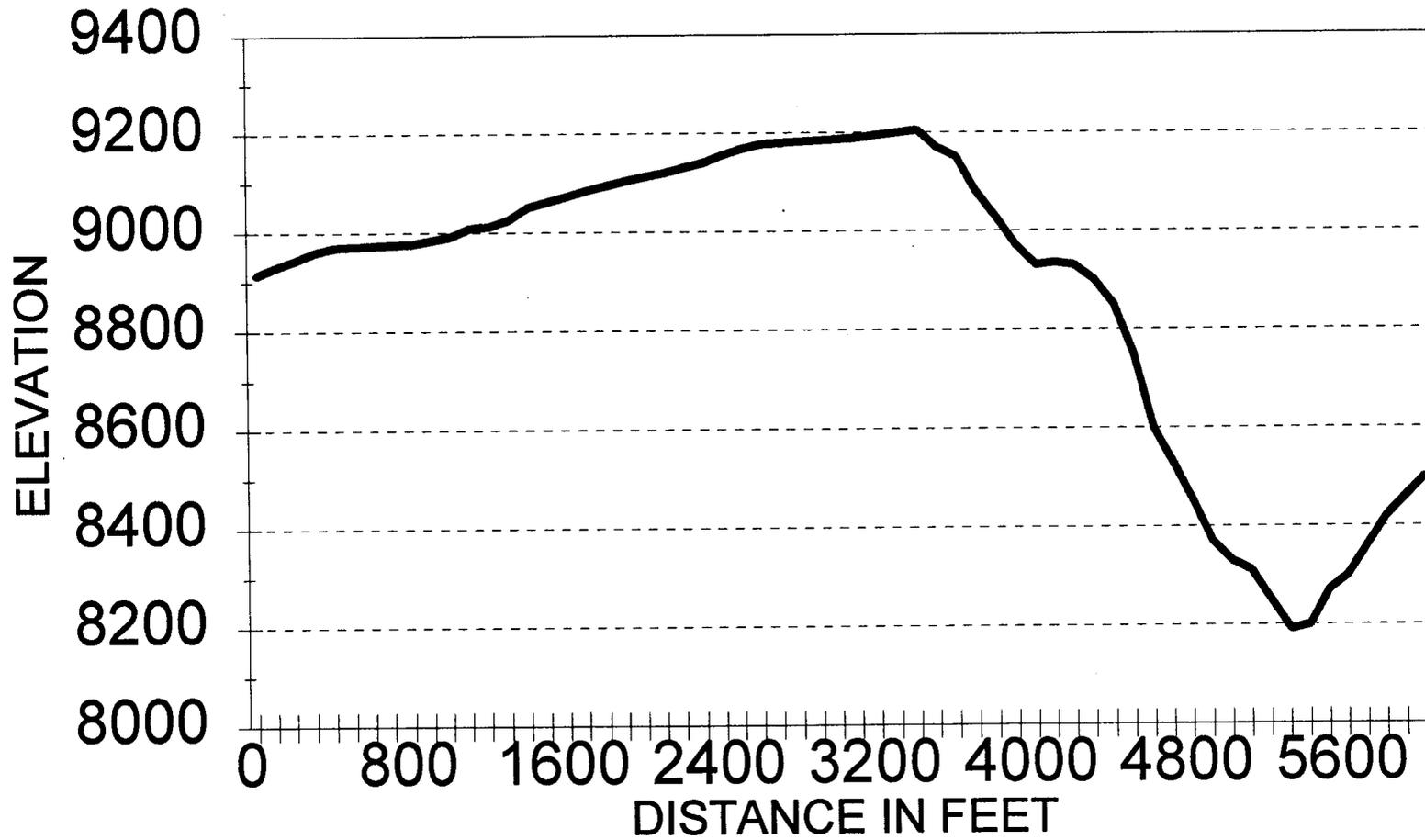


FIGURE 42T

**AREA 13 TOPOGRAPHIC PROFILE**  
NORTH-SOUTH

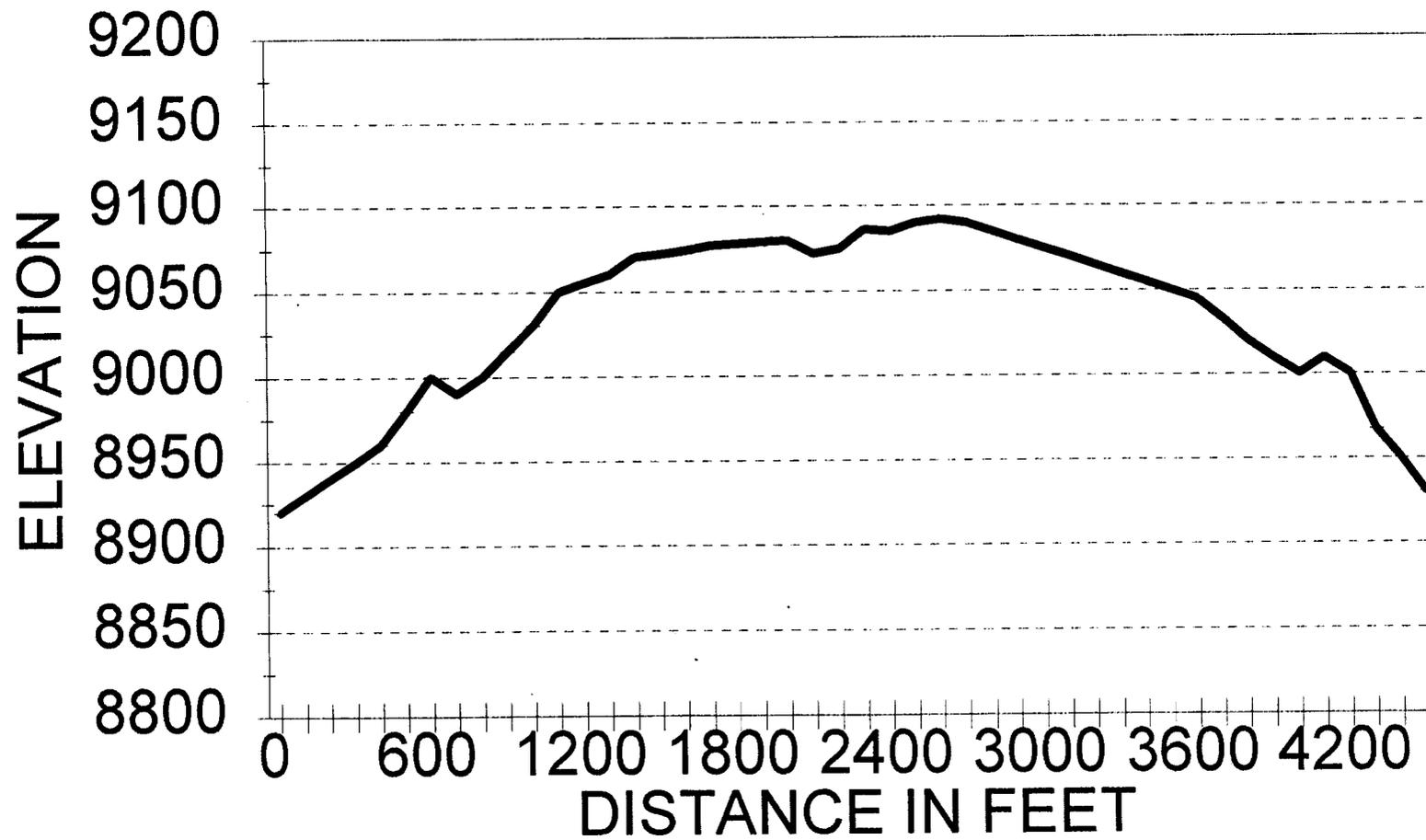


FIGURE 43T  
