

FIGURE 46
 AREA 14 SUBSIDENCE PROFILE
 NORTH-SOUTH

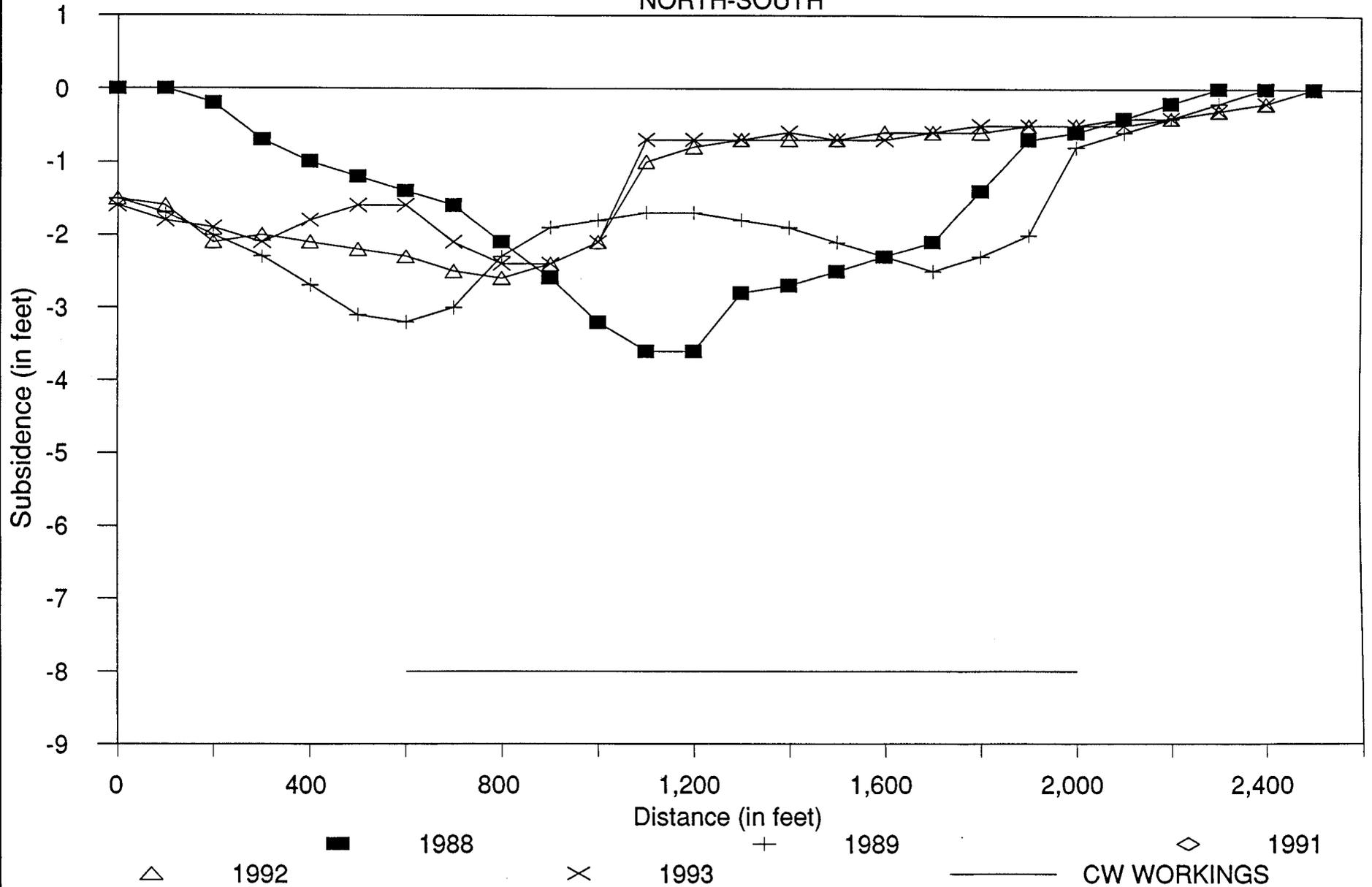
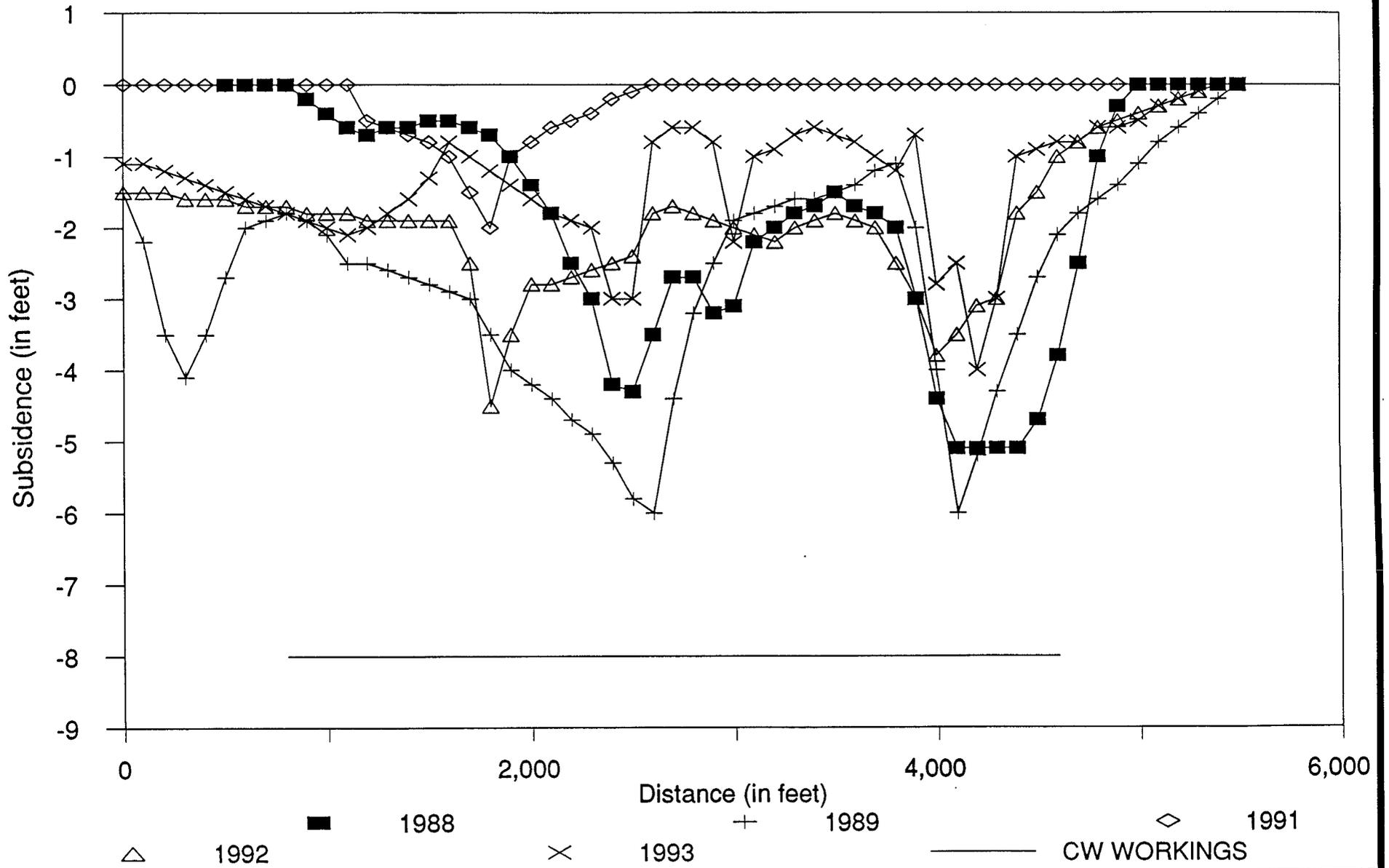


FIGURE 47
AREA 14 SUBSIDENCE PROFILE
WEST-EAST



Area 15

Cottonwood 9th and 12th West Longwall Panels

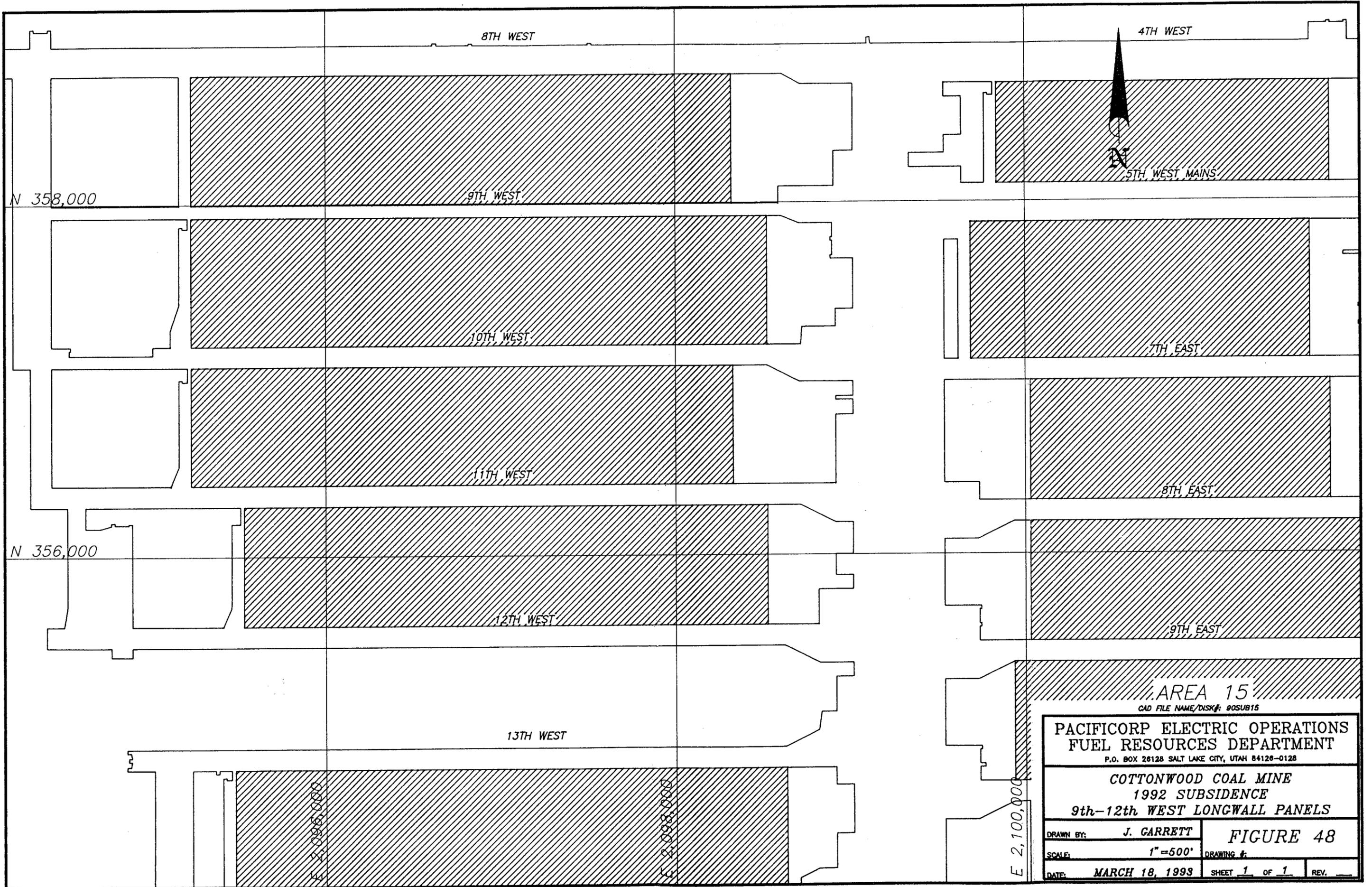
Subsidence in 9th and 10th West was first monitored and detected in 1988 when longwall extraction began there. The 9th through 12th West panels were all completed by fall of 1989 (Figure 48).

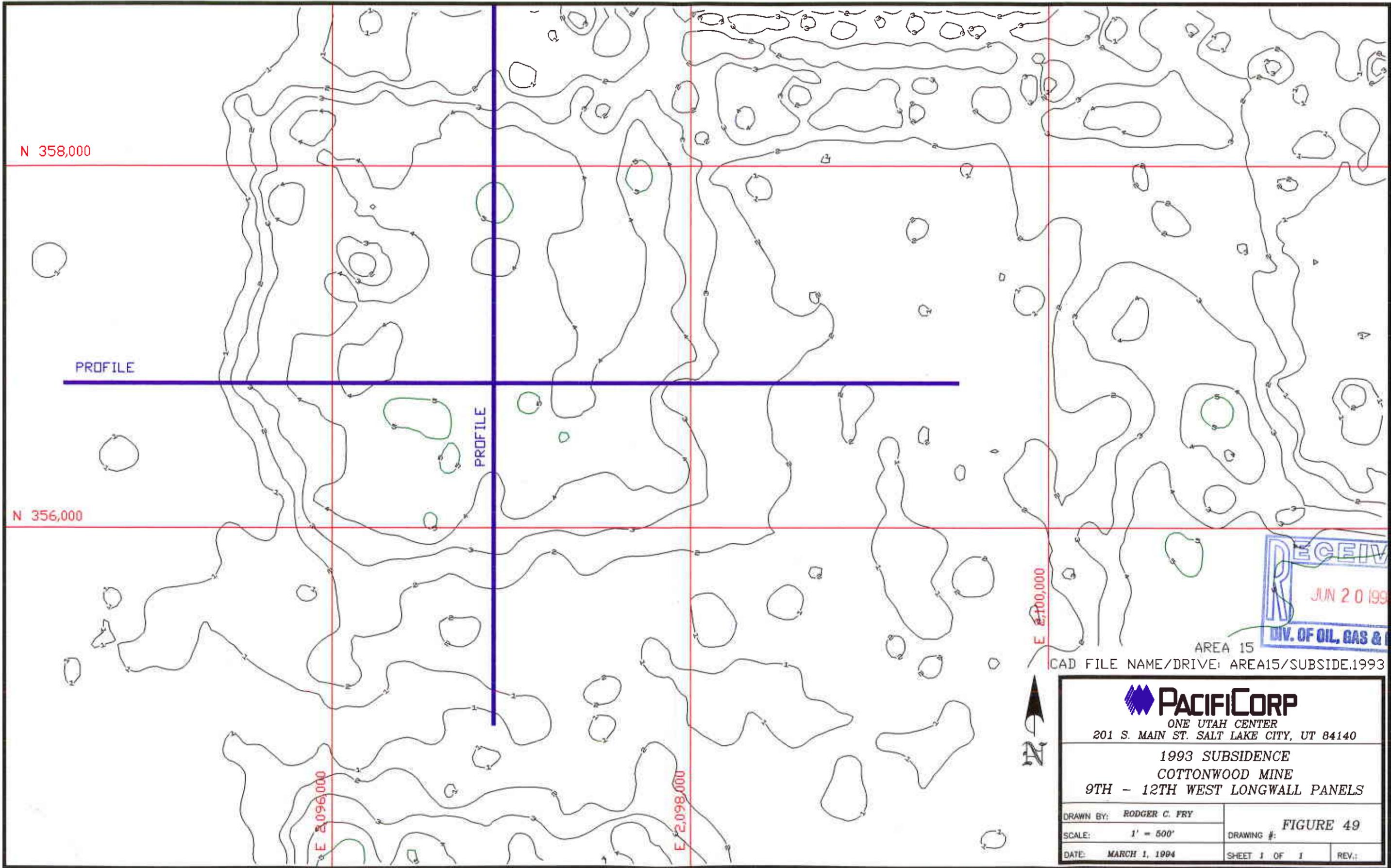
The surface above these panels is comprised mainly of steep to moderate slopes with a small flat area forming the top of East Mountain on the area's eastern edge. Overburden ranges from 800 feet to over 2000 feet.

Maximum measured subsidence to date is over five (5) feet above 11th West (Figures 49, 50, and 51).

Calculated angle-of-draw is less than zero on the south and east and reaches 20 degrees on the west.

There are no known springs in the area.





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AREA 15
 CAD FILE NAME/DRIVE: AREA15/SUBSIDE.1993

 PACIFICORP ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140	
1993 SUBSIDENCE COTTONWOOD MINE 9TH - 12TH WEST LONGWALL PANELS	
DRAWN BY: RODGER C. FRY SCALE: 1" = 500' DATE: MARCH 1, 1994	FIGURE 49 DRAWING #: SHEET 1 OF 1 REV.:

FIGURE 50
 AREA 15 SUBSIDENCE PROFILE
 NORTH-SOUTH

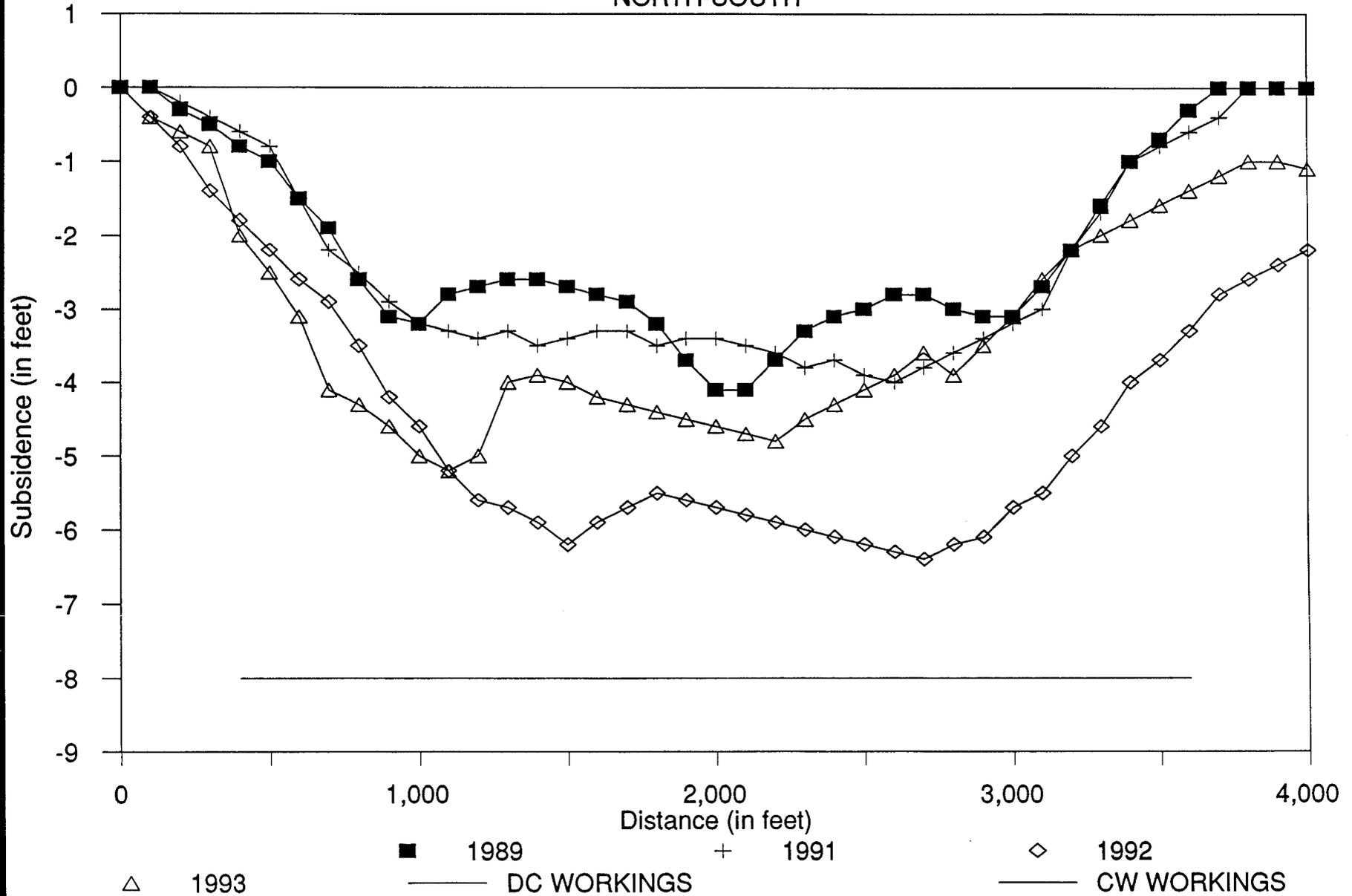
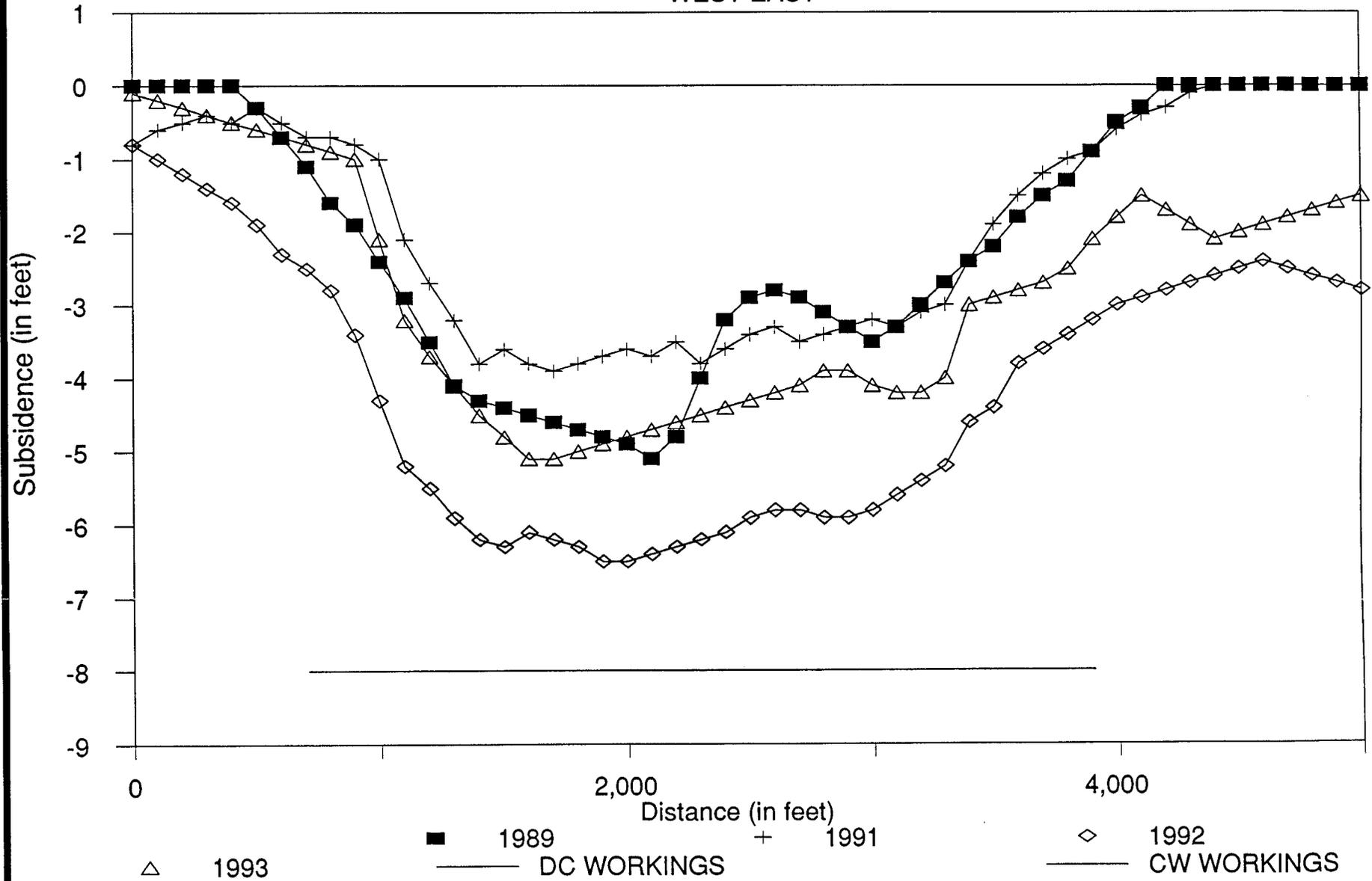


FIGURE 51
 AREA 15 SUBSIDENCE PROFILE
 WEST-EAST



Area 16

Cottonwood 8th Through 11th East Longwall Panels

Mining in Area 16 began in the 8th East panel in June of 1989, and ended in the 8th East panel in May, 1992 (Figure 52).

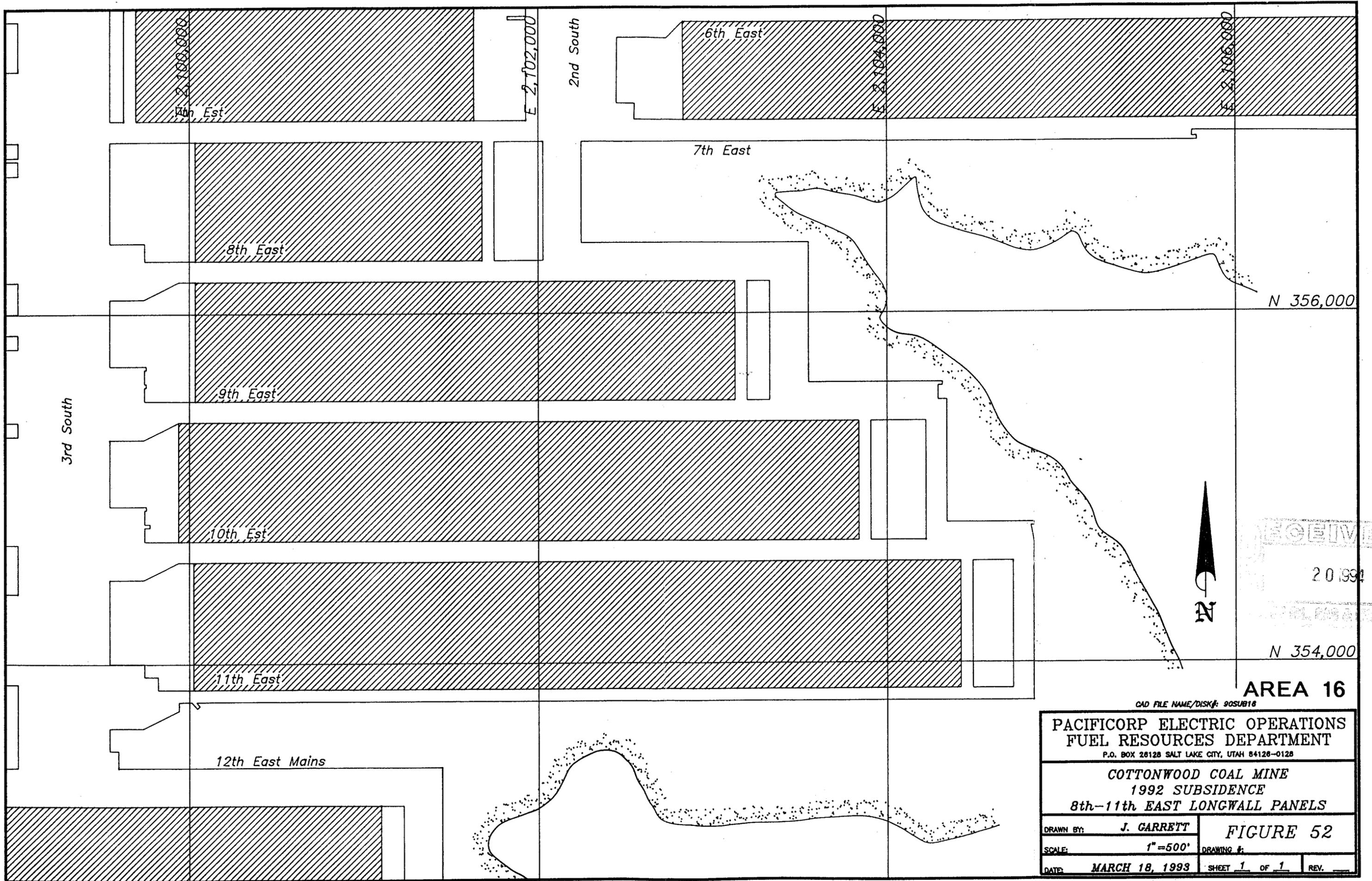
Topography in Area 16 is very similar to that of Area 14 with cliffs and very steep slopes covered by a few scattered pinon, juniper, mountain brush, and grasses. Overburden ranges from near 100 feet near outcrop to about 1800 feet.

As with Area 14 cliff spalling has occurred in places and the resulting talus has accumulated on the steep slopes below the cliffs. No surface cracks have been observed to date.

Maximum subsidence observed to date is eleven (11) feet and occurs over the 11th East panel where the overburden is less than 600 feet (Figure 53, 54, and 55).

The angle-of-draw was not calculated because the steep slopes and other adjacent workings make accurate measurement difficult.

There are no known springs in the area. Strata on both the surface and in underground mine workings are typically very dry; therefore, mining is not expected to affect the hydrology.



