

**APPENDIX 7-1**

Water Rights Data

File in.  
 Confidential  
 Shelf  
 Expandable  
Refer to Record No. 1035 Date 09/15/2008  
In C100 700372008 Submittal  
For additional information  
*Confidential*

x

Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007

WATER RIGHT: 90-572 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP\*\*\*\*\*

NAME: George J. Conover ADDR: Ferron UT 84532

DATES, ETC.\*\*\*\*\*

LAND OWNED BY APPLICANT? Yes FILED: |PRIORITY: 00/00/1885|PUB BEGAN: |PUB ENDED: |NEWSPAPER: ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE: EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: |LAP, ETC: |LAPS LETTER: RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ] PD Book No. Map: 420 Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT\*\*\* (Points of Diversion: Click on Location to access PLAT Program.)\*\*\*\*\*

FLOW: 0.066 cfs SOURCE: Unnamed Spring COUNTY: Carbon COMMON DESCRIPTION:

POINT OF DIVERSION: ( 1) Stockwatering directly on spring located at S 660 ft. E 660 ft. from N4 corner, Sec 15, T13S, R13E, SLBM.

COMMENT: Administratively updated by State Engineer.

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**USES OF WATER**

**RIGHT**\*\*\*\*\*

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SUPPLEMENTAL GROUP NO. 613899. Water Rights Appurtenant to the following use(s) :

- 90-493,494,495,496,497
- 498,499,500,501,502
- 517,518,519,520,521
- 522,523,524,525,526
- 528,529,530,531,532
- 533,534,535,536,537
- 538,539,540,541,542
- 543,544,545,546,547
- 548,549,550,551,552
- 553,554,555,556,557
- 558,559,560,561,562
- 563,564,565,566,567
- 568,569,570,571,572
- 573,574,575,576,577
- 578,579,580,581,582
- 583,584,586,587,588
- 589,590,591,592,593
- 594,595,596,597,598
- 599,712,713,714,715
- 716,717,718,719,720
- 721,722,723,724,725
- 726,727,728,729,730
- 731,732,733,734,735
- 736,737,738,739,740
- 741,742,743,744,745
- 746,747,748,749,750
- 751,752,753,754,755
- 756,757,758,759,760
- 761,762,763,764,765
- 766,767,768,769,770
- 771,772,773,774,775
- 776,777,778,779,780
- 781,782,783,784,785
- 786,787,788,789,790
- 791,792,793,794,795
- 796,797,798,799,800
- 801,802,803,804,805
- 806,807,808,809,810
- 811,812,813,814,815
- 816,817,818,819,821
- 822,823,824,825,826
- 827,828,829,830,831
- 832,840,841,842,843
- 844,845,846,847,848
- 849,850,851,852,853
- 854,856,857,858,859
- 860,861,862,863,864
- 865,866,867,868,869

870,871

.....  
.....

###STOCKWATER: Group Total: 1000.0000 Stock  
Div Limit: 28.0 acft. PERIOD OF USE: 01/01 TO 12/31  
\*\*\*Sole Supply for Stockwatering for 90-572 in this Group has NOT YET  
been evaluated\*\*\*

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PLACE OF USE for  
STOCKWATERING\*\*\*\*\*  
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SOUTH-WEST¼			SOUTH-EAST¼			NORTH-WEST¼			NORTH-EAST¼				
NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	NW		
Sec 15	T 13S	R 13E	SLBM	*	:	:	:	*	* X:	:	:	*	* :
:	:	*	*	:	:	:	*						

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OTHER  
COMMENTS\*\*\*\*\*  
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3/48 Interest  
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\*\*\*\*\*E N D O F D  
A T A\*\*\*\*\*  
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Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007

WATER RIGHT: 91-543 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP\*\*\*\*\*

NAME: Canyon Fuel Company LLC
ADDR: Attn: Property Administration
CityPlace One Suite 300
St. Louis MO 63141
INTEREST: 100% REMARKS: c/o Ark Land Company

DATES, ETC.\*\*\*\*\*

LAND OWNED BY APPLICANT?
FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE
ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: 09/15/1964|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]
PD Book No. 3 Map: 34
Type of Right: Diligence Claim Source of Info: Proposed
Determination Status:

LOCATION OF WATER RIGHT\*\*\* (Points of Diversion: Click on Location to access PLAT Program.)\*\*\*\*\*

FLOW: SOURCE: Soldier
Creek
COUNTY: Carbon COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:

( 1) Stockwatering directly on stream from a point at N 660 ft. E 660 ft. from SW corner, Sec 05, T13S, R12E, SLBM, to a point at N 660 ft. E 660 ft. from W4 corner, Sec 08, T13S, R12E, SLBM.

COMMENT: Administratively updated by State

Engineer.

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**USES OF WATER**

**RIGHT**\*\*\*\*\*
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SUPPLEMENTAL GROUP NO. 615994. Water Rights Appurtenant to the following use(s):
91-522,523,524,525,526
527,528,529,530,531
532,533,534,535,543
552,743

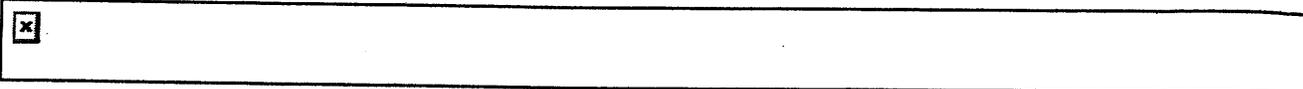
.....
###STOCKWATER: Group Total: 300.0000 Stock
Div Limit: 8.4 acft. PERIOD OF USE: 01/01 TO 12/31
\*\*\*Sole Supply for Stockwatering for 91-543 in this Group has NOT YET been evaluated\*\*\*

