Supplemental Information for the Relinquishment of Federal Acreage East Mountain Logical Mining Unit

June 12, 1995

PACIFICORP

c/o Interwest Mining Company
(Managing Agent)

Energy West Mining Company
(Mine Operator)

DEE W. JENSE
Vice President

One Utah Center, Suite 2000
Salt Lake City, Utah 84140-0020
(801) 220-4617 • FAX (801) 220-4725

INTERWEST MINING COMPANY

A Subsidiary of PacifiCorp

June 12, 1995

HAND DELIVERED

Mr. Mat Millenbach
State Director
United States Department of the Interior
Bureau of Land Management
Utah State Office
324 South State, Suite 301
Salt Lake City, Utah 84111-2303

RE: Supplemental Information to Applications for Relinquishment of Federal Coal Lease Acreage - SL066116, SL-064607/064621, SL-070645/U-02292, U-02664, U-1358, U-47978, U-47979 and U-024319 East Mountain LMU, Emery County, Utah

Dear Mr. Millenbach:

In response to your letter of April 21, 1995, and in a concerted effort with your office and other regulatory agencies to resolve this very long outstanding matter, Interwest Mining Company on behalf of PacifiCorp, hereby submits three (3) copies each of Supplemental Information to assist in the review process of the pending relinquishment applications. In addition, we take this opportunity to welcome to our offices this day, members of your staff, the U.S. Forest Service (USFS) and the Utah Division of Oil, Gas & Mining (DOGM), to discuss and provide further explanation on this matter. Copies of the Supplemental Information will be given directly to the USFS and DOGM while at this meeting.

The Supplemental Information contained herein has been collected and prepared primarily to address the issue of *"substantial completeness"* as it pertains to areas of mining-induced subsidence. The purpose of this exercise is to provide the agencies with lease-specific summary information on the disposition of subsided areas with descriptions of hydrologic and vegetative impacts. Our subsidence monitoring data comes from several years of collecting both aerial photogrammetric and conventional surveying information. From this information, we have demonstrated that the areas of mining-induced subsidence have reached their predicted values and are considered substantially complete with no significant or irreparable damage to the environment, inclusive of the hydrology, vegetation, wildlife and other land uses. Based upon these findings and demonstrations, we conclude that the federal acreage applied for relinquishment will not impair the public interest in accordance with 43 CFR 3452.1-3.

This Supplemental Information has been collected and prepared by Interwest Mining Company (managing agent) and Energy West Mining Company (mine operator), both wholly owned subsidiaries of the Lessee, PacifiCorp. The information contained within this submittal is true and correct to best of our knowledge and belief.

Therefore, with the submission of this Supplemental Information, we respectfully request the BLM to consider the pending applications for approval and would appreciate a timely response.

In addition, this Supplemental Information is submitted as "Confidential Information" in accordance with 43 CFR 3481.3(b)(1993).

Should you have any questions or need additional information, please feel free to contact Scott Child of my staff at 220-4612.

Sincerely,

D.W. Jense
Vice President

Enclosures

SMC111\UTBLM95.005

cc: IMC w/o copy encl. - D. Baker, J. B. Harvey, J.R. Key, S. Kochevar, G. Takenaka, B. Webster
IMC w/copy encl. - S. Child, R. Fry
EWMC w/o copy encl. - L. LaFrentz, D. Lauriski, M. Moon
EWMC w/copy encl. - V. Payne, C. Semborski
SRBJ&G w/copy encl. - J. Kirkham
USFS (2 copies) - A. Howe, C. Reed
DOGM (1 copy) - P. Grubaugh-Littig

Semborski

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INTERWEST MINING COMPANY

A Subsidiary of PacifiCorp

HAND DELIVERED

August 13, 1996

Mr. Doug Koza
Deputy State Director, Mineral Resources
United States Department of the Interior
Bureau of Land Management
Utah State Office
324 South State Street, Suite 301
Salt Lake City, Utah 84111-2303

RE: Revised Supplemental Information for the Relinquishment of Federal Coal Lease Acreage East Mountain Logical Mining Unit, Manti-LaSal National Forest, Emery County, Utah

Dear Doug:

In following up with BLM's decision letter of December 14, 1996, wherein partial relinquishment of federal coal lease acreage was accepted, this letter and the enclosed materials are provided to address the remaining issues on the balance of acreage originally sought for relinquishment in 1992.

As previously mentioned to you, we have been working with the Manti-LaSal National Forest Service to address their concerns and provide answers to their deficiency letter to the BLM dated 8-15-95. Over the past few months, we have provided draft responses directly to them and each party has had the opportunity to provide constructive comment in resolving the remaining issues. Therefore, enclosed are three (3) copies of the referenced "Revised Supplemental Information" in its final form. As mentioned, the preparation of this revised information (dated 6-4-96) has been closely coordinated with the Forest Service to meet their acceptance and now awaits a favorable decision by the BLM.

To assist you in updating your loose leaf binders with the revised information, the following listing is provided:

1. Remove the Table of Contents and replace with Table of Contents Revised 6-4-96.

2. Remove Data Summary Report and replace with Data Summary Report Revised 6-4-96.

3. Maps
   Remove "1994 Subsidence Map East Mountain All Areas" and replace with "1995 Subsidence Map East Mountain All Areas."
   Leave Total Subsidence Map - August 1994 - Lease Relinquishment Areas.
   Leave Total Subsidence Map - August 1994 - Lease U-47978.
   Add Lease Relinquishment Topographic Map (11"x17") with Profile Lines.

4. Profiles and Isograms

Remove "Photogrammetric Files" Index Tab and replace with "Profiles and Isograms" Index Tab.
Add Figure 5 dated 6-4-96.
Remove Figure 6 and replace with Figure 6 Revised 6-4-96.
Remove Figure 7 and replace with Figure 7 Revised 6-4-96.
Add Figure 10 dated 6-4-96.
Remove Figure 11 and replace with Figure 11 Revised 6-4-96.
Remove Figure 12 and replace with Figure 12 Revised 6-4-96.
Add Figure 13A dated 6-4-96.
Remove Figure 14 and replace with Figure 14 Revised 6-4-96.
Add Figure 14T dated 6-4-96.
Add Figure 28 dated 6-4-96.
Remove Figure 29 and replace with Figure 29 Revised 6-4-96.
Add Figure 29T dated 6-4-96.
Add Figure 32 dated 6-4-96.
Remove Figure 33 and replace with Figure 33 Revised 6-4-96.
Add Figure 33T dated 6-4-96.
Add Figure 41 dated 6-4-96.
Remove Figure 42 and replace with Figure 42 Revised 6-4-96.
Add Figure 42T dated 6-4-96.
Remove Figure 43 and replace with Figure 43 Revised 6-4-96.
Add Figure 43T dated 6-4-96.
Add Figure 45 dated 6-4-96.
Remove Figure 46 and replace with Figure 46 Revised 6-4-96.
Add Figure 46T dated 6-4-96.
Remove Figure 47 and replace with Figure 47 Revised 6-4-96.
Add Figure 47T dated 6-4-96.
Add Figure 49 dated 6-4-96.
Remove Figure 50 and replace with Figure 50 Revised 6-4-96.
Add Figure 50T dated 6-4-96.
Remove Figure 51 and replace with Figure 51 Revised 6-4-96.
Add Figure 51T dated 6-4-96.
Add Figure 53 dated 6-4-96.
Remove Figure 54 and replace with Figure 54 Revised 6-4-96.
Add Figure 54T dated 6-4-96.
Remove Figure 55 and replace with Figure 55 Revised 6-4-96.
Add Figure 55T dated 6-4-96.
Add Figure 57 dated 6-4-96.
Remove Figure 58 and replace with Figure 58 Revised 6-4-96.
Add Figure 58T dated 6-4-96.
Remove Figure 59 and replace with Figure 59 Revised 6-4-96.
Add Figure 59T dated 6-4-96.
Add Figure LR-15 (4 Sheets) 1992-95 Subsidence dated 6-4-96.

5. Survey Target Profiles

Remove Newberry Canyon PR-1 through PR-10 and replace with Newberry Canyon PR-1 through PR-10 Revised 6-4-96.
Remove Corncob Wash PR-11 through PR-14 and replace with Corncob Wash PR-11 through PR-14 Revised 6-4-96.
Remove Miller Canyon PR-1 through PR-5 and replace with Miller Canyon PR-1 through PR-5 Revised 6-4-96.
Add Grimes Wash PR-1 through PR-4 dated 6-4-96.
Add Survey Elevations (listing) All Prism Locations dated 6-4-96.

6. Vegetation Monitoring Photographs
Add Index Tab and Photographs at the end of the binder.

With the submission of this Revised Supplemental Information, we respectfully request the BLM to accept the remaining balance of acreage originally sought for relinquishment. A prompt turn around time is very much appreciated.

In addition, this revised information is submitted as "Confidential Information" in Accordance with 43 CFR 3481.3(b)(1995).

Should you have any questions, please feel free to contact me at 220-4612.

Sincerely,

Scott M. Child
Property Management Administrator

Enclosures

SMC12\UTBLM96.004

cc: IMC w/o copy encl. - D. Baker, J. B. Harvey, D.W. Jense
IMC w/copy encl. - R. Fry
EWMC w/o copy encl. - L. LaFrentz, D. Lauriski, C. Pollastro
EWMC w/copy encl. - V. Payne, C. Semborski
USFS (3 copies) - A. Howe, C. Reed, D. Harber
DOGM (1 copy) - P. Grubaugh-Littig
Stoel Rives w/copy - J. Kirkham, Esq.
PacifiCorp Federal Affairs, Washington D.C. w/copy encl. - K. Lynch
Crowell & Moring w/copy encl. - S. Quarles, Esq.

Supplemental Information for the Relinquishment of Federal Acreage East Mountain Logical Mining Unit

June 12, 1995

PACIFICORP

c/o Interwest Mining Company
(Managing Agent)

Energy West Mining Company
(Mine Operator)

Supplemental Information for the Relinquishment of Federal Acreage East Mountain Logical Mining Unit

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SUPPLEMENTAL INFORMATION FOR THE RELINQUISHMENT OF FEDERAL ACREAGE EAST MOUNTAIN LOGICAL MINING UNIT

June 12, 1995
(Revised June 4, 1996)

I. Introduction

PacifiCorp has submitted acreage relinquishment applications to the Bureau of Land Management ("BLM") in two separate phases to (1) reduce acreage from its federal coal lease holdings, and (2) effectively manage the leases comprised within the East Mountain Logical Mining Unit ("LMU"). Phase I was submitted on April 22, 1992 and Phase II on October 16, 1992. Both applications have sought to relinquish federal lease acreage which has either been (1) mined out, (2) considered sub–economic due to limited mining access because of inherent faulting and adverse geologic conditions, and/or (3) the remaining unmined areas are burned, and no recoverable reserves remain.

Phase I initially contained 4,221.23 acres, and Phase II included 1,190.00 acres for a total of 5,411.23 acres. Since the applications were filed, there have been some changes which affect the overall acreage sought for relinquishment. These changes are listed below.

(1) One individual lease, SL–050133, was ruled upon following the submittal of the original application. Approval was granted by the BLM on March 9, 1993, relinquishing the entire 80 acres.

(2) On May 11, 1994, PacifiCorp filed a partial withdrawal of the relinquishment as to 40 acres from Lease U–024319 which is to be deleted from the Phase I application.

(3) Under the Phase I application, PacifiCorp originally sought to relinquish 480 acres of the total 520 acres from Lease SL–066116. Upon BLM's lease readjustment decision dated April 25, 1995, PacifiCorp in turn gave notice to BLM, dated May 15, 1995, that it relinquishes Lease SL–066116 in its entirety (all 520 acres).

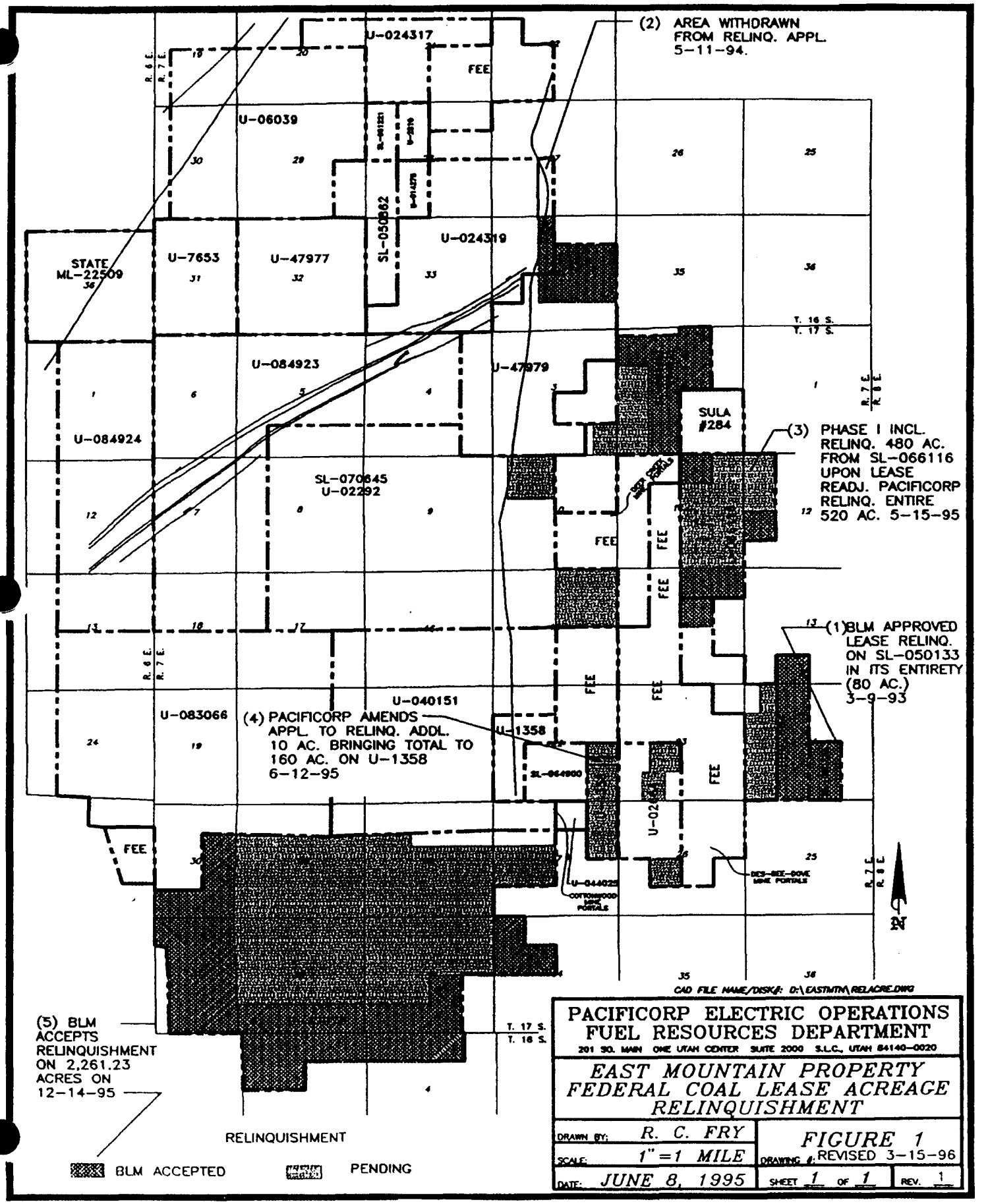
(4) Again, under Phase I, PacifiCorp originally sought to relinquish 150 acres from Lease U–1358. Upon further review, it has been determined to relinquish a total of 160 acres. Therefore, this supplemental information amends PacifiCorp's application to relinquish an additional 10 acres from Lease U–1358.

(5) On December 14, 1995, BLM issued a decision accepting the relinquishment of 2,261.23 acres. Refer to *Table 1*

Altogether, the federal lease acreage applied for relinquishment is currently 5,341.23 acres. Refer to *Figure 1* for lease configuration and areas applied for relinquishment. *Table 1* provides an updated listing of each lease and the acreage applied for relinquishment.

TABLE 1

Federal Lease Number	Type of Relinquishment	Phase I & II Relinquished Acreage	BLM Accepted Relinquished Acreage 12/14/95	Pending Remaining Acreage
SL–066116	FULL	520.00	160.00	360.00
SL–064607 / SL–064621	PARTIAL	443.92	293.92	150.00
SL–070645 / U–02292	PARTIAL	250.00	0	250.00
U–02664	PARTIAL	490.00	240.00	250.00
U–024319	PARTIAL	40.00	40.00	0
U–1358	PARTIAL	160.00	0	160.00
U–47978	PARTIAL	3,257.31	1,347.31	1,910.00
U–47979	PARTIAL	180.00	180.00	0
Total Acreage Applied for Relinquishment		**5,341.23**	**2,261.23**	**3,080.00**


(2) AREA WITHDRAWN FROM RELINQ. APPL. 5-11-94.
U-024317
FEE
U-06039
SL-050062
U-024319
STATE ML-22509
U-7653
U-47977
U-084923
U-47979
U-084924
SL-070645 U-02292
SULA #284
(3) PHASE I INCL. RELINQ. 480 AC. FROM SL-066116 UPON LEASE READJ. PACIFICORP RELINQ. ENTIRE 520 AC. 5-15-95
(1) BLM APPROVED LEASE RELINQ. ON SL-050133 IN ITS ENTIRETY (80 AC.) 3-9-93
U-040151
U-083066
(4) PACIFICORP AMENDS APPL. TO RELINQ. ADDL. 10 AC. BRINGING TOTAL TO 160 AC. ON U-1358 6-12-95
U-1358
SL-064900
U-044022
COTTONWOOD MINE PORTALS
DEER CREEK MINE PORTALS
T. 16 S.
T. 17 S.
R. 6 E.
R. 7 E.
(5) BLM ACCEPTS RELINQUISHMENT ON 2,261.23 ACRES ON 12-14-95
RELINQUISHMENT
BLM ACCEPTED
PENDING
CAD FILE NAME/DISK#: D:\EASTMTN\RELACRE.DWG
PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT
201 SO. MAIN ONE UTAH CENTER SUITE 2000 S.L.C., UTAH 84140-0020
EAST MOUNTAIN PROPERTY
FEDERAL COAL LEASE ACREAGE
RELINQUISHMENT
DRAWN BY: R. C. FRY
SCALE: 1" = 1 MILE
DATE: JUNE 8, 1995
FIGURE 1
DRAWING #: REVISED 3-15-96
SHEET 1 OF 1
REV. 1

Both applications have been in the review process by BLM, with regulatory input from the Manti LaSal National Forest ("Forest Service") and the Utah Division of Oil Gas & Mining ("DOGM"), for over three years. The following supplemental information is submitted on behalf of PacifiCorp to provide lease–specific information to the regulatory agencies as it relates to the *"substantial completeness"* issues on areas of mining–induced subsidence, together with summary descriptions on hydrologic and vegetative impacts. The term *"substantial completeness"*, although undefined by regulation with no mention or reference in BLM guidelines, has put the Lessee, PacifiCorp, in an onerous position of providing information which potentially has no bounds and goes beyond the scope of complying with the terms and conditions of the federal leases. However, in a concerted effort with the regulatory agencies, this supplemental information has been prepared by Interwest Mining Company ("managing agent") and Energy West Mining Company ("mine operator"), both wholly–owned subsidiaries of PacifiCorp, to demonstrate the disposition of subsidence activities within the East Mountain LMU.

It is PacifiCorp's experience, based upon subsidence data collected, evaluated and quantified over the past 16 years from coal mining induced subsidence on East Mountain, that subsidence is "substantially complete" within two to three years following the conclusion of mining. However, the determination of "substantial completeness" will vary from area to area because the factors affecting the occurrence of subsidence will be unique to each given area.

Data collected above areas where longwall mining has taken place demonstrates that subsidence occurs rapidly; generally within six months of mining. Data collected above areas where room–and–pillar methods were used demonstrates that subsidence will occur over a longer period of time. The factors affecting the occurrence of subsidence include: (1) percent of recovery, (2) overburden thickness and geologic composition (burned areas), (3) extent of area mined, (4) multiple seam mining, (5) longwall mining methods versus room–and–pillar mining methods, and (6) disposition of the surface, i.e., flatness, steep rugged terrain and escarpments. (Factor Number 6 affects not only the rate at which

subsidence occurs, but also the accuracy of the methods used in subsidence monitoring).

For purposes of lease relinquishment, subsidence may be considered "substantially complete" when no "measurable subsidence" has occurred during a monitoring period ending two or more years following completion of mining within the area for which relinquishment is sought. The term "measurable subsidence" shall refer to measured subsidence which exceeds the accuracy parameters of the subsidence monitoring methods used for the area (i.e., photogrammetric and/or conventional survey). The term "accuracy parameters" refers to the precision and/or detection limits of applicable surveying methods as applied to the specific site. Where the surface being surveyed is relatively flat the detection limits may be as small as one foot. In areas of steep rugged terrain (including escarpments), the detection limit is generally greater and would be no less than two feet.

II. *Statement of Need*

PacifiCorp reiterates its need to relinquish acreage from its East Mountain federal lease holdings to effectively meet increasing challenges associated with managing coal leases and mining reserves which provide secure, high quality, low cost fuel for power generation, while maintaining the environmental integrity of the areas applied for relinquishment. The need is simply two–fold:

(1) Reduce overall federal acreage holdings by relinquishing mined–out, sub–economic inaccessible and burned areas.

(2) Provide additional opportunity under the federal acreage threshold limitation to acquire additional federal coal reserves to be used for future power generation.

III. Compliance of Lease Terms and Conditions

To further assist in the compliance review of PacifiCorp's obligation under the federal coal leases, a spreadsheet (included in the Appendix) has been prepared evaluating each lease term, conditions and stipulations for all the federal leases involved in the relinquishment. From this internal review, PacifiCorp has, to the best of its knowledge, complied with all the lease terms, conditions and stipulations. Notwithstanding the arbitrary nature of the *"substantial completeness"* issue, PacifiCorp established subsidence and hydrology monitoring systems beginning in 1980 to locate, measure and quantify the effects of underground mining activities. This information has been compiled annually and submitted to DOGM, the mine permit regulatory agency. It is this same information that will be used to demonstrate the results and current disposition on areas of mining–induced subsidence.

IV. PacifiCorp Subsidence Monitoring and Methodology

PacifiCorp's subsidence monitoring program is primarily based on aerial photogrammetry. A baseline photogrammetric survey was conducted in 1980 which includes over 12,000 elevations measured on a 200–foot spacing grid. These elevations are then compared to elevations measured from photographs taken annually in August. This method has proven to be the best way to collect subsidence data on East Mountain. In flat areas with limited vegetation, the elevations on the photographs can be read with a precision of one–half foot. In steeper areas where cliffs are present, the resolution becomes less reliable, and inaccuracies of greater than 10 feet can occur. In these steep areas, photogrammetric monitoring can, and has been, augmented by conventional survey data. A map depicting the total subsidence on East Mountain is included in the Appendix (1994 Subsidence East Mountain All Areas). This map was also included in the 1994 Annual Subsidence Monitoring Report and can be compared to similar maps contained in previous years' monitoring reports. The map shows large areas where subsidence has occurred above mined out areas. Maps are also included in the Appendix that show the detailed subsidence in the lease relinquishment areas (Total Subsidence August 1994 Lease Relinquishment Areas

and Total Subsidence August 1994 Lease U–47978). In areas where the land surface is flat or gently rolling, the subsidence shown on these maps conforms with the undermined areas, i.e., where longwall panels are present, subsidence is greater than in main entry areas, and subsidence is minimal in areas where barrier pillars are present. In areas where escarpments and steep slopes are present, the subsidence depicted on the maps often fluctuates because of the inaccuracies in the steep topography as can be seen by the numerous "bulls eye" in areas where no mining has occurred in Leases U–47979 and U–47978. It is in these areas that a comparison of conventional survey data and the photogrammetric data reveals that false areas of subsidence are indicated by the photogrammetric data primarily due to the resolution of the steep terrain.

> ***Please Note:*** *Subsidence profiles contained in the Appendix have been updated to include the 1995 data. These profiles depict yearly subsidence since 1982, with the exception of 1990. The 1990 data (computer files) were damaged rendering them unreadable.*

The U.S. Bureau of Mines completed an independent study (1994) of the mining impacts on the Hydrology of East Mountain (Response of Springs to Longwall Coal Mining at the Deer Creek and Cottonwood Mines, Wasatch Plateau, Ut. Information Circular 9405, U.S. Bureau of Mines). The data in this study was collected by PacifiCorp from springs determined to represent hydrologic conditions on East Mountain. This determination was made by an ad hoc committee including representatives of DOGM and the Forest Service. This document is cited as support in the environmental assessment for Coal Lease Application UTU–67939, Winter Quarters Tract (July 1995). This study failed to find any springs that have been impacted by mining. This report is included in the Appendix.

V. *Lease-Specific Information Subsidence of Affected Areas Assessment of Environmental Impacts*

Refer to the following tables.

FEDERAL LEASE SL-066116 Full Relinquishment (360 Acres Pending)	
Mining Activity	One seam only (Blind Canyon) Pillar extraction mining in 2nd North of the Beehive Mine was completed in 1983. Mining was completed in a narrow corridor of coal that was present between the Bear Canyon fault and burned coal.
Subsidence *Reference Material included herewith:* *Figures 28, 29 and 29T, Total Subsidence August 1995 Lease Relinquishment Areas* *Additional Reference Material:* *Figures 28 in the Annual Subsidence Monitoring Reports for 1991, 1992, 1993 and 1994.*	This lease is in an area where the topography is very steep and rugged (see topographic map in Appendix). Because of the steep and rugged terrain, the resolution of the photogrammetric monitoring is sometimes diminished causing fluctuating results and/or "noise" which creates anomalies on the computer-generated plots. Where this occurs, each area is inspected on the ground and from a helicopter to either verify or refute any changes in the subsidence data. No conventional (on-the-ground) survey monitoring methods were utilized. After carefully scrutinizing and quantifying the photogrammetric data, *Figure 29* (Area 7 Subsidence Profile) was developed and is located in the Appendix. *Figure 29* shows that between 1982 and 1995 subsidence has occurred in some areas. The 1995 data shows less cumulative subsidence than has been measured in one or more of the previous years. Subsidence stability is more clearly illustrated by comparing *Figure 28* (1995 Subsidence Beehive Mine 2nd North off 8th West), included in the Appendix, with the same figure number included in the 1991, 1992, 1993 and 1994 Annual Subsidence Monitoring Reports. These figures illustrate no measurable subsidence has occurred since 1991. *The data collected to date shows no areas of continued subsidence and supports the position that subsidence is substantially complete.*
Hydrology	This area receives very little groundwater recharge, and the strata above the coal seam is dry. No springs are located in this area. Because of these facts, the subsidence has had no impact on the hydrology of the area.

FEDERAL LEASE SL-066116 Full Relinquishment (360 Acres Pending) (continued)	
Vegetation	The predominant vegetation community associated with this lease is Pinyon–Juniper. Assessment of impacts to vegetation in this lease are made by examining aerial photographs, which are taken annually, and color infra–red (IR) photographs taken on five–year intervals. The photographs are reviewed to identify long–term changes in major vegetation communities. Annual site visits are conducted to confirm information obtained from the aerial photographs and to observe general vegetation conditions. Additionally, during annual monitoring helicopter flights, the area is examined for evidence of changes in vegetation. Examination of recent black and white and color IR aerial photographs (see Appendices) indicate no change in the vegetation since mining has occurred.
Wildlife	The land within this lease is classed in the Forest Land and Resource Management Plan as Range and General Big Game Winter Range. According to UDWR, the area is rated as high priority summer habitat for deer and critical winter habitat for elk. Because no significant changes to vegetation or the topography of the land surface have been observed, it is concluded that none of the identified uses have been impacted. No raptor nests have been observed in this lease. This area is included in the annual raptor surveys which have been conducted since 1986.
Other Land Uses	Because of the steepness of the area, additional land uses, other than recreation (hiking and hunting) are not expected to occur. No conditions, resulting from subsidence, have been observed that would affect these uses.

FEDERAL LEASE SL-064607 / SL-064621 Partial Relinquishment (150.00 Acres Pending)	
Mining Activity	One seam only (Blind Canyon) Mining within this lease began in 1973 and was completed in 1979. The coal mining was conducted using room and pillar methods with pillar extraction in the First North and 1½ North sections of the Deer Creek Mine. The workings were mined adjacent to burned coal on both the east and west and the abandoned Paramount mine on the north.
Subsidence *Reference Material included herewith:* *Figures 13A and 14 and Topographic Map, Total Subsidence August 1995 Lease Relinquishment Areas.* *Additional Reference Material:* *Figure 13A in the Annual Subsidence Reports for 1993 and 1994.*	This lease is in an area where the topography is very steep and rugged. Because of the steep and rugged terrain, the resolution of the photogrammetric monitoring is sometimes diminished causing fluctuating results and/or "noise" which creates anomalies on the computer-generated plots. Where this occurs, each area is inspected on the ground and from a helicopter to either verify or refute any changes in the subsidence data (see topographic map in Appendix). No conventional (on-the-ground) survey monitoring methods were utilized. *Figure 14*, included herein, compares the subsidence profiles that were developed between the years of 1989 and 1995. The data indicates some subsidence has occurred between 1989 and 1991 on the south end of the profile. The 1995 profile shows that the measurements were about a foot lower than 1994 for much of the profile. This, however, is less than the resolution of the data in such steep terrain. A comparison of *Figure 13A* (1995 Subsidence Deer Creek Mine 1st North Area), in Appendix, with the same figure in the Annual Subsidence Monitoring Reports for 1991, 1992, 1993 and 1994 shows the trend of subsidence change since 1991. The most noticeable change occurred between 1993 and 1995, where in 1994 the data showed up to seven feet of subsidence in three areas to the east of the profile lines. The 1993 and 1995 data indicates that the subsidence was one foot or less in these areas even though the same data points were used in the 1994 interpretations. To the southwest of the profile line, the 1994 data indicated areas of subsidence up to nine feet on *Figure 13A*. However, the 1995 *Figure 13A* compares closely to the 1993 *Figure 13A*, neither of which displays the extremes shown on the 1994 *Figure 13A*.

FEDERAL LEASE SL-064607 / SL-064621 Partial Relinquishment (150.00 Acres Pending) (continued)	
Subsidence (cont'd)	Subsidence in this area has caused some small fracturing to appear on the land surface within the Castlegate Sandstone. These fractures were first noted in 1982, and no visible change has occurred since that time. This area has been reviewed in the field and from a helicopter annually since 1982, and no changes have been observed. Additionally, subsidence monitoring in this area was done photogrammetrically. *No change in subsidence has been measured since 1991, and subsidence has reached predicted values. Therefore, subsidence is considered to be substantially complete.*
Hydrology	No springs are present within the relinquishment area, and the coal overburden strata is dry. Therefore, subsidence has had no effect on hydrology.
Vegetation	The vegetation community in this lease is Pinyon–Juniper. Assessment of impacts to vegetation in this lease are made by examining aerial photographs, which are taken annually, and color IR photographs taken on five–year intervals. The photographs are reviewed to identify long–term changes in major vegetation communities. Annual site visits are conducted to confirm information obtained from the aerial photographs and to observe general vegetation conditions. Additionally, during annual monitoring helicopter flights, the area is examined for evidence of changes in vegetation. Examination of recent black and white and color IR aerial photographs (see Appendices) indicate no change in the vegetation since mining has occurred. It appears that no impacts to that vegetation have resulted from subsidence or the minor fractures.
Wildlife	This lease includes high priority deer summer habitat and critical elk winter habitat. No raptor nests exist within the lease. No wildlife uses have been impacted by subsidence or the minor fractures.

FEDERAL LEASE SL-064607 / SL-064621 Partial Relinquishment (150.00 Acres Pending) (continued)	
Other Land Uses	In addition to wildlife habitat, this lease is within a Range unit. Because of the steepness of the area, utilization appears somewhat limited. No conditions, resulting from subsidence, have been observed that affect these uses or will affect future use of the area.

FEDERAL LEASE SL-070645 / U-02292 Partial Relinquishment (250 Acres Pending)	
Mining Activity	One seam only (Blind Canyon) The relinquishment within this lease is comprised of two parcels. Parcel 1 is in the area of the 1st, 2nd and 3rd Left Sections off 2nd North in the Deer Creek Mine, which was mined prior to 1979. Parcel 2 is in an area of the original McKinnon Mine workings mined prior to 1973. The 2nd East off 1st South room and pillar section was completed in 1981. Both of these areas were mined using room and pillar mining with pillar extraction.
Subsidence *Reference Material included herewith:* *Topographic map and Figures LR-15 for 1992, 1993, 1994 and 1995.*	Mining in Parcel 1 and the northern ¾ of Parcel 2 was completed before subsidence monitoring was initiated. The southern ¼ of Parcel 2, where mining has occurred (1980-81), has been monitored and included in Area 2 of the annual Subsidence Monitoring Reports within the remaining areas. It is most likely that some subsidence has occurred, but it cannot be quantified. No conventional survey monuments are in these areas. The areas have been photographed annually for subsidence since 1982 annually. Contour maps of subsidence measured in 1992, 1993, 1994 and 1995 have been included in the Appendix (see *Figures LR-15* for the referenced years). In Parcel 1 of the lease relinquishment area, the terrain is very steep and rugged. Because of this, variability exists in the data from one year to the next. The subsidence in 1995 shows up to three feet of subsidence has occurred in the southwest portion of this block, and in 1993 this area showed five feet of subsidence occurring and four feet in 1992. The data indicates that subsidence is stable between 1992 and 1995. In Parcel 2 of the relinquishment area of this lease, the maps show subsidence of up to seven feet has occurred since the baseline survey was flown in 1980. This is the result of the adjacent longwall panels to the south in the Deer Creek Mine that were pulled starting in 1979. No change in subsidence can be detected between 1992 and 1995.

FEDERAL LEASE SL-070645 / U-02292 Partial Relinquishment (250 Acres Pending) (continued)	
Subsidence (cont'd)	Both parcels have been inspected in the field and using helicopter surveys annually to identify any effects of subsidence. *No effects have been identified. Therefore, subsidence is considered to be substantially complete.*
Hydrology	No springs are located within the parcels relinquished. The nearest spring to these areas is Sheep Herder Springs (82–52), which is located ¼ mile to the west of Parcel 2. This spring has shown no change in quality or discharge since mining has occurred.
Vegetation	The vegetation in this lease is primarily Mixed Conifer with small areas of Pinyon–Juniper in the southern portion of Parcel 1 and small areas of Sagebrush in Parcel 2. Assessment of impacts to vegetation in this lease are made by examining aerial photographs, which are taken annually, and color IR photographs taken on five–year intervals. The photographs are reviewed to identify long–term changes in major vegetation communities. Annual site visits are conducted to confirm information obtained from the aerial photographs and to observe general vegetation conditions. Additionally, during annual monitoring helicopter flights, the area is examined for evidence of changes in vegetation. Examination of recent black and white and color IR aerial photographs (see Appendices) indicate no change in the vegetation since mining has occurred.
Wildlife	The area is classified as high priority summer habitat for deer and elk. No impacts to these uses are known to have occurred.
Other Land Uses	Land uses in these areas include range, grazing, recreation and forestry. Some commercial timber may occur in Parcel 2. None of these uses appear to have been affected by subsidence.

FEDERAL LEASE U-02664 Partial Relinquishment (250 Acres Pending)	
Mining Activity	Two seams (Blind Canyon and Hiawatha) This lease is comprised of two non–contiguous blocks of coal. The eastern block was unmined (with the exception of approximately 600 feet along the west side of the Maple Gulch Fault) because access to the coal in this eastern area is precluded by the fault. No economic recoverable coal remains within this eastern parcel; therefore, the area has been relinquished. Coal from the western block was mined in the Beehive and Little Dove Mines located in the Blind Canyon Seam and in the Deseret Mine located in the Hiawatha Seam. All of the mining was completed prior to 1980 using room and pillar methods.
Subsidence *Reference Material included herewith:* *Topographic Map and Figures 41 and 42.* *Additional Reference Material:* *Figure 41 in the 1993 and 1994 Annual Subsidence Monitoring Report.*	Part of the area is located in a region where the topography is steep and rugged which causes a reduction in the accuracy of the photogrammetric data (see topography sheet included in the Appendix). Subsidence within this area has reached a maximum of two feet. No change in subsidence has occurred since 1992, and the area is stable (see *Figures 33, 33T, 42, 42T, 43 and 43T* located in the Appendix). Also, the subsidence contour maps (*Figures 32 and 41*) for 1995, included herein, when compared to the same figures located in the Subsidence Monitoring Reports for 1993 and 1994, show no increase in the amount of subsidence. A field inspection and helicopter survey conducted annually has not identified any visible evidence of subsidence. No conventional methods were used. *Whereas, no change in subsidence has been measured since 1992, subsidence is considered to be substantially complete.*
Hydrology	No springs are located within the relinquishment area. The nearest spring is 82–51 located ½ mile to the west. This spring has shown no change in quality or discharge since mining has occurred.

FEDERAL LEASE U-02664 Partial Relinquishment (250 Acres Pending) (continued)	
Vegetation	*40-Acre Parcel* in center of Section 26 with Pinyon–Juniper. Assessment of impacts to vegetation in this portion of the lease are made using aerial photographs and observations made during annual raptor monitoring helicopter flights. No conditions have been observed that have indicated the need for closer examination. Therefore, site visits have been limited to the northern ¼ of the parcel, an area of least extreme topographic relief. *Eastern Block* – Approximately 50% Mixed Conifer and 50% Pinyon–Juniper. There is very little mining in this area. Assessments of impacts to vegetation in this portion of the lease are made using aerial photographs and observations made during annual raptor monitoring helicopter flights. The area is very steep, and no conditions have been observed that have indicated the need for closer examination; therefore, no site visits have been conducted in this area. *Western Block* – Sagebrush only in this area. Assessments of impacts to vegetation in this portion of the lease are made using aerial photographs and annual on–the–ground site visits. During the site visits, the area is observed from a vehicle and on foot. The general condition of the various vegetation types is assessed during the visits. No significant changes in the vegetation have been observed. No subsidence–related impacts have been observed in any of the areas.
Wildlife	*All Blocks* – High priority summer habitat for deer and critical winter habitat for elk. *40-Acre Parcel* – Raptor nests adjacent to area. The area is within active golden eagle territory. *Eastern Block* – Raptor nests within lease and adjacent to lease. No subsidence–related impacts have been observed in any of the areas.

FEDERAL LEASE U-02664 Partial Relinquishment (250 Acres Pending) (continued)	
Other Land Uses	*40-Acre Parcel* – This area is classed in the Forest Land and Resource Management Plan as General Big Game Winter Range. *Eastern Block* – This area is classed as Range and General Big Game Winter Range. *Western Block* – This area is classed as Range. Observations discussed in the Vegetation section above result in the conclusion that none of these uses in the areas appear to have been affected by subsidence.

FEDERAL LEASE U-024319 Partial Relinquishment (0 Acres Pending)	
Mining Activity	None. Underground access to the coal within the 40 acres designated for relinquishment is blocked by the Pleasant Valley Fault. No mining has been undertaken within this area.
Subsidence	None.
Hydrology	No mining has occurred, and the hydrology is unchanged.
Vegetation	The vegetation is approximately 25% Mixed Conifer and 75% Pinyon–Juniper. No mining has occurred. No subsidence–related impacts have been observed.
Wildlife	The area is classified as high priority summer habitat for deer and critical winter habitat for elk. Raptor nest sites are present. No impacts.
Other Land Uses	The area is steep and rugged. There are no uses other than wildlife habitat.

FEDERAL LEASE U-1358 Partial Relinquishment (160 Acres Pending)	
Mining Activity	Two seams (Blind Canyon and Hiawatha) Mining within this lease occurred between 1979 and 1983. Room and pillar mining, with pillar extraction, was conducted in Deer Creek Mine in the Blind Canyon Seam and in the Wilberg Mine in the Hiawatha Seam. In both mines, the coal was 16 feet thick per seam. When the mines intersected burned coal, pillars were then pulled on retreat.
Subsidence *Reference Material included herewith:* *Total Subsidence August 1995 Lease Relinquishment Areas, Topographic Map, Figures 6 and 7 and Prism Data for Grimes Wash PR-1 through PR-4.* *Additional Reference Material:* *Figure 5 from 1984 through 1994 Annual Subsidence Monitoring Report.*	When the mine pillars were pulled, the collapse of the overlying strata caused a transfer of overburden stress to the adjacent areas. This caused the collapse of the thick burned coal clinker beds and created substantial subsidence outside of the area mined. This subsidence was first noticed in 1982 and reached a maximum of 28 feet. Several large fractures are present on the surface. The subsidence monitoring, including the prism data, in this area has shown no signs of movement since 1990 (see *Figures 6 and 7* and prism profiles for Grimes Wash PR-1 through PR-4 in the Appendix). The fractures have, for the most part, filled in naturally with soil. A reclamation plan is being formulated by PacifiCorp and the Forest Service to be implemented in the 1996 field season. Even though this area has experienced the most dramatic subsidence on East Mountain, the area is stable. This area has been reviewed in the field and from a helicopter annually since 1982, and no changes have been observed. *No change in the amount of subsidence has been detected since 1990, and no specific mechanism exists to cause further subsidence. Therefore, subsidence is considered to be substantially complete.*
Hydrology *Additional Reference Material:* *1995 Annual Hydrologic Monitoring Report.*	No springs are located within the acreage being relinquished. The graben formed by the subsidence has created a topographic low area trapping precipitation. As a result, a damp area has formed wherein riparian type vegetation has been established. The damp area has not been noticed to flow water; hence, no water quality data or flow data is available. The spring nearest to this area, 82-51 (located 800 feet east of this lease) has shown no change in quality or discharge since mining has occurred.

FEDERAL LEASE U-1358 Partial Relinquishment (160 Acres Pending) (continued)	
Vegetation	Vegetation is sagebrush in the Northern ¼ and Pinyon-Juniper in the Southern ¾. Subsidence has impacted the central portion of the proposed relinquishment area within the Pinyon-Juniper community. Several trees at the perimeter of the subsided area were uprooted. Subsidence formed a graben which has resulted in the growth of riparian type vegetation in some areas due to retention of precipitation.
Wildlife	The area is rated as high priority summer habitat for deer and critical winter habitat for elk. Subsidence does not appear to have affected these uses. The area was fenced to exclude livestock. The fence may have affected wildlife movement initially, but the deer and elk appear to have adapted to the presence of the fence. The fence does not present a barrier to other wildlife species. No evidence has been found which would indicate the fractures are hazardous to wildlife. The vertical faces at some locations along the fractures provide habitat for burrowing animals.
Other Land Uses	Land uses associated with the proposed relinquishment include grazing, recreation and forestry in the Northern ¼ of the area. The area impacted by subsidence is primarily steep terrain. Wildlife habitat is the primary land use. However, historically, some grazing occurred in the area which subsided; therefore, the subsided area was fenced to exclude livestock.

FEDERAL LEASE U-47979 Partial Relinquishment (0 Acres Pending)	
Mining Activity	Coal within this area is not minable because access to the coal has been blocked by the Pleasant Valley Fault. No mining has occurred within this area.
Subsidence	None.
Hydrology	No impact.
Vegetation	The vegetation community associated with this lease is P-inyon–Juniper. No impacts have been observed.
Wildlife	The area is rated high priority summer habitat for deer and critical winter habitat for elk. Neither of these uses have been impacted. No raptor nests have been observed in this lease.
Other Land Uses	Due to steepness, only wildlife habitat exists.

FEDERAL LEASE U-47978
Partial Relinquishment (1,910.00 Acres Pending)

Mining Activity	One seam only (Hiawatha) This lease was acquired in 1981. Mining began in 1984 and was completed in 1992. Mining was conducted using longwall methods designed to allow for maximum recovery of the coal and to minimize the effects of subsidence on the surface.
Subsidence *Reference Material included herewith:* *Total Subsidence August 1995 Lease U-47978 Map, Topographic Map, Figures 45, 46, 46T, 47, 47T, 49, 50, 50T, 51, 51T, 53, 54, 54T, 55, 55T, 57, 58, 58T, 59 and 59T, Prism Survey Profiles PR-1 through PR-10 Newberry Canyon, PR-11 through PR-14 Corncob Wash, PR-1 through PR-5 Miller Canyon.* *Additional Reference Material:* *Figures 45, 59, 53 and 57 located in the 1993, 1994 and 1995 Annual Subsidence Monitoring Reports.*	Monitoring of subsidence in this area has shown that the area has subsided up to seven feet. The monitoring has indicated that the subsidence occurs very quickly after mining, with over 90% occurring within the first year. This is documented in the Annual Subsidence Monitoring reports. In these reports, the relinquishment area is divided into four areas monitored for subsidence. These areas are each comprised of a group of two or more parallel longwall panels and are identified as Areas 14, 15, 16 and 17. Areas 15 and 17 are located where the ground is gently rolling or somewhat flat, while Areas 14 and 16 are very rugged with steep cliffs (refer to Topographic Map and *Figures 46T, 47T, 50T, 51T, 54T, 55T 58T and 59T*). The subsidence within these areas has been monitored using photogrammetry, conventional surveying, time domain reflectometry and visual helicopter reconnaissance. The first area mined was Area 14. This area was mined between September 1986 and March 1987. Subsidence in this area has been shown to be generally between three and five feet. Because this area is very steep and rugged, it is difficult to monitor the subsidence using photogrammetric means. Elevations on the photographs are measured on a 200–foot grid. Because the area is so rugged, the resolution is limited, thereby creating several one–point anomalies shown on the computer generated subsidence map. These anomalies, or "bulls eyes", indicate as much as 30 feet in some areas, which generally indicates errors in reading the photography. A subsidence map with current data collected in August 1995 for Area 14 is in the Appendix (see *Figure 45*). The profiles created from the photogrammetric data are shown in *Figures 46 and 47* in the Appendix.

FEDERAL LEASE U-47978
Partial Relinquishment (1,910.00 Acres Pending) (continued)

Subsidence *(cont'd)*	Failure (spalling) of the Castlegate escarpment occurred along the north side of Newberry Canyon in association with mining the 6th and 7th East panels. Spalling first occurred in October 1986, approximately one month following start-up of longwall mining in 6th East and continued intermittently during extraction of 6th and 7th East panels. Spalling ceased in mid-September 1987, approximately three months following completion of extraction of the 7th East panel. In these areas, we have also been monitoring the cliff stability using permanent survey prism targets installed on the cliff. Profiles of the prism survey data collected in the areas of Newberry Canyon are listed as: PR-1, PR-2, PR-3, PR-4, PR-5 and PR-6 located in the Appendix. These surveyed prisms show no movement greater than 0.5 feet, with the exception of PR-4, which showed one foot of movement between 1990 and 1992 but was back to the elevation measured in 1990 when surveyed in 1996. Adjacent prisms, PR-3, confirm that the subsidence is stable and substantially complete even though the photogrammetry has shown various "bulls eyes" of false subsidence caused by inadequate photo resolution of the steep terrain. Additionally, field observations confirm that no significant cliff spalling has occurred since 1987. The second area mined is Area 15 in the Subsidence Monitoring Report. This area was mined in 1988 through the fall of 1989. Subsidence in this area has reached a little over five feet. For the most part, this area has rolling terrain which can be monitored effectively using photogrammetric means. The most current photogrammetric data is shown on *Figure 49* located in the Appendix. The profiles from this area are shown in *Figures 50 and 51* located in the Appendix. Survey prism targets in Miller Canyon have also been measured and further confirm that subsidence is substantially complete in this rugged area. This data is shown in Profiles PR-1 through PR-5 Miller Canyon located in the Appendix.

FEDERAL LEASE U-47978
Partial Relinquishment (1,910.00 Acres Pending) (continued)

Subsidence *(cont'd)*

The third area of subsidence in this lease is Area 16. Mining in this area started in June 1989 and was completed in May 1992. Subsidence in this area has reached slightly over five feet. Because most of the area is fairly flat, the subsidence is well documented by the photogrammetric monitoring. Some areas undermined are very steep and, as in Area 14, several "bulls eyes" appear from the photogrammetric monitoring. The most current data (1995 Subsidence Cottonwood Mine 6th and 7th East Longwall Panels) shows only one area where the cumulative subsidence had increased since 1994. This area is located 2,500 feet east of the west end of *Figure 47*. At this location, the 1995 measurement shows less subsidence than was measured in 1989. An inspection of *Figure 47T* shows the topography to be very steep which inhibits the resolution of the data.

The photogrammetric profiles in this area are shown in *Figures 54 and 55* in the Appendix. In the steep area where the photogrammetric monitoring is ineffective, several survey prism targets have been monitored.

Data from these targets, listed as PR–5 through PR–10 in Newberry Canyon and PR–11 through PR–14 in Corn Cob Wash are shown in the Appendix. These profiles show no movement since 1992. The subsidence area appears to be stable and substantially complete.

Minor spalling of the Castlegate escarpment occurred in association with mining of 9th and 10th East panels in Area 16. This spalling occurred along the south side of Newberry Canyon. Significant spalling occurred in association with extraction of the 11th East panel, in an area known as Corn Cob Wash. Spalling occurred in a similar pattern as was observed previously. Spalling began in October 1989 and continued intermittently until December 1990, following completion of mining in 11th East. Field observations confirm that no significant cliff spalling has occurred since 1990.

FEDERAL LEASE U-47978
Partial Relinquishment (1,910.00 Acres Pending) (continued)

Subsidence (cont'd)	The fourth area of subsidence within this lease is Area 17. This area was mined between October 1990 and March 1992.The subsidence has reached a total of slightly over six feet. For the most part, the topography in this area is fairly flat and is well suited for photogrammetric monitoring. The most current photogrammetric data is shown on *Figure 57* located in the Appendix. This area has shown no movement since 1992 as indicated on the photogrammetric profiles, *Figures 58 and 59* located in the Appendix. Additional data regarding the speed at which subsidence occurs was documented in this area using time domain reflectometry. In this method, a drill hole was completed from the surface down through the coal seam and centered in a longwall that was to be mined. A coaxial cable was then cemented in the drill hole. By measuring the electrical properties of this cable from the surface of the ground, it was possible to measure when the cable was sheared and at what depth as the drill hole was undermined by the longwall equipment. When this was done, it was determined that no deformation of the cable occurred until the longwall had reached the cable. Immediately after the cable was undermined, the cable began to be sheared – first near the coal seam, and as time passed, progressively further up the hole. The shearing of the cable reached 85 feet from the surface of the ground within 43 days of it being undermined (see the Appendix, Time Domain Reflectometry). This information strongly supports the other subsidence data collected which suggests that subsidence is rapid in occurring. The impacts which mining and subsidence have had on the surface within this lease are small. In an area of the Castlegate Cliffs in Area 14, a collapse occurred in 1986 and 1987. The debris that fell from the cliff covered the talus slope below and had some impact on the vegetation in that area. Some fractures are also present along the northern limit of the relinquishment area. The fractures are healing naturally and appear to be stable. No subsidence movement has been seen since 1992, and subsidence in the area is considered to be substantially complete.

FEDERAL LEASE U-47978 Partial Relinquishment (1,910.00 Acres Pending) (continued)	
Subsidence (cont'd)	*Photogrammetric data has effectively shown that subsidence has stabilized in areas where the land surface is flat. The photogrammetric monitoring shows erratic changes in subsidence in steep areas because of limited resolution of the data. In those areas, the conventional survey data shows all areas monitored to be stable. The subsidence above the longwall panels has reached predicted values. Therefore, subsidence within this lease is considered to be substantially complete.*
Hydrology	One spring is located within the relinquishment area. This spring is 84–56 and has been monitored since 1984. It has shown no change in quality or discharge since the mining has occurred (see Appendix, Bureau of Mines Report).
Vegetation	The vegetation in this lease is Mixed Conifer, Sagebrush, Pinyon–Juniper, Mountain Brush, Grass and Riparian. Major subsidence–related impact to vegetation in the lease area resulted from cliff failure and deposition of talus materials. This occurred in the Newberry Canyon and Corn Cob Wash areas. Approximately 35 acres of Pinyon–Juniper, Mountain Brush, Grass mixed vegetation community and 0.006 acres (250^2) of Riparian vegetation were impacted in Newberry Canyon. Approximately 33 acres of Pinyon–Juniper, Mountain Brush, Grass mixed vegetation were impacted in Corn Cob Wash. Grasses and forbs are beginning to re–establish in the impacted areas. *Hedysarum occidentale* var. *canone*, a sensitive plant species occurs within Lease U–47978. An unknown number of individual plants and several populations in Newberry Canyon have been impacted by talus deposition, which occurred during 1986 and 1987. Monitoring of one impacted population (73 plants) and an adjacent non–impacted population (30 plants) was initiated in 1989 to asses the recovery of the impacted population. Hedysarum is known to inhabit disturbed areas. Subsequent monitoring of the Newberry Canyon populations indicated establishment of new plants within the impacted population and continued annual growth of impacted plants similar to that observed in the non–impacted population.

FEDERAL LEASE U-47978 Partial Relinquishment (1,910.00 Acres Pending) (continued)	
Vegetation (cont'd)	The overall viability of Hedysarum within this lease area does not appear to have been adversely impacted. The majority of the lease relinquishment area shows no evidence of impacts to vegetation.
Wildlife	The most significant impact to wildlife in Newberry Canyon was the loss of golden eagle nest sites. Three of five nests in Newberry Canyon were destroyed due to cliff failure. However, no adult or young eagles nor any eggs were lost. Annual raptor surveys have been conducted since 1986 at Newberry Canyon, PacifiCorp's mine permit areas and adjacent areas equivalent to approximately a 10–mile radius area surrounding Newberry Canyon. Golden eagle nesting activities have been documented during the surveys. The patterns of reproductive activity observed at Newberry Canyon has been similar to that of other territories observed within the survey area. Mining–related impacts have not negatively affected the golden eagle territory in Newberry Canyon. The lease relinquishment area includes high priority deer winter and summer range and high priority summer and critical winter range for elk. The areas impacted by subsidence related talus deposition are very steep and rugged and receive minimal use by these wildlife species. The areas affected by surface fractures are more heavily used by deer and elk, but the fractures do not appear to have negatively affected these species.
Other Land Uses	Land uses within the lease relinquishment area include recreation, forestry, commercial timber and grazing. In 1987, the Forest Service directed the applicant to place warning signs along roads in the vicinity of the head of Newberry Canyon and at the mouth of the canyon. The signs indicated that active mining was occurring in the area. This potentially impacted recreational use of the area. However, because of the ruggedness of Newberry Canyon, recreation is limited. The warning signs were removed in 1995, as directed by the Forest Service. Land uses within Lease U–47978 were not otherwise affected.

VI. Conclusion

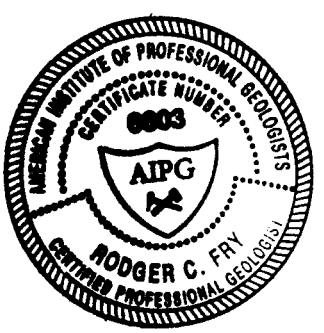
Based upon the extensive monitoring conducted by PacifiCorp and/or its wholly–owned subsidiaries, the independent studies referred to above, the findings and the interpretations quantified in this supplemental information, PacifiCorp concludes that in those areas of mining–induced subsidence, subsidence activities are substantially complete with no significant impact or irreparable damage to the environment inclusive of hydrology, vegetation, wildlife and other land uses. Furthermore, it is hereby demonstrated that the federal acreage applied for relinquishment in Phase I and Phase II applications, and as herein amended in Table 1, will not impair the public interest as all obligations under the regulations and terms of the leases have been met.

PacifiCorp respectfully requests and urges the BLM to take action to approve the remaining relinquishments.

VII. 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, in my opinion, subsidence within all relinquishment areas referred to in this document is considered to be substantially complete.

Dated this 2 day of August, 1996.



Rodger C. Fry
No. 6603

SUPPLEMENTAL INFORMATION FOR THE RELINQUISHMENT OF FEDERAL ACREAGE EAST MOUNTAIN LOGICAL MINING UNIT

June 12, 1995

I. Introduction

PacifiCorp has submitted acreage relinquishment applications to the Bureau of Land Management ("BLM") in two separate phases to (1) reduce acreage from its federal coal lease holdings, and (2) effectively manage the leases comprised within the East Mountain Logical Mining Unit ("LMU"). Phase I was submitted on April 22, 1992 and Phase II on October 16, 1992. Both applications have sought to relinquish federal lease acreage which has either been (1) mined out, (2) considered sub–economic due to limited mining access because of inherent faulting and adverse geologic conditions, and/or (3) the remaining unmined areas are burned, and no recoverable reserves remain.

Phase I initially contained 4,221.23 acres, and Phase II included 1,190.00 acres for a total of 5,411.23 acres. Since the applications were filed, there have been some changes which affect the overall acreage sought for relinquishment. These changes are listed below.

(1) Only one individual lease, SL–050133, has been ruled upon since the submittal of the original application. Approval was granted by the BLM on March 9, 1993, relinquishing the entire 80 acres.

(2) On May 11, 1994, PacifiCorp filed a partial withdrawal of the relinquishment as to 40 acres from Lease U–024319 which is to be deleted from the Phase I application.

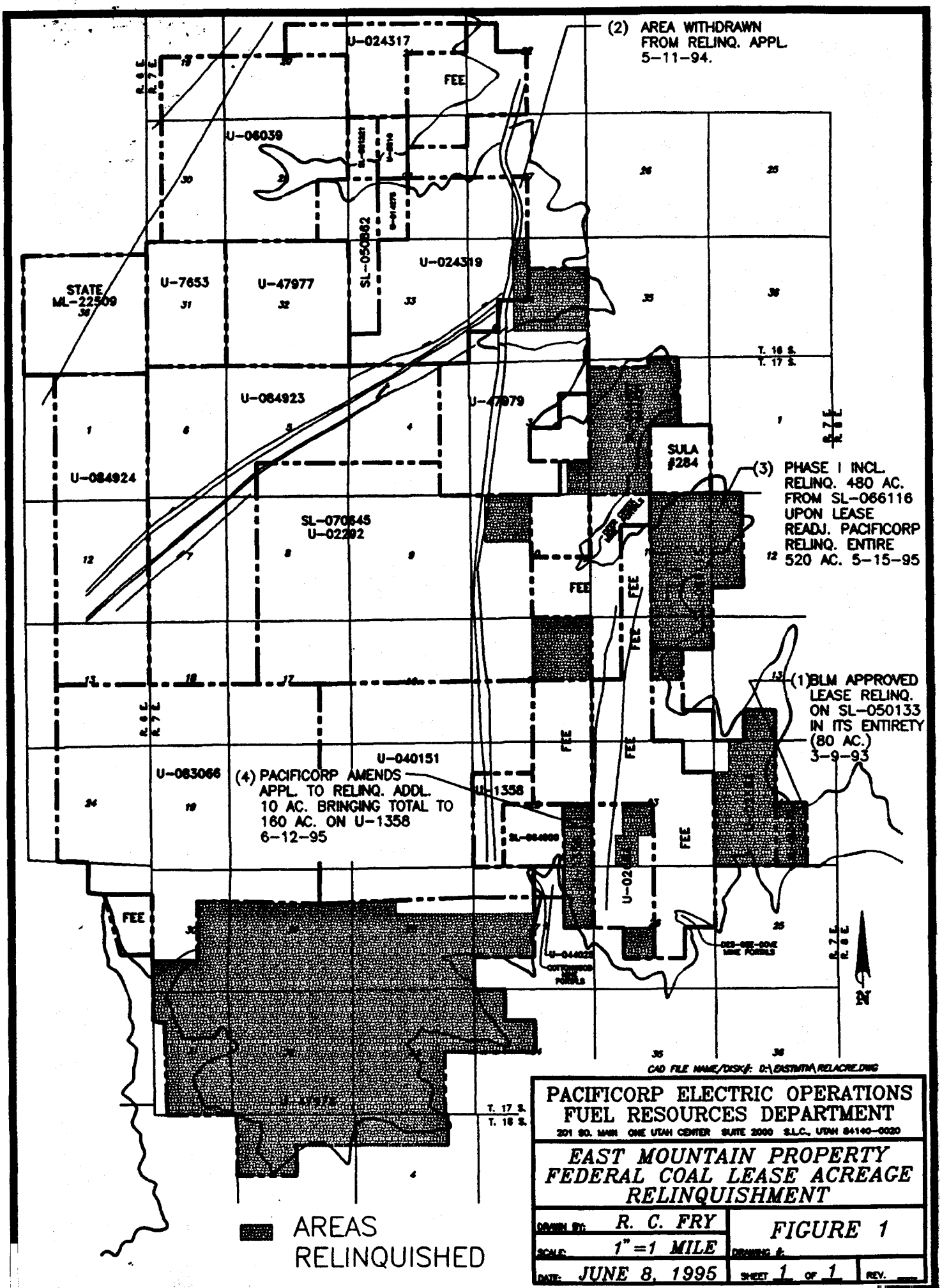
(3) Under the Phase I application, PacifiCorp originally sought to relinquish 480 acres of the total 520 acres from Lease SL–066116. Upon BLM's lease readjustment decision dated April 25, 1995, PacifiCorp in turn gave notice to BLM, dated May 15, 1995, that it relinquishes Lease SL–066116 in its entirety (all 520 acres).

(4) Again, under Phase I, PacifiCorp originally sought to relinquish 150 acres from Lease U–1358. Upon further review, it has been determined to relinquish a total of 160 acres. Therefore, this supplemental information amends PacifiCorp's application to relinquish an additional 10 acres from Lease U–1358.

Altogether, the federal lease acreage applied for relinquishment is currently 5,341.23 acres. Refer to *Figure 1* for lease configuration and areas applied for relinquishment. *Table 1* provides an updated listing of each lease and the acreage applied for relinquishment.

TABLE 1

Federal Lease Number	Type of Relinquishment	Relinquished Acreage
SL–066116	FULL	520.00
SL–064607 / SL–064621	PARTIAL	443.92
SL–070645 / U–02292	PARTIAL	250.00
U–02664	PARTIAL	490.00
U–024319	PARTIAL	40.00
U–1358	PARTIAL	160.00
U–47978	PARTIAL	3,257.31
U–47979	PARTIAL	180.00
Total Acreage Applied for Relinquishment		**5,341.23**



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PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT
201 SO. MAIN ONE UTAH CENTER SUITE 2000 S.L.C., UTAH 84140-0020

EAST MOUNTAIN PROPERTY
FEDERAL COAL LEASE ACREAGE
RELINQUISHMENT

DRAWN BY: R. C. FRY		*FIGURE 1*
SCALE: 1" = 1 MILE	DRAWING #:	
DATE: JUNE 8, 1995	SHEET 1 OF 1	REV.

Both applications have been in the review process by BLM, with regulatory input from the Manti LaSal National Forest ("Forest Service") and the Utah Division of Oil Gas & Mining ("DOGM"), for over three years. The following supplemental information is submitted on behalf of PacifiCorp to provide lease– specific information to the regulatory agencies as it relates to the *"substantial completeness"* issues on areas of mining–induced subsidence, together with summary descriptions on hydrologic and vegetative impacts. The term *"substantial completeness"*, although undefined by regulation with no mention or reference in BLM guidelines, has put the Lessee, PacifiCorp, in an onerous position of providing information which potentially has no bounds and goes beyond the scope of complying with the terms and conditions of the federal leases. However, in a concerted effort with the regulatory agencies, this supplemental information has been prepared by Interwest Mining Company ("managing agent") and Energy West Mining Company ("mine operator"), both wholly–owned subsidiaries of PacifiCorp, to demonstrate the disposition of subsidence activities within the East Mountain LMU.

II. Statement of Need

PacifiCorp reiterates its need to relinquish acreage from its East Mountain federal lease holdings to effectively meet increasing challenges associated with managing coal leases and mining reserves which provide secure, high quality, low cost fuel for power generation, while maintaining the environmental integrity of the areas applied for relinquishment. The need is simply two–fold:

(1) Reduce overall federal acreage holdings by relinquishing mined out, sub–economic inaccessible and burned areas.

(2) Provide additional opportunity under the federal acreage threshold limitation to acquire additional federal coal reserves to be used for future power generation.

III. Compliance of Lease Terms and Conditions

To further assist in the compliance review of PacifiCorp's obligation under the federal coal leases, a spreadsheet (included in the Appendix) has been prepared evaluating each lease term, conditions and stipulations for all the federal leases involved in the relinquishment. From this internal review, PacifiCorp has, to the best of its knowledge, complied with all the lease terms, conditions and stipulations. Notwithstanding the arbitrary nature of the *"substantial completeness"* issue, PacifiCorp established subsidence and hydrology monitoring systems beginning in 1980 to locate, measure and quantify the effects of underground mining activities. This information has been compiled annually and submitted to DOGM, the mine permit regulatory agency. It is this same information that will be used to demonstrate the results and current disposition on areas of mining–induced subsidence.

IV. PacifiCorp Subsidence Monitoring and Methodology

PacifiCorp's subsidence monitoring program is primarily based on aerial photogrammetry. A baseline photogrammetric survey was conducted in 1980 which includes over 12,000 elevations measured on a 200–foot spacing grid. These elevations are then compared to elevations measured from photographs taken annually in August. This method has proven to be the best way to collect subsidence data on East Mountain. In flat areas with limited vegetation, the elevations on the photographs can be read with a precision of one–half foot. In steeper areas where cliffs are present, the resolution becomes less reliable, and inaccuracies of greater than 10 feet can occur. In these steep areas, photogrammetric monitoring can, and has been, augmented by conventional survey data. A map depicting the total subsidence on East Mountain is included in the Appendix (1994 Subsidence East Mountain All Areas). This map was also included in the 1994 Annual Subsidence Monitoring Report and can be compared to similar maps contained in previous years' monitoring reports. The map shows

large areas where subsidence has occurred above mined out areas. Maps are also included in the Appendix that show the detailed subsidence in the lease relinquishment areas (Total Subsidence August 1994 Lease Relinquishment Areas and Total Subsidence August 1994 Lease U–47978). In areas where the land surface is flat or gently rolling, the subsidence shown on these maps conforms with the undermined areas, i.e., where longwall panels are present, subsidence is greater than in main entry areas, and subsidence is minimal in areas where barrier pillars are present. In areas where escarpments and steep slopes are present, the subsidence depicted on the maps often fluctuates because of the inaccuracies in the steep topography as can be seen by the numerous "bulls eye" in areas where no mining has occurred in Leases U–47979 and U–47978. It is in these areas that a comparison of conventional survey data and the photogrammetric data reveals that false areas of subsidence are indicated by the photogrammetric data primarily due to the resolution of the steep terrain.

The U.S. Bureau of Mines completed an independent study (1994) of the mining impacts on the Hydrology of East Mountain (Response of Springs to Longwall Coal Mining at the Deer Creek and Cottonwood Mines, Wasatch Plateau, Ut. Information Circular 9405, U.S. Bureau of Mines). This study failed to find any springs that have been impacted by mining. This report is included in the Appendix.

V. *Lease-Specific Information Subsidence of Affected Areas Assessment of Environmental Impacts*

Refer to the following tables.

FEDERAL LEASE SL-066116 Full Relinquishment (520 Acres)	
Mining Activity	One seam only (Blind Canyon) Pillar extraction mining in 2nd North of the Beehive Mine was completed in 1983. Mining was completed in a narrow corridor of coal that was present between the Bear Canyon fault and burned coal.
Subsidence	The area had subsided to a maximum of six feet as of 1984. No subsidence has been detected since that time. *Figure 29* (included in the Appendix) is a profile of subsidence. This profile shows some small variations in elevation readings from one year to the next. This area is very steep, and the diminished resolution of the photogrammetric survey causes the variations noted. No conventional methods were utilized. *The amount of subsidence has not increased since 1984, and the amount of total subsidence measured meets predicted values. Therefore, the subsidence in this area is considered to be substantially complete.*
Hydrology	This area receives very little groundwater recharge, and the strata above the coal seam is dry. No springs are located in this area. Because of these facts, the subsidence has had no impact on the hydrology of the area.
Vegetation	The predominant vegetation community associated with this lease is Pinyon–Juniper. Subsidence has had no observable impact on the vegetation.
Wildlife	The area is rated as high priority summer habitat for deer and critical winter habitat for elk. Neither of these uses have been impacted. No raptor nests have been observed in this lease.
Other Land Uses	Because of the steepness of the area, the area is classified as non–rangeland. No land uses, other than wildlife habitat, are identified for the area.

FEDERAL LEASE SL-064607 / SL-064621 Partial Relinquishment (443.92 Acres)	
Mining Activity	One seam only (Blind Canyon) Mining within this lease began in 1973 and was completed in 1979. The coal mining was conducted using room and pillar methods with pillar extraction in the First North and 1½ North sections of the Deer Creek Mine. The workings were mined adjacent to burned coal on both the east and west and the abandoned Paramount mine on the north.
Subsidence	Subsidence in this area has reached a maximum of seven feet. *Figure 14* from the Annual Subsidence Monitoring Report 1994 (included in the Appendix) shows that subsidence within the lease has been stable since 1991. This subsidence has caused some small fracturing to appear on the land surface within the Castlegate Sandstone. These fractures were first noted prior to 1983, and no visible change has occurred since that time. *Subsidence monitoring in this area was done photogrammetrically. No change in subsidence has been measured since 1991, and subsidence has reached predicted values. Therefore, subsidence is considered to be substantially complete.*
Hydrology	No springs are present within the relinquishment area, and the coal overburden strata is dry. Therefore, subsidence has had no effect on hydrology.
Vegetation	The vegetation community in this lease is Pinyon–Juniper. It appears that no impacts to that vegetation have resulted from subsidence or the minor fractures.
Wildlife	This lease includes high priority deer summer habitat and critical elk winter habitat. No raptor nests exist within the lease. No wildlife uses have been impacted by subsidence or the minor fractures.
Other Land Uses	Because of the steepness of the area, no lands uses, other than wildlife habitat, are associated with this lease.

FEDERAL LEASE SL-070645 / U-02292 Partial Relinquishment (250 Acres)	
Mining Activity	One seam only (Blind Canyon) The relinquishment within this lease is comprised of two parcels. The first parcel is above the original McKinnon Mine workings mined prior to 1973. The second parcel is in the area of the 1st, 2nd and 3rd Left Sections off 1½ North in the Deer Creek Mine, which was mined prior to 1980. Both of these areas were mined using room and pillar mining with pillar extraction.
Subsidence	The mining was completed well before subsidence monitoring was initiated. It is most likely that some subsidence has occurred, but the total amount cannot be quantified. However, no subsidence has occurred since photogrammetric monitoring began in 1980. No conventional survey monuments are in this area. *No change in subsidence has been measured since 1980. Therefore, subsidence is considered to be substantially complete.*
Hydrology	No springs are located within the area relinquished. The nearest spring to this area is Sheep Herder Springs (82–52), which is located ¼ mile to the west. This spring has shown no effect from mining.
Vegetation	The vegetation in this lease is primarily Mixed Conifer with small areas of Pinyon–Juniper in the southern portion of the first parcel and small areas of Sagebrush in the second parcel. No subsidence–related impacts have been observed.
Wildlife	The area is classified as high priority summer habitat for deer and elk. No impacts to these uses are known to have occurred.
Other Land Uses	Land uses in these areas include grazing, recreation and forestry. Some commercial timber may occur in the second parcel. None of these uses appear to have been affected by subsidence.

FEDERAL LEASE SL-02664 Partial Relinquishment (490 Acres)	
Mining Activity	Two seams (Blind Canyon and Hiawatha) This lease is comprised of two non–contiguous blocks of coal. The eastern block was, for the most part, unmined because access to the coal in this area is precluded by a fault. The coal present to the east of the fault is not considered economic; therefore, the area has been relinquished. Coal from the western block was mined in the Beehive and Little Dove Mines located in the Blind Canyon Seam and in the Deseret Mine located in the Hiawatha Seam. All of the mining was completed prior to 1980 using room and pillar methods.
Subsidence	Subsidence within this area has reached a maximum of three feet. No change in subsidence has occurred since 1992, and the area is stable. See *Figure 42* located in the Appendix. No conventional methods were used. *No change in subsidence has been measured since 1992, and subsidence is considered to be substantially complete.*
Hydrology	No springs are located within the relinquishment area. The nearest spring is 82–51 located ½ mile to the west. It has shown no change due to mining.
Vegetation	***40-Acre Parcel*** in center of Section 26 with Pinyon–Juniper. ***Eastern Block*** – Approximately 50% Mixed Conifer and 50% Pinyon–Juniper. There is very little mining in this area. ***Western Block*** – Sagebrush only in this area. No subsidence–related impacts have been observed in any of the areas.