AREA 16

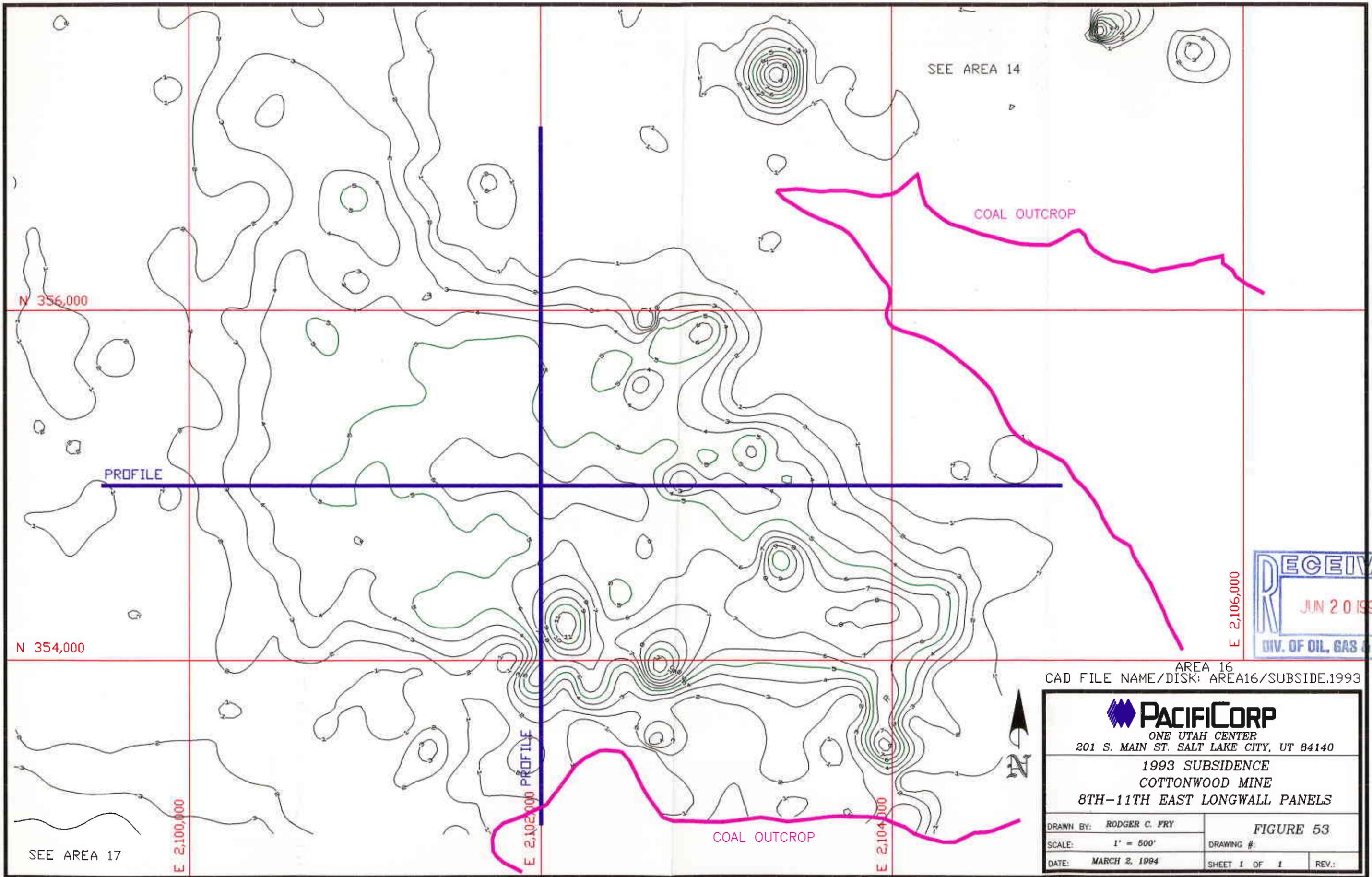
CAD FILE NAME/DISK#: 90SUB16

**PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT**
P.O. BOX 28128 SALT LAKE CITY, UTAH 84128-0128

**COTTONWOOD COAL MINE
1992 SUBSIDENCE
8th-11th EAST LONGWALL PANELS**

DRAWN BY:	J. GARRETT	FIGURE 52
SCALE:	1" = 500'	
DATE:	MARCH 18, 1993	SHEET 1 OF 1 REV. _____

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N 354,000



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AREA 16
 CAD FILE NAME/DISK: AREA16/SUBSIDE.1993

 <p>PACIFICORP ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140</p>		
<p>1993 SUBSIDENCE COTTONWOOD MINE 8TH-11TH EAST LONGWALL PANELS</p>		
<p>DRAWN BY: RODGER C. FRY</p>	<p>FIGURE 53</p>	
<p>SCALE: 1" = 500'</p>	<p>DRAWING #:</p>	
<p>DATE: MARCH 2, 1994</p>	<p>SHEET 1 OF 1</p>	<p>REV.:</p>

SEE AREA 17

SEE AREA 14

PROFILE

COAL OUTCROP

COAL OUTCROP

E 2,102,000 PROFILE

E 2,100,000

E 2,104,000

E 2,106,000

N 356,000

N 354,000

FIGURE 54
AREA 16 SUBSIDENCE PROFILE
NORTH-SOUTH

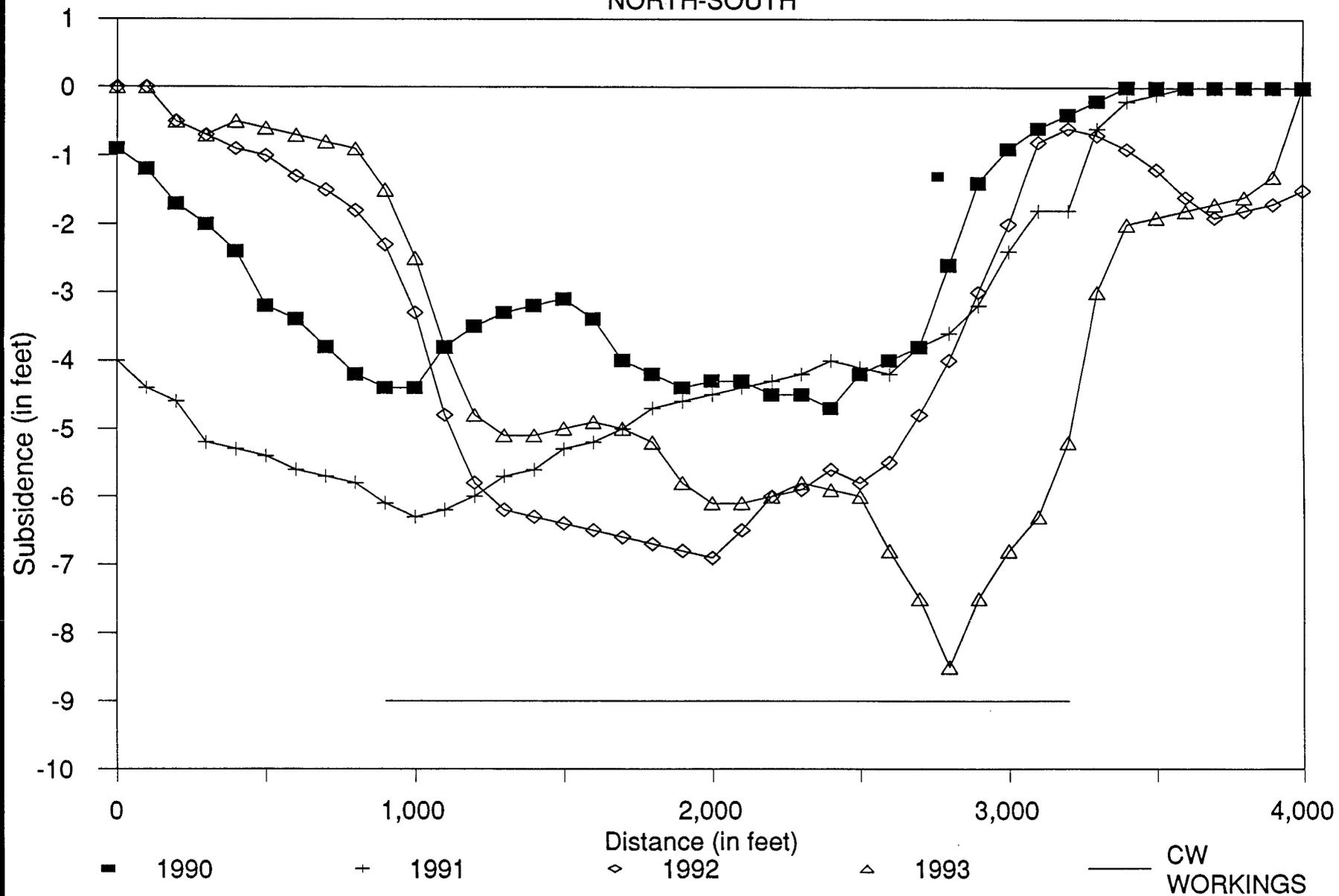
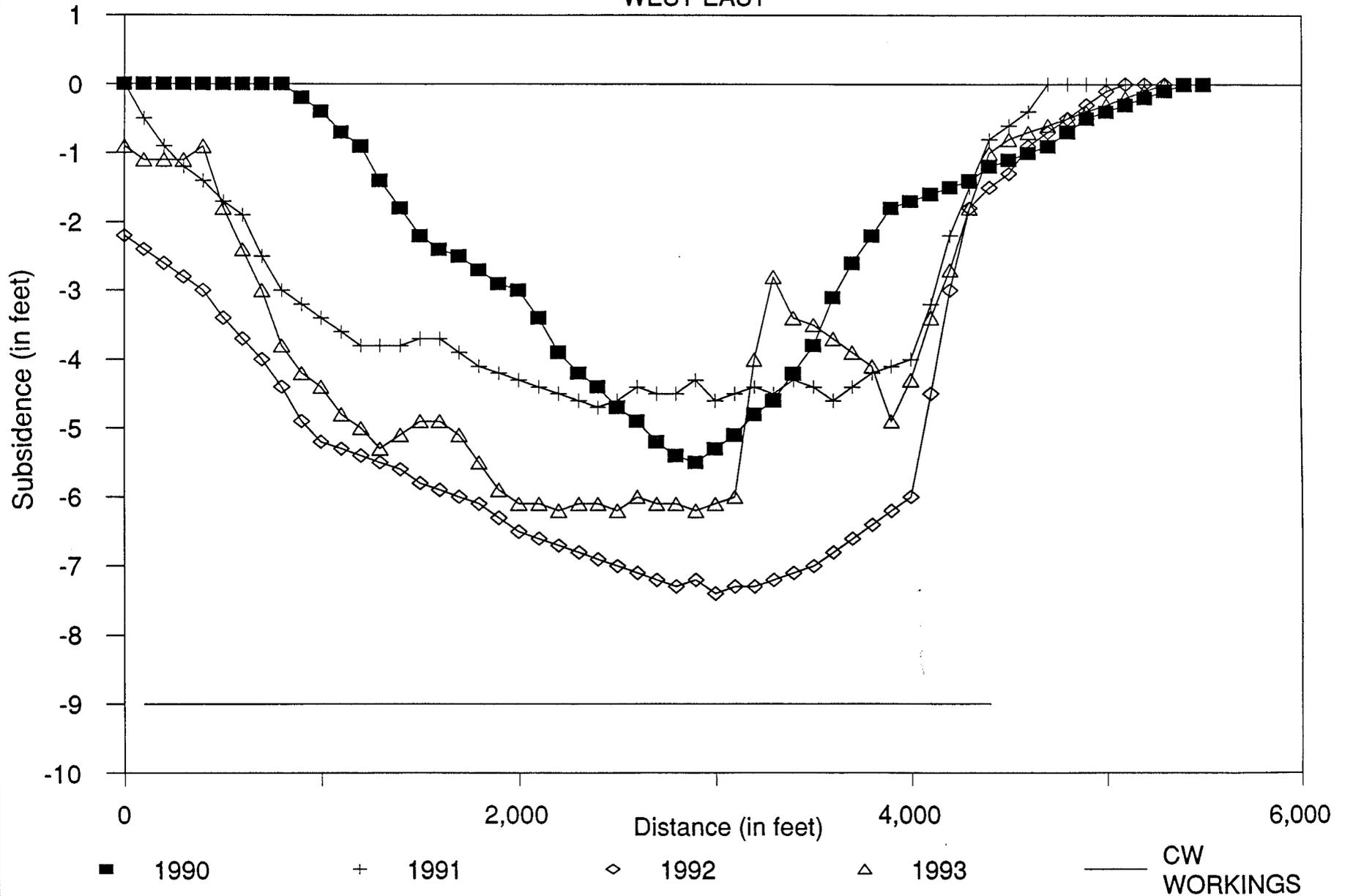


FIGURE 55
AREA 16 SUBSIDENCE PROFILE
WEST-EAST



Area 17

Cottonwood 13th Through 16th West Longwall Panels

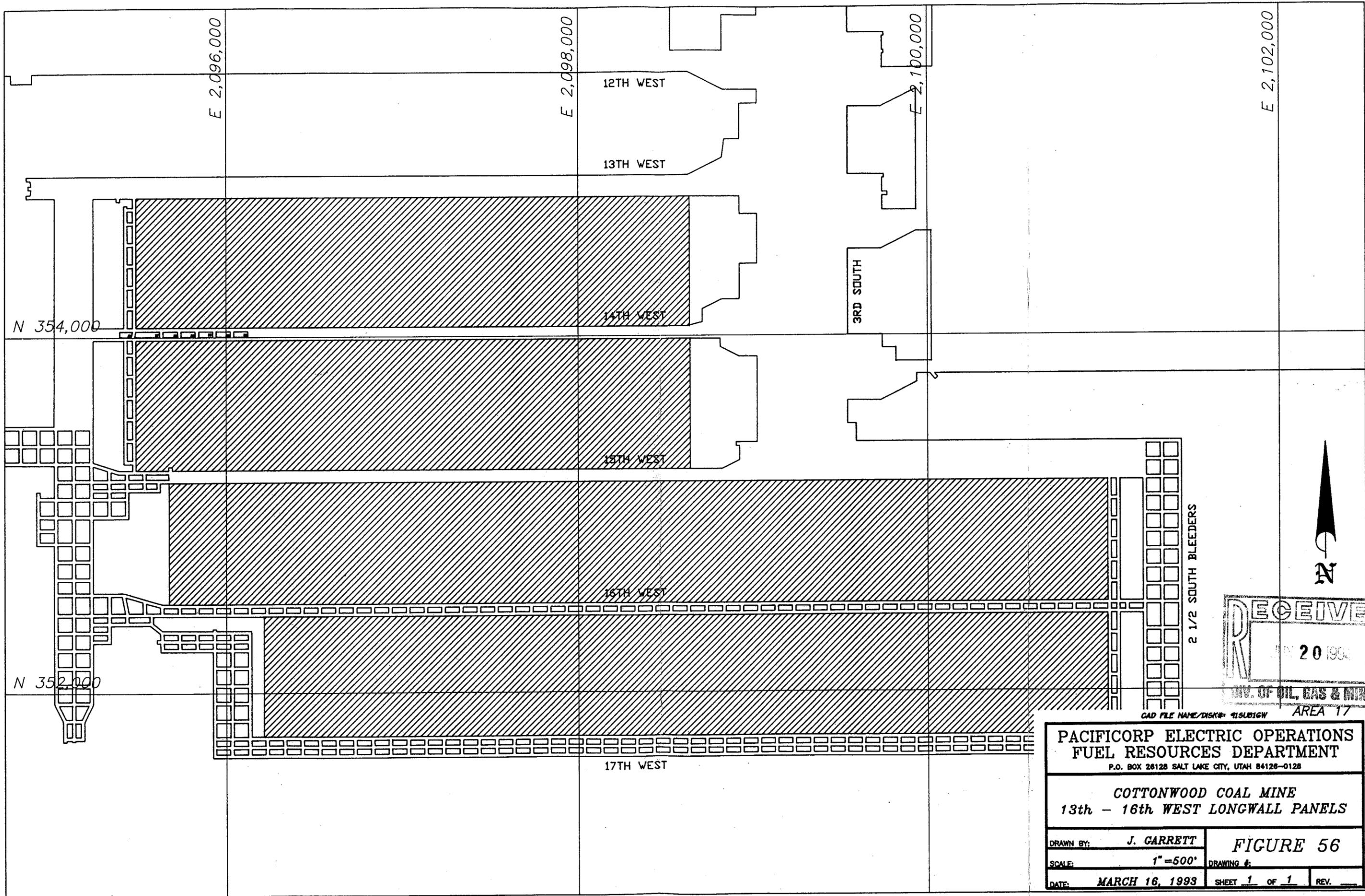
Mining in the 16th West longwall panel began in October 1990 and the panel was completed in March 1991. Mining in the area was completed in March, 1992 with the completion of the 13th West longwall panel (figure 56).

The topography over these longwall panels is characterized by steep slopes covered with conifer and aspen trees which extend up from the cliffs which surround the east, south and west sides of the panels. The panels are covered by overburden ranging from 800 feet at both the west and east end of the panels to over 1,800 feet in the center of the panels.

The measured subsidence exceeds seven (7) feet in an area above the 16th west panel. The subsidence zone follows a narrow east-west trending trough centered above the two longer panels and then extends north above the 14th and 13th west longwall panels (figures 57, 58, and 59). No surface fractures have been observed in the area above these longwall panels.

On the south side of the subsidence zone, the angle of draw is less than 10 degrees.

No springs are located above this area and the strata is not saturated. Therefore, it is not likely that this subsidence will have any effect on the hydrology of the area.



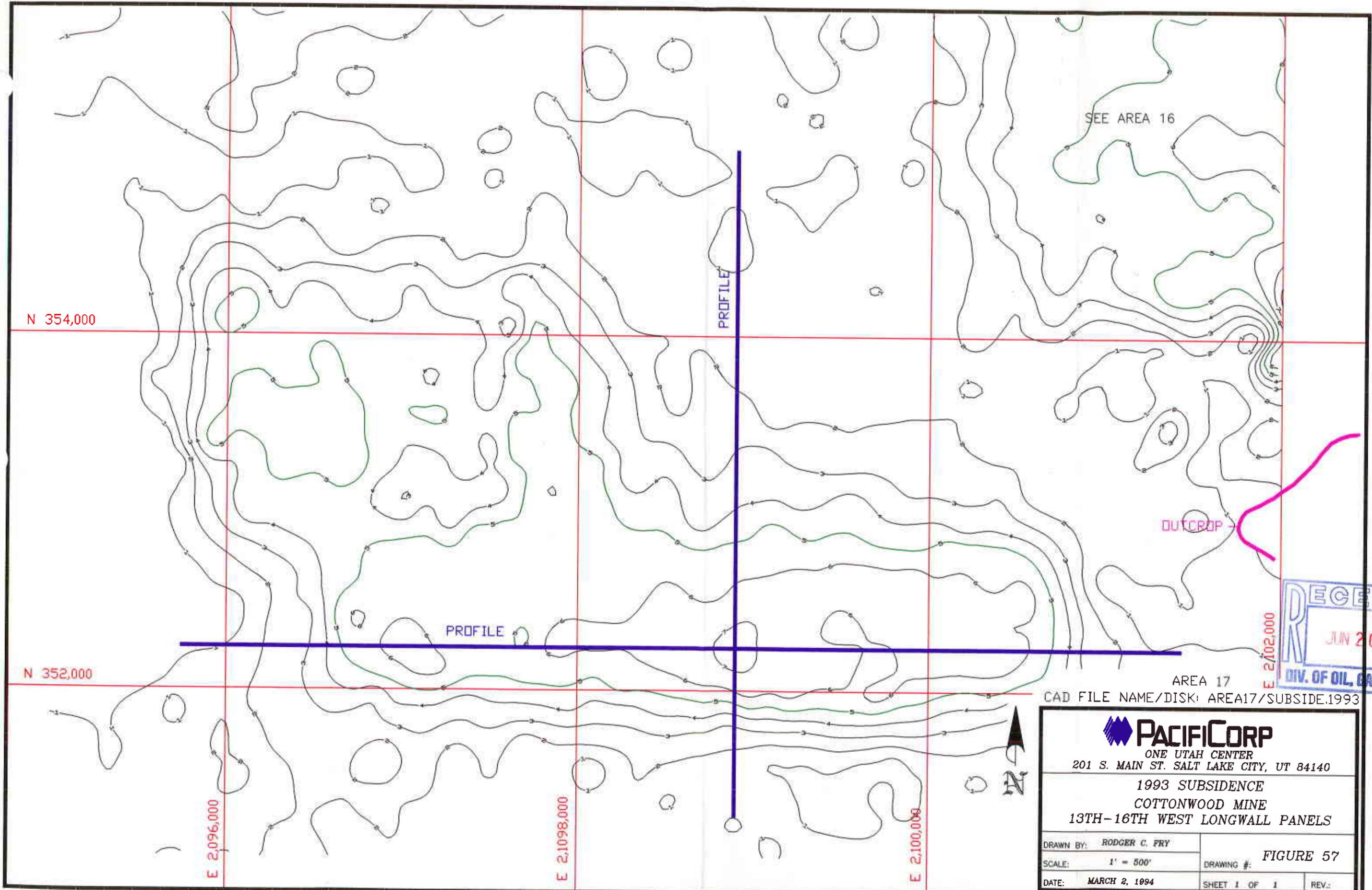
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 AREA 17

CAD FILE NAME/DISK: 915LDIGW

PACIFICORP ELECTRIC OPERATIONS
 FUEL RESOURCES DEPARTMENT
 P.O. BOX 28128 SALT LAKE CITY, UTAH 84128-0128

COTTONWOOD COAL MINE
 13th - 16th WEST LONGWALL PANELS

DRAWN BY:	J. GARRETT	DRAWING #:	FIGURE 56
SCALE:	1" = 500'		
DATE:	MARCH 16, 1993	SHEET 1 OF 1	REV.



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AREA 17
 CAD FILE NAME/DISK: AREA17/SUBSIDE.1993

 ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140		
1993 SUBSIDENCE COTTONWOOD MINE 13TH-16TH WEST LONGWALL PANELS		
DRAWN BY: RODGER C. FRY	DRAWING #: FIGURE 57	
SCALE: 1" = 500'	DATE: MARCH 2, 1994	SHEET 1 OF 1
		REV.:

FIGURE 58
AREA 17 SUBSIDENCE PROFILE
NORTH-SOUTH

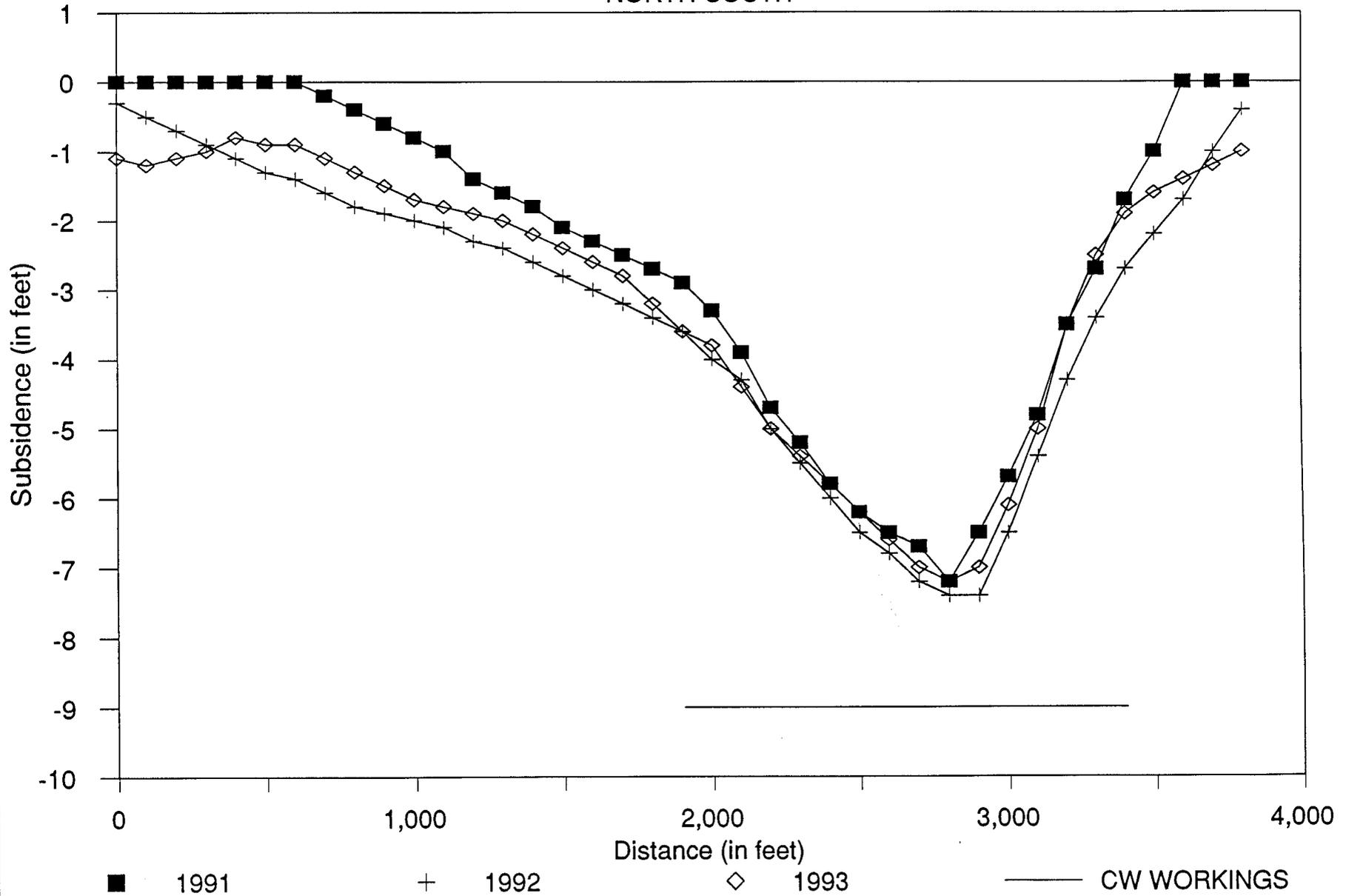
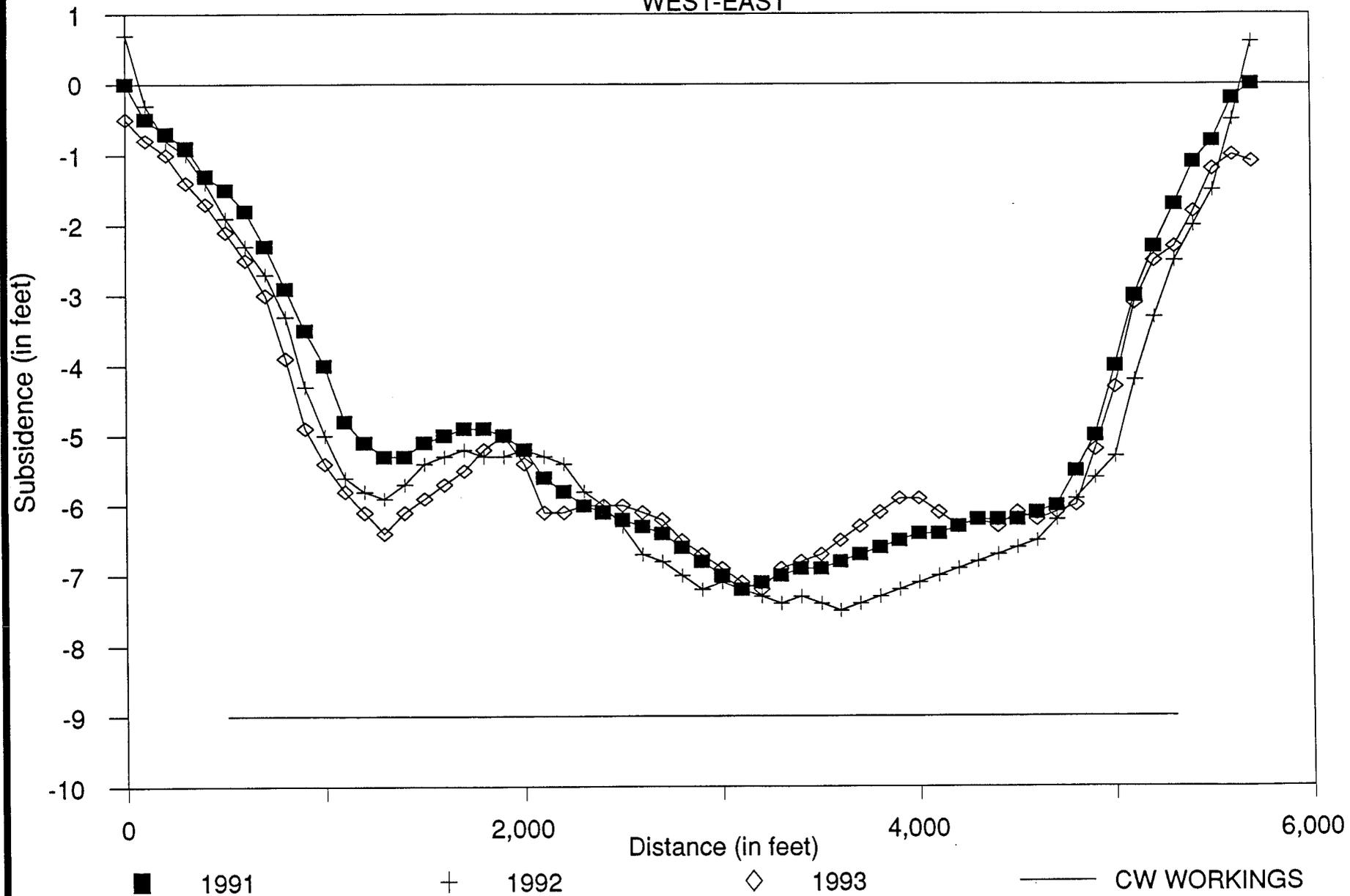


FIGURE 59
AREA 17 SUBSIDENCE PROFILE
WEST-EAST



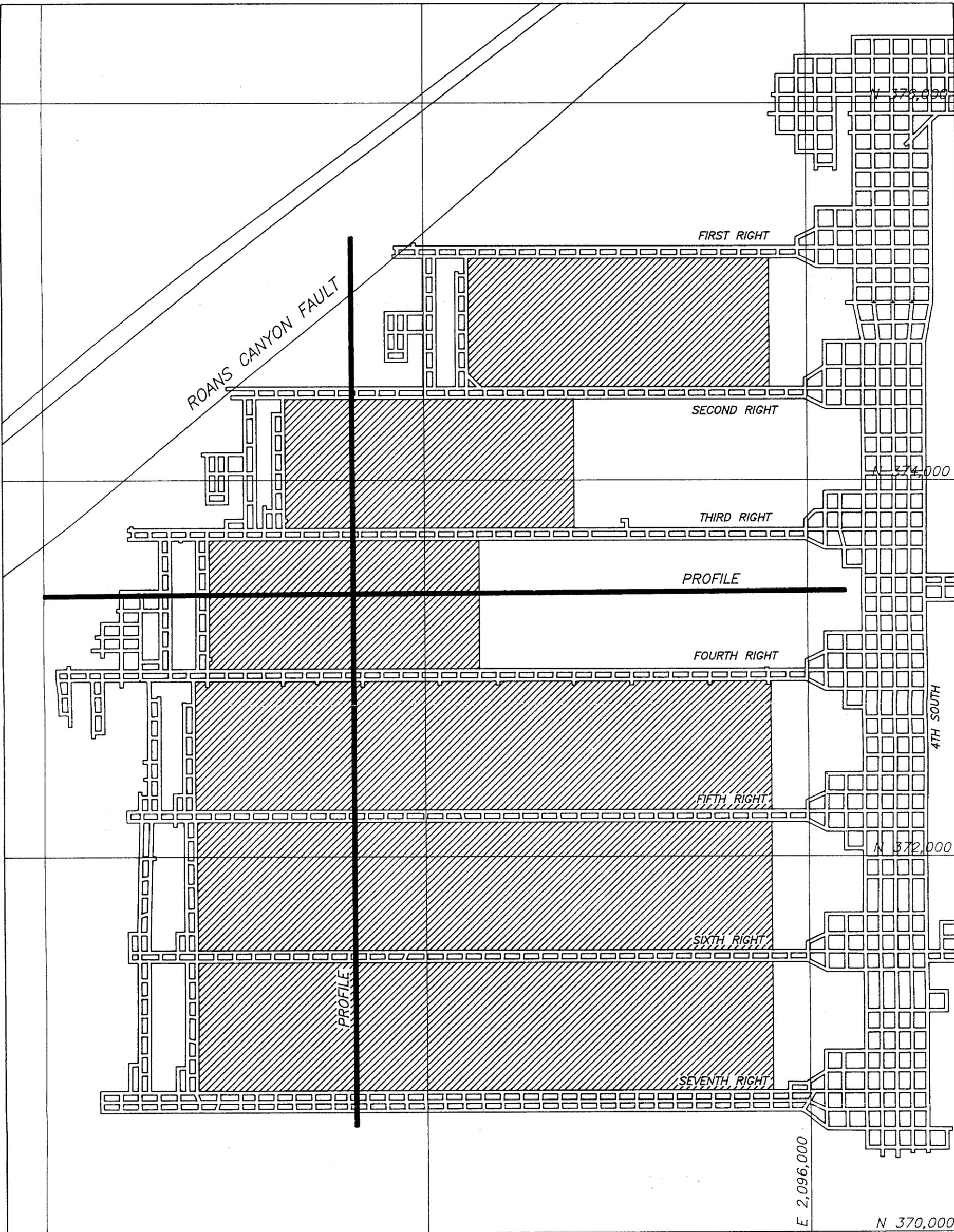
Area 18

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 eight (8) feet (Figures 61, 62, and 63). 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 these springs (see appendix and the 1992 Hydrologic Monitoring report).