=====
**PLACE OF USE for**

**STOCKWATERING**\*\*\*\*\*
\*\*\*\*\*

=====
SOUTH-WEST¼ NORTH-WEST¼ NORTH-EAST¼
SOUTH-EAST¼ NW NE SW SE NW NE SW SE NW
NE SW SE NW NE SW SE
Sec 05 T 13S R 12E SLBM \* : : : \* \* : : : \* \* :
: X: \* \* : : : \*
Sec 08 T 13S R 12E SLBM \* : : X: \* \* : : : \* \* :
: : \* \* : : : \*

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\*\*\*\*\*E N D O F D
A T A\*\*\*\*\*
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Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007

WATER RIGHT: 91-3498 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP\*\*\*\*\*

NAME: W. Lavon & Marianne W. Day ADDR: Castle Dale UT REMARKS: joint tenants

DATES, ETC.\*\*\*\*\*

LAND OWNED BY APPLICANT? Yes FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB ENDED: |NEWSPAPER: ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE: EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 03/08/1972|LAP, ETC: |LAPS LETTER: RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ] PD Book No. 5 Map: 46 Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT\*\*\* (Points of Diversion: Click on Location to access PLAT Program.)\*\*\*\*\*

FLOW: 0.011 cfs SOURCE: Unnamed Spring COUNTY: Carbon COMMON DESCRIPTION:

POINT OF DIVERSION: ( 1) Stockwatering directly on spring located at N 660 ft. E 660 ft. from S4 corner, Sec 22, T13S, R13E, SLBM.

COMMENT: Administratively updated by State

Engineer.

=====
**USES OF WATER**

**RIGHT\*\*\*\*\***

SUPPLEMENTAL GROUP NO. 614121. Water Rights Appurtenant to the following use(s):

- 91-1661,1662,1664,1665,1666
1667,1668,1669,1671,1672
1673,1674,1682,1683,1685
1686,1687,1688,1689,1690
1692,1693,1694,1695,1703
1704,1706,1707,1708,1709
3474,3475,3476,3477,3478
3479,3480,3481,3482,3483
3484,3485,3486,3487,3488
3489,3490,3491,3492,3493
3494,3495,3496,3497,3498

###STOCKWATER:

Group Total: 1000.0000 Stock

Div Limit: 15.0 acft.

PERIOD OF USE: 01/01 TO 12/31

\*\*\*Sole Supply for Stockwatering for 91-3498 in this Group has NOT YET been evaluated\*\*\*

PLACE OF USE for

STOCKWATERING\*\*\*\*\*

Table with 4 columns: SOUTH-WEST¼, SOUTH-EAST¼, NORTH-WEST¼, NORTH-EAST¼. Sub-headers: NE SW SE, NW NE SW SE, NW NE SW SE, NW. Data row: Sec 22 T 13S R 13E SLBM, \* : : : \*, \* : : : \*, \* :

OTHER

COMMENTS\*\*\*\*\*

7/24 Interest.

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\*\*\*\*\*END OF D
A T A\*\*\*\*\*
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Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007

WATER RIGHT: 91-4797 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP\*\*\*\*\*

NAME: Ralph Stevenson
ADDR: P.O. Box 52
Wellington UT 84542

NAME: Glen Wells
ADDR: P.O. Box 52
Wellington UT 84542

DATES, ETC.\*\*\*\*\*

LAND OWNED BY APPLICANT?
FILED: 04/05/1988|PRIORITY: 00/00/1869|PUB BEGAN: |PUB
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE
ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: 04/05/1988|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]
PD Book No. Map: 57
Type of Right: Diligence Claim Source of Info: Water
User's Claim Status: Water User's Claim

LOCATION OF WATER RIGHT\*\*\* (Points of Diversion: Click on Location to access PLAT Program.)\*\*\*\*\*

FLOW: SOURCE: Unnamed
Stream
COUNTY: Carbon COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:

( 1) Stockwatering directly on stream from a point at N 660 ft. E 660 ft. from S4 corner, Sec 34, T13S, R13E, SLBM, to a point at N 660 ft. W 660 ft. from S4 corner, Sec 34, T13S, R13E, SLBM.

COMMENT: Administratively updated by State Engineer.

SOURCE: Unnamed Stream

USES OF WATER

RIGHT\*\*\*\*\*

SUPPLEMENTAL GROUP NO. 615674. Water Rights Appurtenant to the following use(s): 91-1717,1719,1720,1721,1722 1724,1725,1726,3253,4795 4796,4797,4798

###STOCKWATER: Group Total: 120.0000 Stock Div Limit: PERIOD OF USE: 04/15 TO 10/31 \*\*\*Sole Supply for Stockwatering for 91-4797 in this Group has NOT YET been evaluated\*\*\*

PLACE OF USE for STOCKWATERING\*\*\*\*\*

SOUTH-WEST¼ SOUTH-EAST¼ NORTH-WEST¼ NORTH-EAST¼ NW NE SW SE NW NE SW SE NW NE SW SE NW NE SW SE \* : : : \* \* : : : \* \* : : : \* : : X\* \* : : X: \*

\*\*\*\*\* END OF DATA\*\*\*\*\*

Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007

WATER RIGHT: 91-4798 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP\*\*\*\*\*

NAME: Ralph Stevenson
ADDR: PO Box 52
Wellington, Utah 84542

NAME: Glen Wells
ADDR: PO Box 52
Wellington, Utah 84542

DATES, ETC.\*\*\*\*\*

LAND OWNED BY APPLICANT? Yes
FILED: |PRIORITY: / /1869|PUB BEGAN: |PUB
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE
ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: 02/22/1990|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]
PD Book No. Map: 57
Type of Right: Pending Adjudication Claim Source of Info: Water
User's Claim Status: Water User's Claim

LOCATION OF WATER RIGHT\*\*\*(Points of Diversion: Click on Location to access PLAT Program.)\*\*\*\*\*

FLOW: 0.015 cfs SOURCE: Unnamed
Spring
COUNTY: Carbon COMMON DESCRIPTION: 7 miles NNW of Sunnyside

POINT OF SPRING:

(1) S 1980 ft W 660 ft from NE cor, Sec 33, T 13S, R 13E, SLBM

Diverting Works:

Source:

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USES OF WATER

RIGHT\*\*\*\*\*  
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SUPPLEMENTAL GROUP NO. 615674. Water Rights Appurtenant to the following use(s):

91-1717,1719,1720,1721,1722

1724,1725,1726,3253,4795

4796,4797,4798

.....