**AREA 13 TOPOGRAPHIC PROFILE**  
WEST-EAST

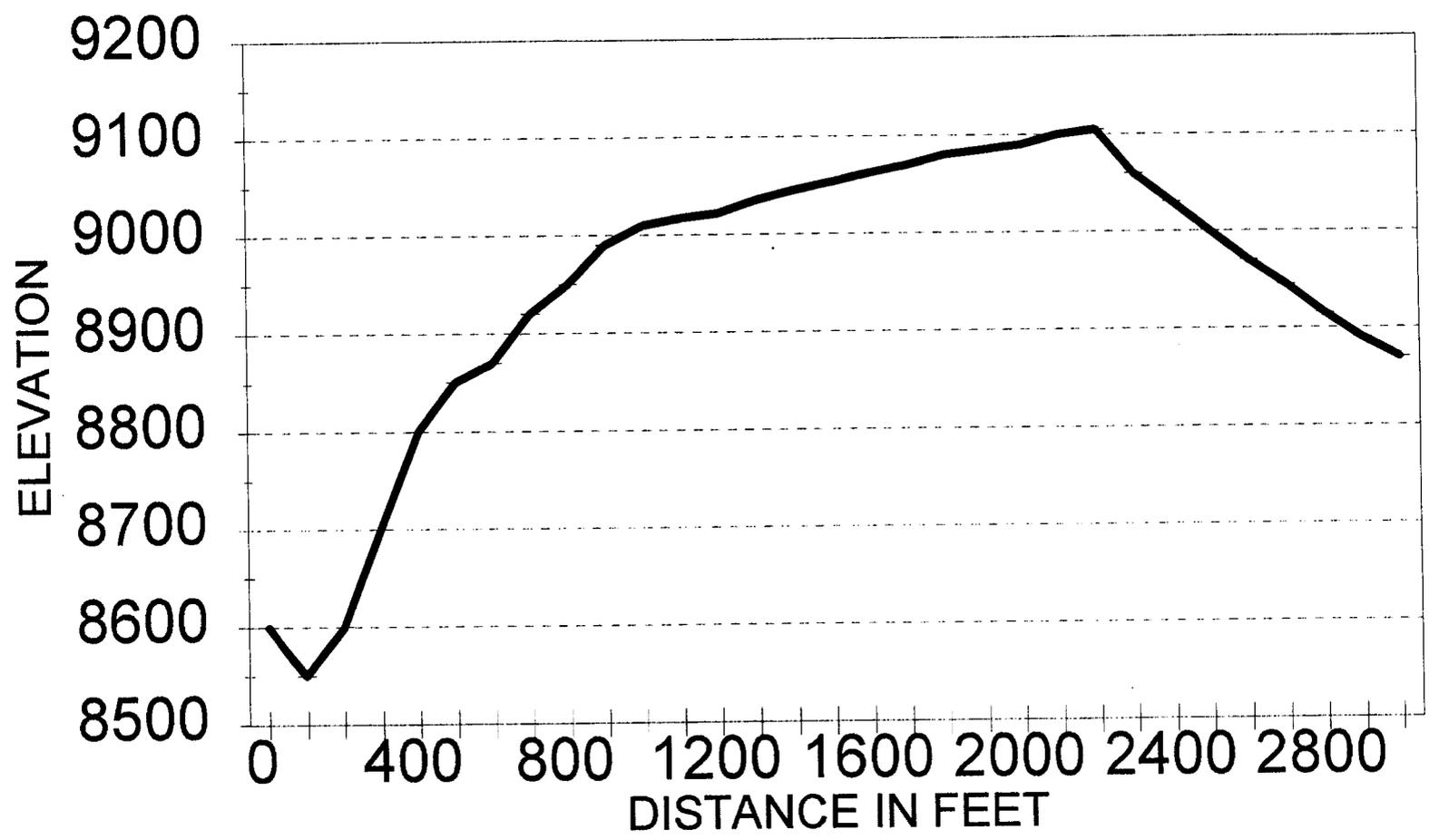


FIGURE 46T  
**AREA 14 TOPOGRAPHIC PROFILE**  
NORTH-SOUTH

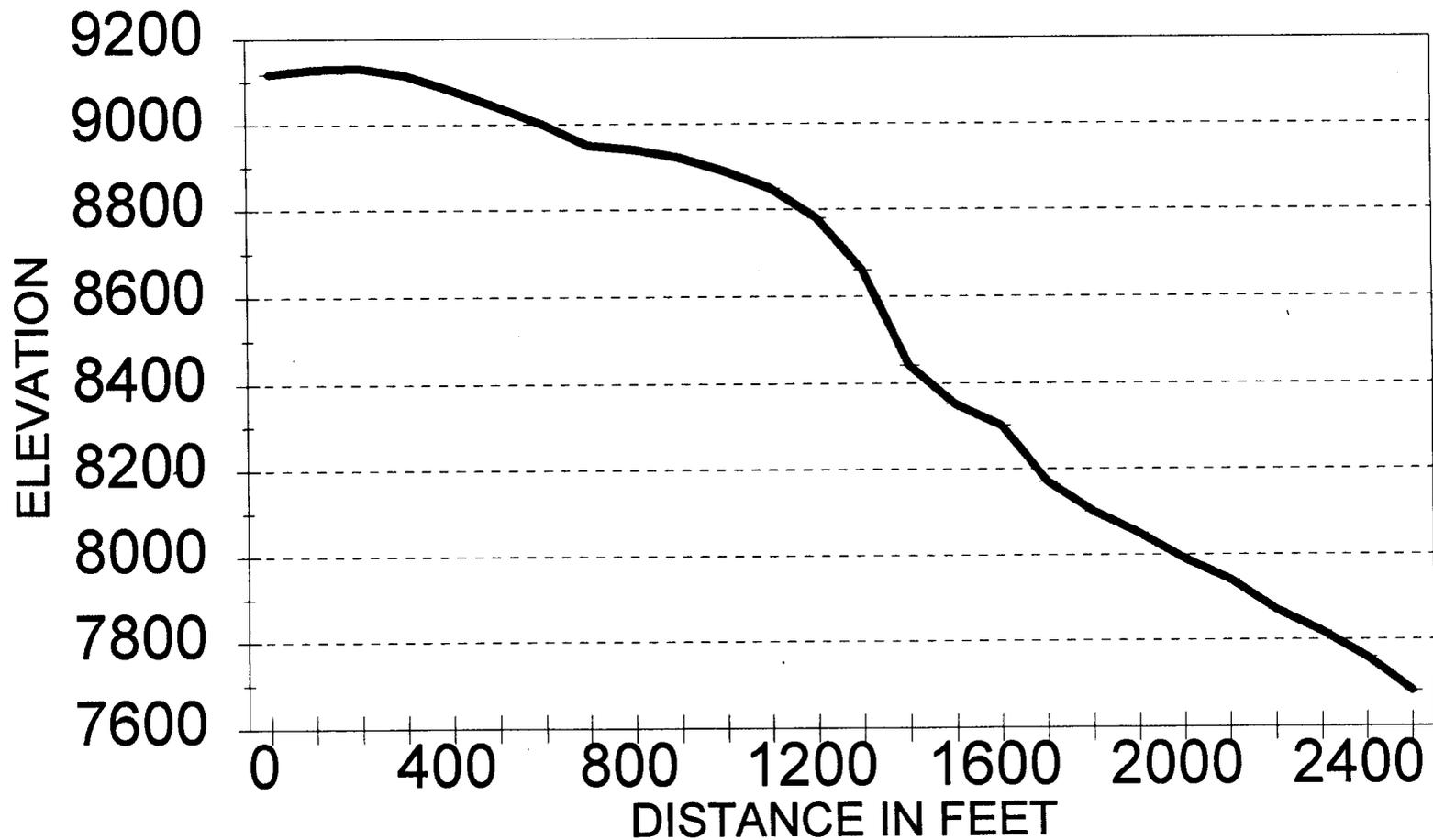