E 2,092,000

E 2,094,000

E 2,096,000

N 370,000

N 376,000

N 374,000

N 372,000



CAD FILE NAME/DISK#: 91SUB7R AREA 18

**PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT**
P.O. BOX 28128 SALT LAKE CITY, UTAH 84126-0128

**DEER CREEK MINE
2nd-7th RIGHT LONGWALL PANELS**

DRAWN BY: J. GARRETT

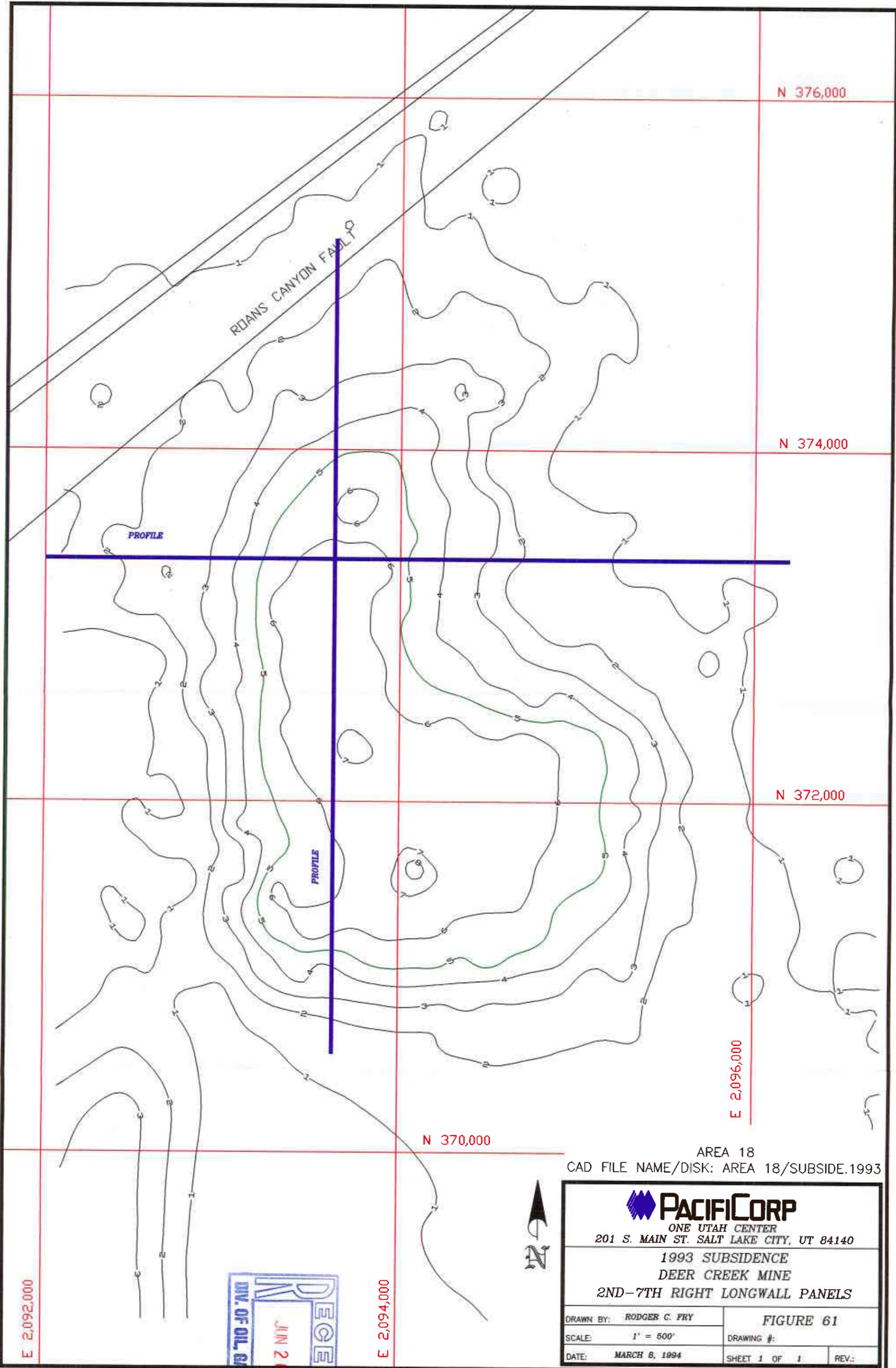
FIGURE 60

SCALE: 1" = 500'

DRAWING #:

DATE: MARCH 16, 1993

SHEET 1 OF 1 REV. _____



AREA 18
 CAD FILE NAME/DISK: AREA 18/SUBSIDE.1993



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

1993 SUBSIDENCE
 DEER CREEK MINE
 2ND-7TH RIGHT LONGWALL PANELS

DRAWN BY: RODGER C. FRY	FIGURE 61	
SCALE: 1" = 500'	DRAWING #:	
DATE: MARCH 8, 1994	SHEET 1 OF 1	REV.:

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FIGURE 62
 AREA 18 SUBSIDENCE PROFILE
 NORTH-SOUTH

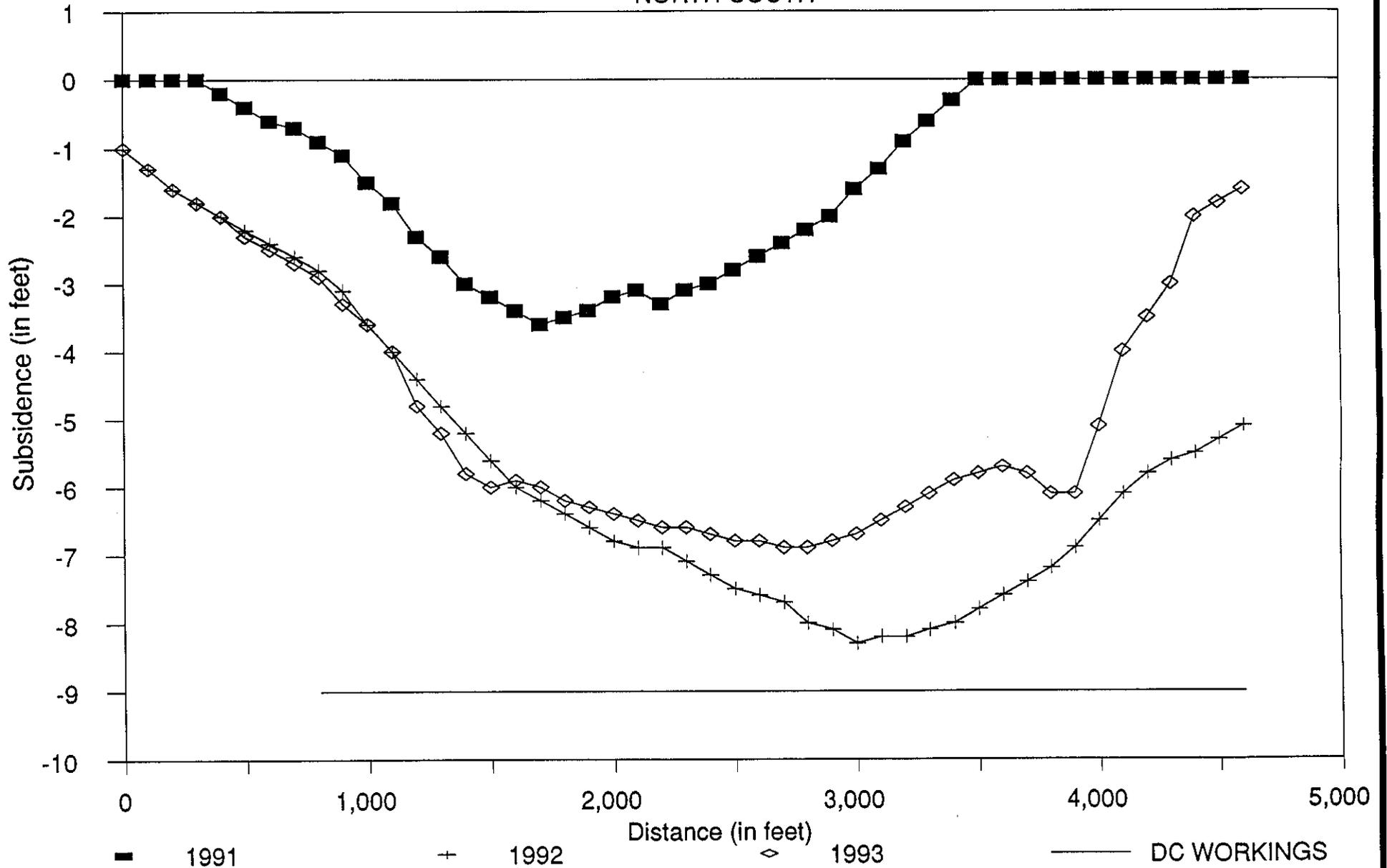
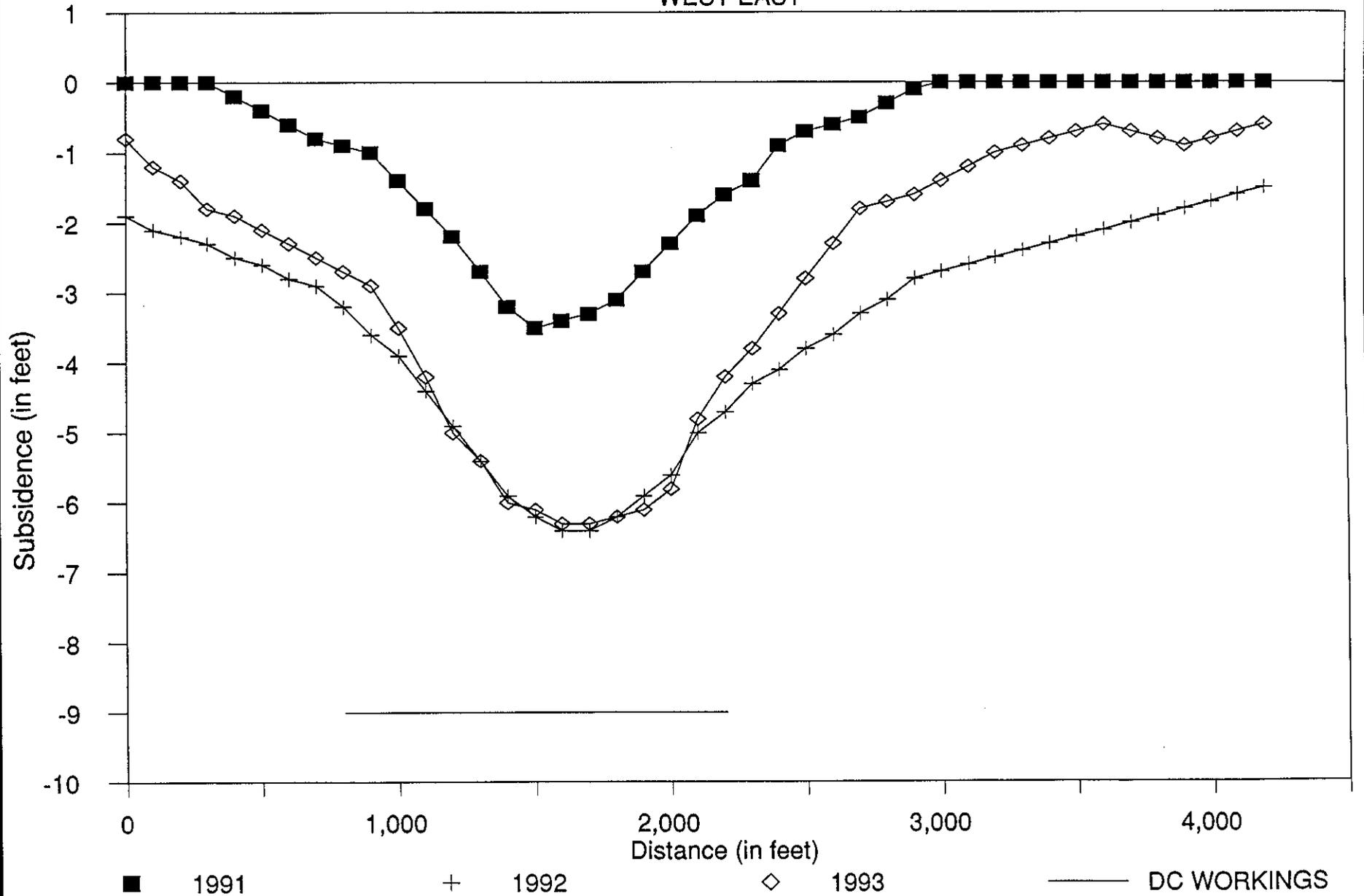


FIGURE 63
AREA 18 SUBSIDENCE PROFILE
WEST-EAST



Area 19

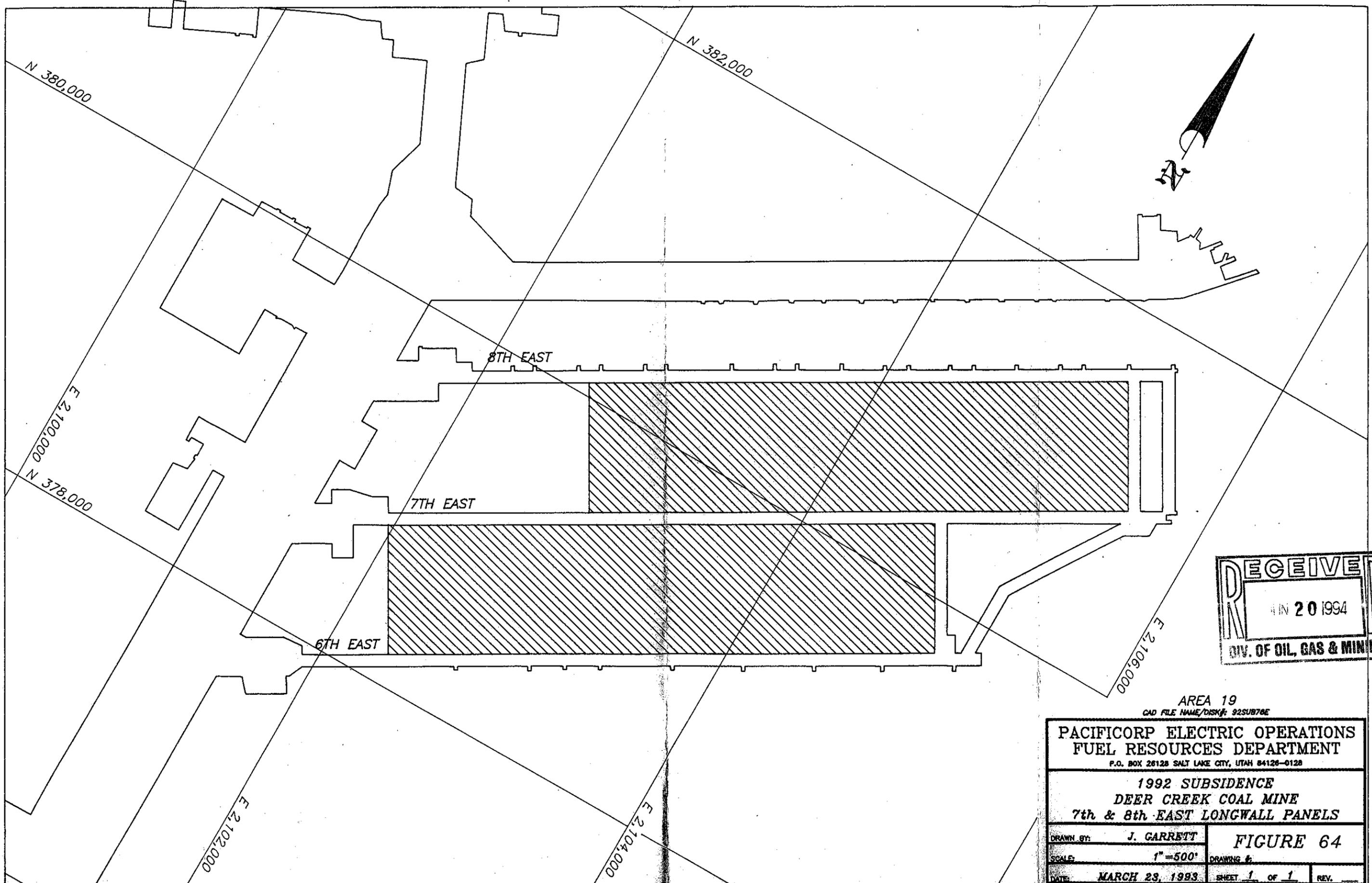
Deer Creek 7th and 8th East Longwall Panels off 3rd North

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 (Figures 65 and 66).

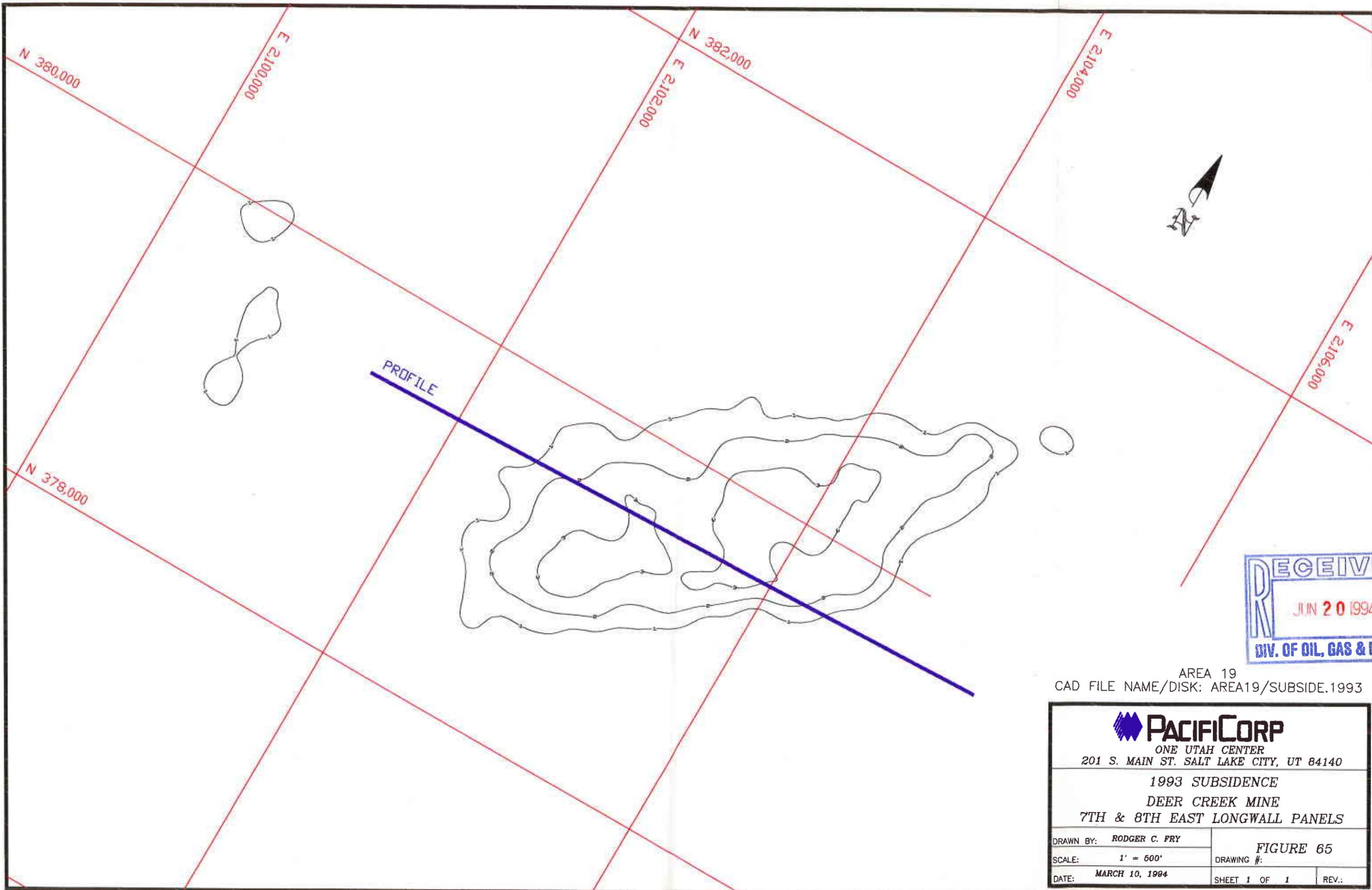
This area is overlain by a few springs. Monitoring of these springs has shown no change in the quality or quantity of water discharged from the springs (see appendix and the 1992 Hydrologic Monitoring Report).



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AREA 19
 CAD FILE NAME/DISK#: 92SUB78E

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

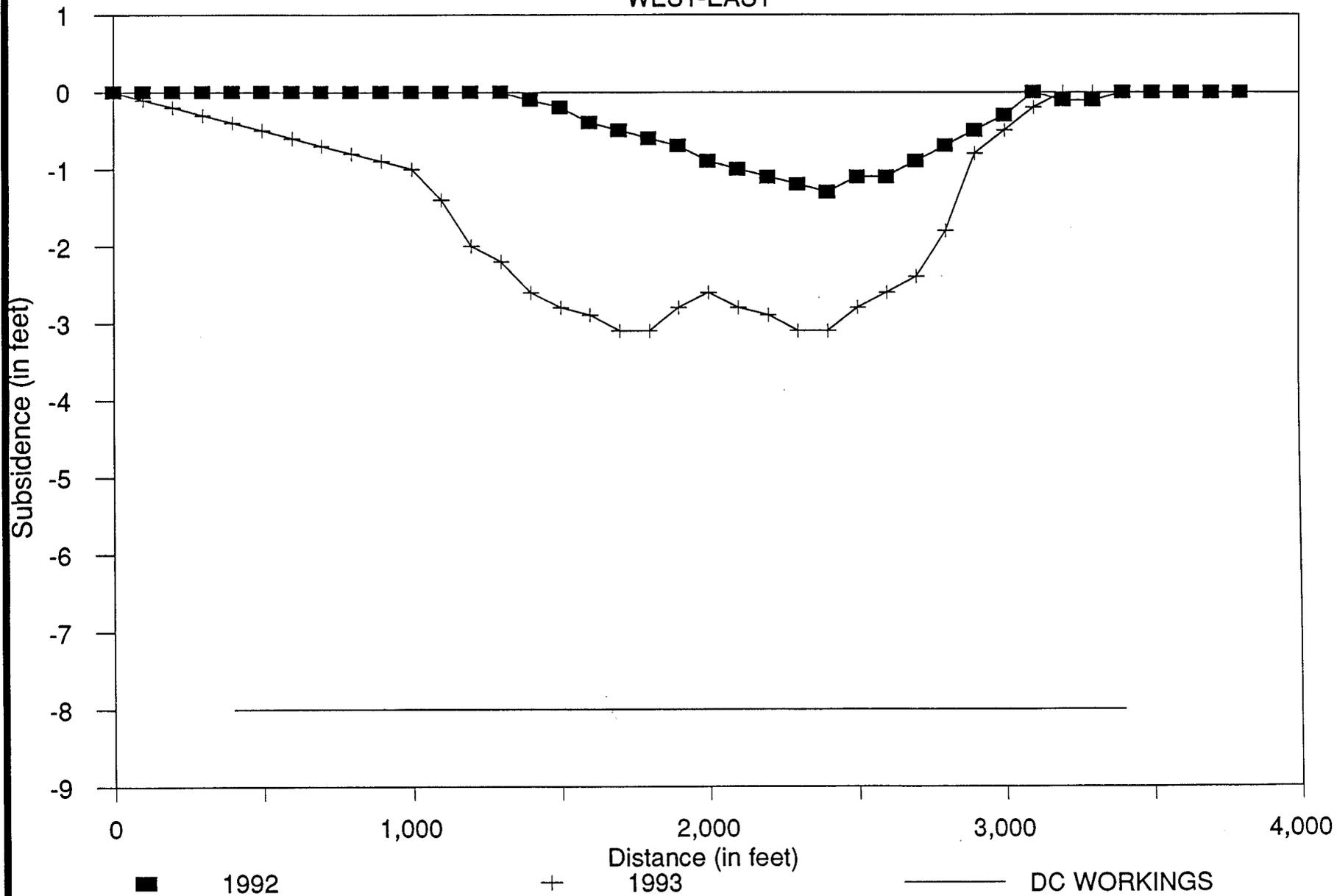


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AREA 19
 CAD FILE NAME/DISK: AREA19/SUBSIDE.1993

 ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140		
1993 SUBSIDENCE DEER CREEK MINE 7TH & 8TH EAST LONGWALL PANELS		
DRAWN BY: RODGER C. FRY SCALE: 1' = 500' DATE: MARCH 10, 1994	DRAWING #: FIGURE 65	SHEET 1 OF 1 REV.:

FIGURE 66
AREA 19 SUBSIDENCE PROFILE
WEST-EAST



AREA 20

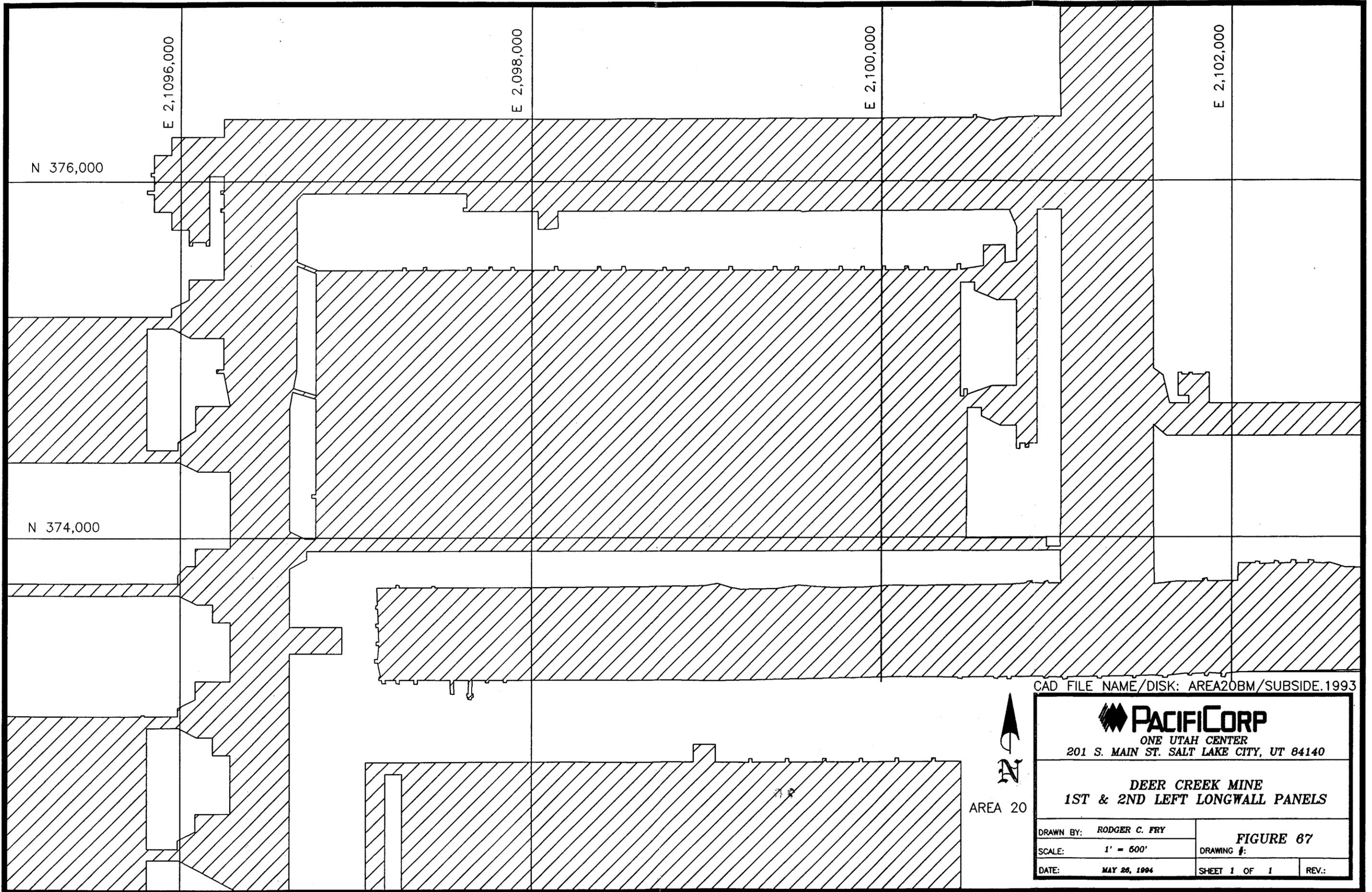
DEER CREEK 1ST & 2ND LEFT LONGWALL PANELS OFF 3 1/2 SOUTH

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 at the end of August mining was approximately 50% complete in this panel (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 (Figures 68 and 69). It is anticipated that additional subsidence will occur in this area in the coming year. No angle of draw was calculated because subsidence is still thought to be in progress.