FEDERAL LEASE SL-02664 Partial Relinquishment (490 Acres)	
Wildlife	*All Blocks* – High priority summer habitat for deer and critical winter habitat for elk. *40-Acre Parcel* – Raptor nests adjacent to area. The area is within active golden eagle territory. *Eastern Block* – Raptor nests within lease and adjacent to lease. No subsidence–related impacts have been observed in any of the areas.
Other Land Uses	*40-Acre Parcel* – Steep, non–rangeland. Only wildlife habitat. *Eastern Block* – Primarily non–rangeland due to steepness. Small portion of recreation, forestry and grazing. No commercial timber. *Western Block* – Land uses include recreation, forestry and grazing. There is no commercial timber. None of these uses in the areas appear to have been affected by subsidence.

FEDERAL LEASE U-024319 Partial Relinquishment (40 Acres)	
Mining Activity	None. Underground access to the coal within the 40 acres designated for relinquishment is blocked by the Pleasant Valley Fault. No mining has been undertaken within this area.
Subsidence	None.
Hydrology	No mining has occurred, and the hydrology is unchanged.
Vegetation	The vegetation is approximately 25% Mixed Conifer and 75% Pinyon–Juniper. No mining has occurred. No subsidence–related impacts have been observed.
Wildlife	The area is classified as high priority summer habitat for deer and critical winter habitat for elk. Raptor nest sites are present. No impacts.
Other Land Uses	The area is steep and rugged. There are no uses other than wildlife habitat.

FEDERAL LEASE U-1358 Partial Relinquishment (160 Acres)	
Mining Activity	Two seams (Blind Canyon and Hiawatha) Mining within this lease occurred between 1979 and 1983. Room and pillar mining, with pillar extraction, was conducted in Deer Creek Mine in the Blind Canyon Seam and in the Wilberg Mine in the Hiawatha Seam. In both mines, the coal was 16 feet thick per seam. When the mines intersected burned coal, pillars were then pulled on retreat.
Subsidence	When the mine pillars were pulled, the collapse of the overlying strata caused a transfer of overburden stress to the adjacent areas. This caused the collapse of the thick burned coal clinker beds and created substantial subsidence outside of the area mined. This subsidence was first noticed in 1982 and reached a maximum of 28 feet. Several large fractures are present on the surface. The subsidence in this area has shown no signs of movement since 1985 (see *Figures 6 and 7* in the Appendix), and the fractures have, for the most part, filled in naturally with soil. At the time, Utah Power & Light Company (now PacifiCorp) proposed to regrade the land surface to even out the area where the fractures were present, but the Forest Service did not want it reclaimed at that time. Even though this area has experienced the most dramatic subsidence on East Mountain, the area is stable, and no movement has been detected since 1985. *No change in the amount of subsidence has been detected since 1985, and no specific mechanism exists to cause further subsidence. Therefore, subsidence is considered to be substantially complete.*
Hydrology	No springs are located within the acreage being relinquished.

FEDERAL LEASE U-1358 Partial Relinquishment (160 Acres)	
Vegetation	Vegetation is sagebrush in the Northern ¼ and Pinyon–Juniper in the Southern ¾. Subsidence has impacted the central portion of the proposed relinquishment area within the Pinyon–Juniper community. Several trees at the perimeter of the subsided area were uprooted. Subsidence formed a graben which has resulted in somewhat enhanced vegetation in some areas due to retention of precipitation.
Wildlife	The area is rated as high priority summer habitat for deer and critical winter habitat for elk. Subsidence does not appear to have affected these uses. The area was fenced to exclude livestock. The fence may have affected wildlife movement initially, but the deer and elk appear to have adapted to the presence of the fence. The fence does not present a barrier to other wildlife species. No evidence has been found which would indicate the fractures are hazardous to wildlife. The vertical faces at some locations along the fractures provide habitat for burrowing animals.
Other Land Uses	Land uses associated with the proposed relinquishment include grazing, recreation and forestry in the Northern ¼ of the area. The area impacted by subsidence is primarily steep terrain. Wildlife habitat is the primary land use. However, historically, some grazing occurred in the area which subsided; therefore, the subsided area was fenced to exclude livestock.

FEDERAL LEASE U-47979 Partial Relinquishment (180 Acres)	
Mining Activity	Coal within this area is not minable because access to the coal has been blocked by the Pleasant Valley Fault. No mining has occurred within this area.
Subsidence	None.
Hydrology	No impact.
Vegetation	The vegetation community associated with this lease is Pinyon–Juniper. No impacts have been observed.
Wildlife	The area is rated high priority summer habitat for deer and critical winter habitat for elk. Neither of these uses have been impacted. No raptor nests have been observed in this lease.
Other Land Uses	Due to steepness, only wildlife habitat exists.

FEDERAL LEASE U-47978 Partial Relinquishment (3,257.31 Acres)	
Mining Activity	One seam only (Hiawatha) This lease was acquired in 1981. Mining began in 1984 and was completed in 1992. Mining was conducted using longwall methods designed to allow for maximum recovery of the coal and to minimize the effects of subsidence on the surface.
Subsidence	Monitoring of subsidence in this area has shown that the area has subsided up to seven feet. The monitoring has indicated that the subsidence occurs very quickly after mining, with over 90% occurring within the first year. This is documented in the Annual Subsidence Monitoring reports. In these reports, the relinquishment area is divided into four areas monitored for subsidence. These areas are each comprised of a group of two or more parallel longwall panels and are identified as Areas 14, 15, 16 and 17. Areas 15 and 17 are located where the ground is gently rolling or somewhat flat, while Areas 14 and 16 are very rugged with steep cliffs. The subsidence within these areas has been monitored using photogrammetry, conventional surveying, time domain reflectometry and visual helicopter reconnaissance. The first area mined was Area 14. This area was mined between September 1986 and March 1987. Subsidence in this area has been shown to be generally between three and five feet. Because this area is very steep and rugged, it is difficult to monitor the subsidence using photogrammetric means. Elevations on the photographs are measured on a 200-foot grid. Because the area is so rugged, the resolution is limited, thereby creating several one-point anomalies shown on the computer generated subsidence map. These anomalies, or "bulls eyes", indicate as much as 30 feet in some areas, which generally indicates errors in reading the photography.

FEDERAL LEASE U-47978 Partial Relinquishment (3,257.31 Acres)	
Subsidence (cont'd)	The profiles created from the photogrammetric data are shown in *Figures 46 and 47* in the Appendix. In these areas, we have also been monitoring the cliff stability using permanent survey prism targets installed on the cliff. Profiles of the prism survey data collected in the areas of Newberry Canyon are listed as: PR–1, PR–2, PR–3, PR–4, PR–5 and PR–6 located in the Appendix. These surveyed prisms show no movement in recent years which confirm that the subsidence is stable and substantially complete even though the photogrammetry has shown various "bulls eyes" of false subsidence caused by inadequate photo resolution of the steep terrain. The second area mined is Area 15 in the Subsidence Monitoring Report. This area was mined in 1988 through the fall of 1989. Subsidence in this area has reached a little over five feet. For the most part, this area has rolling terrain which can be monitored effectively using photogrammetric means. The profiles from this area are shown in *Figures 50 and 51* located in the Appendix. Survey prism targets in Miller Canyon have also been measured and further confirm that subsidence is substantially complete in this rugged area. This data is shown in Profiles PR–1 through PR–5 Miller Canyon located in the Appendix. The third area of subsidence in this lease is Area 16. Mining in this area started in June 1989 and was completed in May 1992. Subsidence in this area has reached slightly over five feet. Because most of the area is fairly flat, the subsidence is well documented by the photogrammetric monitoring. Some areas undermined are very steep and, as in Area 14, several "bulls eyes" appear from the photogrammetric monitoring. The photogrammetric profiles in this area are shown in *Figures 54 and 55* in the Appendix. In the steep area where the photogrammetric monitoring is ineffective, several survey prism targets have been monitored. Data from these targets, listed as PR–5 through PR–10 in Newberry Canyon and PR–11 through PR–14 in Corn Cob Wash are shown in the Appendix. These profiles show no movement since 1992. The subsidence area appears to be stable and substantially complete.

FEDERAL LEASE U-47978 Partial Relinquishment (3,257.31 Acres)	
Subsidence (cont'd)	The fourth area of subsidence within this lease is Area 17. This area was mined between October 1990 and March 1992.The subsidence has reached a total of slightly over six feet. For the most part, the topography in this area is fairly flat and is well suited for photogrammetric monitoring. This area has shown no movement since 1992 as indicated on the photogrammetric profiles, *Figures 58 and 59* located in the Appendix. Additional data regarding the speed at which subsidence occurs was documented in this area using time domain reflectometry. In this method, a drill hole was completed from the surface down through the coal seam and centered in a longwall that was to be mined. A coaxial cable was then cemented in the drill hole. By measuring the electrical properties of this cable from the surface of the ground, it was possible to measure when the cable was sheared and at what depth as the drill hole was undermined by the longwall equipment. When this was done, it was determined that no deformation of the cable occurred until the longwall had reached the cable. Immediately after the cable was undermined, the cable began to be sheared – first near the coal seam, and as time passed, progressively further up the hole. The shearing of the cable reached 85 feet from the surface of the ground within 43 days of it being undermined (see the Appendix, Time Domain Reflectometry). This information strongly supports the other subsidence data collected which suggests that subsidence is rapid in occurring. The impacts which mining and subsidence have had on the surface within this lease are small. In an area of the Castlegate Cliffs in Area 14, a collapse occurred in 1986 and 1987. The debris that fell from the cliff covered the talus slope below and had some impact on the vegetation in that area. Some fractures are also present along the northern limit of the relinquishment area. The fractures are healing naturally and appear to be stable. No subsidence movement has been seen since 1992, and subsidence in the area is considered to be substantially complete.

FEDERAL LEASE U-47978 Partial Relinquishment (3,257.31 Acres)	
Subsidence (cont'd)	*Photogrammetric data has effectively shown that subsidence has stabilized in areas where the land surface is flat. The photogrammetric monitoring shows erratic changes in subsidence in steep areas because of limited resolution of the data. In those areas, the conventional survey data shows all areas monitored to be stable. The subsidence above the longwall panels has reached predicted values. Therefore, subsidence within this lease is considered to be substantially complete.*
Hydrology	One spring is located within the relinquishment area. This spring is 84–56 and has been monitored since 1984. It has shown no change in quality or discharge since the mining has occurred (see Appendix, Bureau of Mines Report).
Vegetation	The vegetation in this lease is Mixed Conifer, Sagebrush, Pinyon–Juniper, Mountain Brush, Grass and Riparian. Major subsidence–related impact to vegetation in the lease area resulted from cliff failure and deposition of talus materials. This occurred in the Newberry Canyon and Corn Cob Wash areas. Approximately 35 acres of Pinyon–Juniper, Mountain Brush, Grass mixed vegetation community and 0.006 acres (250 feet^2) of Riparian vegetation were impacted in Newberry Canyon. Approximately 33 acres of Pinyon–Juniper, Mountain Brush, Grass mixed vegetation were impacted in Corn Cob Wash. Grasses and forbs are beginning to re–establish in the impacted areas. The majority of the lease relinquishment area shows no evidence of impacts to vegetation.
Wildlife	The most significant impact to wildlife in Newberry Canyon was the loss of golden eagle nest sites. Three of five nests in Newberry Canyon were destroyed due to cliff failure. However, no adult or young eagles nor any eggs were lost. Additionally, the reproductive viability of the Newberry Canyon territory has not been impacted. The territory has been included in annual raptor surveys since 1986. The Newberry Canyon territory has been comparably productive when compared to adjacent territories.

FEDERAL LEASE U-47978 Partial Relinquishment (3,257.31 Acres)	
Wildlife **(cont'd)**	The lease relinquishment area includes high priority deer winter and summer range and high priority summer and critical winter range for elk. The areas impacted by subsidence related talus deposition are very steep and rugged and receive minimal use by these wildlife species. The areas affected by surface fractures are more heavily used by deer and elk, but the fractures do not appear to have negatively affected these species.
Other Land Uses	Land uses within the lease relinquishment area include recreation, forestry, commercial timber and grazing. None of these uses have been impacted by subsidence.

VI. Conclusion

Based upon the extensive monitoring conducted by PacifiCorp and/or its wholly–owned subsidiaries, the independent studies referred to above, the findings and the interpretations quantified in this supplemental information, PacifiCorp concludes that in those areas of mining–induced subsidence, subsidence activities are substantially complete with no significant impact or irreparable damage to the environment inclusive of hydrology, vegetation, wildlife and other land uses. Furthermore, it is hereby demonstrated that the federal acreage applied for relinquishment in Phase I and Phase II applications, and as herein amended in Table 1, will not impair the public interest as all obligations under the regulations and terms of the leases have been met.

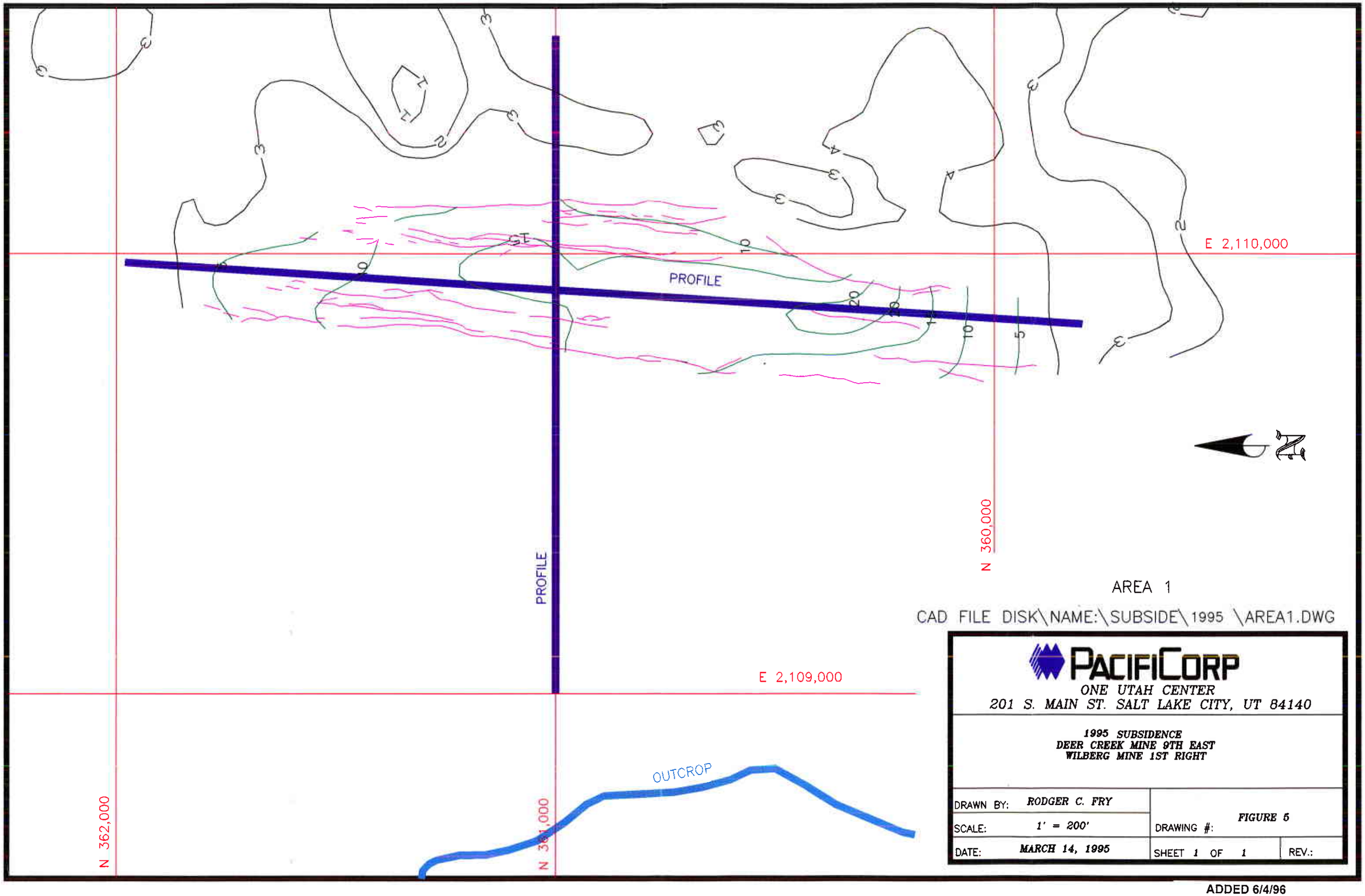
PacifiCorp respectfully requests and urges the BLM to take action to approve the remaining relinquishments.

VII. 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, in my opinion, subsidence within all relinquishment areas referred to in this document is considered to be substantially complete.

Dated this 12th day of June, 1995.

Rodger C. Fry
No. 6603



AREA 1

CAD FILE DISK\NAME:\SUBSIDE\1995 \AREA1.DWG

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

1995 SUBSIDENCE
DEER CREEK MINE 9TH EAST
WILBERG MINE 1ST RIGHT

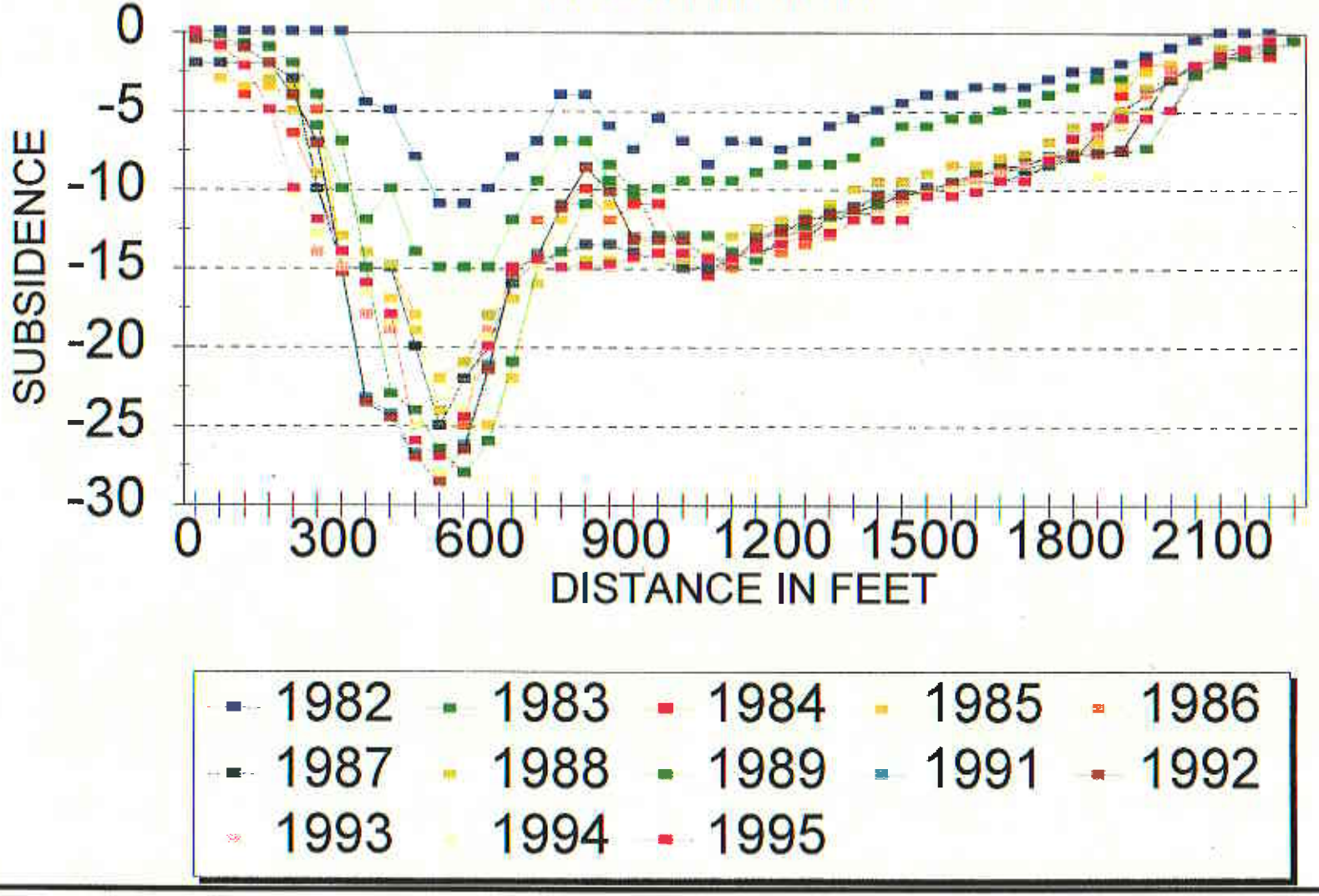
DRAWN BY:	RODGER C. FRY	DRAWING #:	FIGURE 5
SCALE:	1' = 200'		
DATE:	MARCH 14, 1995	SHEET 1 OF 1	REV.:

ADDED 6/4/96

FIGURE 6

AREA 1 SUBSIDENCE PROFILE

SOUTH-NORTH

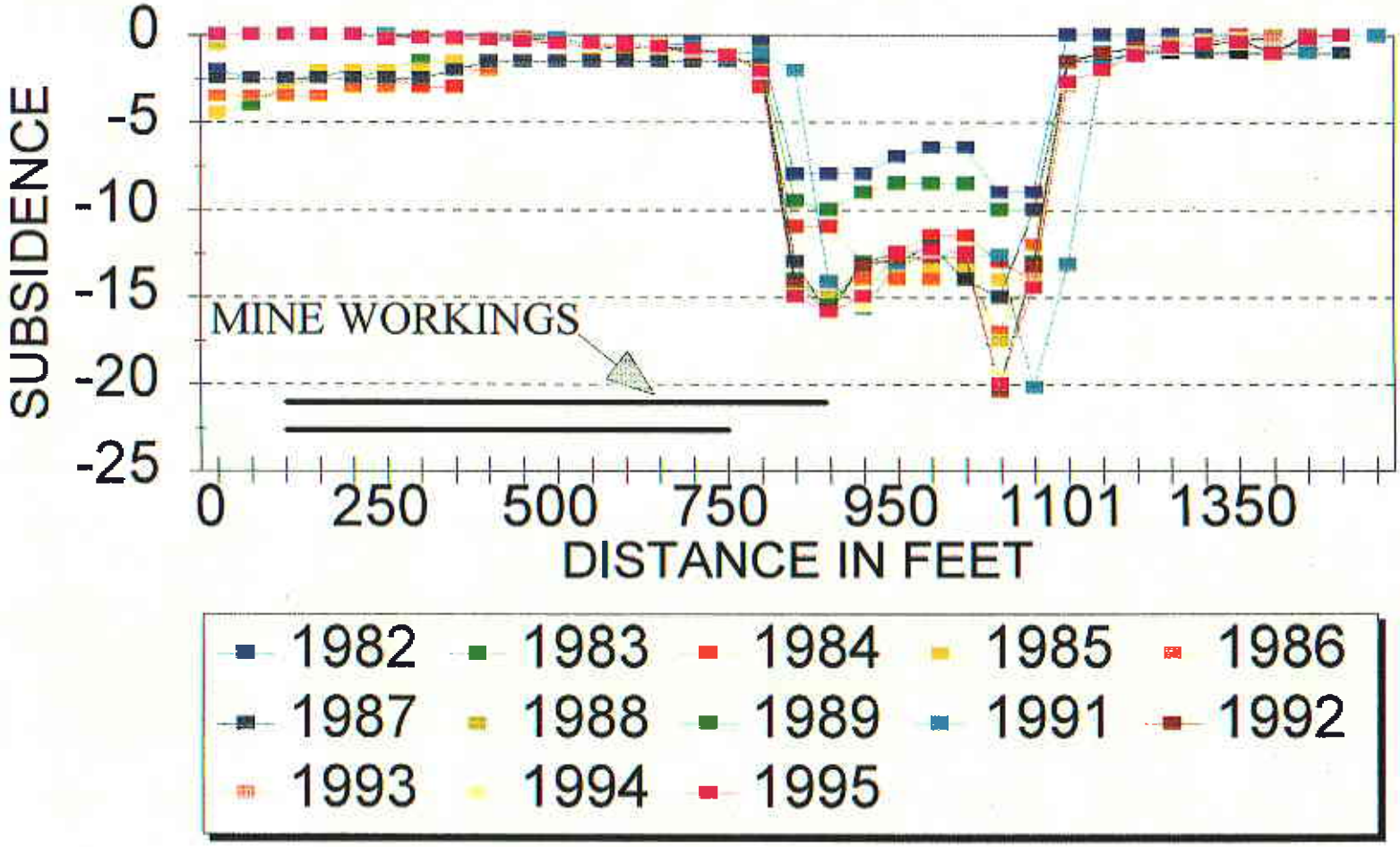


REVISED 6/4/96

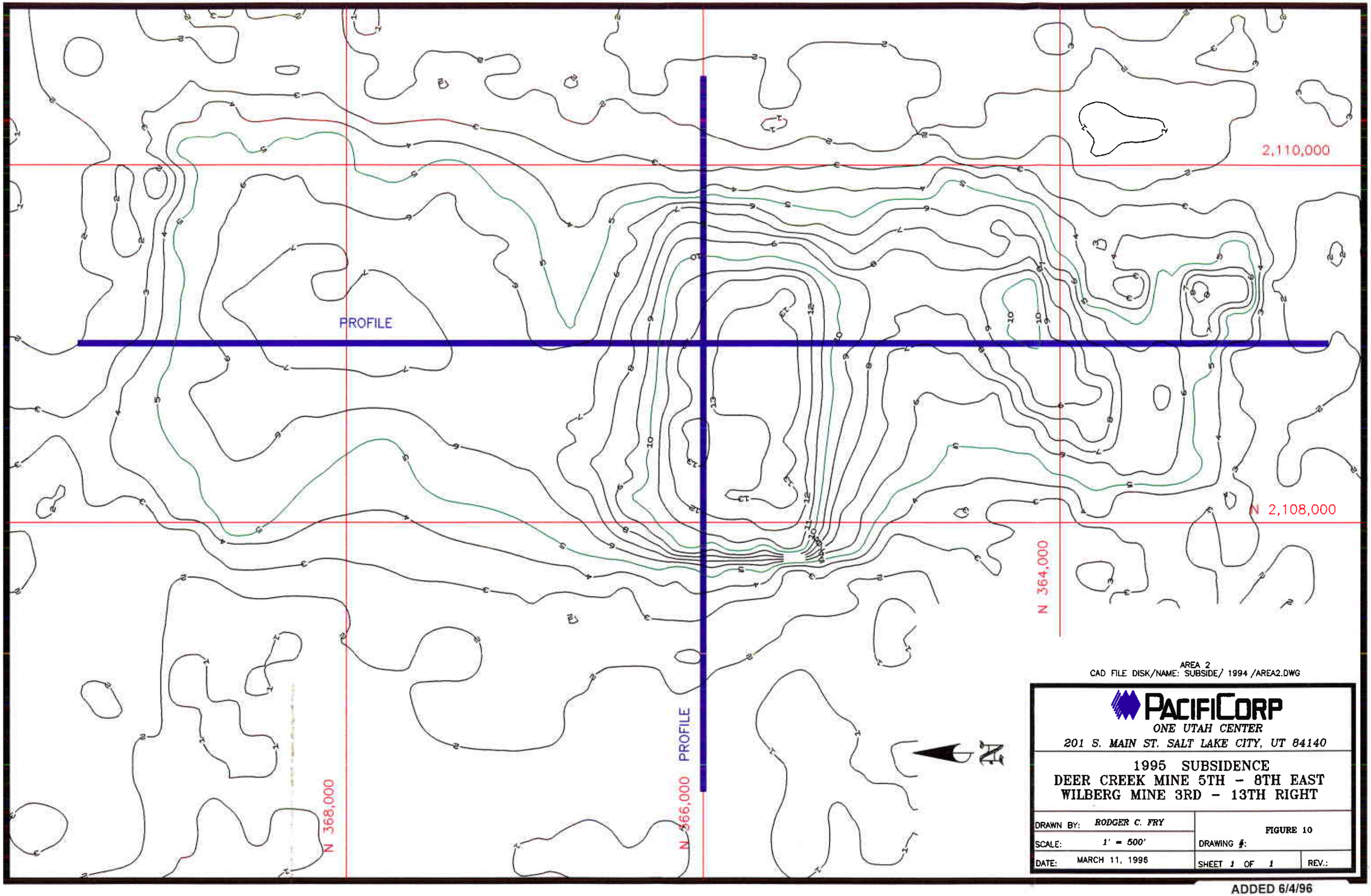
FIGURE 7

AREA 1 SUBSIDENCE PROFILE

WEST-EAST



REVISED 6/4/96



AREA 2
CAD FILE DISK/NAME: SUBSIDE/ 1994 /AREA2.DWG

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

1995 SUBSIDENCE
DEER CREEK MINE 5TH - 8TH EAST
WILBERG MINE 3RD - 13TH RIGHT

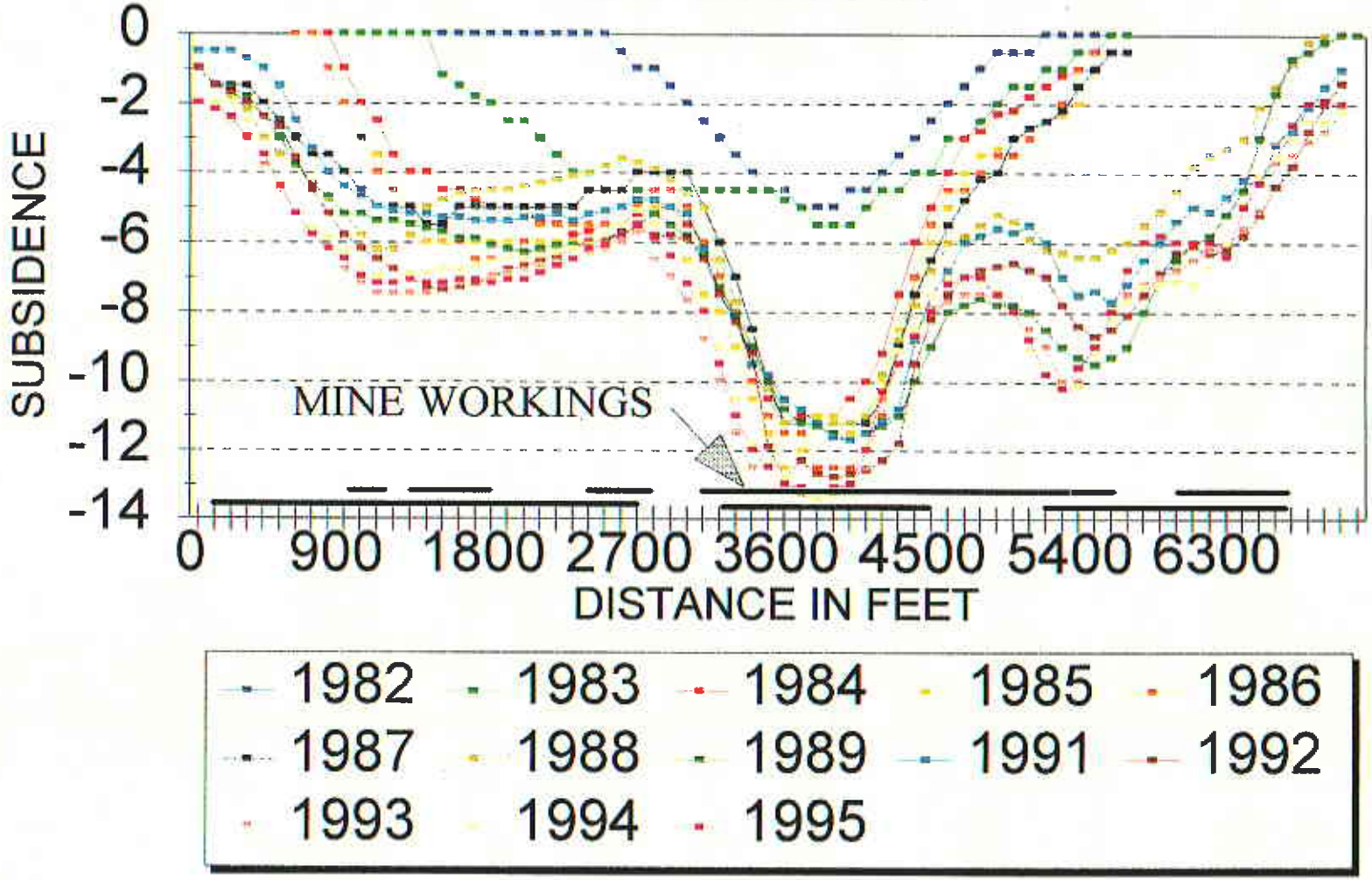
DRAWN BY: RODGER C. FRY	FIGURE 10	
SCALE: 1' = 500'	DRAWING #:	
DATE: MARCH 11, 1996	SHEET 1 OF 1	REV.:

ADDED 6/4/96

FIGURE 11

AREA 2 SUBSIDENCE PROFILE

NORTH-SOUTH

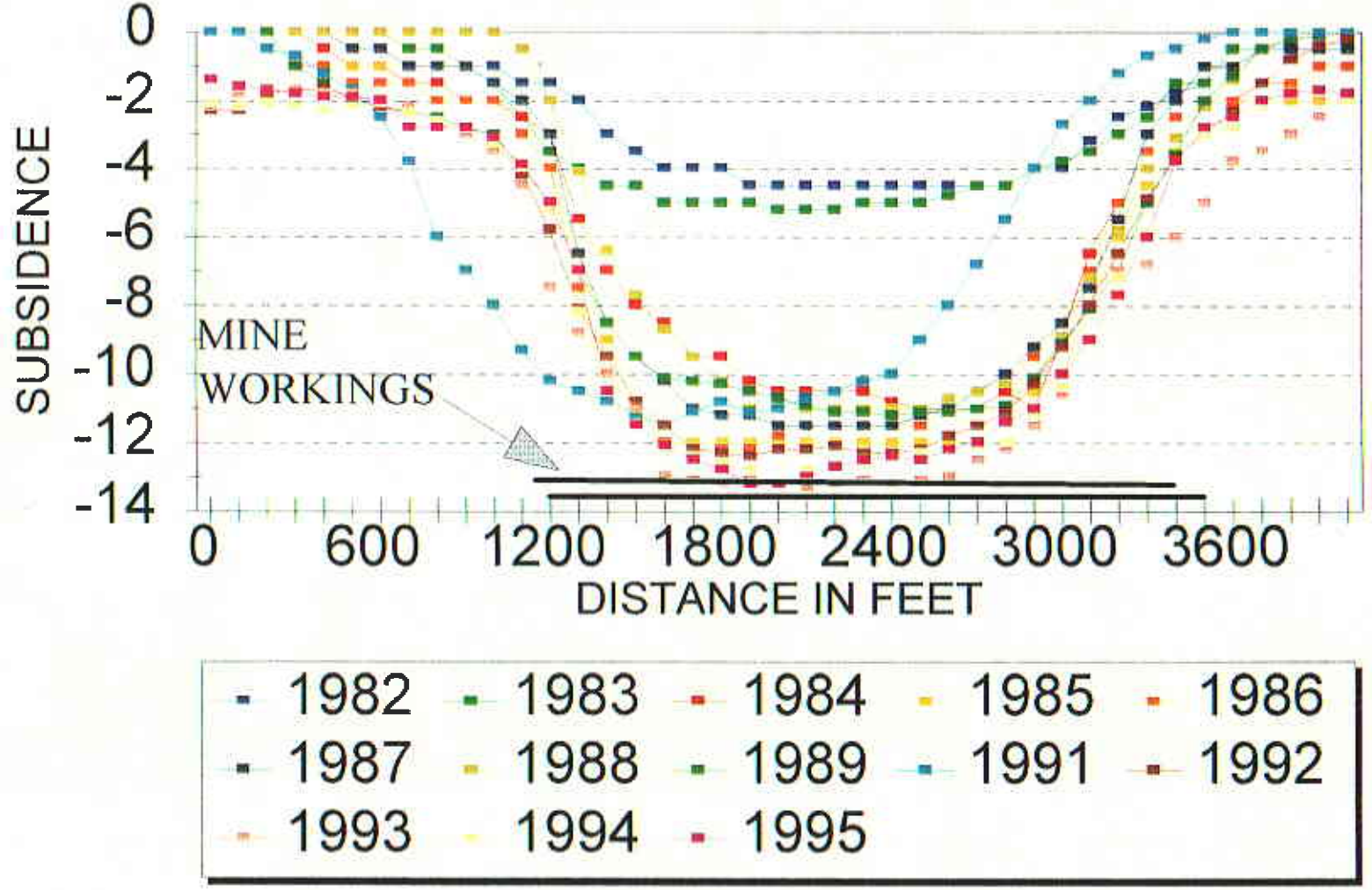


REVISED 6/4/96

FIGURE 12

AREA 2 SUBSIDENCE PROFILE

WEST-EAST



REVISED 6/4/96

N 380,000

N 378,000

N 376,000

E 2,106,000

E 2,108,000

E 2,110,000

E 2,112,000

FAULT

OUTCROP

FAULT

PROFILE

N

AREA 3
CAD FILE DISK\NAME:\SUBSIDE\ 1995 \AREA3.DWG

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

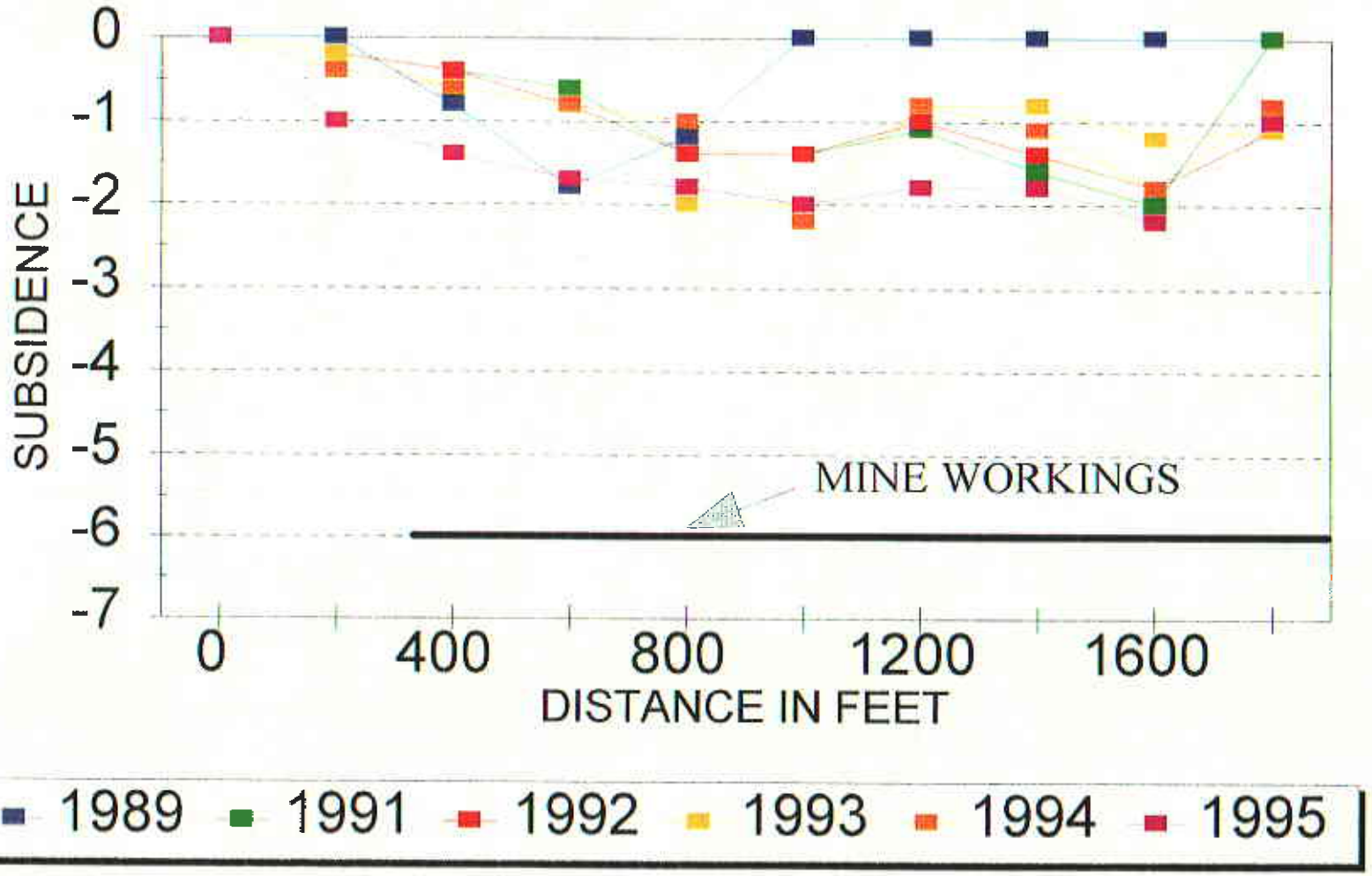
1995 SUBSIDENCE
DEER CREEK MINE
1ST NORTH AREA

DRAWN BY:	RODGER C. FRY	FIGURE 13A	
SCALE:	1" = 500'	DRAWING #:	
DATE:	DEC. 12, 1995	SHEET 1 OF 1	REV.: ADDED 6/4/96

FIGURE 14

AREA 3 SUBSIDENCE PROFILE

NORTH-SOUTH

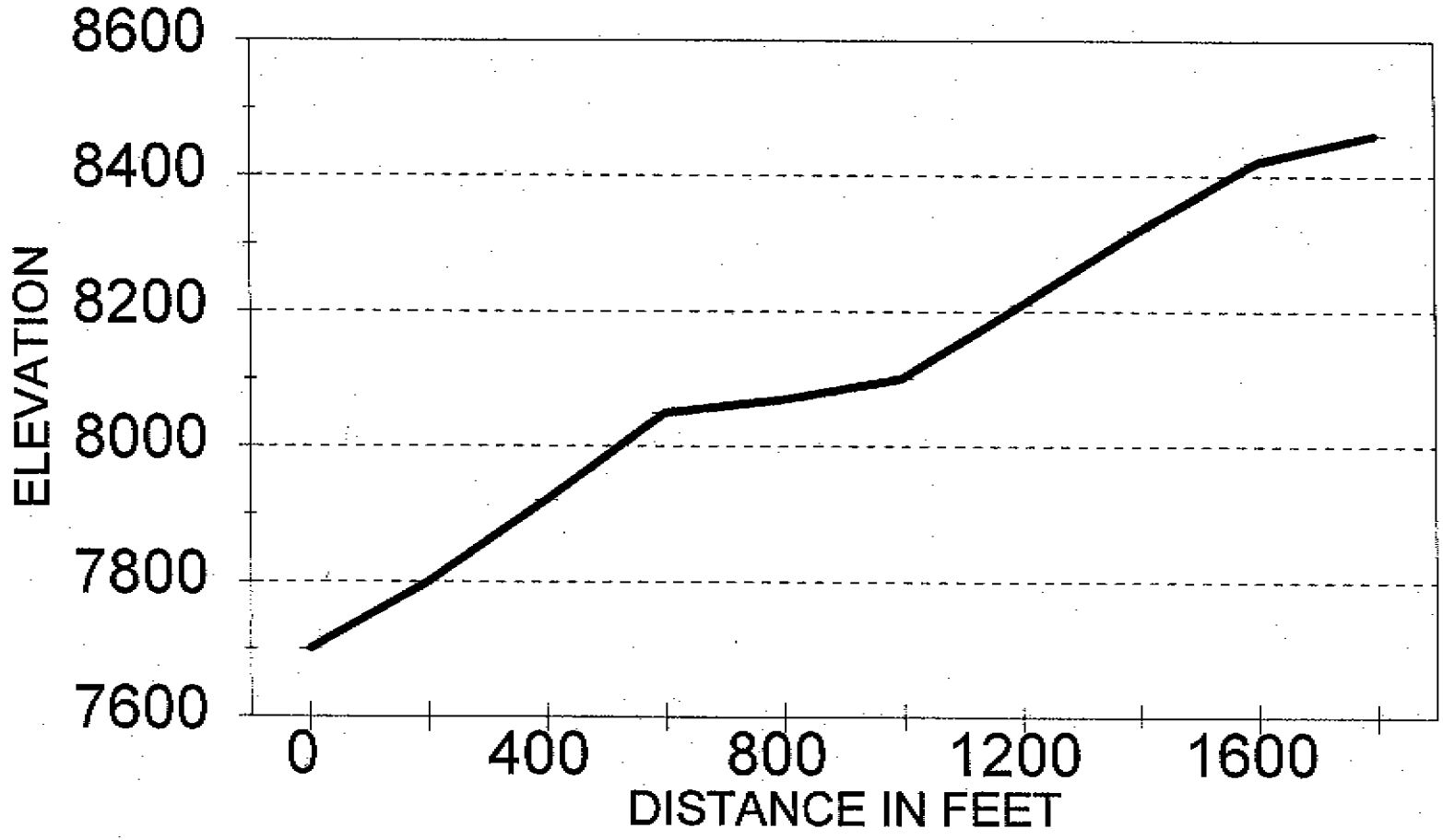


REVISED 6/4/96

FIGURE 14T

AREA 3 TOPOGRAPHIC PROFILE

NORTH-SOUTH



ADDED 6/4/96

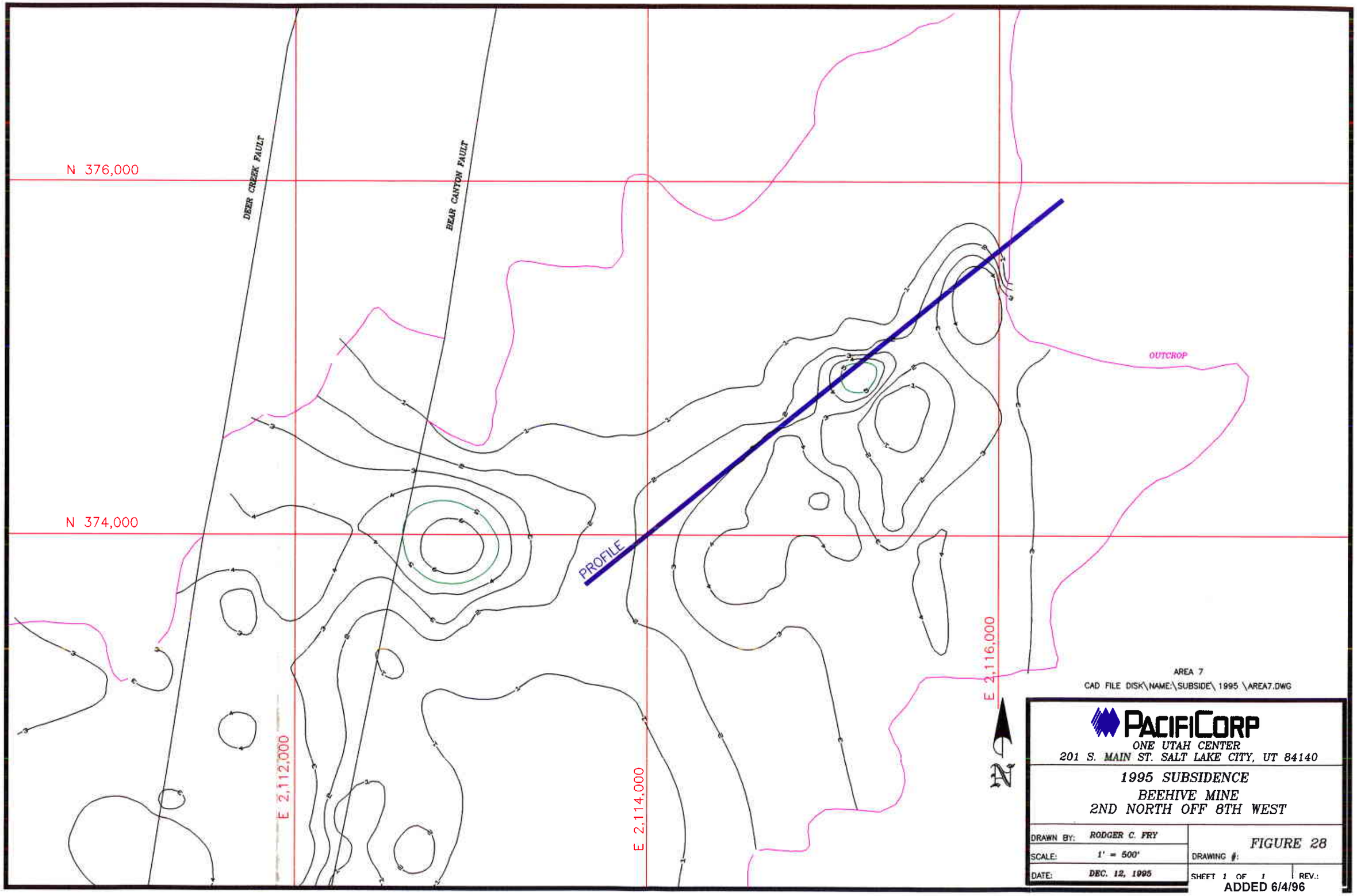
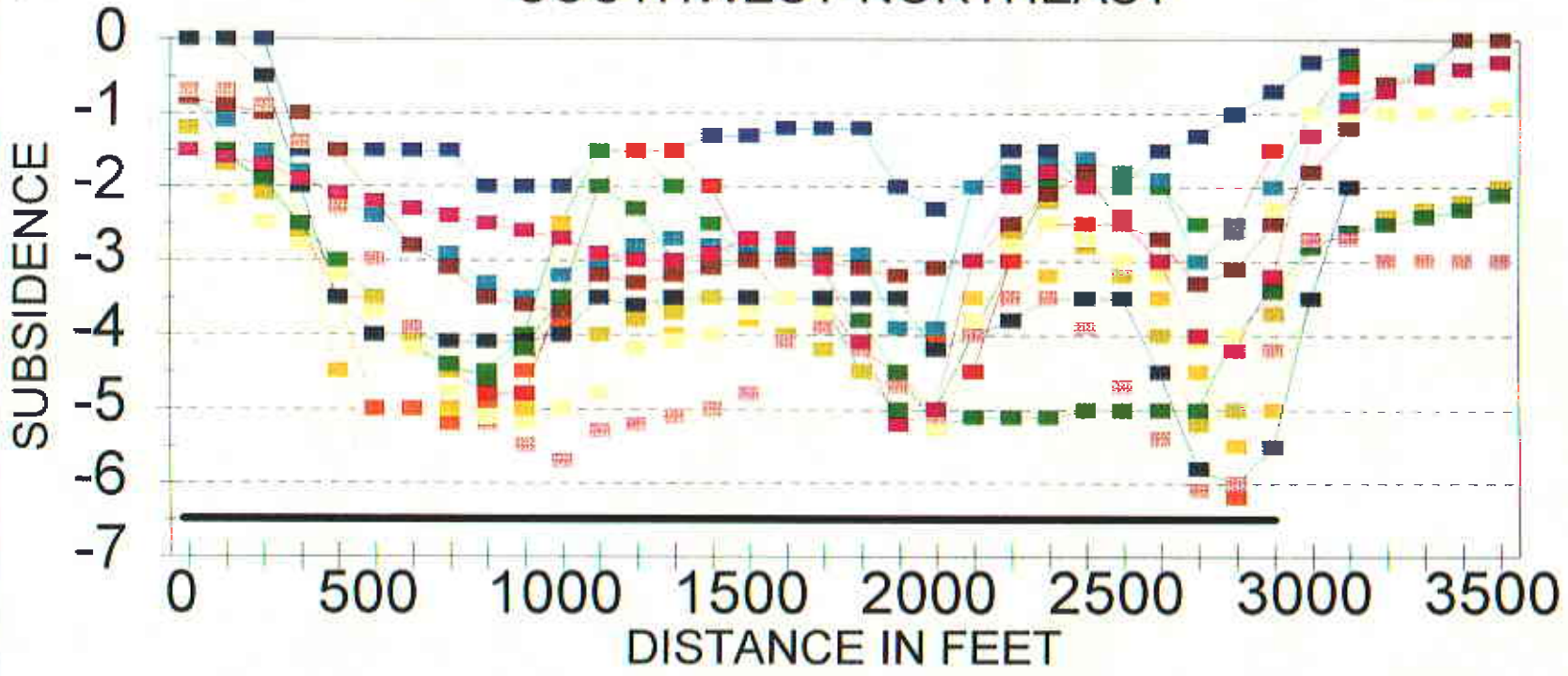

N 376,000
N 374,000
E 2,112,000
E 2,114,000
E 2,116,000
DEER CREEK FAULT
BEAR CANYON FAULT
OUTCROP
PROFILE
AREA 7
CAD FILE DISK\NAME:\SUBSIDE\ 1995 \AREA7.DWG
PACIFICORP
ONE UTAH CENTER
201 S. MAIN ST. SALT LAKE CITY, UT 84140
1995 SUBSIDENCE
BEEHIVE MINE
2ND NORTH OFF 8TH WEST
DRAWN BY: RODGER C. FRY
SCALE: 1" = 500'
DATE: DEC. 12, 1995
FIGURE 28
DRAWING #:
SHEET 1 OF 1
REV.:
ADDED 6/4/96

FIGURE 29

AREA 7 SUBSIDENCE PROFILE

SOUTHWEST-NORTHEAST

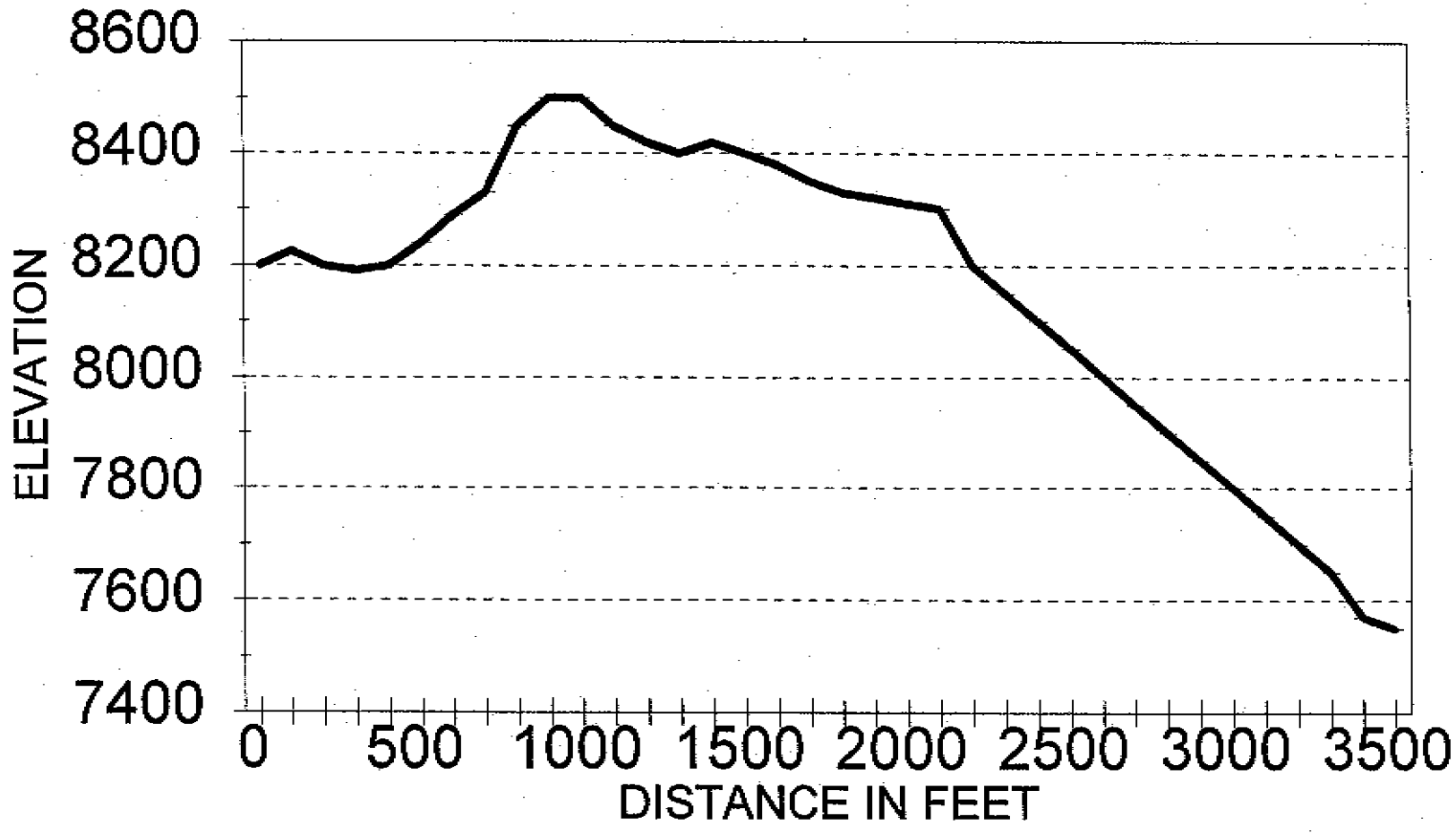


REVISED 6/4/96

FIGURE 29T

AREA 7 TOPOGRAPHIC PROFILE

SOUTHWEST-NORTHEAST



ADDED 6/4/96

N 366,000

PROFILE

N 364,000

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E 2,114,000

E 2,116,000

N

AREA 8

CAD FILE DISK\NAME:\SUBSIDE\ 1995 \AREA8.DWG

PACIFICORP

ONE UTAH CENTER

201 S. MAIN ST. SALT LAKE CITY, UT 84140

1995 SUBSIDENCE

DES-BEE-DOVE MINES

DESERET 3-9 WEST & 1-5 EAST

BEEHIVE 3-8 WEST & 3-9 EAST

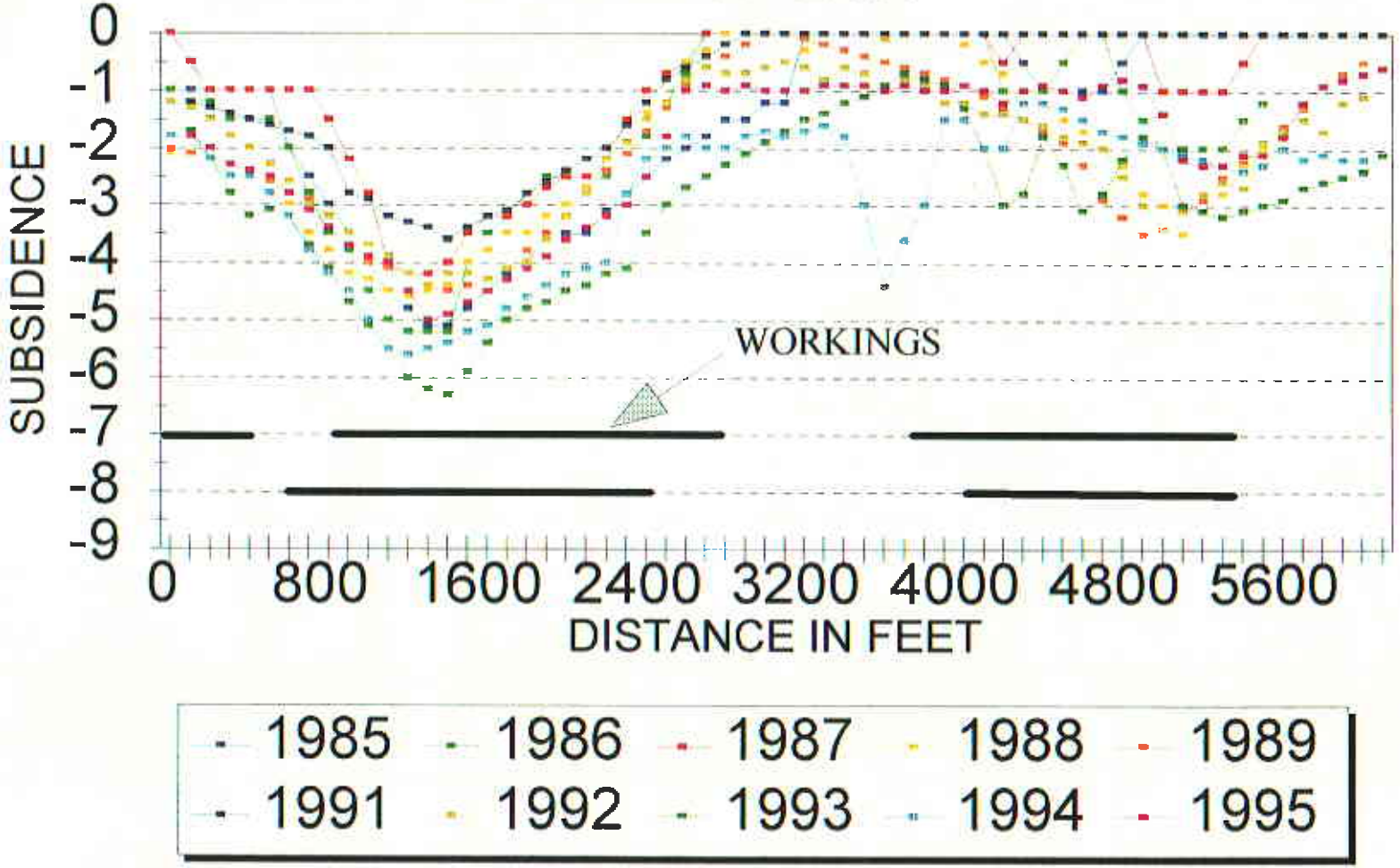
DRAWN BY:	RODGER C. FRY	DRAWING #:	FIGURE 32
SCALE:	1" = 500'		
DATE:	DEC. 12, 1995	SHEET	

ADDED 6/4/96

FIGURE 33

AREA 8 SUBSIDENCE PROFILE

WEST- EAST

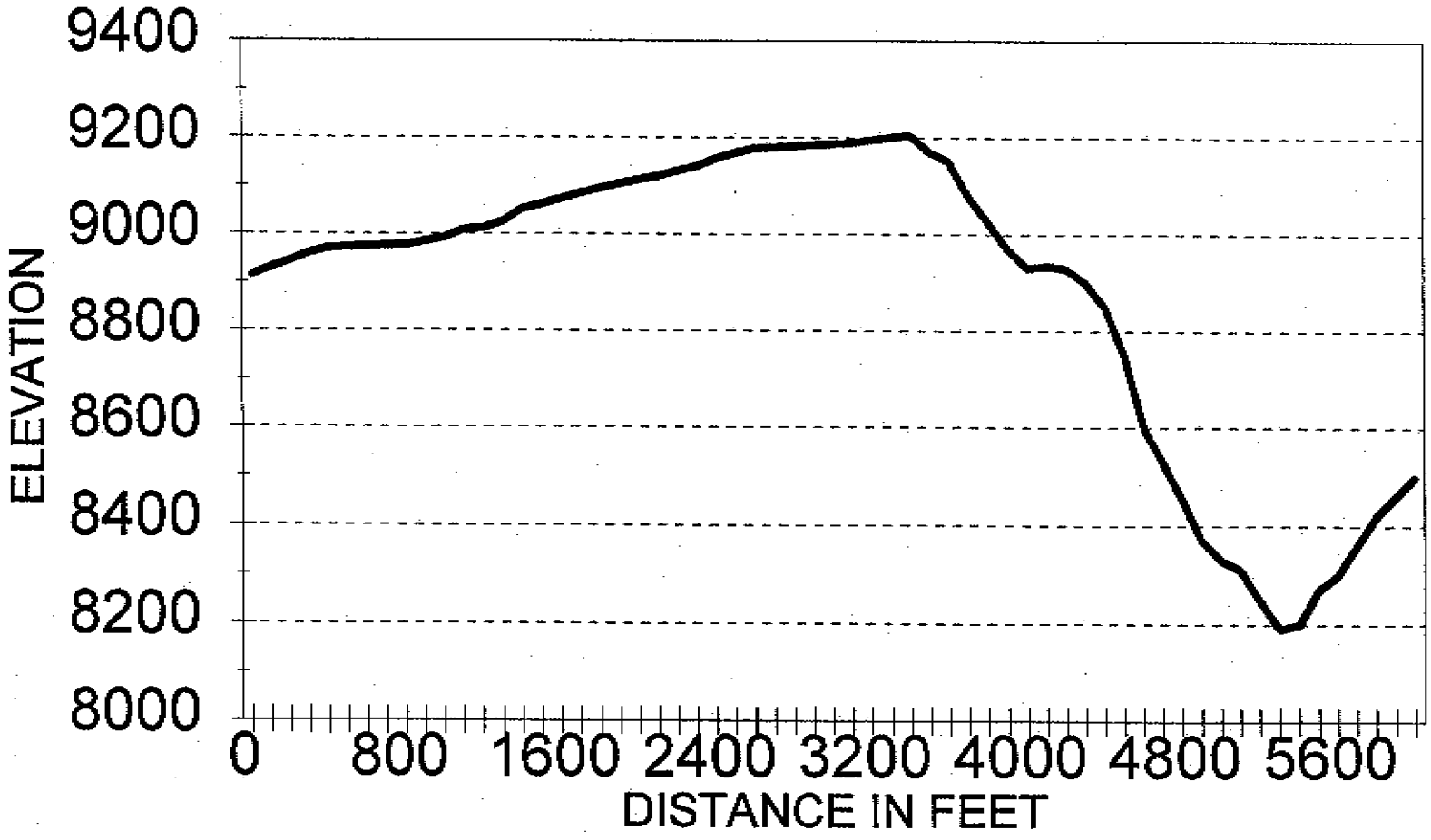


REVISED 6/4/96

FIGURE 33T

AREA 8 TOPOGRAPHIC PROFILE

WEST - EAST



ADDED 6/4/96

N 362,000

N 360,000

N 358,000

E 2,110,000

E 2,112,000

E 2,114,000

E 2,116,000

SEE AREA 1

AREA OF COMPLEX SUBSIDENCE

PROFILE

PROFILE

92

N

AREA 13

CAD FILE : \SUBSIDE\ 1995 \AREA13.DWG

PACIFICORP

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

1995 SUBSIDENCE
DES-BEE-DOVE MINES
SOUTHERN AREAS

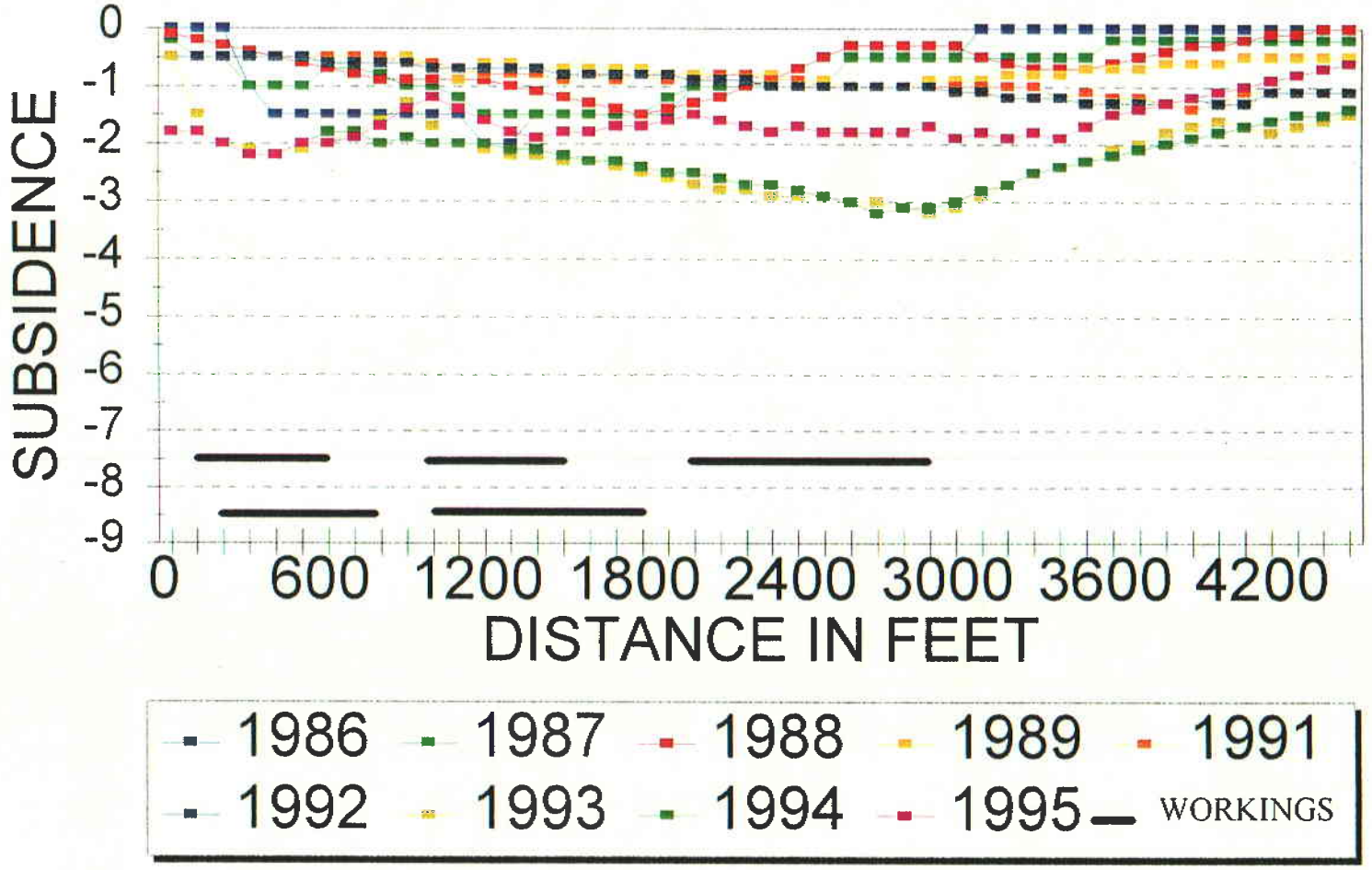
DRAWN BY:	RODGER C. FRY	FIGURE 41	
SCALE:	1" = 500'	DRAWING #:	
DATE:	DEC. 12, 1995	SHEET 1 OF 1	REV.:

ADDED 6/4/96

FIGURE 42

AREA 13 SUBSIDENCE PROFILE

NORTH-SOUTH

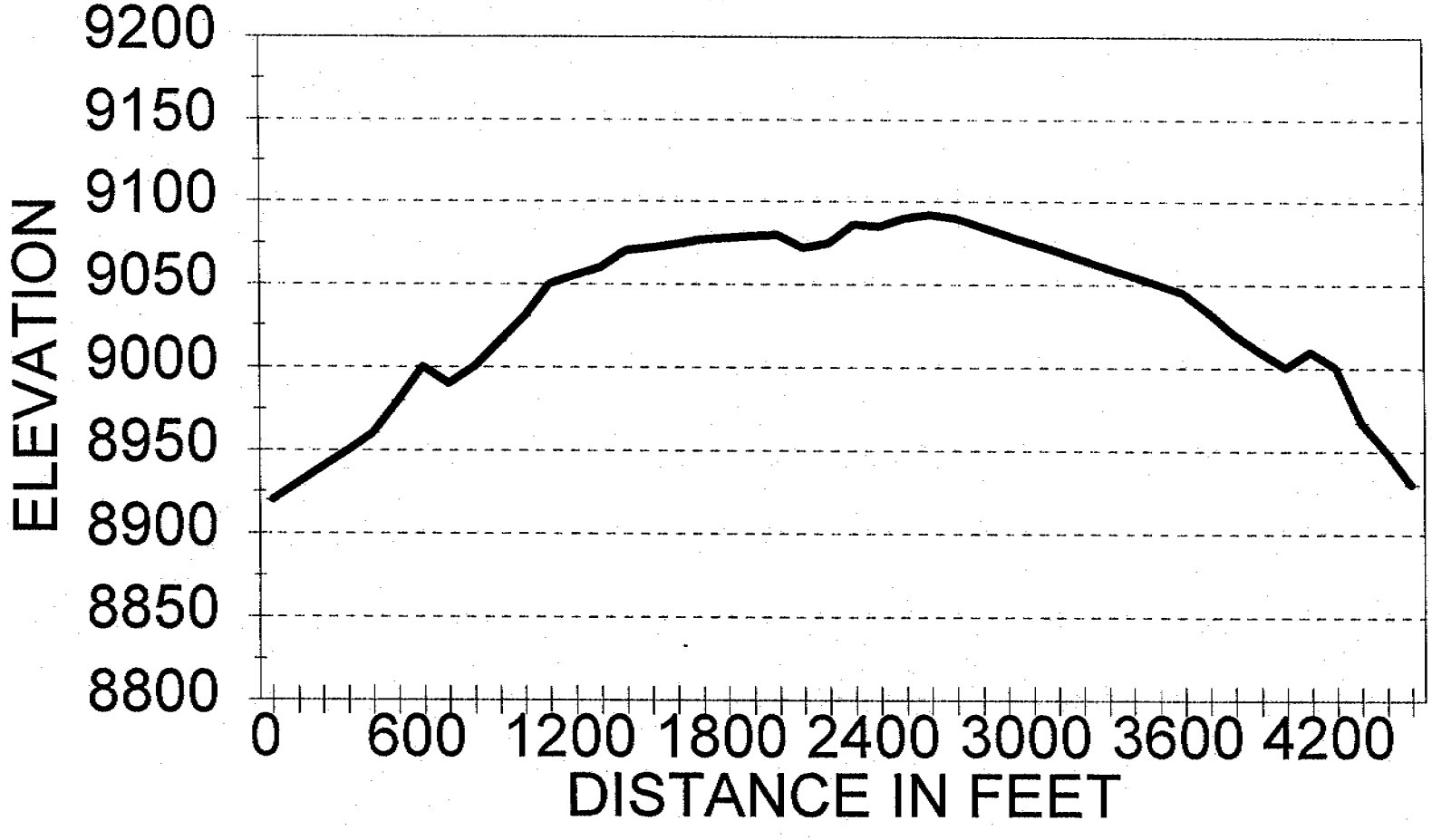


REVISED 6/4/96

FIGURE 42T

AREA 13 TOPOGRAPHIC PROFILE

NORTH-SOUTH

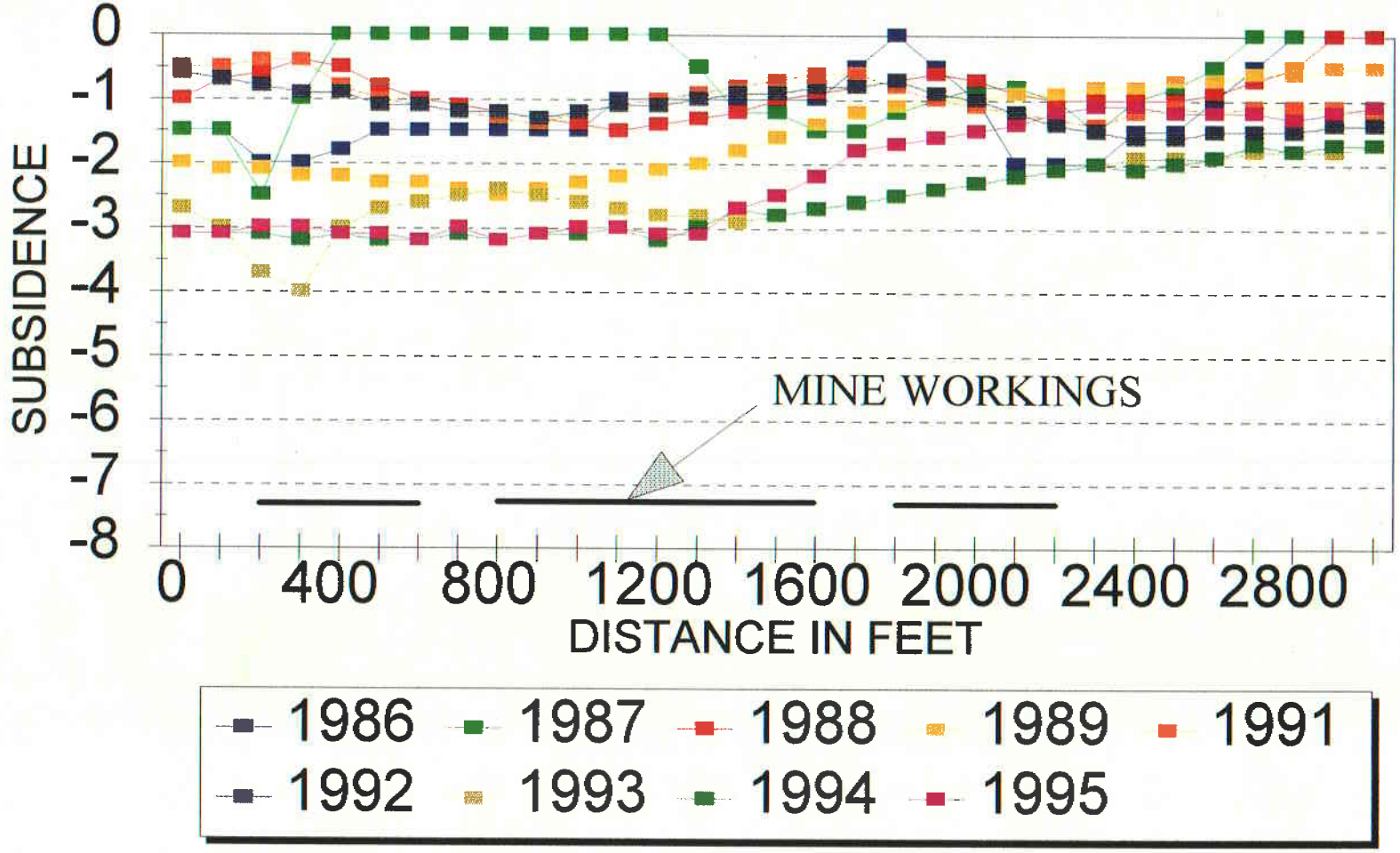


ADDED 6/4/96

FIGURE 43

AREA 13 SUBSIDENCE PROFILE

WEST-EAST

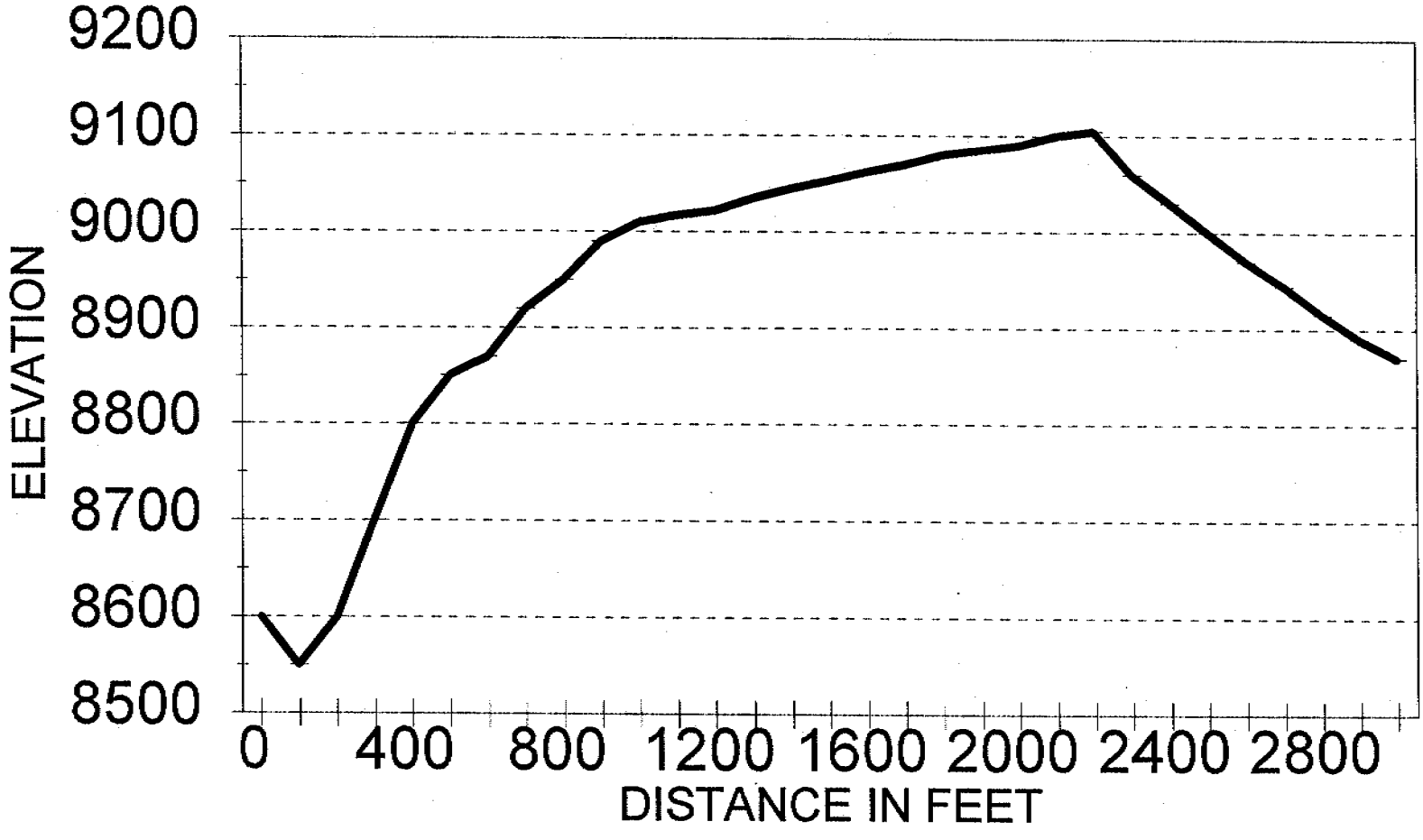


REVISED 6/4/96

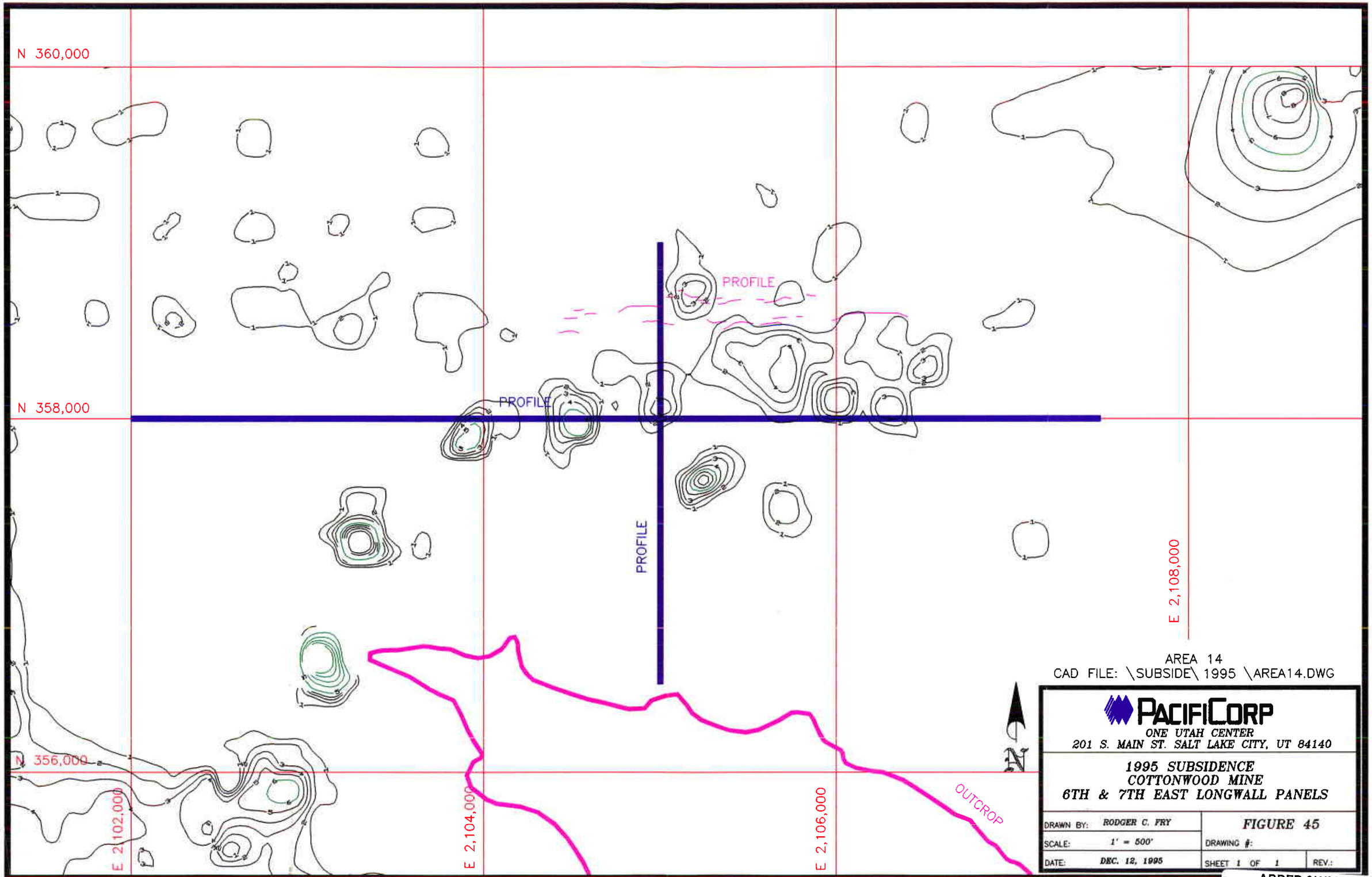
FIGURE 43T

AREA 13 TOPOGRAPHIC PROFILE

WEST-EAST



ADDED 6/4/96



AREA 14
CAD FILE: \SUBSIDE\ 1995 \AREA14.DWG

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

1995 SUBSIDENCE
COTTONWOOD MINE
6TH & 7TH EAST LONGWALL PANELS

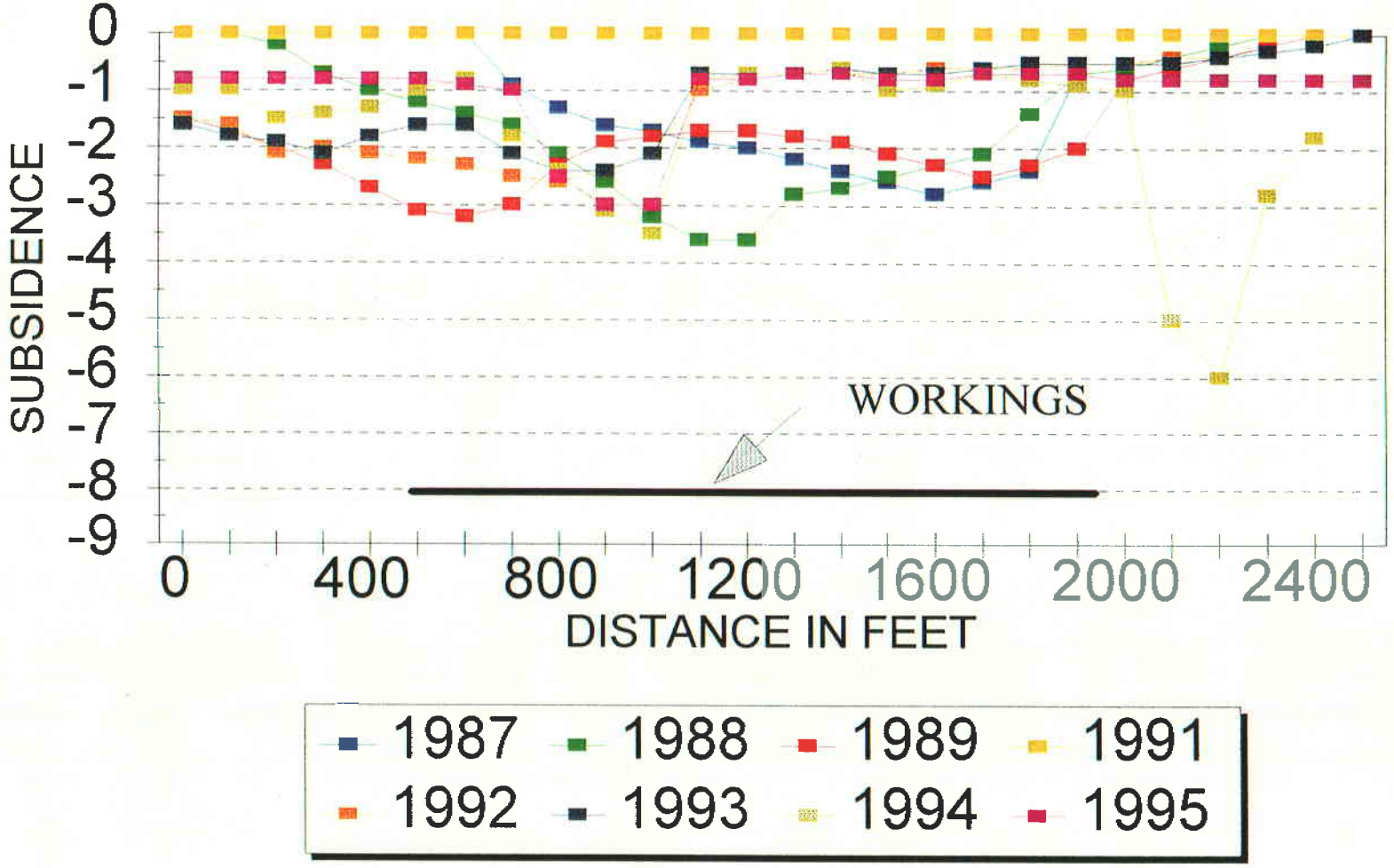
DRAWN BY:	RODGER C. FRY	FIGURE 45	
SCALE:	1" = 500'	DRAWING #:	
DATE:	DEC. 12, 1995	SHEET 1 OF 1	REV.:

ADDED 6/4/96

FIGURE 46

AREA 14 SUBSIDENCE PROFILE

NORTH-SOUTH

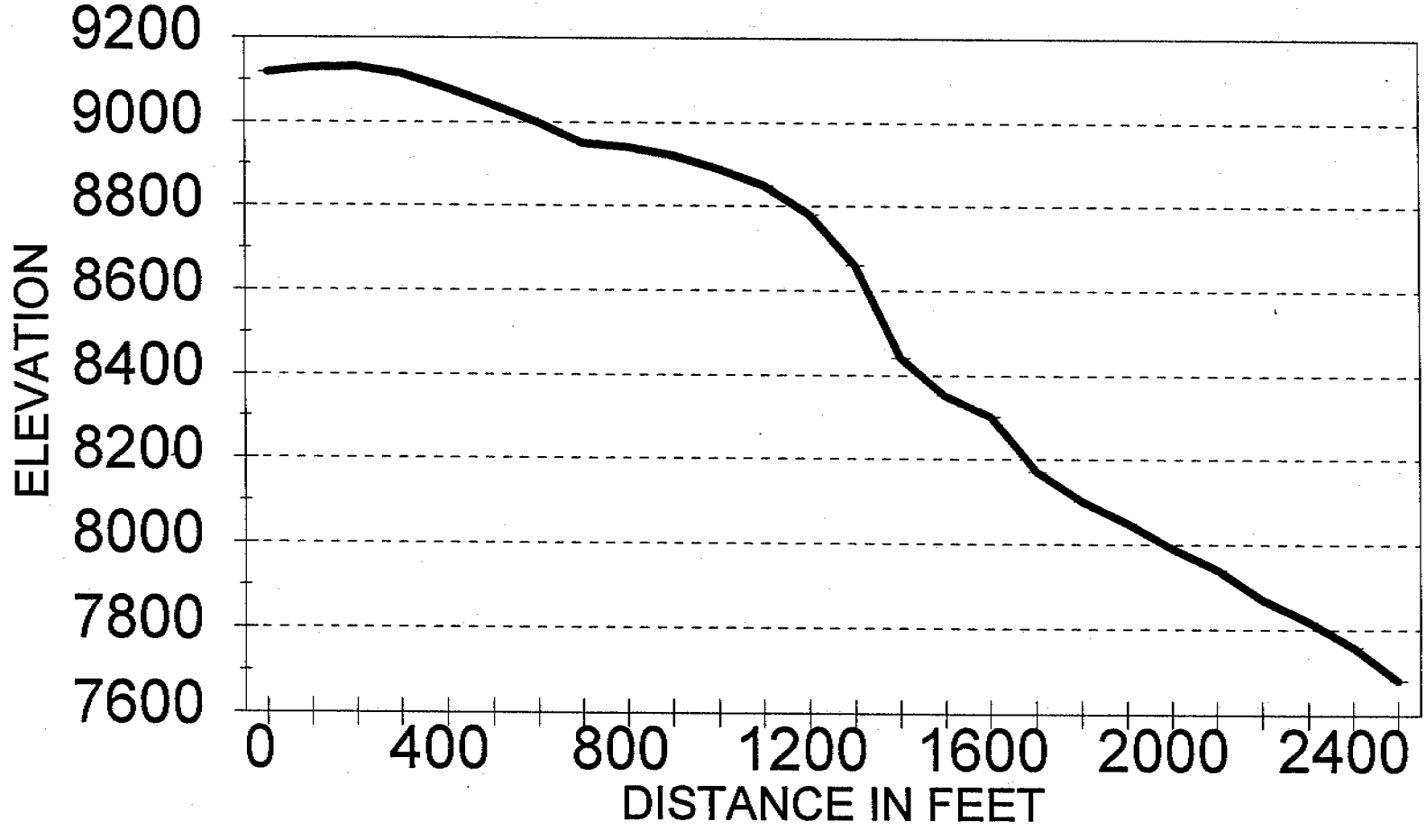


REVISED 6/4/96

FIGURE 46T

AREA 14 TOPOGRAPHIC PROFILE

NORTH-SOUTH

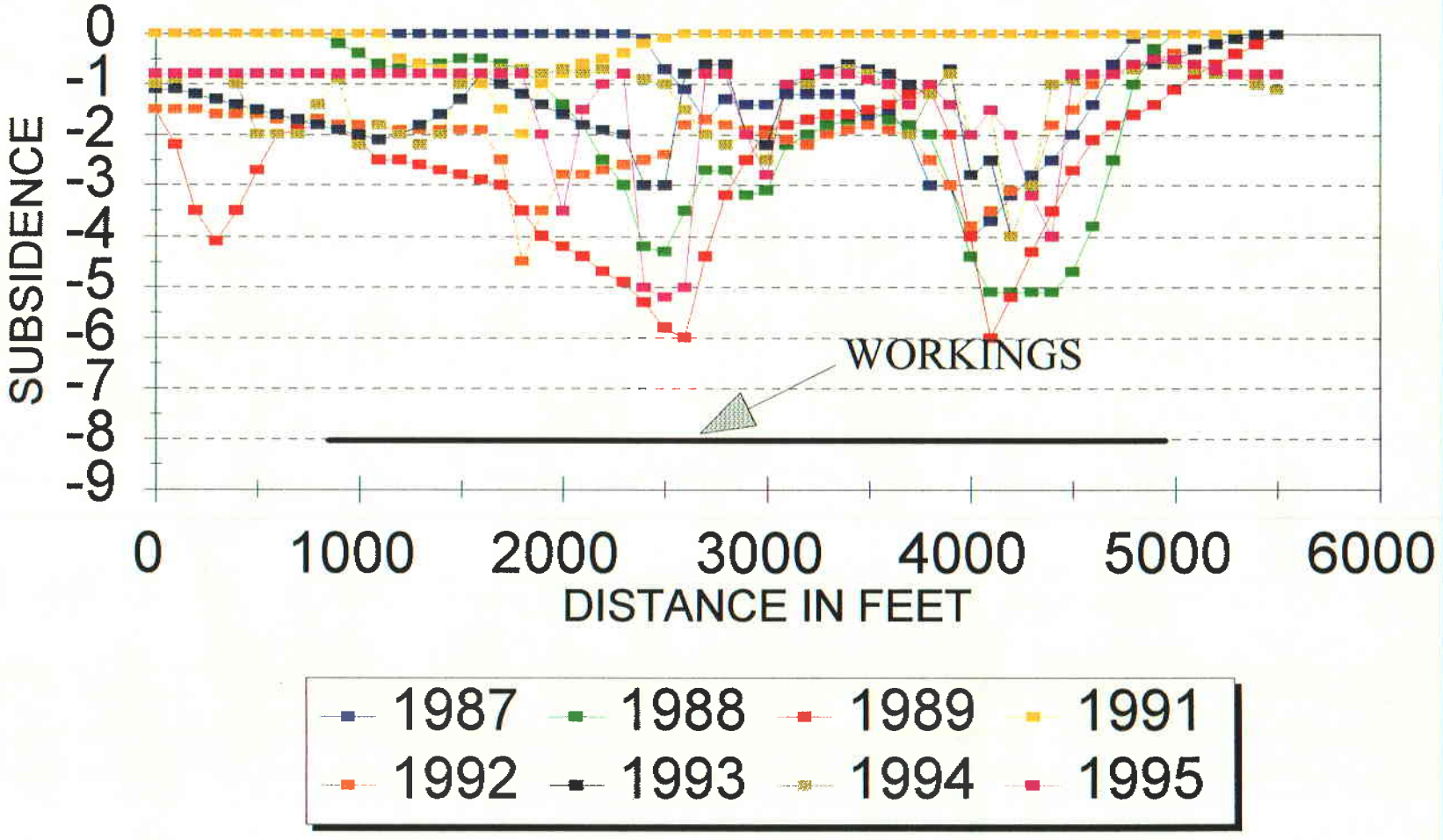


ADDED 6/4/96

FIGURE 47

AREA 14 SUBSIDENCE PROFILE

WEST - EAST

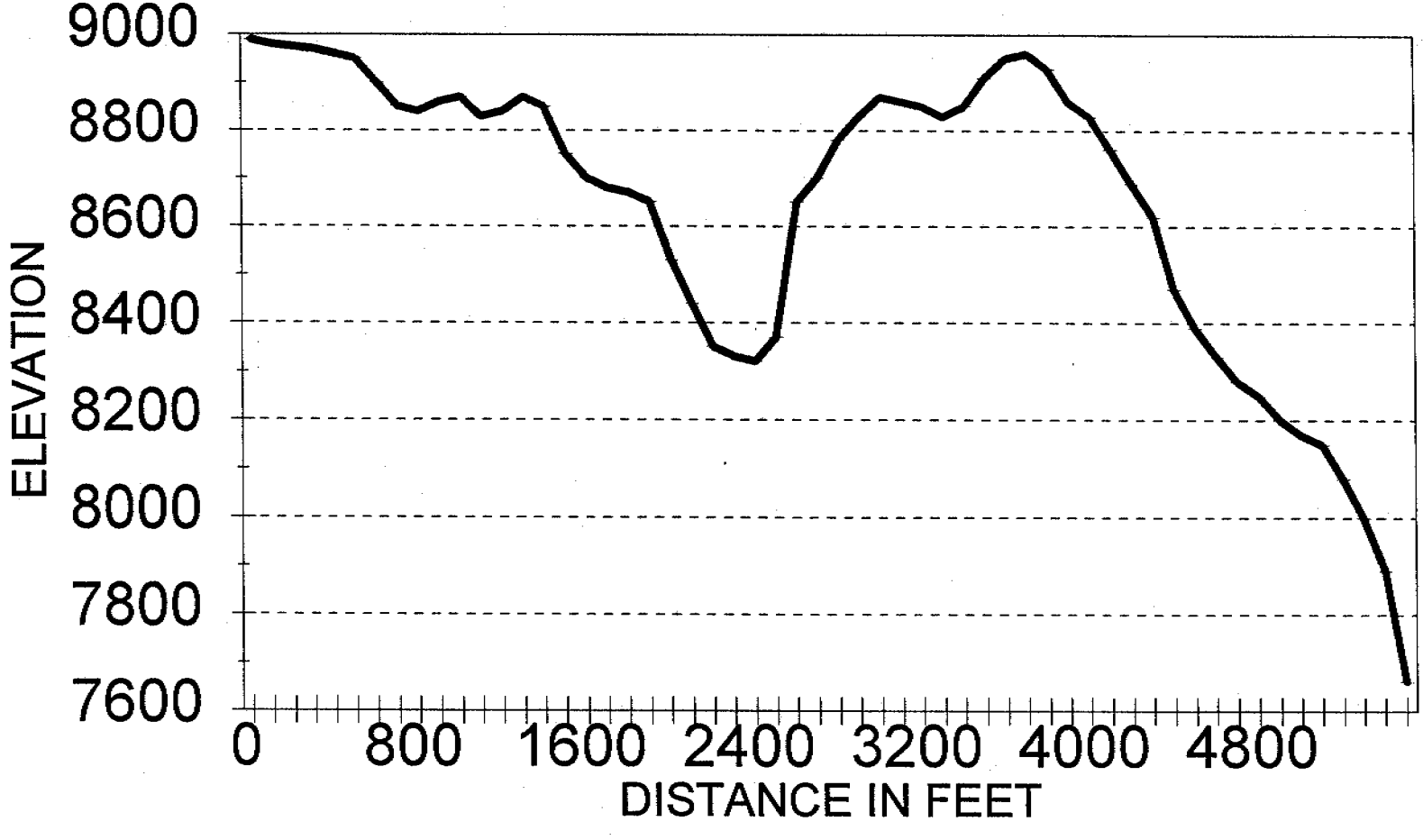


REVISED 6/4/96

FIGURE 47T

AREA 14 TOPOGRAPHIC PROFILE

WEST - EAST



ADDED 6/4/96

N 358,000

N 356,000

E 2,096,000

E 2,098,000

E 2,100,000

PROFILE

PROFILE

N

AREA 15

CAD FILE: \SUBSIDE\ 1995 \AREA15.DWG

PACIFICORP

ONE UTAH CENTER

201 S. MAIN ST. SALT LAKE CITY, UT 84140

1995 SUBSIDENCE
COTTONWOOD MINE
9TH - 12TH WEST LONGWALL PANELS

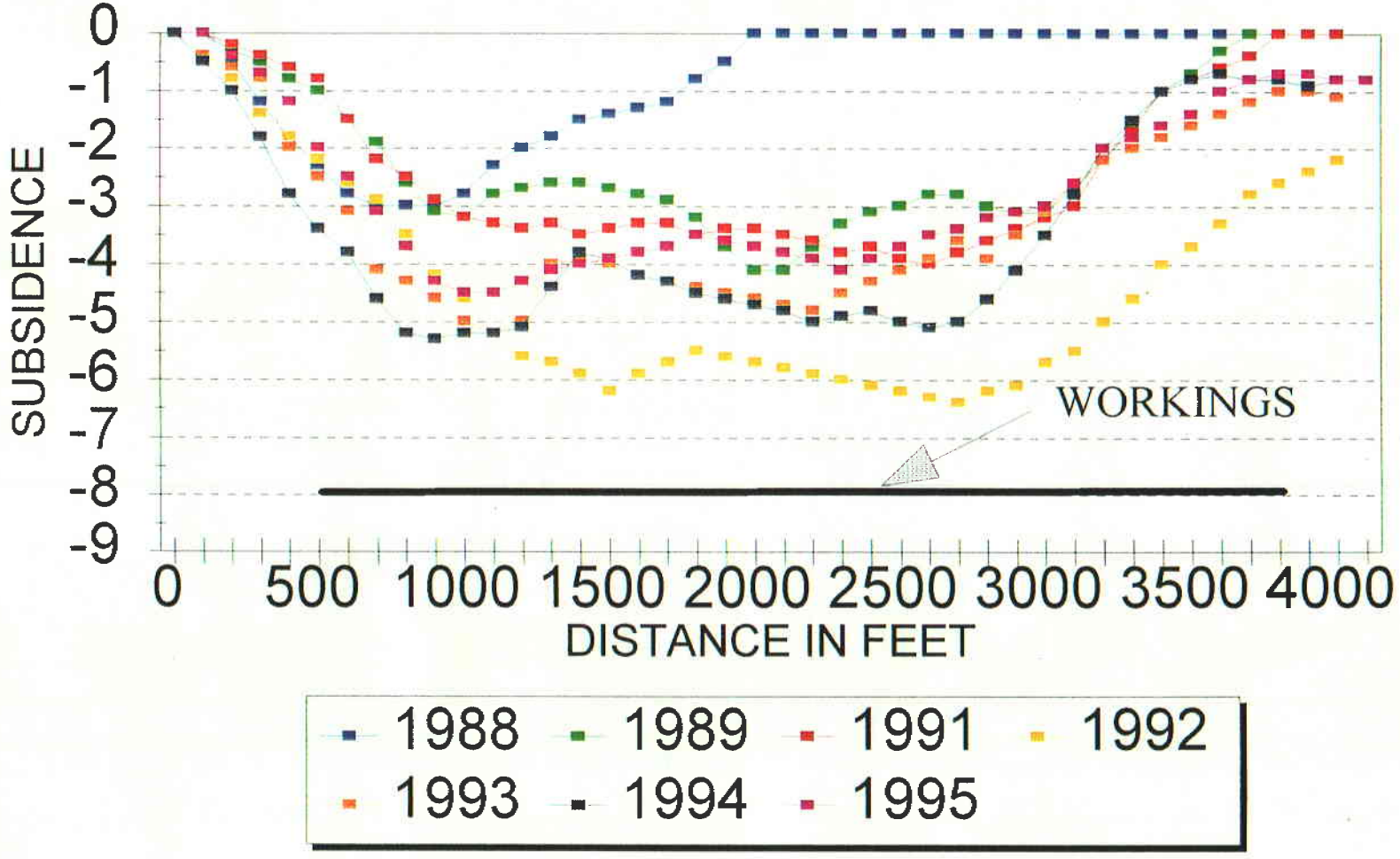
DRAWN BY:	RODGER C. FRY	FIGURE 49	
SCALE:	1" = 500'	DRAWING #:	
DATE:	DEC. 12, 1995	SHEET 1 OF 1	REV.:

ADDED 6/4/96

FIGURE 50

AREA 15 SUBSIDENCE PROFILE

NORTH-SOUTH

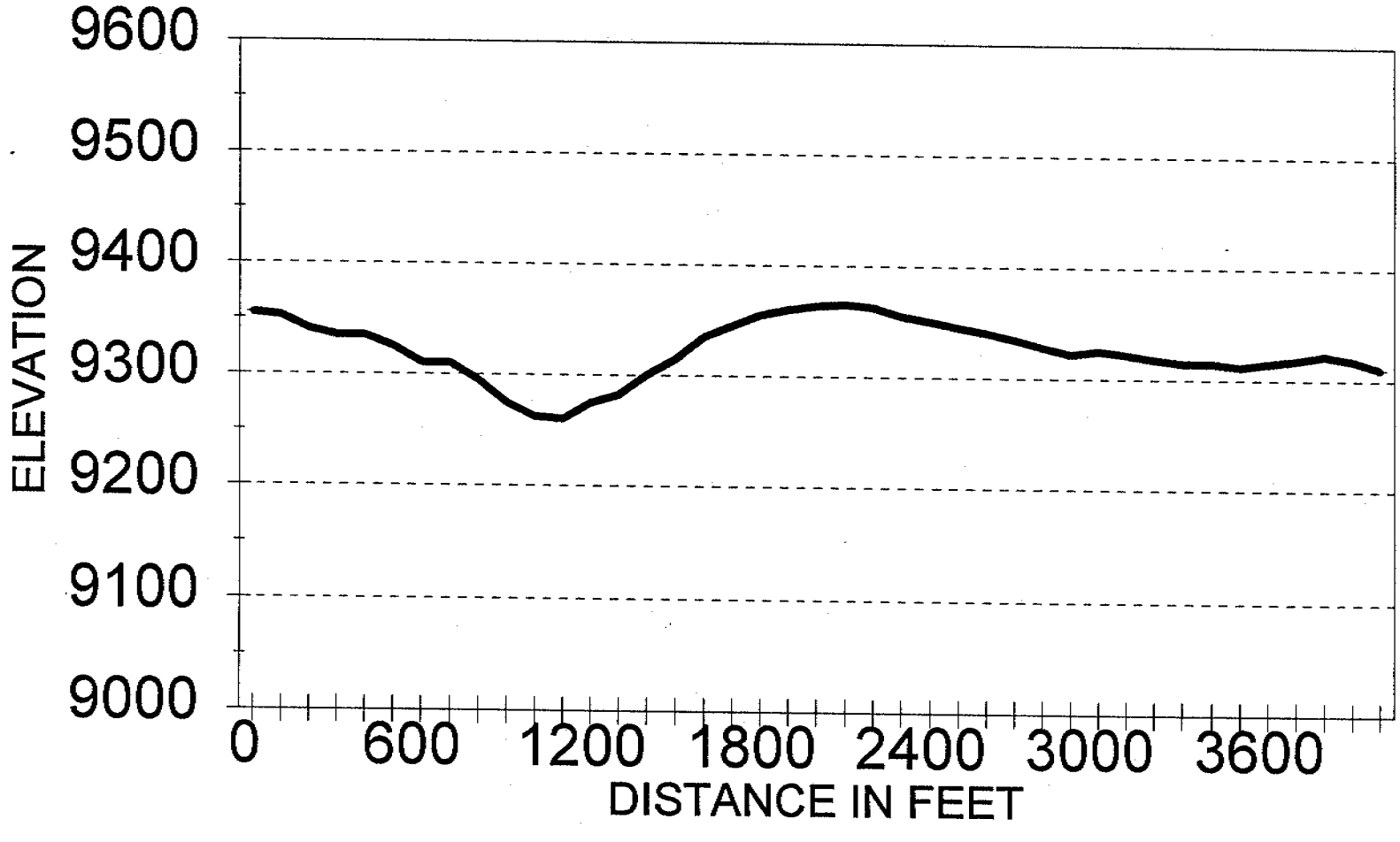


REVISED 6/4/96

FIGURE 50T

AREA 15 TOPOGRAPHIC PROFILE

NORTH-SOUTH



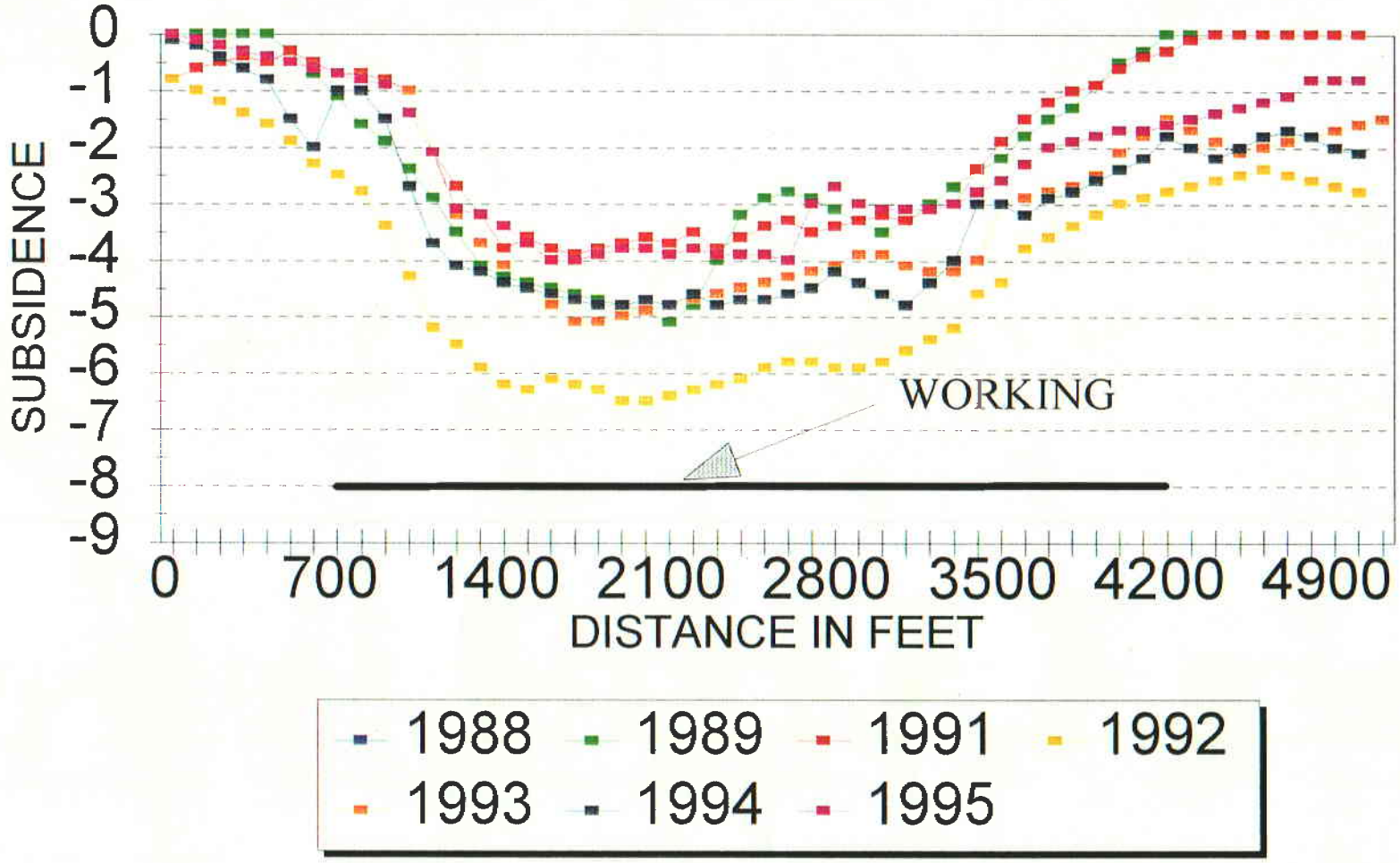
ADDED 6/4/96

ADDED 6/4/96

FIGURE 51

AREA 15 SUBSIDENCE PROFILE

WEST-EAST

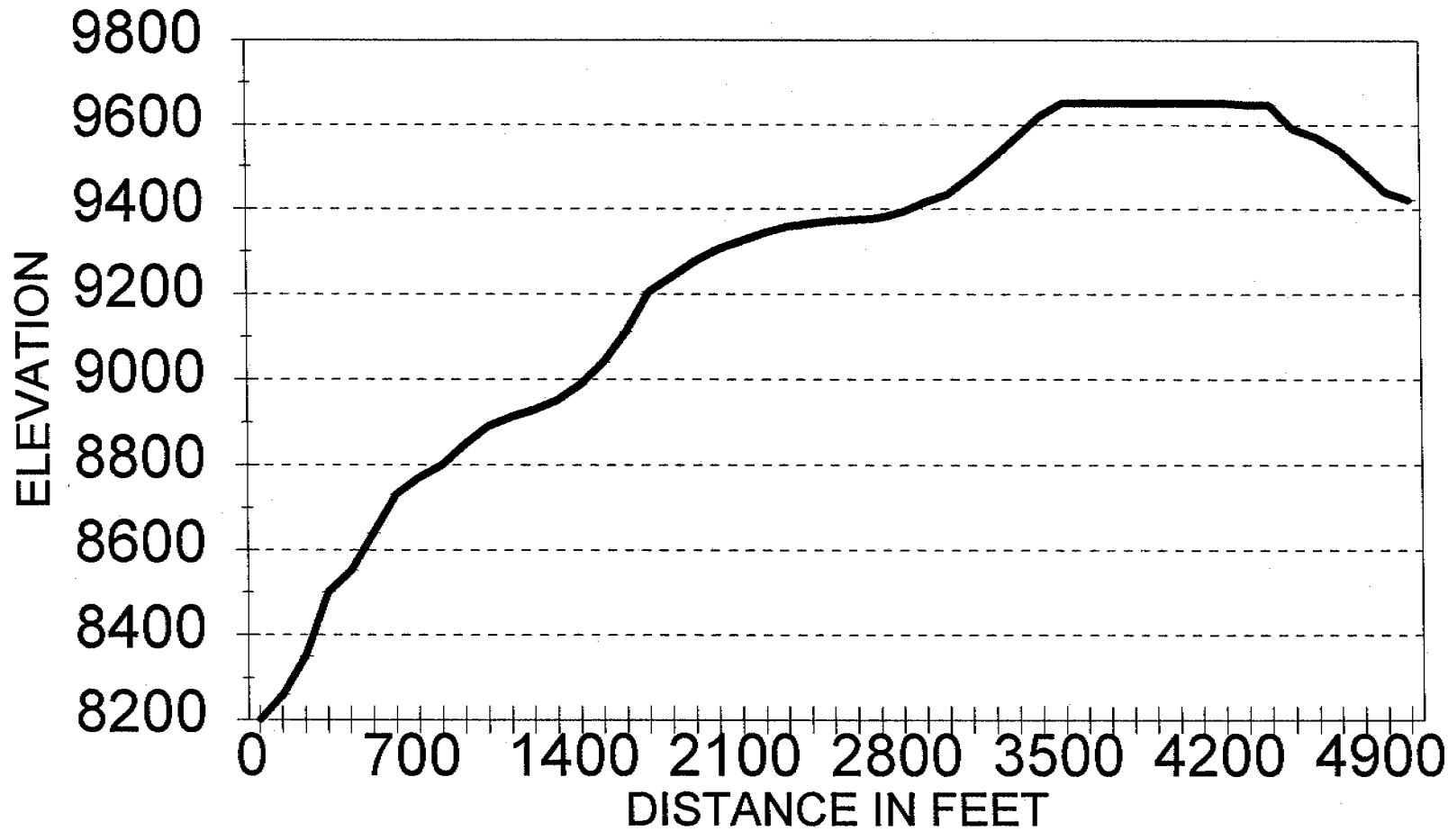


REVISED 6/4/96

FIGURE 51T

AREA 15 TOPOGRAPHIC PROFILE

WEST-EAST



ADDED 6/4/96

SEE AREA 14

COAL OUTCROP

PROFILE

N 356,000

PROFILE

N 354,000

E 2,106,000

E 2,100,000

E 2,102,000

E 2,104,000

SEE AREA 17

COAL OUTCROP

AREA 16

CAD FILE NAME:\SUBSIDE\ 1994 \AREA16.DWG

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

1995 SUBSIDENCE
COTTONWOOD MINE
8TH-11TH EAST LONGWALL PANELS

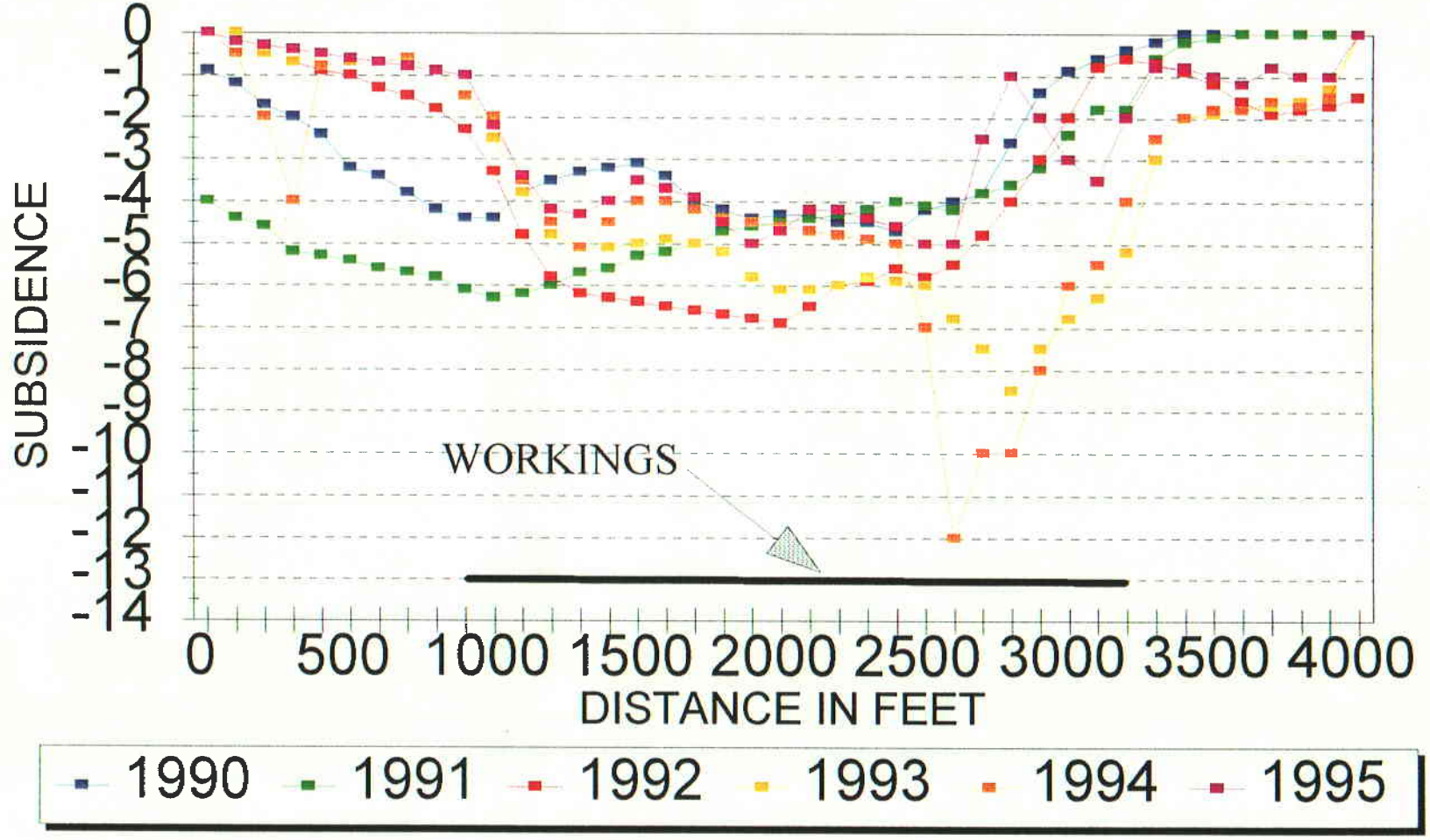
DRAWN BY:	RODGER C. FRY	FIGURE 53	
SCALE:	1" = 500'	DRAWING #:	
DATE:	DEC. 12, 1995	SHEET 1 OF 1	REV.:

ADDED 6/4/96

FIGURE 54

AREA 16 SUBSIDENCE PROFILE

NORTH-SOUTH

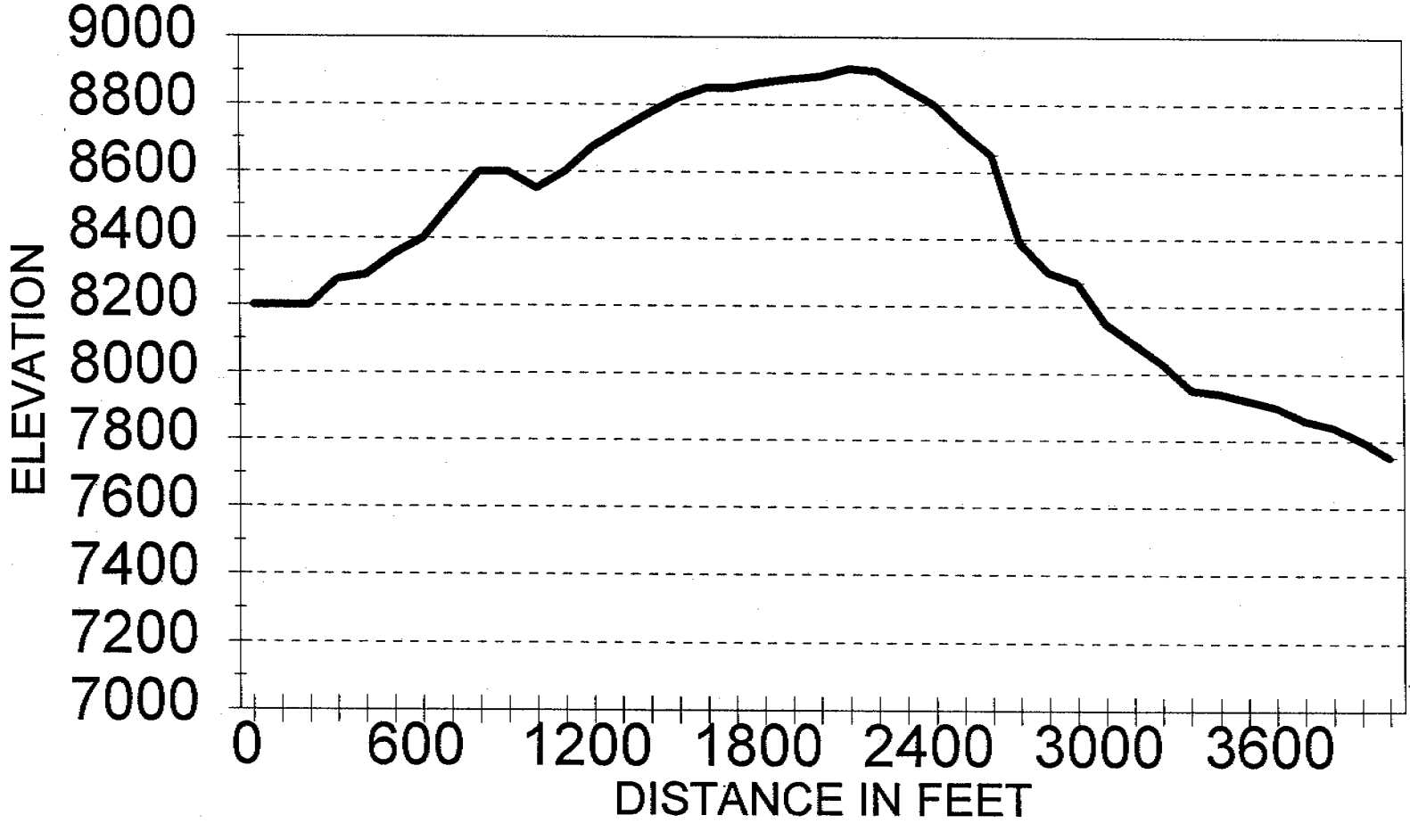


REVISED 6/4/96

FIGURE 54T

AREA 16 TOPOGRAPHIC PROFILE

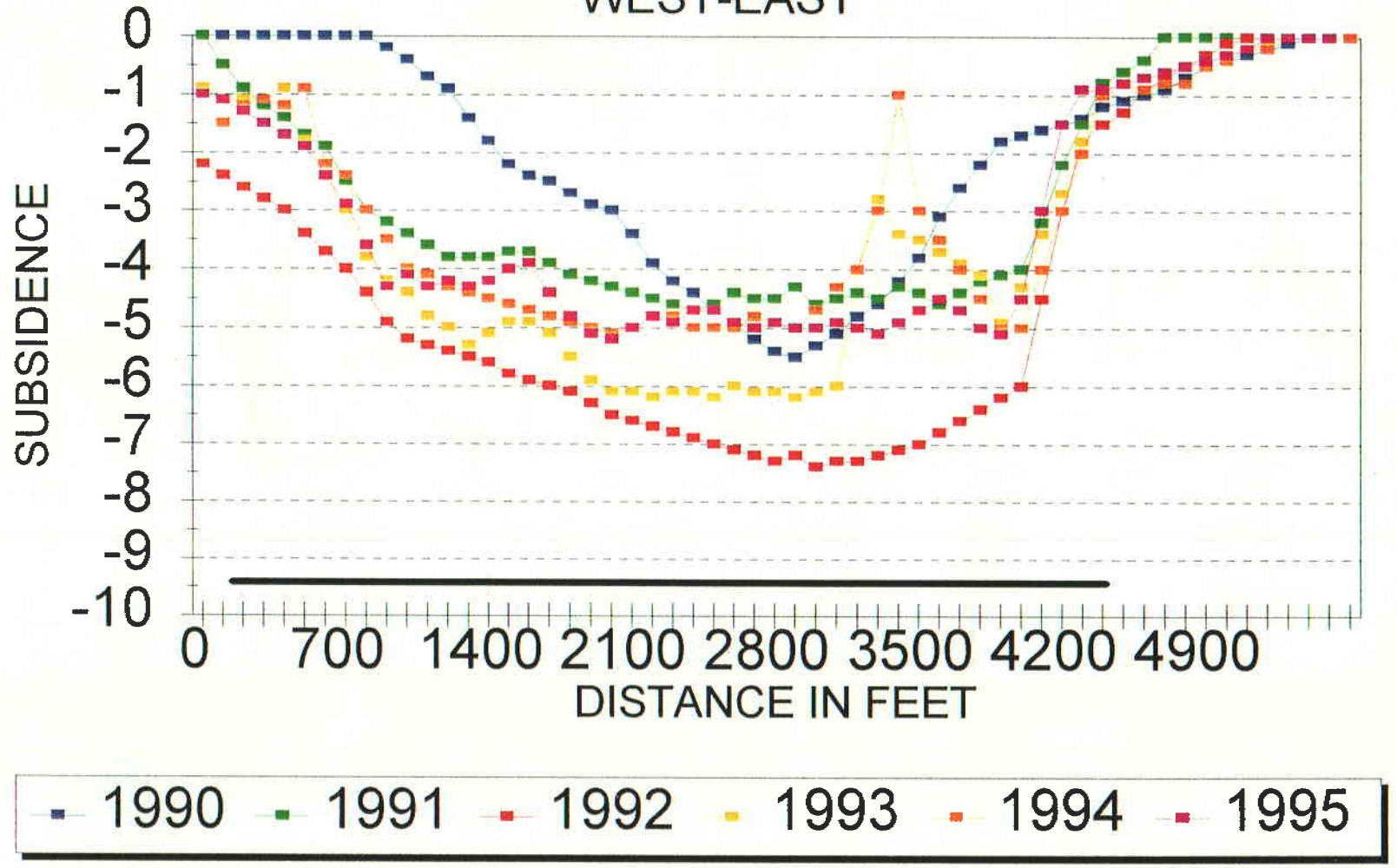
NORTH-SOUTH



ADDED 6/4/96

FIGURE 55

AREA 16 SUBSIDENCE PROFILE

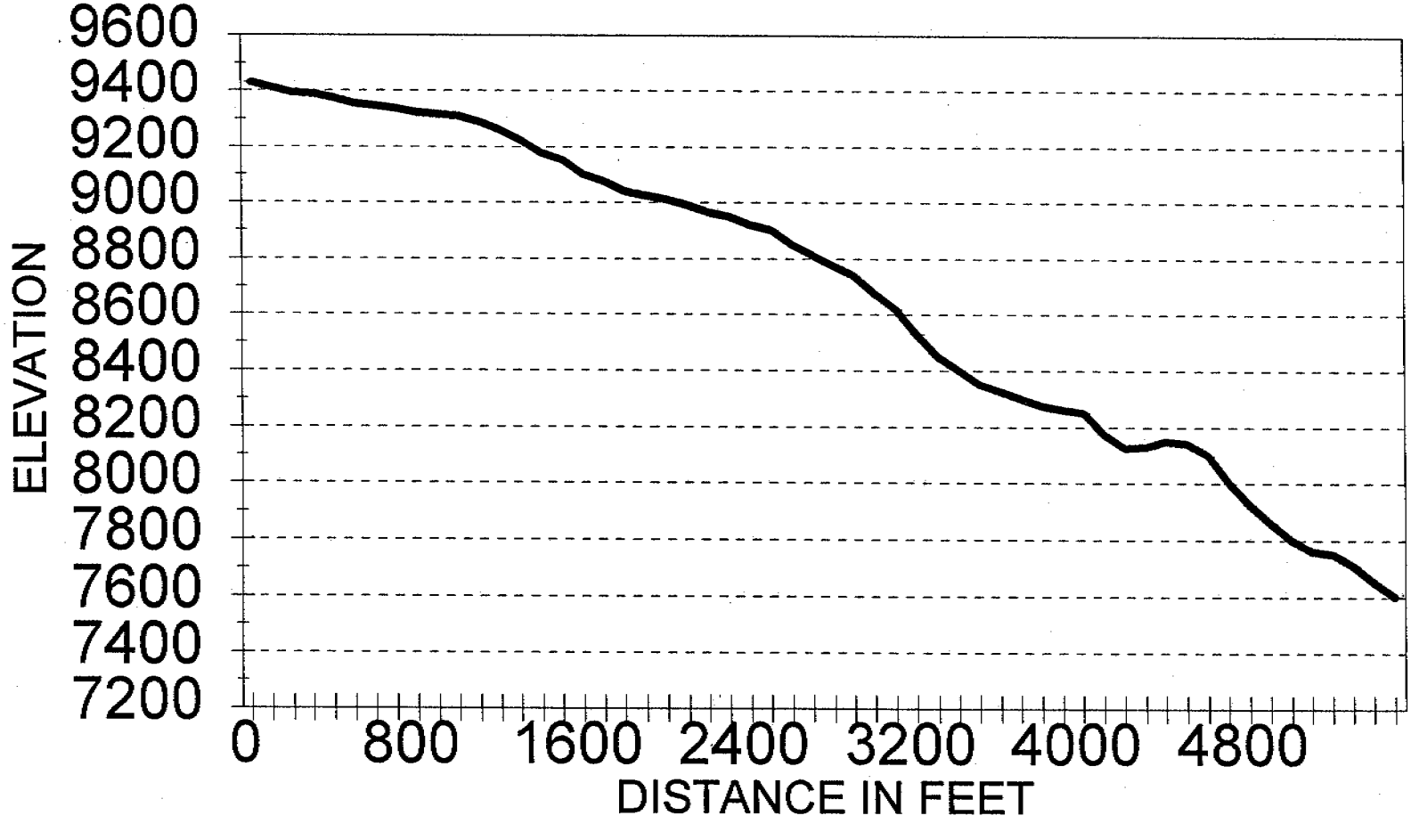


REVISED 6/4/96

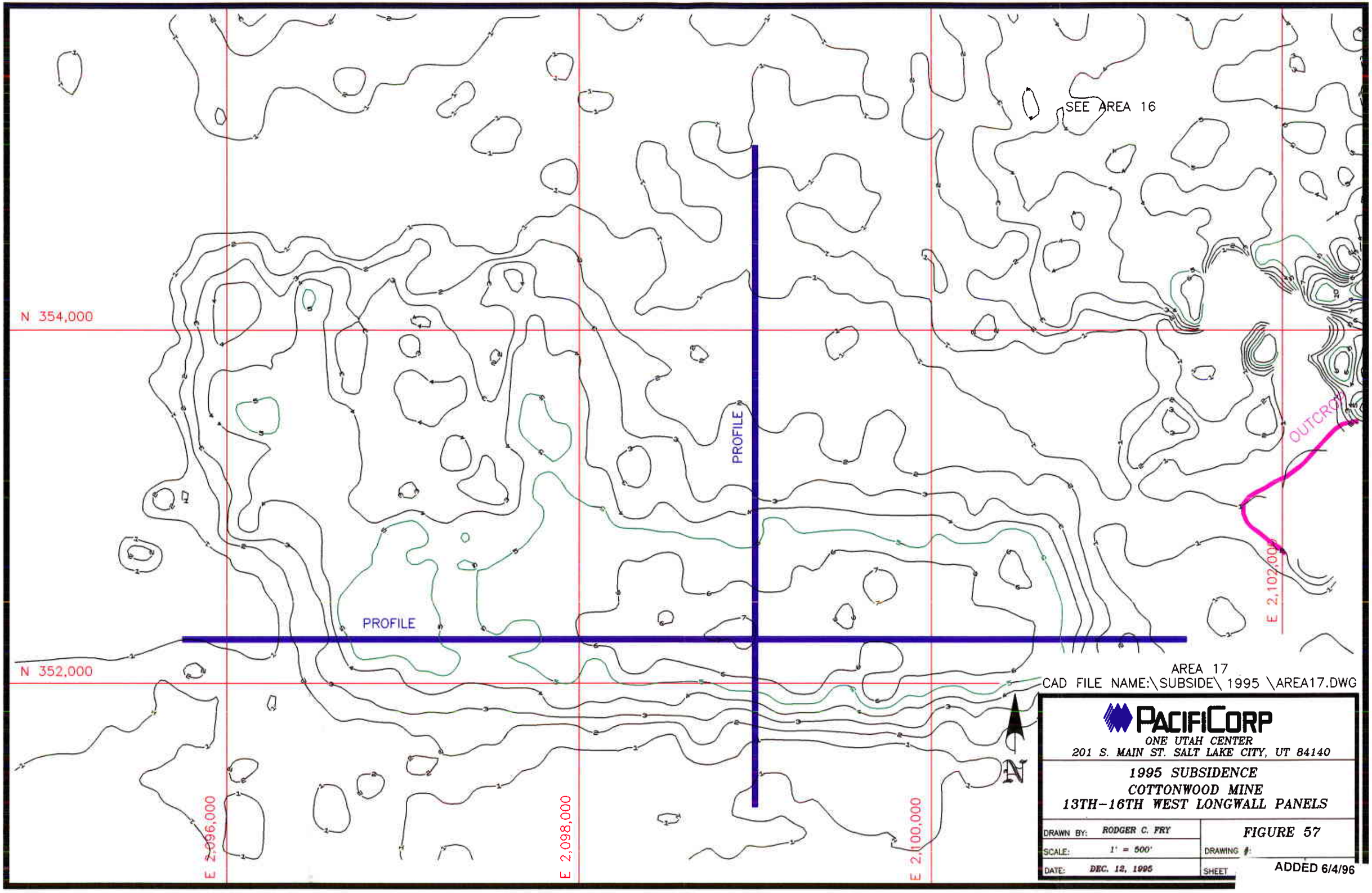
FIGURE 55T

AREA 16 TOPOGRAPHIC PROFILE

WEST-EAST



ADDED 6/4/96



AREA 17
CAD FILE NAME:\SUBSIDE\ 1995 \AREA17.DWG

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

1995 SUBSIDENCE
COTTONWOOD MINE
13TH-16TH WEST LONGWALL PANELS

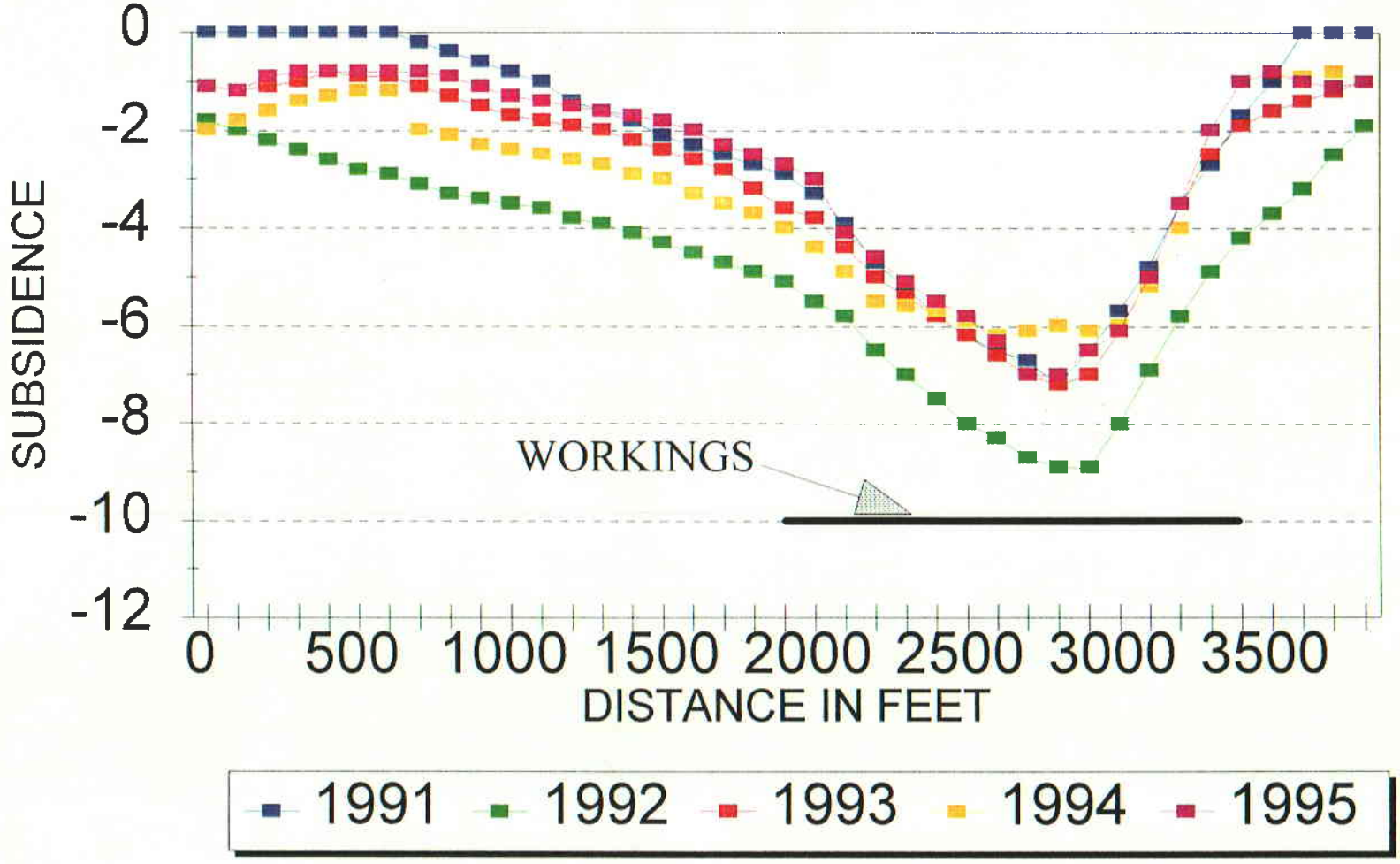
DRAWN BY:	RODGER C. FRY	FIGURE 57	
SCALE:	1" = 500'	DRAWING #:	
DATE:	DEC. 12, 1995	SHEET	