###STOCKWATER: Group Total: 120.0000 Stock  
Div Limit: PERIOD OF USE: 04/15 TO 10/31

\*\*\*Sole Supply for Stockwatering for 91-4798 in this Group has NOT YET been evaluated\*\*\*

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PLACE OF USE for

STOCKWATERING\*\*\*\*\*  
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SOUTH-WEST¼			SOUTH-EAST¼			NORTH-WEST¼			NORTH-EAST¼					
NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	NW			
Sec 33	T 13S	R 13E	SLBM	*	:	:	:	*	*	:	:	X*	*	:
:	:	*	*	:	:	:	*							

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\*\*\*\*\*E N D O F D

A T A\*\*\*\*\*

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Select Related Information

**(WARNING: Water Rights makes NO claims as to the accuracy of this data.)** RUN DATE: 10/08/2007 Page 1

CHANGE: a19877 WATER RIGHT: 91-4987 CERT. NO.:

AMENDATORY? No  
BASE WATER RIGHTS: 91-4987

RIGHT EVIDENCED BY: 91-23 & 491 (A5039) Cert. No. 1685

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X],  
Reservoir Storage [ ].

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NAME: Canyon Fuel Company LLC.  
ADDR: 6955 Union Park Center Suite 550  
Midvale UT 84047

INTEREST: 100% REMARKS:

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FILED: 03/19/1996|PRIORITY: 01/30/1913|ADV BEGAN: 04/25/1996|ADV  
ENDED: 05/02/1996|NEWSPAPER: Sun Advocate

ProtestEnd:05/22/1996|PROTESTED: [No ]|HEARNG HLD: |SE

ACTION: [Approved]|ActionDate:07/16/1996|PROOF DUE:

EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:

|CERT/WUC: |LAP, ETC: 03/31/1997|LAPS LETTER:

RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:

[ ]

Status: Terminated

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\*\*\*\*\*H E R E T O F O R E\*\*\*\*\*  
\*\*\*\*\*H E R E A F T E R\*\*\*\*\*  
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|FLOW: 4.0 cfs

||FLOW: 500.0 acre-feet

|SOURCE: Dugout Canyon Creek

||SOURCE: Dugout Canyon Creek

|COUNTY: Carbon

||COUNTY: Carbon COM DESC: 11 miles NE of Wellington

This water right will be used to

provide dust suppression and fire protection

water for both surface and underground

operations at the Dugout Canyon Mine.

POINT(S) OF DIVERSION ----->

CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

Point Surface:

Point Surface:

(1) N 1260 ft E 120 ft from SW cor, Sec 03, T 14S, R 12E, SLBM (1)

N 3360 ft E 1860 ft from SW cor, Sec 23, T 13S, R 12E, SLBM

Dvrting Wks:

Dvrting Wks: Stilling well in creek with submersible pump

Source:

Source: Dugout Canyon Creek

Stream Alt?: No

PLACE OF USE ----->

CHANGED as follows:

	--NW%	--NE%	--SW%	--SE%	
	N N S S	N N S S	N N S S	N N S S	
	W E W E	W E W E	W E W E	W E W E	
Sec 09 T 14S R 12E SLBM	* : : : **	: : : **	: : : **	: : : **	:X:X:X*   Sec
09 T 13S R 12E SLBM	* : : : **	: : : **	: : : **	: : : **	:X:X*
Sec 10 T 14S R 12E SLBM	*X:X:X: **X:	:X: **X:	**X:X:X**	: : : *	Sec
10 T 13S R 12E SLBM	* : : : **	: : : **	**X:X:X**	X:X:X*X*	
Sec 15 T 14S R 12E SLBM	* :X: :X**	:X: **	:X:X:X**X:	:X: *	Sec
11 T 13S R 12E SLBM	* : : : **	: : : **	**X:X:X**	X:X:X*	
Sec 22 T 14S R 12E SLBM	*X:X:X:X**	: : : **	: : : **	: : : *	Sec
14 T 13S R 12E SLBM	*X:X:X**X:	X:X:X**X:	X:X:X**X:	X:X:X*	Sec
15 T 13S R 12E SLBM	*X:X:X**X:	X:X:X**X:	X:X:X**X:	X:X:X*	Sec
16 T 13S R 12E SLBM	*X:X:X**X:	X:X:X**X:	X:X:X**X:	X:X:X*	Sec

17 T 13S R 12E SLBM	* : : : ** : : : ** :X: :X**X:X:X:X*	Sec
20 T 13S R 12E SLBM	* :X:X:X**X:X: : ** : : : ** : : : *	Sec
21 T 13S R 12E SLBM	*X:X: : **X:X:X:X** : : : ** : : : *	Sec
22 T 13S R 12E SLBM	*X:X:X:X**X:X:X*X**X:X: : **X:X: : *	Sec
23 T 13S R 12E SLBM	*X:X:X:X**X: :X: ** : : : ** : : : *	Sec

NATURE OF USE ----->  
 CHANGED as follows:

SUPPLEMENTAL to Other Water Rights: Yes  
 SUPPLEMENTAL to Other Water Rights: No

IRR: 605.7000 acs Sol/Sup: 293.4300 acs USED 04/01 - 09/30

STK: 810.0000 Cattle or Equivalent USED 04/01 - 09/30

District: Dugout Canyon USED 01/01 - 12/31 || MIN:

Name: Dugout Canyon

Ores: Coal

OTHER: Dust suppression and USED 01/01 - 12/31 || OTH:

fire protection

RESERVOIR STORAGE --> || SAME  
 AS HERETOFORE

Storage 03/01 to 07/31, in Clark's Valley Reservoir

with a maximum capacity of 460.500 acre-feet, located in: | |

--NW%-- --NE%-- --SW%-- --SE%-- | |

Height of Dam: ft | N N S S | N N S S | N N S S | N N S S | |

Area Inundat acs | W E W E | W E W E | W E W E | W E W E | |

Sec 10 T 14S R 12E SLBM \* : : : \*\* : : : \*\* : : : X\*\* : : X: \* | |

Sec 15 T 14S R 12E SLBM \* : X: : \*\*X: : : \*\* : : : \*\* : : : \* | |

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EXTENSIONS OF TIME WITHIN WHICH TO FILE  
PROOF\*\*\*\*\*  
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FILED: 02/24/2000 | PUB BEGAN: | PUB ENDED:  
| NEWSPAPER:  
ProtestEnd: | PROTESTED: [No ] | HEARNG HLD: | SE  
ACTION: [Approved] | ActionDate: 03/23/2000 | PROOF DUE: 07/31/2005

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A T A \*\*\*\*\*  
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Select Related Information

**(WARNING: Water Rights makes NO claims as to the accuracy of this data.)** RUN DATE: 10/08/2007 Page 1

CHANGE: t22301 WATER RIGHT: 91-23 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-23

RIGHT EVIDENCED BY: 91-23, 491 (A5039) Cert. 1685

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [ ]

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NAME: Nielson Construction Company Inc.

ADDR: P.O. Box 620  
Huntington UT 84528

REMARKS:

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FILED: 06/12/1998|PRIORITY: 06/12/1998|ADV BEGAN: |ADV

ENDED: |NEWSPAPER:

ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE

ACTION: [Approved]|ActionDate:06/15/1998|PROOF DUE:

EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:

|CERT/WUC: |LAP, ETC: 06/11/1999|LAPS LETTER:

RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:

[ ]

Status: Lapsed

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\*\*\*\*\*H E R E T O F O R E\*\*\*\*\*  
\*\*\*\*\*H E R E A F T E R\*\*\*\*\*  
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|FLOW: 19.0 acre-feet

||FLOW: 19.0 acre-feet

|SOURCE: Dugout Canyon Creek

||SOURCE: Dugout Canyon Creek

|COUNTY: Carbon

||COUNTY: Carbon COM DESC: 8 miles N. of Sunnyside Jct.

Water will be used to construct Dugout

Canyon Road.

POINT(S) OF DIVERSION ----->

CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

Point Surface:

Point Surface:

(1) N 1260 ft E 120 ft from SW cor, Sec 03, T 14S, R 12E, SLBM (1)  
S 2500 ft E 1230 ft from NW cor, Sec 23, T 13S, R 12E, SLBM

Dvrting Wks:

Dvrting Wks:

Source:

Source:

S 2300 ft E 2010 ft from NW cor, Sec 34, T 13S, R 12E, SLBM (2)

Dvrting Wks:

Source:

Stream Alt?: No

PLACE OF USE ----->

CHANGED as follows:

	--NW¼--	--NE¼--	--SW¼--	--SE¼--	
					N N S S   N N S S   N N S S   N N S S
	N N S S	N N S S	N N S S	N N S S	W E W E   W E W E   W E W E   W E W E

22 T 13S R 12E SLBM	*X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*	Sec
23 T 13S R 12E SLBM	*X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*	Sec
27 T 13S R 12E SLBM	*X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*	Sec
34 T 13S R 12E SLBM	*X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*	Sec
13 T 14S R 11E SLBM	*X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*	Sec

24 T 14S R 11E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*	Sec
03 T 14S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*	Sec
04 T 14S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*	Sec
05 T 14S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*	Sec
08 T 14S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*	Sec
17 T 14S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*	Sec
18 T 14S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*	Sec

NATURE OF USE ----->

CHANGED as follows:

SUPPLEMENTAL to Other Water Rights: No  
 SUPPLEMENTAL to Other Water Rights: No

IRR: 605.7000 acs Sol/Sup: 293.4300 acs USED 04/01 - 09/30

STK: 810.0000 Cattle or Equivalent USED 04/01 - 09/30

ROAD MAINTENANCE: Road construction and USED 06/12 - 06/11  
 dust suppression.

RESERVOIR STORAGE -->  
 AS HERETOFORE

|| SAME

Storage 03/01 to 07/31, in Clark's Valley Reservoir  
 with a maximum capacity of 460.500 acre-feet, located in:  
 --NW¼-- --NE¼-- --SW¼-- --SE¼--  
 Height of Dam: ft |N N S S||N N S S||N N S S||N N S S||

Area Inundat                   acs|W E W E||W E W E||W E W E||W E W E||

Sec 10 T 14S R 12E SLBM       \* : : : \*\* : : : \*\* : : :X\*\* : :X: \*||

Sec 15 T 14S R 12E SLBM       \* :X: : \*\*X: : : \*\* : : : \*\* : : : \*||

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Select Related Information

**(WARNING: Water Rights makes NO claims as to the accuracy of this data.)** RUN DATE: 10/08/2007 Page 1

CHANGE: t22354 WATER RIGHT: 91-519 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-519

RIGHT EVIDENCED BY: 91-519

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [ ].