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



 PACIFICORP ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140		
DEER CREEK MINE 1ST & 2ND LEFT LONGWALL PANELS		
DRAWN BY:	RODGER C. FRY	FIGURE 67 DRAWING #: SHEET 1 OF 1 REV.:
SCALE:	1' = 500'	
DATE:	MAY 26, 1994	

N 376,000

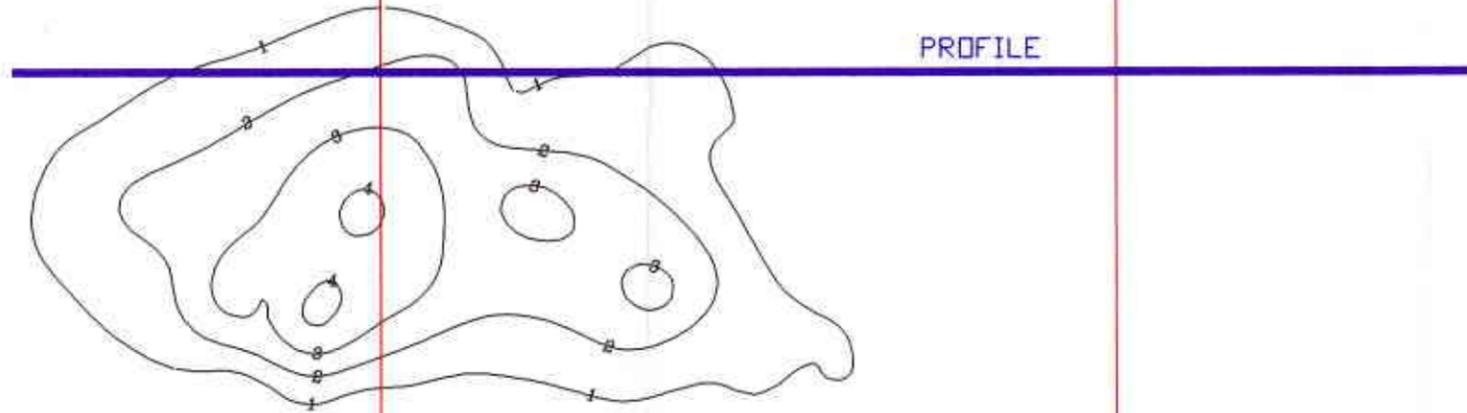
N 374,000

E 2,096,000

E 2,098,000

E 2,100,000

E 2,102,000



PROFILE



AREA 20
 CAD FILE NAME/DISK: AREA20/SUBSIDE.1993

PACIFICORP

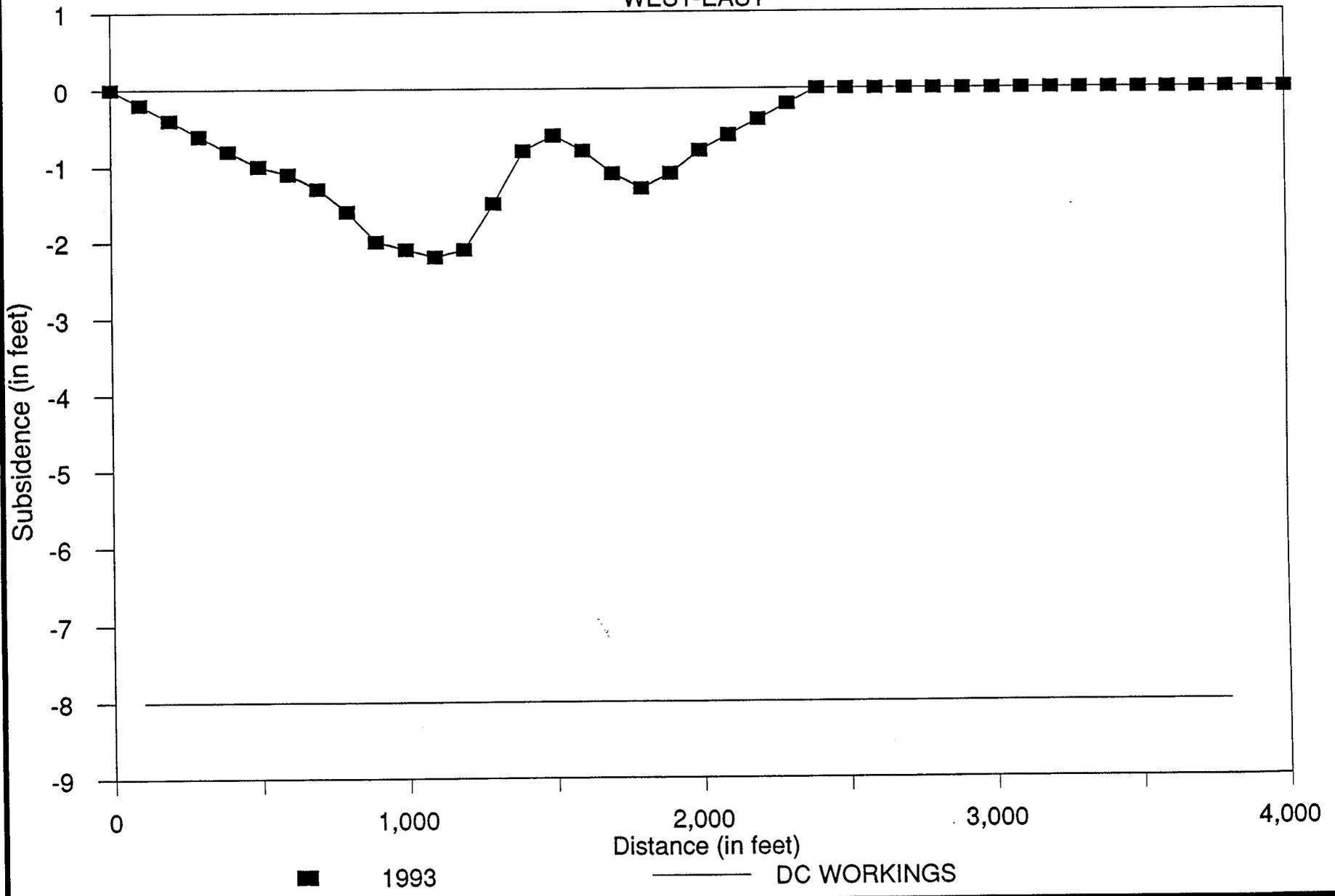
ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

1993 SUBSIDENCE
 DEER CREEK MINE
 1ST & 2ND LEFT LONGWALL PANELS

DRAWN BY: RODGER C. FRY	FIGURE 68	
SCALE: 1" = 500'	DRAWING #:	
DATE: MARCH 14, 1994	SHEET 1 OF 1	REV.:



FIGURE 69
AREA 20 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.

<u>Area</u>	Subsidence (feet)		
	<u>Predicted Maximum</u>	<u>Observed</u>	<u>% of Predicted</u>
*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	5.5	71
4 DC 2-17R	8.1	7.2	89
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
13 Des-Bee-Dove Southern Areas	2.0	1.8	90
14 Cottonwood 6-7E	7.6	9.0	92
15 Cottonwood 9-12W	7.2	5.0	125
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 Creekf 1st & 2nd L	7.8	4.1	52

* This area does not fit the NCB prediction model.

In most areas subsidence is less than the maximum predicted by the NCB model, possibly due to the fact that in some areas mining occurred very recently and subsidence has not yet reached its maximum. It could also be that 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, 4, 5, 6, 8, 9, 12, 13, 15, 16, 17, 18, 19 and 20 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, 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 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. The agency has recommended that no reclamation be undertaken in Areas 1 or 14 at this time; PacifiCorp will reclaim the areas when and if it is deemed necessary.

As mentioned in the section of this report detailing Area 14, in order to mitigate the effects of subsidence there PacifiCorp may be required to use other means which may include replacing possible lost eagle nesting sites, filling and re-contouring surface cracks, and replacing or improving wildlife habitat. Again, whether or not PacifiCorp is required to perform any of this work will depend on the assessment of the regulating state and federal agencies.

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.

Summary

As of August 1993 PacifiCorp has identified twenty (20) 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.

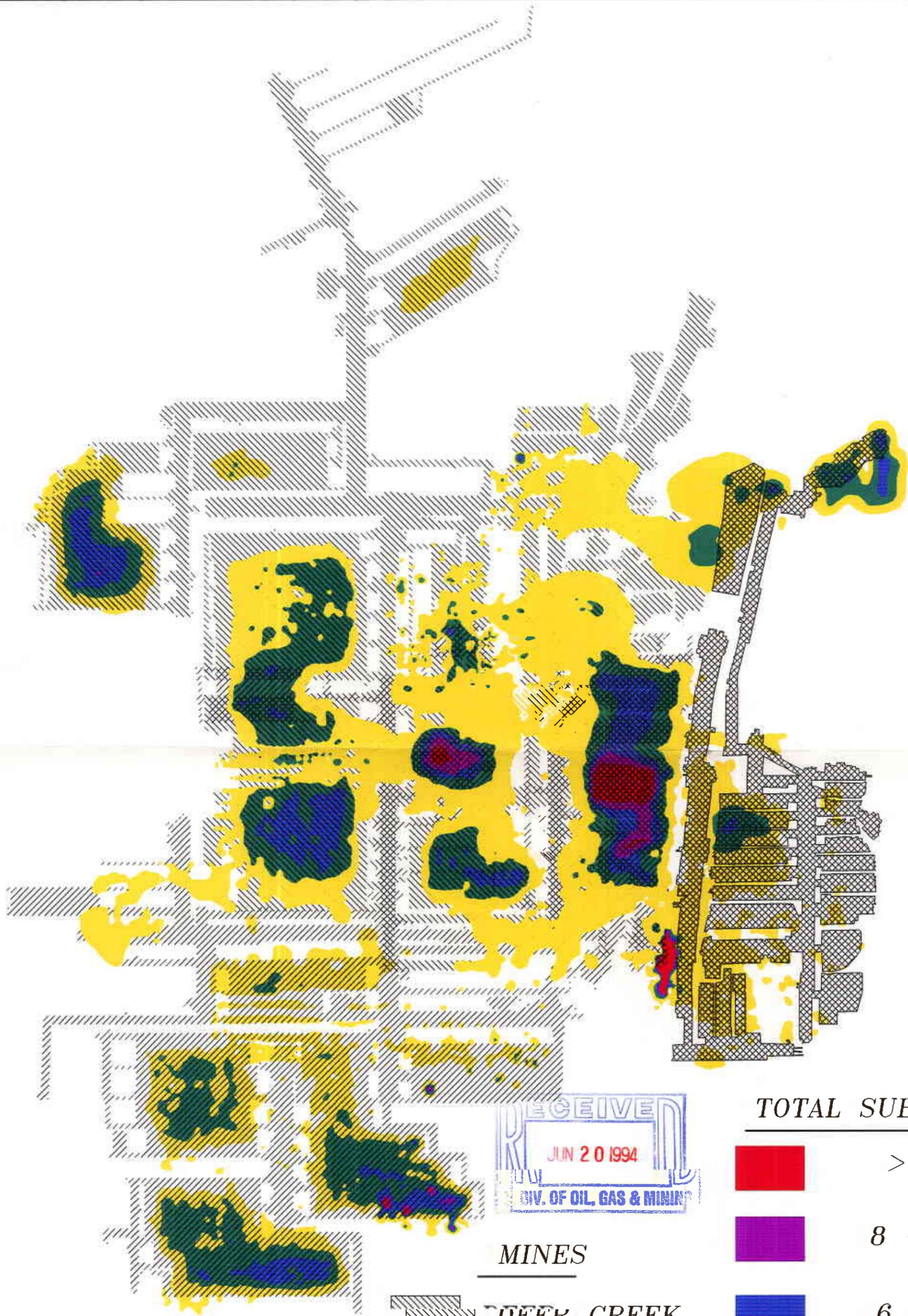
In areas where overburden is thicker and other, more clay-rich formations crop out, longwall and room-and-pillar mining methods have allowed the multiple seam mining of large quantities of coal without apparent impact on the environment because the overburden yields through plastic deformation. Areas 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.

APPENDICES

SUBSIDENCE MAP

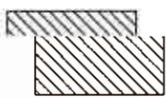
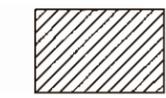


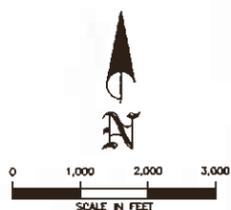
TOTAL SUBSIDENCE

	> 10 FEET
	8 - 10 FEET
	6 - 8 FEET
	4 - 6 FEET
	2 - 4 FEET

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MINES

	DEER CREEK
	COTTONWOOD
	DES-BEE-DOVE



CAD FILE NAME/DISE: ALL/RCF.SUBSIDE.1993

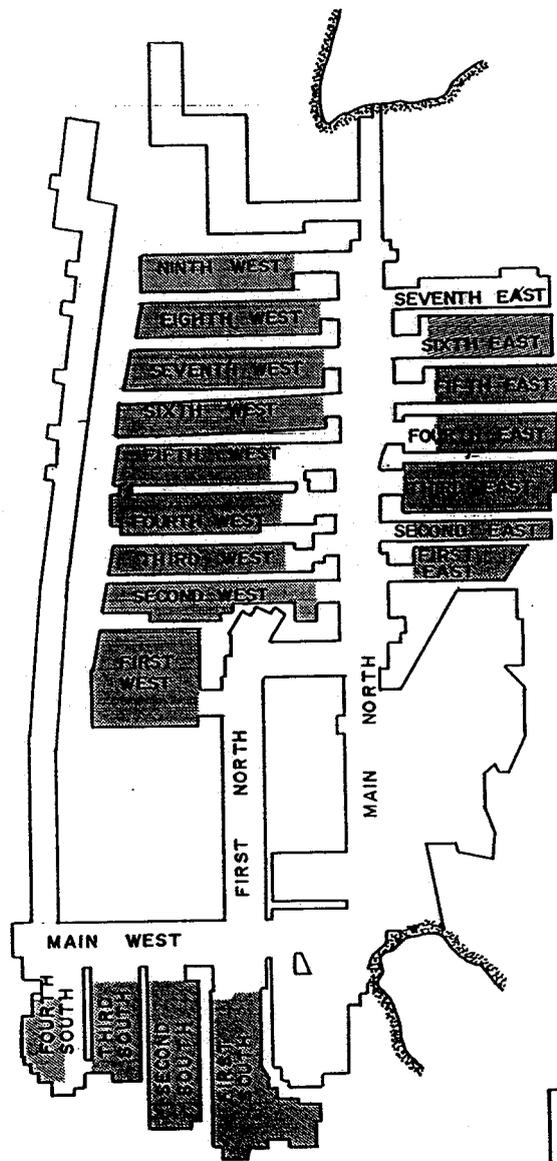
PACIFICORP
 ONE UTAH CENTER
 201 S. MAIN ST. SALT LAKE CITY, UT 84140

**1993 SUBSIDENCE
 EAST MOUNTAIN
 TOTAL SUBSIDENCE**

DRAWN BY: RODGER C. FRY	DRAWING #:
SCALE: 1" = 3,294'	REV.:
DATE: MARCH 28, 1994	SHEET 1 OF 1

RAW DATA

Des-Bee-Dove Mines



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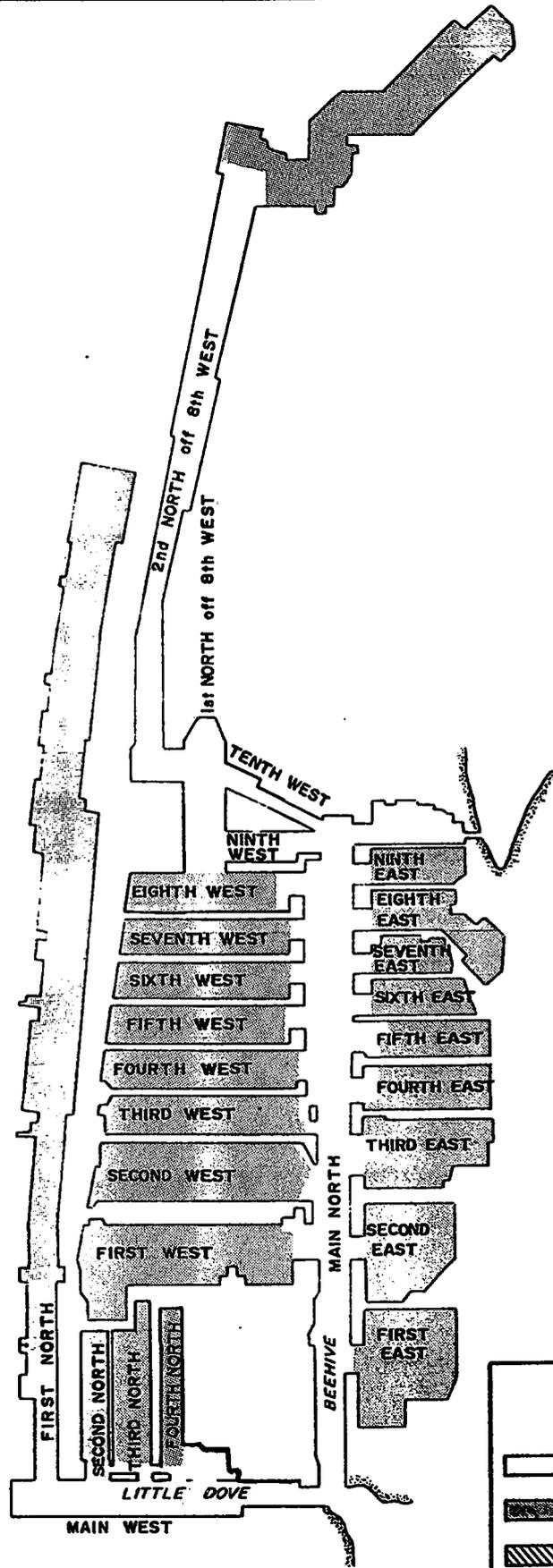
LEGEND

-  MINE WORKINGS
-  MINING COMPLETED
-  ACTIVE MINING AREA

MINE WORKINGS UPDATED TO 9/1/86

DESERET COAL MINE

SCALE: 1" = 2000'



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LEGEND

- MINE WORKINGS
- MINING COMPLETED
- ACTIVE MINING AREA

BEEHIVE & LITTLE DOVE COAL MINES

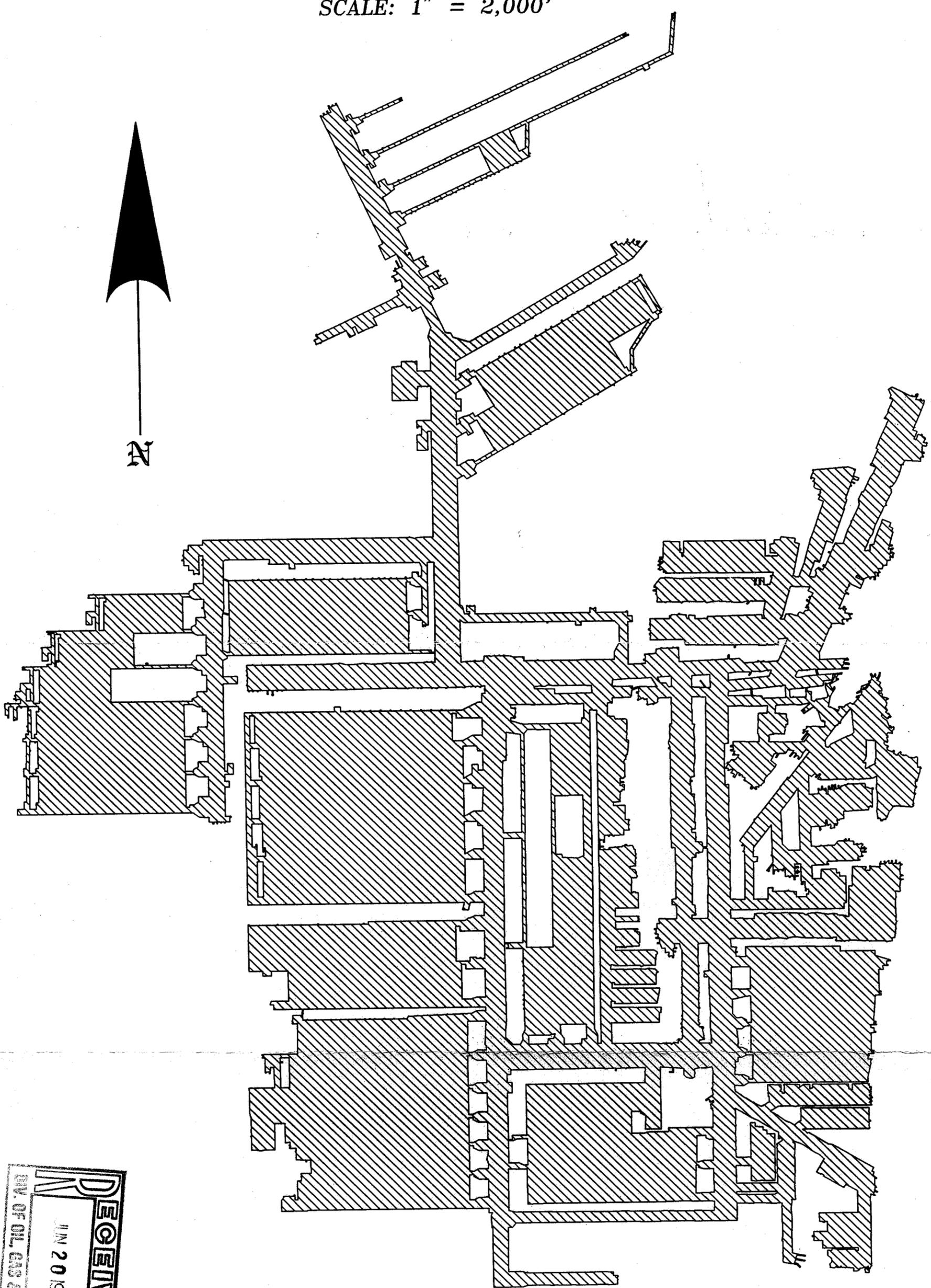
SCALE: 1" = 2000'

UPDATED TO: 5/30/86

Deer Creek Mine

DEER CREEK MINE

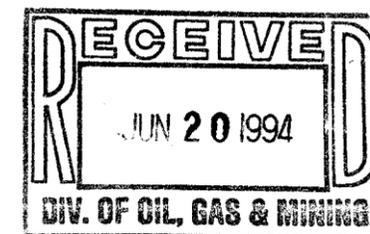
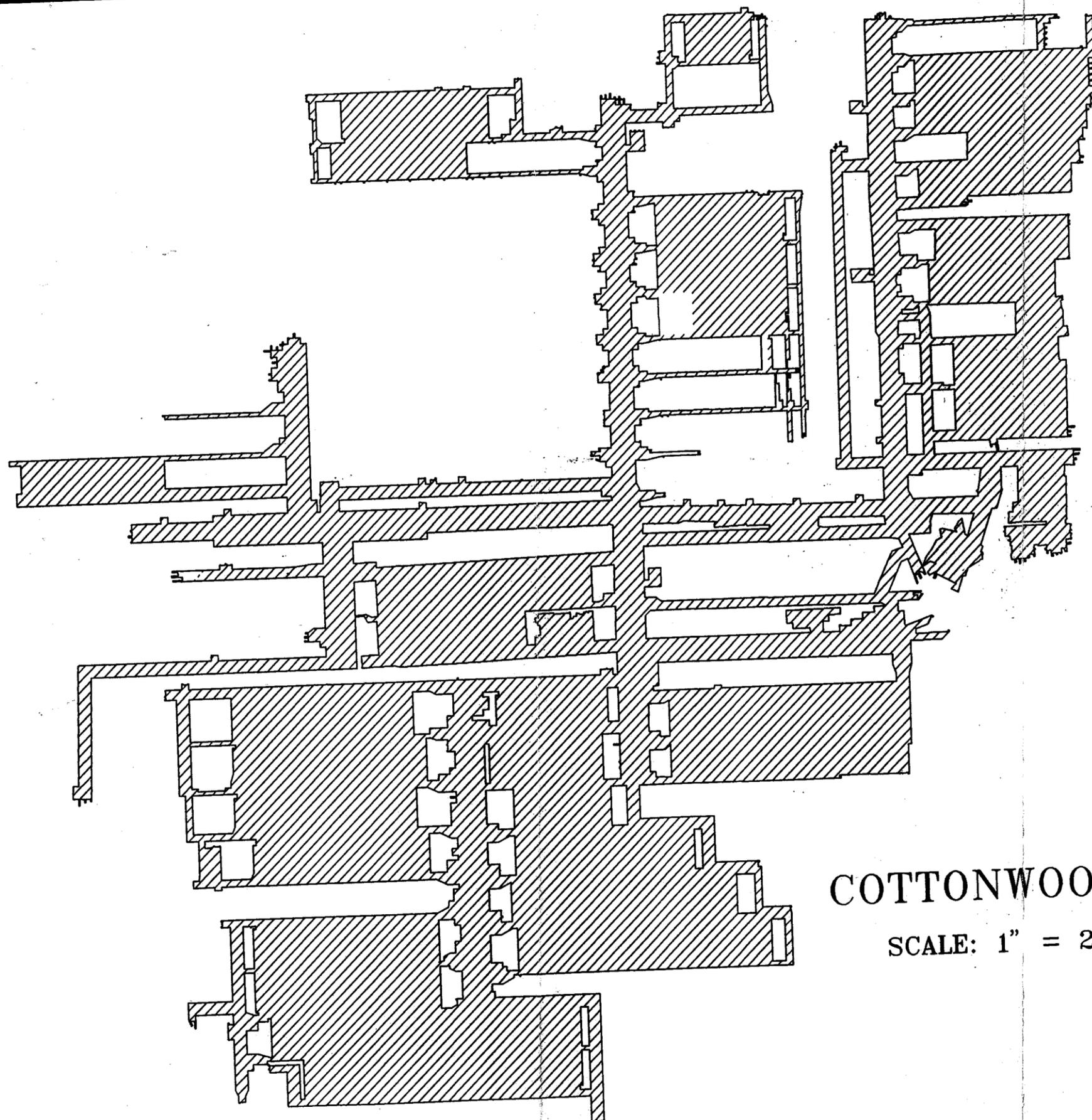
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MINE WORKINGS UPDATED TO: AUGUST 31, 1993

Wilberg/Cottonwood Mine

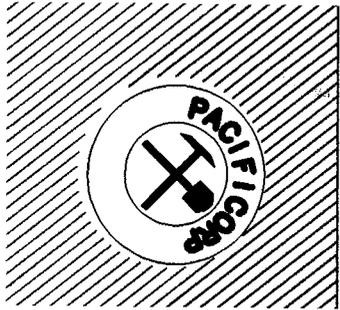


COTTONWOOD MINE

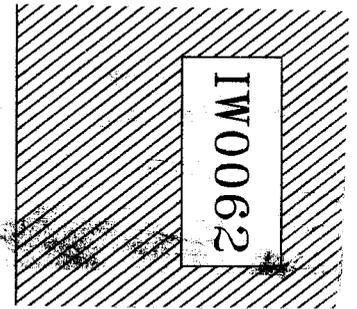
SCALE: 1" = 2,000'

MINE WORKINGS UPDATED TO: AUGUST 31, 1993

Spring Map with 5-Year Mine Plan
Showing Subsidence



ANNUAL SUBSIDENCE MONITORING REPORT
EAST MOUNTAIN PROPERTY
1993



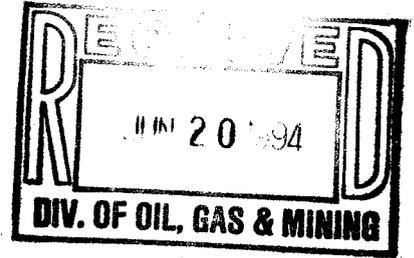
PACIFICORP
TECHNICAL SERVICES REPORT
RODGER C. FRY

IW0062

CENTRAL ENGINEERING
ANNUAL SUBSIDENCE MONITORING REPORT
EAST MOUNTAIN PROPERTY
1993



MAY 31, 1994



PACIFICORP
SUBSIDENCE MONITORING PROGRAM
ANNUAL REPORT FOR 1993

June 1994

Submitted to:

United States Department of the Interior
Office of Surface Mining
Minerals Management Service
Utah Division of Oil, Gas and Mining

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Subsidence Map

Raw Data

Des-Bee-Dove Mines

Deer Creek Mine

Wilberg/Cottonwood Mine

Spring Map with 5-Year Mine Plan Showing Subsidence

INTRODUCTION

PacifiCorp's East Mountain Subsidence Monitoring Study is an ongoing project designed to detect, observe, and report the effects of mining-induced subsidence above the Deer Creek, Wilberg/Cottonwood, Des-Bee-Dove and Trail Mountain Mines (see Figure 1). This, the twelfth such annual report submitted, covers the period between August 31, 1992 and August 31, 1993.

The initial report submitted in 1982 details the monitoring methods used in the study; therefore, they are not discussed in depth here. Briefly, PacifiCorp uses aerial photogrammetric survey methods and annual helicopter reconnaissance flights to monitor subsidence. The aerial photogrammetry work is contracted to a mapping company. Contracts for the work are bid and awarded for a three year period. In 1991, the work was re-bid and a different company was awarded the job. This is the third contractor that has been involved with the project. Between 1982 and 1987 the work was contracted through Intermountain Aerial Surveys. They established reading points on generally a 200 foot grid but adjusted the location of each point to be on easily reproducible locations. Between 1988 and 1990 the work was contracted to Maps Inc. Because of the type of equipment it was better for them to establish uniform grid points on 200 foot spacing. In 1991 the work was contracted to MapCon Mapping Consultants. The owners of this company were previously employed by Intermountain Aerial Surveys and felt that better results could be

obtained by using the original grid established by Intermountain Aerial Surveys. Therefore, they reverted back to the original monitoring grid. A change in the method of reading the aerial photographs may result in some slight changes in measured subsidence in some areas. Also, it is crucial that accurate panelled control be surveyed and recorded on the photographs to enable close subsidence readings. Between 1987 and 1990, some of the survey control in the more difficult to reach areas were not properly panelled and could not be identified on the photographs. It appears that this diminished the precision of the subsidence reading in some of the areas during those years.

In the spring of 1994, a comparison of change in subsidence over the past 3 years in the south end of East Mountain was made. In this study an error in the baseline elevations in the 1992 subsidence data was discovered. The contractor had added 1.5 feet to the elevation of the baseline data from 1986. Normally they would remove this 1.5 feet prior to sending the data to PacifiCorp but they failed to do this in this case. This exaggerated the amount of subsidence in some of the points on East Mountain by 1.5 feet for the data in the 1992 report. The profiles in this report that include 1992 data have been corrected.