FIGURE 47T

**AREA 14 TOPOGRAPHIC PROFILE**  
WEST - EAST

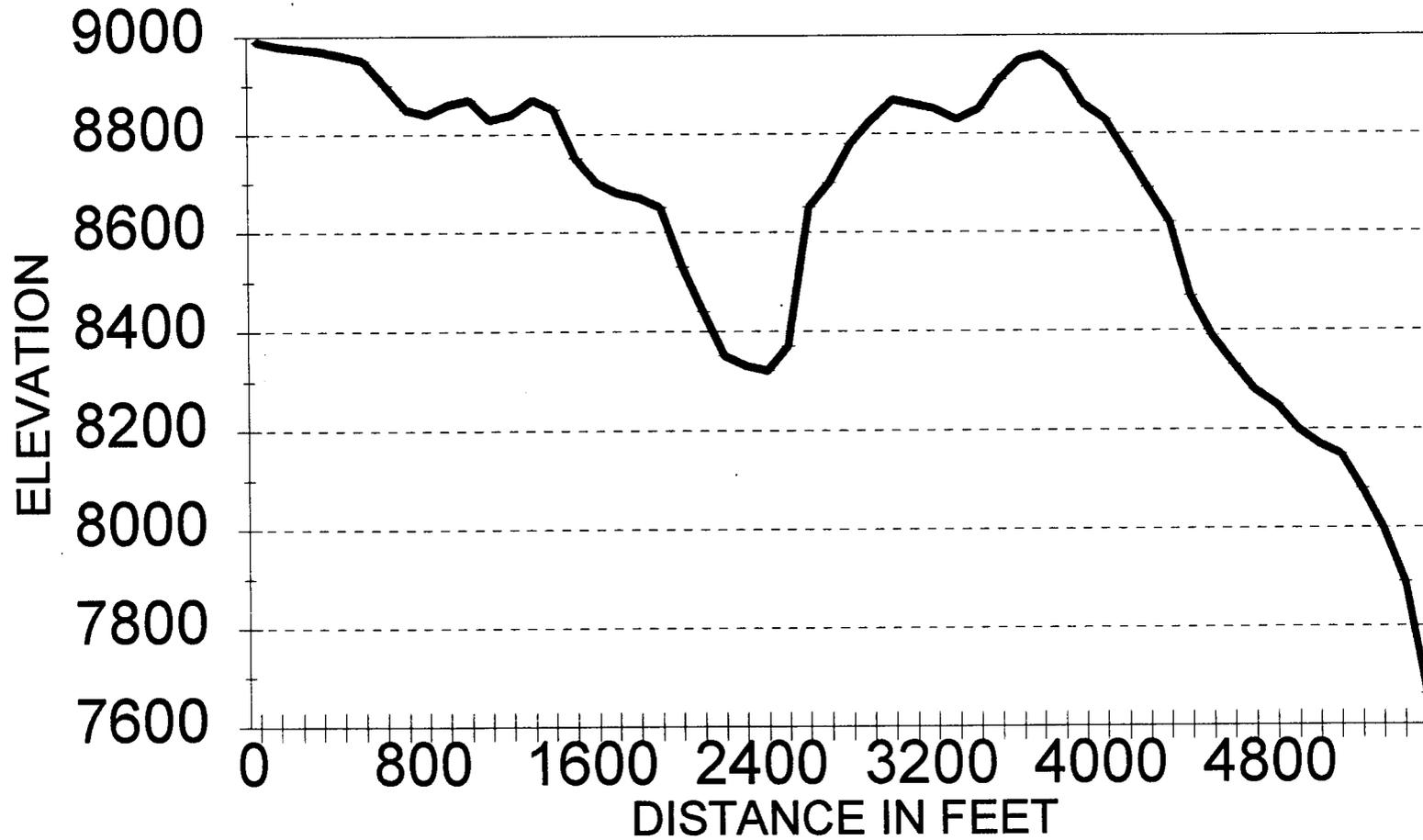


FIGURE 50T  
**AREA 15 TOPOGRAPHIC PROFILE**  
NORTH-SOUTH