\*-----\*

NAME: Canyon Fuels Company LLC  
ADDR: 6955 Union Park Center, Suite 550  
Midvale UT 84047

REMARKS:

\*-----\*

FILED: 05/21/1998|PRIORITY: 06/30/1998|ADV BEGAN: |ADV  
ENDED: |NEWSPAPER:  
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE  
ACTION: [Approved]|ActionDate:07/01/1998|PROOF DUE:  
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:  
|CERT/WUC: |LAP, ETC: 06/30/1999|LAPS LETTER:  
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:  
[ ]

Status: Lapsed

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\*\*\*\*\*H E R E T O F O R E\*\*\*\*\*  
\*\*\*\*\*H E R E A F T E R\*\*\*\*\*  
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|FLOW: 1.0 cfs OR 224.8 acre-feet  
||FLOW: 0.25 cfs OR 84.0 acre-feet  
|-----|

|SOURCE: Soldier Creek  
||SOURCE: Soldier Creek  
|-----|

|COUNTY: Carbon  
||COUNTY: Carbon COM DESC: Soldier Creek Mine  
|-----|

|  
This application is being filed to |

allow the applicant to divert make-up water  
 from Soldier Creek and pump it into  
 the mine through a former discharge line  
 for use as described herein.

POINT(S) OF DIVERSION ----->

CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

Point Surface:

Point Surface:

(1) N 1040 ft E 740 ft from SW cor, Sec 19, T 13S, R 12E, SLBM (1)  
 N 30 ft W 1140 ft from SE cor, Sec 07, T 13S, R 12E, SLBM

Dvrting Wks:

Dvrting Wks: Portable pump & pipelines to place of use

Source:

Source: Soldier Creek

Stream Alt?: No

PLACE OF USE ----->

CHANGED as follows:

	--NW%	--NE%	--SW%	--SE%		--NW%	--NE%	--SW%	--SE%	
	N N S S	N N S S	N N S S	N N S S		N N S S	N N S S	N N S S	N N S S	
	W E W E	W E W E	W E W E	W E W E		W E W E	W E W E	W E W E	W E W E	
Sec 25 T 13S R 11E SLBM	* : : *	* : : *	* : : *	* : : *		* : : *	* : : *	* : : *	* : : *	Sec
07 T 13S R 12E SLBM	* : : *	* : : *	* : : *	* : : *		* : : *	* : : *	* : : *	* : : *	
Sec 30 T 13S R 12E SLBM	* : : *	* : : *	* : : *	* : : *		* : : *	* : : *	* : : *	* : : *	

NATURE OF USE ----->  
| CHANGED as follows:

-----  
| SUPPLEMENTAL to Other Water Rights: No  
SUPPLEMENTAL to Other Water Rights: No

IRR: 73.1000 acs Sol/Sup: acs USED 04/01 - 10/31||

.....  
| STK: 130.0000 Cattle or Equivalent USED 01/01 - 12/31||  
.....

District: Soldier Creek USED 07/01 - 06/30| | MIN:

Name: Soldier Creek | |

Ores: Coal | |

-----  
| INDUSTRIAL: In-mine process water USED 07/01 - 06/30| | OTH:  
| and dust suppression | |  
-----

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Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007 Page 1

CHANGE: t22425 WATER RIGHT: 91-519 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-519

RIGHT EVIDENCED BY: 91-519

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [ ].

\*-----\*

NAME: Canyon Fuel Company LLC
ADDR: 6955 Union Park Center, Suite 550
Midvale UT 84047

REMARKS:

\*-----\*

FILED: 08/03/1998|PRIORITY: 08/03/1998|ADV BEGAN: |ADV
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE
ACTION: [Approved]|ActionDate:08/03/1998|PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: |LAP, ETC: 11/30/1998|LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]

Status: Lapsed

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\*\*\*\*\*HERETOFORE\*\*\*\*\*
\*\*\*\*\*HEREAFTER\*\*\*\*\*
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|FLOW: 2.0 acre-feet
||FLOW: 2.0 acre-feet
|-----|

|SOURCE: Soldier Creek
||SOURCE: Pine Cyn., Soldier, Fish, & Dugout Creeks
|-----|

|COUNTY: Carbon
||COUNTY: Carbon COM DESC: 12 miles NE of Wellington
|-----|

The water from this permit will be

used to drill locations A,B,E, & F in 1998.

See attached sheet.

POINT(S) OF DIVERSION ----->

CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

Point Surface:

Point Surface:

(1) N 1040 ft E 740 ft from SW cor, Sec 19, T 13S, R 12E, SLBM (1)  
N 2190 ft W 650 ft from SE cor, Sec 04, T 13S, R 12E, SLBM

Dvrting Wks:

Dvrting Wks: Pond

Source:

Source:

N 1680 ft E 460 ft from SW cor, Sec 06, T 13S, R 12E, SLBM (2)

Dvrting Wks:

Source: Soldier Creek

N 310 ft W 860 ft from SE cor, Sec 09, T 13S, R 12E, SLBM (3)

Dvrting Wks: Pond

Source:

S 1100 ft E 1400 ft from NW cor, Sec 15, T 13S, R 12E, SLBM (4)

Dvrting Wks: Pond

Source:

S 150 ft E 710 ft from W4 cor, Sec 23, T 13S, R 12E, SLBM (5)

Dvrting Wks:

Source: Dogout Creek

Stream Alt?: No

PLACE OF USE ----->

CHANGED as follows:

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-----|-----
|NW%--  --NE%--  --SW%--  --SE%--  |NW%--  --NE%--  --SW%--  --SE%--  |
|N N S S|N N S S|
|W E W E|W E W E|
|Sec 25 T 13S R 11E SLBM * : : : ** : : : ** : : : ** :X: :X*|Sec
15 T 13S R 12E SLBM * : : : ** : : : ** :X: : ** : : : *|
|Sec 30 T 13S R 12E SLBM * : : : ** : : : ** : :X: ** : : : *|Sec
16 T 13S R 12E SLBM * : : : ** : : : ** : : : ** :X: : *|
|21 T 13S R 12E SLBM * : : : ** :X: : ** : : : ** : : : *|
|22 T 13S R 12E SLBM * : : : ** :X: : ** : : : ** : : : *|

```

NATURE OF USE ----->

CHANGED as follows:

SUPPLEMENTAL to Other Water Rights: No  
 SUPPLEMENTAL to Other Water Rights: No

IRR: 73.1000 acs Sol/Sup: acs USED 04/01 - 10/31|

STK: 130.0000 Cattle or Equivalent USED 01/01 - 12/31|

OIL EXPLORATION: Exploration drilling USED 08/03 - 11/30| OTH:

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Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007 Page 1

CHANGE: t23594 WATER RIGHT: 91-519 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-519

RIGHT EVIDENCED BY: 91-519

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [ ].

-----\*

NAME: Canyon Fuel Company LLC
ADDR: 6955 Union Park Center Suite 550
Midvale UT 84047

INTEREST: 100% REMARKS:

-----\*

FILED: 07/26/1999|PRIORITY: 07/26/1999|ADV BEGAN: |ADV
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE
ACTION: [Approved]|ActionDate:08/10/1999|PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: |LAP, ETC: 11/30/1999|LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]

Status: Lapsed

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\*\*\*\*\*H E R E T O F O R E\*\*\*\*\*
\*\*\*\*\*H E R E A F T E R\*\*\*\*\*
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|FLOW: 2.0 acre-feet
||FLOW: 2.0 acre-feet
|-----|

|SOURCE: Soldier Creek
||SOURCE: Trib. to Pine, Soldier, Fish and Dugout Creeks
|-----|

|COUNTY: Carbon
||COUNTY: Carbon COM DESC: 12 miles NE of Wellington
|-----|

The water from this permit will be

used to drill locations G, H, I, J, & N-alt  
in 1999. See attached sheets.

POINT(S) OF DIVERSION ----->

CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

Point Surface:

Point Surface:

(1) N 1040 ft E 740 ft from SW cor, Sec 19, T 13S, R 12E, SLBM | (1)  
N 2190 ft W 650 ft from SE cor, Sec 04, T 13S, R 12E, SLBM |

Dvrting Wks: Earthen ditches

Dvrting Wks: Pond

Source:

Source:

N 1680 ft E 460 ft from SW cor, Sec 05, T 13S, R 12E, SLBM | (2)

Dvrting Wks:

Source: Soldier Creek

N 2000 ft W 50 ft from SE cor, Sec 09, T 13S, R 12E, SLBM | (3)

Dvrting Wks: Pond

Source:

N 700 ft W 2400 ft from SE cor, Sec 14, T 13S, R 12E, SLBM | (4)

Dvrting Wks:

Source: Dugout Creek

S 1100 ft E 1400 ft from NW cor, Sec 15, T 13S, R 12E, SLBM | (5)

Dvrting Wks: Pond

Source:

S 750 ft W 1400 ft from NE cor, Sec 16, T 13S, R 12E, SLBM | (6)

Dvrting Wks:

Source: Fish Creek

S 150 ft E 710 ft from W4 cor, Sec 23, T 13S, R 12E, SLBM | (7)

Dvrtng Wks:

Source: Dugout Creek

Stream Alt?: No

PLACE OF USE ----->

CHANGED as follows:

	--NW%	--NE%	--SW%	--SE%	
					N N S S N N S S N N S S N N S S
					W E W E W E W E W E W E W E W E
Sec 25 T 13S R 11E SLBM	*	:	:	:	** : : : ** : : : ** : : : ** :X: :X* Sec
14 T 13S R 12E SLBM	*	:	:	:	X** : : : ** : : : ** :X: : * Sec
15 T 13S R 12E SLBM	*	:	X:	:	** :X: : ** : : : ** : : : * Sec
16 T 13S R 12E SLBM	*	:	:	:	**X: : : ** :X: : ** : : : * Sec

NATURE OF USE ----->

CHANGED as follows:

SUPPLEMENTAL to Other Water Rights: No  
SUPPLEMENTAL to Other Water Rights: No

IRR: 73.1000 acs Sol/Sup: acs USED 04/01 - 10/31

STK: 130.0000 Cattle or Equivalent USED 01/01 - 12/31

OTHER: Exploration Drilling USED 07/26 - 11/30

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Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007 Page 1

CHANGE: t25914 WATER RIGHT: 91-23 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-23

RIGHT EVIDENCED BY: 91023, 491 (A5039) Cert. #1685

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [ ].

\*-----\*

NAME: Canyon Fuel Company LLC

ADDR: P.O. Box 1029

Wellington UT 84542

REMARKS:

\*-----\*

FILED: 08/20/2001|PRIORITY: 08/20/2001|ADV BEGAN: |ADV

ENDED: |NEWSPAPER:

ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE

ACTION: [Approved]|ActionDate:08/24/2001|PROOF DUE:

EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:

|CERT/WUC: |LAP, ETC: 10/31/2001|LAPS LETTER:

RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:

[ ]

Status: Lapsed

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\*\*\*\*\*HERETOFORE\*\*\*\*\*
\*\*\*\*\*HEREAFTER\*\*\*\*\*
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|FLOW: 2.5 acre-feet

||FLOW: 2.5 acre-feet

|SOURCE: Dugout Canyon Creek

||SOURCE: Pace Creek

|COUNTY: Carbon

||COUNTY: Carbon COM DESC: 2 mi. North of Clark's Valley

|POINT(S) OF DIVERSION ----->

||CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

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-----|-----
Point Surface:
|Point Surface:
| (1) N 1260 ft E 120 ft from SW cor, Sec 03, T 14S, R 12E, SLBM| (1)
N 1150 ft W 950 ft from SE cor, Sec 19, T 13S, R 13E, SLBM|
| Dvrting Wks:
Dvrting Wks:
| Source:
Source:
|
| (2)
N 1150 ft E 1200 ft from SW cor, Sec 20, T 13S, R 13E, SLBM|
|
Dvrting Wks:
|
Source:
|
| (3)
S 150 ft E 1850 ft from NW cor, Sec 30, T 13S, R 13E, SLBM|
|
Dvrting Wks:
|
Source:
|
|
|
|
|Stream Alt?: No
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PLACE OF USE ----->  
 |CHANGED as follows:

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--NW%-- --NE%-- --SW%-- --SE%-- ||
--NW%-- --NE%-- --SW%-- --SE%-- |
|N N S S|N N S S|N N S S|N N S S||
|N N S S|N N S S|N N S S|N N S S|
|W E W E|W E W E|W E W E|W E W E||
|W E W E|W E W E|W E W E|W E W E|
|19 T 13S R 13E SLBM *X: : : ** : : : ** : : : ** : : : X*|
|24 T 13S R 13E SLBM * : : : ** : : : **X: : : ** : : : *|
|30 T 13S R 13E SLBM * :X: : ** : : : ** : : : ** : : : *|
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NATURE OF USE ----->  
 |CHANGED as follows:

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SUPPLEMENTAL to Other Water Rights: Yes  
 SUPPLEMENTAL to Other Water Rights: No

---

IRR: 605.7000 acs Sol/Sup: 293.4300 acs USED 04/01 - 09/30

STK: 810.0000 Cattle or Equivalent USED 04/01 - 09/30

OIL EXPLORATION: Exploratory Drilling USED 08/27 - 10/31

OTH:

---

RESERVOIR STORAGE --> AS HERETOFORE

---

Storage 03/01 to 07/31, in Clark's Valley Reservoir

with a maximum capacity of 460.500 acre-feet, located in:

--NW¼-- --NE¼-- --SW¼-- --SE¼--

Height of Dam: ft |N N S S| |N N S S| |N N S S| |N N S S|