Using the aerial photographs derived from a flight conducted on August 6, 1993, elevations were measured at 10,165 different points. These elevations were then compared with the baseline survey elevations measured

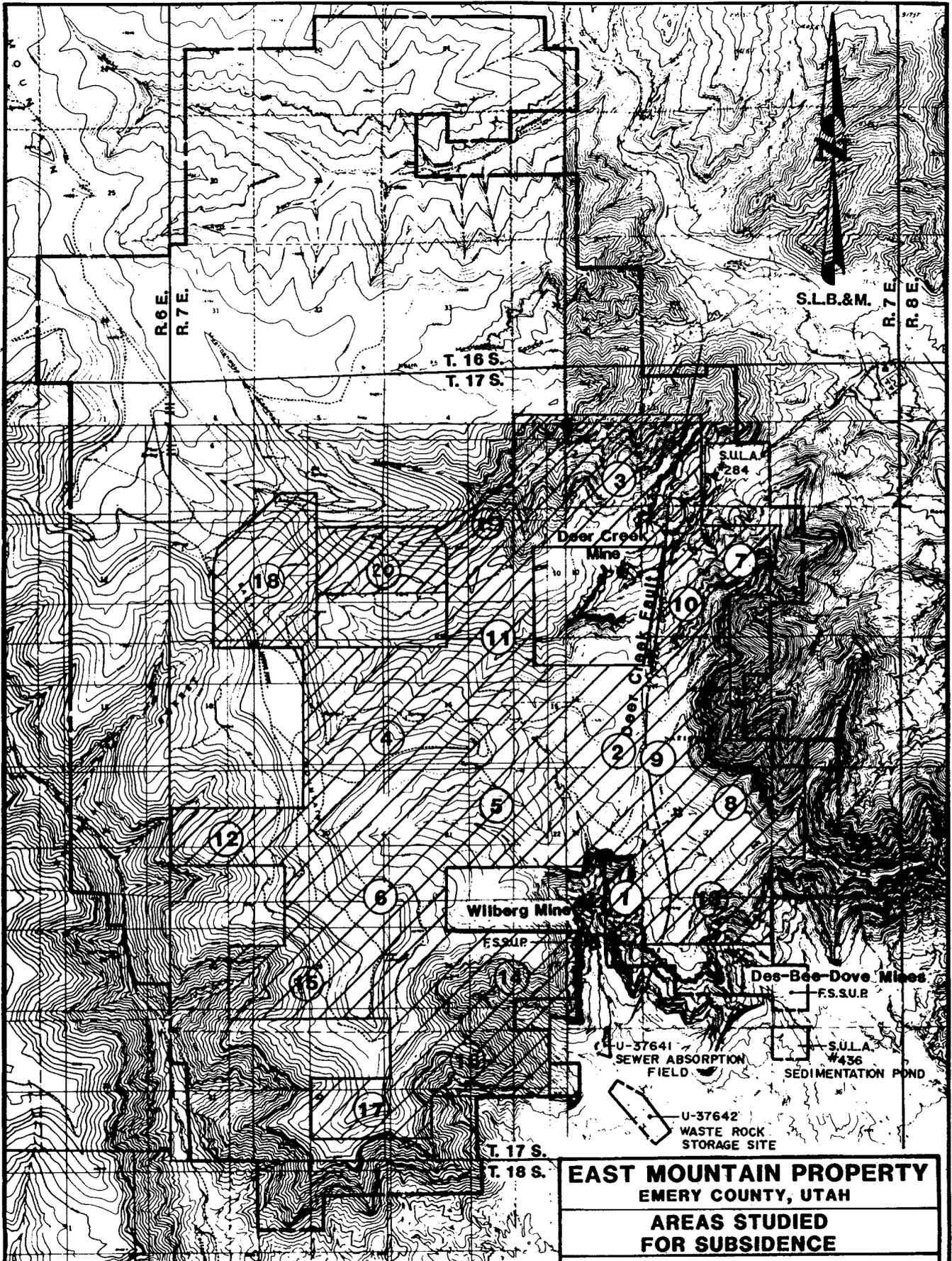
from the aerial photos collected in 1980, 1986, and 1987. The difference in elevation is the amount of subsidence that has occurred. Where the amount of subsidence measured at one point is significantly different than all surrounding points and by itself formed a one point anomaly, the point is considered bad and was eliminated from the analysis. These points comprised less than 0.2% of the total number of points collected. A map of all areas of subsidence is included in the appendix to this report. The raw data is included in the appendix of this report on a 3 1/2 inch disk in an ASCII file called SUB. DAT.

The photography completed on August 6, 1993 included a baseline survey of all of Trail Mountain including the Lease By Application area and all of East and Trail Mountains were photographed using color infrared film.

Prior to PacifiCorp's acquisition of the Trail Mountain Mine from ARCO Coal Co., they monitored subsidence using on the ground monumentation. Nowhere did the monitoring identify subsidence greater than a few tenths of feet. Since the acquisition of the property no mining has occurred. When mining does commence, we will read the elevations from that years photography.

Location

Figure 2 shows all areas above PacifiCorp's coal mines which have potential for mining-induced subsidence. A helicopter reconnaissance flight



NUMBERS KEYED TO TEXT

 = AREAS STUDIED FOR SUBSIDENCE

 = U.P.&L.CO. PERMIT BOUNDARY LINE

**EAST MOUNTAIN PROPERTY
EMERY COUNTY, UTAH**

**AREAS STUDIED
FOR SUBSIDENCE**

UTAH POWER & LIGHT COMPANY
DEPARTMENT OF MINING & EXPLORATION

DATE: 2/11/86

BY: LJ GUM

SCALE: 1" = 1 MILE

FIGURE 2

during 1993 revealed no new areas of visible surface disturbance. Following the helicopter reconnaissance, fractures were discovered above the 7th Right Longwall Panel in the Cottonwood mine. These fractures are discussed in detail in the area 11 section of this report. In areas where subsidence has been detected, data is shown in the form of contour maps and profiles. Both indicate elevation change from pre-mining elevations. The profile figures may show data for several years to better track the subsidence history of the area.

In many areas of subsidence the angle-of-draw has been calculated and reported; however, in the majority of cases the angle should not be considered the actual final angle-of-draw due to several factors. For example, the zone of subsidence to date may be small and contained within the underlying mined area, suggesting that the subsidence has not yet reached its maximum extent. Also, many mined sections are surrounded by other older workings which influence the calculation. In a few areas where the mined-out workings are surrounded by burned coal, the failure of clinker beds promotes subsidence outside the mined area resulting in an angle-of-draw greater than might be expected.

Area 1

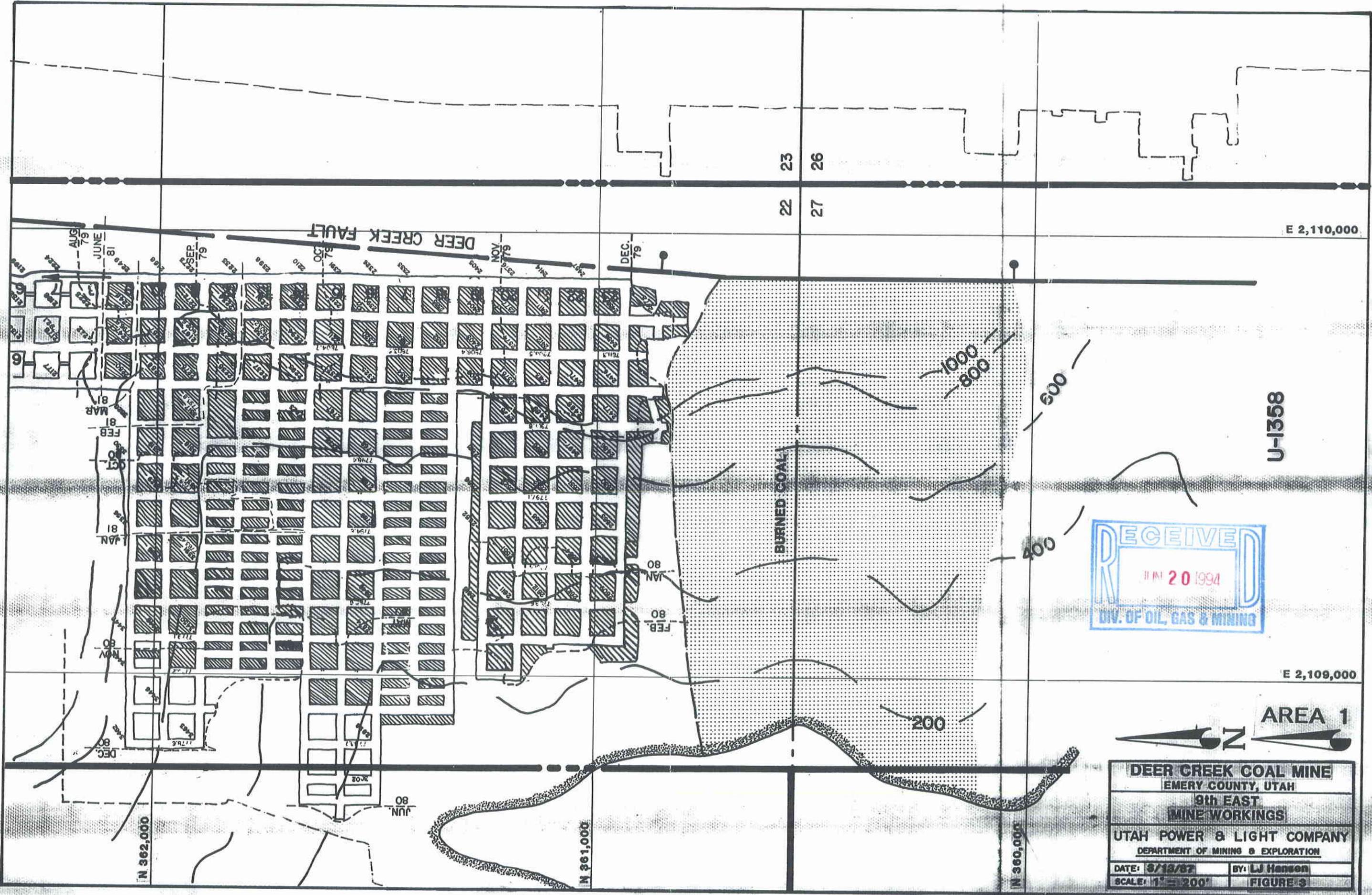
Deer Creek 9th East - Wilberg 1st Right

Subsidence in Area 1 was first documented in the 1981 Subsidence Monitoring Report submitted in 1982. The relationship of the subsidence to the underlying Deer Creek and Wilberg mine workings is shown in Figures 3, 4, and 5. Each map covers the same area, Figure 5 being a contour map of subsidence on the surface over the mine workings depicted in the other two figures. The most recent mining in this area occurred in the Wilberg 1st Right section in June 1984.

Figures 6 and 7 are north to south and west to east profiles showing the amount of subsidence in this area during the past eight years. The location of each line is shown on Figure 5. The area has seen little change since 1985 and appears to have totally stabilized. Maximum subsidence remains at about twenty-eight (28) feet. A detailed look from a helicopter revealed that the subsidence maximum is located on a steep slope, about 200 feet south of the southernmost mining, where a good-sized rotational slump has occurred. The workings here are also surrounded by burned coal. It is probable that the combination of steep slopes and crushing of clinker beds has allowed subsidence to occur well outside the area of mine workings. An inspection of the area from the ground indicates that many of the open fractures forming the graben-like structure have begun to heal and fill in with soil.

Calculation of the angle-of-draw is complicated because the workings are nearly surrounded by faults, burned coal, and other mine workings. Due to this complexity, angle-of-draw was not determined for Area 1.

There are no springs, and no hydrologic impacts due to mining have been observed at this location.



23
26
22
27

E 2,110,000

U-1358



E 2,109,000

AREA 1

DEER CREEK COAL MINE	
EMERY COUNTY, UTAH	
9th EAST MINE WORKINGS	
UTAH POWER & LIGHT COMPANY	
DEPARTMENT OF MINING & EXPLORATION	
DATE: 8/13/87	BY: LJ Hansen
SCALE: 1" = 200'	FIGURE 3

N 362,000

N 361,000

N 360,000

DEER CREEK FAULT

BURNED COAL

200

400

500

800

1000

AUG 79

JUNE 81

SEP 79

NOV 79

DEC 79

MAR 81

FEB 81

OCT 81

JAN 81

FEB 81

MAR 81

APR 81

MAY 81

JUN 81

JUL 81

AUG 81

SEP 81

OCT 81

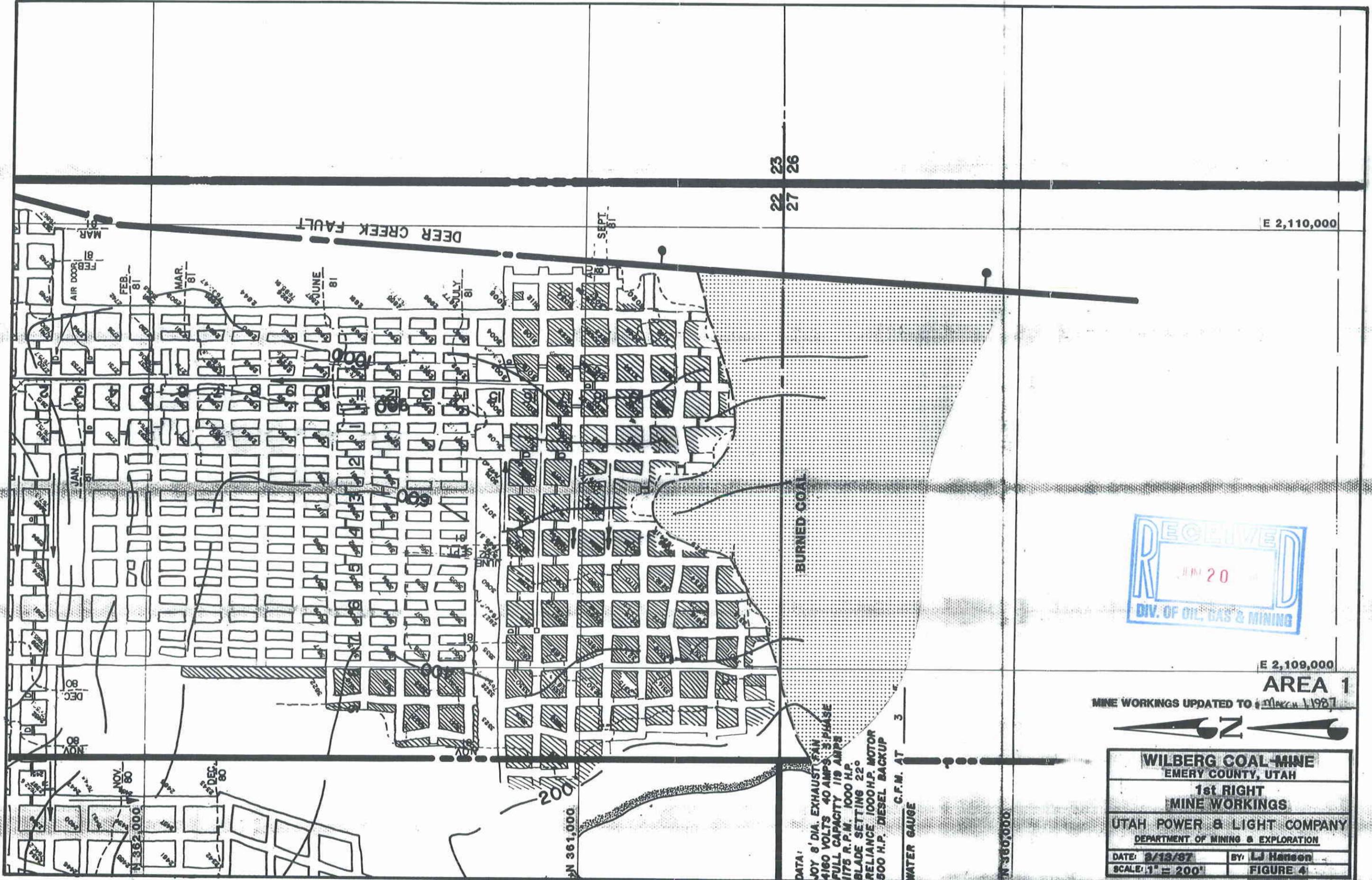
NOV 81

DEC 81

JAN 80

FEB 80

JUN 80

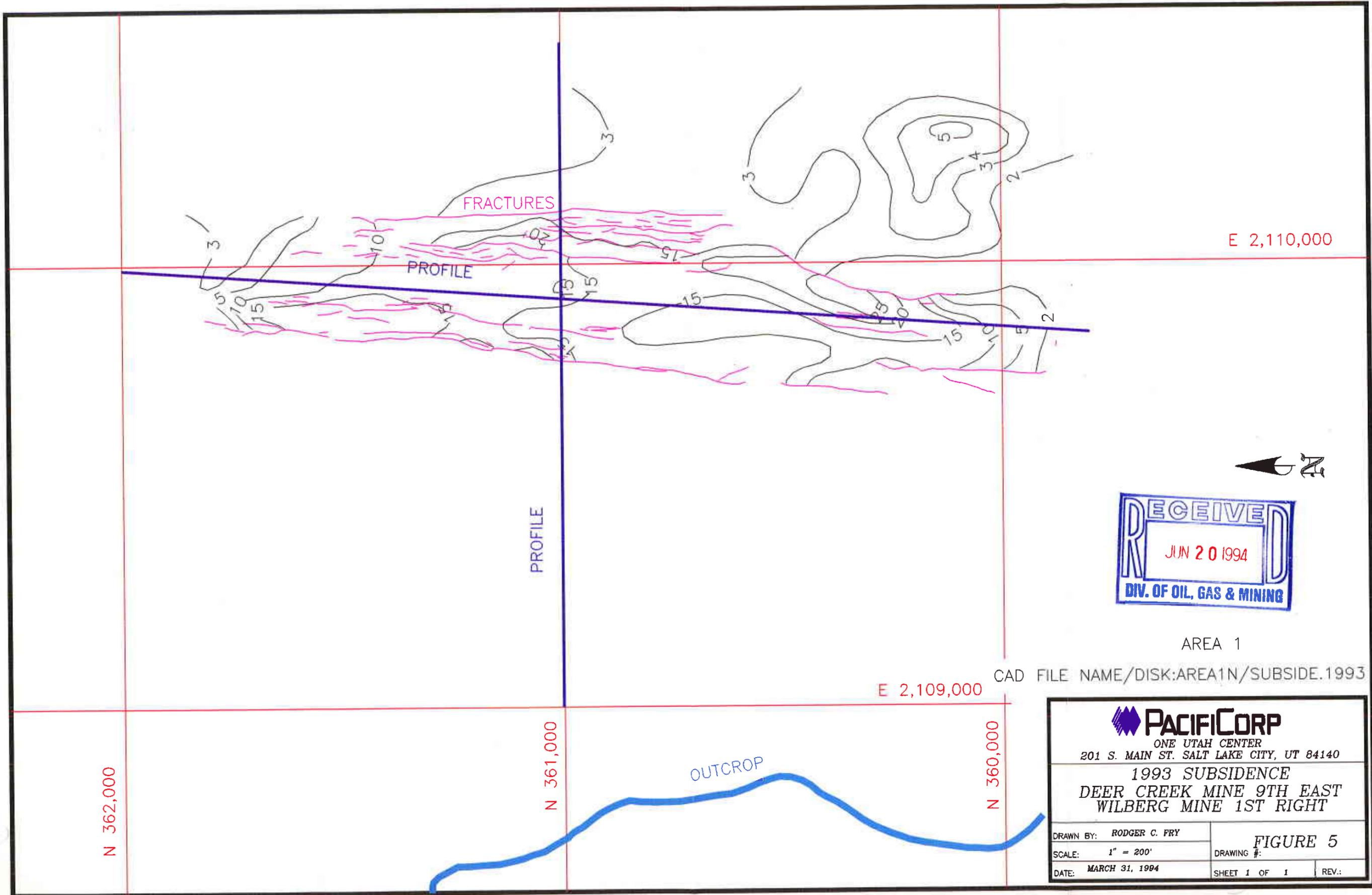


DATA:
 40Y 8" DIA. EXHAUST FAN
 4160 VOLTS 40 AMPS 3-PHASE
 FULL CAPACITY 119 AMP
 1175 R.P.M. 1000 H.P.
 BLADE SETTING 22°
 RELIANCE 1000H.P. MOTOR
 500 H.P. DIESEL BACKUP
 C.F.M. AT 3'
 WATER GAUGE

E 2,109,000
AREA 1
 MINE WORKINGS UPDATED TO March 1987



WILBERG COAL MINE EMERY COUNTY, UTAH	
1st RIGHT MINE WORKINGS	
UTAH POWER & LIGHT COMPANY DEPARTMENT OF MINING & EXPLORATION	
DATE: 8/13/87	BY: LJ Hansen
SCALE: 1" = 200'	FIGURE 4



E 2,110,000



AREA 1

CAD FILE NAME/DISK:AREA1N/SUBSIDE.1993

E 2,109,000

N 362,000

N 361,000

N 360,000

<p>PACIFICORP ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140</p>		
<p>1993 SUBSIDENCE DEER CREEK MINE 9TH EAST WILBERG MINE 1ST RIGHT</p>		
<p>DRAWN BY: RODGER C. FRY</p>	<p>FIGURE 5</p>	
<p>SCALE: 1" = 200'</p>	<p>DRAWING #:</p>	
<p>DATE: MARCH 31, 1994</p>	<p>SHEET 1 OF 1</p>	<p>REV.:</p>

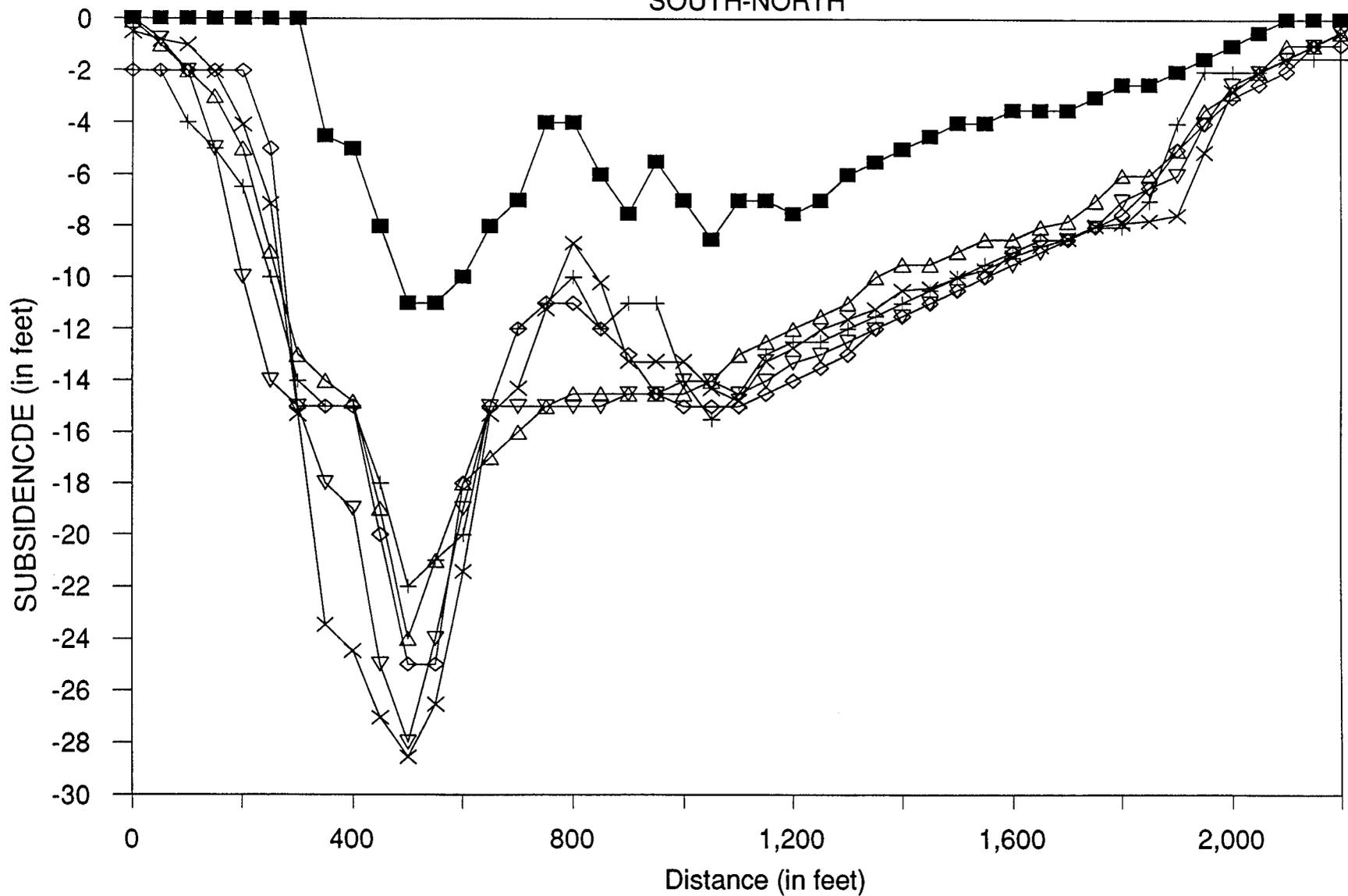
OUTCROP

FRACTURES

PROFILE

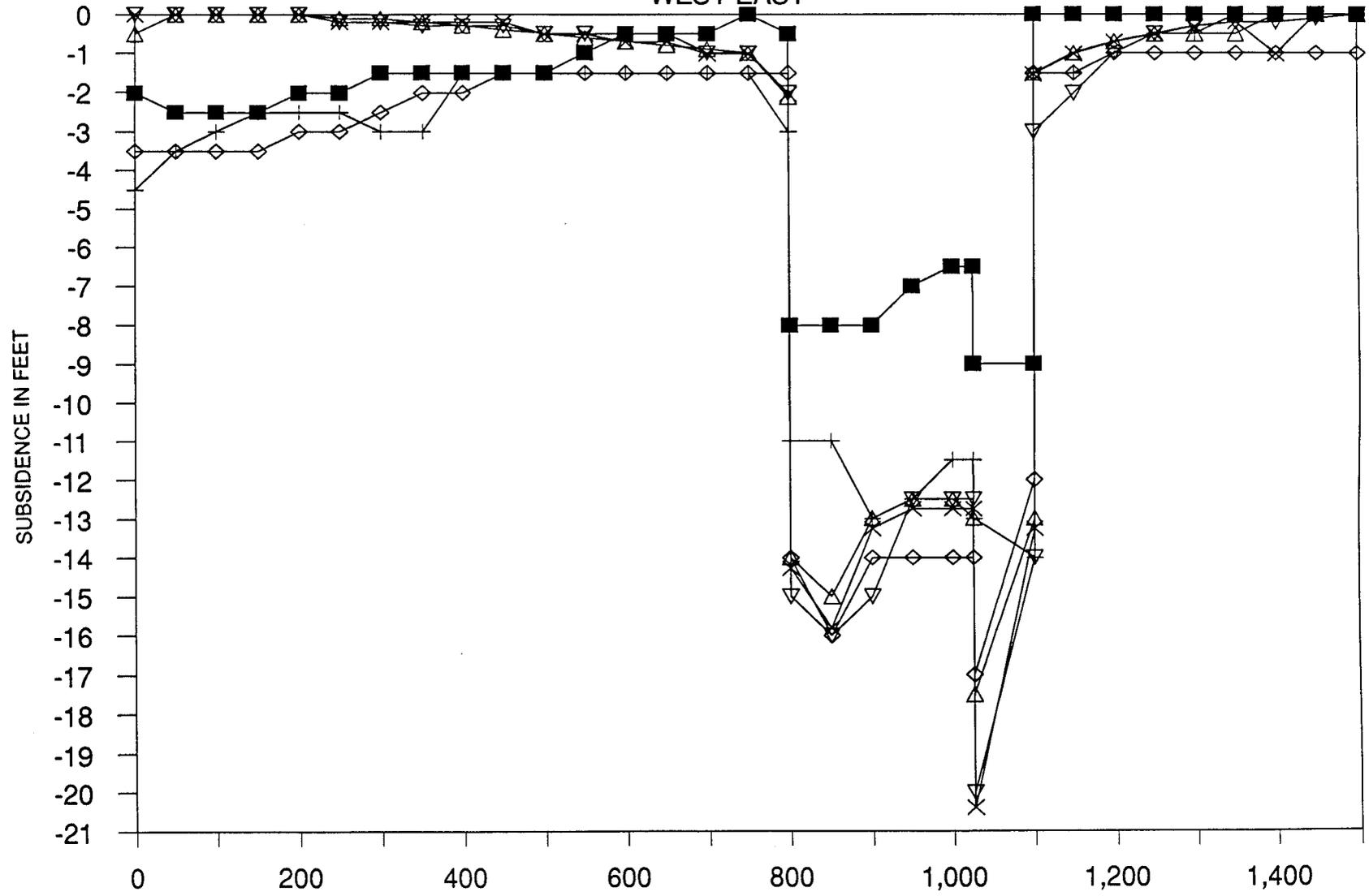
PROFILE

FIGURE 6
AREA 1 SUBSIDENCE PROFILE
SOUTH-NORTH



■	1982	+	1984	◇	1986
△	1988	×	1992	▽	1993

FIGURE 7
AREA 1 SUBSIDENCE PROFILE
 WEST-EAST



■	1982	+	1984	◇	1986
△	1988	×	1992	▽	1993

Area 2

Deer Creek 5th, 6th, 7th, and 8th East Longwall Panels

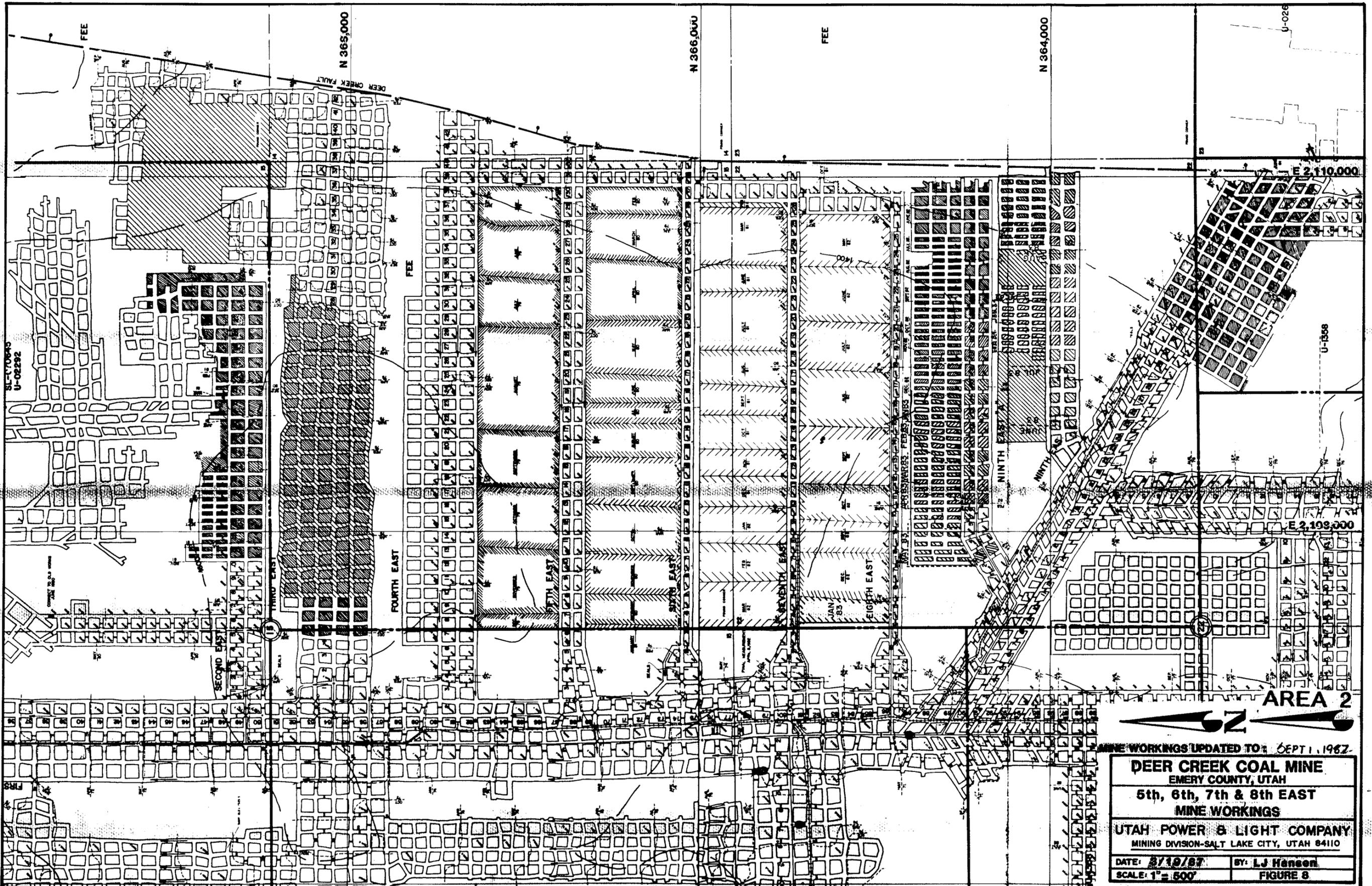
Wilberg 3rd through 13th Right Panels

Mining in the Deer Creek Mine in Area 2 was completed by February 1985. Coal extraction in the underlying Wilberg Mine 3rd and 4th Right panels was completed between September 1987 and the end of January 1988 (Figures 8 and 9).