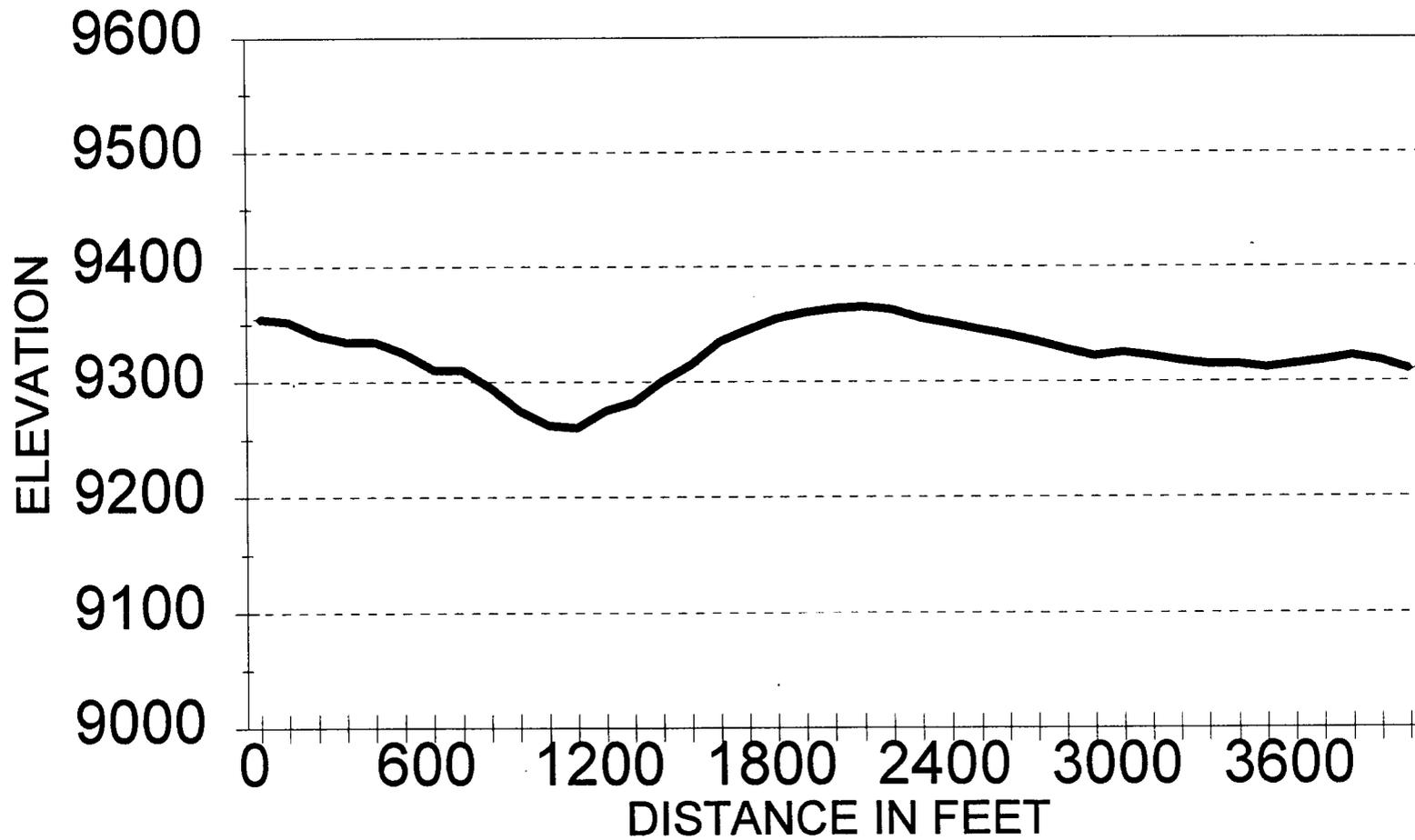


FIGURE 51T  
**AREA 15 TOPOGRAPHIC PROFILE**  
WEST-EAST

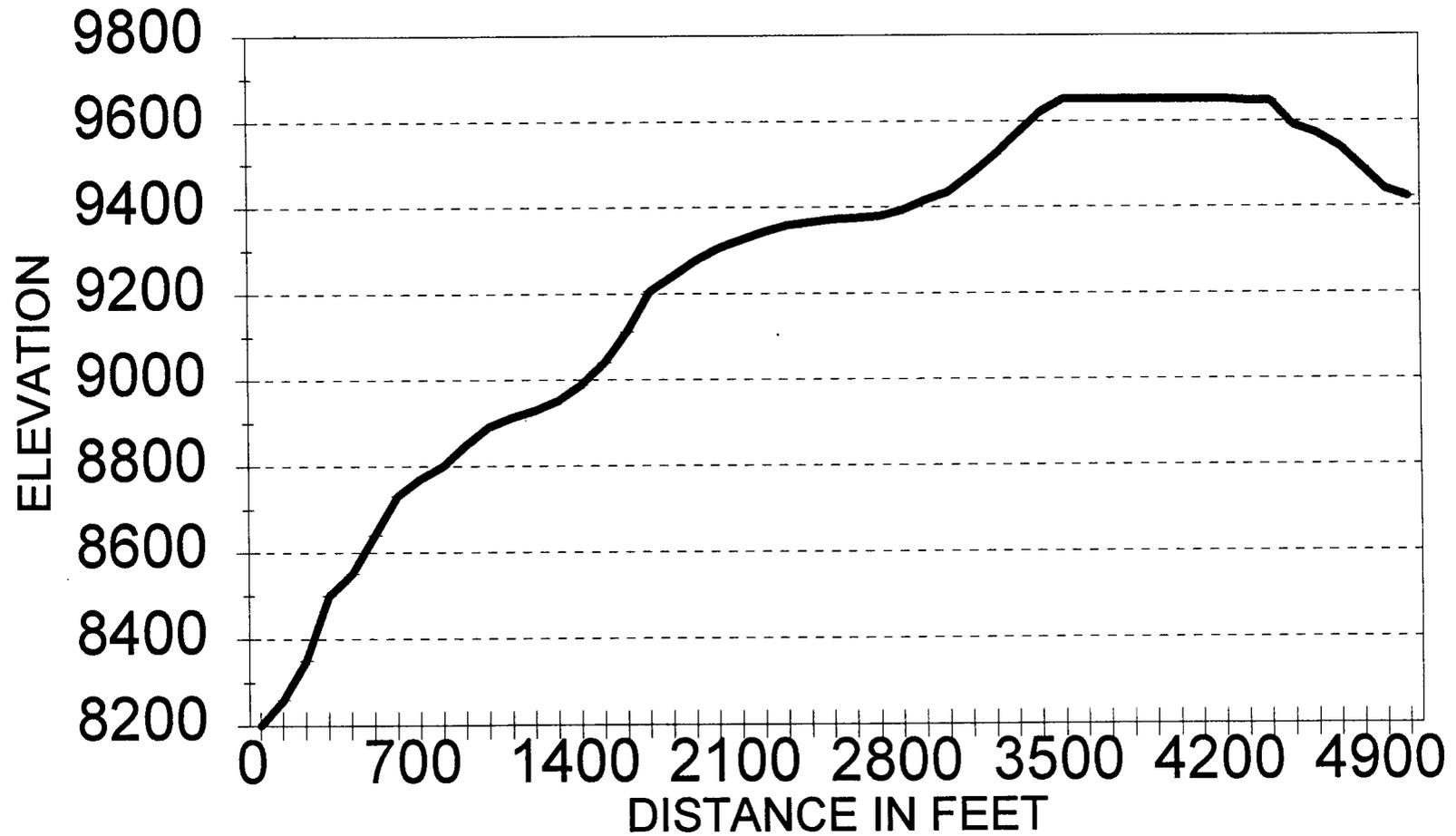


FIGURE 54T