ADDED 6/4/96

FIGURE 58

AREA 17 SUBSIDENCE PROFILE

NORTH-SOUTH

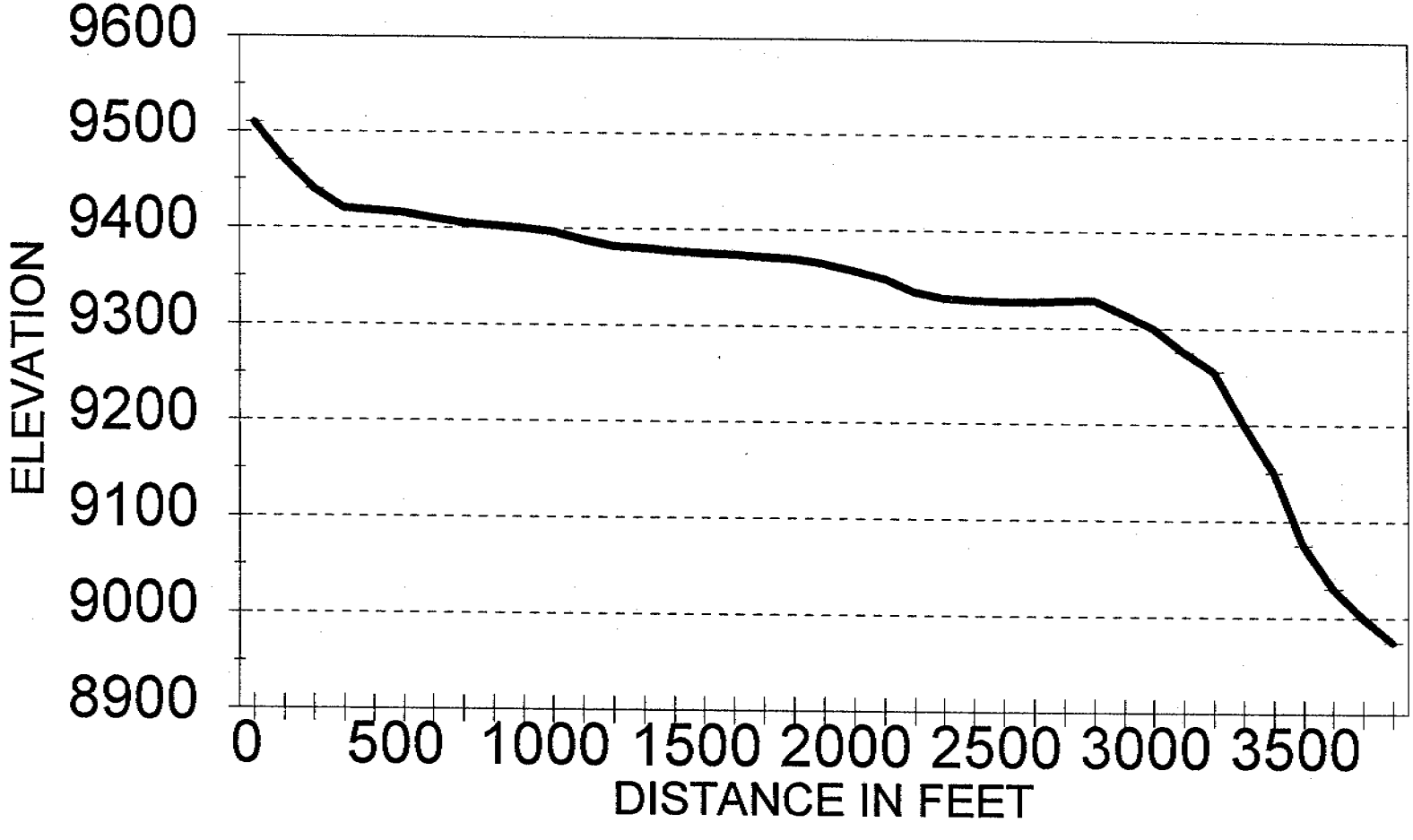


REVISED 6/4/96

FIGURE 58T

AREA 17 TOPOGRAPHIC PROFILE

NORTH-SOUTH

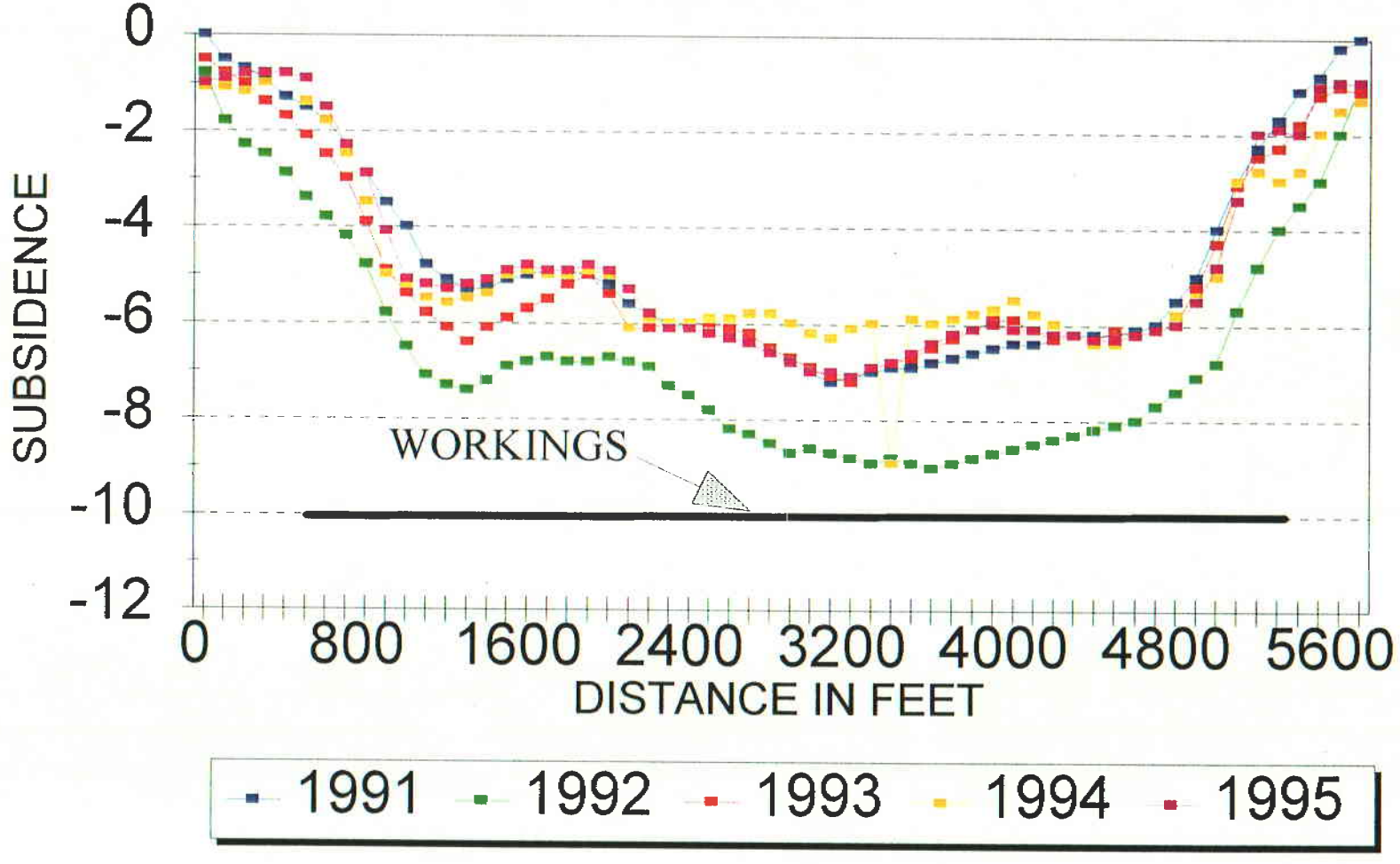


ADDED 6/4/96

FIGURE 59

AREA 17 SUBSIDENCE PROFILE

WEST-EAST

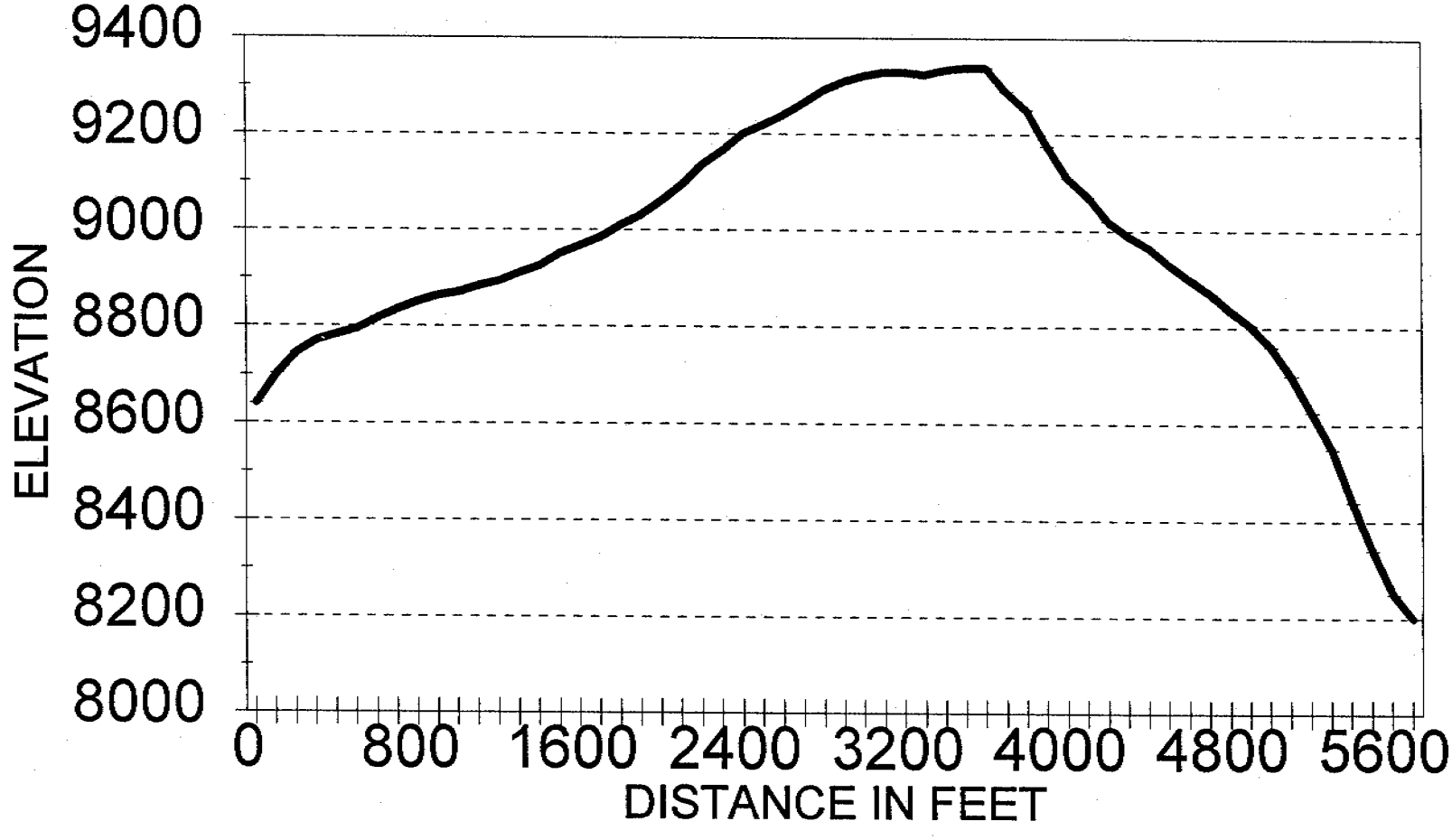


REVISED 6/4/96

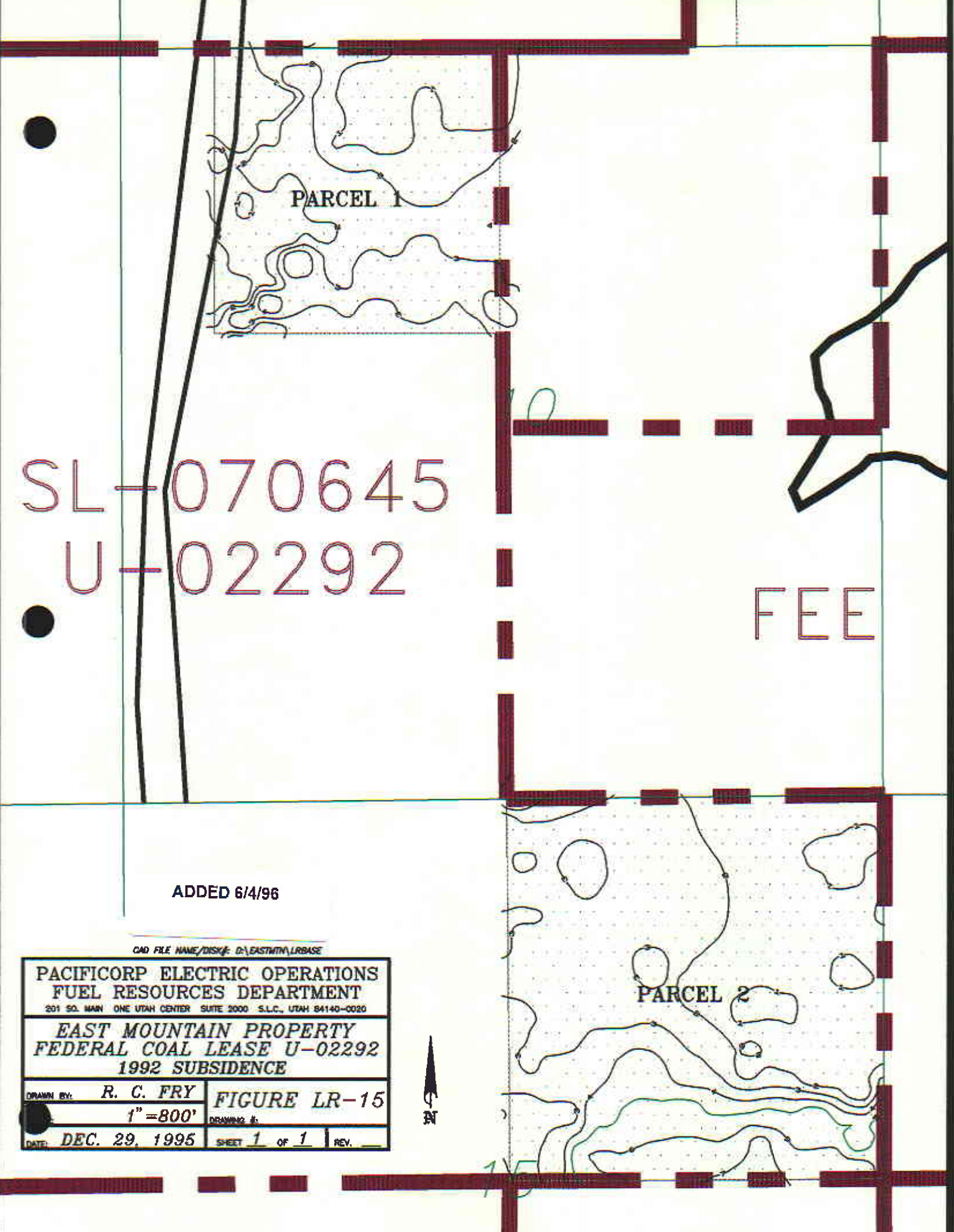
FIGURE 59T

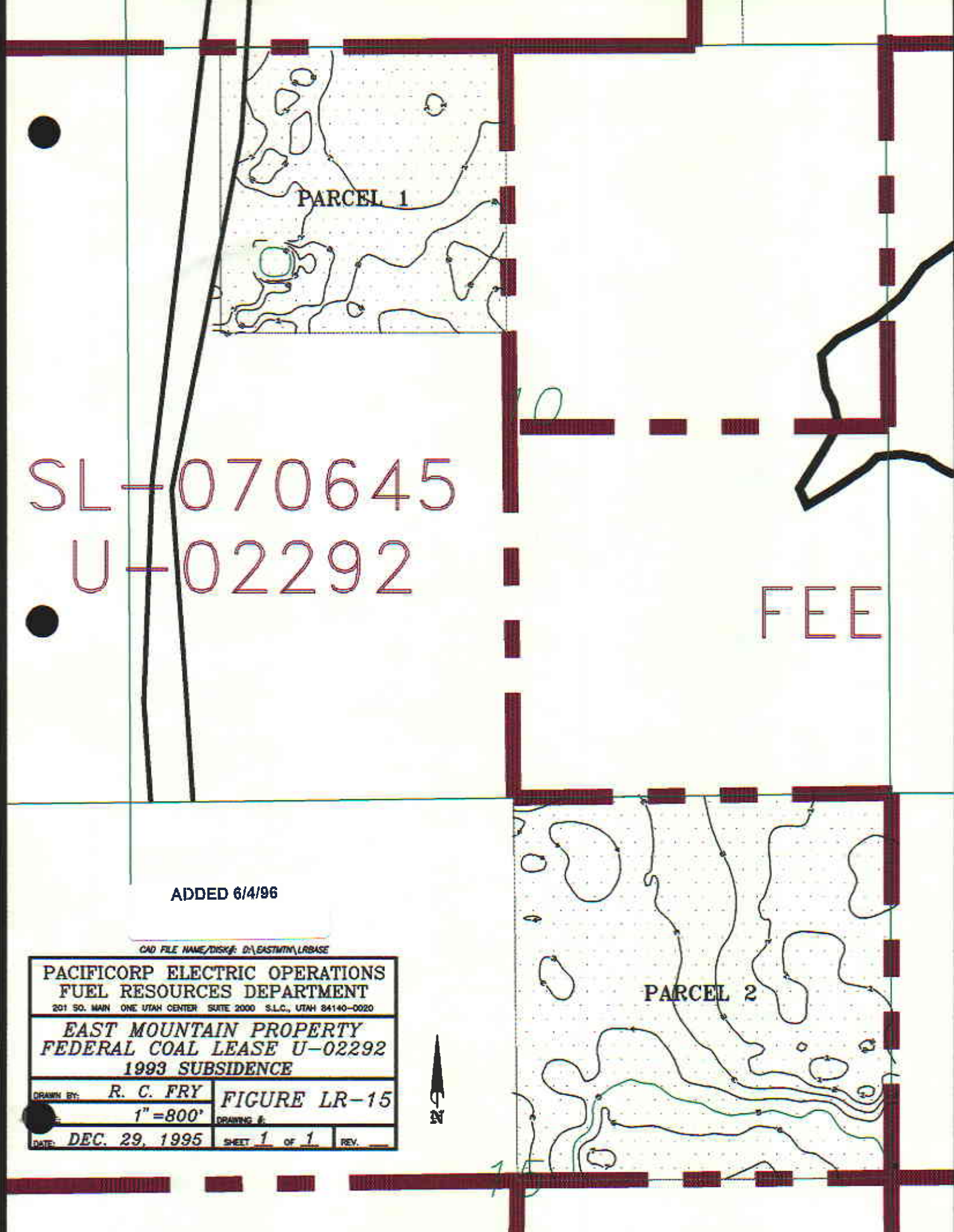
AREA 17 TOPOGRAPHIC PROFILE

WEST-EAST



ADDED 6/4/96


PARCEL 1
SL-070645
U-02292
FEE
PARCEL 2
ADDED 6/4/96
CAD FILE NAME/DISK#: D:\EASTMTN\LRBASE
PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT
201 SO. MAIN ONE UTAH CENTER SUITE 2000 S.L.C., UTAH 84140-0020
EAST MOUNTAIN PROPERTY
FEDERAL COAL LEASE U-02292
1992 SUBSIDENCE
DRAWN BY: R. C. FRY
1"=800'
DATE: DEC. 29, 1995
FIGURE LR-15
DRAWING #:
SHEET 1 OF 1
REV.
N



ADDED 6/4/96

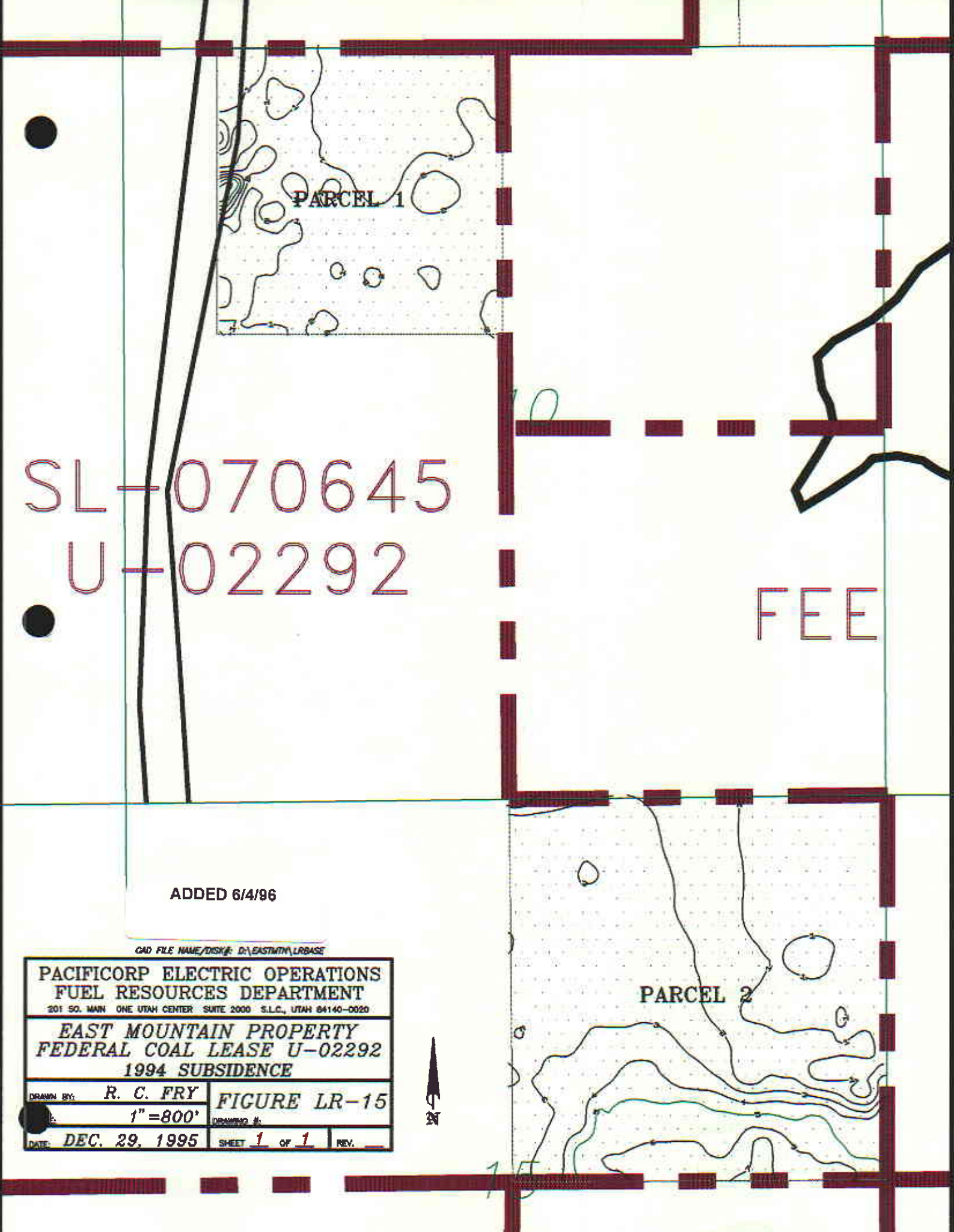
CAD FILE NAME/DISK#: D:\EASTMTN\LRBASE

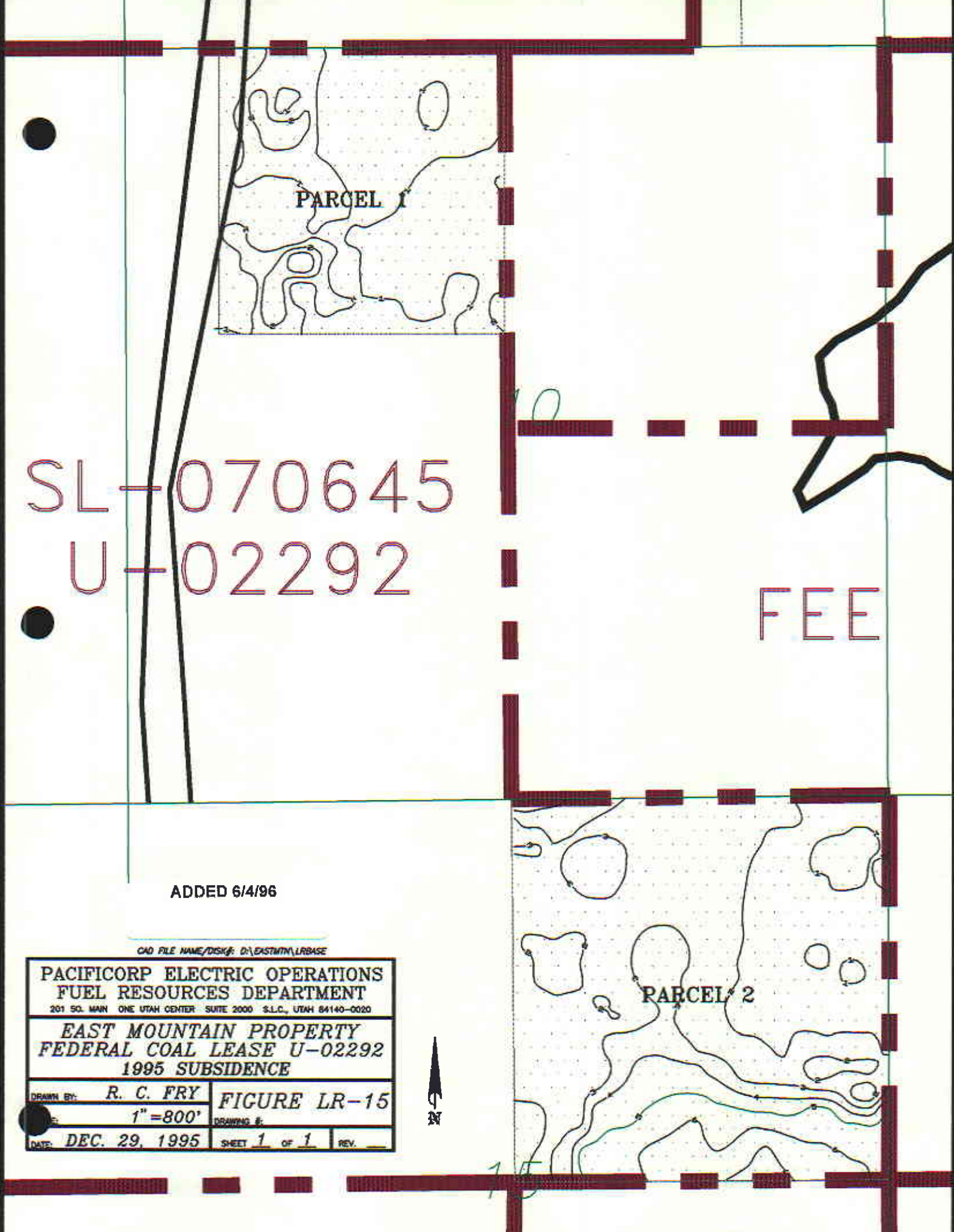
PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT
201 SO. MAIN ONE UTAH CENTER SUITE 2000 S.L.C., UTAH 84140-0020

EAST MOUNTAIN PROPERTY
FEDERAL COAL LEASE U-02292
1993 SUBSIDENCE

DRAWN BY: R. C. FRY
1" =800'
DATE: DEC. 29, 1995

FIGURE LR-15
DRAWING #:
SHEET 1 OF 1
REV. ___


PARCEL 1
SL-070645
U-02292
FEE
PARCEL 2
ADDED 6/4/96
CAD FILE NAME/DISK#: D:\EASTMTN\LRBASE
PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT
201 SO. MAIN ONE UTAH CENTER SUITE 2000 S.L.C., UTAH 84140-0020
EAST MOUNTAIN PROPERTY
FEDERAL COAL LEASE U-02292
1994 SUBSIDENCE
DRAWN BY: R. C. FRY
1" =800'
DATE: DEC. 29, 1995
FIGURE LR-15
SHEET 1 OF 1
REV.
N