Maximum subsidence in Area 2 has increased to 13 feet in one area above the center of the multiple seam mining area (Figure 10). The subsidence profiles (Figures 11 and 12) indicate that the subsidence trough has deepened slightly in the last 3 years. Neither PacifiCorp nor other contracted personnel have detected any surface fissures or other visible disturbance in the area.

Angle-of-draw has been calculated where possible. On the eastern side of Area 2 the angle is influenced by the Deer Creek Fault and the adjacent Little Dove Mine workings across the fault; thus, no angle was calculated. On other sides it ranges from less than zero to 11 degrees.

No springs have been identified over the subsidence area but two springs, one-fourth to one-third mile to the west, show no effects from mining (see Hydrologic Monitoring Report, 1992).



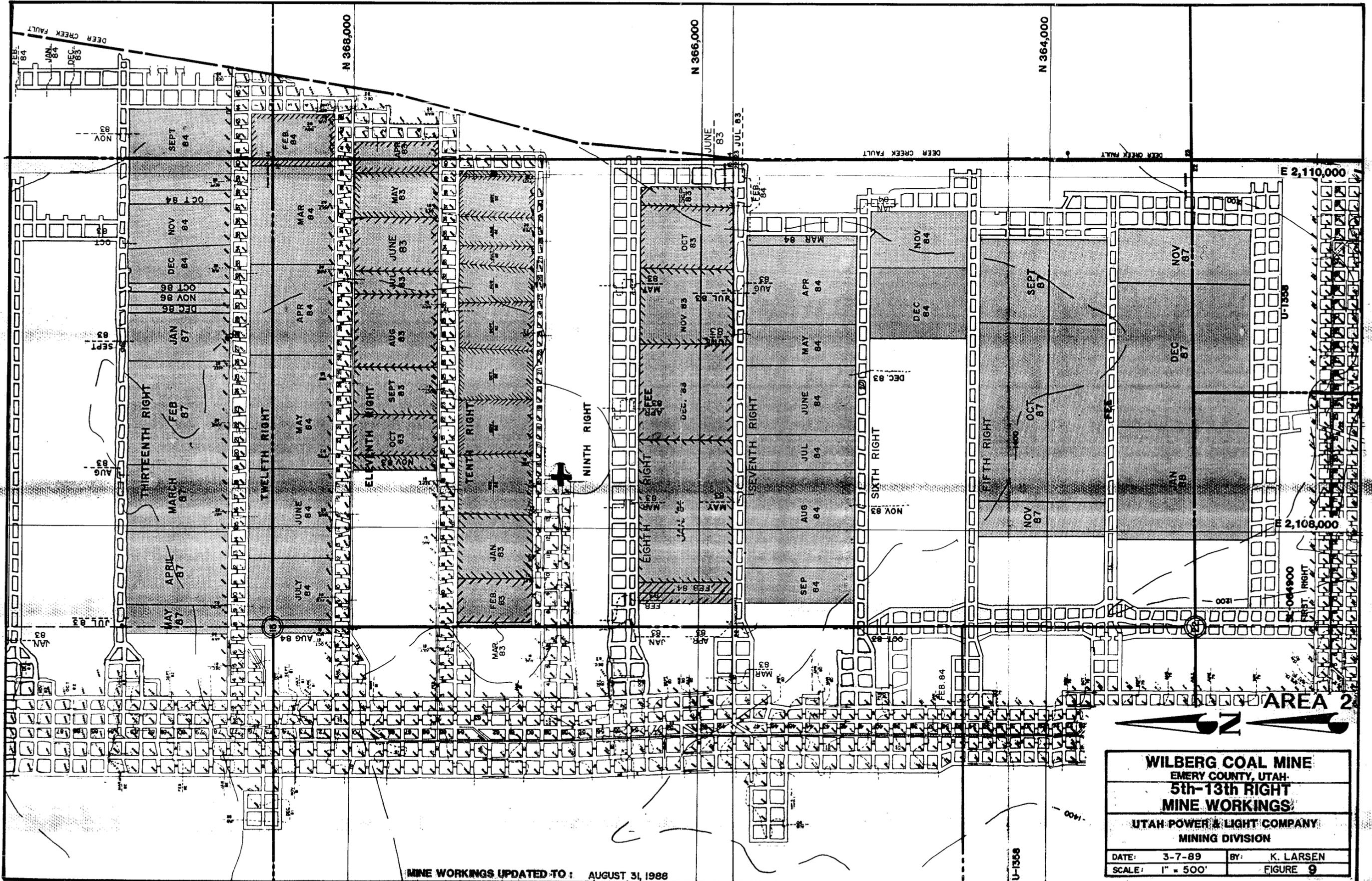
AREA 2



MINE WORKINGS UPDATED TO: SEPT 1, 1967

DEER CREEK COAL MINE	
EMERY COUNTY, UTAH	
5th, 6th, 7th & 8th EAST	
MINE WORKINGS	
UTAH POWER & LIGHT COMPANY	
MINING DIVISION-SALT LAKE CITY, UTAH 84110	
DATE: 8/10/67	BY: L.J. Hansen
SCALE: 1" = 500'	FIGURE 8

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MINE WORKINGS UPDATED TO : AUGUST 31, 1988

WILBERG COAL MINE	
EMERY COUNTY, UTAH	
5th-13th RIGHT	
MINE WORKINGS	
UTAH POWER & LIGHT COMPANY	
MINING DIVISION	
DATE: 3-7-89	BY: K. LARSEN
SCALE: 1" = 500'	FIGURE 9

AREA 2

U-1358

U-1358

U-1358

E 2,110,000

E 2,108,000

N 368,000

N 366,000

N 364,000

JUNE 83

JUL 83

FEB 84

MAR 84

APR 84

MAY 84

JUN 84

JUL 84

AUG 84

SEPT 84

OCT 84

NOV 84

DEC 84

JAN 85

FEB 85

MAR 85

APR 85

MAY 85

JUN 85

JUL 85

AUG 85

SEPT 85

OCT 85

NOV 85

DEC 85

JAN 86

FEB 86

MAR 86

APR 86

MAY 86

JUN 86

JUL 86

AUG 86

SEPT 86

OCT 86

NOV 86

DEC 86

JAN 87

FEB 87

MAR 87

APR 87

MAY 87

JUN 87

JUL 87

AUG 87

SEPT 87

OCT 87

NOV 87

DEC 87

JAN 88

FEB 88

MAR 88

APR 88

MAY 88

JUN 88

JUL 88

AUG 88

SEPT 88

OCT 88

NOV 88

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MAR 2003

APR 2003

MAY 2003

JUN 2003

JUL 2003

AUG 2003

SEPT 2003

OCT 2003

NOV 2003

DEC 2003

JAN 2004

FEB 2004

MAR 2004

APR 2004

MAY 2004

JUN 2004

JUL 2004

AUG 2004

SEPT 2004

OCT 2004

NOV 2004

DEC 2004

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MAR 2005

APR 2005

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JUN 2005

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AUG 2005

SEPT 2005

OCT 2005

NOV 2005

DEC 2005

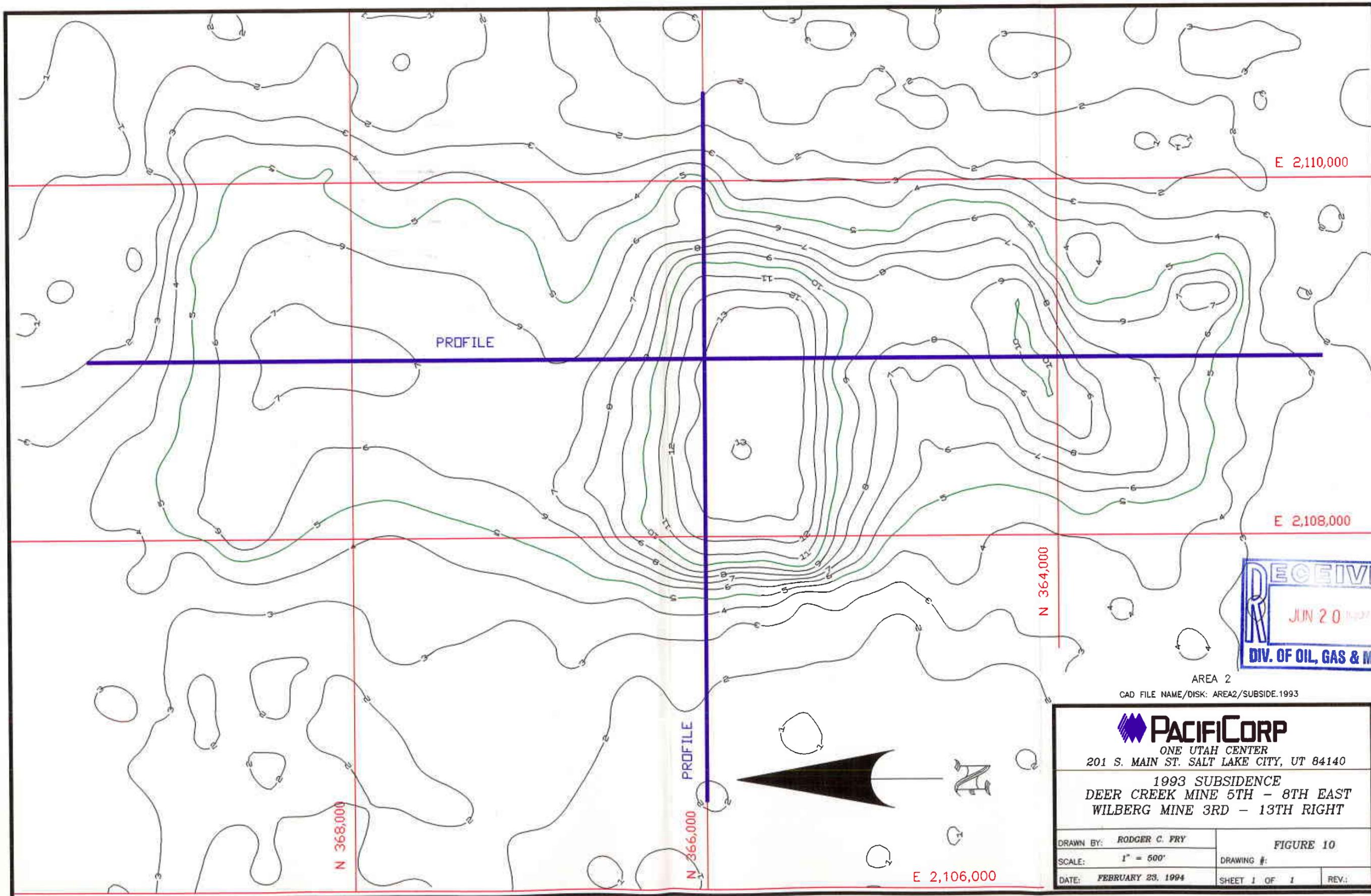
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AREA 2
 CAD FILE NAME/DISK: AREA2/SUBSIDE.1993

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

1993 SUBSIDENCE
 DEER CREEK MINE 5TH - 8TH EAST
 WILBERG MINE 3RD - 13TH RIGHT

DRAWN BY: RODGER C. FRY	FIGURE 10
SCALE: 1" = 500'	DRAWING #:
DATE: FEBRUARY 23, 1994	SHEET 1 OF 1
	REV:

FIGURE 11
 AREA 2 SUBSIDENCE PROFILE
 NORTH-SOUTH

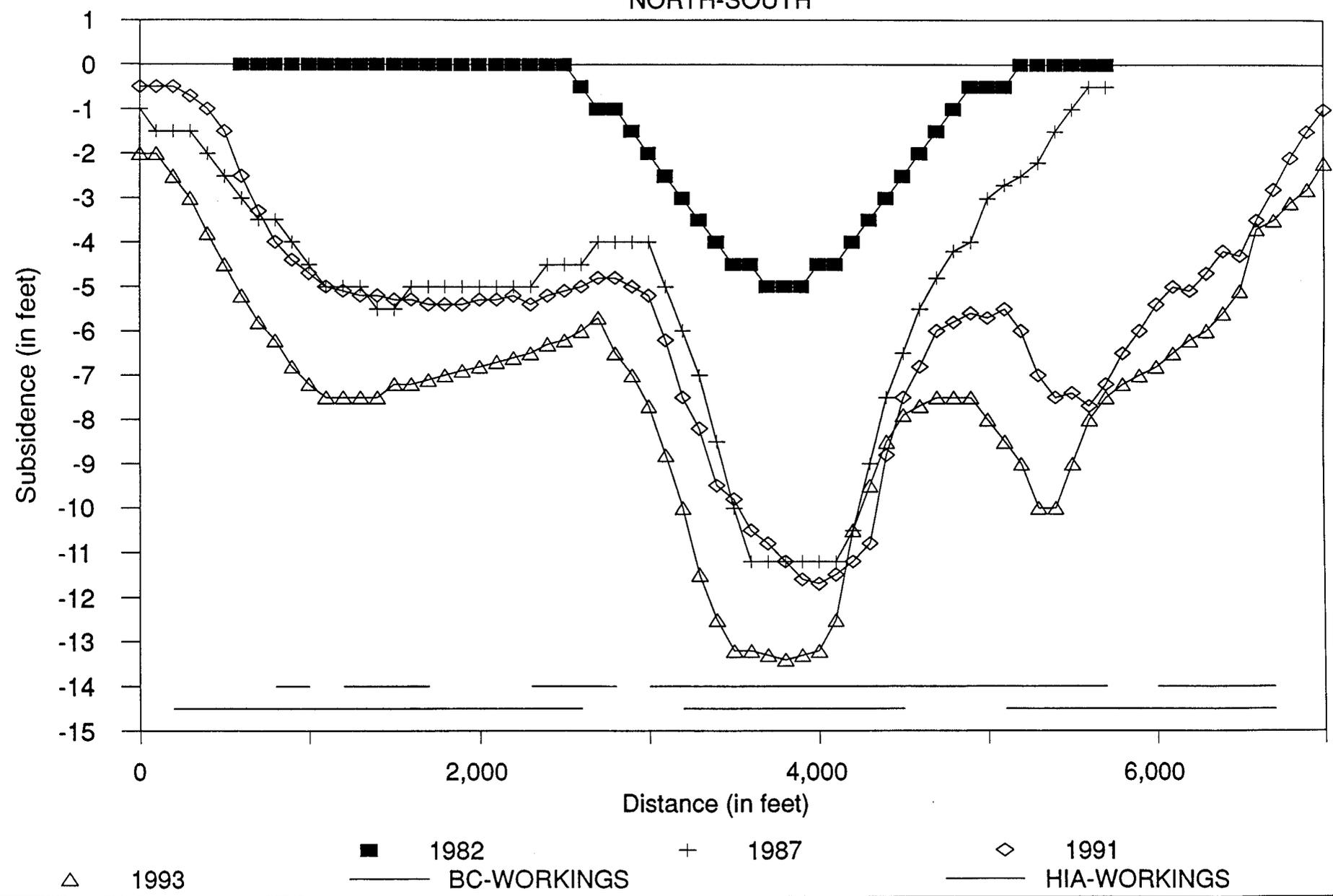
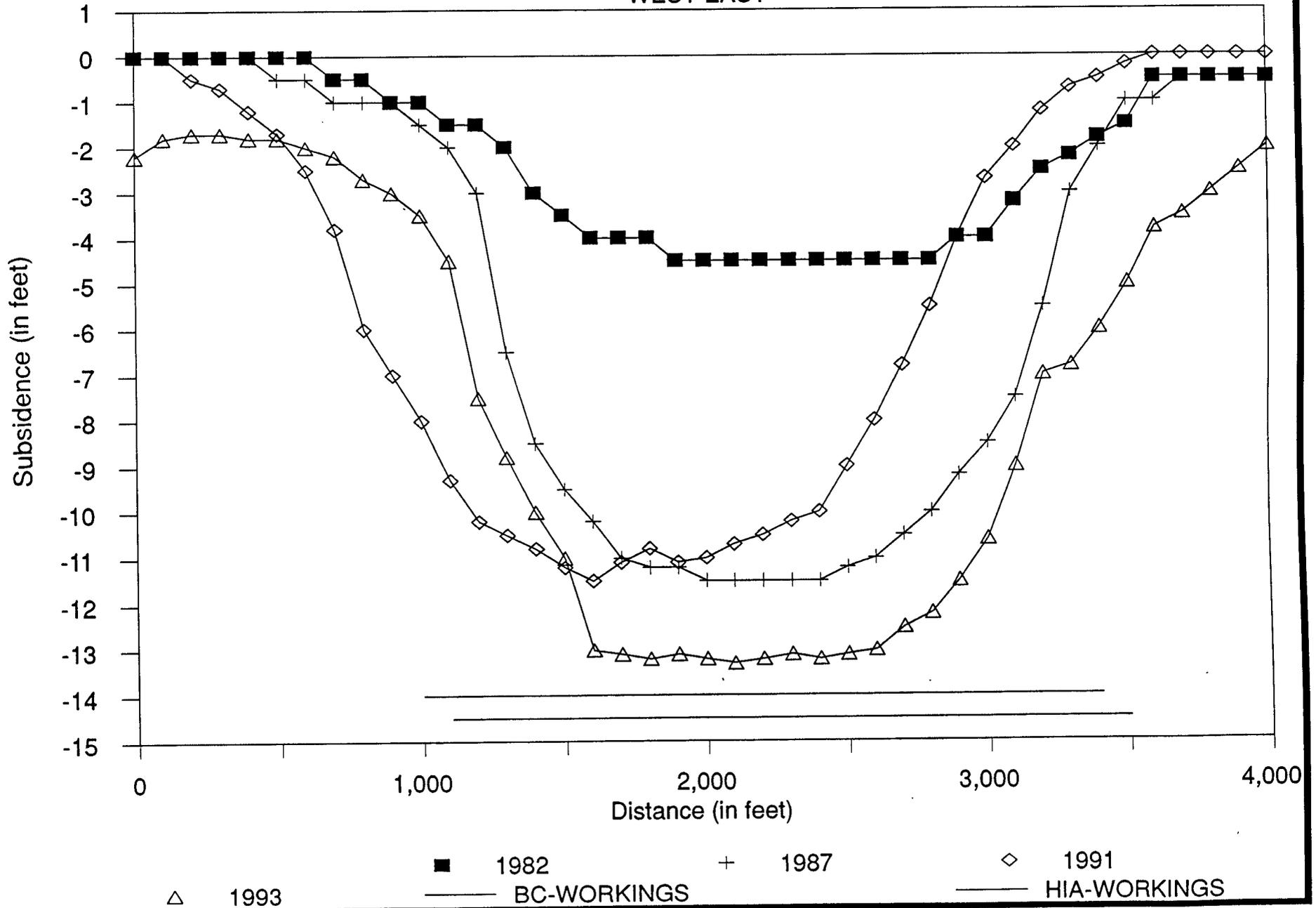


FIGURE 12
 AREA 2 SUBSIDENCE PROFILE
 WEST-EAST



Area 3

Deer Creek 1st North Area

Most of the 1st North section of the Deer Creek Mine was abandoned and sealed in 1978 after being mined out. The southern portion is still open and may be used for access to a block of coal which lies to the west. Pillar extraction in the 3rd Left and 1-1/2 North sections was completed early in 1980 (Figure 13).

The subsidence above 1st North occurs on a narrow ridge capped by a highly fractured sandstone. The subsidence measured is depicted in Figure 13A. Figure 14 is a profile of total subsidence as it occurred along a line of points above the workings.

A Helicopter survey in 1993 did not reveal any new surface cracks or new areas of cliff failure.

No angle-of-draw was determined due to the steep slopes, burned coal, and mode of subsidence.

The strata surrounding and above the 1st North workings are generally dry; therefore, mining has not adversely affected the groundwater.



DEER CREEK COAL MINE
 EMERY COUNTY, UTAH
MINE WORKINGS
 1st NORTH AREA

UTAH POWER & LIGHT COMPANY
 MINING DIVISION-SALT LAKE CITY, UTAH 84119

DRAWN BY: LJ Hansen	CHECKED BY:	DATE: Mar. 19, 1967
Scale 1" = 500'	Sheet No.	Drawing Number FIGURE 13

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AREA 3



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AREA 3
 CAD FILE NAME/DISK/AREA3/SUBSIDE/1993

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

1993 SUBSIDENCE
 DEER CREEK MINE
 1ST NORTH AREA

DRAWN BY: RODGER C. FRY

FIGURE 13A

SCALE: 1" = 500'

DRAWING #:

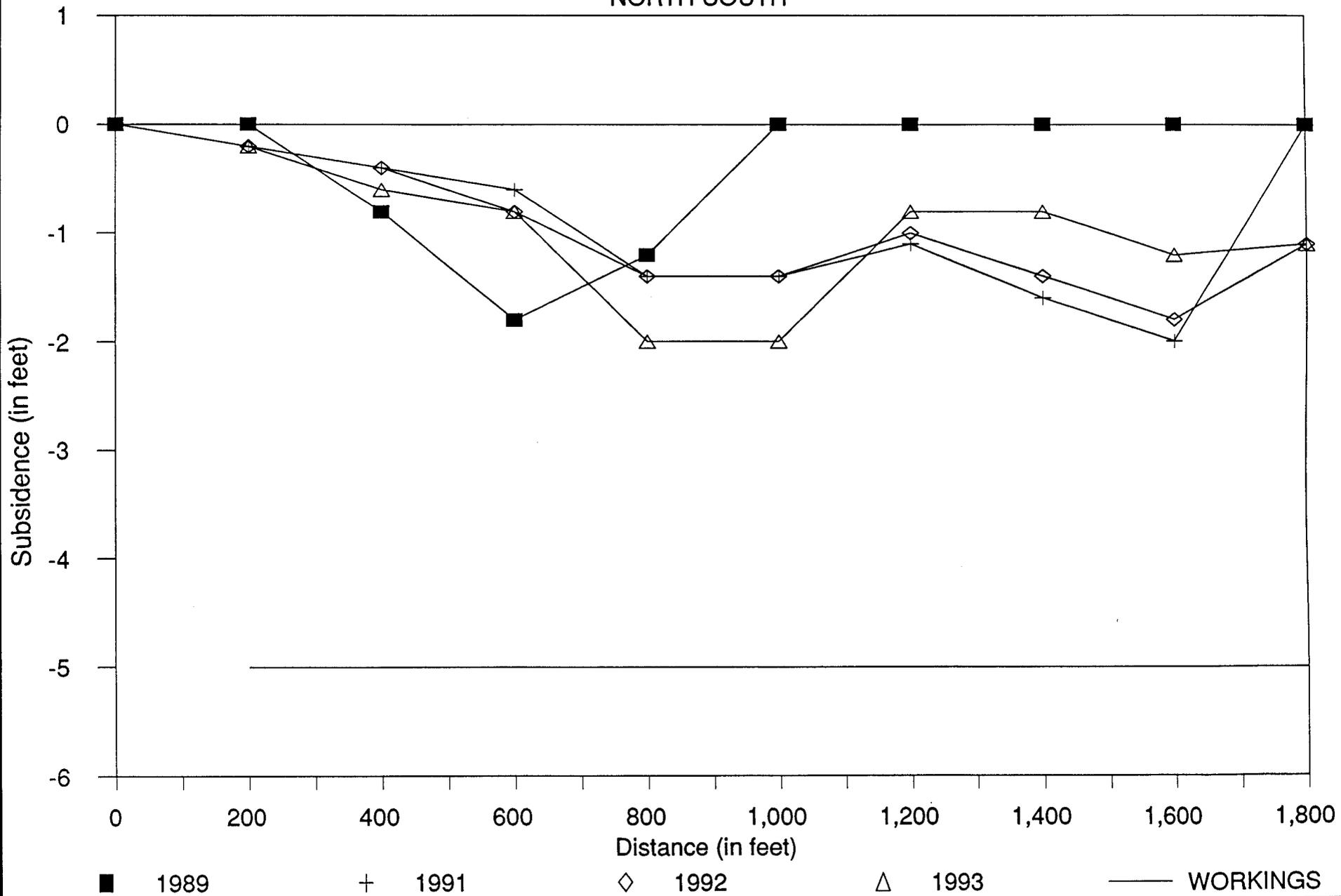
DATE: APRIL 6, 1994

SHEET 1 OF 1

REV.:



FIGURE 14
AREA 3 SUBSIDENCE PROFILE
NORTH-SOUTH



Area 4

Deer Creek 2nd through 17th Right Longwall Panels

Subsidence in Area 4 was detected for the first time in 1984 by photogrammetric methods. Longwall mining commenced in the 2nd Right longwall panels in 1980 and by the end of August 1991 the 2nd through 17th Right panels had been completed (Figure 15).

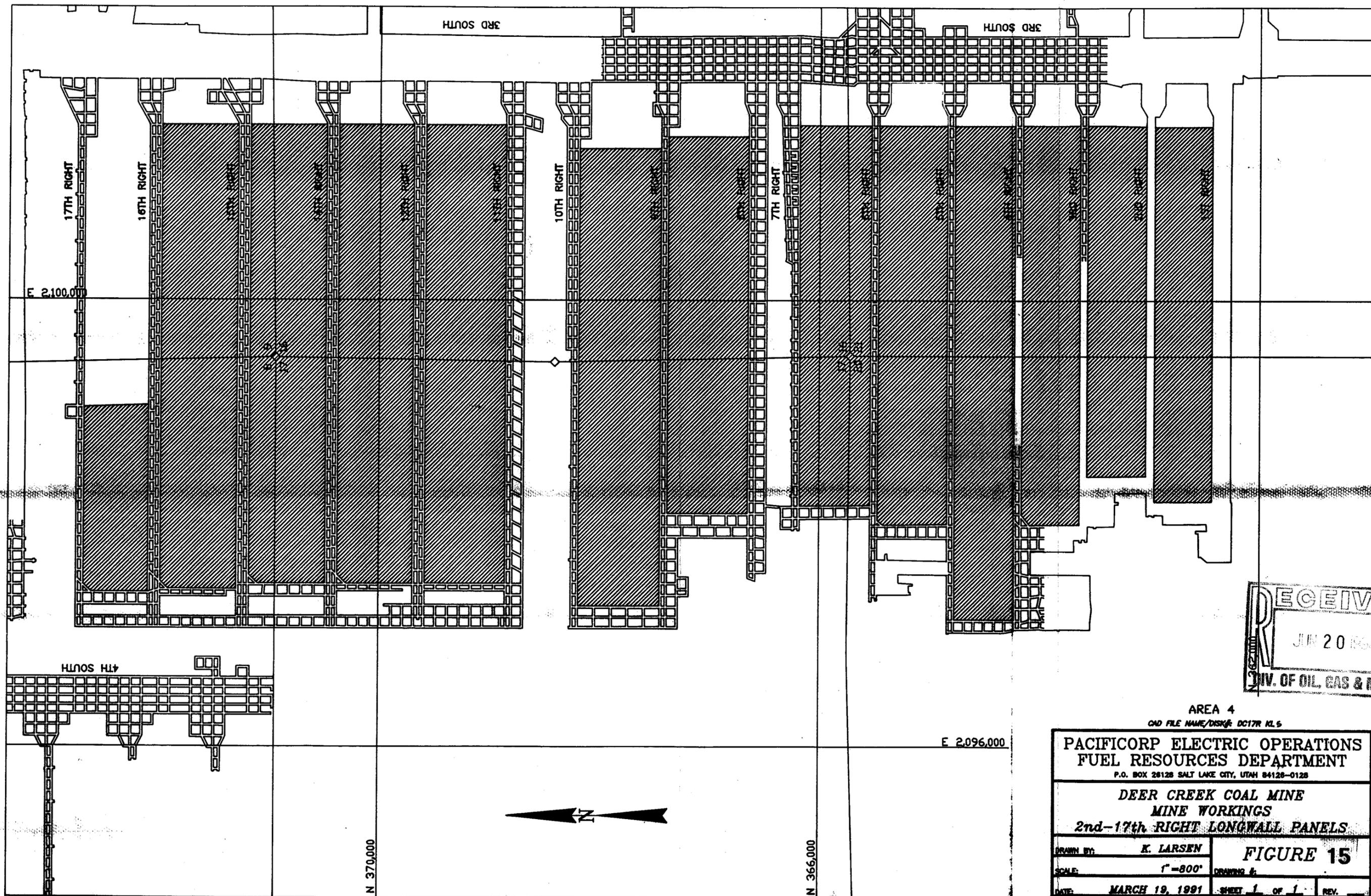
Maximum subsidence is just over seven (7) feet over the 5th Right longwall panel (Figure 16). The profiles, Figures 17 and 18 show some variability from year to year. This area is heavily vegetated and it is thought that this creates difficulties in obtaining consistent readings from year to year. The calculated angle-of-draw of the subsidence ranges from less than zero to 22 degrees.