**AREA 16 TOPOGRAPHIC PROFILE**  
NORTH-SOUTH

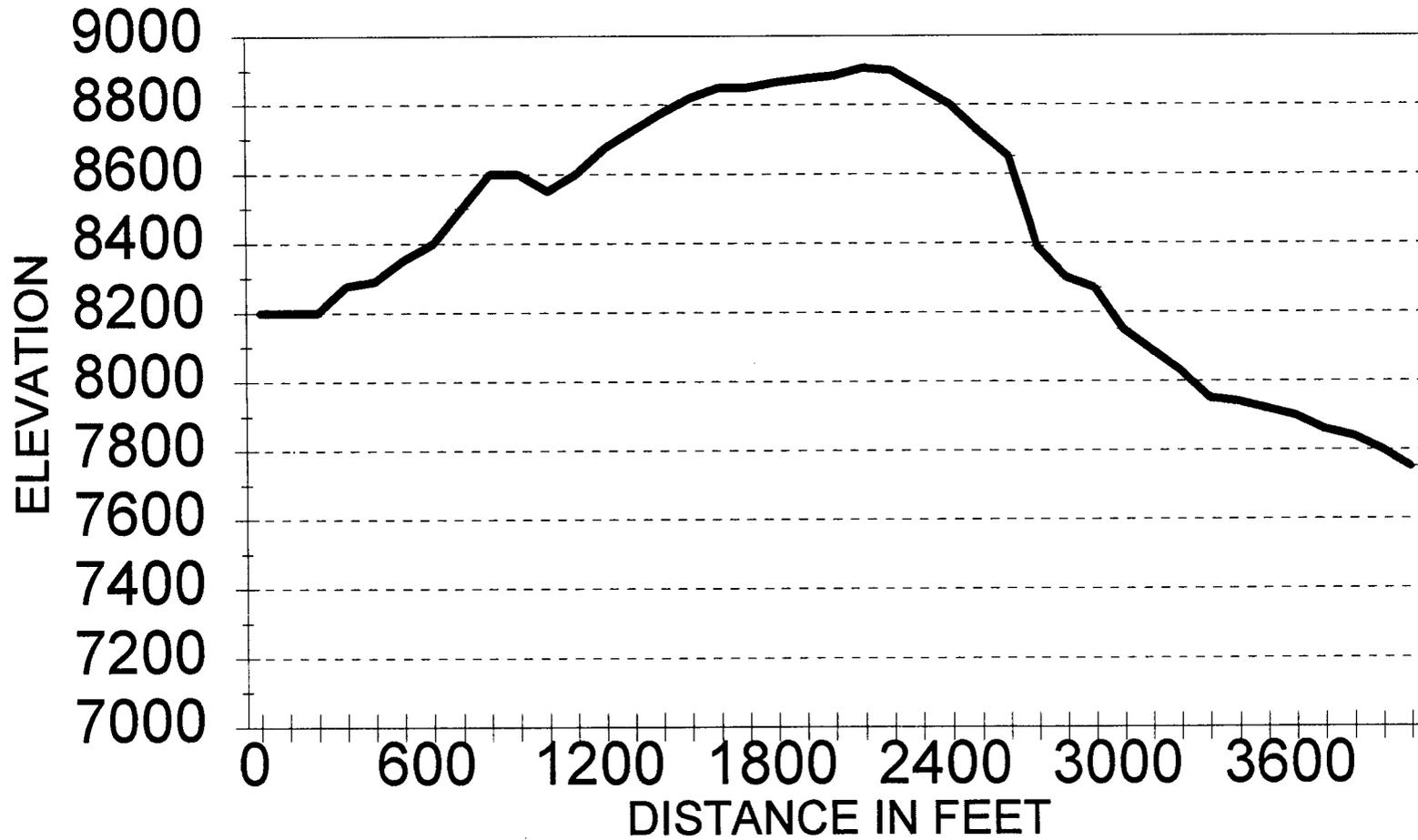


FIGURE 55T  
**AREA 16 TOPOGRAPHIC PROFILE**  
WEST-EAST