ADDED 6/4/96

CAD FILE NAME/DISK#: D:\EASTMTN\LRBASE

PACIFICORP ELECTRIC OPERATIONS
FUEL RESOURCES DEPARTMENT
201 SO. MAIN ONE UTAH CENTER SUITE 2000 S.L.C., UTAH 84140-0020

EAST MOUNTAIN PROPERTY
FEDERAL COAL LEASE U-02292
1995 SUBSIDENCE

DRAWN BY: R. C. FRY	FIGURE LR-15
SCALE: 1" =800'	DRAWING #:
DATE: DEC. 29, 1995	SHEET 1 OF 1 REV. —

STATE
ML-22509

U-7653

U-47977

SL-050862

U-024319

U-084924

U-084923

U-47979

SL-064607
SL-064621

SULA
#284

SL-070645
U-02292

FEE

FEE

FEE

SL-066116

U-083066

U-040151

FEE

FEE

U-1358

SL-064900

U-1108

U-02664

U-02664

SL-050133

FEE

U-044025

FEE

U-47978

AREA 1 PROFILE FIGURE 1

AREA 3 PROFILE FIGURE 14

AREA 7 PROFILE FIGURE 9

AREA 8 PROFILE FIGURE 33

AREA 1 PROFILE FIGURE 42

AREA 13 PROFILE FIGURE 43

AREA 14 PROFILE FIGURE 46

AREA 14 PROFILE FIGURE 47

AREA 15 PROFILE FIGURE 50

AREA 15 PROFILE FIGURE 51

AREA 16 PROFILE FIGURE 54

AREA 16 PROFILE FIGURE 55

AREA 17 PROFILE FIGURE 58

AREA 17 PROFILE FIGURE 59

ADDED 6/4/96

LEGEND

LEASE LINE

RELINQUISHED AREA

AREA 8 PROFILE FIGURE 33 — PROFILE LINE LOCATION

0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000

SCALE IN FEET

INTERWEST
MINING COMPANY
ONE UTAH CENTER
201 SOUTH MAIN STREET
SALT LAKE CITY, UT. 84140-0020

LEASE RELINQUISHMENT
TOPOGRAPHIC MAP
WITH PROFILE LINES

DRAWN BY:	E. C. PRY	RELOVER.DWG
SCALE:	1" = 2,000'	
DATE:	MARCH 5, 1996	

FIGURE 6

AREA 1 SUBSIDENCE PROFILE

NORTH-SOUTH

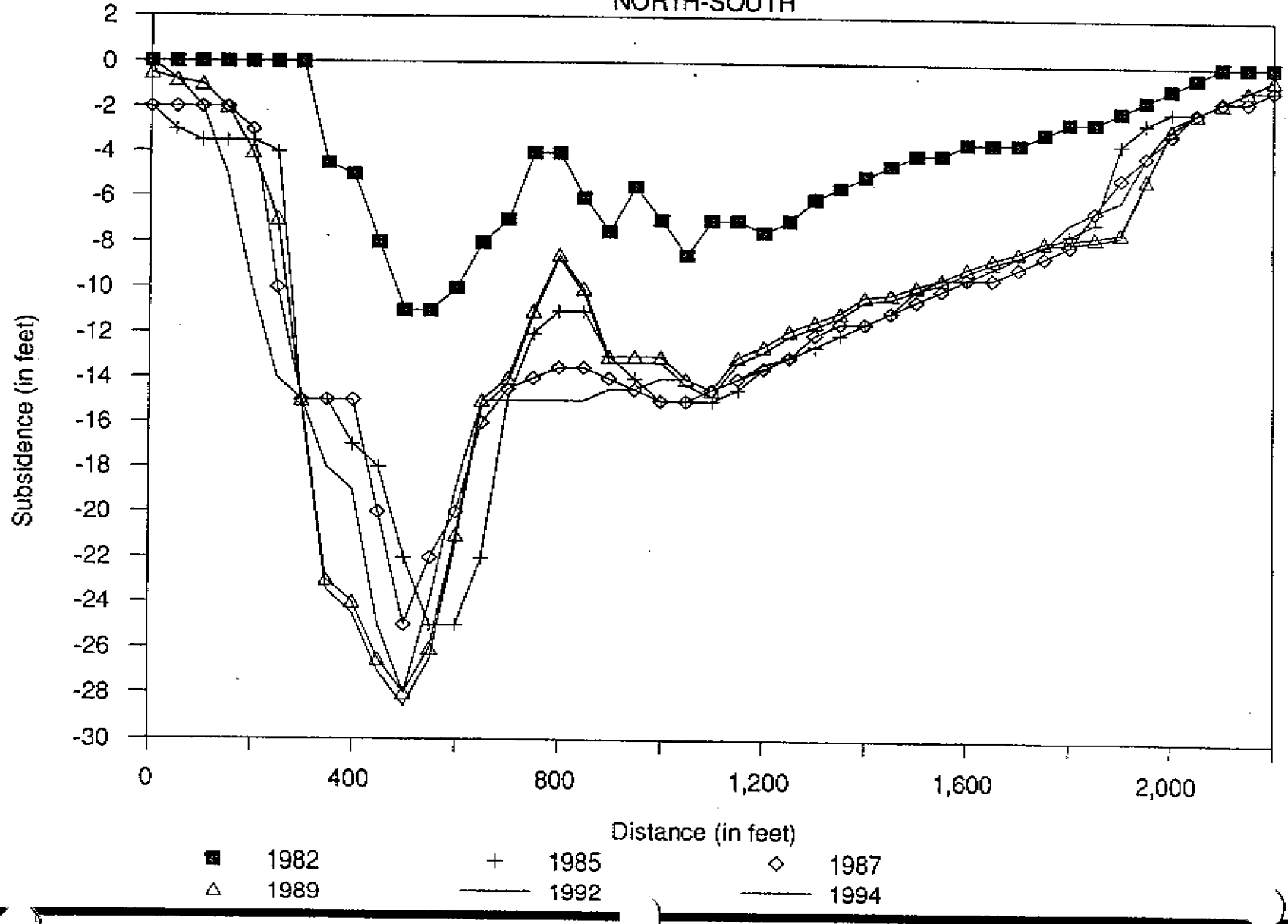


FIGURE 7

AREA 1 SUBSIDENCE PROFILE

WEST-EAST

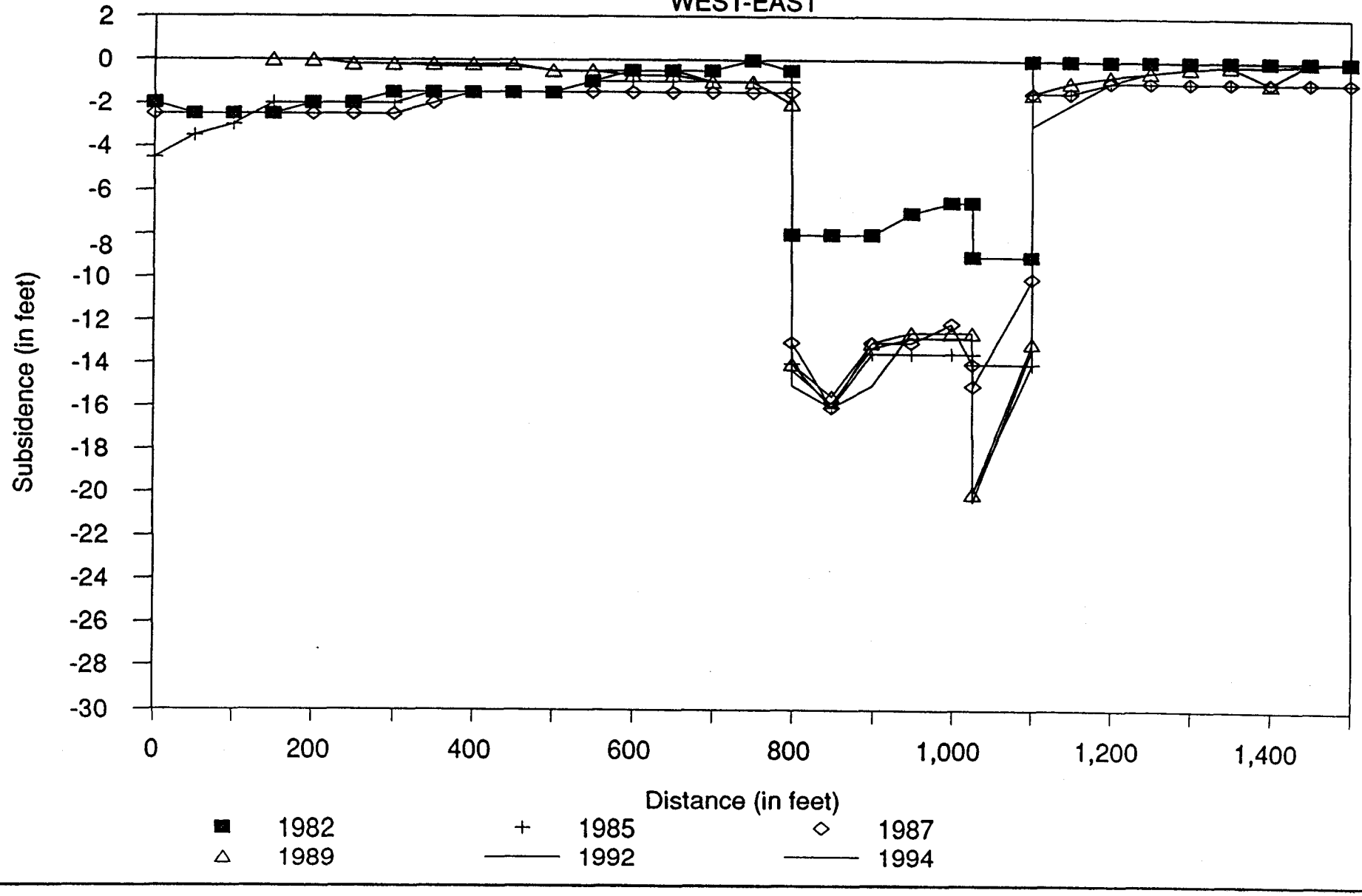


FIGURE 11
AREA 2 SUBSIDENCE PROFILE
NORTH-SOUTH

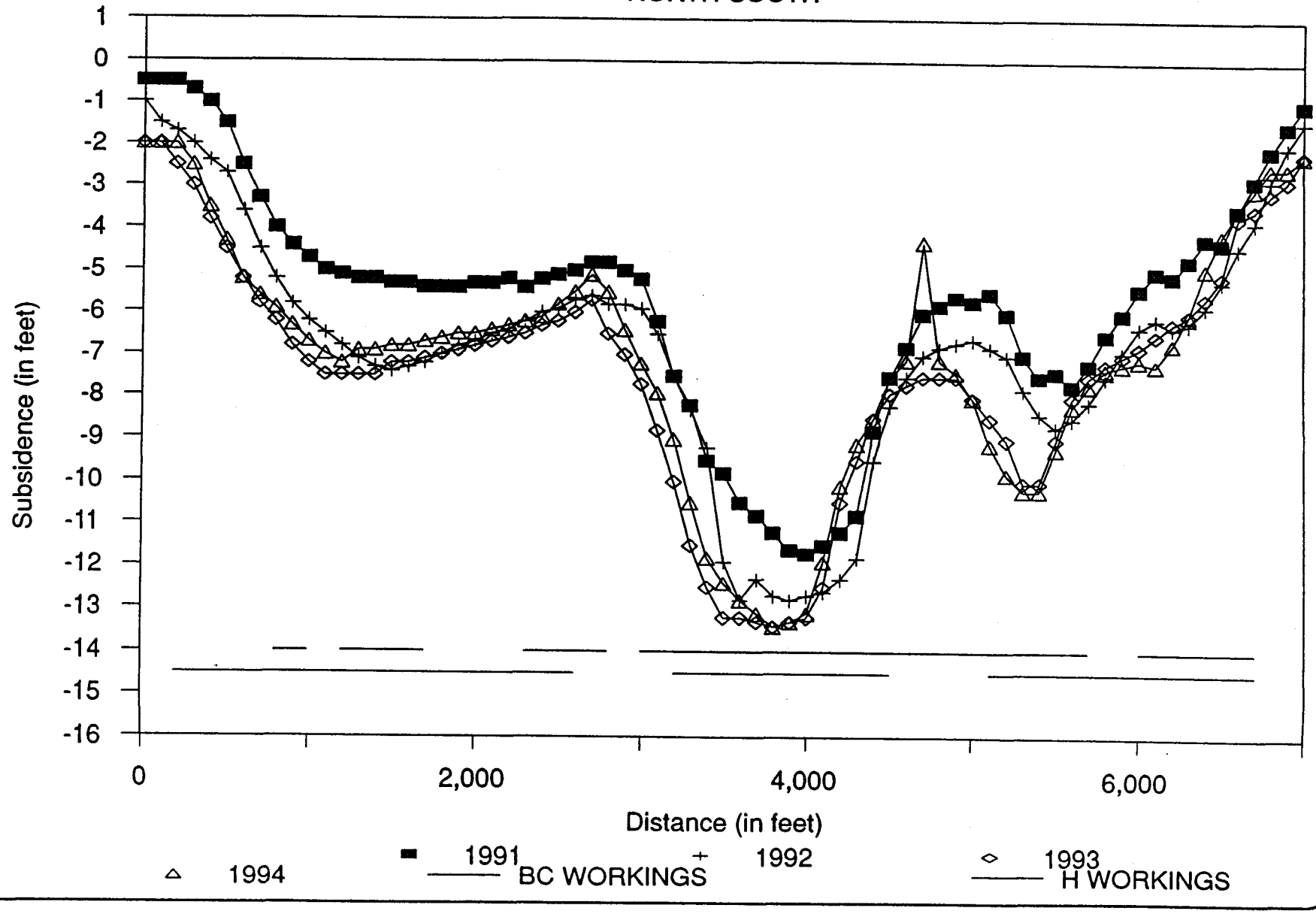


FIGURE 12

AREA 2 SUBSIDENCE PROFILE

WEST-EAST

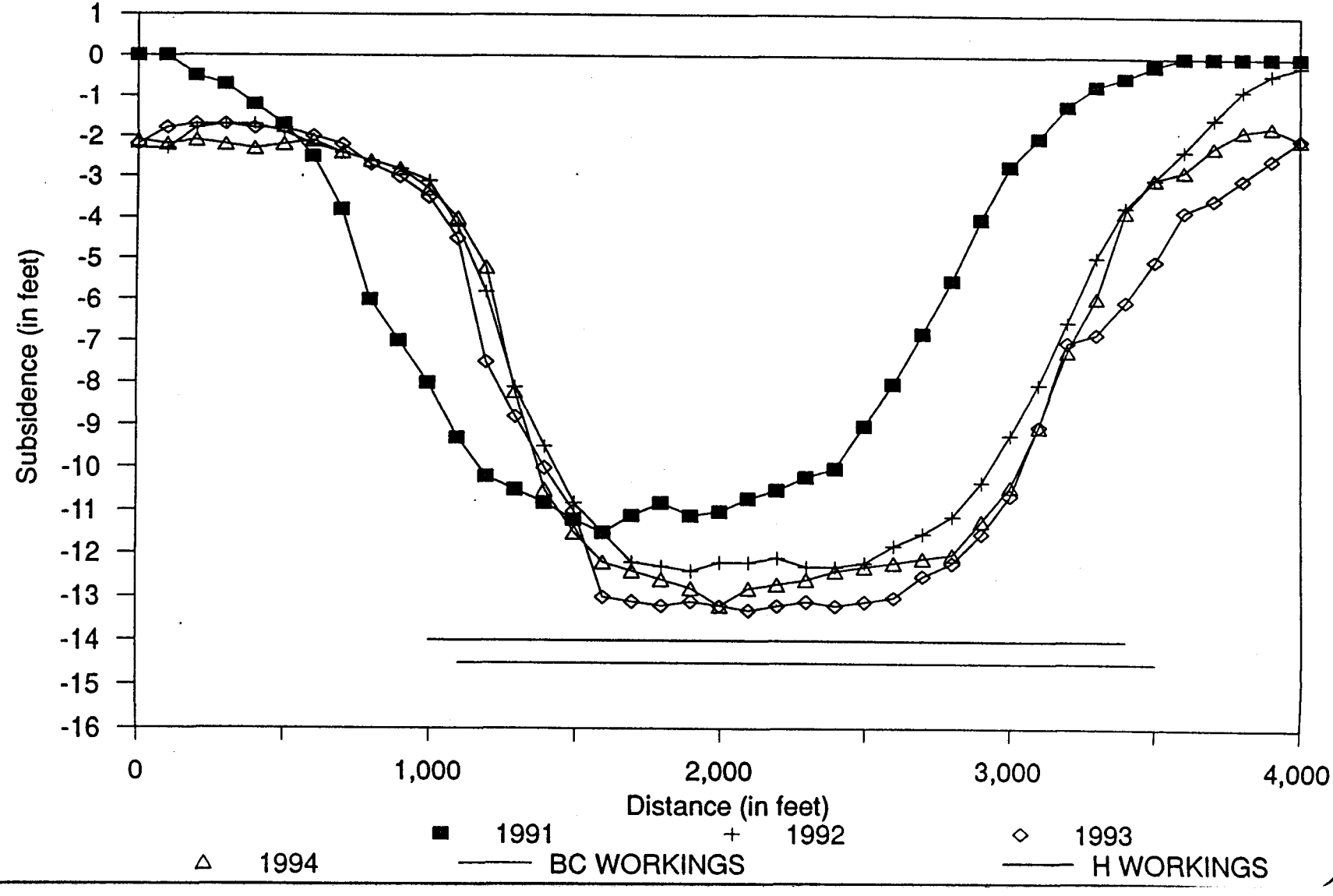


FIGURE 14

AREA 3 SUBSIDENCE PROFILE

NORTH-SOUTH

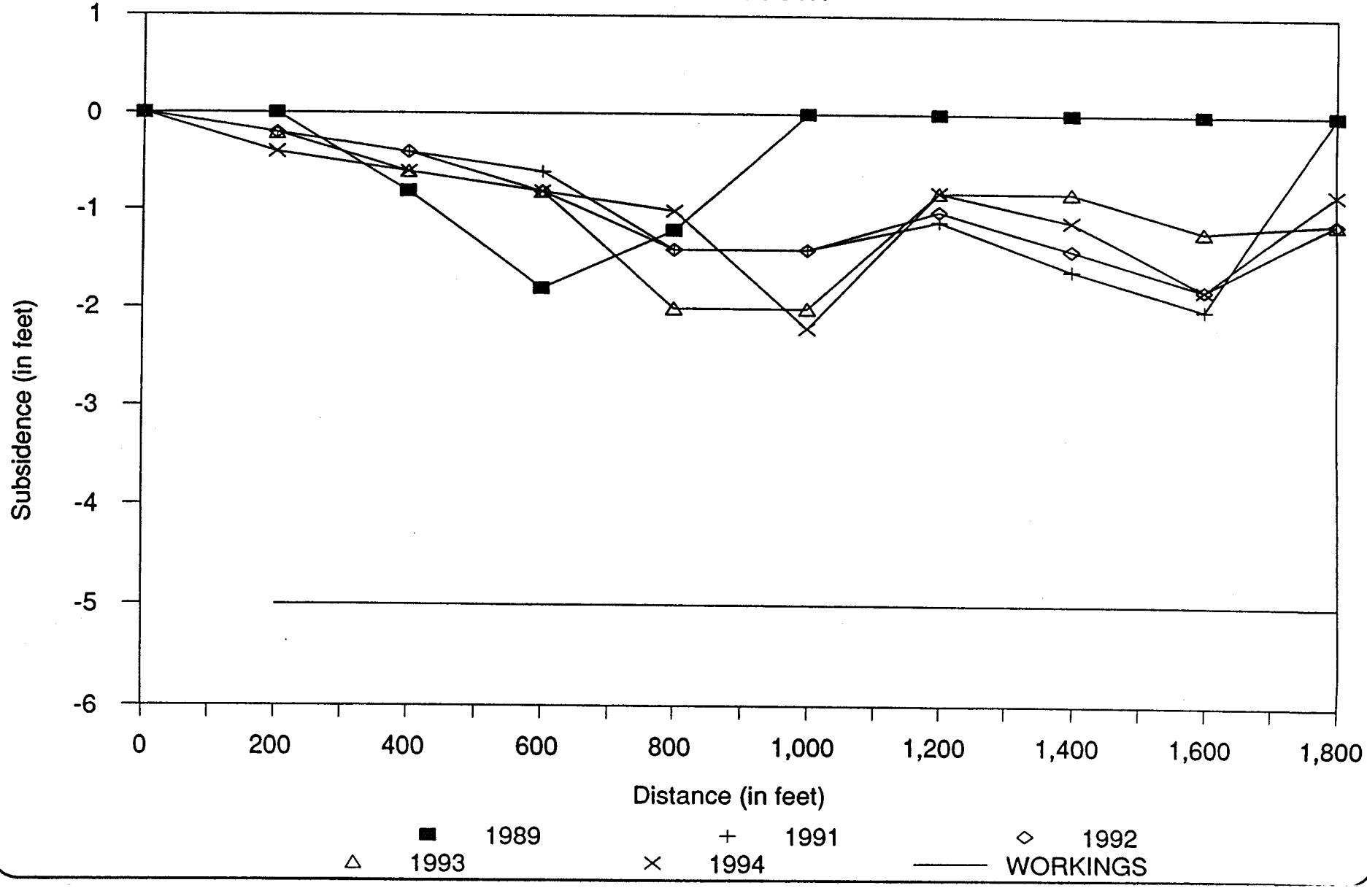


FIGURE 29

AREA 7 SUBSIDENCE PROFILE

SOUTHWEST-NORTHEAST

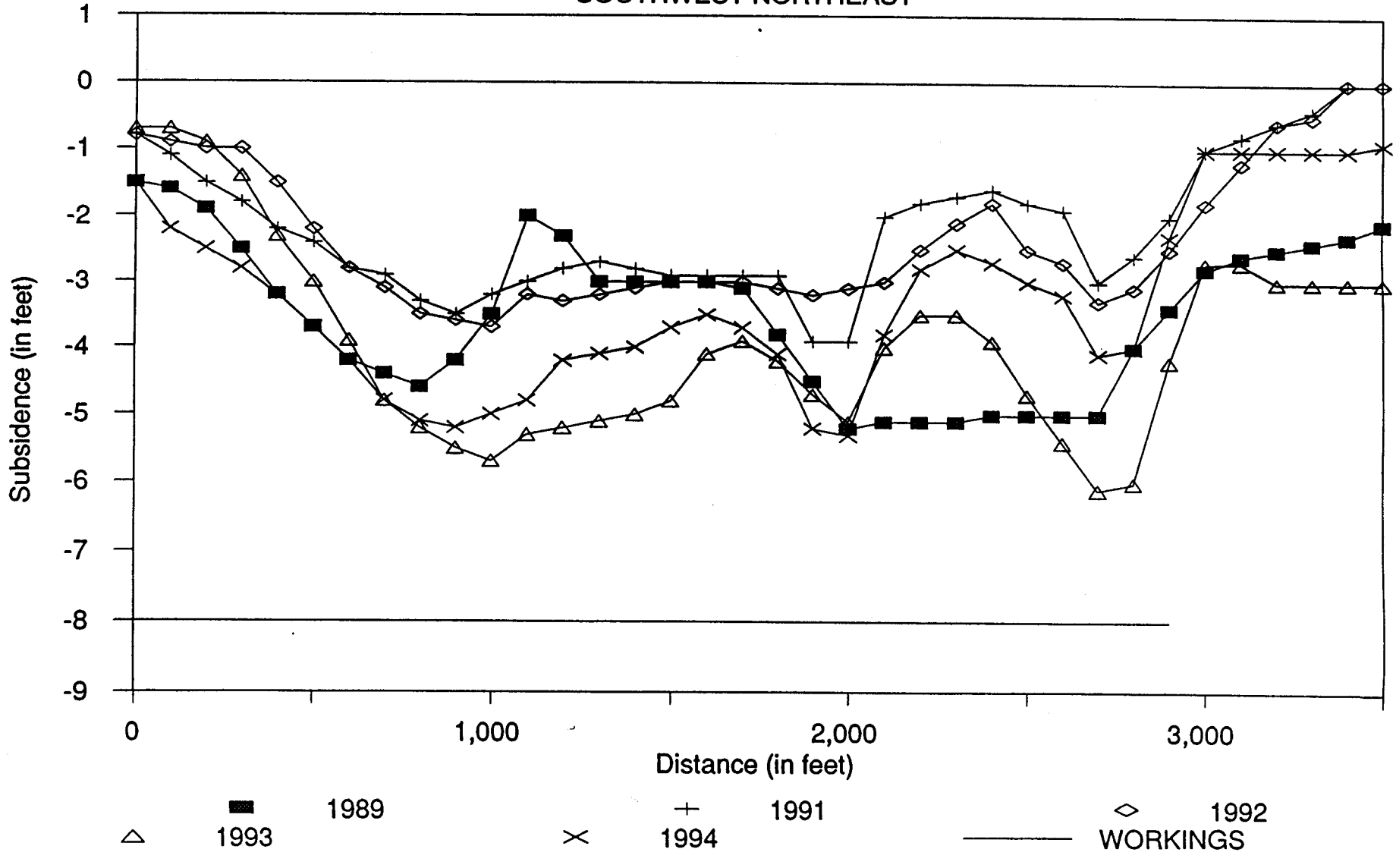


FIGURE 33

AREA 8 SUBSIDENCE PROFILE

WEST-EAST

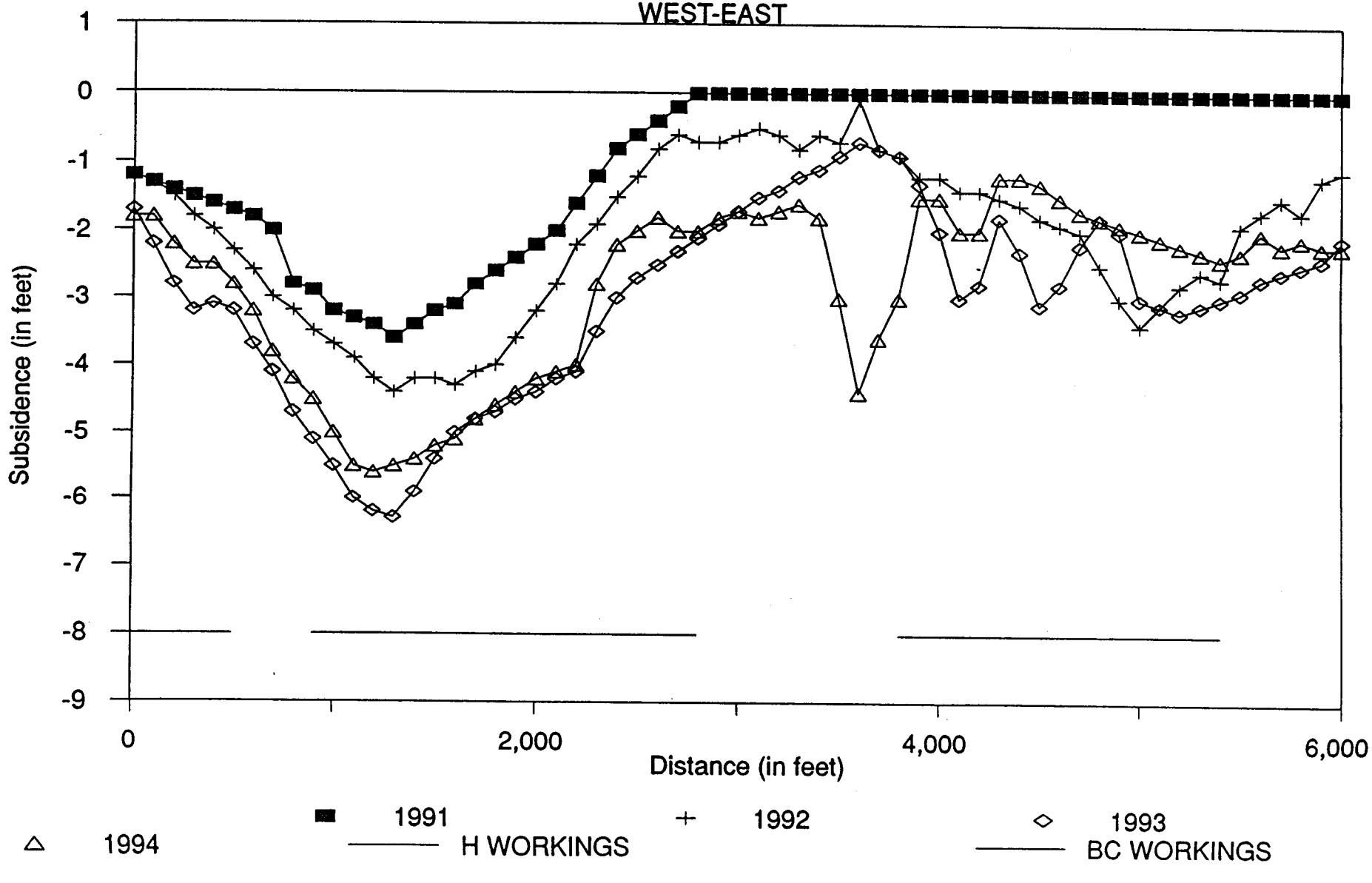


FIGURE 42

AREA 13 SUBSIDENCE PROFILE

NORTH-SOUTH

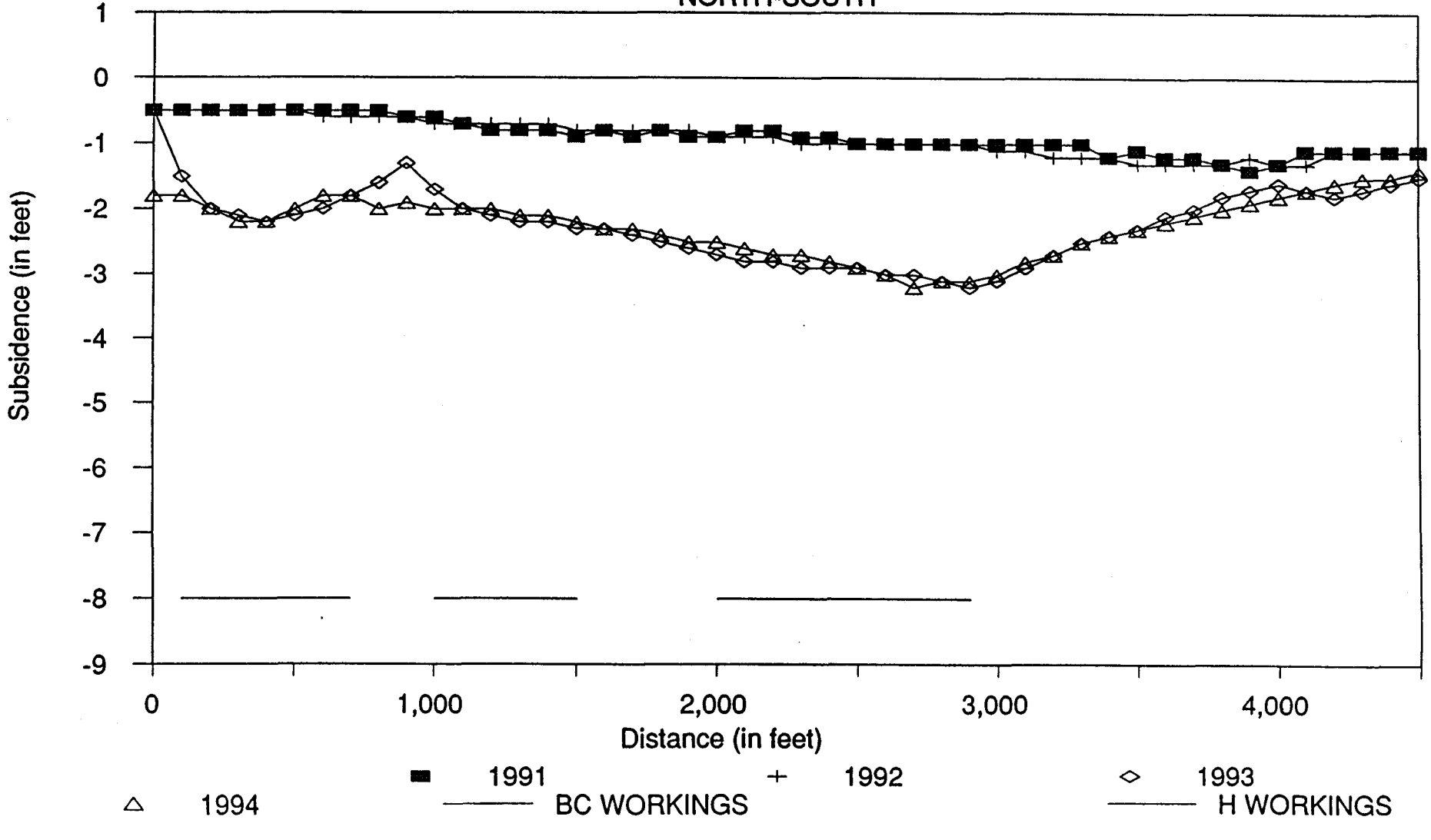


FIGURE 43

AREA 13 SUBSIDENCE PROFILE

WEST-EAST

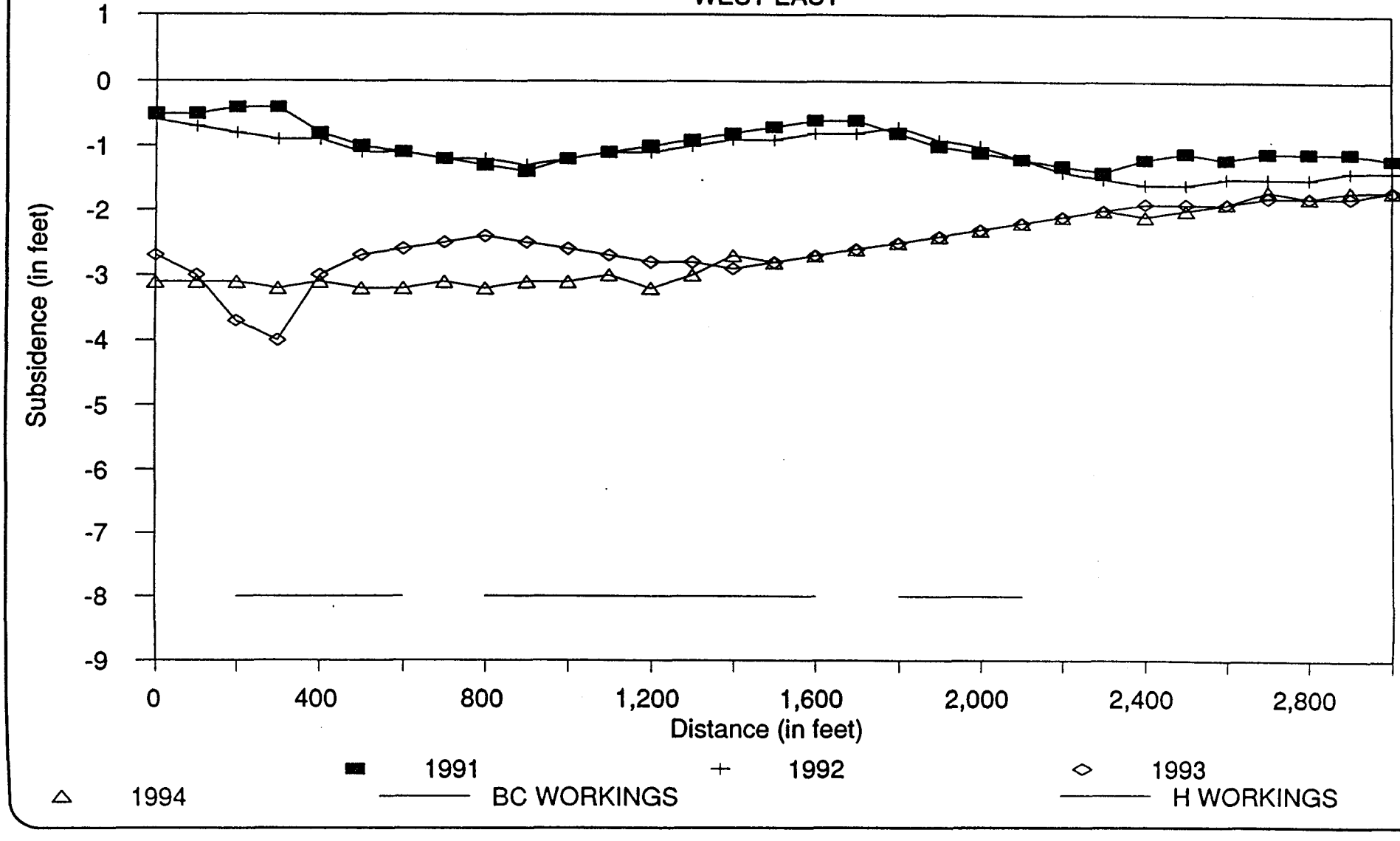


FIGURE 46

AREA 14 SUBSIDENCE PROFILE

NORTH-SOUTH

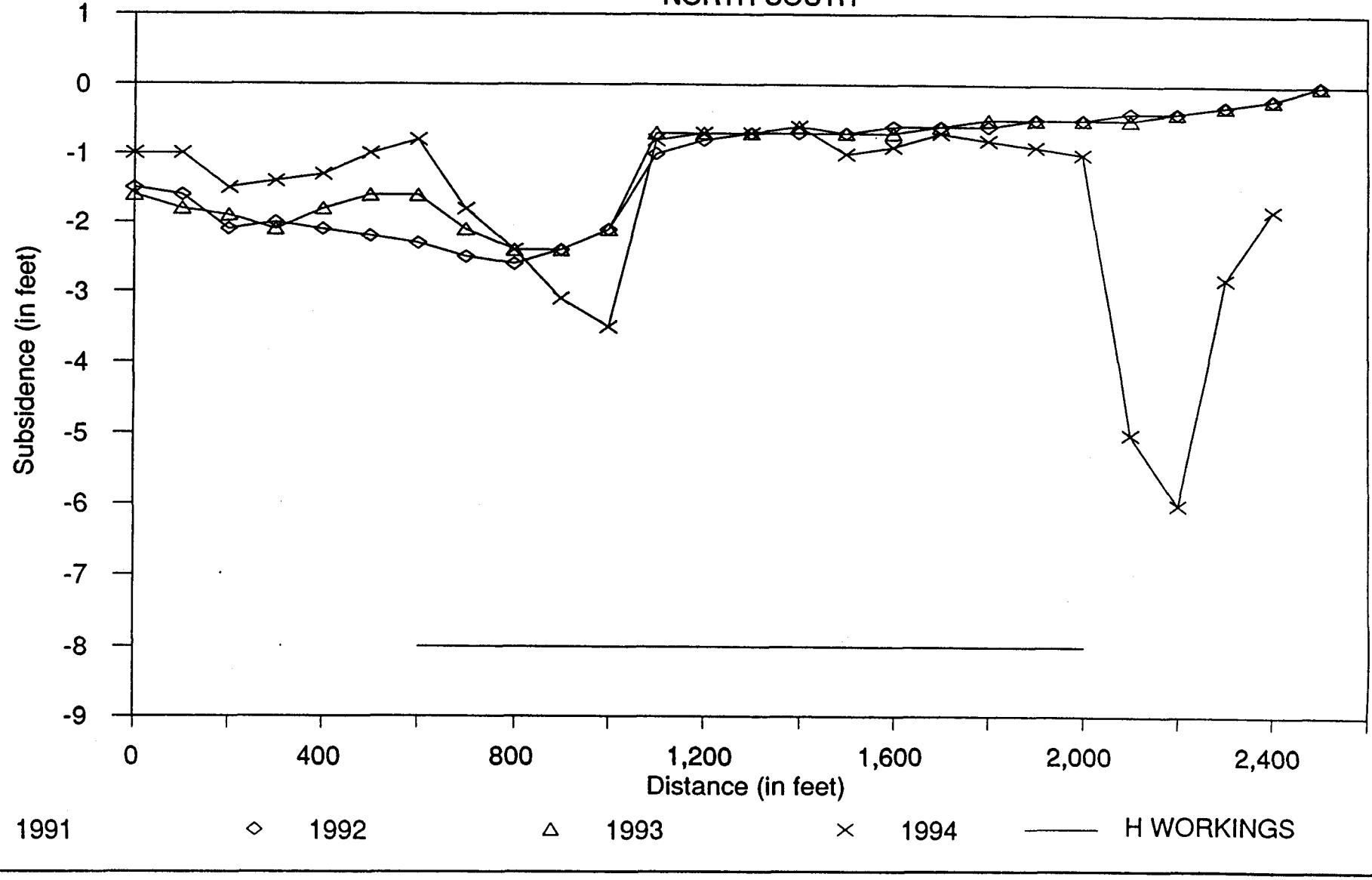


FIGURE 47

AREA 14 SUBSIDENCE PROFILE

WEST-EAST

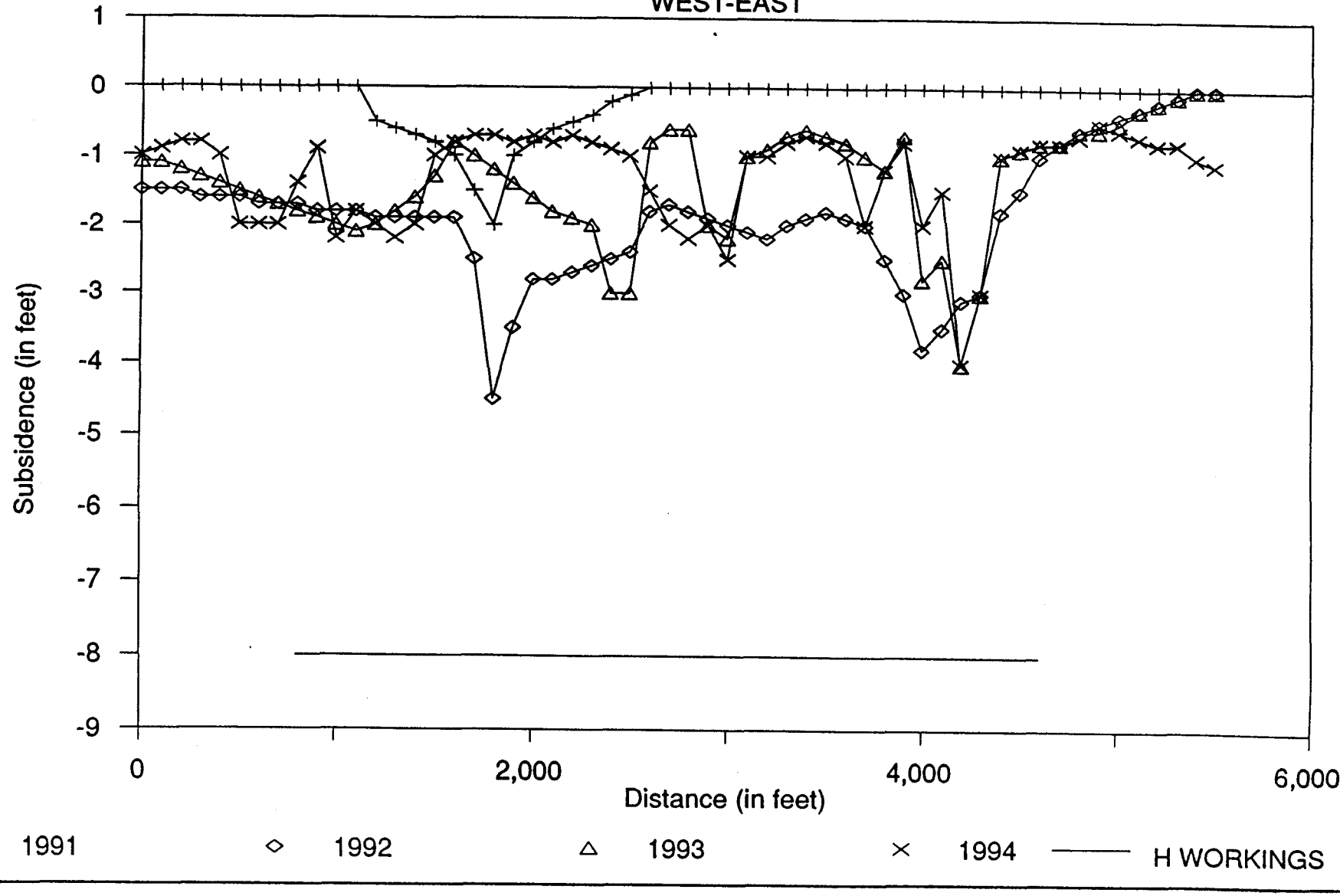


FIGURE 50

AREA 15 SUBSIDENCE PROFILE

NORTH-SOUTH

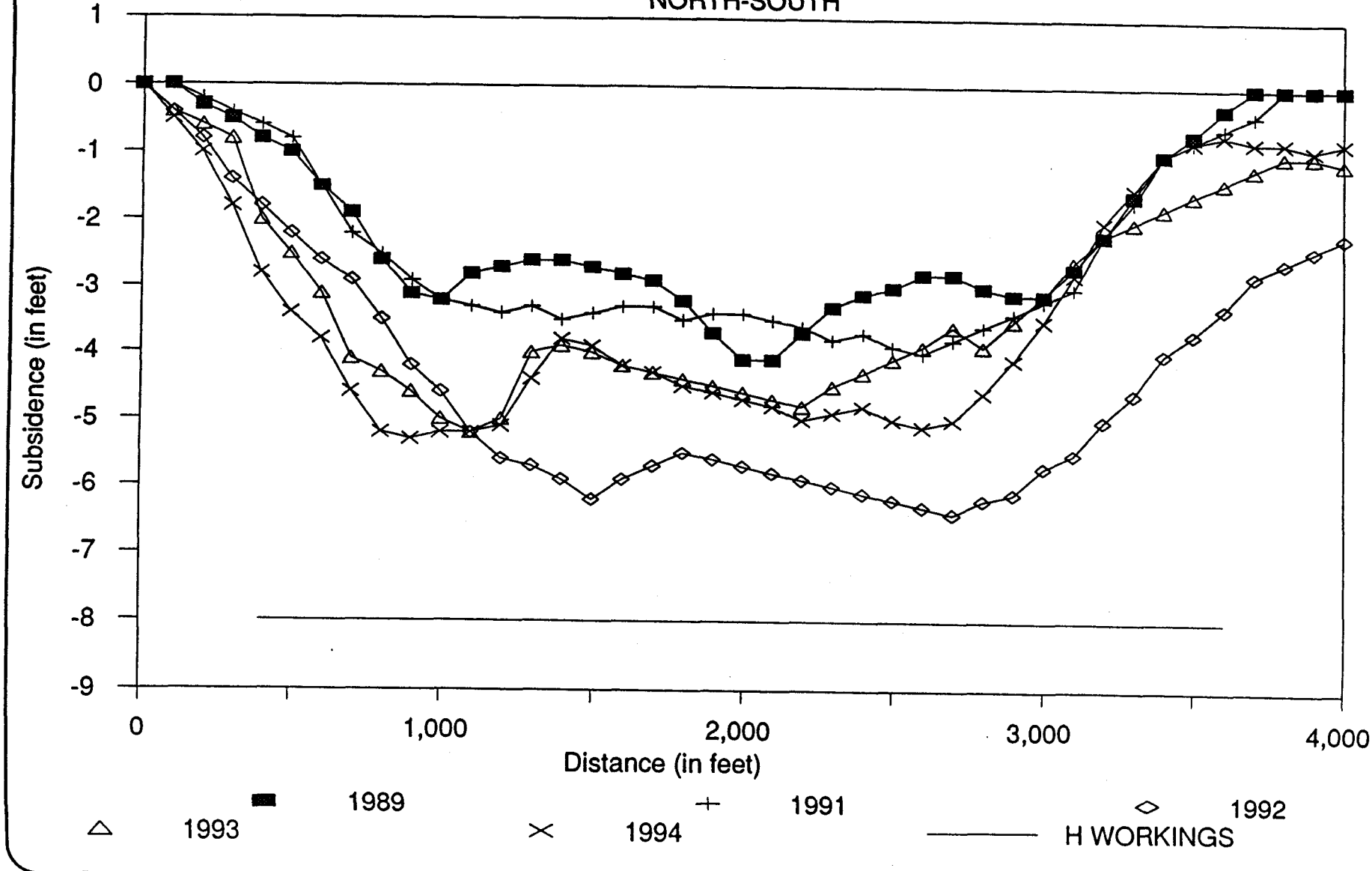


FIGURE 51

AREA 15 SUBSIDENCE PROFILE

WEST-EAST

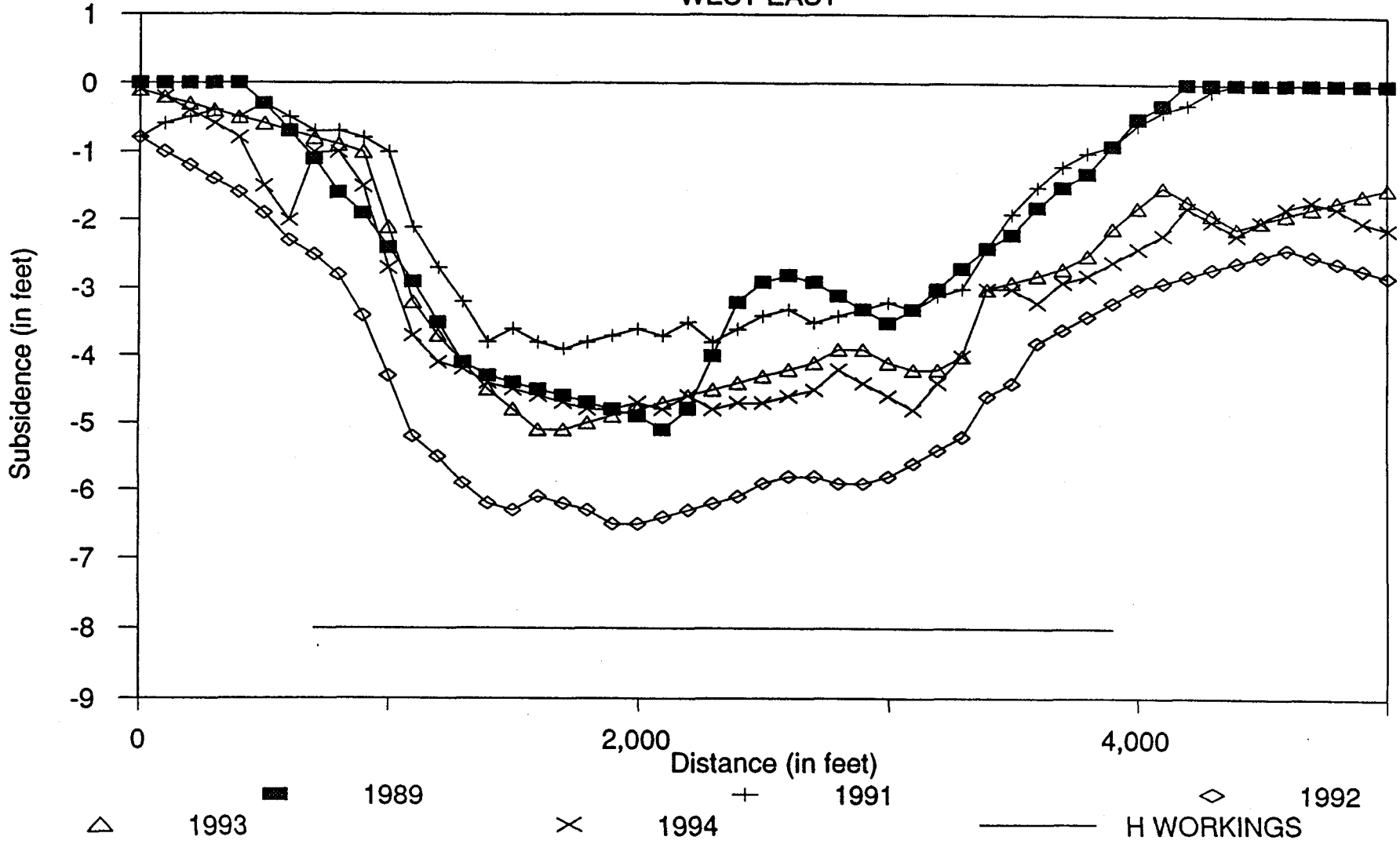


FIGURE 54

AREA 16 SUBSIDENCE PROFILE

NORTH-SOUTH

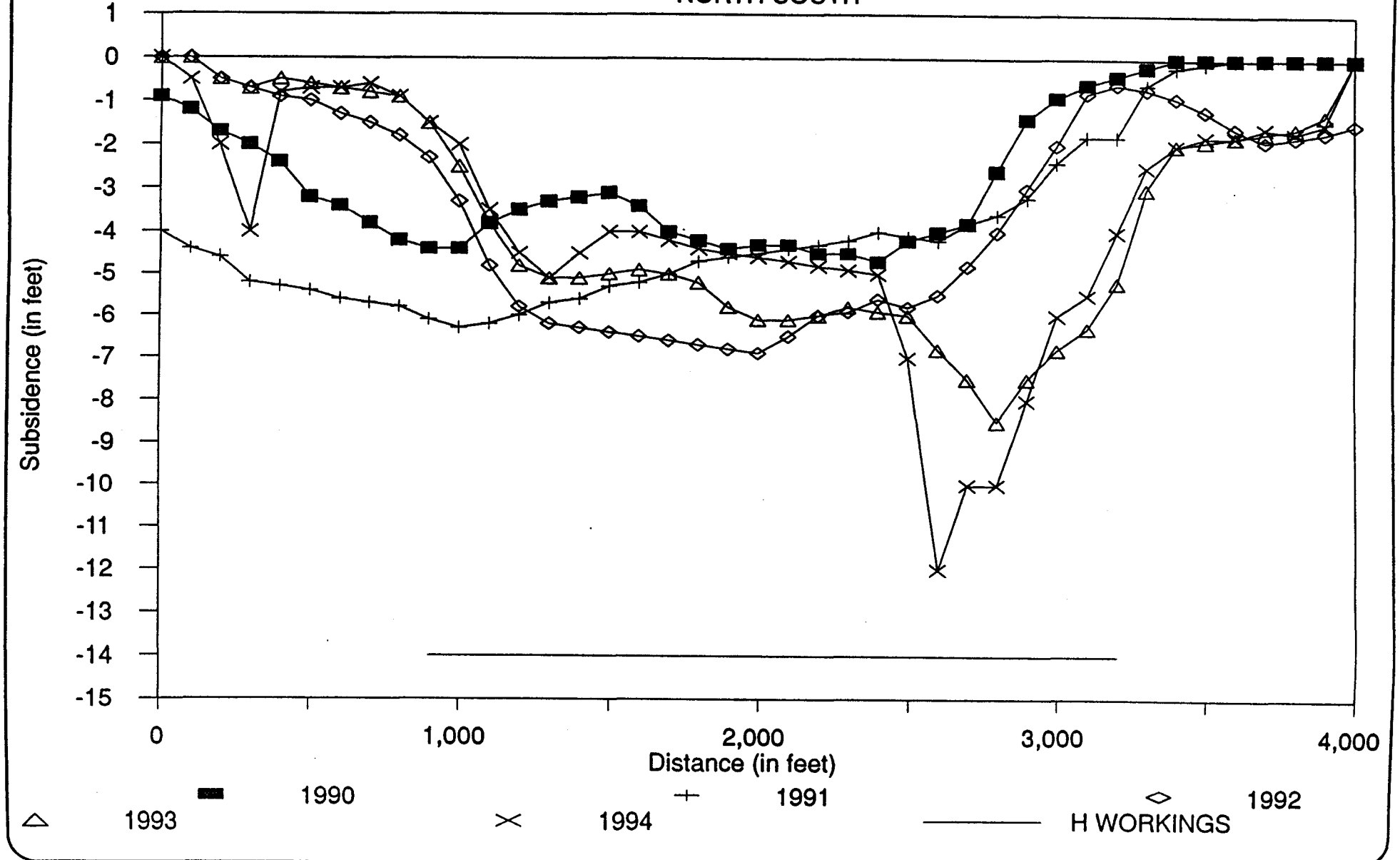


FIGURE 55

AREA 16 SUBSIDENCE PROFILE

WEST-EAST

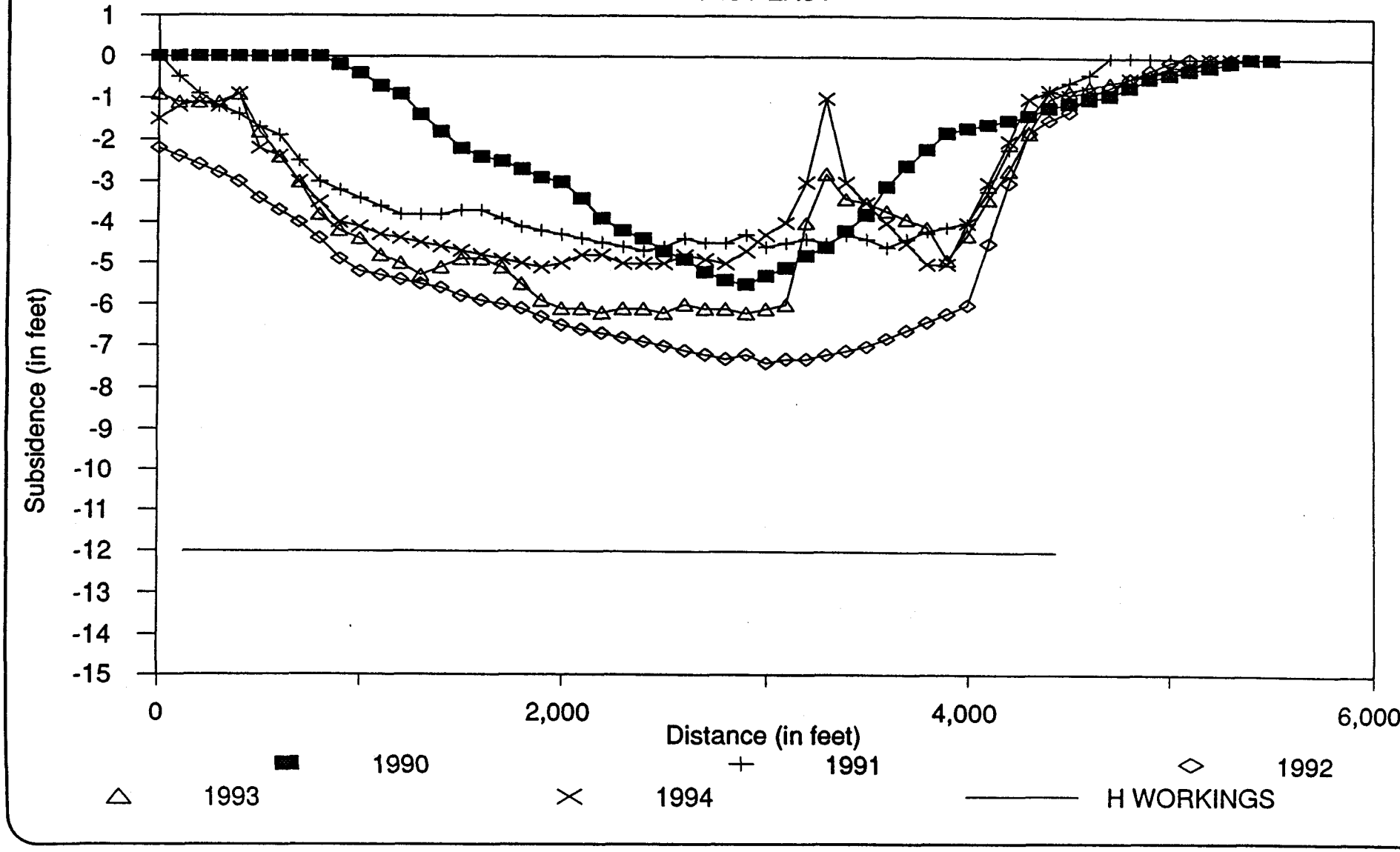


FIGURE 58

AREA 17 SUBSIDENCE PROFILE

NORTH-SOUTH

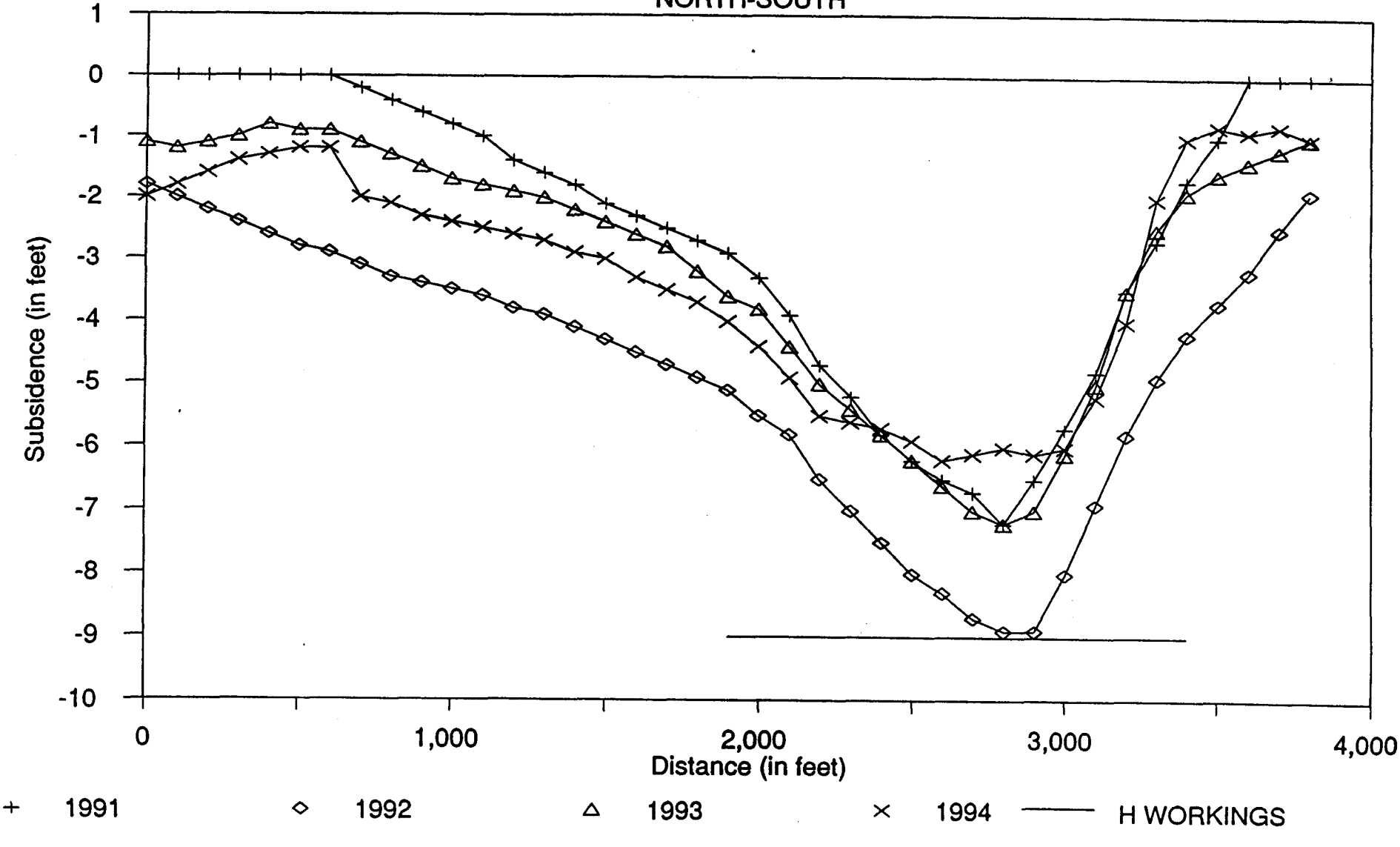
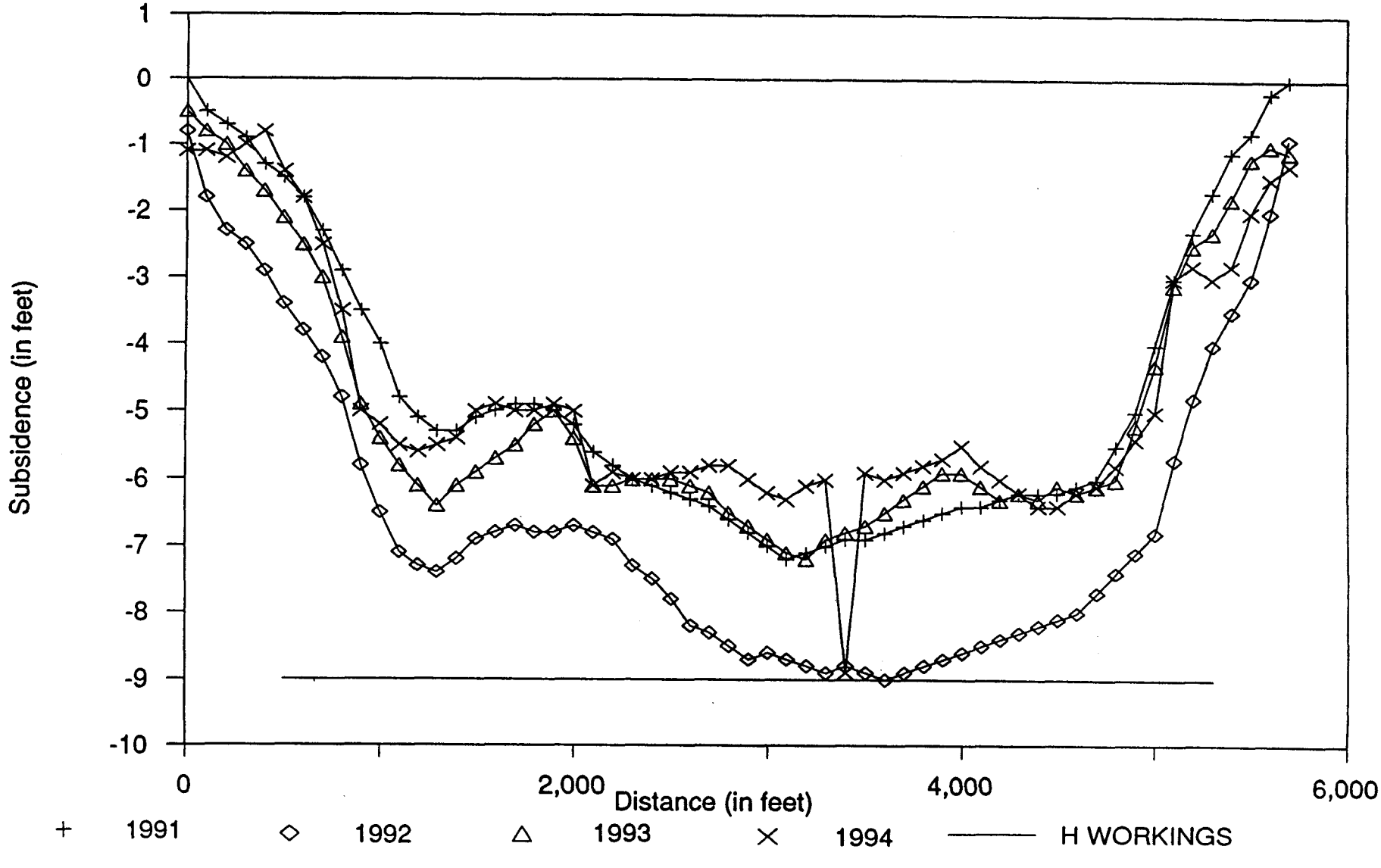