Several springs are located on East Mountain above these longwall panels and the 2nd through 5th Left panels located directly to the east (see Area 5). Fluctuations in spring flow occur from year to year but seem to be related to variations in precipitation rather than mining. Flows are generally low in dry years and higher in wetter years (see Hydrologic Monitoring Report, 1992 and the Appendices to this report).

The left fork of the Grimes Wash drainage crosses the middle of the subsidence area. Stream monitoring has revealed no changes attributable to

mining. This stream has been called Perennial by the US Forest Service, but our data indicates that it is ephemeral.

Figure 15



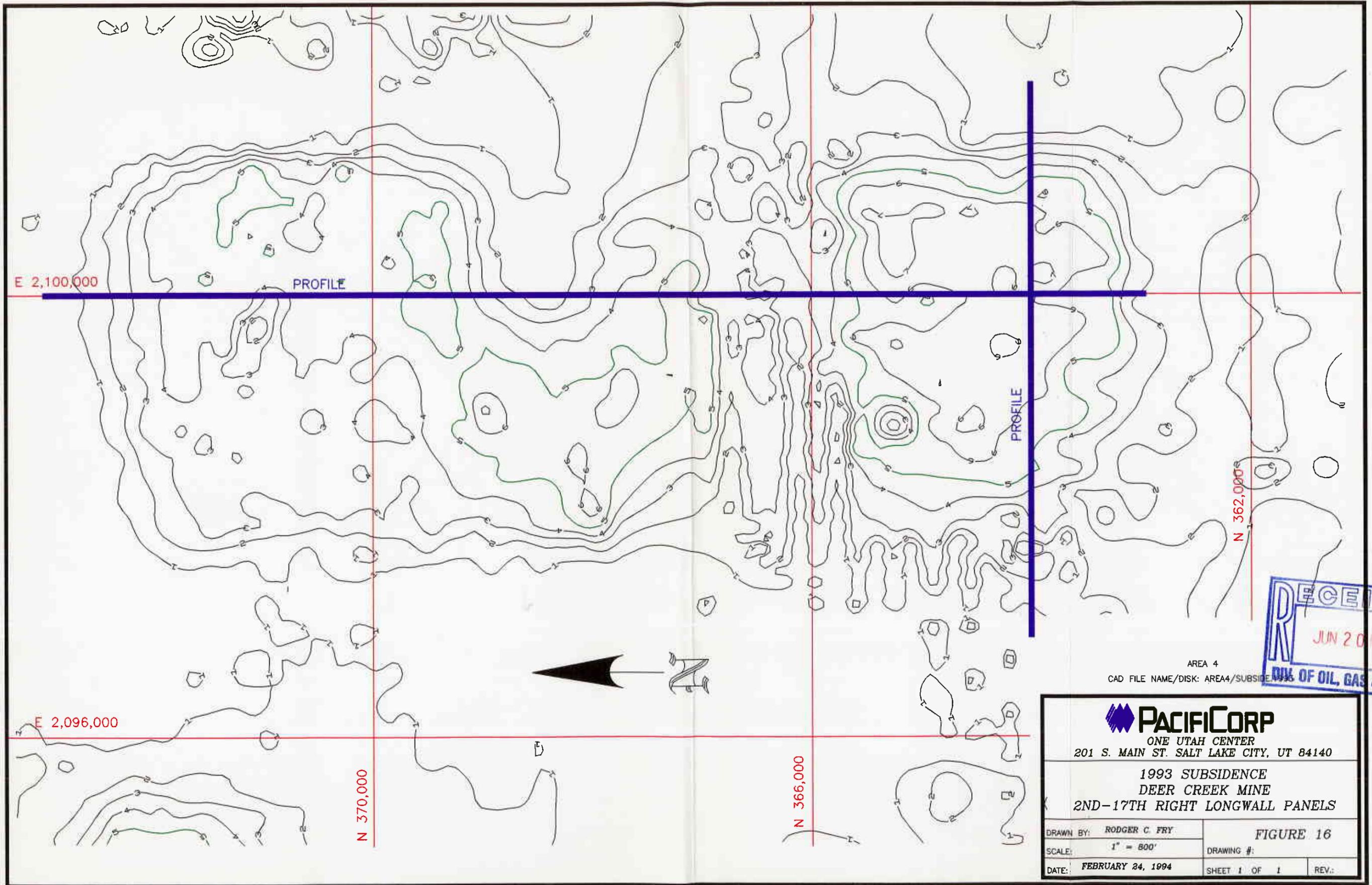
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 DIV. OF OIL, GAS & MINING

AREA 4
 CAD FILE NAME/DISK# DC17R KL 5

PACIFICORP ELECTRIC OPERATIONS
 FUEL RESOURCES DEPARTMENT
 P.O. BOX 28128 SALT LAKE CITY, UTAH 84128-0128

DEER CREEK COAL MINE
 MINE WORKINGS
 2nd-17th RIGHT LONGWALL PANELS

DRAWN BY:	K. LARSEN	FIGURE 15
SCALE:	1" = 800'	
DATE:	MARCH 19, 1991	SHEET 1 of 1 REV.



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 DIV OF OIL, GAS & MINING

AREA 4
 CAD FILE NAME/DISK: AREA4/SUBSIDE 1993

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

1993 SUBSIDENCE
 DEER CREEK MINE
 2ND-17TH RIGHT LONGWALL PANELS

DRAWN BY: RODGER C. FRY	FIGURE 16
SCALE: 1" = 800'	DRAWING #:
DATE: FEBRUARY 24, 1994	SHEET 1 OF 1
	REV.:

FIGURE 17
AREA 4 SUBSIDENCE PROFILE
NORTH-SOUTH

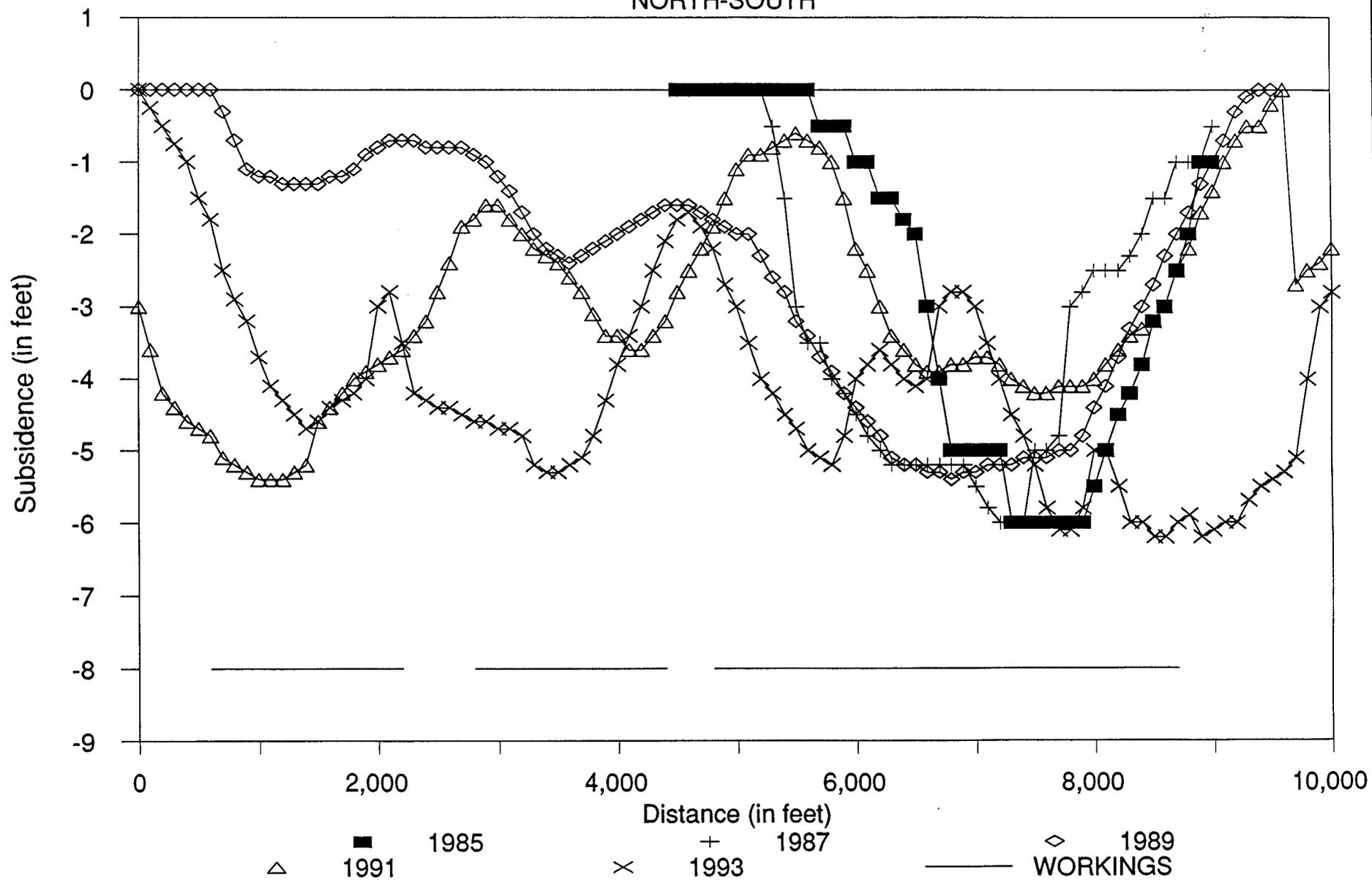
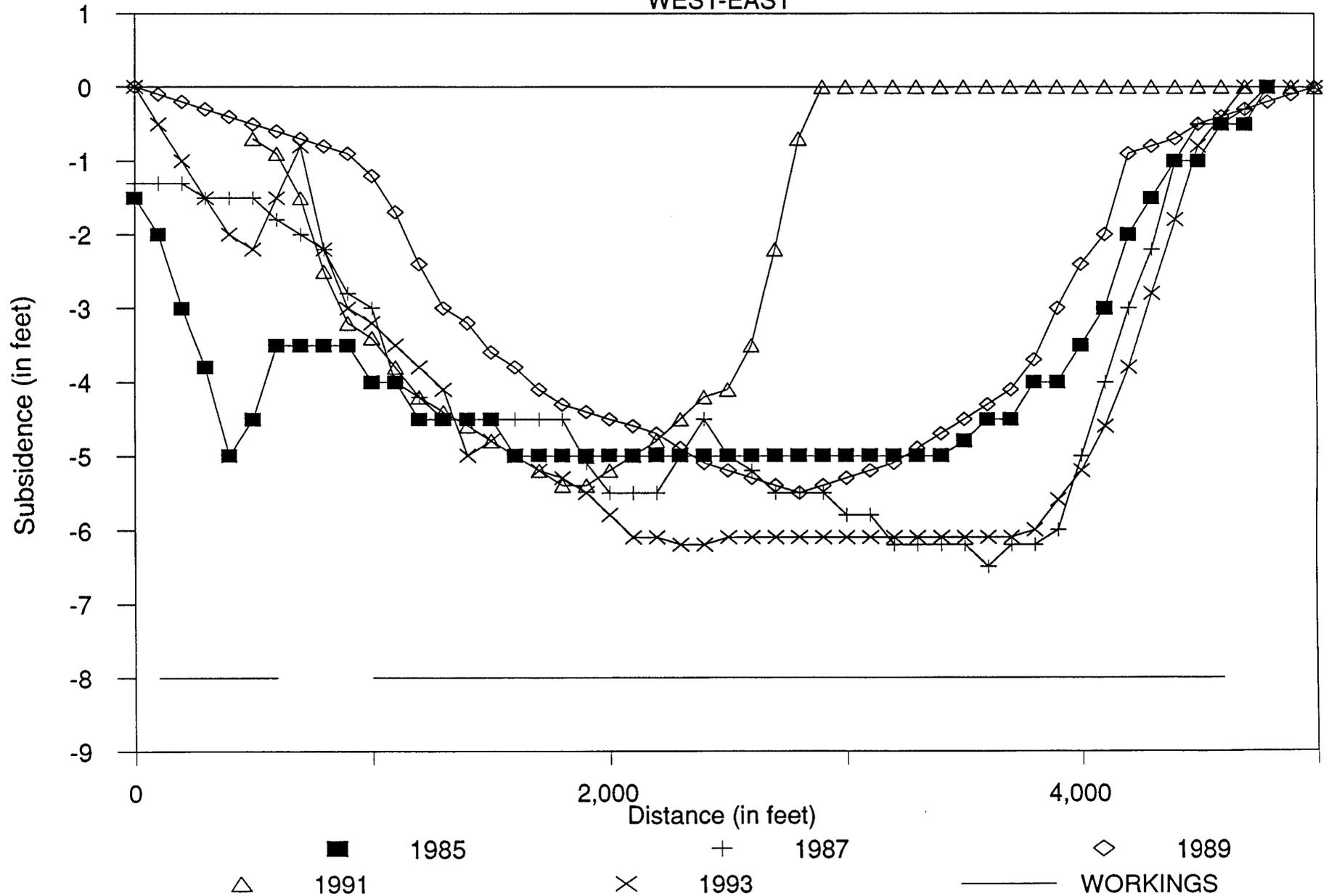


FIGURE 18
 AREA 4 SUBSIDENCE PROFILE
 WEST-EAST



Area 5

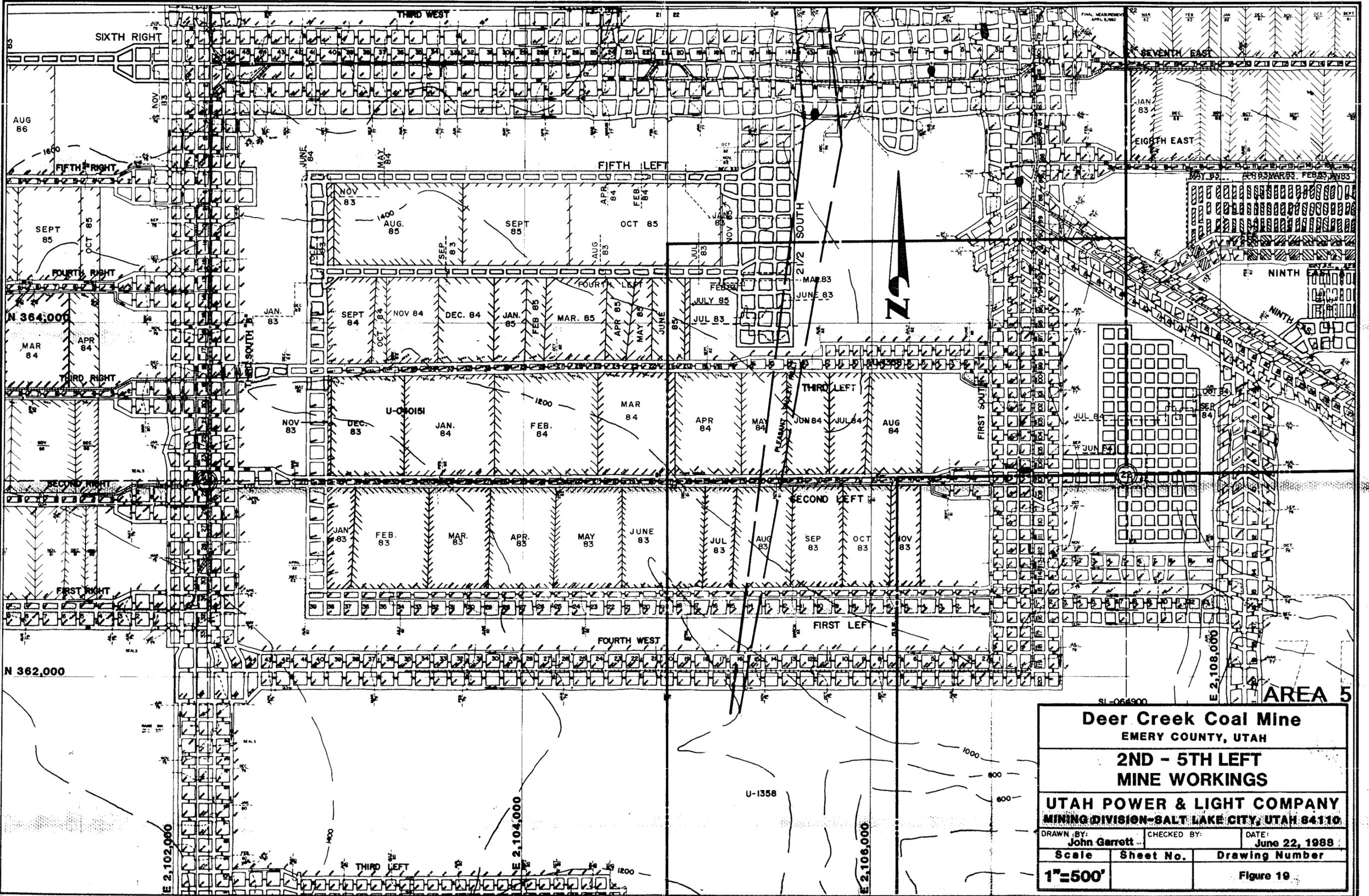
Deer Creek 2nd through 5th Left Longwall Panels

Photogrammetry revealed subsidence in Area 5 for the first time in 1984. Mining of the 2nd Left longwall panel began in January 1983, and by October 1985 all four panels had been completed (Figure 19).

Maximum subsidence over the panels is about seven (7) feet (Figure 20). The maximum subsidence shows an increase since 1991 over the center of the panels (Figures 21 and 22). No surface disturbance has been identified over the panels.

As mentioned in the previous section, none of the springs located above the workings show any adverse effects due to mining.

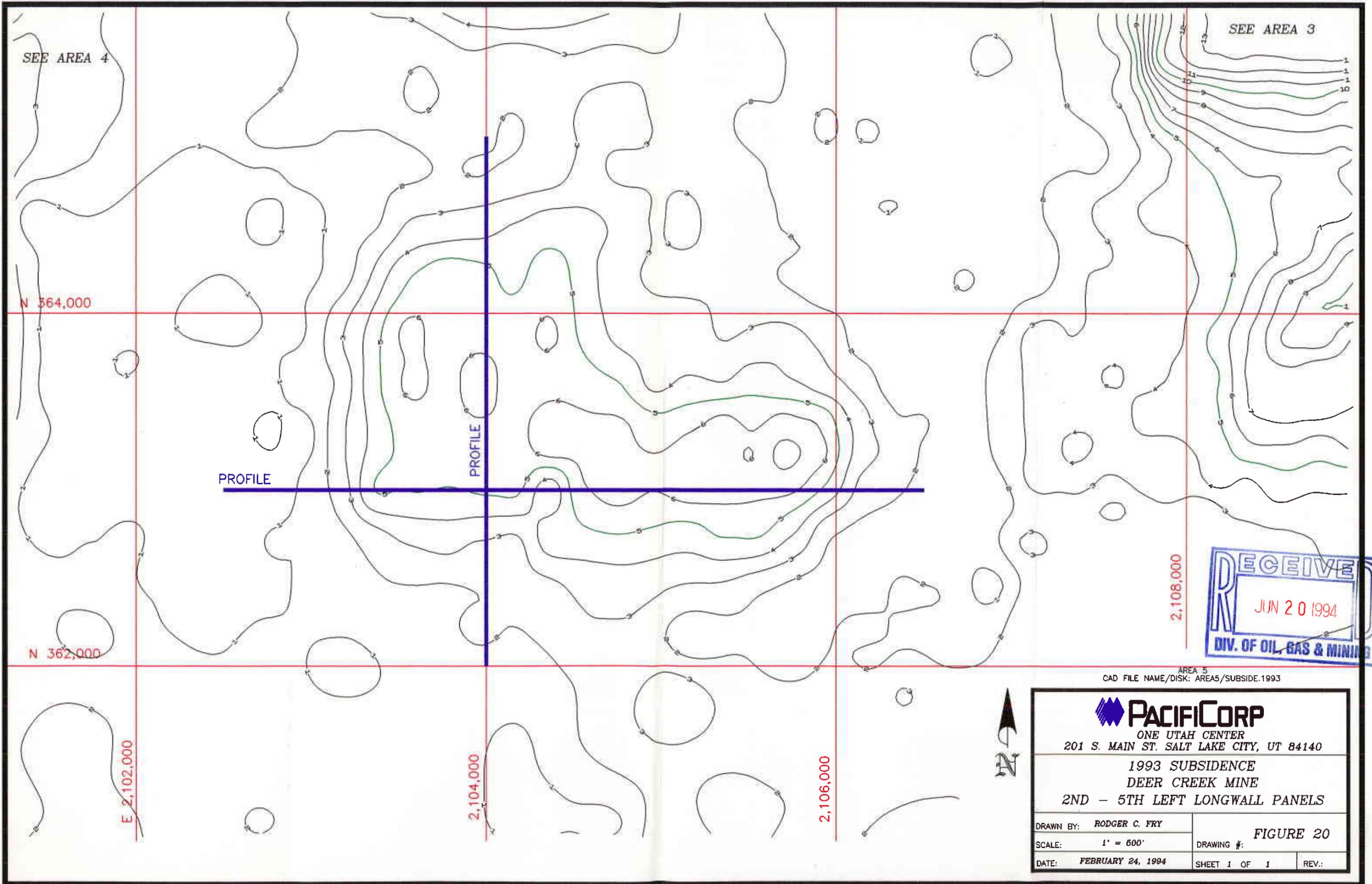
Measured angle-of-draw is between zero and 13 degrees.



SI-064900

AREA 5

Deer Creek Coal Mine		
EMERY COUNTY, UTAH		
2ND - 5TH LEFT		
MINE WORKINGS		
UTAH POWER & LIGHT COMPANY		
MINING DIVISION-SALT LAKE CITY, UTAH 84110		
DRAWN BY:	CHECKED BY:	DATE:
John Garrett	[Signature]	June 22, 1988
Scale	Sheet No.	Drawing Number
1"=500'		Figure 19



SEE AREA 3

SEE AREA 4

PROFILE

PROFILE

N 364,000

N 362,000

E 2,102,000

2,104,000

2,106,000

2,108,000

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AREA 5
CAD FILE NAME/DISK: AREA5/SUBSIDE.1993



 PACIFICORP ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140		
1993 SUBSIDENCE DEER CREEK MINE 2ND - 5TH LEFT LONGWALL PANELS		
DRAWN BY: RODGER C. FRY	FIGURE 20	
SCALE: 1" = 600'	DRAWING #:	
DATE: FEBRUARY 24, 1994	SHEET 1 OF 1	REV.:

FIGURE 21
 AREA 5 SUBSIDENCE PROFILE
 NORTH-SOUTH

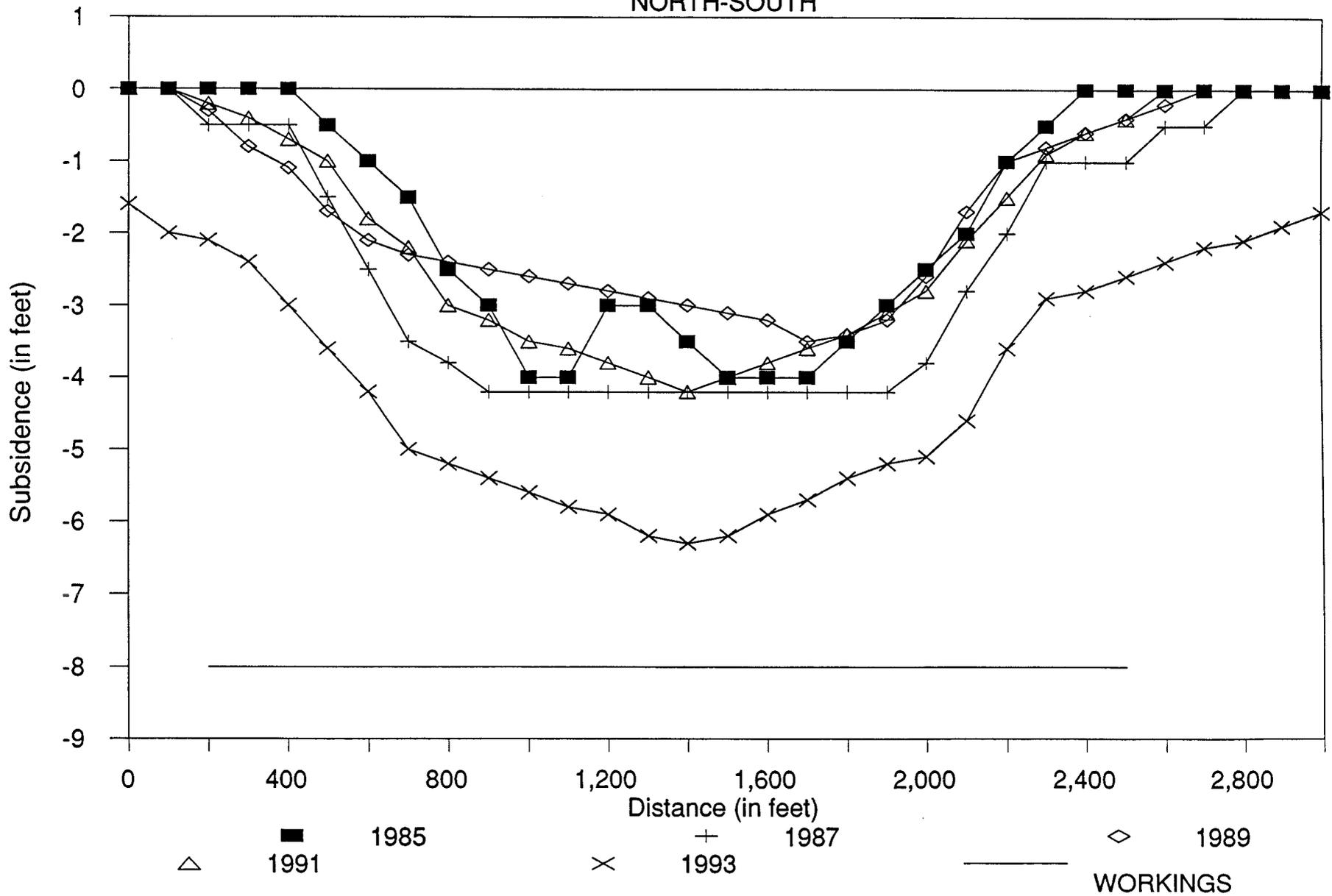
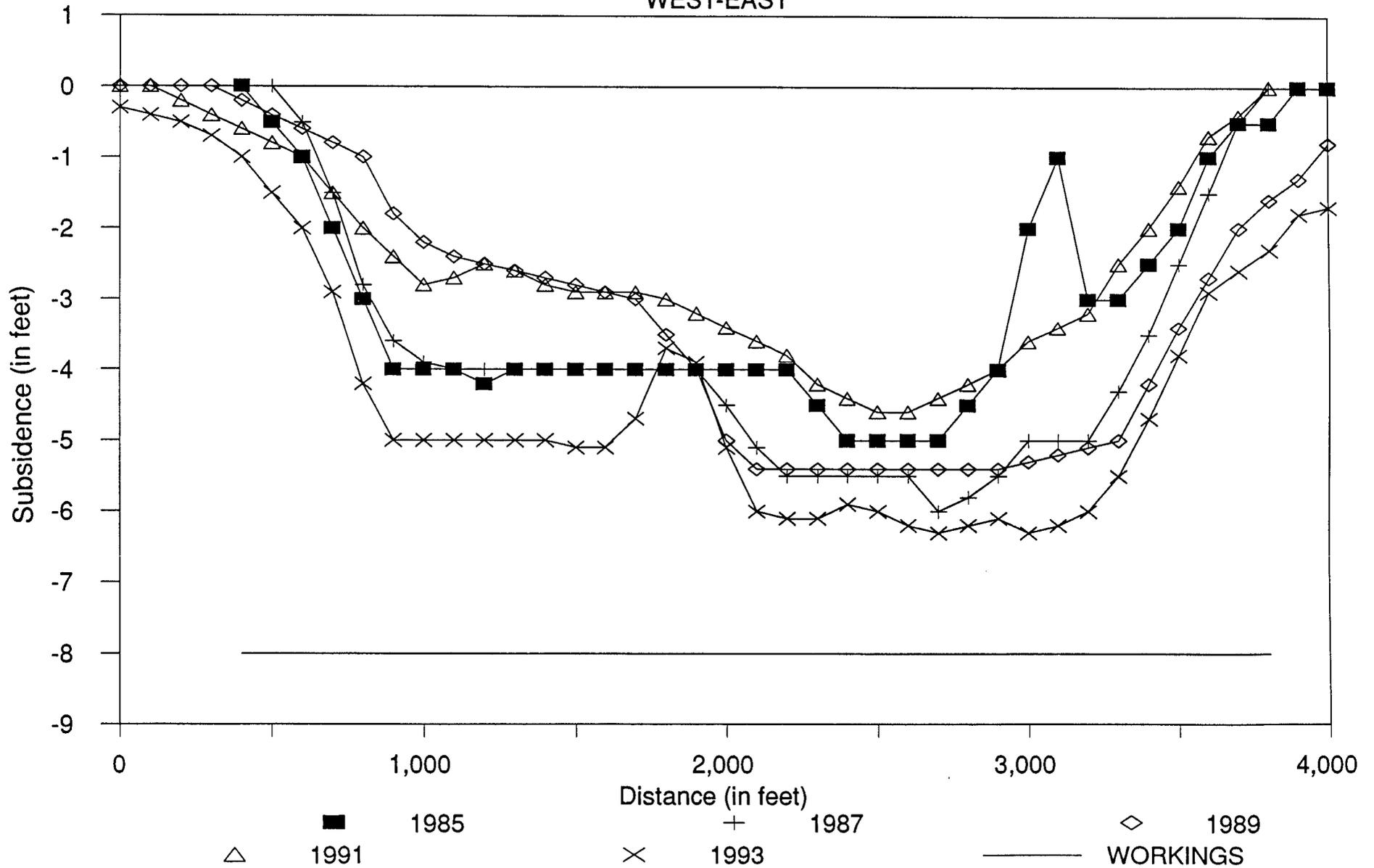


FIGURE 22
AREA 5 SUBSIDENCE PROFILE
WEST-EAST



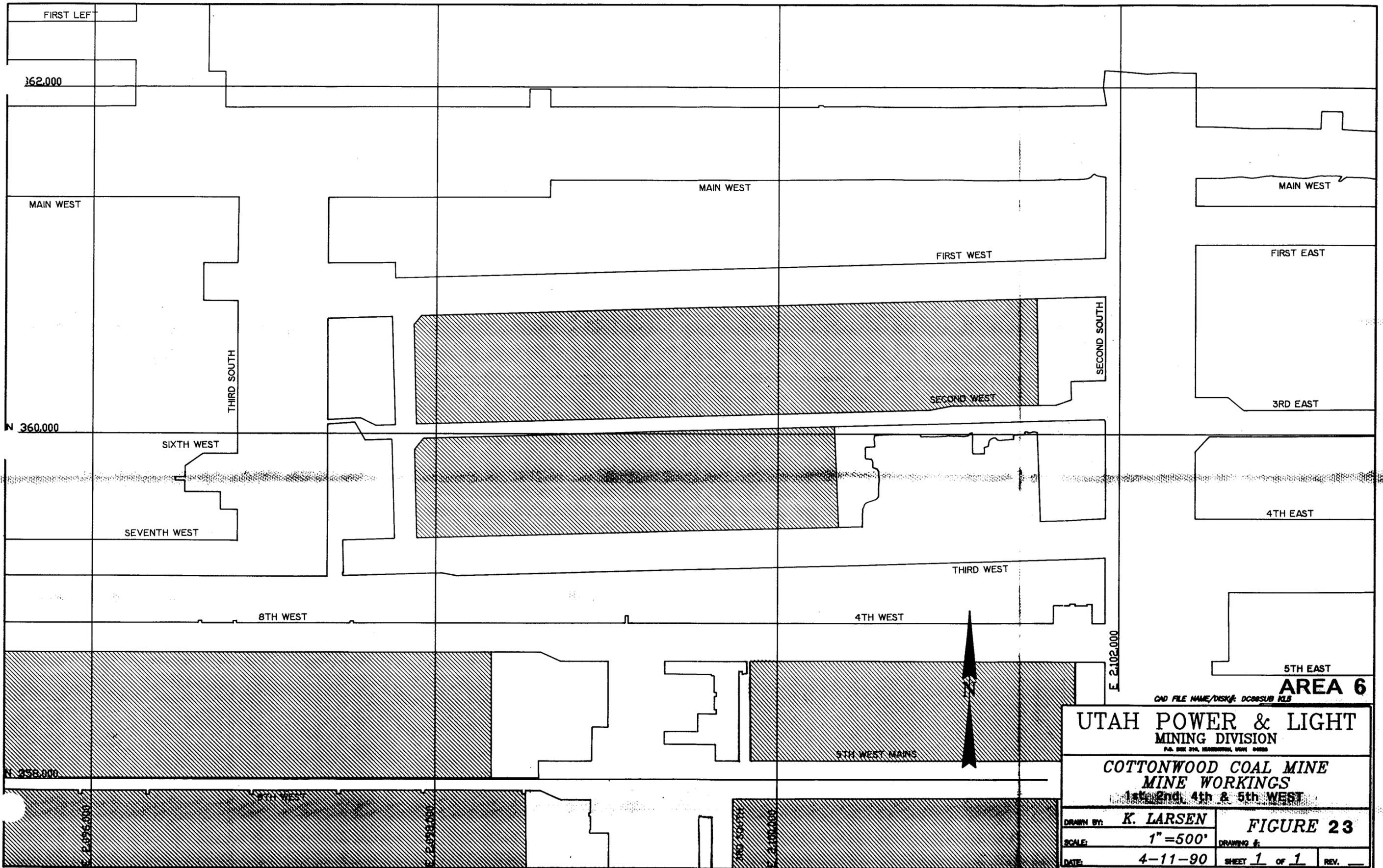
Area 6

Wilberg 1st and 2nd West Longwall Panels

Mining in the Wilberg 1st and 2nd West longwall panels was completed in June 1983 (Figure 23). This area of subsidence has now reached a maximum of five (5) feet over the Second West Longwall Panel. The subsidence in this area has been fairly stable with the exception of continued subsidence in the south which is due to the influence of mining in areas 14 and 15 (Figure 24). The subsidence profiles (Figures 25 and 26) show the change in subsidence since 1984.