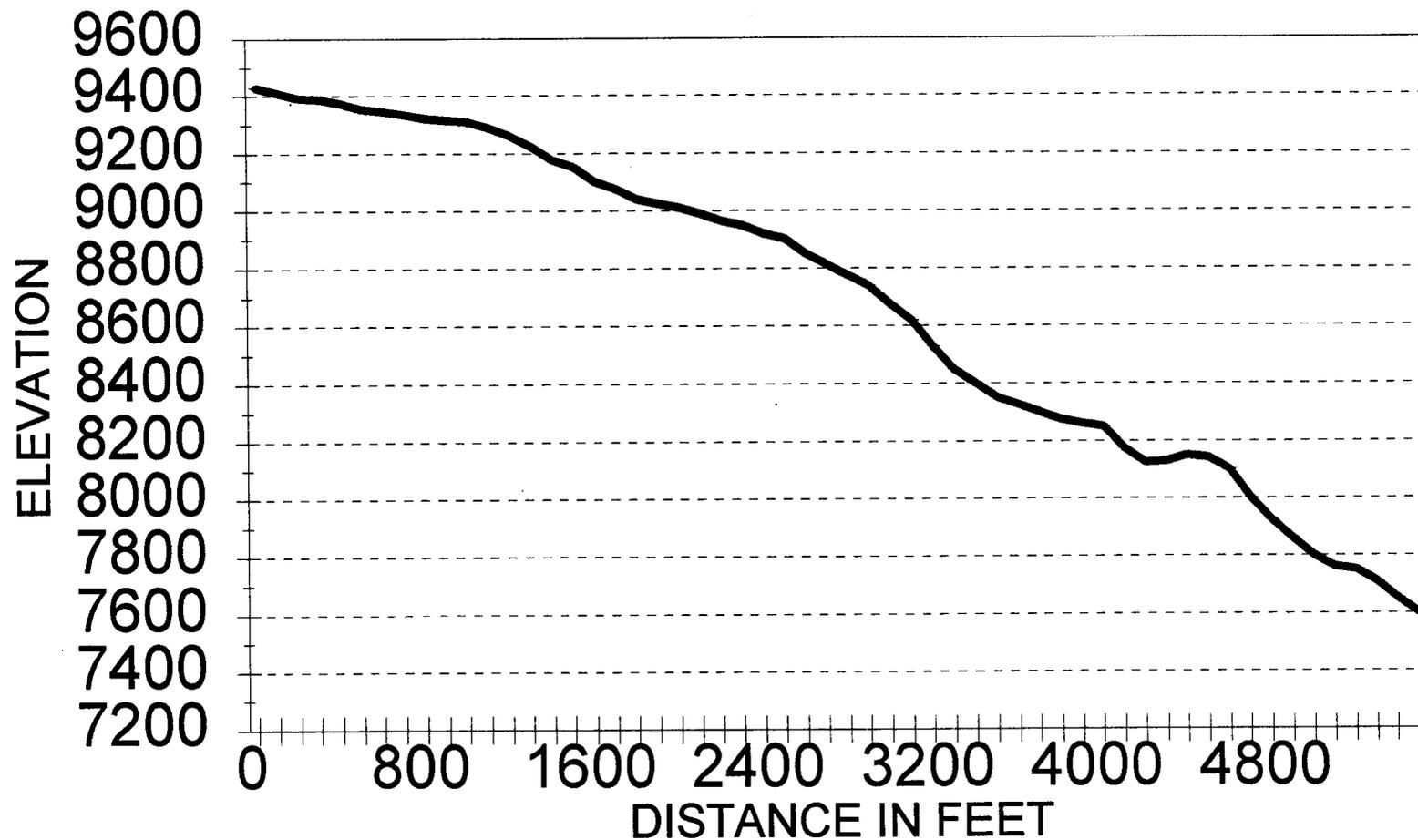


FIGURE 58T  
**AREA 17 TOPOGRAPHIC PROFILE**  
NORTH-SOUTH

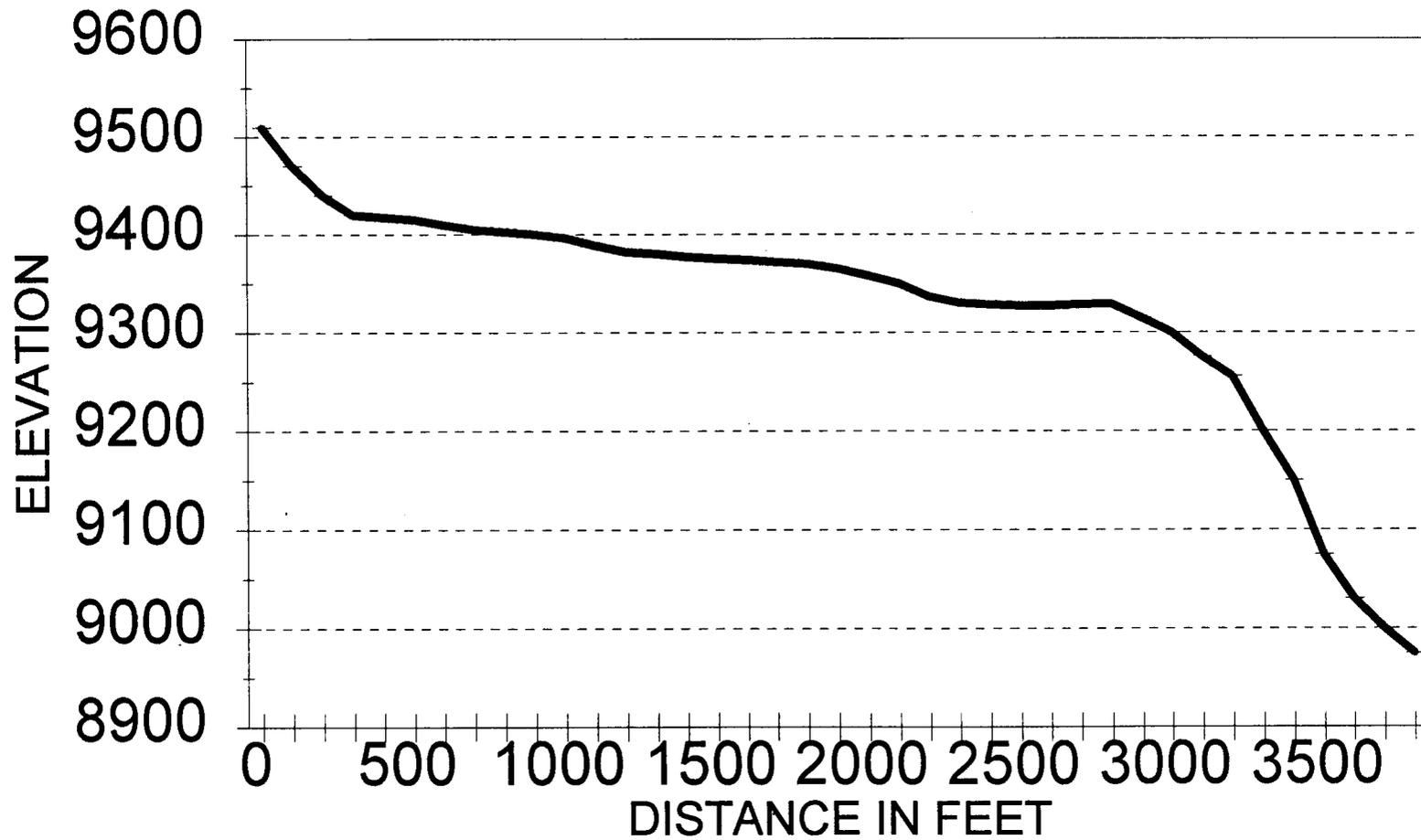
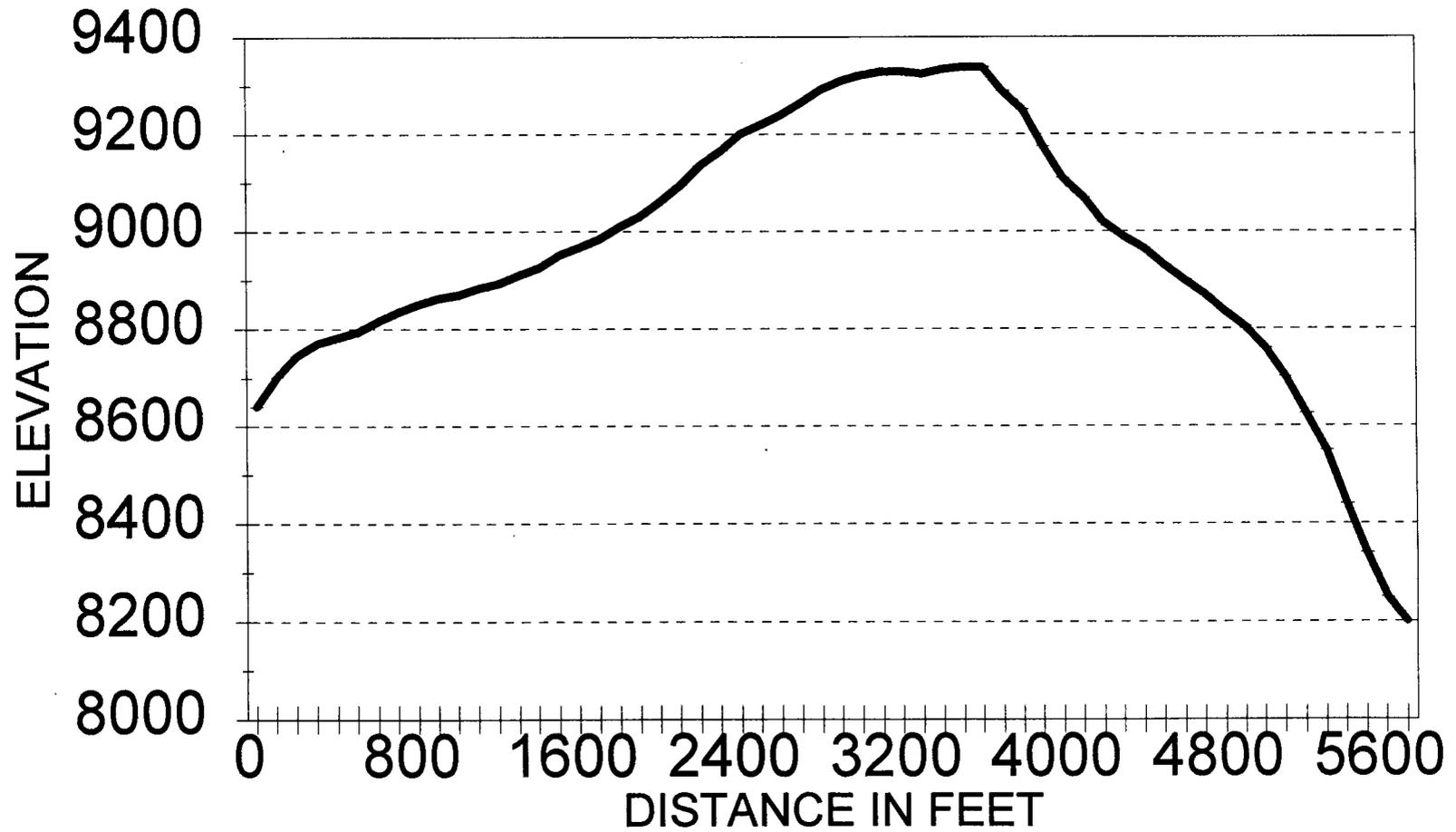