FIGURE 59

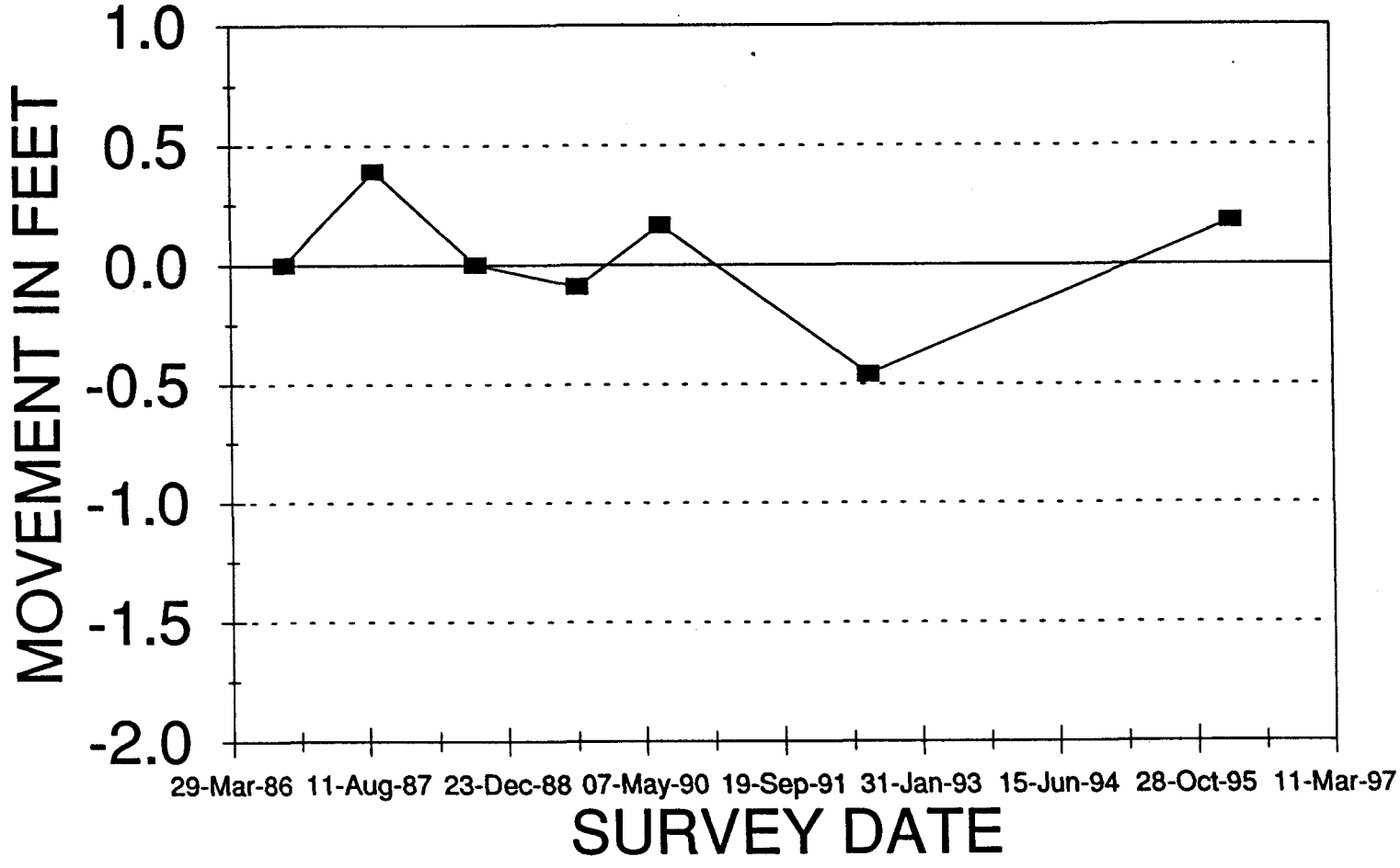
AREA 17 SUBSIDENCE PROFILE

WEST-EAST



NEWBERRY CANYON

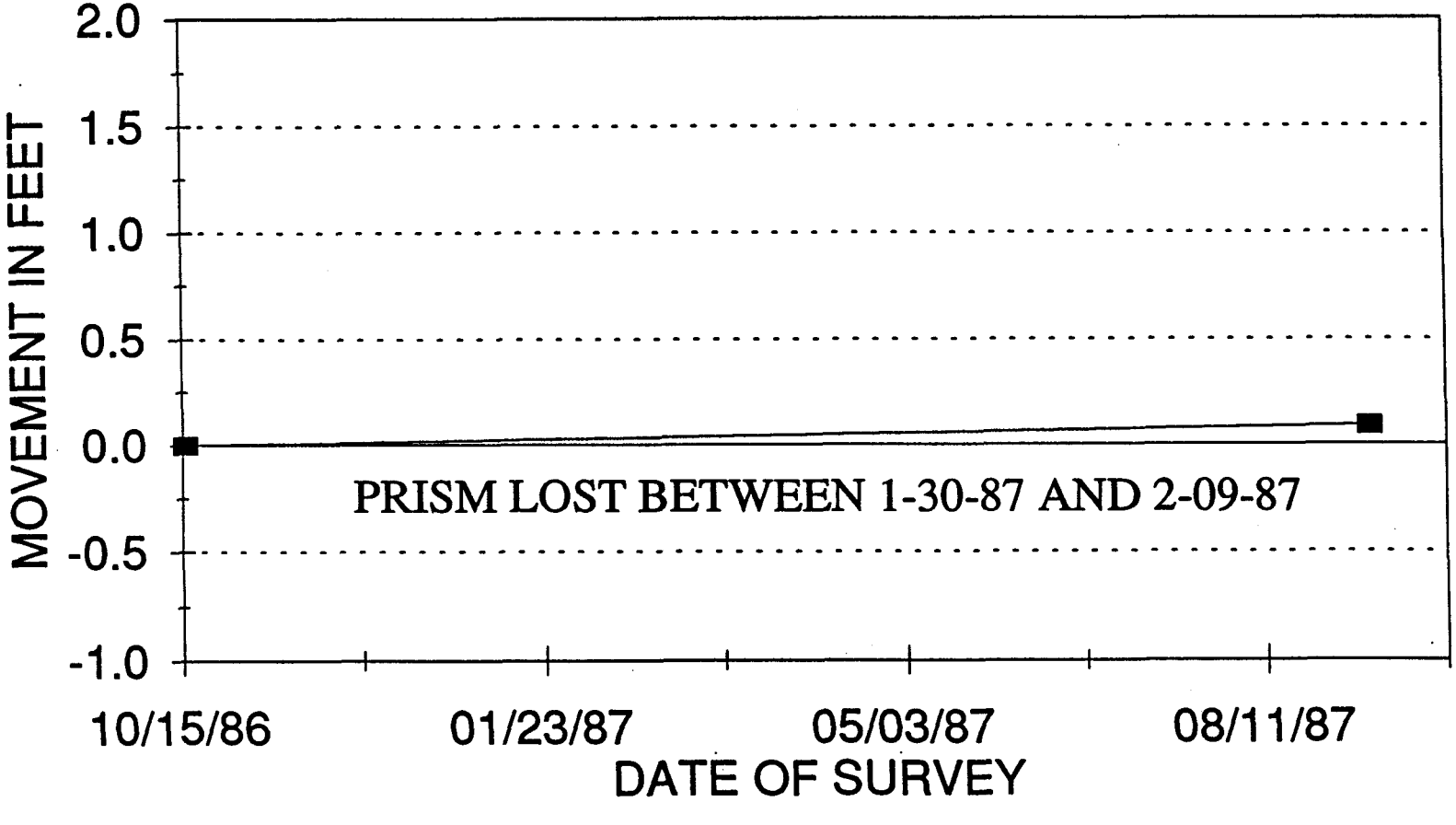
PR-1



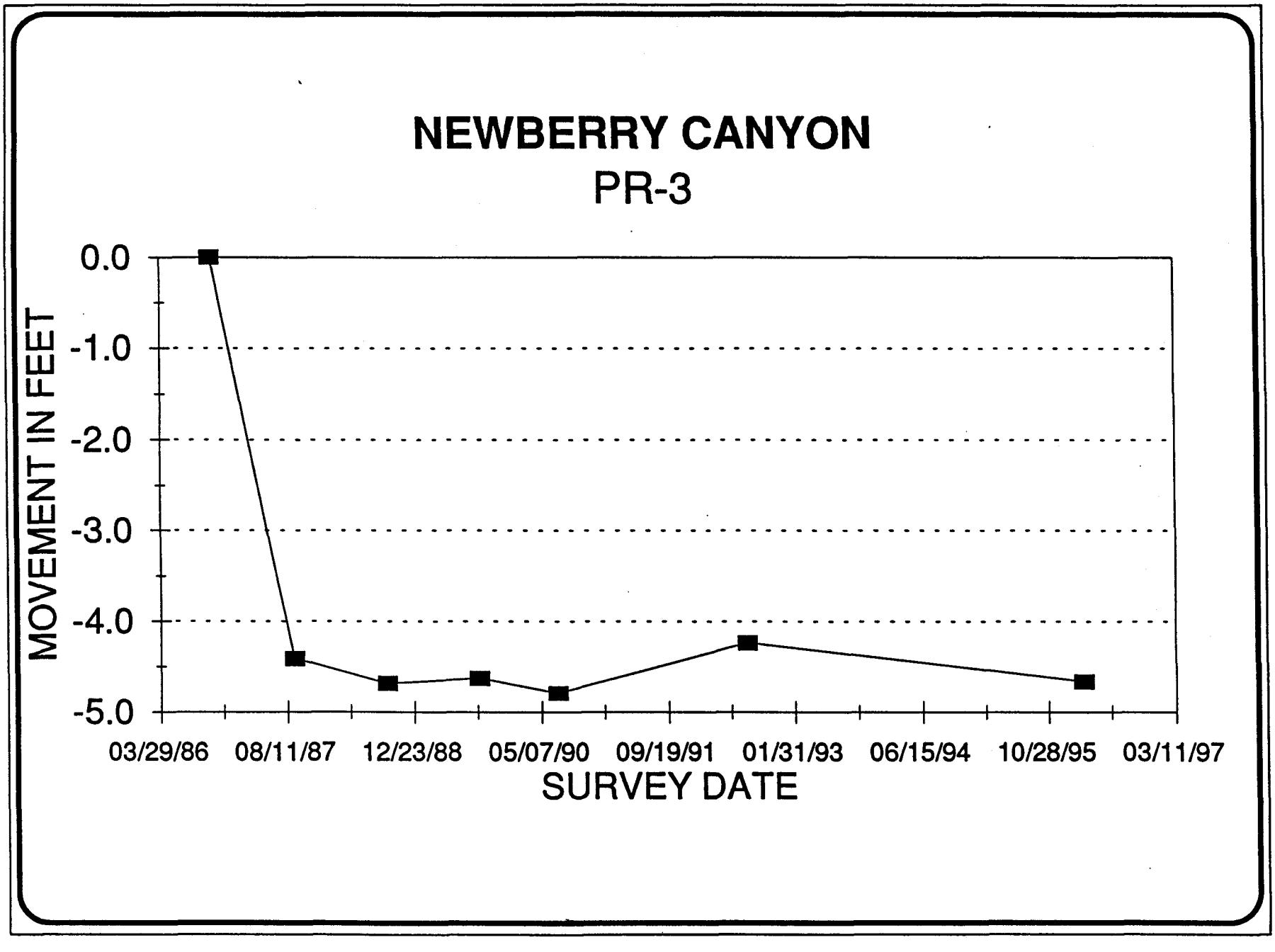
REVISED 6/4/96

NEWBERRY CANYON

PR-2



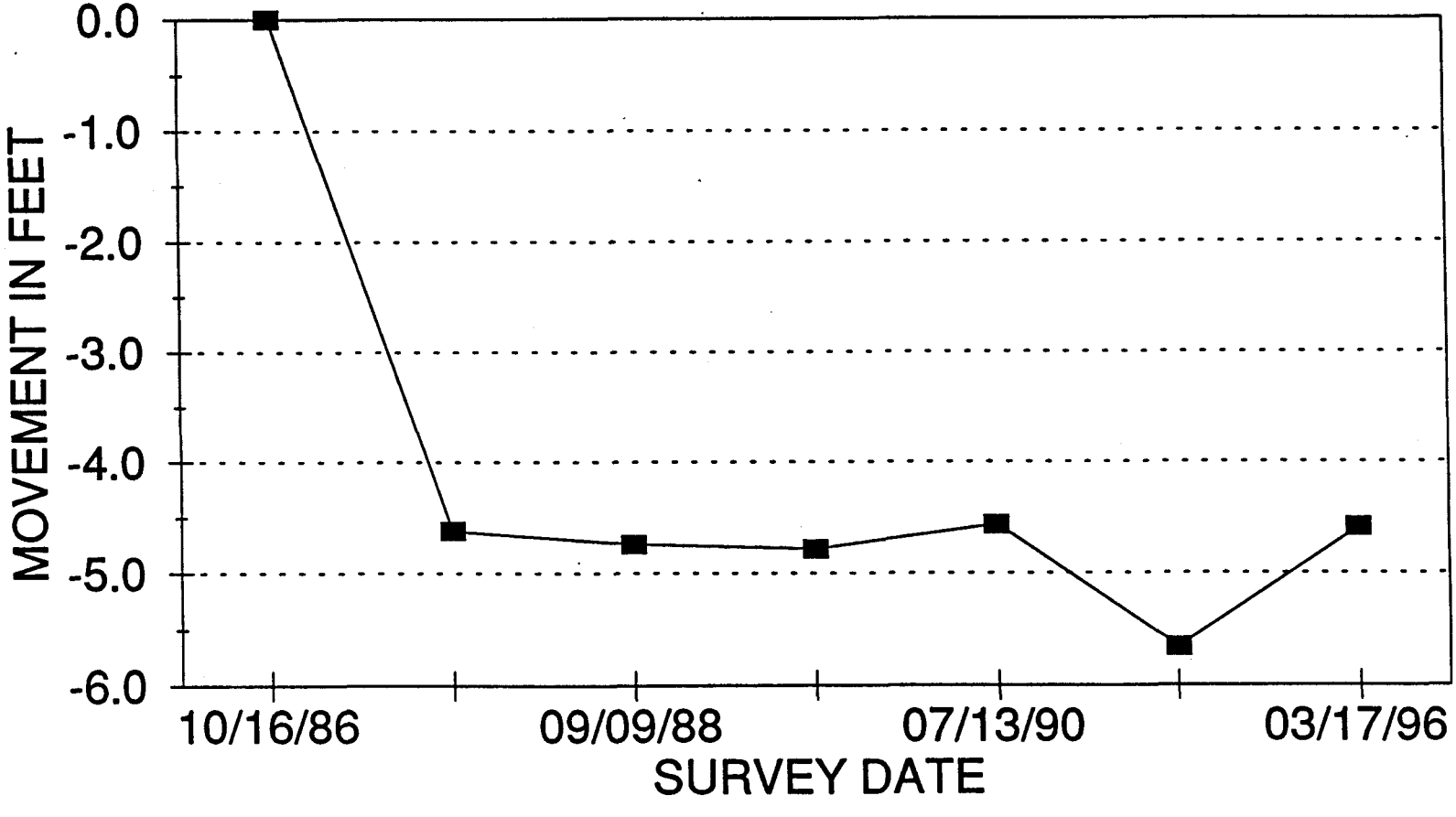
REVISED 6/4/96



REVISED 6/4/96

NEWBERRY CANYON

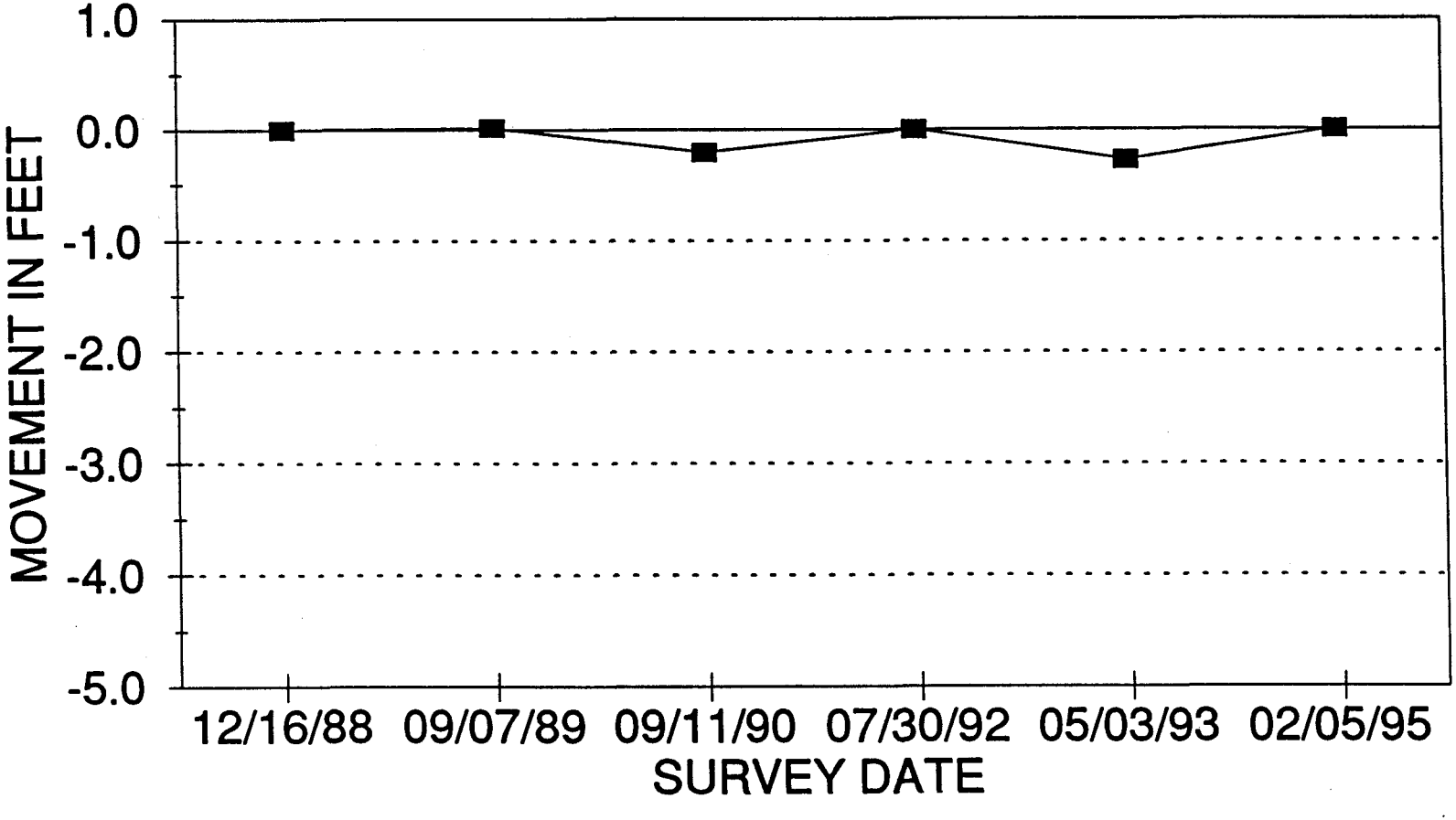
PR-4



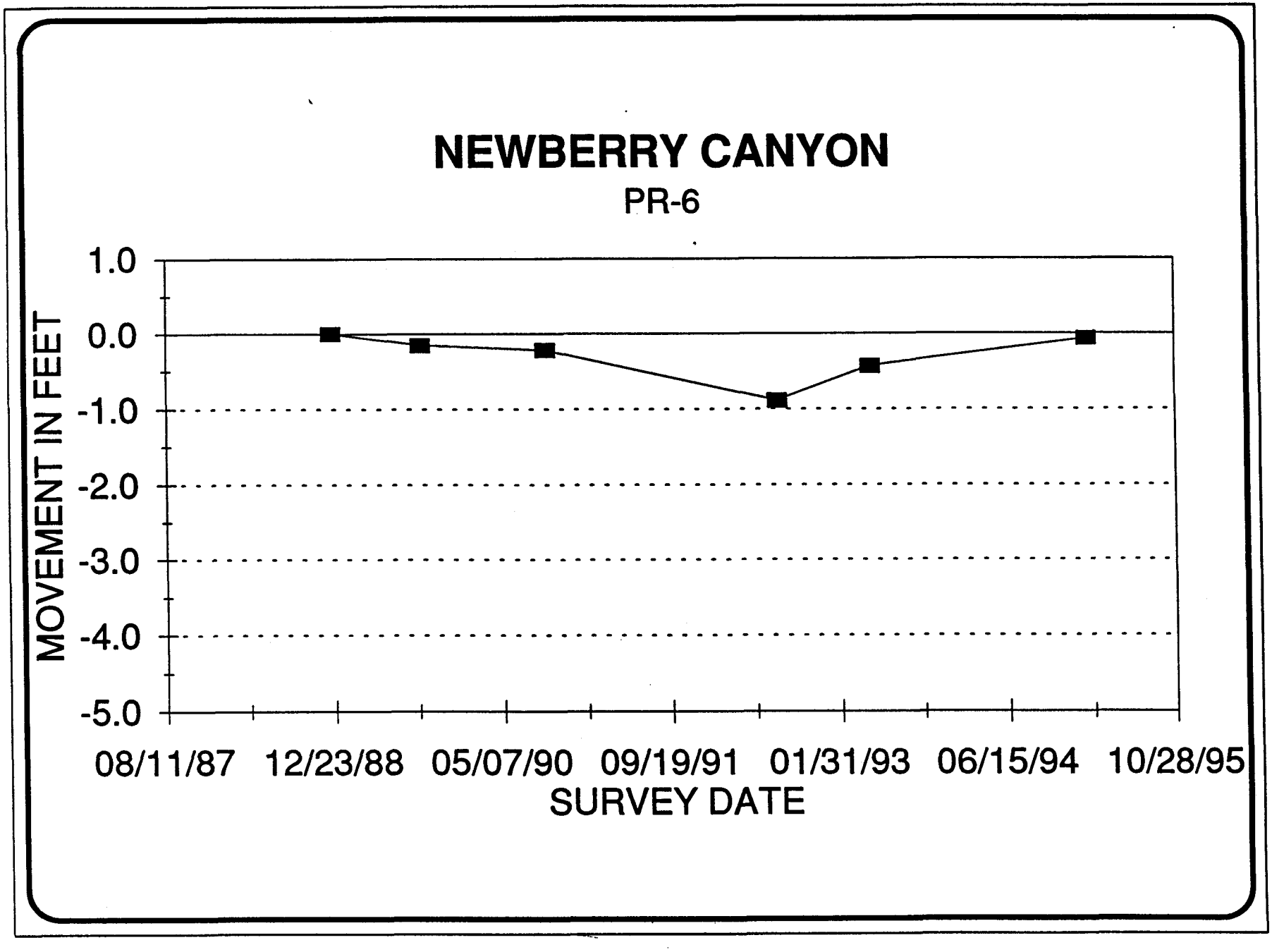
REVISED 6/4/96

NEWBERRY CANYON

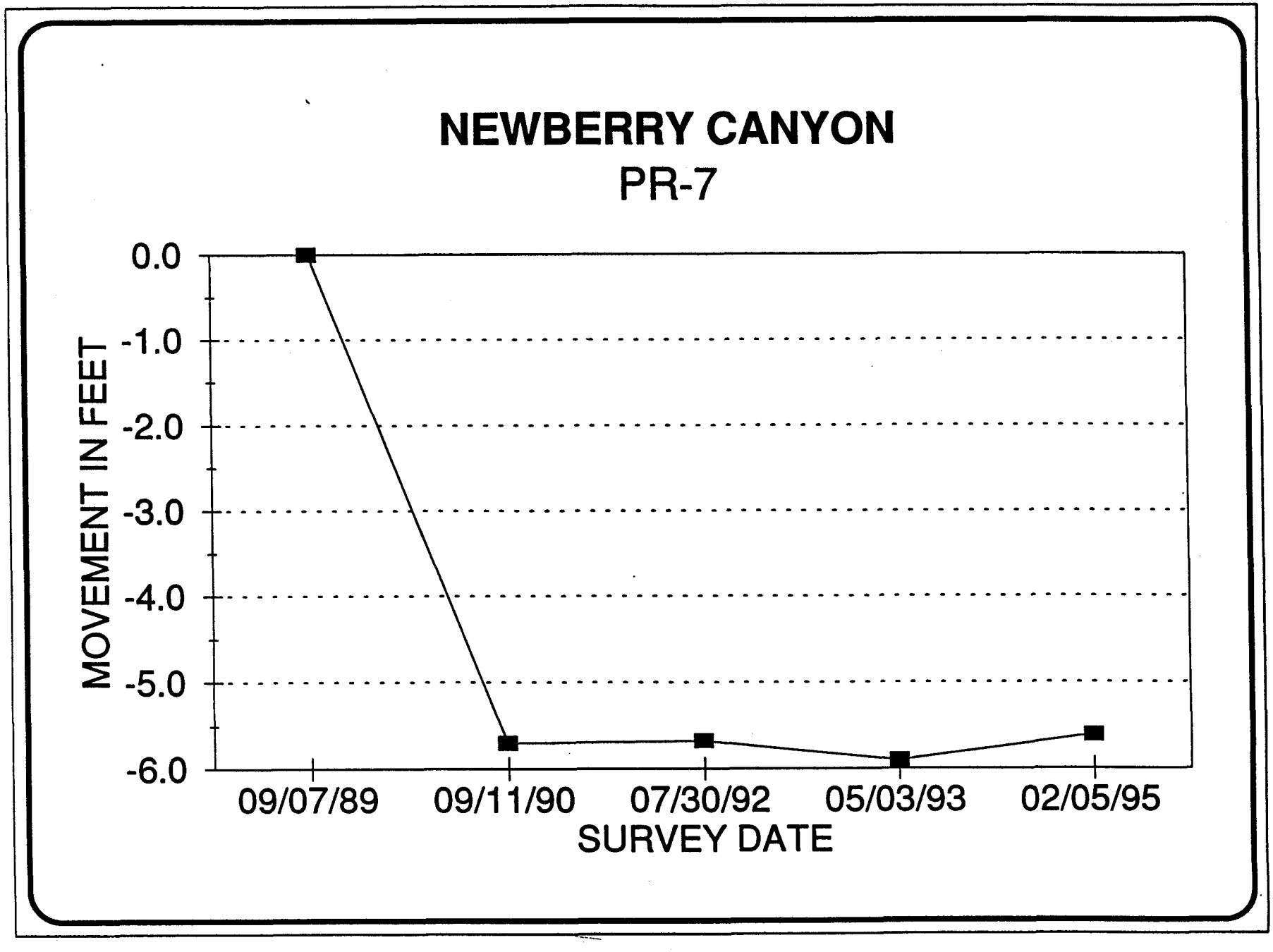
PR-5



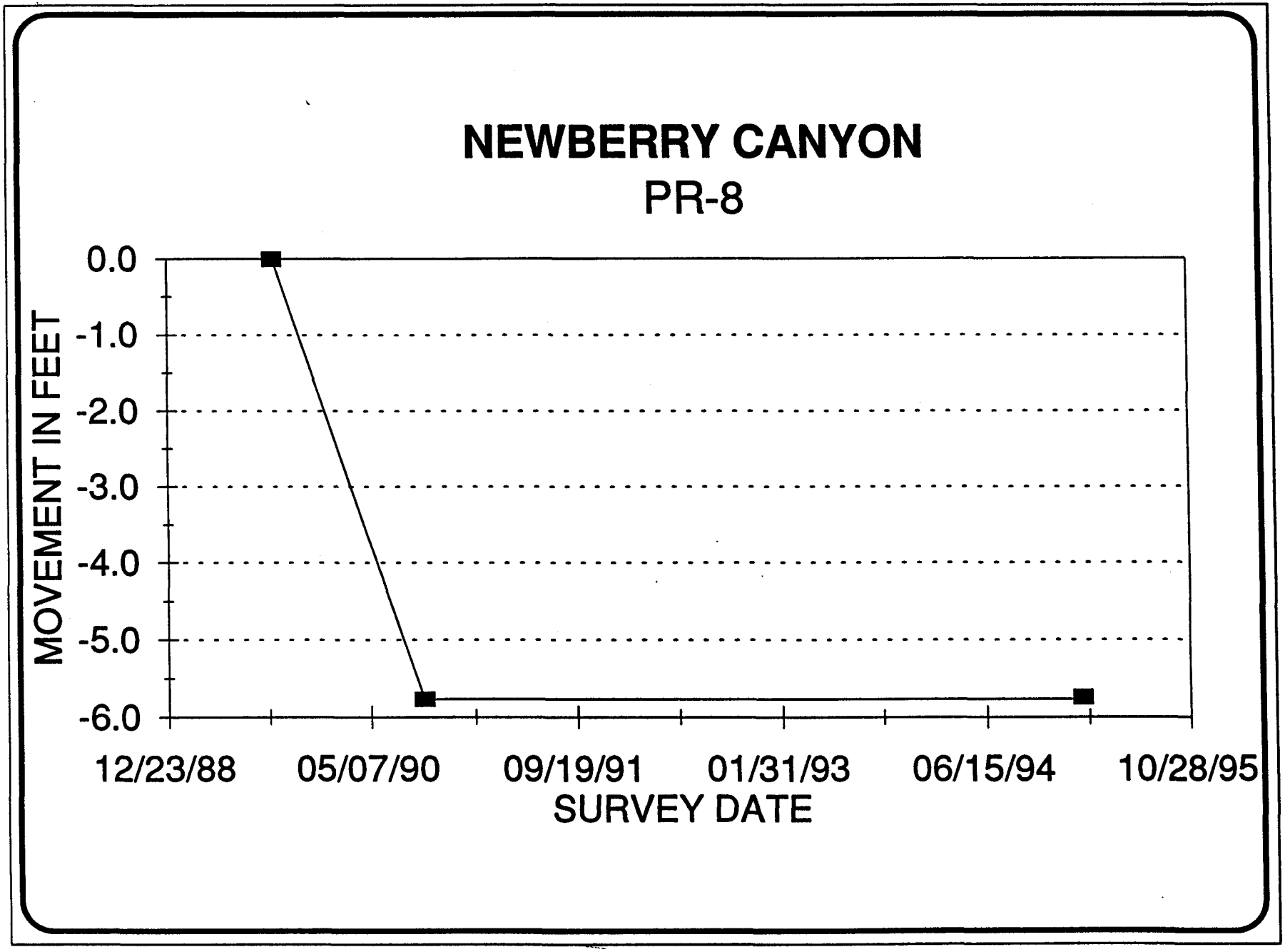
REVISED 6/4/96



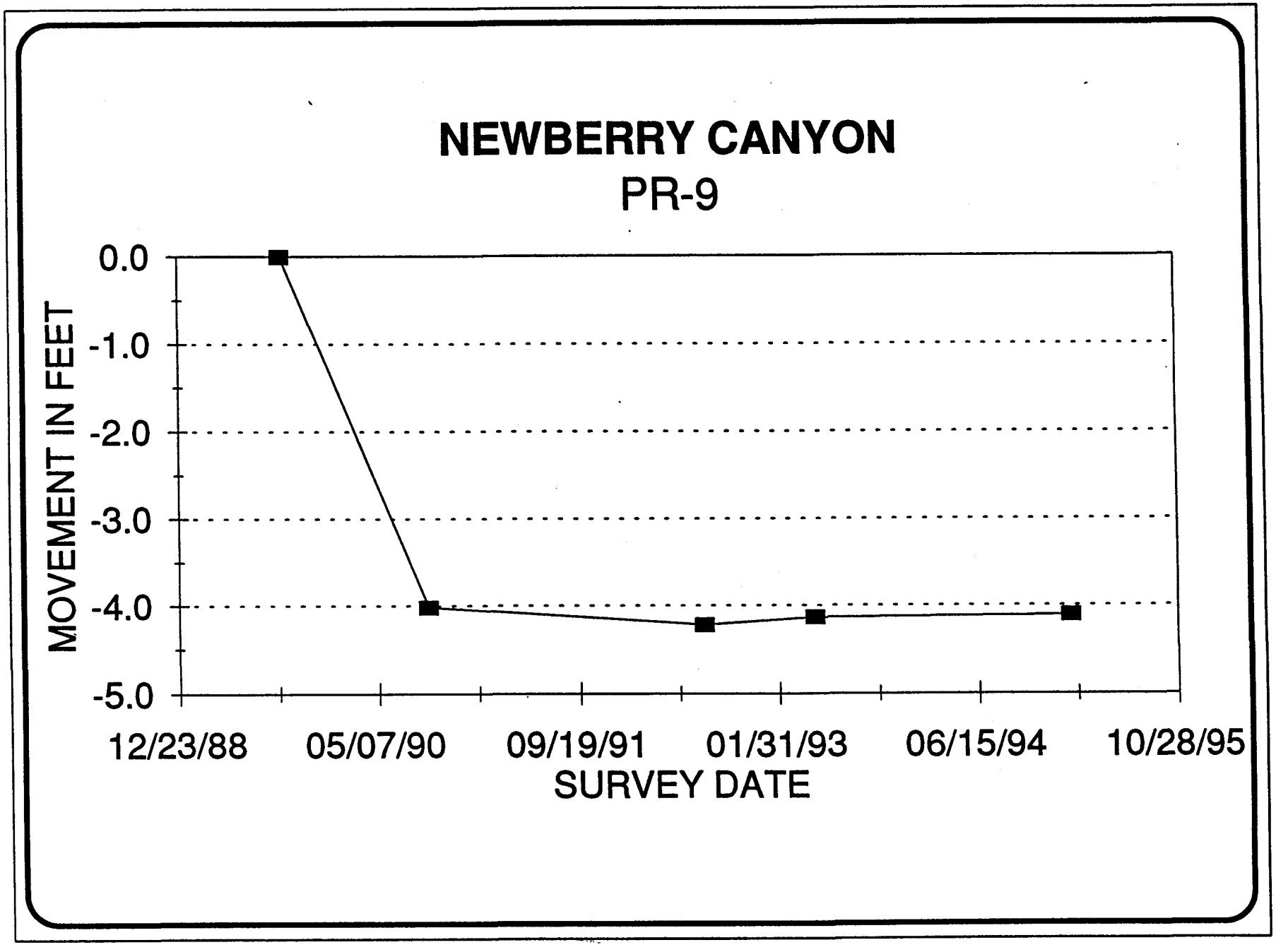
REVISED 6/4/96



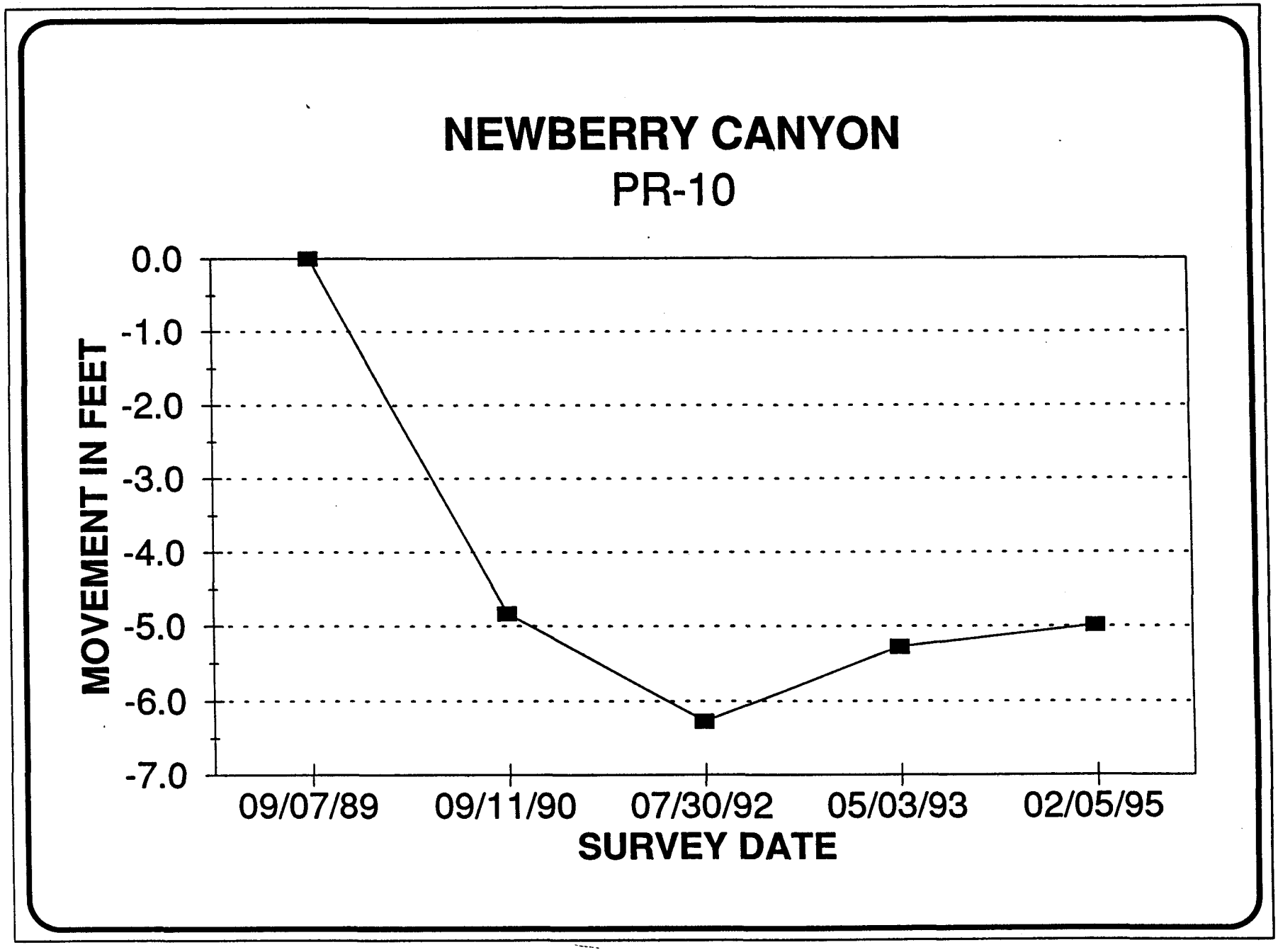
REVISED 6/4/96



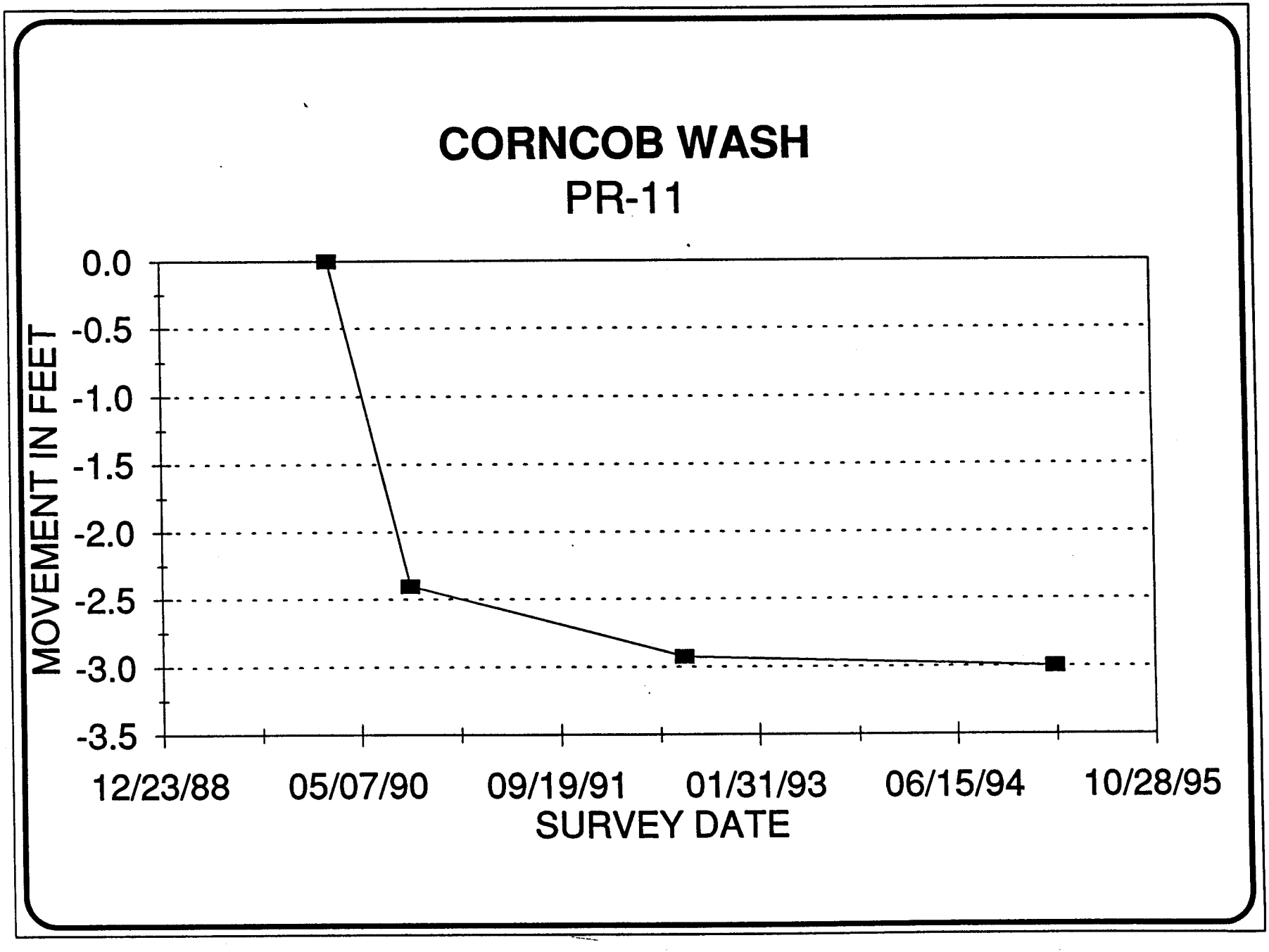
REVISED 6/4/96



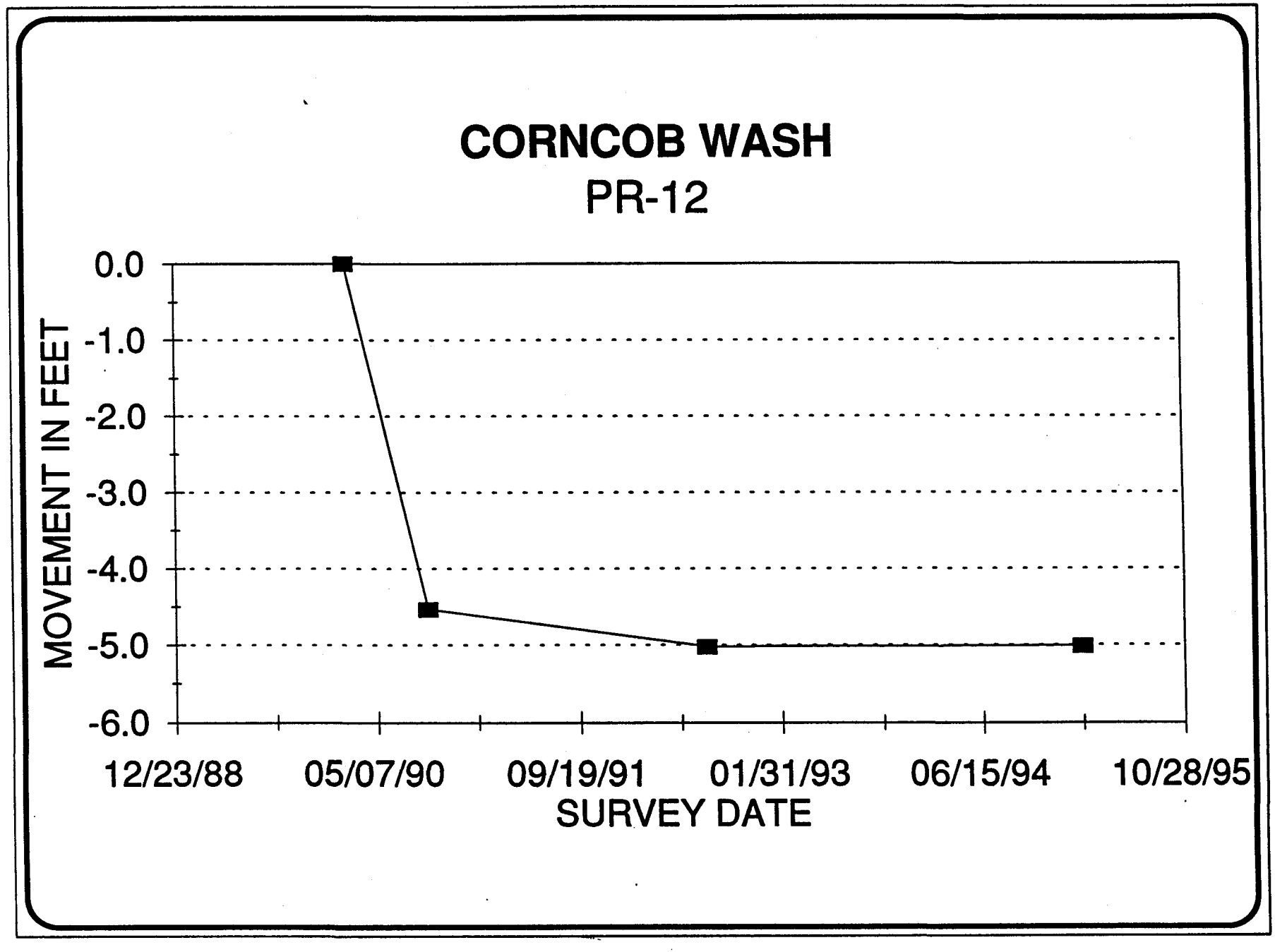
REVISED 6/4/96



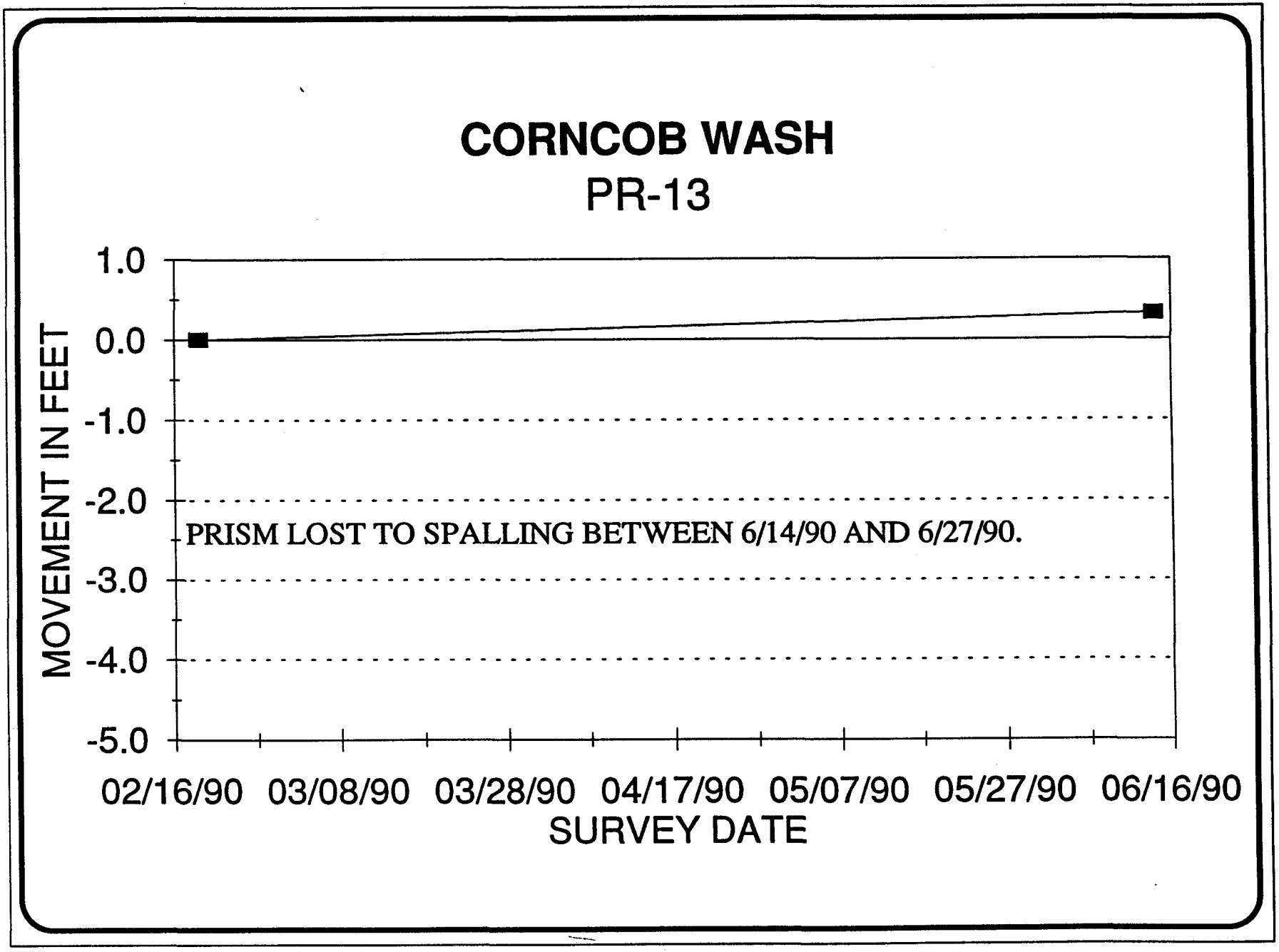
REVISED 6/4/96



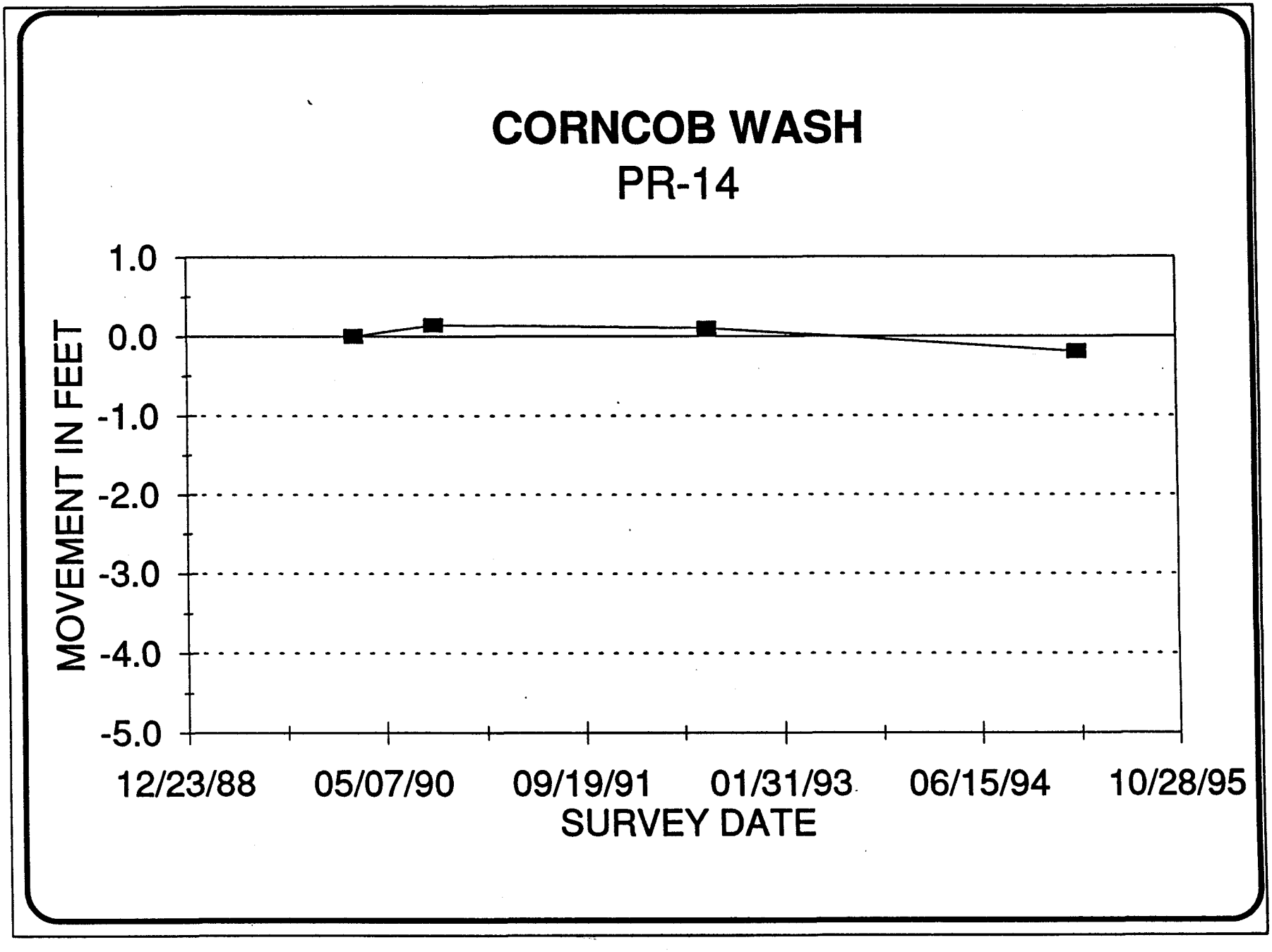
REVISED 6/4/96



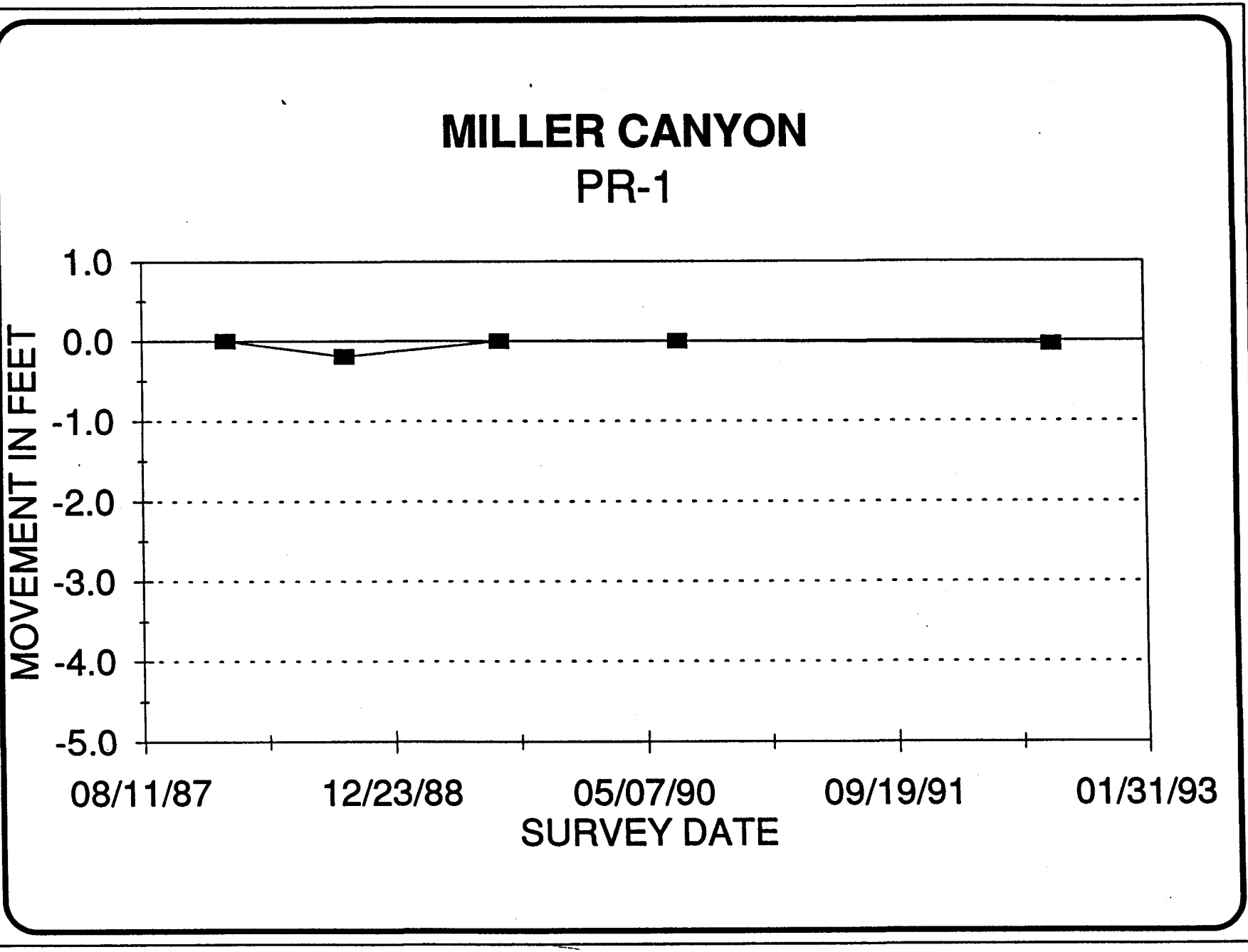
REVISED 6/4/96



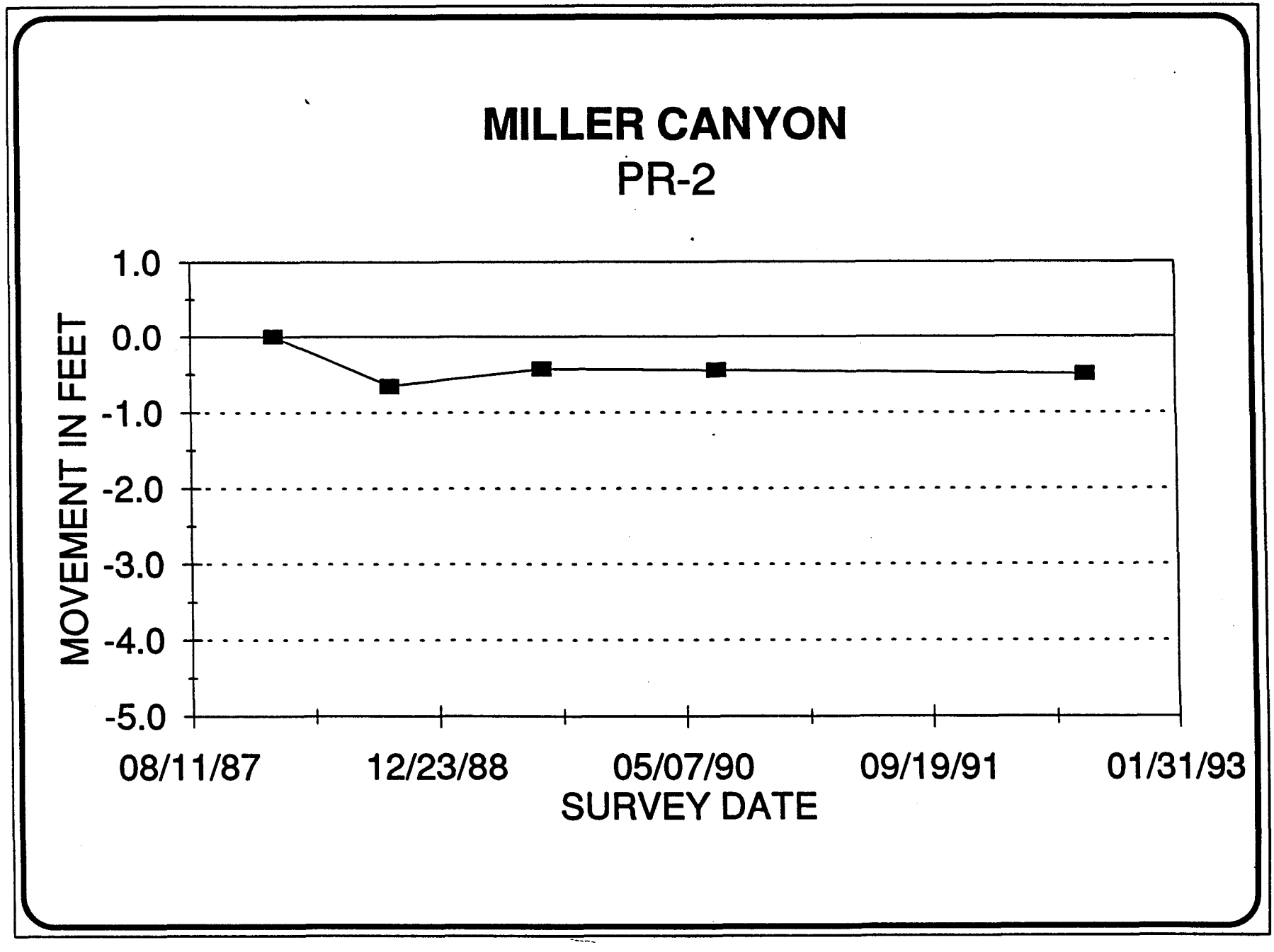
REVISED 6/4/96



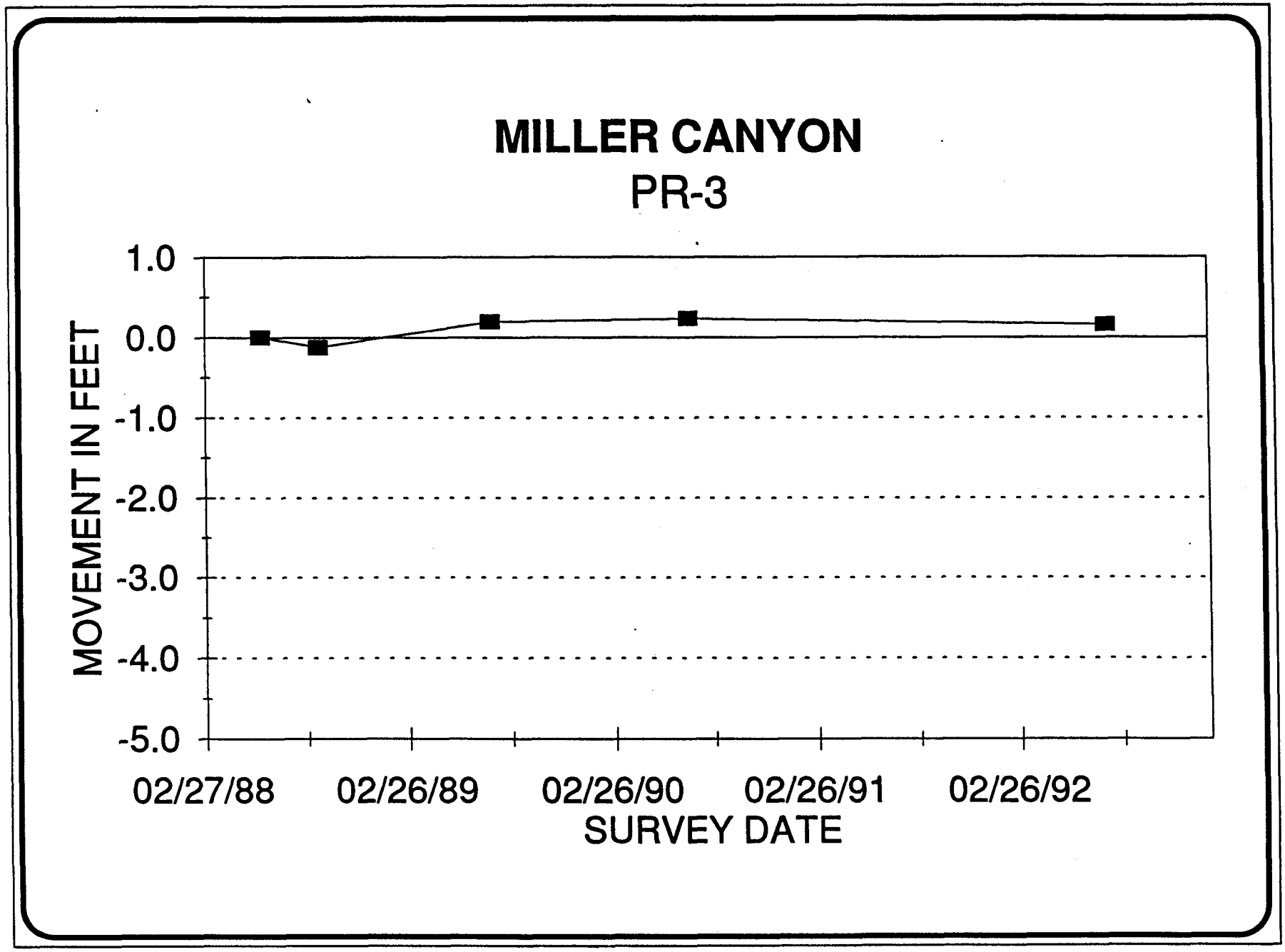
REVISED 6/4/96



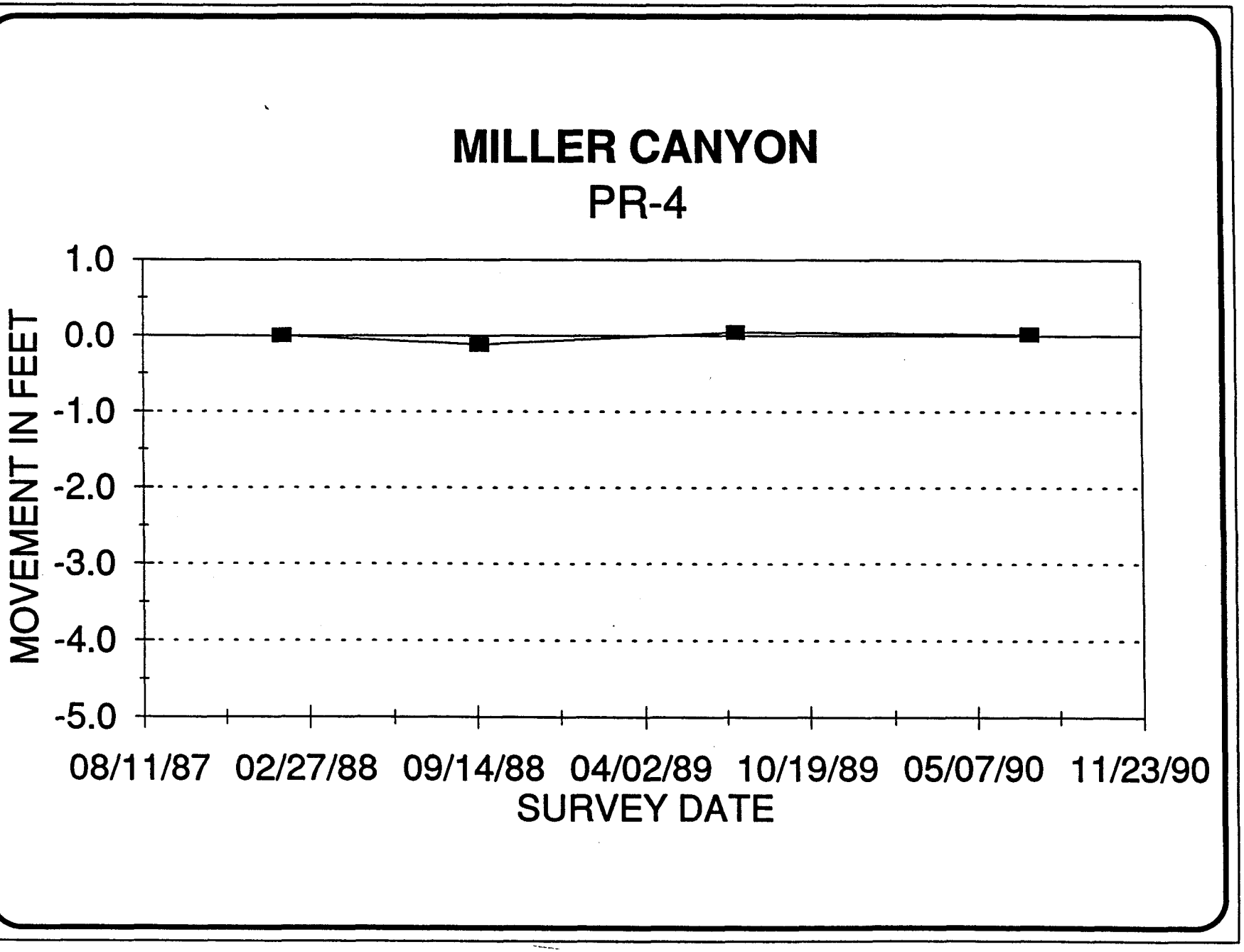
REVISED 6/4/96



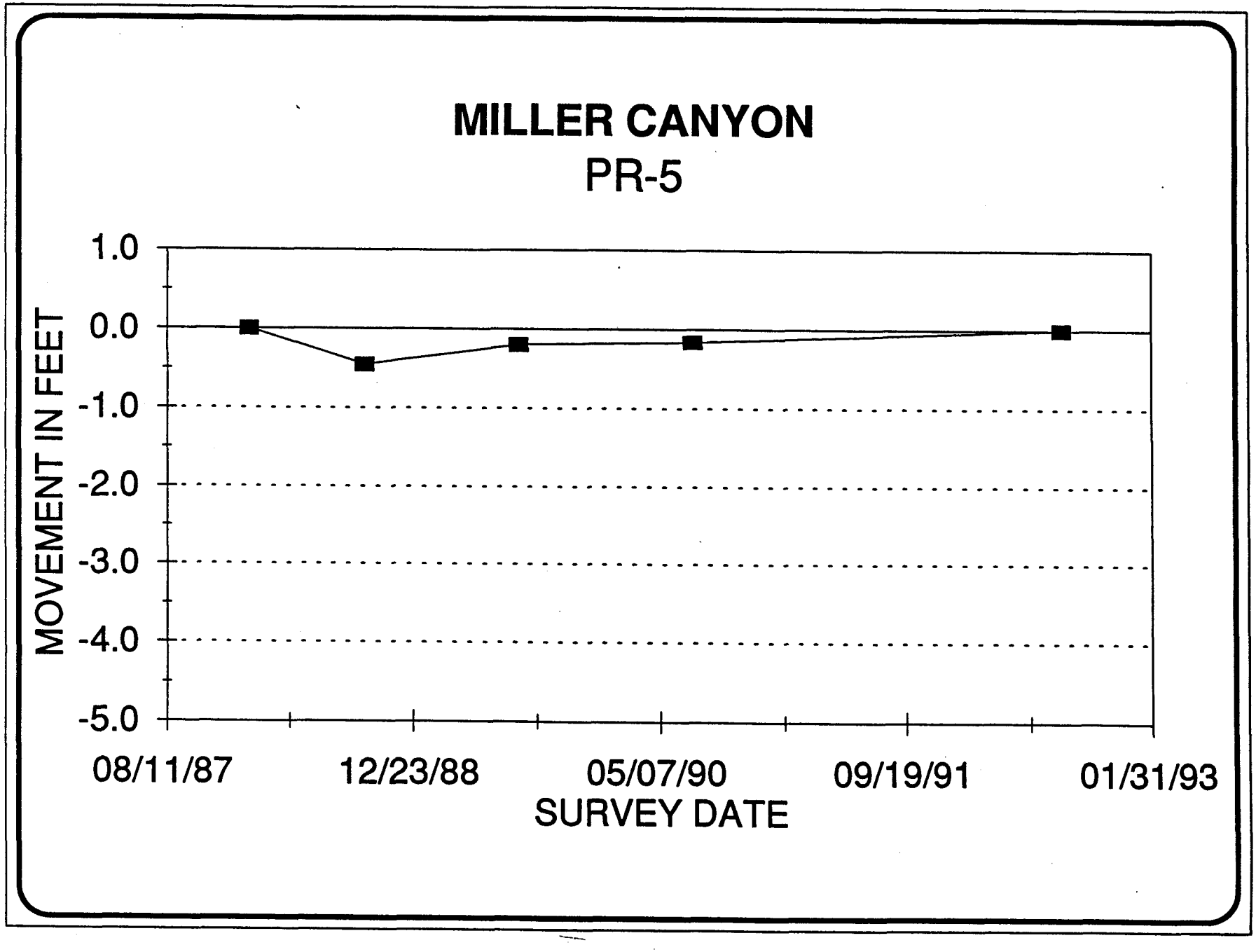
REVISED 6/4/96



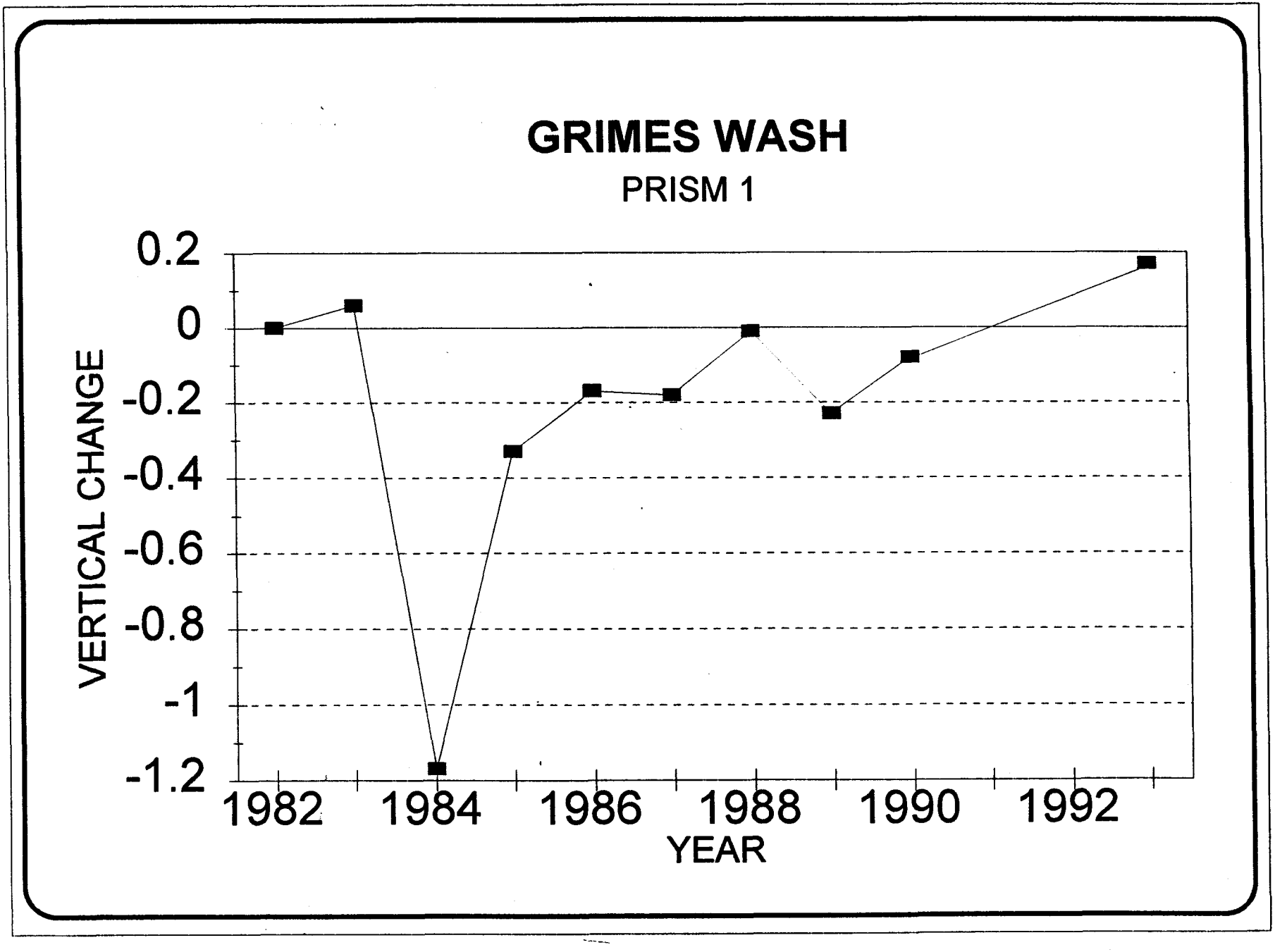
REVISED 6/4/96



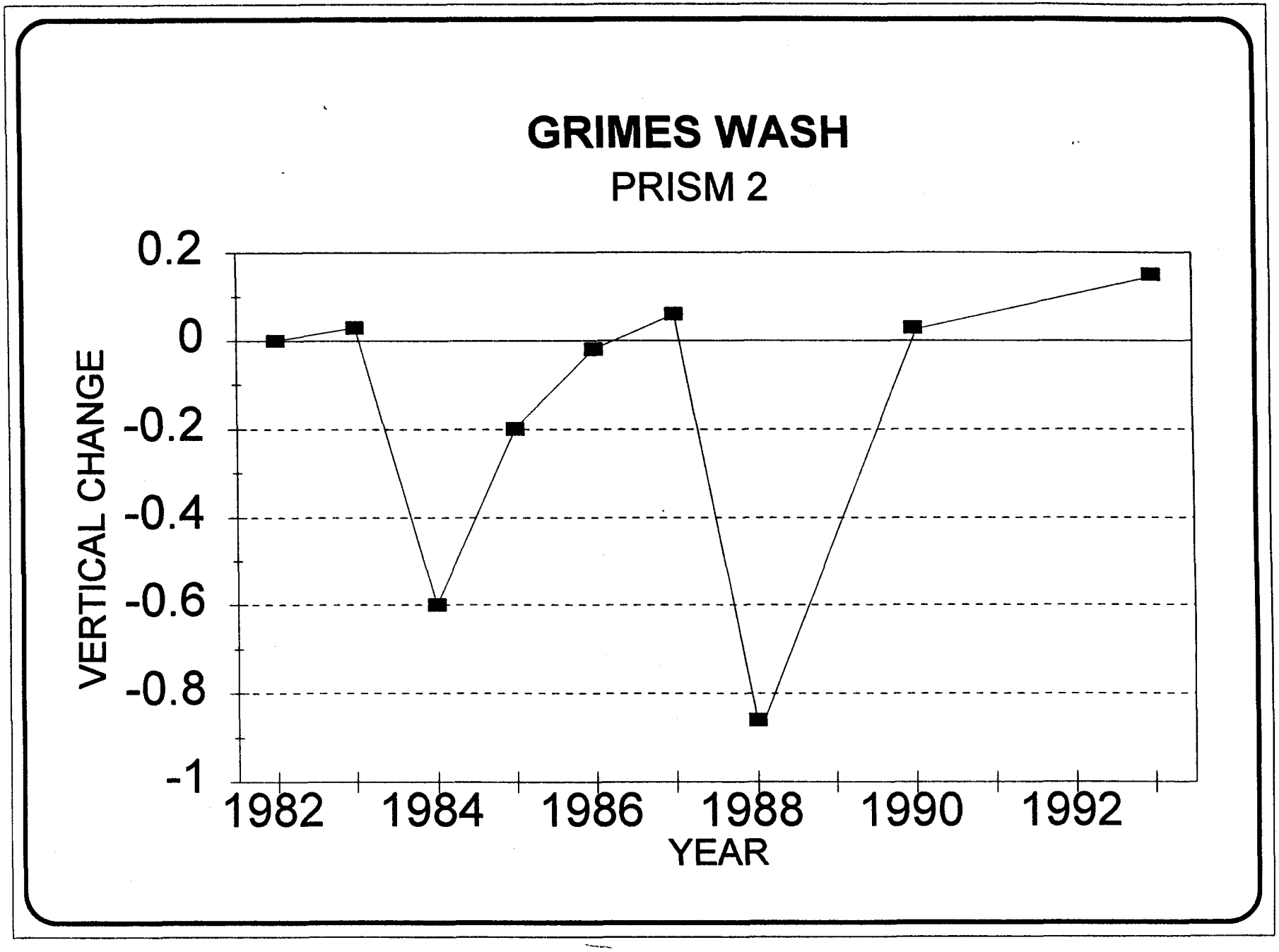
REVISED 6/4/96



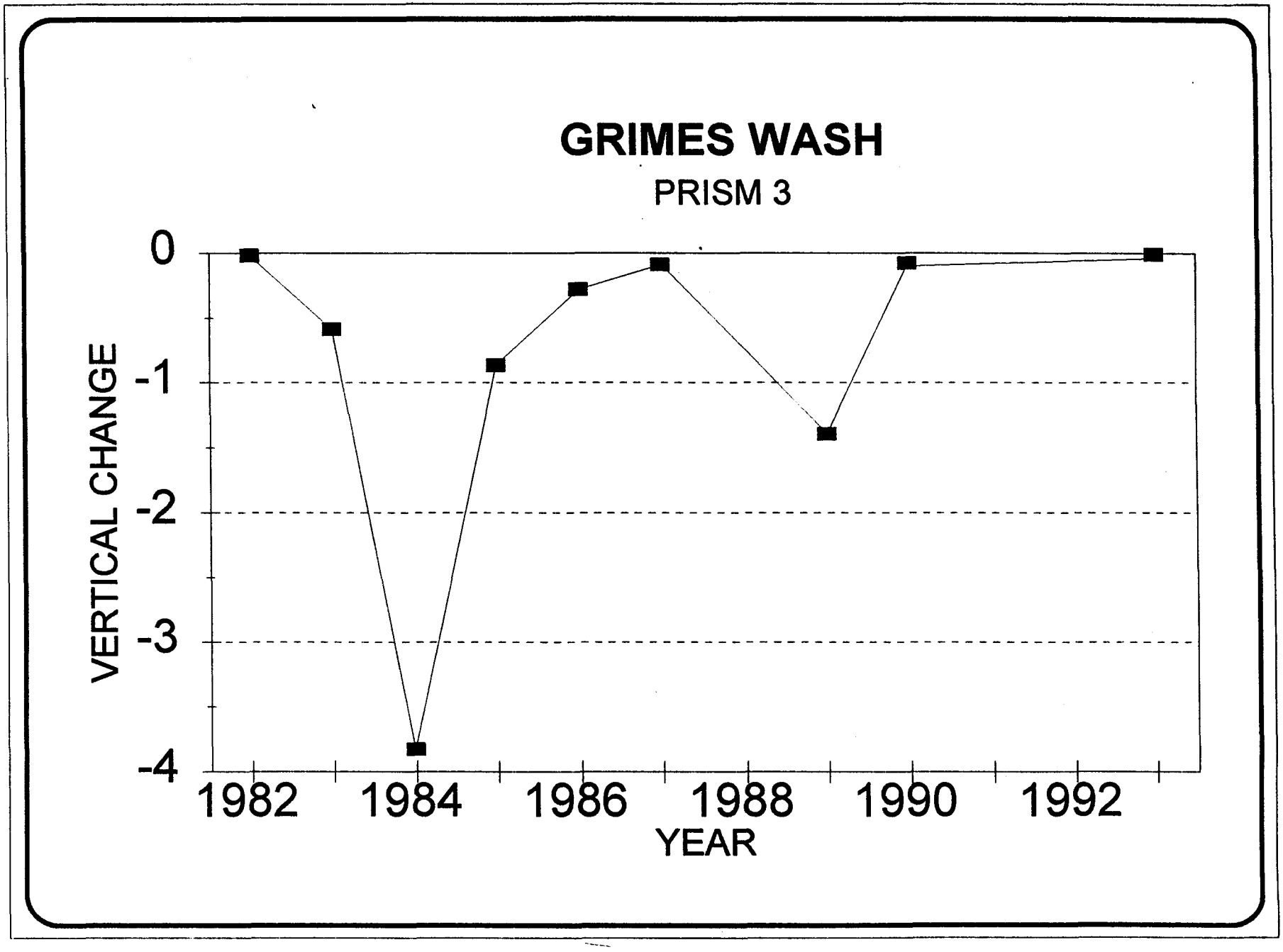
REVISED 6/4/96


GRIMES WASH
PRISM 1
VERTICAL CHANGE
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
1982
1984
1986
1988
1990
1992
YEAR

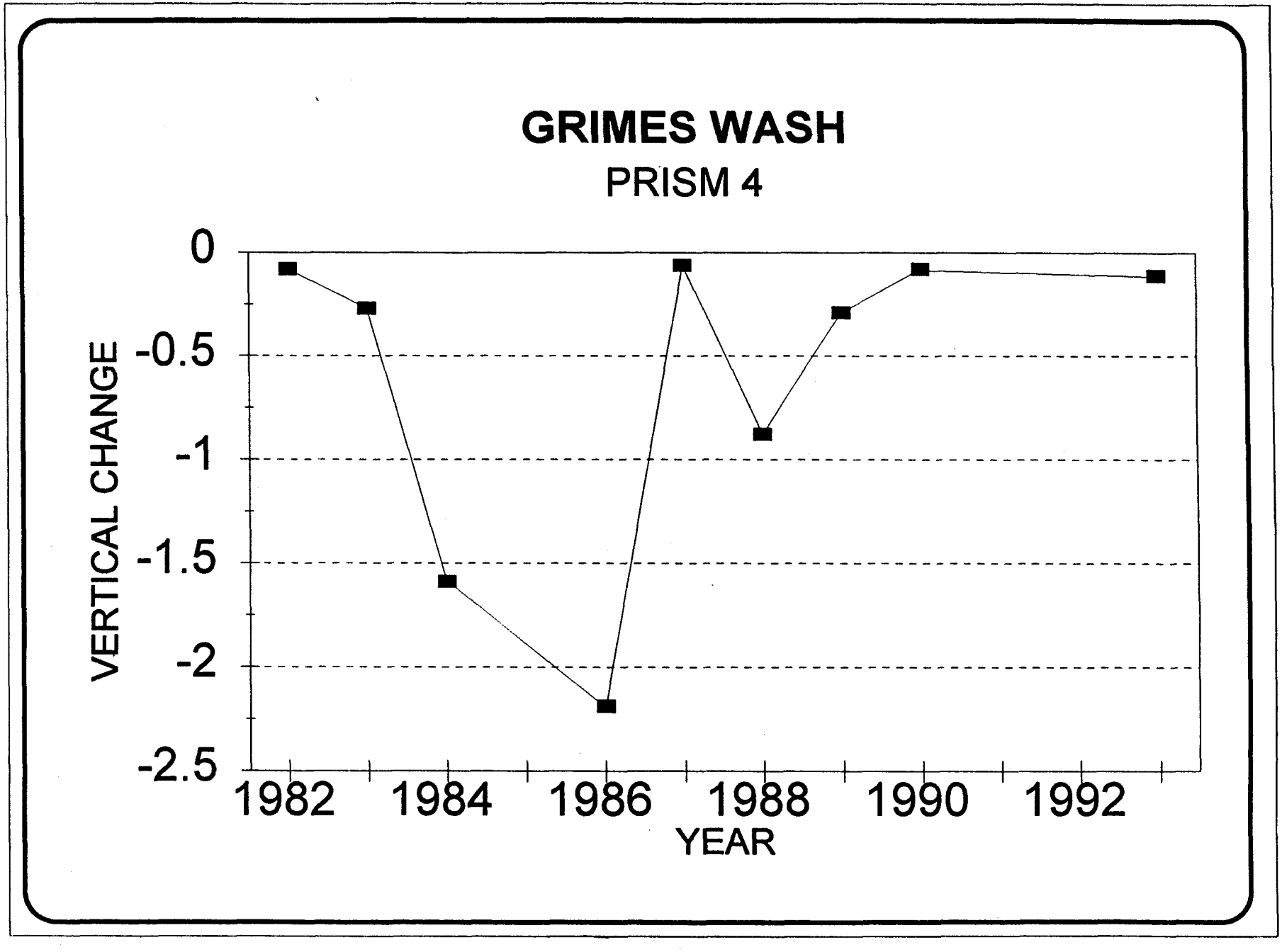
ADDED 6/4/96


GRIMES WASH
PRISM 2
VERTICAL CHANGE
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
1982
1984
1986
1988
1990
1992
YEAR

ADDED 6/4/96


GRIMES WASH
PRISM 3
VERTICAL CHANGE
0
-1
-2
-3
-4
1982
1984
1986
1988
1990
1992
YEAR

ADDED 6/4/96


GRIMES WASH
PRISM 4
VERTICAL CHANGE
0
-0.5
-1
-1.5
-2
-2.5
1982
1984
1986
1988
1990
1992
YEAR

ADDED 6/4/96

NEWBERRY CANYON PRISMS		ELEV.	CHANGE
PR-1			
BASE	10/16/86	8661.51	0.00
	09/09/87	8661.90	0.39
	09/09/88	8661.51	0.00
	09/09/89	8661.42	-0.09
	07/13/90	8661.68	0.17
	07/31/92	8661.05	-0.46
	03/17/96	8661.69	0.18
PR-2			
BASE	16-Oct-86	8661.20	0.00
	09-Sep-87	8661.29	0.09
PRISM LOST DUE TO SPALLING BETWEEN 1-30-87 AND 2-09-87			
PR-3			
BASE	10/16/86	8884.18	0.00
	09/09/87	8879.77	-4.41
	09/09/88	8879.50	-4.68
	09/09/89	8879.55	-4.63
	07/13/90	8879.39	-4.79
	07/31/92	8879.95	-4.23
	03/17/96	8879.52	-4.66
PR-4			
BASE	10/16/86	8679.50	0.00
	09/09/87	8674.88	-4.62
	09/09/88	8674.76	-4.74
	09/09/89	8674.72	-4.78
	07/13/90	8674.94	-4.57
	07/31/92	8673.84	-5.66
	03/17/96	8674.91	-4.59
PR-5			
BASE	12/16/88	8682.62	0.00
	09/07/89	8682.63	0.01
	09/11/90	8682.41	-0.21
	07/30/92	8682.62	0.00
	05/03/93	8682.34	-0.28
	02/05/95	8682.63	0.01
PR-6			
BASE	12/16/88	8636.87	0.00
	09/07/89	8636.72	-0.15
	09/11/90	8636.65	-0.22
	07/30/92	8635.98	-0.89
	05/03/93	8636.44	-0.43
	02/05/95	8636.81	-0.06
PR-7			
BASE	09/07/89	8649.78	0.00
	09/11/90	8644.08	-5.70

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	07/30/92	8644.11	-5.67
	05/03/93	8643.88	-5.90
	02/05/95	8644.18	-5.60
PR-8			
BASE	09/10/89	8653.62	0.00
	09/11/90	8647.85	-5.76
	07/30/92	NO DATA COLLECTED	
	05/03/93	NO DATA COLLECTED	
	02/05/95	8647.88	-5.74
PR-9			
BASE	09/07/89	8666.49	0.00
	09/11/90	8662.47	-4.01
	07/30/92	8662.27	-4.22
	05/03/93	8662.36	-4.13
	02/05/95	8662.38	-4.11
PR-10			
BASE	09/07/89	8670.71	0.00
	09/11/90	8665.87	-4.84
	07/30/92	8664.43	-6.27
	05/03/93	8665.43	-5.28
	02/05/95	8665.72	-4.98
CORN COB WASH			
PR-11			
BASE	02/19/90	8708.98	0.00
	09/11/90	8706.58	-2.40
	07/30/92	8706.05	-2.93
	02/19/95	8705.98	-3.00
PR-12			
BASE	02/19/90	8698.60	0.00
	09/11/90	8694.06	-4.53
	07/30/92	8693.57	-5.02
	02/19/95	8693.59	-5.01
PR-13			
BASE	02/19/90	8654.05	0.00
	06/14/90	8654.38	0.32
	PRISM LOST TO SPALLING BETWEEN 6/14/90 AND 6/27/90		
PR-14			
BASE	02/19/90	8730.70	0.00
	09/11/90	8730.84	0.14
	07/30/92	8730.80	0.10
	02/19/95	8730.51	-0.19
_ER CANYON PRISMS			
PR-1			
BASE	01/27/88	8536.54	0.00

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	09/19/88	8536.35	-0.19
	07/24/89	8536.54	-0.00
	07/13/90	8536.54	-0.01
	07/31/92	8536.51	-0.04
PR-2			
BASE	01/27/88	8832.17	0.00
	09/19/88	8831.52	-0.65
	07/24/89	8831.74	-0.43
	07/13/90	8831.72	-0.45
	07/31/92	8831.68	-0.49
PR-3			
BASE	06/08/88	8426.19	0.00
	09/19/88	8426.07	-0.12
	07/24/89	8426.39	0.20
	07/13/90	8426.43	0.24
	07/31/92	8426.35	0.16
PR-4			
BASE	01/27/88	8781.43	0.00
	09/19/88	8781.31	-0.12
	07/24/89	8781.48	0.05
	07/13/90	8781.45	0.02
	07/31/92	NO DATA COLLECTED	
PR-5			
BASE	01/27/88	8481.41	0.00
	09/19/88	8480.95	-0.46
	07/24/89	8481.21	-0.20
	07/31/92	8481.41	0.00

ADDED 6/4/96

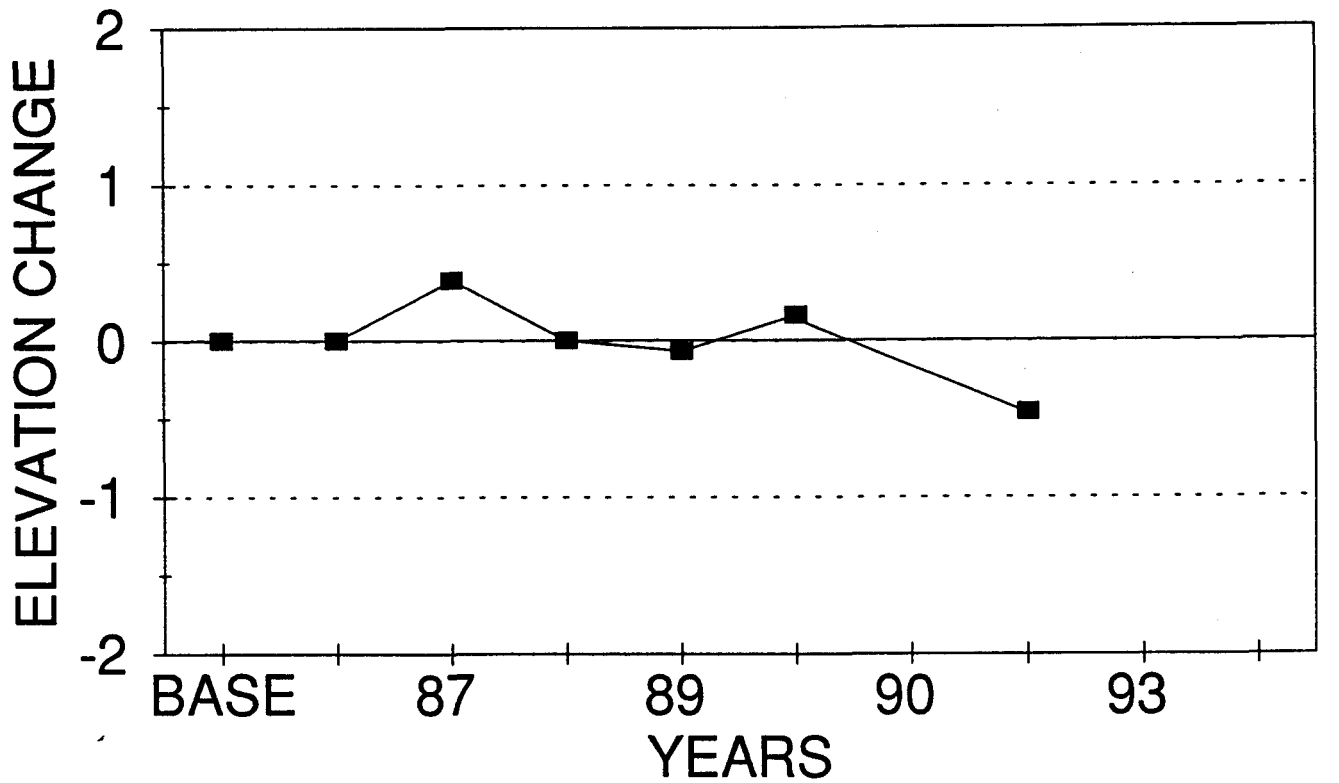
GRIMES WASH PRISMS

LEASE U-1358	CHANGE FROM BASE ELEVATION			
YEAR	PR-1	PR-2	PR-3	PR-4
1982	0.00	0.00	-0.02	-0.08
1983	0.06	0.03	-0.59	-0.27
1984	-1.17	-0.60	-3.83	-1.59
1985	-0.33	-0.20	-0.87	
1986	-0.17	-0.02	-0.28	-2.19
1987	-0.18	0.06	-0.09	-0.06
1988	-0.01	-0.86		-0.88
1989	-0.23		-1.40	-0.29
1990	-0.08	0.03	-0.08	-0.08
1991	NO DATA COLLECTED			
1992	NO DATA COLLECTED			
1993	0.17	0.15	-0.01	-0.11
1994	NO DATA COLLECTED			
1995	NO DATA COLLECTED			