Calculated angle-of-draw ranges from zero to 15 degrees where not influenced by other workings.

Four springs located just north of the area show no effect from the subsidence (see Hydrologic Monitoring Report, 1992).



AREA 6

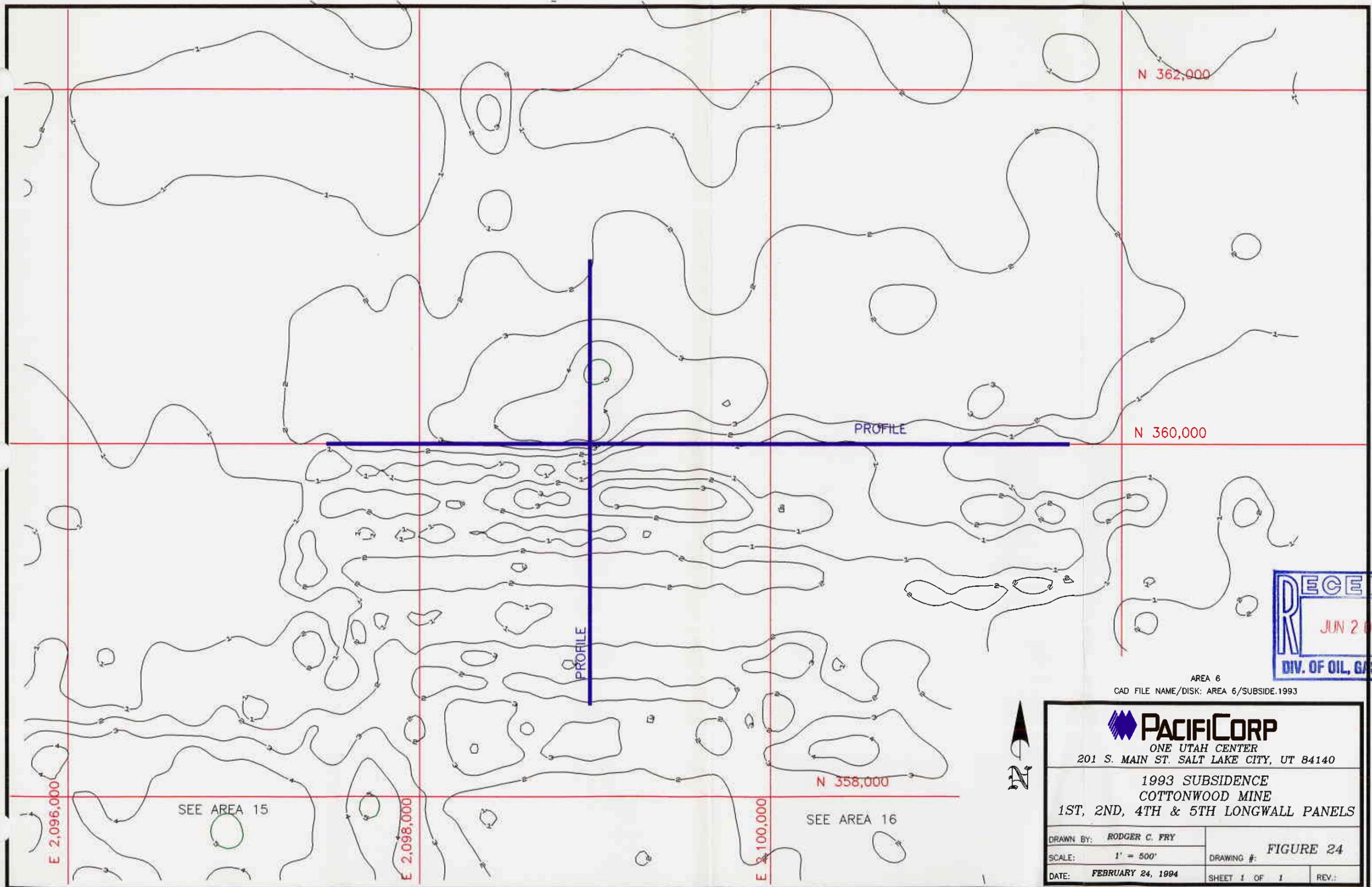
CAD FILE NAME/DISK#: DC08SUB KLS

UTAH POWER & LIGHT
 MINING DIVISION
P.O. BOX 274, BERRINGTON, UTAH 84002

COTTONWOOD COAL MINE
MINE WORKINGS
 1st, 2nd, 4th & 5th WEST

DRAWN BY: **K. LARSEN**
 SCALE: **1" = 500'**
 DATE: **4-11-90**

FIGURE 23
 DRAWING #:
 SHEET **1** OF **1** REV. **—**



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AREA 6
 CAD FILE NAME/DISK: AREA 6/SUBSIDE.1993



 PACIFICORP ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140	
1993 SUBSIDENCE COTTONWOOD MINE 1ST, 2ND, 4TH & 5TH LONGWALL PANELS	
DRAWN BY: RODGER C. FRY SCALE: 1" = 500' DATE: FEBRUARY 24, 1994	DRAWING #: FIGURE 24 SHEET 1 OF 1 REV.:

FIGURE 25
AREA 6 SUBSIDENCE PROFILE
 NORTH-SOUTH

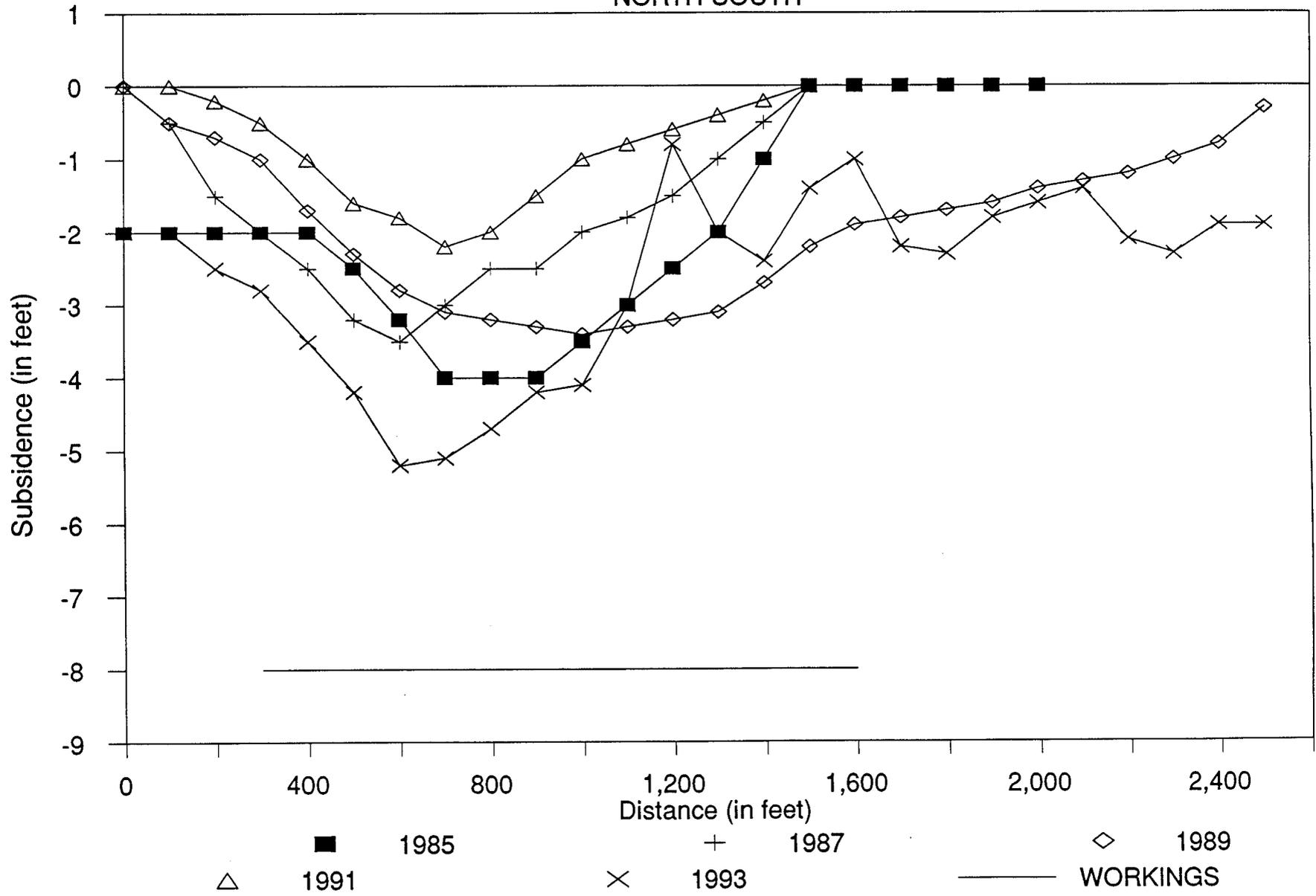
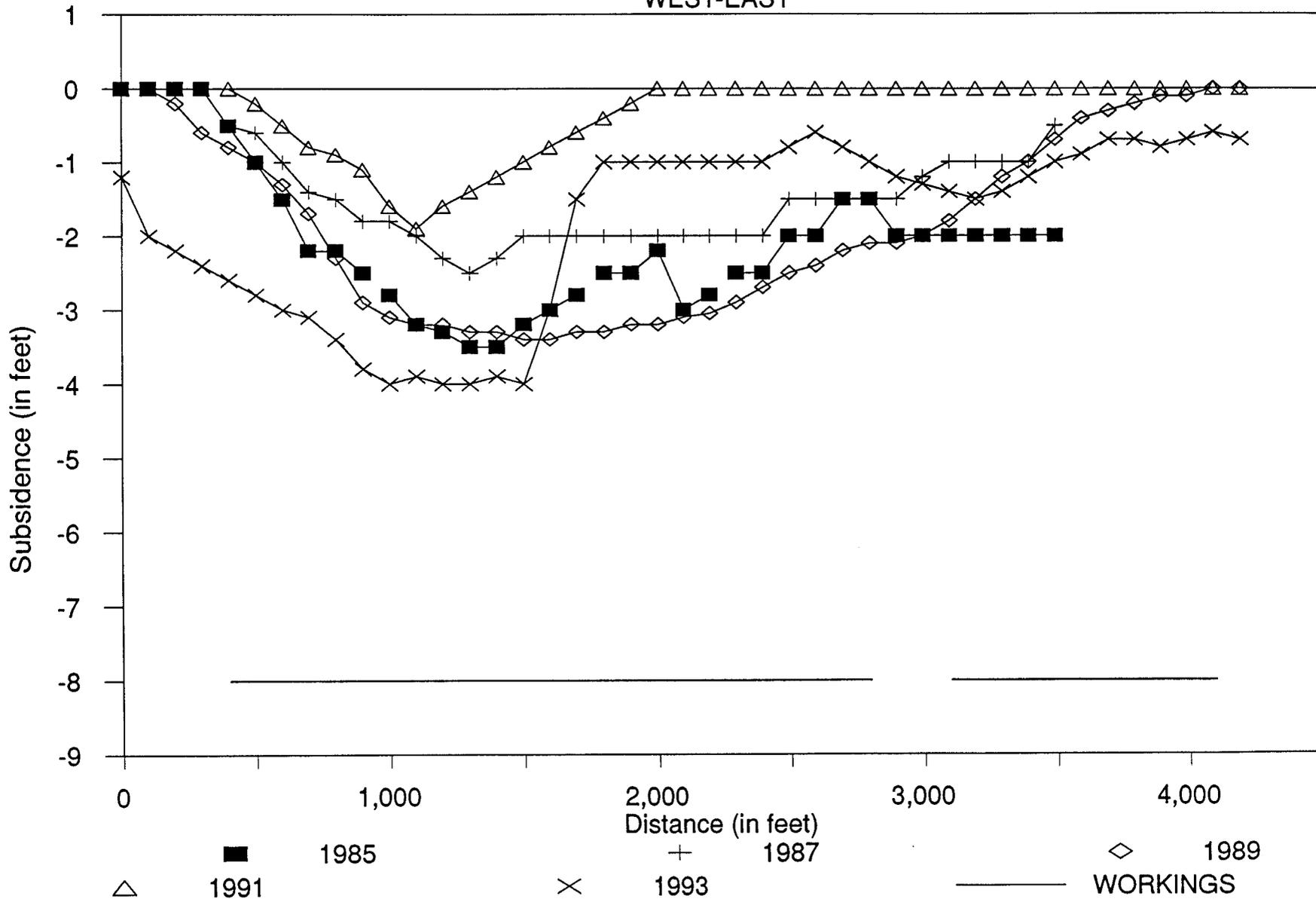


FIGURE 26
 AREA 6 SUBSIDENCE PROFILE
 WEST-EAST



Area 7

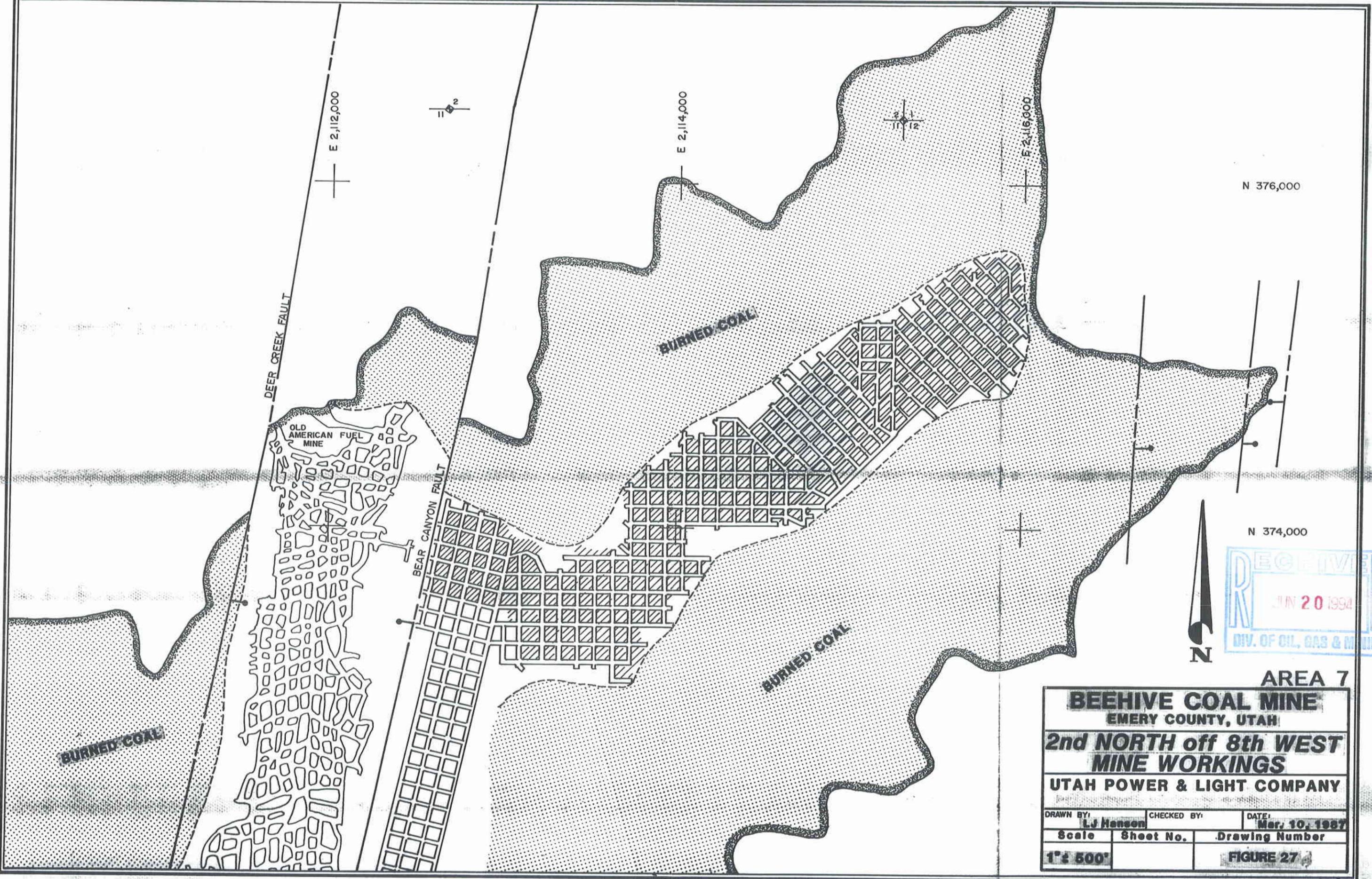
Beehive Mine 2nd North off 8th West

Pillar extraction mining in 2nd North was completed in 1983 and, as shown in Figures 27, 28, and 29, little additional subsidence has occurred over the workings since 1984. The workings are surrounded by burned coal.

Maximum subsidence is as much as six (6) feet. In examining the area by helicopter and aerial photography it is apparent that much of the elevation change measured was due to cliff failure and mass wasting on the steep slopes above the workings, where the rocks were highly fractured prior to mining.

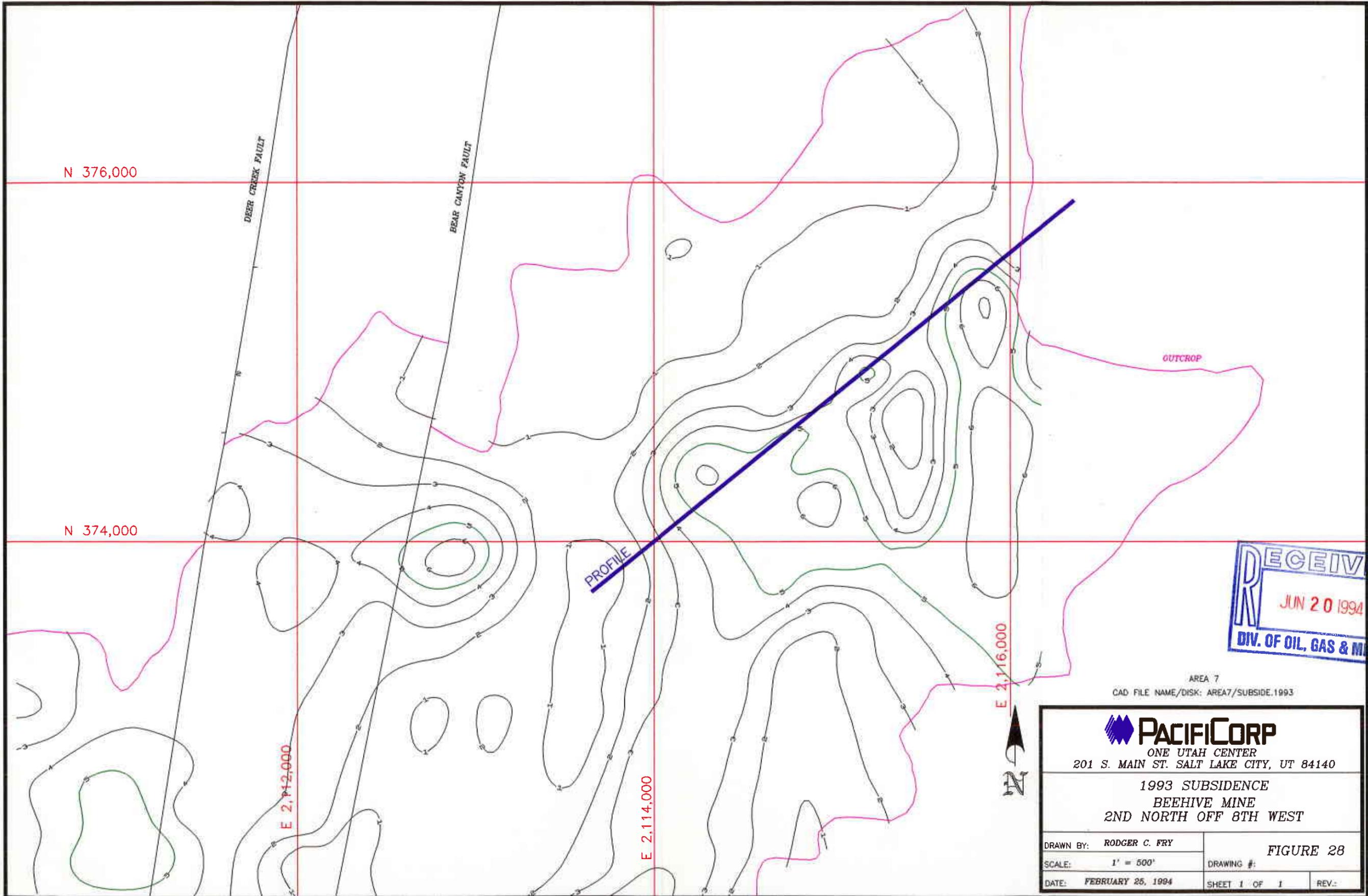
It was not possible to get an accurate angle-of-draw because crushing of the surrounding clinker beds allowed subsidence to occur several thousand feet from the mine workings in some cases.

The subsidence has had no known influence on the hydrology in the area since they lack adequate recharge and are generally dry.



AREA 7

BEEHIVE COAL MINE		
EMERY COUNTY, UTAH		
2nd NORTH off 8th WEST		
MINE WORKINGS		
UTAH POWER & LIGHT COMPANY		
DRAWN BY: L.J. Henson	CHECKED BY:	DATE: Mar. 10, 1987
Scale 1" = 500'	Sheet No.	Drawing Number
		FIGURE 27

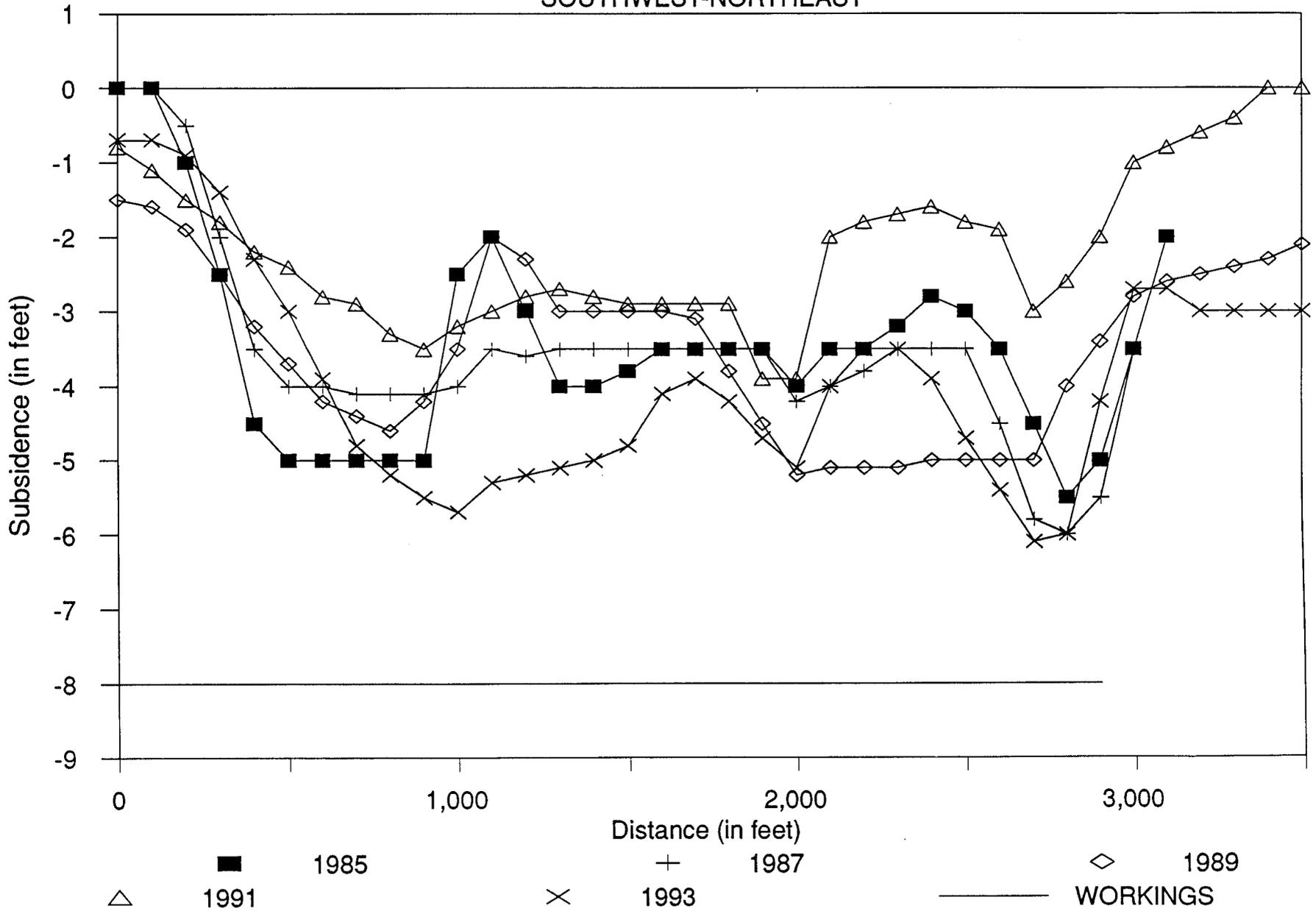


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AREA 7
 CAD FILE NAME/DISK: AREA7/SUBSIDE.1993

ONE UTAH CENTER 201 S. MAIN ST. SALT LAKE CITY, UT 84140		
1993 SUBSIDENCE BEEHIVE MINE 2ND NORTH OFF 8TH WEST		
DRAWN BY: RODGER C. FRY	FIGURE 28	
SCALE: 1" = 500'	DRAWING #:	
DATE: FEBRUARY 25, 1994	SHEET 1 OF 1	REV.:

FIGURE 29
AREA 7 SUBSIDENCE PROFILE
 SOUTHWEST-NORTHEAST



Area 8

Beehive 3rd Through 8th West and 3rd Through 9th East

Deseret 3rd Through 9th West and 1st Through 5th East

Some of the subsidence in Area 8 may have gone undetected because pillar extraction, and presumably subsidence, in part of the area was completed before the establishment of baseline survey data (Figures 30, 31, and 32). The west to east subsidence profile of the area depicted in Figure 33 indicates that subsidence up to slightly over six (6) feet has occurred. On the eastern side subsidence has remained at two feet or less for the last four years. Where not influenced by other workings, the angle-of-draw reached a maximum of 31 degrees on the eastern edge of the area.