FIGURE 59T

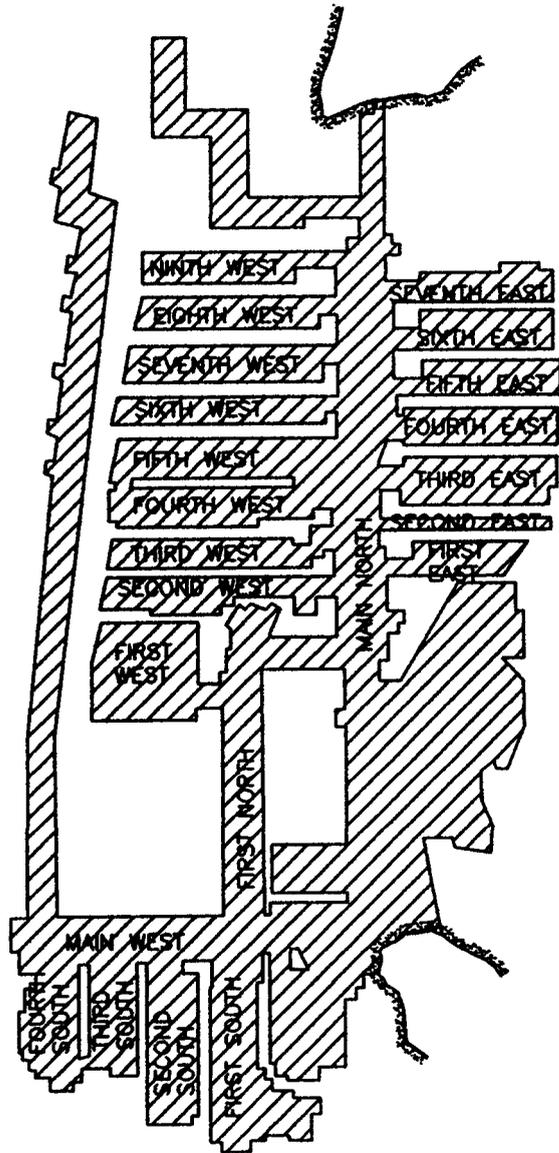
# AREA 17 TOPOGRAPHIC PROFILE

WEST-EAST



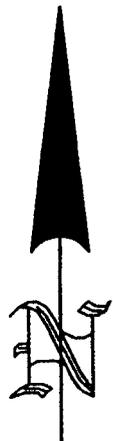
**RAW DATA**

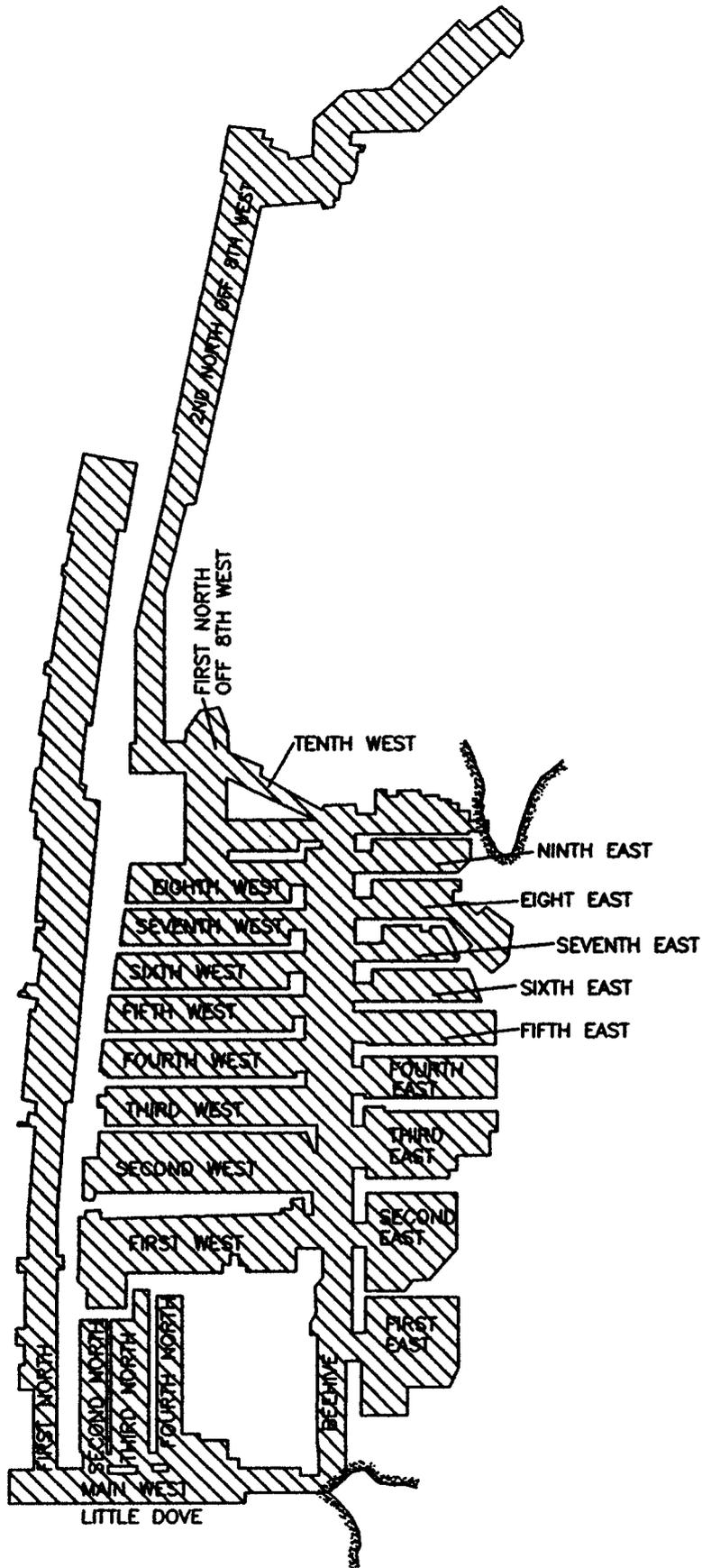
**Des-Bee-Dove Mines**



**DESERET COAL MINE**

SCALE: 1" = 2,000'