ADDED 6/4/96

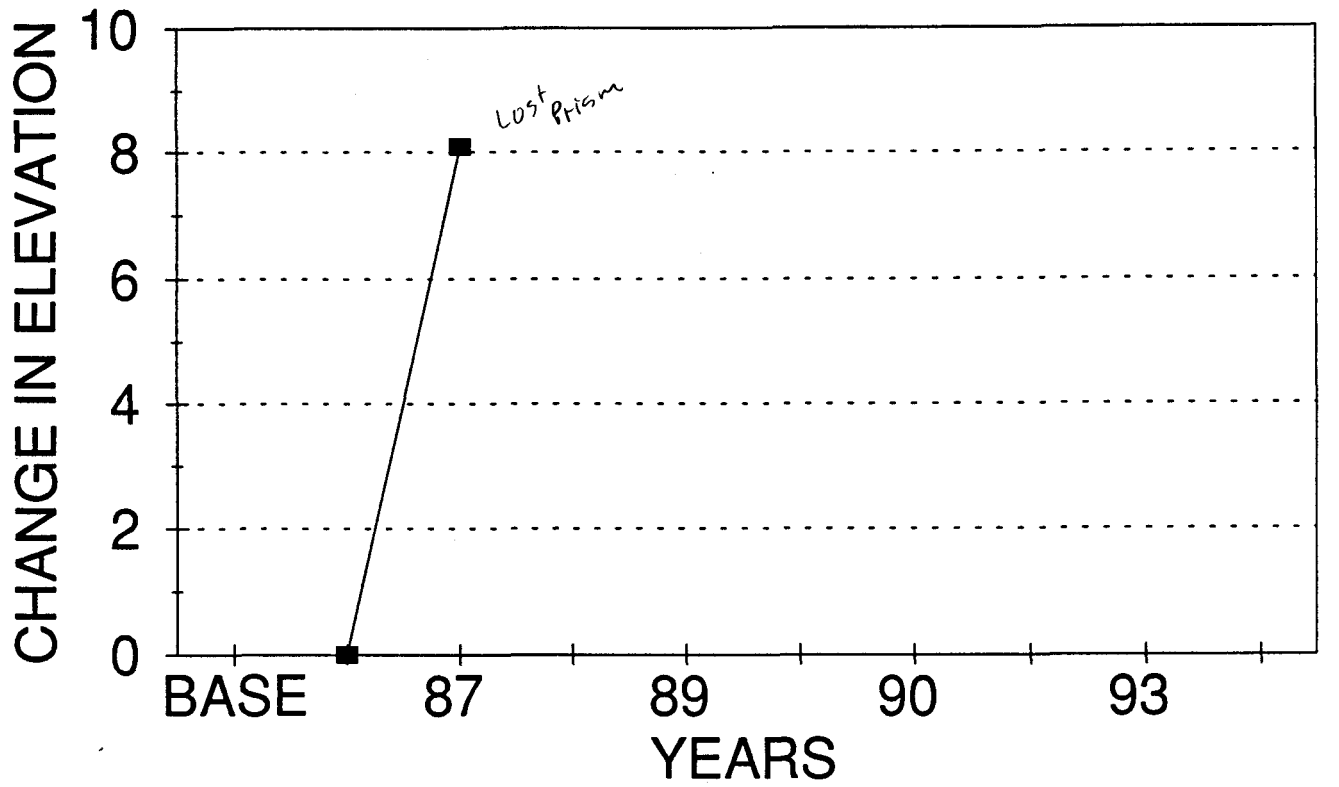
PR-1

NEWBERRY CANYON



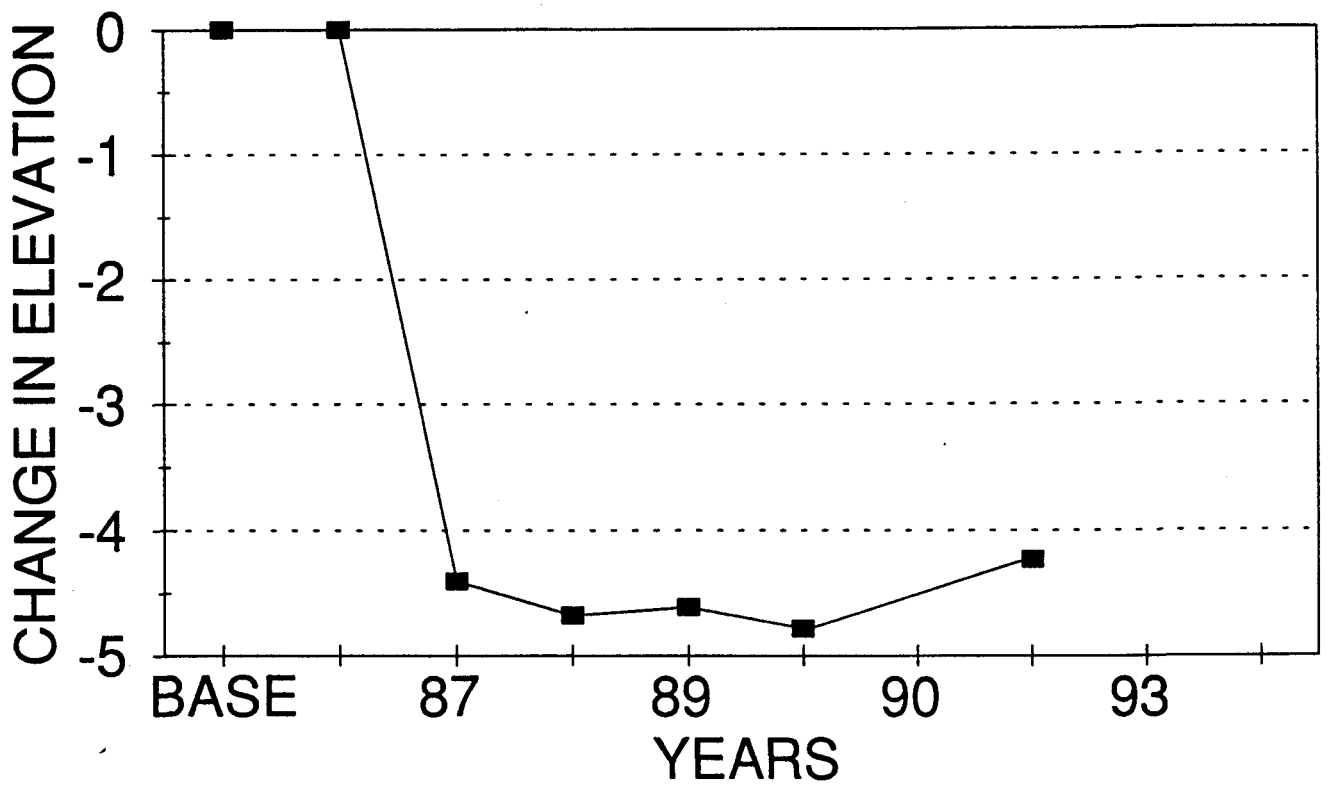
PR-2

NEWBERRY CANYON



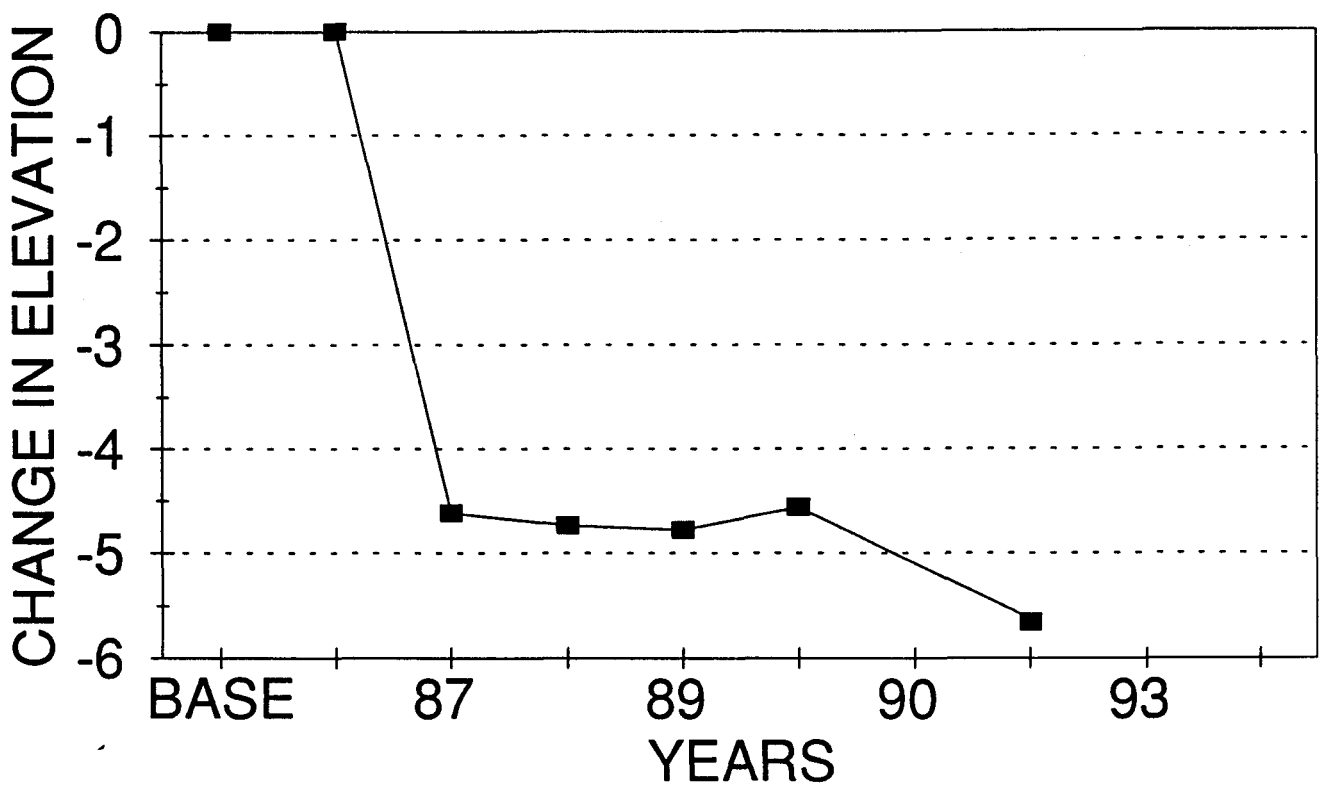
PR-3

NEWBERRY CANYON



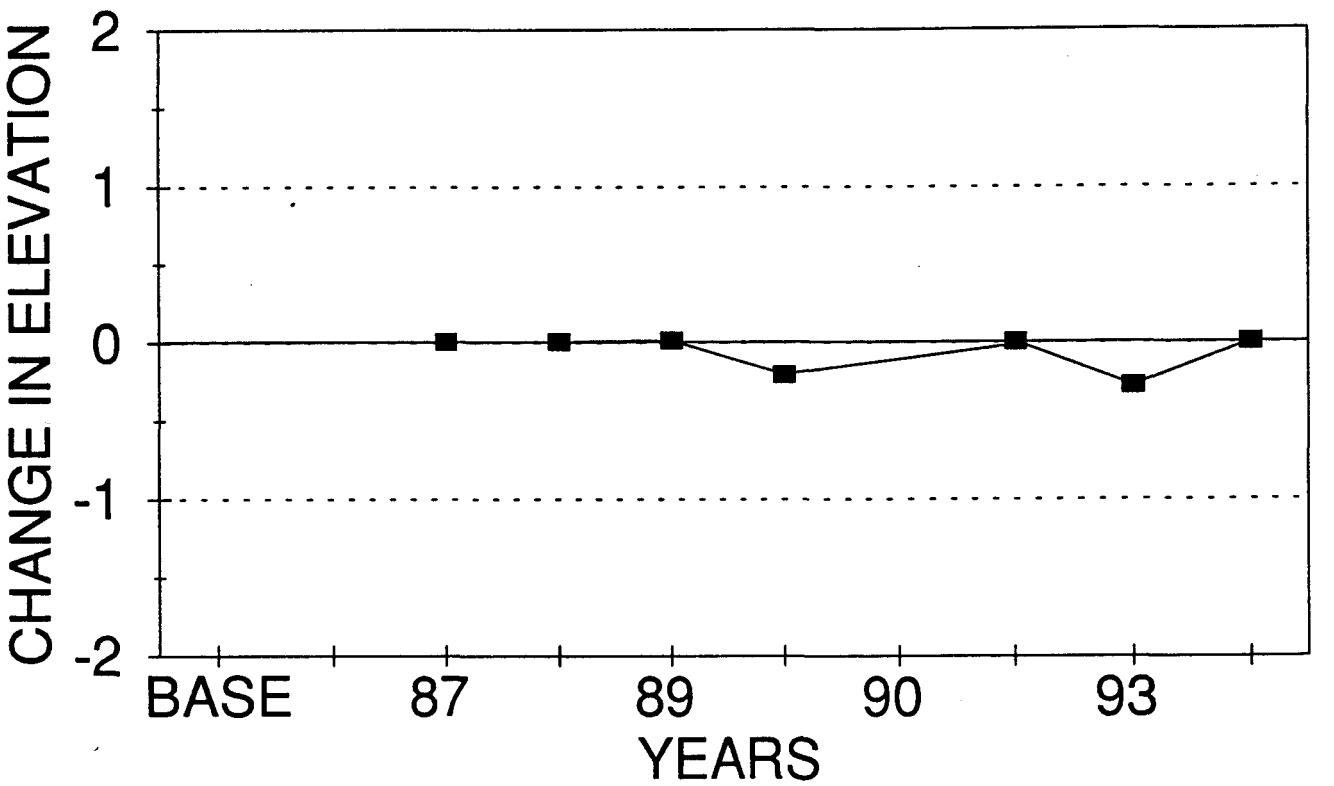
PR-4

NEWBERRY CANYON



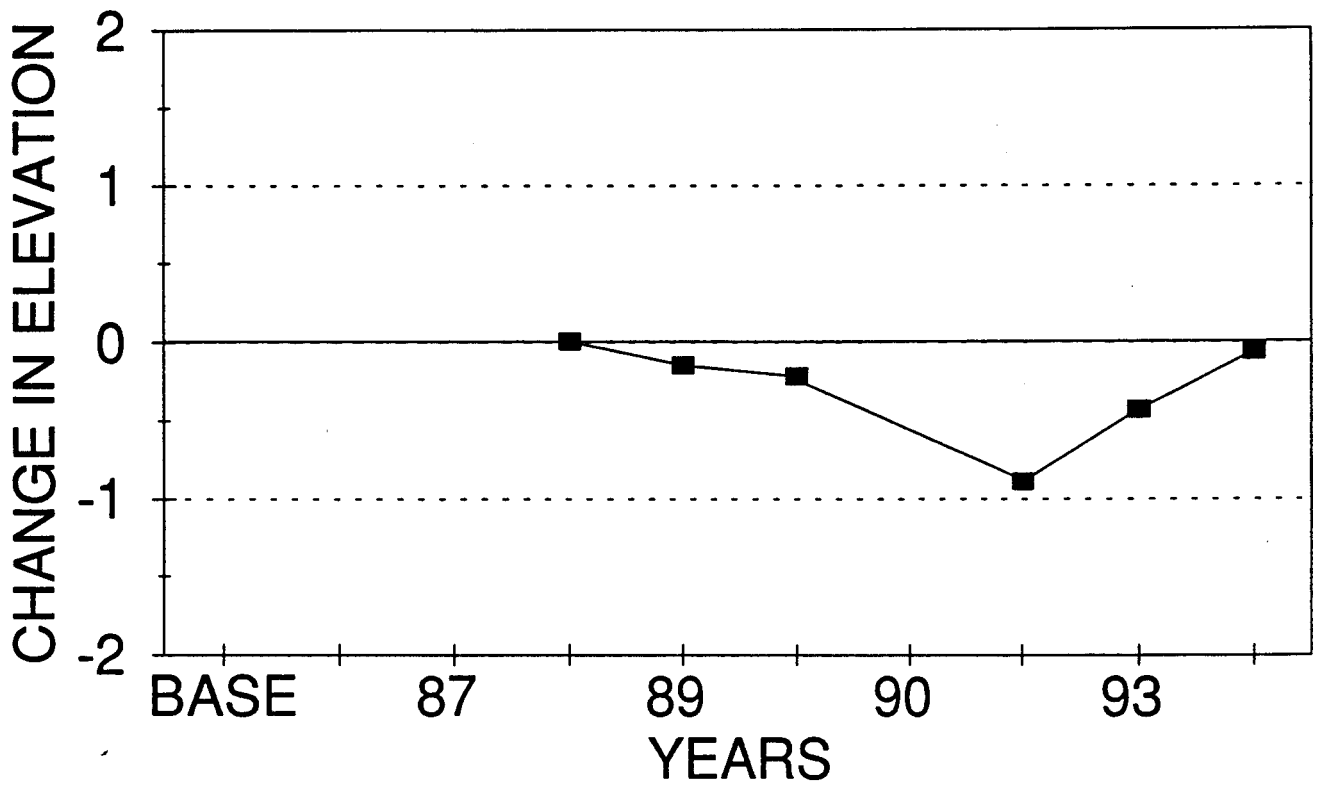
PR-5

NEWBERRY CANYON



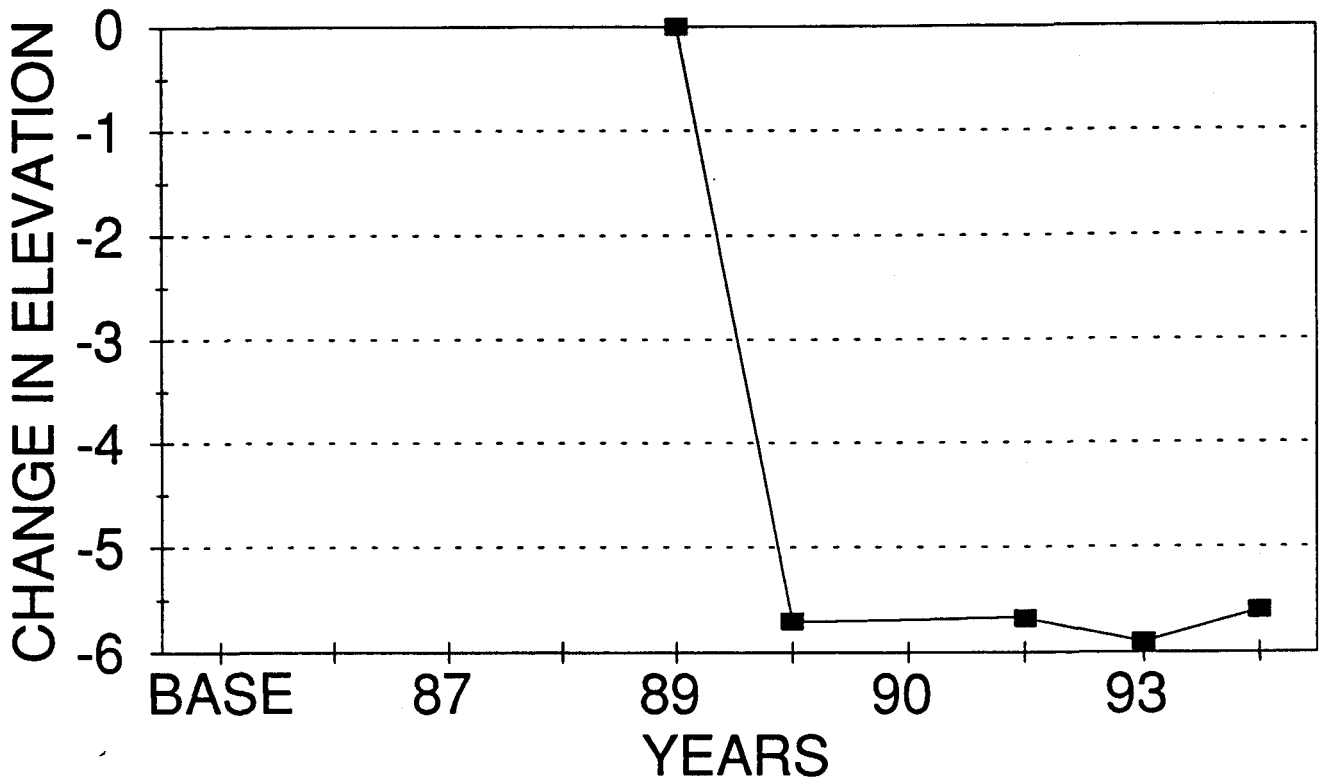
PR-6

NEWBERRY CANYON



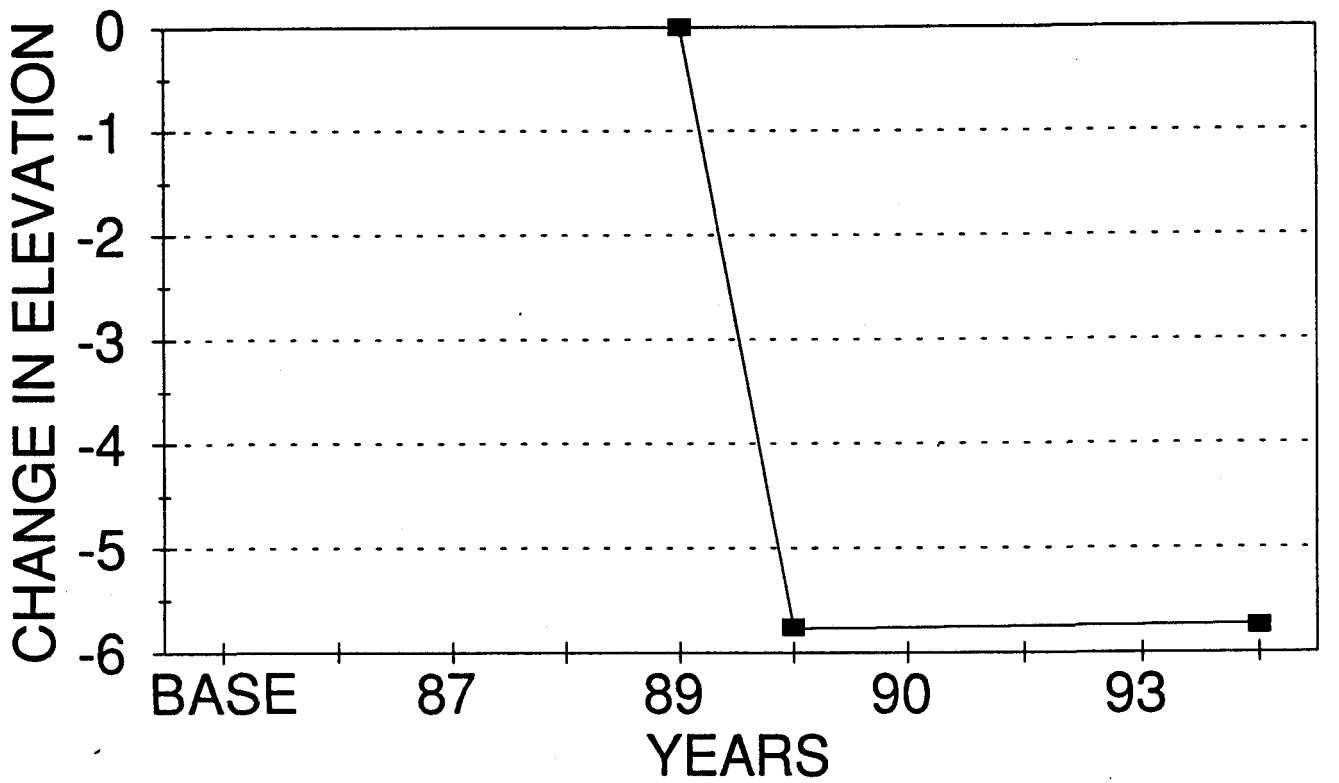
PR-7

NEWBERRY CANYON



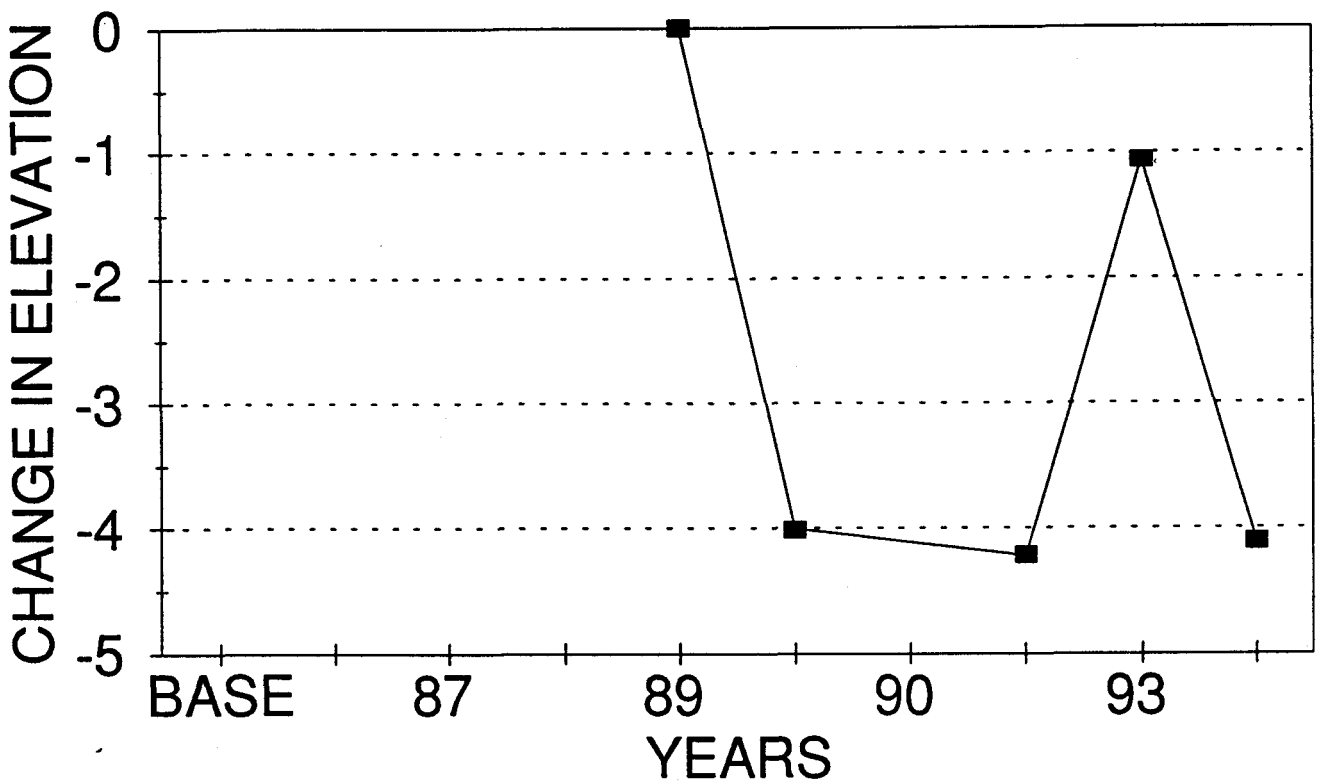
PR-8

NEWBERRY CANYON



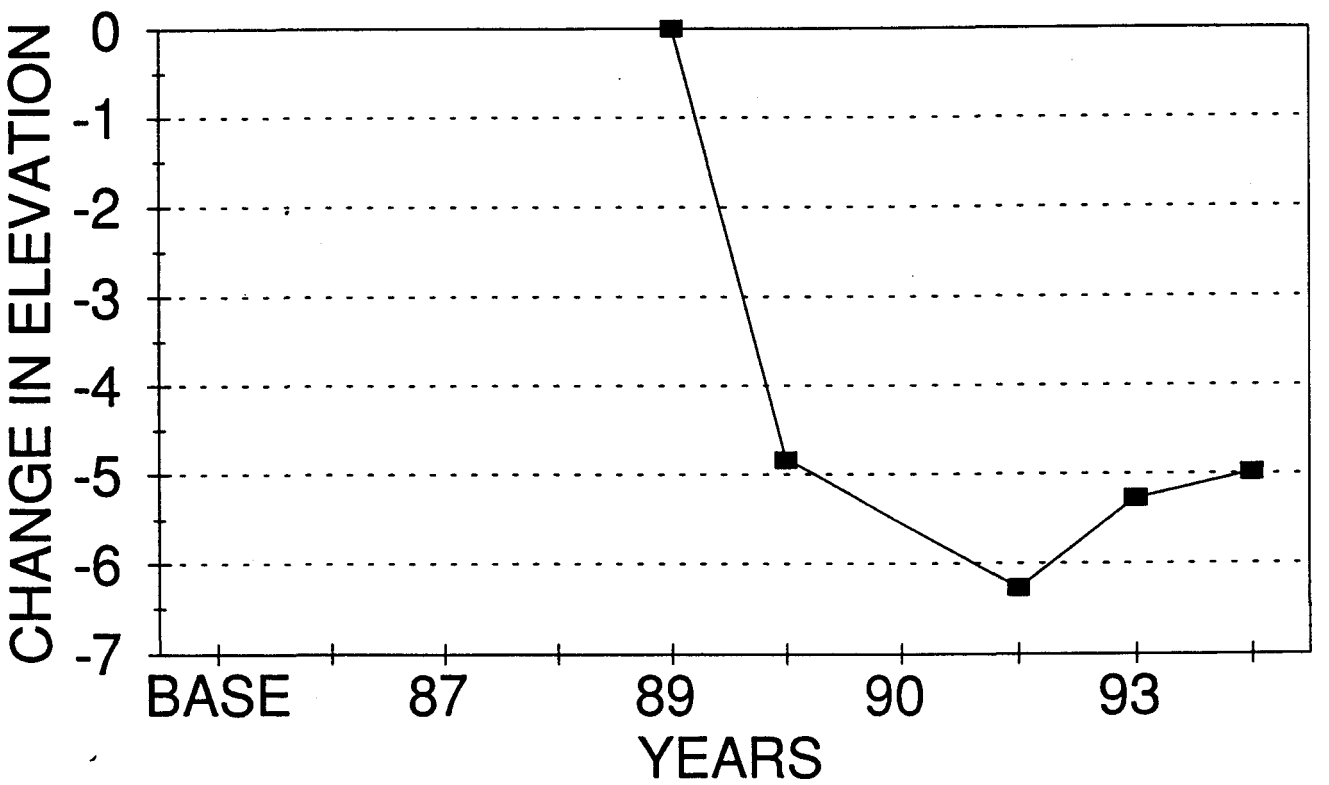
PR-9

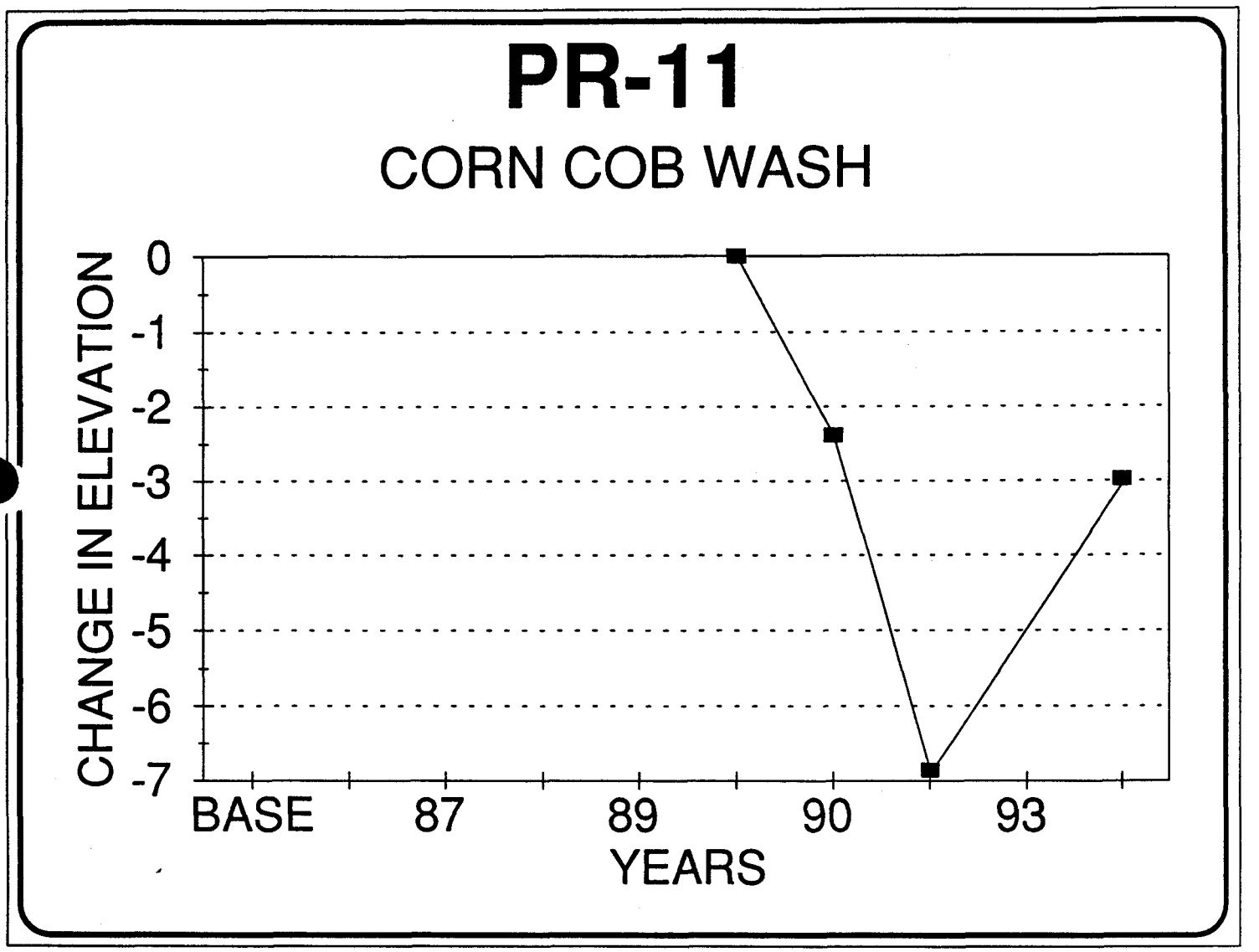
NEWBERRY CANYON



PR-10

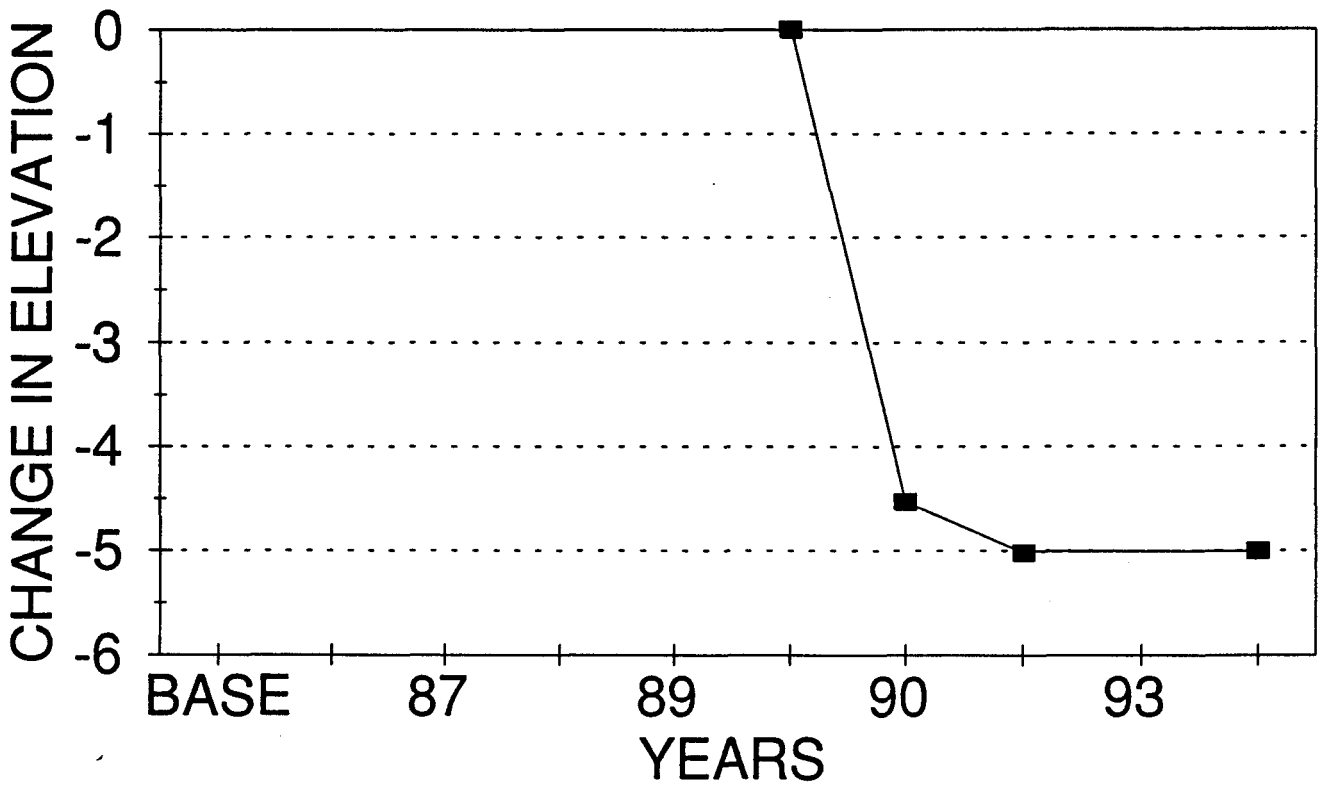
NEWBERRY CANYON




PR-11
CORN COB WASH
CHANGE IN ELEVATION
0
-1
-2
-3
-4
-5
-6
-7
BASE
87
89
90
93
YEARS

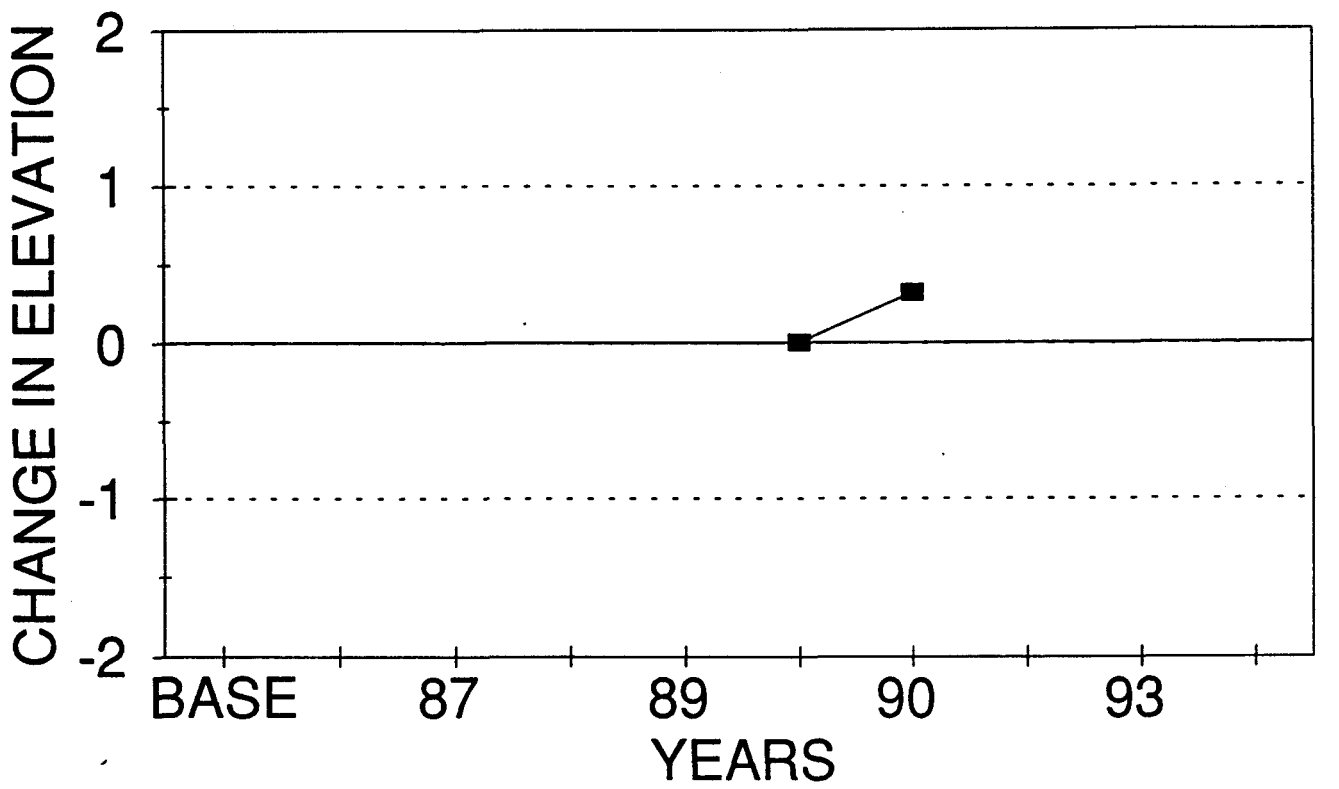
PR-12

CORN COB WASH



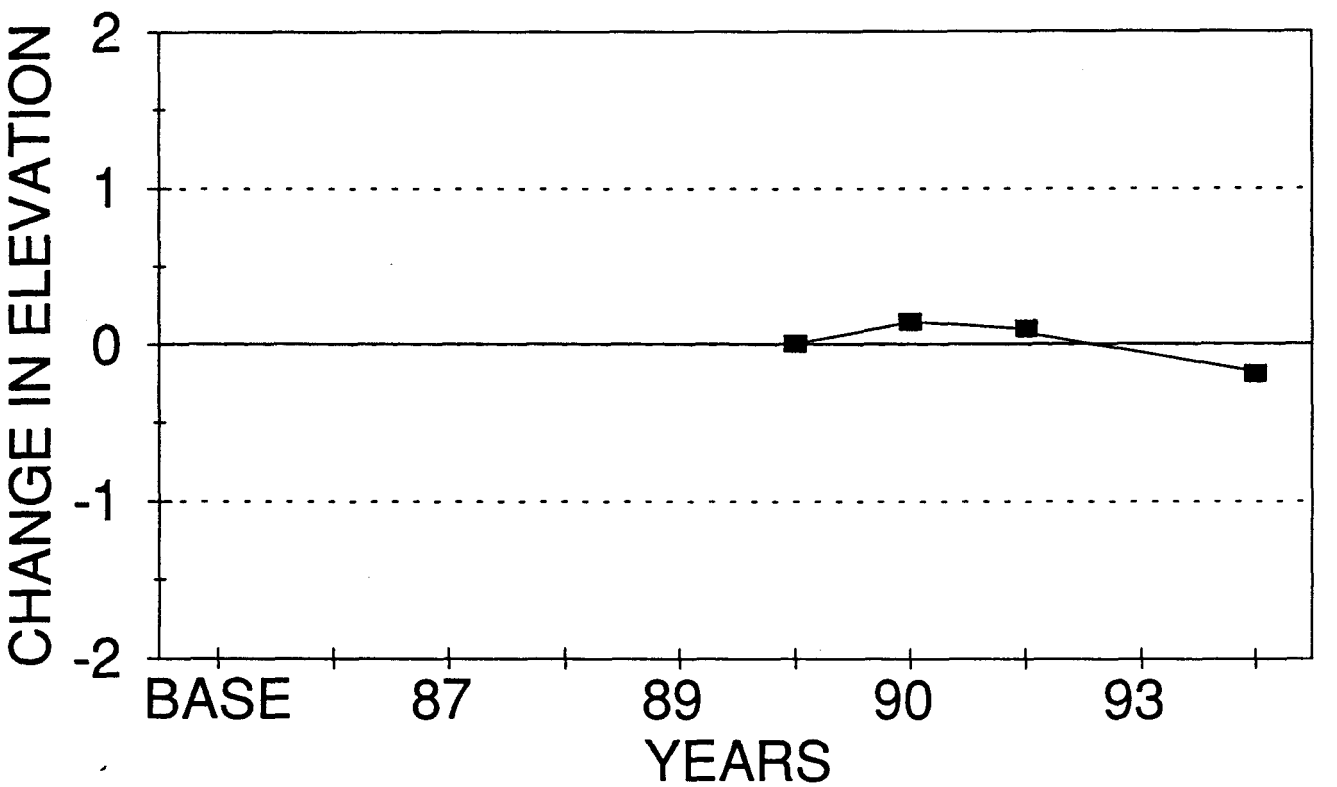
PR-13

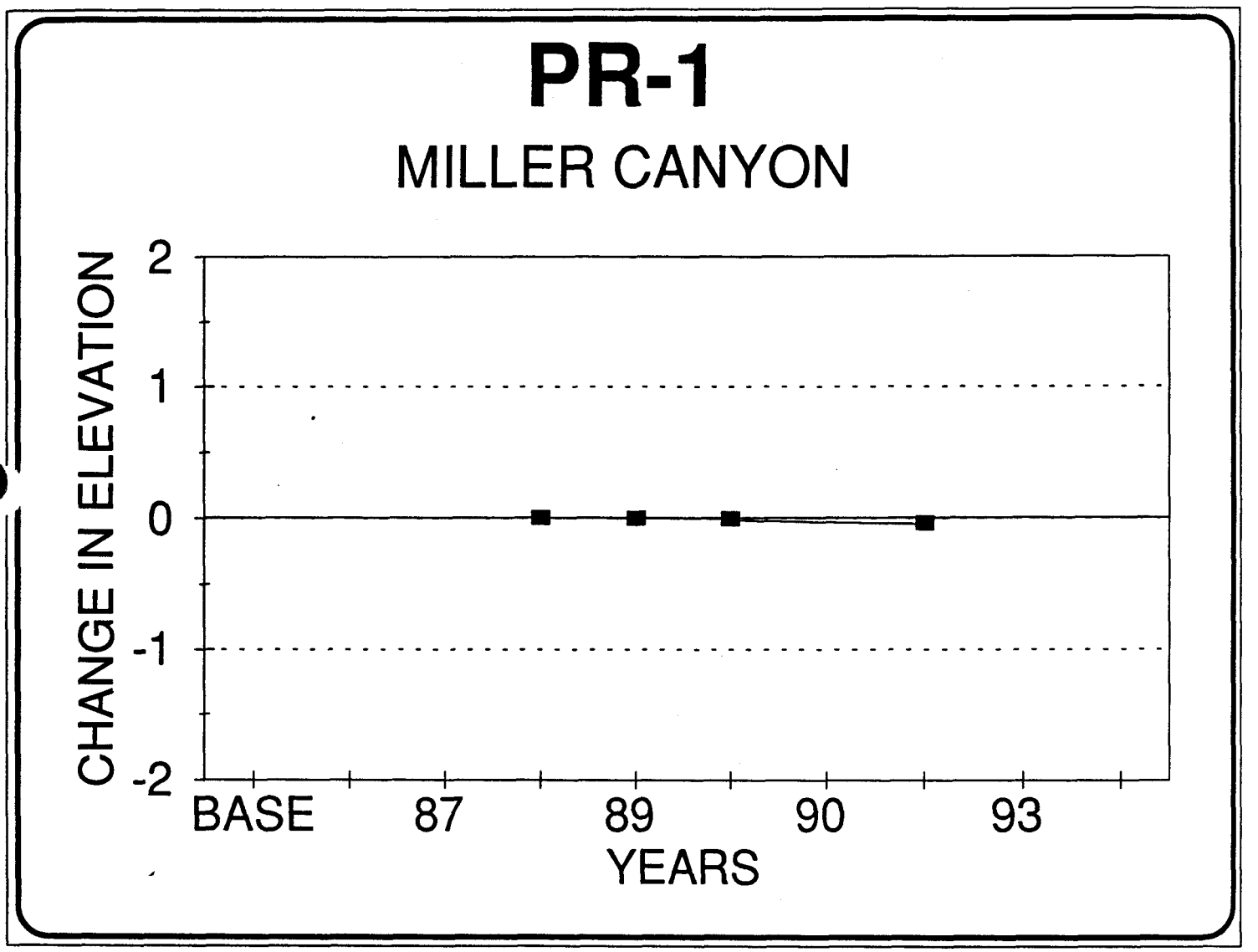
CORN COB WASH

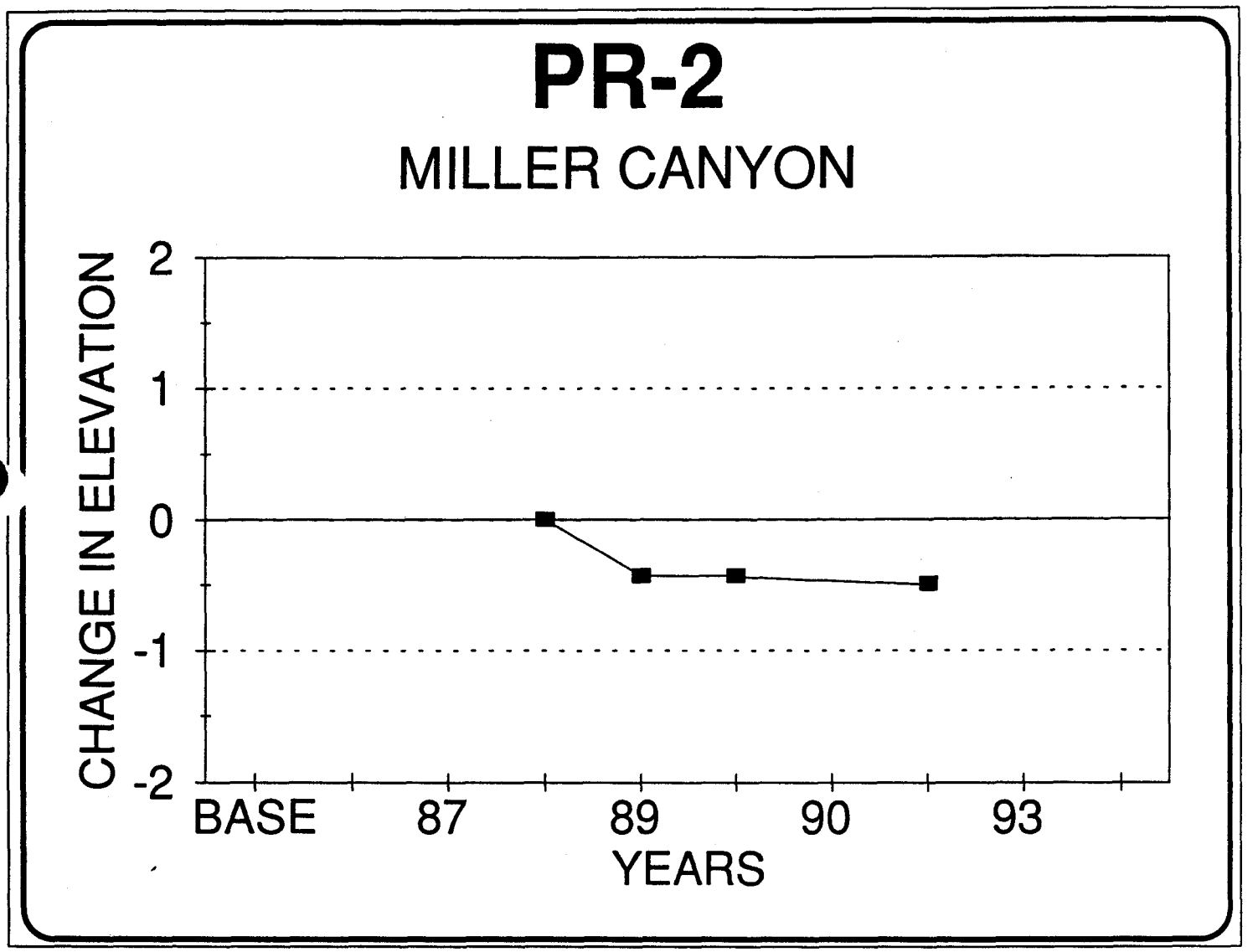


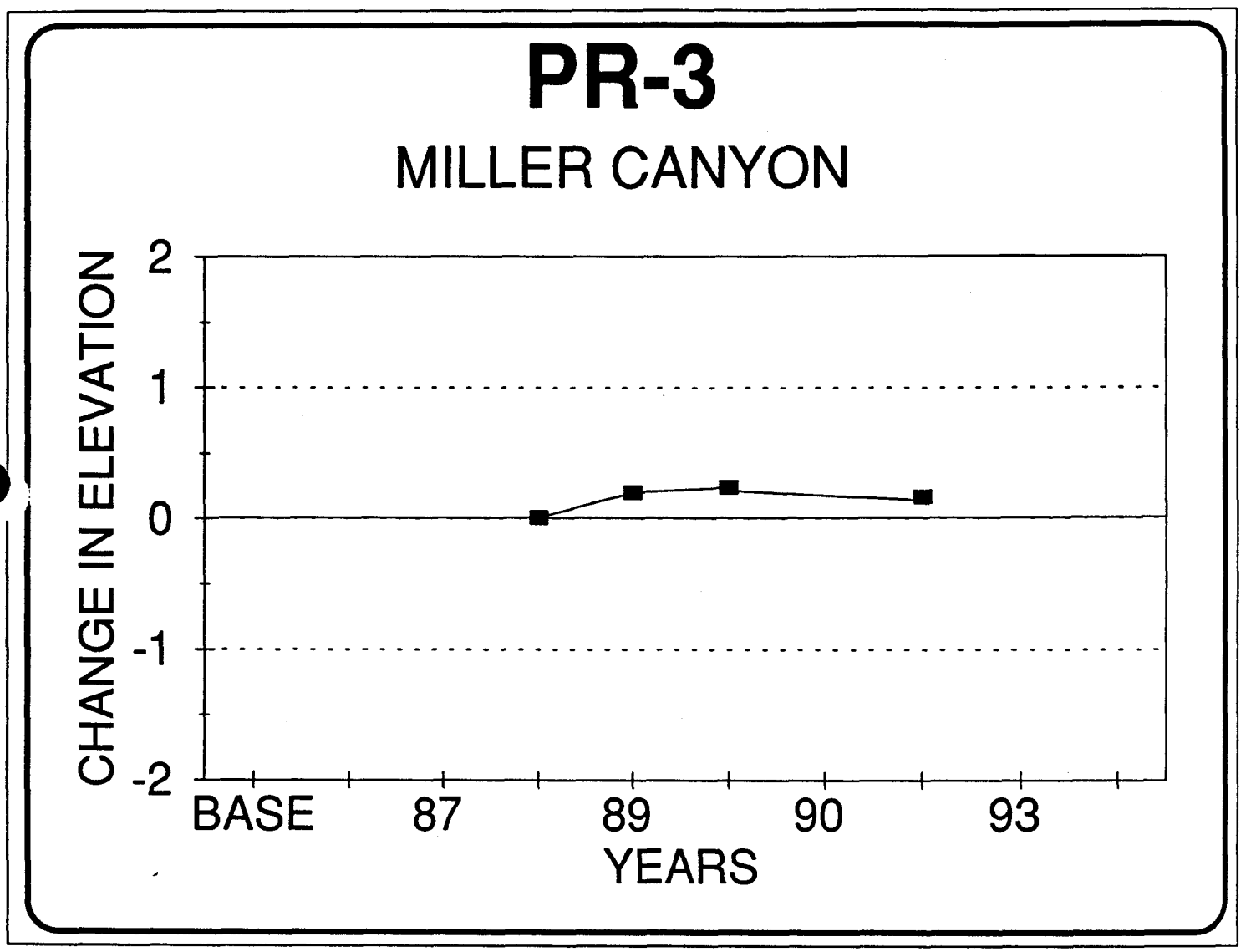
PR-14

CORN COB WASH



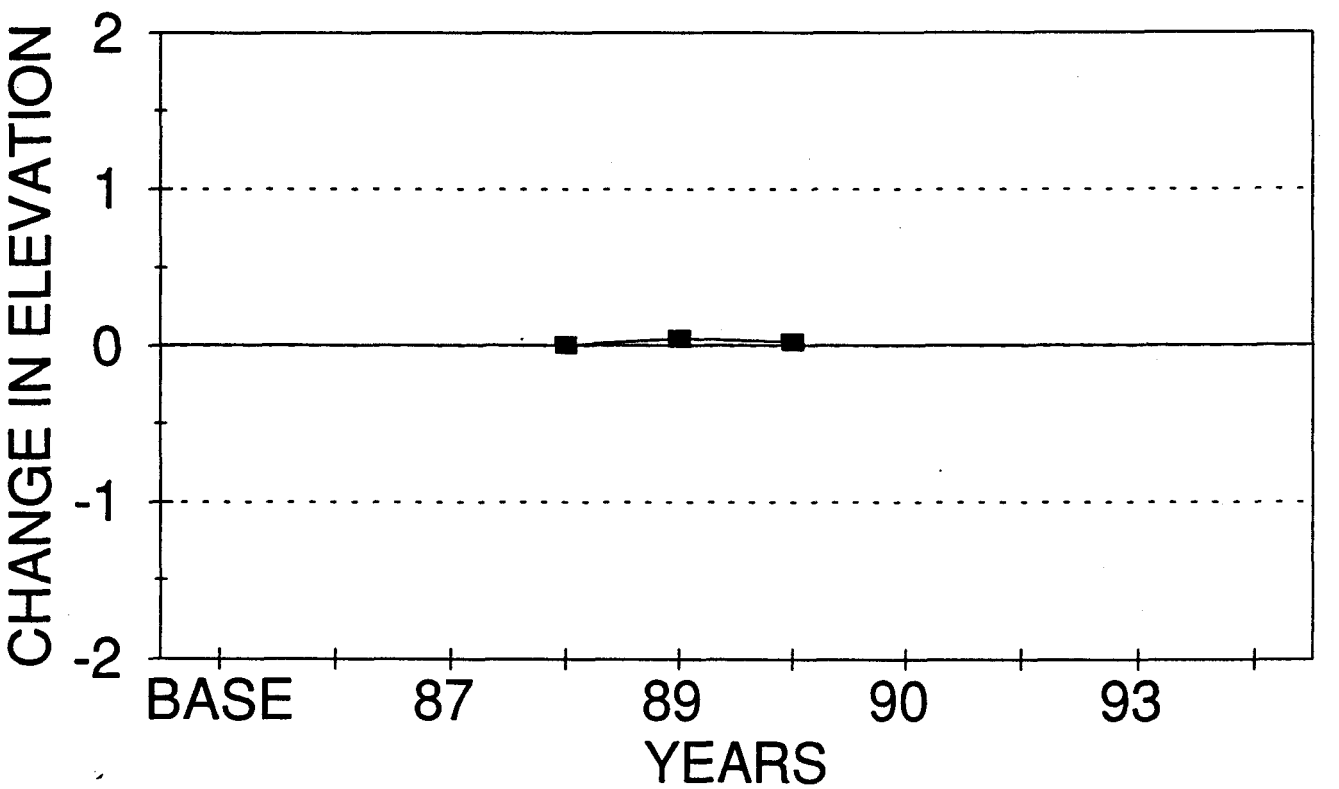

PR-1
MILLER CANYON
CHANGE IN ELEVATION
2
1
0
-1
-2
BASE
87
89
90
93
YEARS


PR-2
MILLER CANYON
CHANGE IN ELEVATION
2
1
0
-1
-2
BASE
87
89
90
93
YEARS


PR-3
MILLER CANYON
CHANGE IN ELEVATION
2
1
0
-1
-2
BASE
87
89
90
93
YEARS

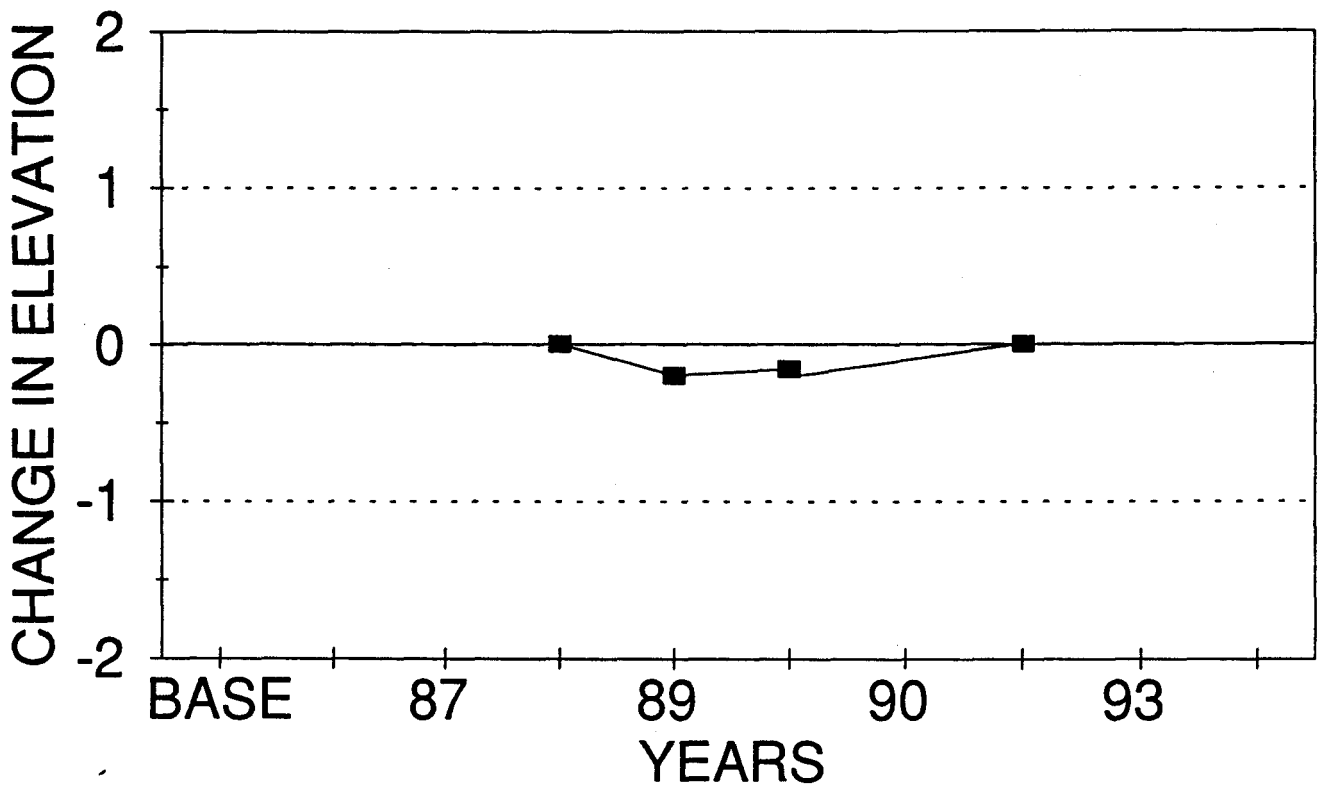
PR-4

MILLER CANYON



PR-5

MILLER CANYON



United States Department of the Interior

BUREAU OF MINES

TWIN CITIES RESEARCH CENTER
5629 MINNEHAHA AVENUE SOUTH
MINNEAPOLIS, MN 55417-3099

Telex: 362735 BOM TCRC UD

November 27, 1991

Mr. Roger Fry
PacifiCorp
324 South State
P.O. Box 26128
Salt Lake City, UT 84126-0128

Dear Roger:

In the interest of providing you with updates on the progress of data acquisition and analysis, I have enclosed plots for some of the TDR signatures from October 15 to November 13. In summary, the interpretation of these changes is as follows:

10/15/91	10 am	end of cable @ 1420 ft (Fig. 1)
10/21/91	10 am	end of cable @ 1420 ft
	1123 pm	longwall shearer hit cable
10/22/91	10 am	tensile failure of cable @ 1314 ft (Fig. 1)
10/24/91	10 am	tensile failure of cable @ 1060 ft (Fig. 1)
		shearing of cable @ 281 ft (Fig. 1 and Fig. 2)
10/26/91	10 am	more than 1 inch of shear displacement @ 281 ft has damaged cable such that it cannot be interrogated below this depth
11/01/91	10 am	shearing of cable @ 88.5 ft and 165 ft (Fig. 1 and Fig. 2)
11/13/91	10 am	more than 1 inch of shear displacement @ 165 ft has damaged cable such that it cannot be interrogated below this depth

Based on this information, strata separation has occurred up to at least 330 ft (1390 ft - 1060 ft) above the coal seam. Beam bending is ongoing in the top 300 ft with shearing along fractures and bedding planes. Only major reflections are visible in Figures 1 and 2. When the signatures are viewed at a smaller scale, it is apparent that shear is occurring along several other fractures and bedding planes in the top 300 ft. As more data is collected and plotted these should become more apparent.

I will now start quantifying the shear displacement based on changes in the magnitude of the TDR reflections. In order to verify that my interpretation is valid it now very important that I have a log for the hole and mine map showing

longwall face locations. In particular, I need to determine if the shear displacements are occurring along bedding planes and to plot shear displacement versus face position relative to the cable location.

I will continue to provide updates as I get more data reduced and plotted. If you have any questions, comments, suggestions, etc. please do not hesitate to call me.

Sincerely,

KEVIN M. O'CONNOR, Civil Engineer
Rock Mass Behavior

cc: Chuck Thomas

United States Department of the Interior

BUREAU OF MINES

TWIN CITIES RESEARCH CENTER
5629 MINNEHAHA AVENUE SOUTH
MINNEAPOLIS, MN 55417-3099

Telex: 362735 BOM TCRC UD

December 16, 1991

Mr. Roger Fry
PacifiCorp
324 South State
P.O. Box 26128
Salt Lake City, UT 84126-0128

Dear Roger:

In the interest of providing you with updates on the progress of data acquisition and analysis, I have enclosed plots for some of the TDR signatures from October 15 to December 4. In summary, only one major change has occurred since my letter of November 27:

12/4/91	10 am	more than 1 inch of shear displacement @ 88.5 ft has damaged cable such that it cannot be interrogated below this depth

Based on this information, beam bending is continuing in the top 300 ft with shearing along fractures and bedding planes. As I mentioned previously, only major reflections are visible in Figure 1. When the signatures are viewed at a smaller scale, it is apparent that shear is occurring along several other fractures and bedding planes in the top 300 ft. As more data is collected and plotted these should become more apparent.

In order to verify that my interpretation is valid it is very important that I have a log for the hole and mine map showing longwall face locations. In particular, I need to determine if the shear displacements are occurring along bedding planes and to plot shear displacement versus face position relative to the cable location.

I will continue to provide updates as I get more data reduced and plotted. If you have any questions, comments, suggestions, etc. please do not hesitate to call me.

Sincerely,

KEVIN M. O'CONNOR, Civil Engineer
Rock Mass Behavior

cc: Chuck Thomas

IC 9405

INFORMATION CIRCULAR/1994

Response of Springs to Longwall Coal Mining at the Deer Creek and Cottonwood Mines, Wasatch Plateau, UT

By Liane L. M. Kadnuck

United States Department of the Interior

Bureau of Mines

U.S. Department of the Interior
Mission Statement

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

Cover: Clockwise from top left: topography of East Mountain Summit; typical topography of Wasatch Plateau; surveying instrument in winter snowpack, soure of recharge for local springs; spring I and the stock watering pond it creates.

Information Circular 9405

Response of Springs to Longwall Coal Mining at the Deer Creek and Cottonwood Mines, Wasatch Plateau, UT

By Liane L. M. Kadnuck

UNITED STATES DEPARTMENT OF THE INTERIOR
Bruce Babbitt, Secretary

BUREAU OF MINES

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CONTENTS

ILLUSTRATIONS

TABLES

UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

cm	centimeter	m	meter
km	kilometer	pct	percent
L/s	liter per second		

BUREAU OF MINES
SPRING CROSS REFERENCE

U.S. B. M. SPRING ID.	ENERGY WEST ID.
A	ELK SPRINGS
B	SHEBA SPRINGS
C	79-15
D	79-35
E	79-29
F	82-52
G	TED'S TUB
H	79-23
I	BURNT TREE
J	79-2
K	80-44
L	80-41
M	80-46
N	84-56

RESPONSE OF SPRINGS TO LONGWALL COAL MINING AT THE DEER CREEK AND COTTONWOOD MINES, WASATCH PLATEAU, UT

By Liane L. M. Kadnuck[1]

ABSTRACT

This report summarizes the results of a hydrologic research study conducted by the U.S. Bureau of Mines (USBM) in cooperation with Energy West Mining Co. at the Deer Creek and Cottonwood Mines, near Orangeville, UT. The USBM evaluated hydrologic and overburden failure data to assess the response of local ground water to underground coal mining in single- and multiple-seam conditions. Fourteen springs located over the two mines were investigated in the study along with overburden failure response caused by longwall panel extraction. Spring discharge was compared to climatic variation and time of undermining to quantify response to undermining. Spring discharge had been reduced owing to below-normal precipitation during the period evaluated. The response of springs to mining in the vicinity was influenced in part by the thick overburden present at the study site, the presence of hydrophilic clays and mudstones in the overburden stratigraphy, and elevation of the springs above the mine level, which buffered the effects of undermining.

[1]Environmental engineer, Denver Research Center, U.S. Bureau of Mines, Denver, CO.

INTRODUCTION

To quantify the response of overburden stratigraphy to high-extraction coal mining, the U.S. Bureau of Mines (USBM) initiated a research program to evaluate the effects of mining and associated subsidence in varying geologic conditions. The primary objective of this program is to understand the mechanics of subsidence and overburden failure response resulting from underground mining in Western U.S. coalfields. Previous USBM studies have focused on surface effects of underground coal mining *(1-5)*.[2] Recognizing that subsidence produces alterations in overburden characteristics which in turn produce associated changes in the hydrologic system, the program was expanded to include characterization of the response of hydrologic systems contained in the overburden. This study addresses the effects of overburden failure on hydrologic resources in proximity to a mined area.

This report describes the response of ground water contained in the overburden to underground mining in the Wasatch Plateau Coalfield. The study involved evaluating the response of local ground water resources overlying the Deer Creek and Cottonwood coal mines in Emery County, UT. The goals of this study were to (1) quantify fluctuations in spring discharge associated with undermining, (2) assess longevity of discharge fluctuations, and (3) correlate the stratigraphic locations and elevations of springs in the overburden stratigraphic column with zones of overburden failure.

ACKNOWLEDGMENTS

PacifiCorp's Fuel Resources Division provided valuable assistance in performing this research. Specifically, Chuck Semborski of the Energy West Mining Co. and Rodger Fry of InterWest Mining contributed much of the data and information contained in this report. Without their assistance, this study could not have been undertaken.

DEER CREEK AND COTTONWOOD MINES STUDY SITE

The Deer Creek and Cottonwood Mines are located in the Wasatch Plateau Coalfield in south-central Utah (figure 1). Two major coal seams are mined in the area by Energy West Mining Co., a subsidiary of PacifiCorp.; the Deer Creek Mine operates in the Blind Canyon Seam, and the Cottonwood Mine produces coal from the Hiawatha Seam approximately 26 m below. The Deer Creek Mine overlies and partly overlaps the Cottonwood Mine; hence the study area contains areas of both single- and multiple-seam mining. The mines are located on East Mountain (elevation 2,942 m). The local topography is typified by rugged mountains dissected by stream-incised canyons. The overburden thickness averages 518 m but ranges from 260 to over 700 m, depending on local topography.

Both mines currently extract coal using longwall retreat methods, and each contains areas of past room-and-pillar extraction. The coal is hard, dense, and ranked B to C bituminous. The Deer Creek Mine operates at an average extraction height of 3.3 m, and the Cottonwood Mine has an average extraction height of 2.6 m.

[2]Italic numbers in parentheses refer to items in the list of references preceding the appendix.

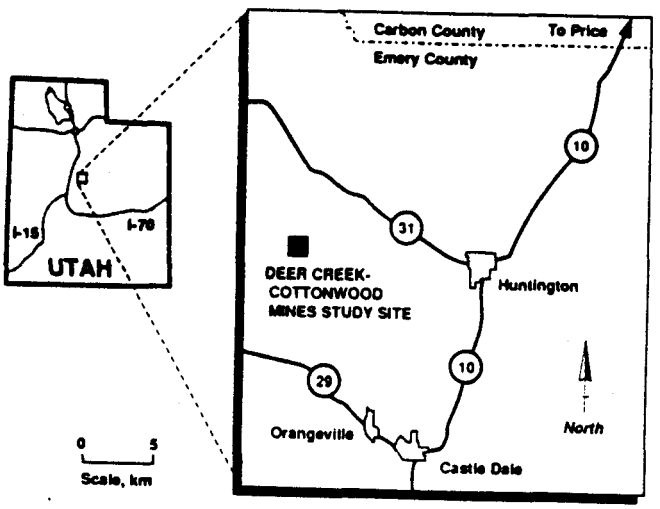

Figure 1.—Project location map.

GEOLOGY

Regional Geology

The mines are located on the Wasatch Plateau, a broad, north-south-trending, flat-topped mesa. The eastern edge of the plateau lies on the western flank of the San Rafael Swell and is typified by gently westward-dipping strata. The western edge of the plateau is complexly faulted and represents the transition between the Colorado plateau

region and the Great Basin. Geologic units outcropping in the area range in age from Cretaceous to Tertiary, with some thin, unconsolidated Quaternary deposits present in stream valleys.

Local Geology

Exposed strata in the mine area are of sedimentary origin. The economic coal deposits are found in the lower part of the stratigraphic section. Generalized lithologies and thicknesses of each geologic unit are summarized in figure 2 *(6)*.

The youngest geologic unit in the area, the Flagstaff Limestone, is a freshwater limestone that caps portions of the top of East Mountain. The Flagstaff is underlain by the North Horn Formation, a variegated shale and mudstone sequence derived from fluvial and lacustrine origins. The Price River Formation forms a steep, receding slope under the North Horn and consists of a conglomeratic fluvial sandstone with shale layers. The North Horn and Price River Formations each contain claystones and mudstones that are rich in hydrophilic clays. The fluvial Castlegate Sandstone forms a cliff between the Price River and Blackhawk Formations. The Blackhawk Formation is a marginal marine sequence of lenticular sandstone beds and carbonaceous shales with economic coal deposits. The Blackhawk is typified as having fluvial channels scoured into the top of the coal deposits. Underlying the Blackhawk is the Star Point Sandstone, a thinly bedded marine sandstone with shale interbeds at the base where it intertongues with the older Masuk Shale Member of the Mancos Formation.

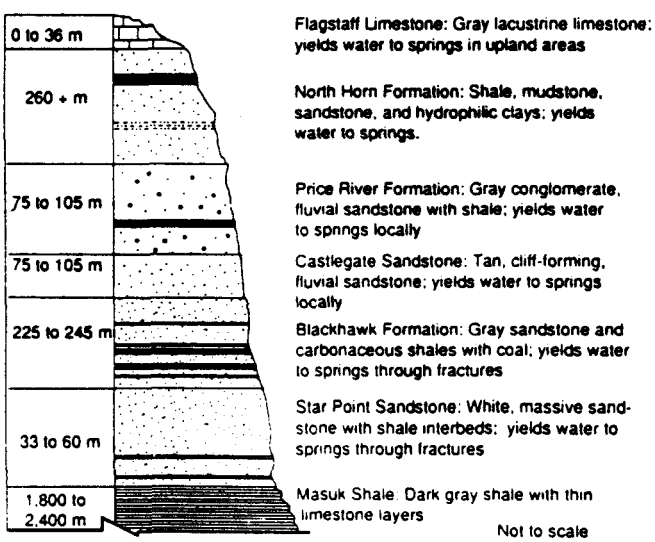

Figure 2.—Generalized overburden stratigraphy (modified from Danielson and others (7)).

The regional dip of the strata is broken by the northeast-trending axis of the Straight Canyon syncline, located on the western end of East Mountain. Faulting is common on the Wasatch Plateau, and three faults, the Deer Creek, Pleasant Valley, and Roan's Canyon, crosscut the permit area *(6)*. Jointing is also prevalent in the area, and joint sets trending northeast-southwest and northwest-southeast crosscut the study area. Figure 3 shows the locations and trends of the major structural features.

HYDROLOGIC SYSTEM

Ground Water Hydrology

Ground water occurs in all exposed geologic units discussed in the previous section in continuous or discontinuous water-bearing zones. The formations yield ground water from perched zones[3] to springs[4] where the hydraulic conductivity of the water-bearing zone is higher than that of the surrounding rock, and where the formations are fractured or faulted. The lateral continuity of these perched water tables is not known, though there is some evidence for limited lateral extent based on springs located at the same elevation *(6)*. The lateral extent of water-bearing zones is limited based on the discontinuous nature of the local topography. A continuous water-bearing unit was found to be present in the Star Point sandstone through drillers' logs and regional ground water studies.

Ground water in the area is recharged largely from precipitation, most of it from snowmelt, which percolates into the subsurface through fractures or matrix flow *(9)*. The flat top of East Mountain allows water to infiltrate to the subsurface through fractures exposed at the surface. Some recharge also infiltrates to the subsurface on the mountain flanks. Older units are recharged mainly from water that migrates through fractures. Impermeable lenses of shale and mudstone in the North Horn and Price River Formations retard downward migration of water, although some water is transmitted to the lower geologic units through continuous fractures. Geotechnical tests performed on the North Horn Formation indicated hydrophilic or swelling materials were present in the clays and mudstones that swelled 40 pct in the first hour of testing *(10)*. As a result, a large number of springs issue from the North Horn and Price River Formations. The Star Point Sandstone and the Blackhawk Formation are recharged from overlying units, mainly through faults and fractures *(6)*.

[3]By definition, perched water is "unconfined ground water separated from an underlying main body of ground water by an unsaturated zone" *(7)*.

[4]By definition, springs are a place where ground water flows naturally from a rock or the soil onto the land surface or into a body of water, and the occurrence depends upon the nature and relationship of rocks, especially permeable and impermeable strata *(8)*.

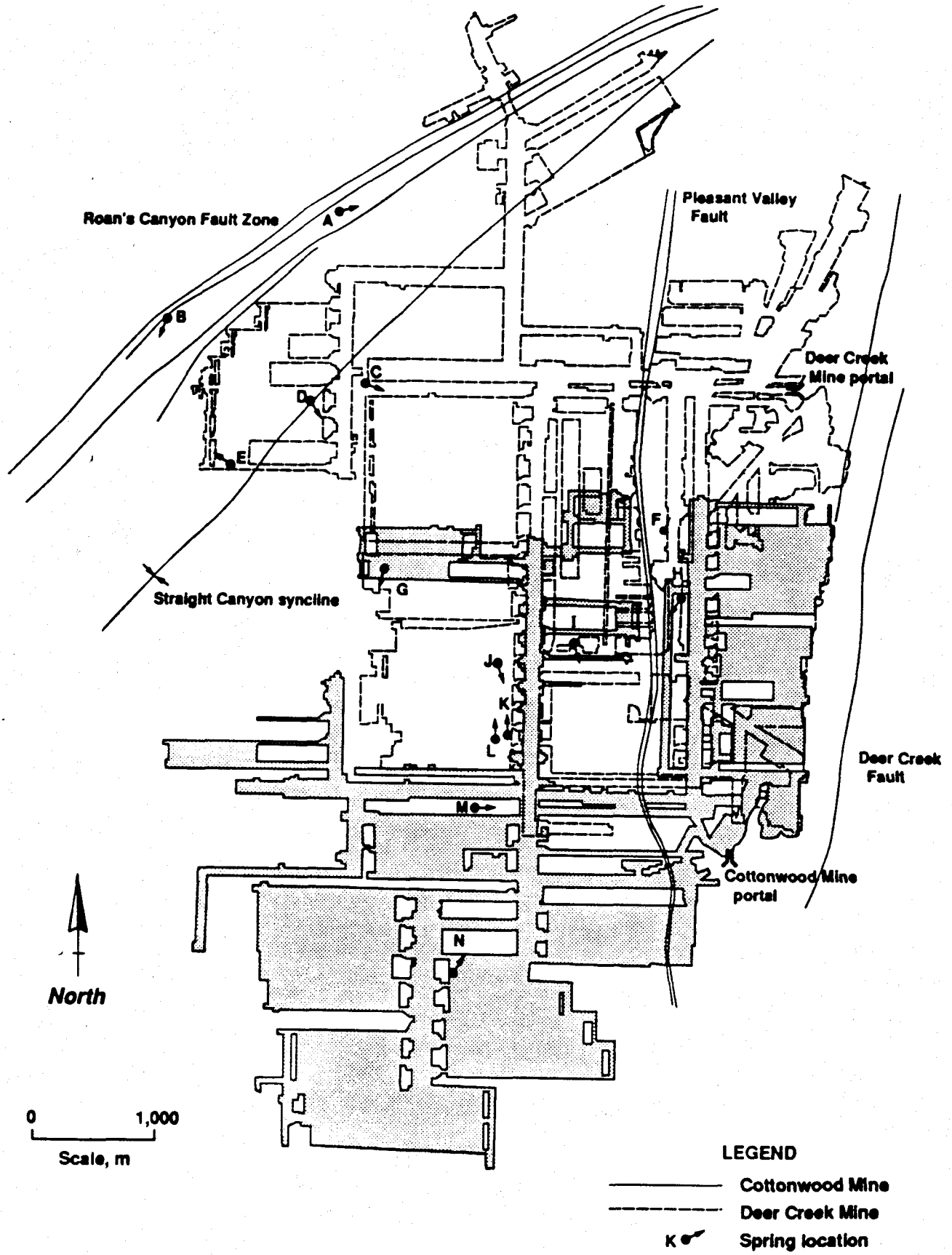

Figure 3.—Mine map showing spring locations.

Water movement is controlled by dip of bedding, primary hydraulic conductivity, and fractures. Regional ground water flow in the immediate area is affected by the Joes Valley and Pleasant Valley fault zones, which are thought to be major conduits of interbasin flow. Water-bearing fractures encountered in the mines further indicate that ground water is transported along faults and fractures *(10)*.

Surface Water Hydrology

As shown on figure 4, East Mountain forms a drainage divide between Huntington Creek to the north and Cottonwood Creek on the south. The north fork of Cottonwood Creek drains the area between Trail and East Mountains, while Huntington Creek drains the area between East Mountain and Gentry Mountain to the north. There are numerous tributaries to these creeks, most of which are ephemeral, flowing only during precipitation events, or intermittent, flowing during wet seasons of the year.

Most of the overland drainage is derived from snowmelt, and most baseflow in the streams originates as ground water discharged from perched aquifers issuing water to springs *(6, 11)*. Large fracture systems associated with the fault zones in the area are thought to control the surface drainage and may intercept creek flow and divert it into other basins. A lineament analysis *(12)* coupled with a drainage trace analysis indicated that the major trunk streams follow a regional northwest-southeast trend and that tributary drainages follow either a north-south, east-west, or northeast-southwest trend. The linearity of the drainage traces suggests that the surface drainage is following fracture or joint systems.

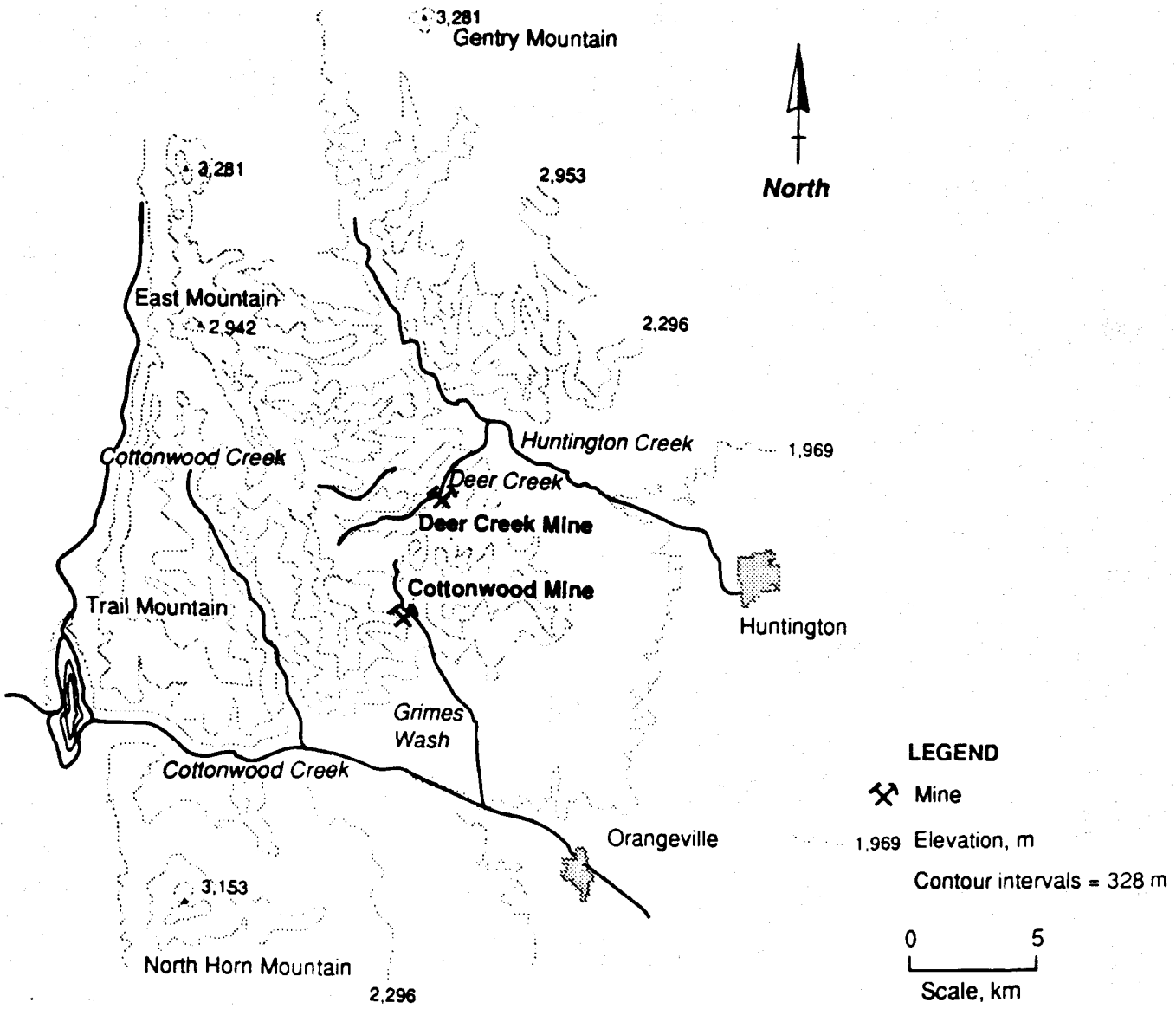

Figure 4.—Topography of East Mountain showing surface drainage.

HYDROLOGIC DATA COLLECTION

The mining company is required by law to monitor quantity of water resources within the permit area. Monitoring includes spring and stream discharge, piezometric levels in the mine floor, and mine discharge from both the Deer Creek and Cottonwood Mines. This study focused on ground water resources located above the mine level, namely springs, that could potentially be affected by mining. Springs issuing from East Mountain within the Deer Creek and Cottonwood Mines permit area were chosen by PacifiCorp and the Utah Division of Oil, Gas and Mining to be monitored for discharge and water quality. Thirty springs within the permit area are monitored, some on a semiannual basis and some on a monthly basis. Discharge monitoring was started in 1979, and additional springs have been added each year since that time; thus records vary for all the springs monitored. Discharge is measured by weirs, flumes, or manually. The 14 springs selected for use in this study were those with the longest available monitoring records. The springs monitored on a monthly basis are measured from July through October, since they are inaccessible during winter months. Discharge is reported from annual runoff through baseflow in the fall.

The monitoring is performed to allow comparison and assessment of the effects that mining has on the springs. The springs were characterized by mine personnel for issuing mechanism (for example, a fracture or a perched zone), issuing formation, and elevation measurements taken. This information is provided in table 1.

Water enters the mines through faults, fractures, and drill holes, and where localized saturated zones (fluvial sandstone channels) are intercepted by mine workings. Water discharged from the mines is measured at the discharge point on a daily basis and reported as a monthly total. Mine water from the Cottonwood Mine is discharged into Grimes Wash, and water from the Deer Creek Mine is discharged into Huntington Creek (figure 4).

Table 1.—Spring characteristics

Spring	Geologic unit	Issuing mechanism	Elevation, m	Location	Date undermined
A	North Horn	Fracture	2,850	Not in mined area	Not applicable.
B	Flagstaff	.do.	2,969	.do.	Do.
C	North Horn	.do.	2,831	Deer Creek barrier pillar	Do.
D	Flagstaff	Formation contact	2,921	Deer Creek panel	Oct. 1991.
E	North Horn	Perched zone	2,868	.do.	Feb. 1992.
F	Price River	.do.	2,743	Deer Creek barrier pillar	Not applicable.
G	North Horn	Fracture	2,831	Deer Creek panel	Apr. 1988.
H	.do.	Formation contact	2,754	Deer Creek mains, Cottonwood pillar	May 1976.
I	.do.	Perched zone	2,822	Deer Creek submains, Cottonwood panel	Aug. 1993.
J	.do.	.do.	2,831	Deer Creek panel	Aug. 1986.
K	Price River	Fracture	2,737	.do.	Dec. 1982.
L	.do.	Perched zone	2,743	.do.	Aug. 1982.
M	North Horn	.do.	2,850	Cottonwood barrier pillar	Not applicable.
N	.do.	Fracture	2,845	Cottonwood panel	Aug. 1989.

ANALYSIS OF SPRING RESPONSE TO MINING

GRAPHS

This study concentrates on characterizing the impacts mining has on perched water-bearing zones in the overburden. In the study area, water-bearing zones above the mine level issue water to springs, representing an important part of water supply in the region for stream baseflow, agricultural, irrigation, and wildlife habitat purposes. Fourteen springs located on East Mountain were targeted for study based on availability of monitoring records and proximity to the mines and were designated with a letter identifier of A to N. Analysis of spring response followed a method used by Coe and Stowe (*13*), which is one of the few published studies that have examined responses of springs to undermining. This methodology required use of information sets including precipitation, spring discharge, and time of undermining.

This method involved comparing spring discharge hydrographs to precipitation for the period of monitoring. Monthly and total annual precipitation data for water years[5] 1981 to 1993 were utilized and are shown on figure A-1 in the appendix. Precipitation data are collected at a weather station on East Mountain on a daily basis. The availability of seasonal, monthly discharge data dictated using seasonal recession curves to assess mining impacts by determining if the springs departed from normal response. Patterns or trends in the spring discharge recession curves were sought to assess if the springs showed similar responses each year to precipitation, runoff, and baseflow conditions. Curves were compared to one another to discern if springs in the area responded differently based on issuing mechanism (fracture versus perched zone). There did not appear to be large differences in response as a result of issuing mechanism. Several years of data prior to mining were incorporated to establish baseline conditions. Spring discharges, shown as seasonal recession curves, are given on figure A-2.

Initial comparison of spring discharge to precipitation indicated that discharge did not immediately follow precipitation. Therefore, a statistical analysis that cross-correlated precipitation data with spring discharge was performed for two of the springs. This analysis showed that the springs in the study area respond to precipitation events within 6 months to 1 year *(14)*. Discharge data for springs I and M were correlated with precipitation; this indicated that there is an approximate 6-month to 1-year lag time between precipitation events and discharge. The lag information was used to better assess variations due to climatic events without confusing them with response that may have been a result of mining. Results of the statistical analysis are given graphically on figure A-3. The graphs show the calculated lag time by offsetting the spring flow hydrograph by 1 year on the precipitation curve; for example, spring flow for 1982 is placed over precipitation for 1981. Local variation of lag time is expected based on differences in elevation, recharge source, and issuing mechanism for each of the springs studied. The statistical correlation gives an indication of the approximate lag time for the area. Figure A-4 gives the statistical results showing match position and correlation coefficient to demonstrate the validity of the correlation of the two data sets.

Spring discharge variation of both preundermining and postundermining was evaluated to identify if the spring discharge changed as the spring was undermined, or as mining progressed close by. Each spring location was compared with a map of mine workings and located with regard to placement over a mine structure such as a panel or a barrier pillar, as shown on figure 3. This information is also listed on table 1. Springs D, E, G, I, J, K, L, and N are located over longwall panels. Springs C, F, H, and M are located over other mine structures such as barrier pillars or mains. Springs A and B are located in an area that has not been undermined and were thus used as controls to identify discharge fluctuations due to climatic events. Spring discharge was carefully compared with precipitation, location of the spring over the extracted area, and time of undermining to assess response.

[5]The water year runs from October 1 to September 30.

RESULTS AND DISCUSSION

Spring A

Possible responses of springs to coal extraction include enhanced recharge to the spring from dilation of pre-existing fractures, reduction of spring discharge due to drainage into subsidence-induced fractures or dilation of existing fractures, or flow loss along planes of bedding separation *(9)*. Springs located over panels are expected to show a greater response to undermining than those located over mains or barrier pillars since most subsidence, and hence overburden deformation, occurs over the longwall panels. In a study in Appalachia where the overburden ranged from 120 to 245 m, rapid and dramatic decreases in spring discharge were observed as the longwall face passed underneath *(13)*. Trevits and Matetic observed a similar response in water wells located over longwall panels with 70 to 210 m of overburden present *(15)*. With the longwall mining method, subsidence occurs quickly after the coal is extracted as the immediate mine roof caves in behind the active face. Reports from mine personnel indicate that the majority of subsidence occurs at the site over single panels within 1 month after undermining.[6] Previous USBM studies reported that maximum subsidence occurred at these mines within a year where a group of panels had been extracted *(1, 3)*. Given these observations, hydrologic response is expected to occur within a similar timeframe as overburden response. As soon as the overburden fractures and moves in response to coal extraction and roof caving, the hydrologic system is also altered. The expected response of springs would be dramatic changes in discharge after undermining occurred.

Springs A and B were located outside the area disturbed by mining and provided information on the normal seasonal response of springs in the area to precipitation or recharge. From 1986 to 1992, precipitation in the area was 70 to 85 pct of normal. The recession curves for these springs show a general downward trend from 1986, in response to the decreased precipitation during that period. Precipitation increased in 1993 and is shown in the increase in spring discharge on the hydrographs (figure A-2). The shapes of the recession curves show smooth and repeatable patterns for the period of record.

Spring I is used as a water source for a stock watering pond. It was undermined by submains in the Deer Creek Mine in 1985, and by a longwall panel in the Cottonwood Mine in August 1993. It was noted that the recession curves departed from a normal shape coincident with mining activity underneath spring I. However, adjustments of valves and blockage in the pipe installed at the spring also occurred during this time, and available data do not allow for distinguishing the effects of the two activities. Weekly discharge measurements were available after the longwall panel passed underneath. Although surface tension cracks appeared in the vicinity, the spring discharge remained constant at 0.6 L/s. According to aerial surveys, the surface subsidence in the vicinity of spring I ranged from 0.6 to 1.2 m.

Spring E was undermined by a Deer Creek panel in February 1992. This spring exhibited inconsistent recession curves in the 5 years prior to undermining and then had a flat recession curve in the year after undermining. The surface subsidence at spring E was estimated to be 1.6 to 1.8 m. The spring has a very low discharge, making detection of discharge alteration more difficult. It is felt that the discharge alteration for this spring is a result of reduced recharge available from the decrease in precipitation.

Spring N was undermined by a Cottonwood panel in August 1989. The recession curves for the spring have a less consistent shape than those for springs A and B, although the shapes of the spring N curves are repeated over several years. The spring exhibits the same response both before and after undermining and also shows a general downward trend from 1986 due to decreased precipitation. The surface subsidence in the vicinity of spring N was 0.6 to 1.2 m. Given the repeatable nature of the recession curves, spring N does not appear to have been affected by mining.

The remaining springs located over panels and springs located over pillars or mains did not exhibit discernible effects from undermining.

Springs H, K, L, and M exhibited flat recession curves at some point during the period of monitoring. In these cases, the springs were reduced to low or no flow. These springs experienced no-flow conditions for several years corresponding to the drought years. Flow returned in springs K, L, and M in 1993; spring H had not recharged

[6]Personal communication with C. A. Semborski, Energy West Mining Co., Sept. 1993.

to normal flow by 1993. The flat curves are likely due to depleted recharge from precipitation to the spring source or to depleted storage. Springs D and N each had 1 year where the recession curves were flat, but returned to normally shaped curves the following year. In these cases, the flat recession curves did not correspond to times of undermining. The control springs, A and B, did not show flat recession curves during the period of study, which is likely a result of fracture recharge conditions and locations at high elevations.

The undermined springs do not show the dramatic decreases in flow that have been observed in other studies. The lack of dramatic effects and the limited response observed may be attributed to several factors. One factor is that the springs that have been undermined are situated above the panels at ratios of panel width to overburden thickness (between the spring and the mine level) greater than 1.0. In a study by Tieman and Rauch (*16*), partial to total dewatering was observed in springs that were located above the panels at panel width to overburden ratios of 0.75 to 1.0. Table 2 summarizes the range of panel width to overburden ratios for springs undermined by panels evaluated in this study. Since the ratios are greater than 1.0 for the springs in this study, dewatering would not be anticipated, based on the observations made by Tieman and Rauch. This does not preclude minor discharge variations occurring as a result of strata movement or stress redistribution. Table 2 also lists the estimated surface subsidence in the vicinity of the springs located over panels.

Table 2.—Ratios of panel width to overburden thickness for springs over panels

Spring	Ratio of panel width to overburden thickness	Surface subsidence, m
D	1.1	0.6 - 1.2
E	1.3	1.2 - 1.8
G	1.1	0.6 - 1.2
I	1.2	0.6 - 1.2
J	1.3	0.6 - 1.2
K	1.2	< 0.6
L	1.1	0.6 - 1.2
N	1.1	0.6 - 1.2

The limited response observed for the springs was thought to be influenced by site-specific conditions that buffered the effects of mining. These include the thick overburden present and the presence of formations in the overburden that contain hydrophilic clays and mudstones. Results from other studies have concluded that the presence of hydrophilic clays lessens the extent of strata dewatering (*13, 17*). Additionally, the presence of a massive sandstone layer (the Castlegate Sandstone) can cause bridging in the overburden, thereby limiting subsidence and associated hydrologic response (*1*).

Another factor contributing to the limited spring response was the elevations of the springs above anticipated heights of fracturing and caving in the overburden, as estimated using formulas developed by Peng (*18*). The relationship of fracture height equal to 30 times mining thickness was used. This relationship was developed based on mining conditions common to Eastern U.S. coalfields and does not account for differences in Western U.S. conditions such as the presence of massive sandstones in the overburden or thicker overburden. However, no similar value has been developed for the West, so the published relationship is commonly applied. Use of the relationship indicated that overburden fracturing might occur up to an elevation of 2,400 m from the Deer Creek Mine and up to approximately 2,330 m from the Cottonwood Mine. Spring K was the lowermost spring studied and was located at 2,737 m, 337 m above the computed height of fracturing. For the case that both coal seams had been extracted, gob formation and fracturing associated with mining the second lower seam would be incorporated into the fracturing produced by mining the first upper seam.[7] A conceptual subsurface overburden failure schematic is shown on figure 5.

Although all the springs studied were located at elevations higher than the computed elevations of fracturing in the overburden, the springs were located in a zone of the overburden where, according to Peng, continuous bending of the strata occurs. Preexisting fractures can dilate in response to the bending, causing flow variation. The bending and redistribution of stresses in the overburden can also cause flow variations.

[7]Personal communication with C. Haycocks, Department of Mining Engineering, Virginia Polytechnic Institute, Aug. 1993.

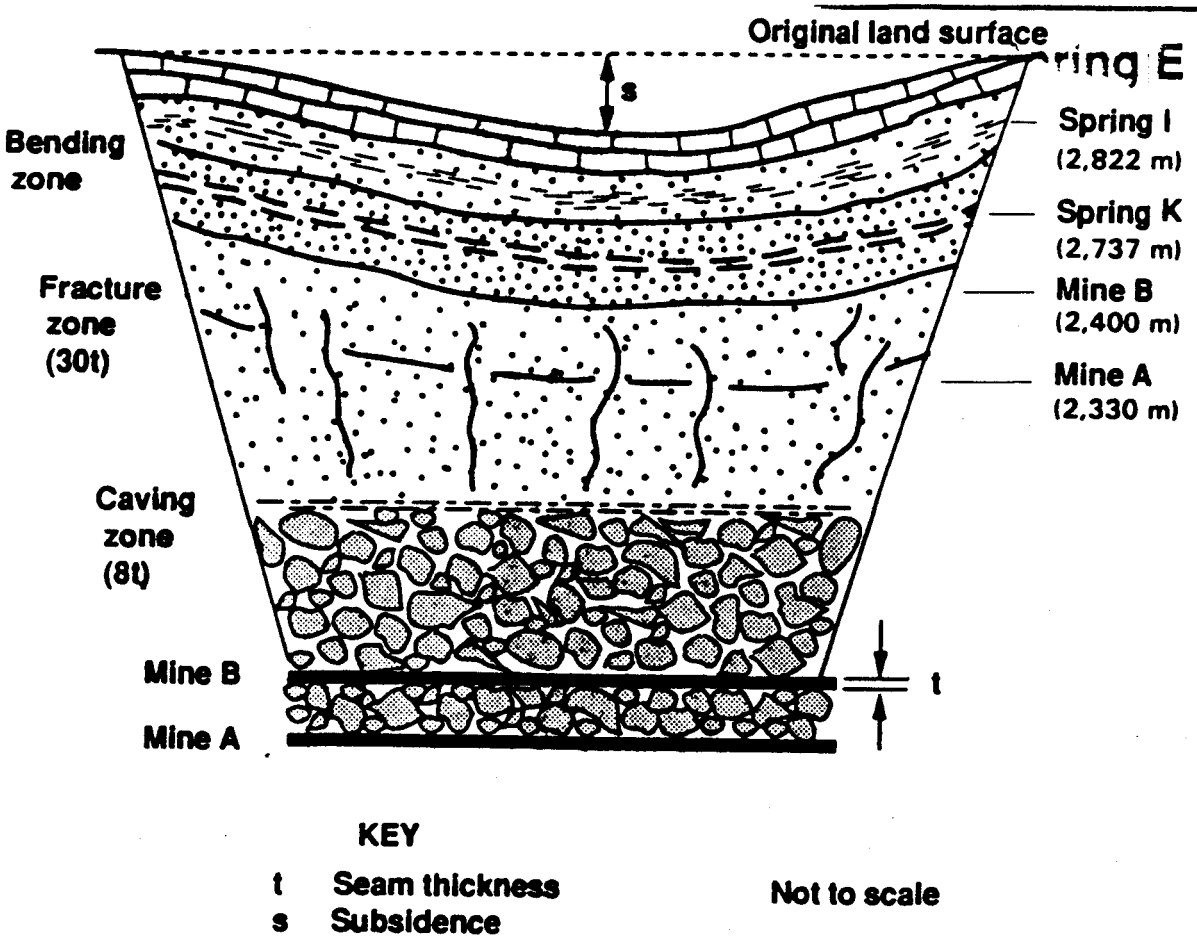

Figure 5.—Conceptual overburden failure schematic.

SUMMARY

The USBM used data available from the Deer Creek and Cottonwood Mines to perform a study of underground coal mining effects on local overburden hydrology. Data used in the study included seasonal and annual spring discharge, precipitation, surface subsidence, and overburden failure mechanics information. These data sets were used to quantify the response of 14 springs to underground mining.

Eight springs occurred over longwall panels. One of the eight, spring I, exhibited a departure from a normal recession curve coincident with the time of mining activity underneath it. Adjustments to valves and blockage of a pipe installed at the spring also occurred in the same time period and contributed to the variations in curve shape. The spring exhibited a constant discharge rate in the weeks after being undermined by a longwall panel, indicating that little variation occurred as a result of mining. The eight springs over panels all occurred at locations where the ratio of panel width to overburden thickness was greater than 1.0, thus limiting dewatering effects, as was observed in previous studies in Eastern U.S. coalfields. Surface subsidence did not appear to play a major role in the response of springs at this site.

Four springs experienced no discharge conditions during the period of study that were attributed to effects of regional decreased precipitation. Springs located over mine structures such as pillars or mains did not exhibit discernible effects from mining. For this study, the long-term availability of water resources was important and therefore dictated examining the seasonal response of springs in relation to mining.

The expected response of springs to undermining would be dramatic alterations in flow, as previously documented in other studies. The lack of observed responses was attributed to geologically driven site-specific conditions that buffered the effects of mining. These conditions included the thickness of overburden between the mine level and the springs, which ranged from 440 to over 600 m. Studies performed in the Appalachian coalfields noted dramatic decreases in spring discharge and water levels in wells

where thinner (70 to 245 m) overburden was present *(13, 15, 17)*. Additionally, the presence of hydrophilic clays and mudstones in the overburden, which act as aquitards retarding the migration of water, likely lessened the vertical extent of strata dewatering, as has been observed in other studies *(17)*. The location of the springs above the estimated elevations of fracturing and caving in the overburden due to subsidence also contributed to the limited effects.

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APPENDIX.—HYDROLOGIC DATA G

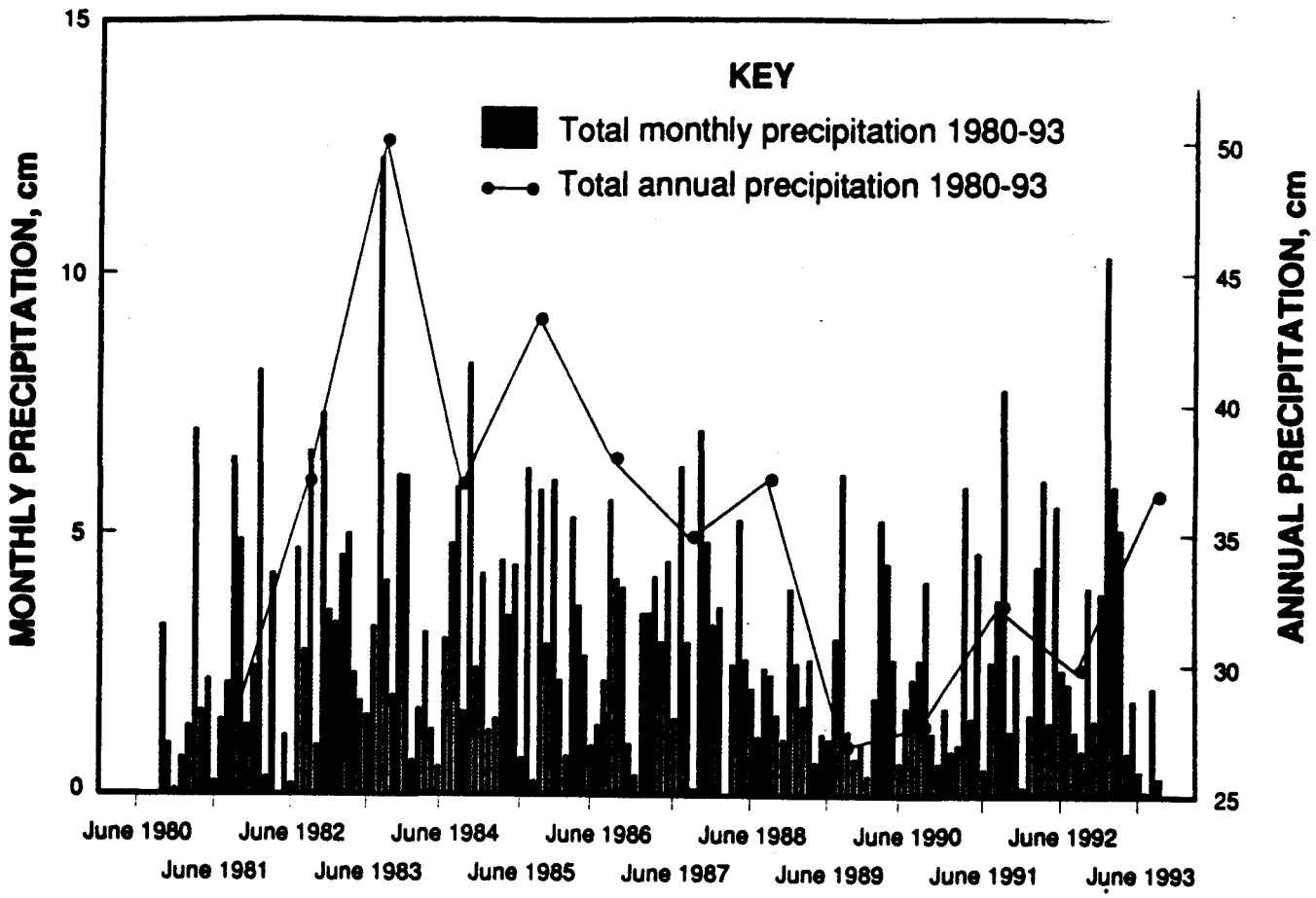


Figure A-1.—East Mountain precipitation for water years 1981-93.

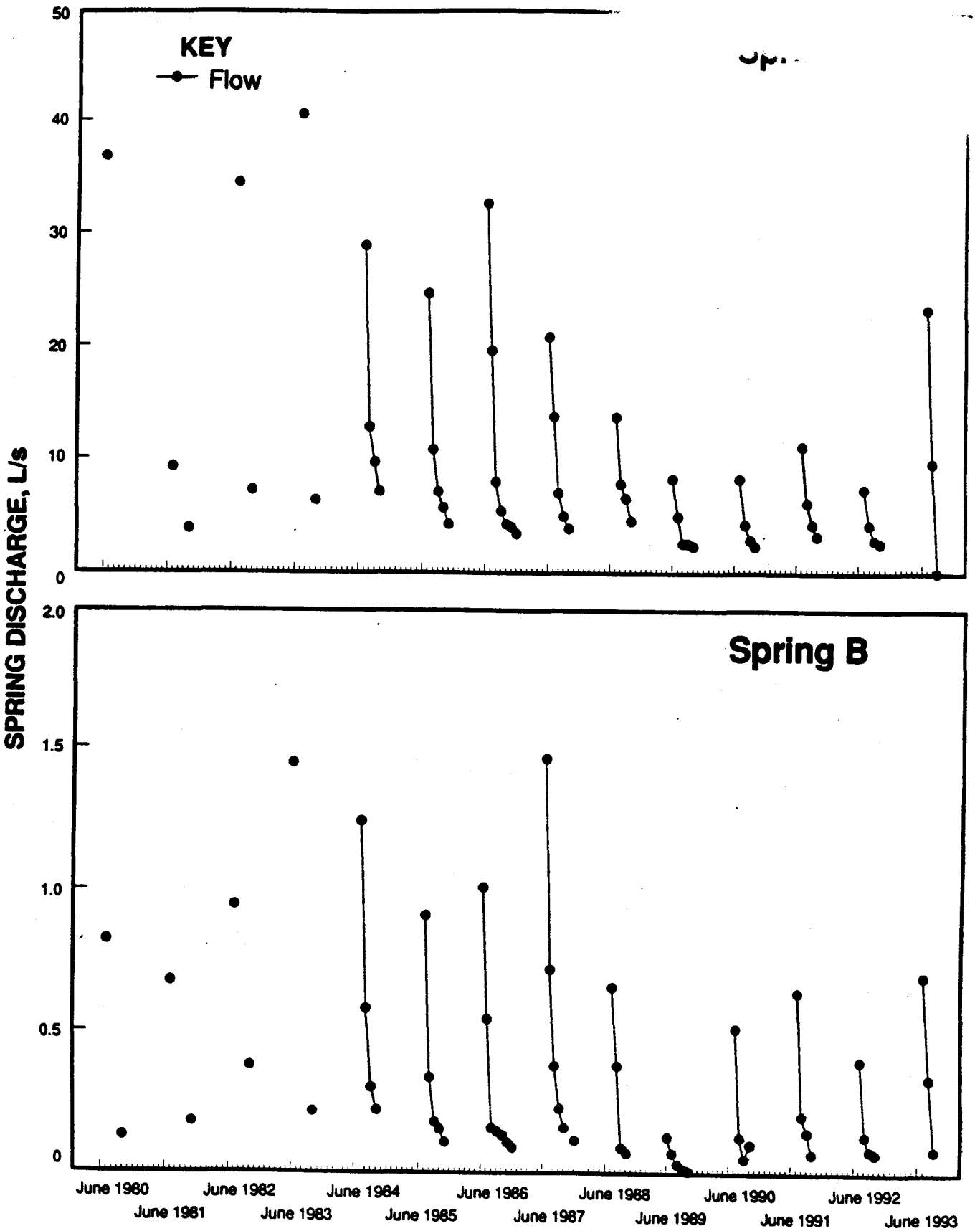
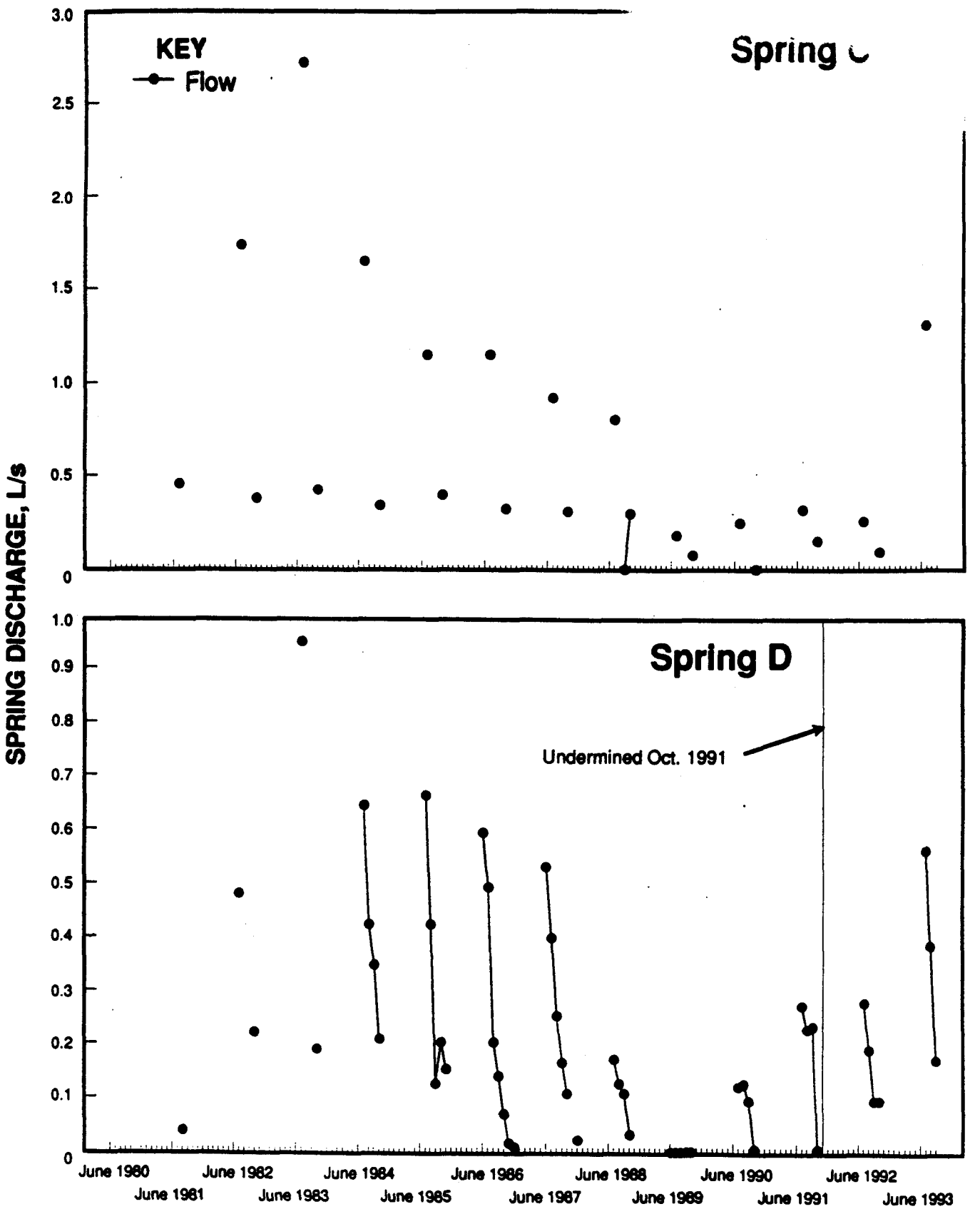


Figure A-2.—Spring discharge hydrographs for water years 1981-93.



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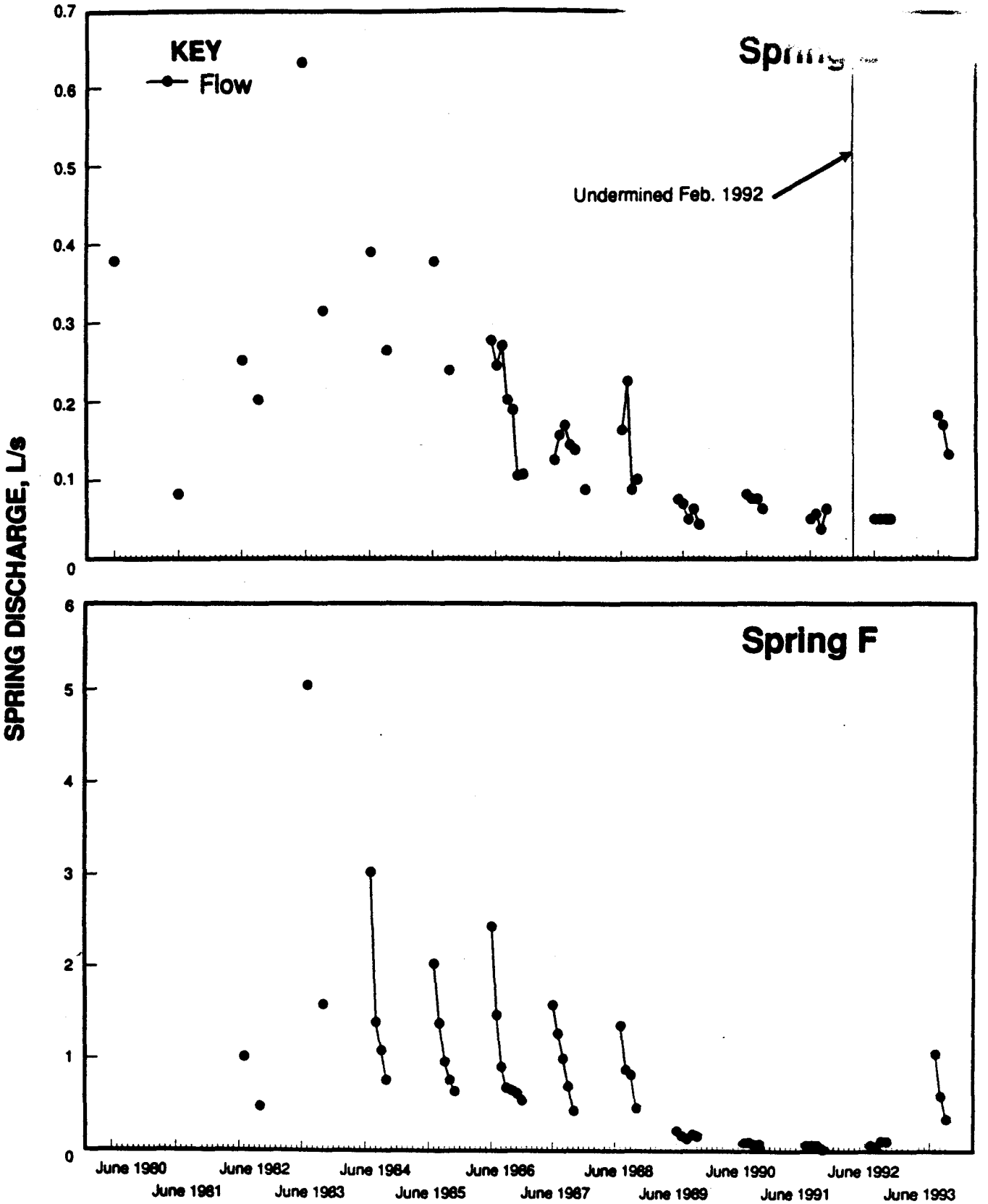


Figure A-2.—Continued.

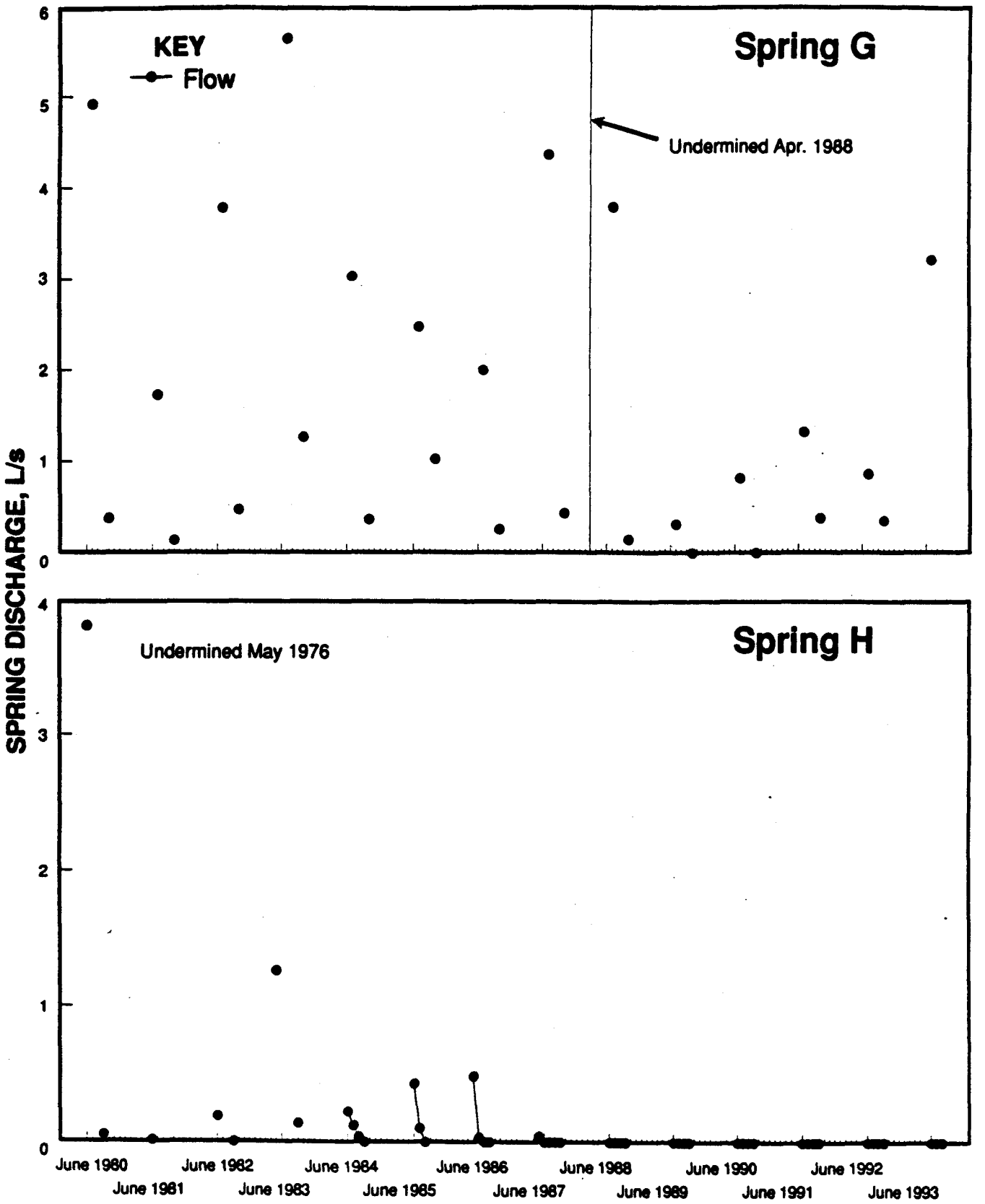


Figure A-2.--Continued.

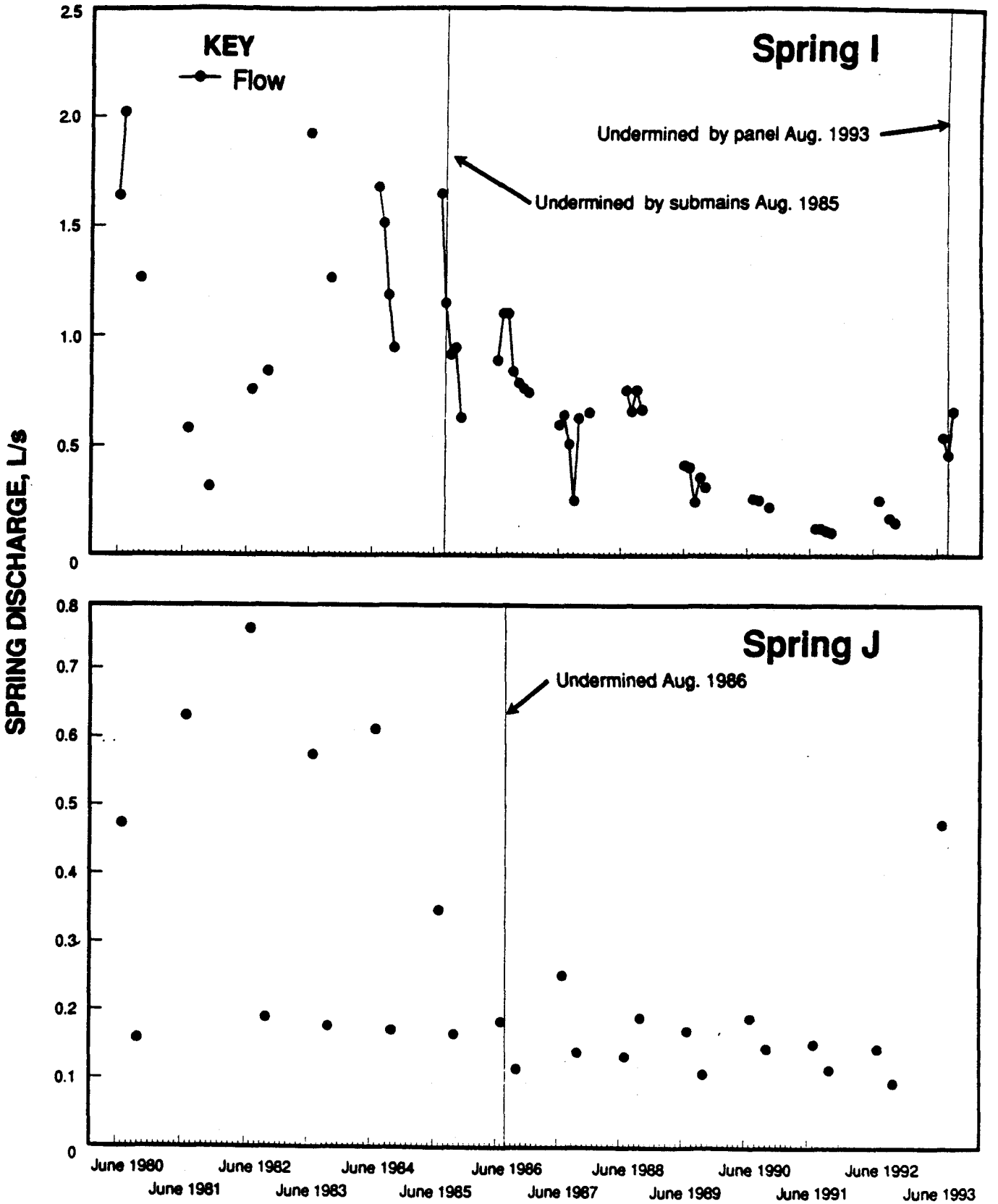


Figure A-2.—Continued.

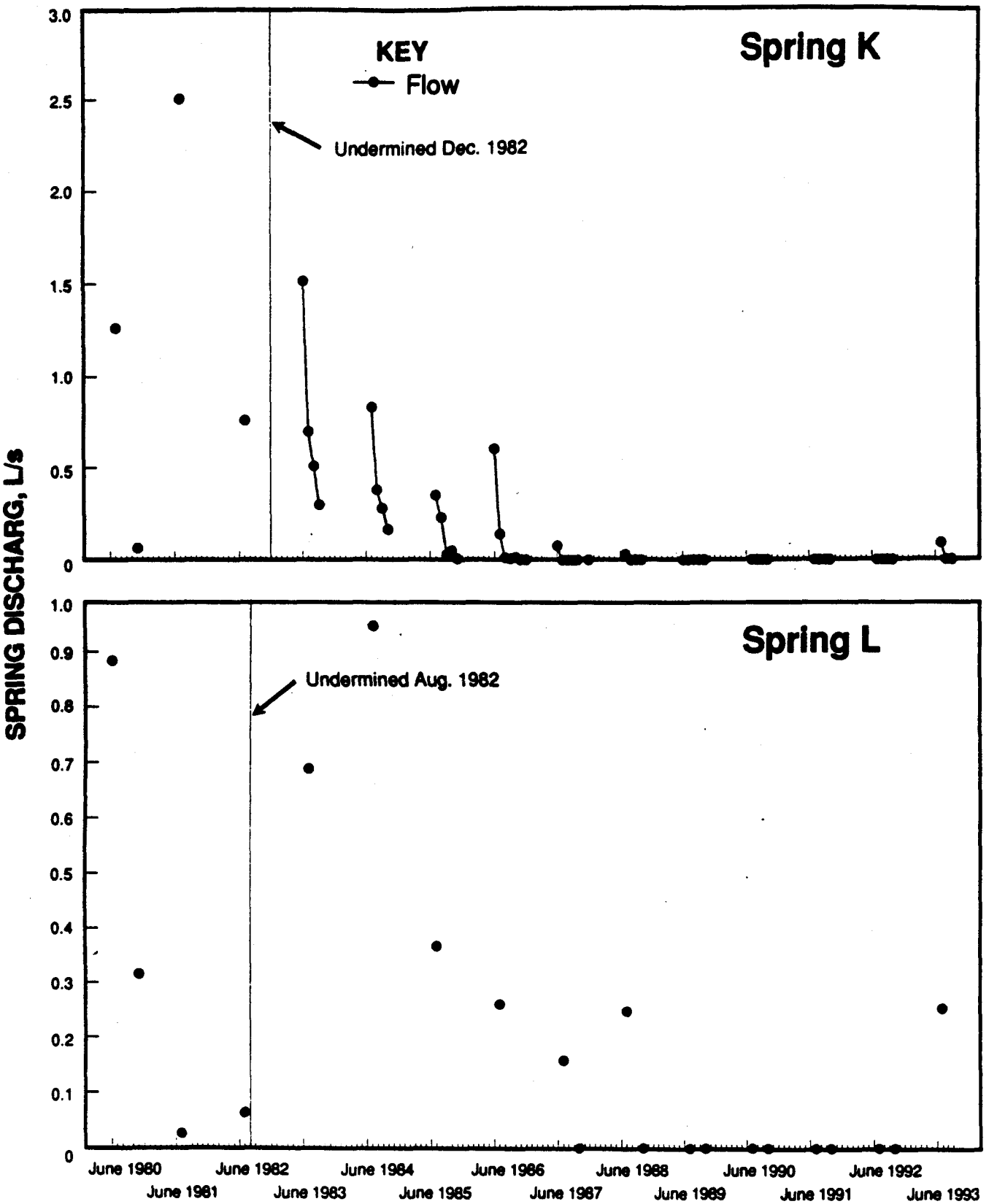
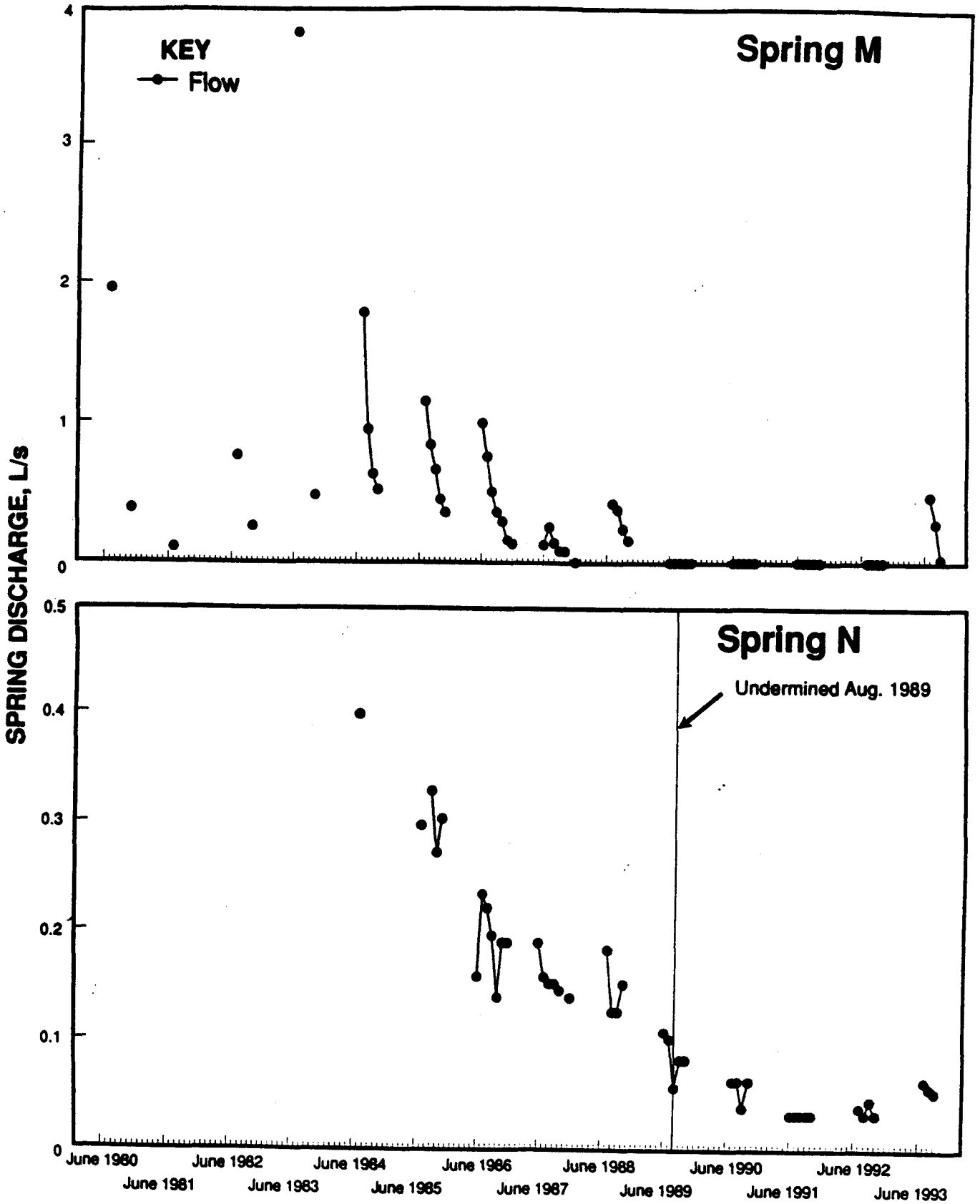


Figure A-2.—Continued.



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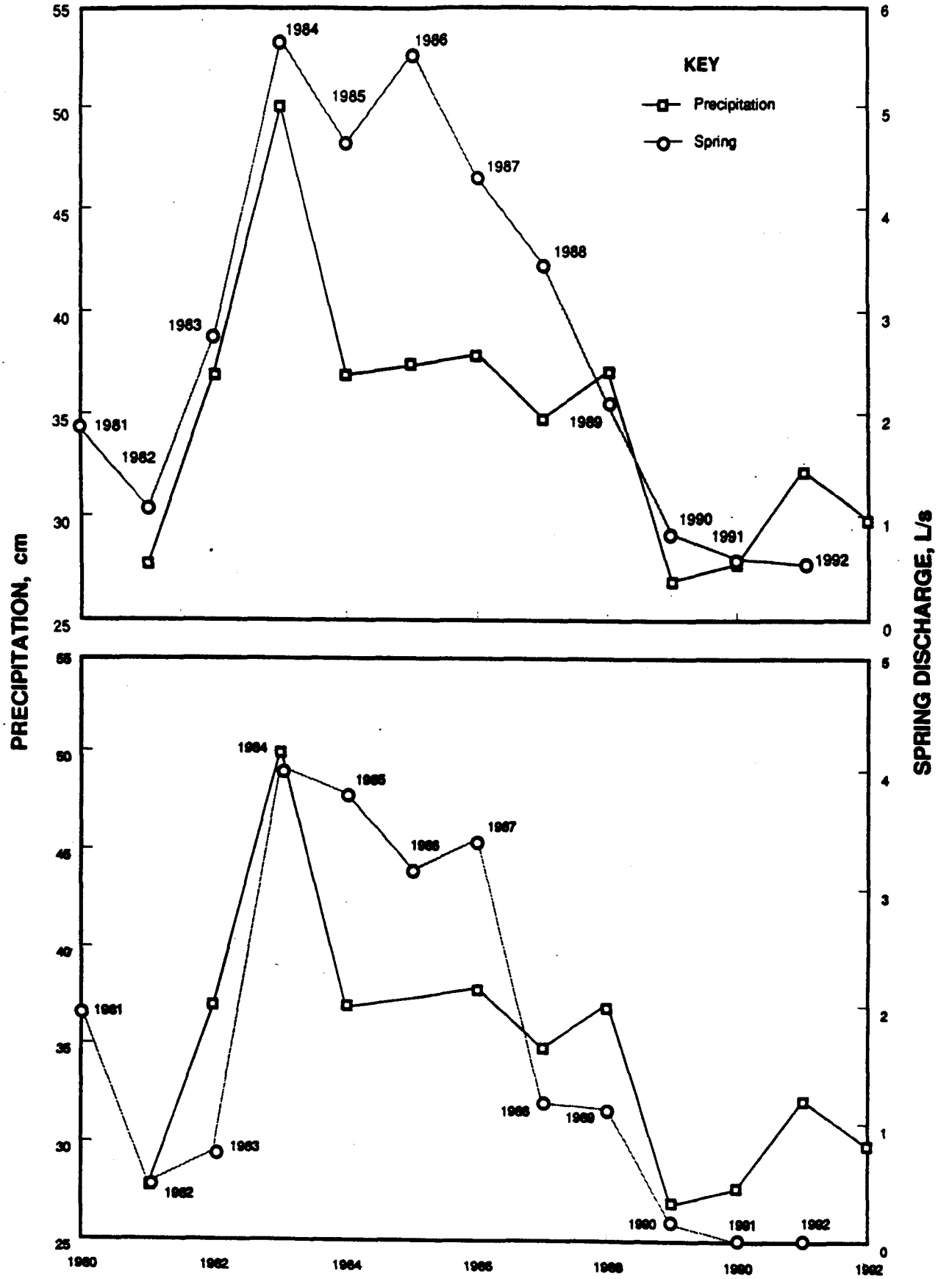


Figure A-3.—Cross-correlated spring and precipitation data. Top, spring I; bottom, spring M.

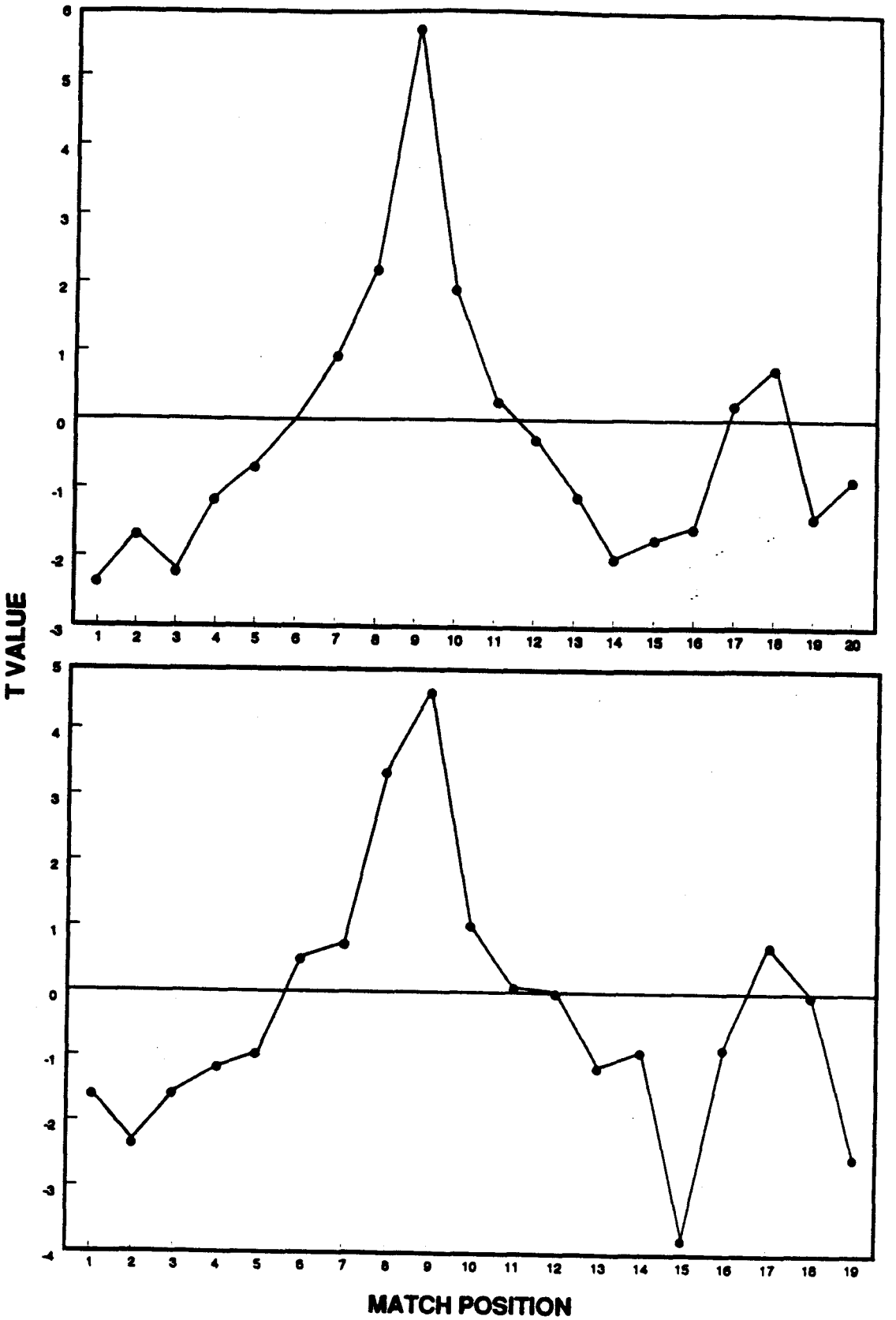


Figure A-4.—Match position versus T value. Top, spring I; bottom, spring M.

East Mountain
Water Quality Data

Spring: EMS 84-56

Post-Mining Data
34 Samples

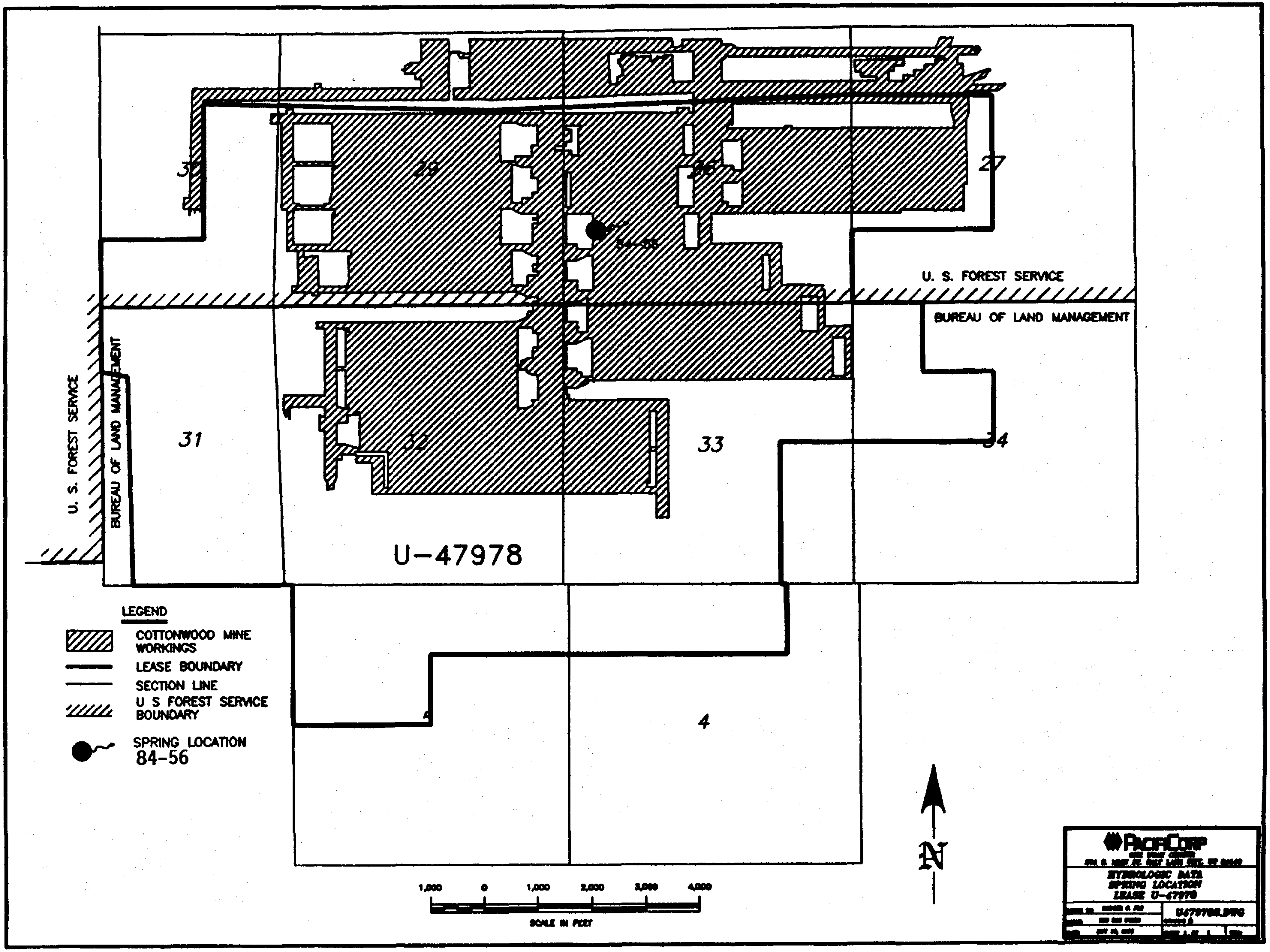
Parameter	Maximum	Minimum	Average	No. Analyses
Bicarbonate	406.00	266.00	346.00	20
Calcium	86.90	39.70	63.70	31
Carbonate	1.00	0.00	1.00	34
Chloride	35.00	4.00	11.10	20
Conductivity	680.00	360.00	533.00	31
Hardness	387.00	235.00	296.00	32
Iron, Diss.	0.20	0.02	0.08	16
Magnesium	42.00	19.80	32.49	31
Manganese	0.20	0.00	0.04	34
pH	8.42	6.70	7.50	34
Potassium	5.00	0.00	1.64	34
Sodium	20.80	11.70	16.52	20
Sulfate	100.00	7.00	29.40	20
TDS	445.00	179.00	327.00	20

East Mountain
Water Quality Data

Spring: EMS 84-56

Pre-Mining Data
2 Samples

Parameter	Maximum	Minimum	Average	No. Analyses
Bicarbonate	348.00	340.00	344.00	2
Calcium	60.00	59.20	59.60	2
Carbonate	0.00	0.00	0.00	0
Chloride	10.20	9.50	9.80	2
Conductivity	610.00	600.00	605.00	2
Hardness	0.00	0.00	0.00	0
Iron, Diss.	0.05	0.05	0.05	2
Magnesium	35.30	33.50	34.40	2
Manganese	0.00	0.00	0.00	0
pH	7.55	7.10	7.33	2
Potassium	1.00	0.80	0.90	2
Sodium	19.00	17.90	18.45	2
Sulfate	23.00	19.00	21.00	2
TDS	331.00	327.00	329.00	2



U. S. FOREST SERVICE
BUREAU OF LAND MANAGEMENT
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Application to Relinquish Federal Coal Lease Acreage
East Mountain Logical Mining Unit

Evaluation of Lease Terms/Conditions/Stipulations

Terms/Conditions/Stipulations	SL-064607-064621 10/4/46	SL-070645-U-02292 4/1/52	U-02664 1/1/57	U-024319 5/1/60	U-1358 8/1/67
PART I LEASE RIGHTS GRANTED	Lease entered into by and between the US BLM and PacifiCorp. Lease readjusted effective 10/4/86.	Lease entered into by and between the US BLM and Malcolm N. McKinnon Trust (PacifiCorp - sublessee). Lease readjusted effective 4/1/92.	Lease entered into by and between the US BLM and UP&L. Lease readjusted effective 1/1/87.	Lease entered into by and between the US BLM and UP&L. Lease readjusted effective 5/1/90.	Lease entered into by and between the US BLM and UP&L. Lease readjusted effective 8/1/87.
Sec 1 Lease readjustment subject to . . .	Mineral Lands Leasing Act of February 25, 1920, as amended.	Mineral Lands Leasing Act of February 25, 1920, as amended.	Mineral Lands Leasing Act of February 25, 1920, as amended.	Mineral Lands Leasing Act of February 25, 1920, as amended.	Mineral Lands Leasing Act of February 25, 1920, as amended.
Sec 2 Lessor grants Lessee the right to drill, mine, extract, and remove coal deposits under lands . . .	Containing 613.92 acres.	Containing 2,560.00 acres.	Tract No. 1 – 760.00 acres Tract No. 2 – 160.00 acres Total – 920.00 acres	Containing 1,040.00 acres.	Containing 320.00 acres.
PART II TERMS AND CONDITIONS **Sec 1** (a) **Rental Rate** – $3.00/acre/year (b) **Rental Credits** – not credited	**Status**: $3/acre/year paid annually with East Mountain LMU rental payment. Payment has been accounted for and reported to MMS.	**Status**: $3/acre/year paid annually with East Mountain LMU rental payment. Payment has been accounted for and reported to MMS.	**Status**: $3/acre/year paid annually with East Mountain LMU rental payment. Payment has been accounted for and reported to MMS.	**Status**: $3/acre/year paid annually with East Mountain LMU rental payment. Payment has been accounted for and reported to MMS.	**Status**: $3/acre/year paid annually with East Mountain LMU rental payment. Payment has been accounted for and reported to MMS.

Terms/Conditions/Stipulations	SL-064607-064621 10/4/46	SL-070645-U-02292 4/1/52	U-02664 1/1/57	U-024319 5/1/60	U-1358 8/1/67
Sec 2(a) Production Royalties	**Status**: 8% production royalty. All coal production has been accounted for and reported to MMS for royalty payments. Payments are current.	**Status**: 8% production royalty. All coal production has been accounted for and reported to MMS for royalty payments. Payments are current.	**Status**: 8% production royalty. All coal production has been accounted for and reported to MMS for royalty payments. Payments are current.	**Status**: 8% production royalty. All coal production has been accounted for and reported to MMS for royalty payments. Payments are current.	**Status**: 8% production royalty. All coal production has been accounted for and reported to MMS for royalty payments. Payments are current.
Sec 2(b) Advance Royalties	**Status**: None	**Status**: None	**Status**: None	**Status**: None	**Status**: None
Sec 3 Bonds	**Status**: Included under East Mountain LMU Bond No. 400 JV 3713, $3,253,000.00.	**Status**: Included under East Mountain LMU Bond No. 400 JV 3713, $3,253,000.00.	**Status**: Included under East Mountain LMU Bond No. 400 JV 3713, $3,253,000.00.	**Status**: Included under East Mountain LMU Bond No. 400 JV 3713, $3,253,000.00.	**Status**: Included under East Mountain LMU Bond No. 400 JV 3713, $3,253,000.00.
Sec 4 Diligence	**Status**: Achieved through East Mountain LMU. The coal resources have either been mined out, burned or are unminable in the area(s) to be relinquished.	**Status**: Achieved through East Mountain LMU. The coal resources have either been mined out, burned or are unminable in the area(s) to be relinquished.	**Status**: Achieved through East Mountain LMU. The coal resources have either been mined out, burned or are unminable in the area(s) to be relinquished.	**Status**: Achieved through East Mountain LMU. The coal resources have either been mined out, burned or are unminable in the area(s) to be relinquished.	**Status**: Achieved through East Mountain LMU. The coal resources have either been mined out, burned or are unminable in the area(s) to be relinquished.
Sec 5 Logical Mining Unit (LMU)	**Status**: Lease has been included in with East Mountain LMU.	**Status**: Lease has been included in with East Mountain LMU.	**Status**: Lease has been included in with East Mountain LMU.	**Status**: Lease has been included in with East Mountain LMU.	**Status**: Lease has been included in with East Mountain LMU.
Sec 6 Documents, Evidence and Inspection	**Status**: All books and records have been kept current and are located at the Lessee's operation in Huntington, Utah. Lessor's rights to investigate leased lands and books is acknowledged.	**Status**: All books and records have been kept current and are located at the Lessee's operation in Huntington, Utah. Lessor's rights to investigate leased lands and books is acknowledged.	**Status**: All books and records have been kept current and are located at the Lessee's operation in Huntington, Utah. Lessor's rights to investigate leased lands and books is acknowledged.	**Status**: All books and records have been kept current and are located at the Lessee's operation in Huntington, Utah. Lessor's rights to investigate leased lands and books is acknowledged.	**Status**: All books and records have been kept current and are located at the Lessee's operation in Huntington, Utah. Lessor's rights to investigate leased lands and books is acknowledged.

Terms/Conditions/Stipulations	SL-064607-064621 10/4/46	SL-070645-U-02292 4/1/52	U-02664 1/1/57	U-024319 5/1/60	U-1358 8/1/67
Sec 7 **Damages to Property and Conduct of Operations**	**Status**: Operations conducted in compliance with MSHA and resource management agencies, respecting diligent operations, prevention of waste and protection of other resources. Conservation of the coal has been achieved. No recoverable coal remains in the areas to be relinquished. The coal has been either mined out, burned or is unminable. Faults and other geologic features have cut off physical and economic access.	**Status**: Operations conducted in compliance with MSHA and resource management agencies, respecting diligent operations, prevention of waste and protection of other resources. Conservation of the coal has been achieved. No recoverable coal remains in the areas to be relinquished. The coal has been either mined out, burned or is unminable. Faults and other geologic features have cut off physical and economic access.	**Status**: Operations conducted in compliance with MSHA and resource management agencies, respecting diligent operations, prevention of waste and protection of other resources. Conservation of the coal has been achieved. No recoverable coal remains in the areas to be relinquished. The coal has been either mined out, burned or is unminable. Faults and other geologic features have cut off physical and economic access.	**Status**: Operations conducted in compliance with MSHA and resource management agencies, respecting diligent operations, prevention of waste and protection of other resources. Conservation of the coal has been achieved. No recoverable coal remains in the areas to be relinquished. The coal has been either mined out, burned or is unminable. Faults and other geologic features have cut off physical and economic access.	**Status**: Operations conducted in compliance with MSHA and resource management agencies, respecting diligent operations, prevention of waste and protection of other resources. Conservation of the coal has been achieved. No recoverable coal remains in the areas to be relinquished. The coal has been either mined out, burned or is unminable. Faults and other geologic features have cut off physical and economic access.
Sec 8 **Protection of Diverse Interests and Equal Opportunity**	**Status**: Lessee has complied with payment of taxes and wages, etc. Operations have been conducted in compliance with rules and regulations pertaining to equal opportunity and MSHA requirements. The mine operations do not have any segregated facilities. Employment practices are in compliance with the lease and both Federal and State laws.	**Status**: Lessee has complied with payment of taxes and wages, etc. Operations have been conducted in compliance with rules and regulations pertaining to equal opportunity and MSHA requirements. The mine operations do not have any segregated facilities. Employment practices are in compliance with the lease and both Federal and State laws.	**Status**: Lessee has complied with payment of taxes and wages, etc. Operations have been conducted in compliance with rules and regulations pertaining to equal opportunity and MSHA requirements. The mine operations do not have any segregated facilities. Employment practices are in compliance with the lease and both Federal and State laws.	**Status**: Lessee has complied with payment of taxes and wages, etc. Operations have been conducted in compliance with rules and regulations pertaining to equal opportunity and MSHA requirements. The mine operations do not have any segregated facilities. Employment practices are in compliance with the lease and both Federal and State laws.	**Status**: Lessee has complied with payment of taxes and wages, etc. Operations have been conducted in compliance with rules and regulations pertaining to equal opportunity and MSHA requirements. The mine operations do not have any segregated facilities. Employment practices are in compliance with the lease and both Federal and State laws.

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Sec 9(a) Transfers – Lease may be transferred	**Status**: Lease was transferred from UP&L Co. and assigned to PacifiCorp due to corporate merger of the two companies. Assignment approved by Utah BLM.	**Status**: Lease was transferred from UP&L Co. and assigned to PacifiCorp due to corporate merger of the two companies. Assignment approved by Utah BLM.	**Status**: Lease was transferred from UP&L Co. and assigned to PacifiCorp due to corporate merger of the two companies. Assignment approved by Utah BLM.	**Status**: Lease was transferred from UP&L Co. and assigned to PacifiCorp due to corporate merger of the two companies. Assignment approved by Utah BLM.	**Status**: Lease was transferred from UP&L Co. and assigned to PacifiCorp due to corporate merger of the two companies. Assignment approved by Utah BLM.
Sec 9(b) Relinquishment	**Partial Relinquishment**: Description of acreage to be relinquished: T. 17 S., R. 7 E. SLBM Section 2: Lots 2, 5, 6, 7, 10, 11, 12, SW¼ Section 3: E½ SE¼ SE¼, E½ W½ SE¼ SE¼ Total Relinquished Acreage: 443.92 acres	**Partial Relinquishment**: Description of acreage to be relinquished: T. 17 S., R. 7 E. SLBM Section 15: NE¼ Section 10: NE¼ NW¼, N½ SE¼ NW¼, NE¼ SW¼ NW¼, E½ NW¼ NW¼ Total Relinquished Acreage: 250.00 acres	**Partial Relinquishment**: Description of acreage to be relinquished: T. 17 S., R. 7 E. SLBM Section 13: SE¼ SW¼ Section 14: SW¼ NE¼ Section 23: NE¼ SW¼, W½ SE¼ SW¼, E½ E½ SW¼ SW¼ Section 24: SW¼, S½ NW¼, NE¼ NW¼, E½ NW¼ NW¼ Section 26: NE¼ SW¼ Total Relinquished Acreage: 490.00 acres	**Partial Relinquishment**: Description of acreage to be relinquished: T. 16 S., R. 7 E. SLBM Section 34: E½ E½ NW¼ Total Relinquished Acreage: 40.00 acres	**Partial Relinquishment**: Description of acreage to be relinquished: T. 17 S., R. 7 E. SLBM Section 22: E½ SE¼ Section 27: E½ NE¼ Total Relinquished Acreage: 160.00 acres
Sec 10 Delivery of Premises, Removal of Machinery, Equipment, etc.	**Status**: The areas proposed for relinquishment are being returned in accordance with this section.	**Status**: The areas proposed for relinquishment are being returned in accordance with this section.	**Status**: The areas proposed for relinquishment are being returned in accordance with this section.	**Status**: The areas proposed for relinquishment are being returned in accordance with this section.	**Status**: The areas proposed for relinquishment are being returned in accordance with this section.
Sec 11 Proceedings in Case of Default	**Status**: Lessor's rights acknowledged.	**Status**: Lessor's rights acknowledged.	**Status**: Lessor's rights acknowledged.	**Status**: Lessor's rights acknowledged.	**Status**: Lessor's rights acknowledged.

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Sec 12 Heirs and Successors In-Interest	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.
Sec 13 Indemnification	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.
Sec 14 Special Statutes	**Status**: Operations have been conducted in compliance with the Federal Water Pollution Control Act and Clean Air Act.	**Status**: Operations have been conducted in compliance with the Federal Water Pollution Control Act and Clean Air Act.	**Status**: Operations have been conducted in compliance with the Federal Water Pollution Control Act and Clean Air Act.	**Status**: Operations have been conducted in compliance with the Federal Water Pollution Control Act and Clean Air Act.	**Status**: Operations have been conducted in compliance with the Federal Water Pollution Control Act and Clean Air Act.
Sec 15 Special Stipulations (1) Regulatory Authority shall mean the State Regulatory Authority. Authorized Officer shall mean the State Director, BLM. Authorized Officer of the Surface Management Agency shall mean the Forest Service.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.
(2) Authorized Officers (BLM, OSM, Forest Service) shall coordinate regulation of mining operations on the lease area.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.
(3) Mining and reclamation operations on this lease are to conform with SMCRA of 1977.	**Status**: Mine operations have been conducted under approved Deer Creek Mine MRP ACT/015/018, February 7, 1991.	**Status**: Mine operations have been conducted under approved Deer Creek Mine MRP ACT/015/018, February 7, 1991 and Cottonwood/Wilberg Mine MRP ACT/015/019, July 6, 1994.	**Status**: Mine operations have been conducted under approved Des-Bee-Dove MRP ACT/015/017, August 29, 1990.	**Status**: Mine operations have been conducted under approved Deer Creek Mine MRP ACT/015/018, February 7, 1991.	**Status**: Mine operations have been conducted under approved Deer Creek Mine MRP ACT/015/018, February 7, 1991 and Cottonwood/Wilberg Mine MRP ACT/015/019, July 6, 1994.

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(4) 43 CFR 3400 pertaining to Coal Management makes provisions to insure the use and protection of the lands. All or part of this lease contains surface lands managed by Manti-LaSal Forest.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.
The following stipulations pertain to lease area and adjacent areas on National Forest lands:					
(5) Before undertaking activities that may disturb the surface of leased lands, Lessee is required to conduct a cultural resource inventory and paleontological appraisal.	**Status**: Where necessary, all cultural resource surveys and inventories have been completed. No paleontological inventory or appraisal was necessary. Lessor's rights acknowledged.	**Status**: Where necessary, all cultural resource surveys and inventories have been completed. No paleontological inventory or appraisal was necessary. Lessor's rights acknowledged.	**Status**: Where necessary, all cultural resource surveys and inventories have been completed. No paleontological inventory or appraisal was necessary. Lessor's rights acknowledged.	**Status**: Where necessary, all cultural resource surveys and inventories have been completed. No paleontological inventory or appraisal was necessary. Lessor's rights acknowledged.	**Status**: Where necessary, all cultural resource surveys and inventories have been completed. No paleontological inventory or appraisal was necessary. Lessor's rights acknowledged.
(6) If threatened or endangered species of plants or animals or migratory species occur in the area, Lessee is required to conduct intensive field inventory of area impacted.	**Status**: Where necessary, an intensive field inventory has been conducted.	**Status**: Where necessary, an intensive field inventory has been conducted.	**Status**: Where necessary, an intensive field inventory has been conducted.	**Status**: Where necessary, an intensive field inventory has been conducted.	**Status**: Where necessary, an intensive field inventory has been conducted.
(7) Lessee is required to secure adequate baseline data to quantify existing surface resources. Study shall be adequate to locate and quantify the geology, topography, hydrology, vegetation and wildlife.	**Status**: Surface resources are basically limited to the natural terrain. Aerial photography and mapping has been conducted to document the resources.	**Status**: Surface resources are basically limited to the natural terrain. Aerial photography and mapping has been conducted to document the resources.	**Status**: Surface resources are basically limited to the natural terrain. Aerial photography and mapping has been conducted to document the resources.	**Status**: Surface resources are basically limited to the natural terrain. Aerial photography and mapping has been conducted to document the resources.	**Status**: Surface resources are basically limited to the natural terrain. Aerial photography and mapping has been conducted to document the resources.

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(8) Powerlines on the lease area shall be constructed to provide adequate protection for large birds. Powerlines will be located at least 100 yards from public roads.	**Status**: A 12.5 kV powerline was constructed in 1972 to the Deer Creek Mine under BLM R/W Grant No. U-18934, acknowledging raptor protection. In some instances, the powerline is less than 100 yards from the county road. Powerline constructed prior to the stipulation. Based on construction characteristics, there is no significant hazard.	**Status**: Other than the 345 kV transmission line, there are no powerlines on this lease that are associated with the mining of this lease.	**Status**: No powerlines exist on this lease that are associated with the mining of this lease.	**Status**: No powerlines exist on this lease that are associated with the mining of this lease.	**Status**: No powerlines exist on this lease that are associated with the mining of this lease.
(9) The limited area available for mine facilities will determine the ultimate size of the surface area utilized for the mine. Site specific environmental analysis will be prepared for each new mine development and modifications to existing developments.	**Status**: Mine development and operations have been compatible with physical environment.	**Status**: Mine development and operations have been compatible with physical environment.	**Status**: Mine development and operations have been compatible with physical environment.	**Status**: Mine development and operations have been compatible with physical environment.	**Status**: Mine development and operations have been compatible with physical environment.
(10) Consideration will be given to reduce adverse visual impacts. Structures and facilities will be designed to reduce visual impacts compatible with the natural surroundings.	**Status**: Acknowledged. Structures on this lease include support facilities to the Deer Creek, but are not located in are to be relinquished.	**Status**: No structures built on this lease. All mining activities were underground.	**Status**: No structures built on this lease. All mining activities were underground.	**Status**: The areas applied for relinquishment have had no mining activities.	**Status**: No structures built on this lease. All mining activities were underground.
(11) Lessee shall establish a monitoring system to locate, measure and quantify the effect of underground mining activities on hydrology and vegetation.	**Status**: Lessee has established a surface subsidence and hydrology monitoring system beginning in 1980.	**Status**: Lessee has established a surface subsidence and hydrology monitoring system beginning in 1980.	**Status**: Lessee has established a surface subsidence and hydrology monitoring system beginning in 1980.	**Status**: Lessee has established a surface subsidence and hydrology monitoring system beginning in 1980.	**Status**: Lessee has established a surface subsidence and hydrology monitoring system beginning in 1980.

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(12) Lessee shall suppress and control fugitive dust.	**Status**: Acknowledged. The majority of the mining operations are conducted underground which have dust suppression in place. No surface operations exist on this lease.	**Status**: Acknowledged. The majority of the mining operations are conducted underground which have dust suppression in place. No surface operations exist on this lease.	**Status**: Acknowledged. The majority of the mining operations are conducted underground which have dust suppression in place. No surface operations exist on this lease.	**Status**: Acknowledged. The majority of the mining operations are conducted underground which have dust suppression in place. No surface operations exist on this lease.	**Status**: Acknowledged. The majority of the mining operations are conducted underground which have dust suppression in place. No surface operations exist on this lease.
(13) Except at approved location, underground mining operations shall be conducted to prevent surface subsidence that would: (1) cause hazardous conditions, escarpment failure and landslides, (2) damage to existing surface structures, (3) damage or alter flow perennial streams.	**Status**: Subsidence has occurred, but with no impacts to surface structures or perennial streams. Subsidence monitoring has indicated that the areas have stabilized.	**Status**: Subsidence has occurred, but with no impacts to surface structures or perennial streams. Subsidence monitoring has indicated that the areas have stabilized.	**Status**: Subsidence has occurred, but with no impacts to surface structures or perennial streams. Subsidence monitoring has indicated that the areas have stabilized.	**Status**: The areas applied for relinquishment have had no mining activities.	**Status**: Subsidence has occurred, but with no impacts to surface structures or perennial streams. Subsidence monitoring has indicated that the areas have stabilized.
(14) All surface breakouts for ventilation tunnels shall be constructed from inside the mine.	**Status**: Other than the main Deer Creek portals, no other breakouts exist on this lease.	**Status**: There are no breakout portals on this lease.	**Status**: There are no breakout portals on this lease.	**Status**: There are no breakout portals on this lease.	**Status**: There are no breakout portals on this lease.
(15) If removal of timber is required, timber shall be removed in accordance with the regulations.	**Status**: No timber has been removed.	**Status**: No timber has been removed.	**Status**: No timber has been removed.	**Status**: No timber has been removed.	**Status**: No timber has been removed.
(16) The coal contained within this lease shall be extracted only by underground mining methods.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.

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(17) Forest Service improvements will need to be protected, restored or replaced for continuance of current land uses.	**Status**: Existing surface improvements are limited to dirt access roads. All observed damage (if any) to the dirt roads has been repaired. Continued monitoring indicates no further damage has occurred.	**Status**: Existing surface improvements are limited to dirt access roads. All observed damage (if any) to the dirt roads has been repaired. Continued monitoring indicates no further damage has occurred.	**Status**: Existing surface improvements are limited to dirt access roads. All observed damage (if any) to the dirt roads has been repaired. Continued monitoring indicates no further damage has occurred.	**Status**: The areas applied for relinquishment have had no mining activities.	**Status**: Existing surface improvements are limited to dirt access roads. All observed damage (if any) to the dirt roads has been repaired. Continued monitoring indicates no further damage has occurred.
(18) To protect wildlife, specific surface uses outside mine development area may be curtailed during specified periods of the year.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.	**Status**: Acknowledged.
(19) Support facilities will be removed from the lease area within two years after final termination.	**Status**: Acknowledged. No support facilities exist on the portion to be relinquished.	**Status**: Acknowledged. No support facilities exist on the portion to be relinquished.	**Status**: Acknowledged. No support facilities exist on the portion to be relinquished.	**Status**: Acknowledged. No support facilities exist on the portion to be relinquished.	**Status**: Acknowledged. No support facilities exist on the portion to be relinquished.
(20) At conclusion of mining, all damaged land monuments (section corners, ¼ corners, etc.) will be replaced.	**Status**: Acknowledged. To the best knowledge of Lessee, mining and related activities have not damaged any survey monuments. In the event a survey monument has been damaged as a result of Lessee's activities, Lessee will replace or restore to its found location.	**Status**: Acknowledged. To the best knowledge of Lessee, mining and related activities have not damaged any survey monuments. In the event a survey monument has been damaged as a result of Lessee's activities, Lessee will replace or restore to its found location.	**Status**: Acknowledged. To the best knowledge of Lessee, mining and related activities have not damaged any survey monuments. In the event a survey monument has been damaged as a result of Lessee's activities, Lessee will replace or restore to its found location.	**Status**: Acknowledged. To the best knowledge of Lessee, mining and related activities have not damaged any survey monuments. In the event a survey monument has been damaged as a result of Lessee's activities, Lessee will replace or restore to its found location.	**Status**: Acknowledged. To the best knowledge of Lessee, mining and related activities have not damaged any survey monuments. In the event a survey monument has been damaged as a result of Lessee's activities, Lessee will replace or restore to its found location.

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(21) Lessee will be responsible to replace any surface water with water from an alternate source.	**Status**: In accordance with best known information available to Lessee, there has been no loss of water as a result of mining operations. In the event it is determined that water has been lost or adversely affected as a result of Lessee's mining operations, if such loss or adverse impact occurs prior to final relinquishment, the water will be replaced from an alternate source in sufficient quantity and quality to maintain current post-mining land uses.	**Status**: In accordance with best known information available to Lessee, there has been no loss of water as a result of mining operations. In the event it is determined that water has been lost or adversely affected as a result of Lessee's mining operations, if such loss or adverse impact occurs prior to final relinquishment; the water will be replaced from an alternate source in sufficient quantity and quality to maintain current post-mining land uses.	**Status**: In accordance with best known information available to Lessee, there has been no loss of water as a result of mining operations. In the event it is determined that water has been lost or adversely affected as a result of Lessee's mining operations, if such loss or adverse impact occurs prior to final relinquishment, the water will be replaced from an alternate source in sufficient quantity and quality to maintain current post-mining land uses.	**Status**: In accordance with best known information available to Lessee, there has been no loss of water as a result of mining operations. In the event it is determined that water has been lost or adversely affected as a result of Lessee's mining operations, if such loss or adverse impact occurs prior to final relinquishment, the water will be replaced from an alternate source in sufficient quantity and quality to maintain current post-mining land uses.	**Status**: In accordance with best known information available to Lessee, there has been no loss of water as a result of mining operations. In the event it is determined that water has been lost or adversely affected as a result of Lessee's mining operations, if such loss or adverse impact occurs prior to final relinquishment, the water will be replaced from an alternate source in sufficient quantity and quality to maintain current post-mining land uses.
(22) Mining operations will not impede movement of livestock.	N/A	N/A	**Status**: Lessee acknowledges use of main access roads for livestock movement on and off of East Mountain. Mine operations have not impeded such movement.	N/A	N/A
(22) Lessee must comply with all rules and regulations governing use of National forest system.	**Status**: Acknowledged.	**Status**: Acknowledged.	N/A	**Status**: Acknowledged.	**Status**: Acknowledged.
(23) Lessee must comply with all rules and regulations governing use of National forest system.	N/A	N/A	**Status**: Acknowledged.	N/A	NA/