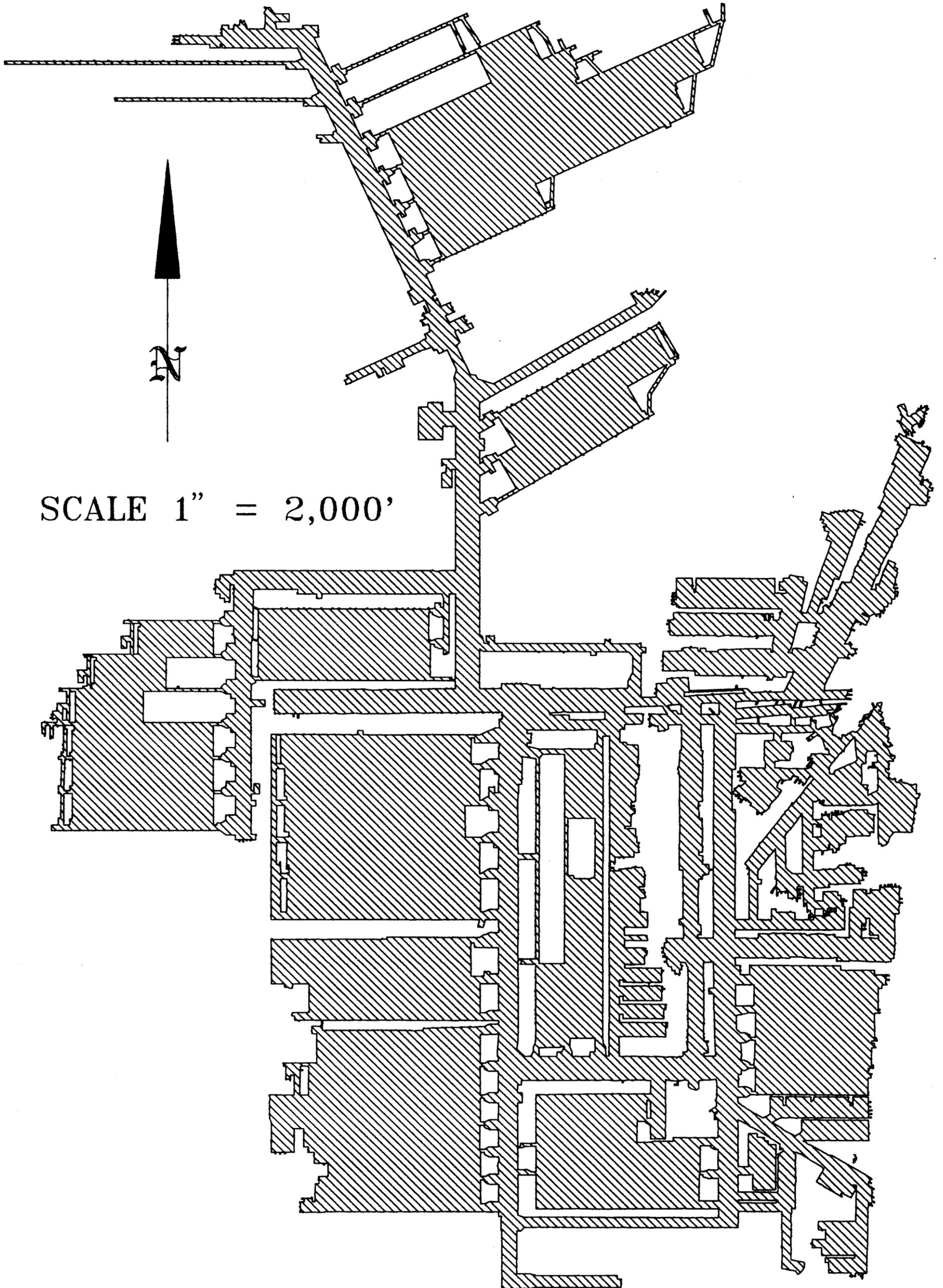


**BEEHIVE & LITTLE DOVE COAL MINES**

SCALE: 1" = 2,000'

## **Deer Creek Mine**

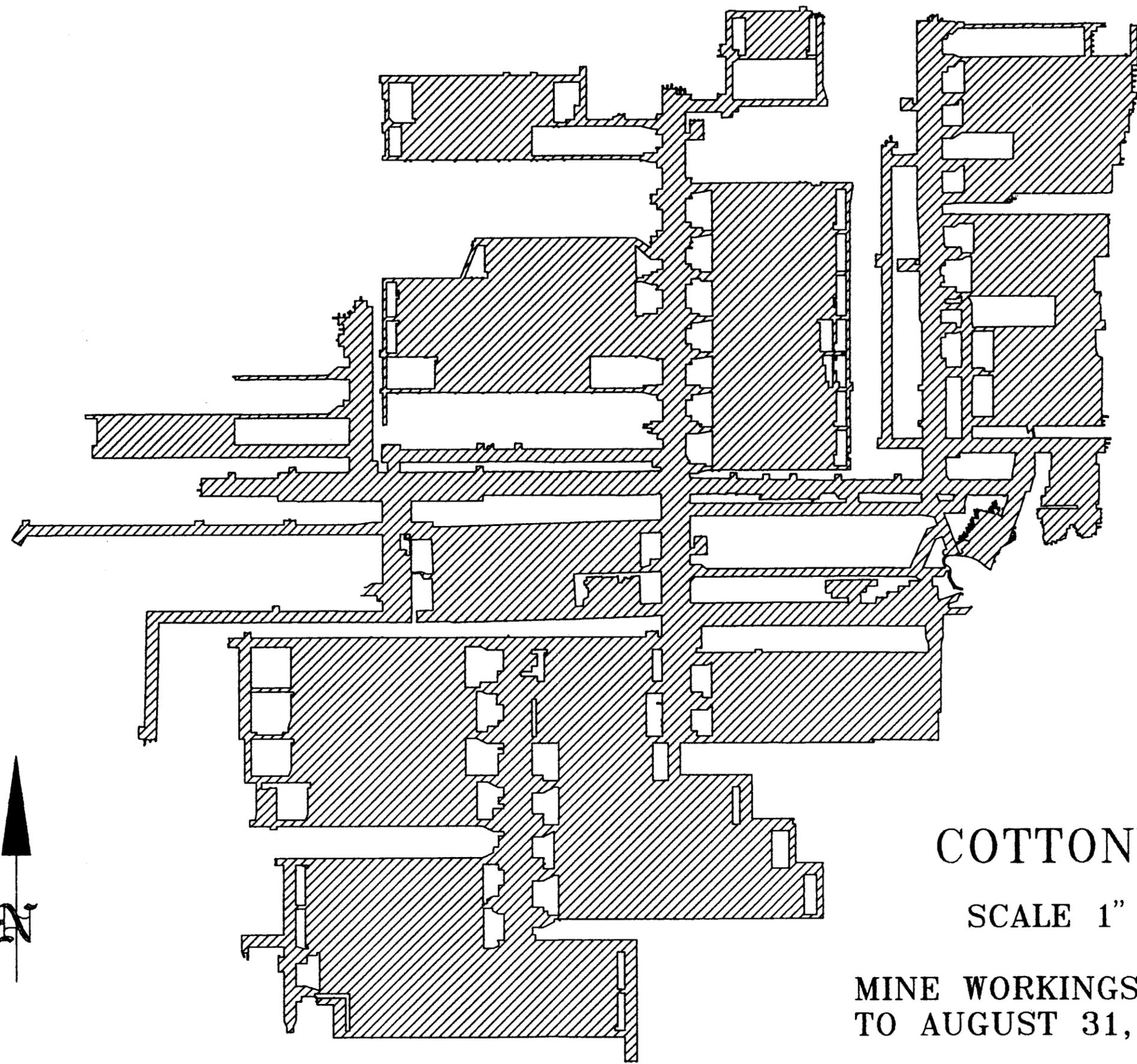
# DEER CREEK MINE



SCALE 1" = 2,000'

MINE WORKINGS UPDATED TO: AUGUST 31, 1995

# **Wilberg/Cottonwood Mine**



# COTTONWOOD MINE

SCALE 1" = 2,00'

MINE WORKINGS UPDATED  
TO AUGUST 31, 1995

**Spring Map with 5-Year Mine Plan**

**Showing Subsidence**