Area Inundat acs |W E W E| |W E W E| |W E W E| |W E W E|

Sec 10 T 14S R 12E SLBM \* : : : \*\* : : : \*\* : : :X\*\* : :X: \*|

Sec 15 T 14S R 12E SLBM \* :X: : \*\*X: : : \*\* : : : \*\* : : : \*|

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Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007 Page 1

CHANGE: t28162 WATER RIGHT: 91-519 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-519

RIGHT EVIDENCED BY: 91-519

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [ ].

-----\*

NAME: Canyon Fuel Company LLC
ADDR: 6955 Union Park Center Suite 550
Midvale UT 84047

REMARKS:

-----\*

FILED: 08/07/2003|PRIORITY: 08/07/2003|ADV BEGAN: |ADV
ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE
ACTION: [Approved]|ActionDate:08/07/2003|PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: |LAP, ETC: 08/06/2004|LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]

Status: Lapsed

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\*\*\*\*\*HERETOFORE\*\*\*\*\*
\*\*\*\*\*HEREAFTER\*\*\*\*\*
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|FLOW: 2.5 acre-feet
||FLOW: 2.5 acre-feet

|SOURCE: Soldier Creek
||SOURCE: Dugout Canyon Creek

|COUNTY: Carbon
||COUNTY: Carbon COM DESC: 12 m. N. Hwy 6 Clark Valley

The water will be used for Dugout



NATURE OF USE ----->

CHANGED as follows:

SUPPLEMENTAL to Other Water Rights: Yes

SUPPLEMENTAL to Other Water Rights: No

IRR: 73.1000 acs Sol/Sup: acs USED 04/01 - 10/31

STK: 130.0000 Cattle or Equivalent USED 01/01 - 12/31

OTHER: Exploration drilling USED 08/07 - 08/06  
and dust suppression

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Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007 Page 1

CHANGE: a27255 WATER RIGHT: 91-4987 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-4987

RIGHT EVIDENCED BY: 91-4987

CHANGES: Point of Diversion [X], Place of Use [ ], Nature of Use [ ], Reservoir Storage [ ].

\*-----\*

NAME: Canyon Fuel Company LLC
ADDR: City Place One Suite 300
St. Louis MO 63141

REMARKS:

\*-----\*

FILED: 11/14/2002|PRIORITY: 11/14/2002|ADV BEGAN: 12/05/2002|ADV

ENDED: 12/12/2002|NEWSPAPER: Sun Advocate

ProtestEnd:01/01/2003|PROTESTED: [No ]|HEARNG HLD: |SE

ACTION: [ ]|ActionDate: |PROOF DUE:

EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:

|CERT/WUC: |LAP, ETC: |LAPS LETTER:

RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:

[ ]

Status: Terminated

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\*\*\*\*\*HERETOFORE\*\*\*\*\*
\*\*\*\*\*HEREAFTER\*\*\*\*\*
\*\*\*\*\*

|FLOW: 250.0 acre-feet

||FLOW: 250.0 acre-feet

|SOURCE: Dugout Canyon Creek

||SOURCE: Underground Water Well (Existing)

|COUNTY: Carbon

||COUNTY: Carbon COM DESC:

The purpose of this application is to

change the point of diversion from  
 Dugout Canyon Creek to the existing  
 well covered by water right 91-5024.

POINT(S) OF DIVERSION ----->

CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

Point Surface:

(1) N 3360 ft E 1860 ft from SW cor, Sec 23, T 13S, R 12E, SLBM

Dvrting Wks:

Source:

Point Underground:

UNDERGROUND: (Click Link for PLAT data, Well ID# link for data.)

S 125 ft E 2307 ft from NW cor, Sec 23, T 13S, R 12E, SLBM

Diameter: 10 ins. Depth: 300 to ft. WELL ID#:

COMMENT: Existing Well

PLACE OF USE ----->

AS HERETOFORE

SAME

--NW%-- --NE%-- --SW%-- --SE%--

|N N S S| |N N S S| |N N S S| |N N S S|

|W E W E| |W E W E| |W E W E| |W E W E|

Sec 09 T 13S R 12E SLBM \* : : : \*\* : : : \*\* : : : \*\* : : : X:X\*

Sec 10 T 13S R 12E SLBM \* : : : \*\* : : : \*\*X:X:X\*\*X:X:X:X\*

Sec 11 T 13S R 12E SLBM \* : : : \*\* : : : \*\*X:X:X\*\*X:X:X:X\*

Sec 14 T 13S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*
Sec 15 T 13S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*
Sec 16 T 13S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X:X*X**X:X:X*X*
Sec 17 T 13S R 12E SLBM	* : : : ** : : : ** :X: :X**X:X:X*X*
Sec 20 T 13S R 12E SLBM	* :X:X:X*X**X:X: : ** : : : ** : : : *
Sec 21 T 13S R 12E SLBM	*X:X: : **X:X:X*X** : : : ** : : : *
Sec 22 T 13S R 12E SLBM	*X:X:X*X**X:X:X*X**X:X: : **X:X: : *
Sec 23 T 13S R 12E SLBM	*X:X:X*X**X: :X: ** : : : ** : : : *

NATURE OF USE ----->		SAME
AS HERETOFORE		
-----		-----
SUPPLEMENTAL to Other Water Rights: Yes		
SUPPLEMENTAL to Other Water Rights: No		
.....		.....
MIN: District: Dugout Canyon	USED 01/01 - 12/31	
Name: Dugout Canyon		
Ores: Coal		
-----		-----
.....		.....
OTH: OTHER:	dust suppression and	USED 01/01 - 12/31
fire protection		
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Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007 Page 1

CHANGE: t29158 WATER RIGHT: 91-409 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-409

RIGHT EVIDENCED BY: 91-409 (A9502) Cert. No. 2207

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [ ]

-----\*

NAME: Canyon Fuel Company

ADDR: HC 35 Box 380

Helper, Utah 84526

INTEREST: 100% REMARKS:

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FILED: 07/01/2004|PRIORITY: 07/01/2004|ADV BEGAN: |ADV

ENDED: |NEWSPAPER:

ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE

ACTION: [Approved]|ActionDate:07/02/2004|PROOF DUE:

EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:

|CERT/WUC: |LAP, ETC: 07/01/2005|LAPS LETTER:

RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:

[ ]  
Status: Lapsed

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\*\*\*\*\*HERE TO F O R E\*\*\*\*\*  
\*\*\*\*\*H E R E A F T E R\*\*\*\*\*  
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|FLOW: 3.0 acre-feet

||FLOW: 3.0 acre-feet

|SOURCE: Pace Canyon Creek

||SOURCE: Pace Canyon Creek

|COUNTY: Carbon

||COUNTY: Carbon COM DESC: 11 mi. No. Hwy 6-Clark Valley

The water will be used for Dugout

Canyon Mine exploration drilling and dust  
suppression.

POINT(S) OF DIVERSION ----->

CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

Point Surface:

Point Surface:

(1) N 1280 ft W 1200 ft from SE cor, Sec 03, T 14S, R 12E, SLBM | (1)  
N 1090 ft W 950 ft from SE cor, Sec 19, T 13S, R 13E, SLBM |

Dvrting Wks:

Dvrting Wks: Portable pump and tank truck

Source:

Source: Pace Canyon Creek

N 1735 ft W 850 ft from NE cor, Sec 19, T 13S, R 13E, SLBM | (2)

Dvrting Wks: Portable pump and tank truck

Source: Pace Canyon Creek

N 1160 ft E 1140 ft from SW cor, Sec 20, T 13S, R 13E, SLBM | (3)

Dvrting Wks: Portable pump and tank truck

Source: Pace Canyon Creek

N 2320 ft W 2230 ft from SE cor, Sec 20, T 13S, R 13E, SLBM | (4)

Dvrting Wks: Portable pump and tank truck

Source: Pace Canyon Creek

Stream Alt?: No

PLACE OF USE ----->

CHANGED as follows:

```

--NW%-- --NE%-- --SW%-- --SE%-- |
|N N S S|N N S S|N N S S|N N S S||
|W E W E|W E W E|W E W E|W E W E||
|Sec 09 T 14S R 12E SLBM * : : : ** : : : ** : : : X** :X: :X*| |Sec
13 T 13S R 12E SLBM * : : : ** : : : ** : : : ** : : : X*|
|Sec 10 T 14S R 12E SLBM * :X:X: **X: :X: **X:X:X:X** : : : *| |Sec
24 T 13S R 12E SLBM * : : : **X: : : ** : : : ** : : : *|
|Sec 15 T 14S R 12E SLBM * :X:X: ** : :X: ** :X: :X**X: :X: *| |Sec
18 T 13S R 13E SLBM * : : : ** : : : ** : : : **X: : : *|
|Sec 22 T 14S R 12E SLBM *X:X:X:X** : : : ** : : : ** : : : *| |Sec
19 T 13S R 13E SLBM * : : : ** : : : X** : : : ** : : : *|
|
20 T 13S R 13E SLBM * : : : ** : : : ** : : : **X: : : *| |Sec

```

```

NATURE OF USE ----->
|CHANGED as follows:
-----|
|SUPPLEMENTAL to Other Water Rights: Yes
|SUPPLEMENTAL to Other Water Rights: No
-----|
|IRR: 645.8000 acs Sol/Sup: 121.3500 acs USED 04/01 - 10/01||
|.....|
|STK: 810.0000 Cattle or Equivalent USED 04/01 - 10/01||
|.....|
|OTHER: Exploration drilling USED 07/02 - 07/01| |OTH:
|and dust suppression |
|-----|

```

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*****END OF D
A T A*****
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*****

```



Select Related Information

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/08/2007 Page 1

CHANGE: t30602 WATER RIGHT: 91-409 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-409

RIGHT EVIDENCED BY: 91-409(A9502) Cert. No. 227

Prior approved Temporary Change Applications for this right: t27967; t28160; t29158

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [X].

-----\*

NAME: Canyon Fuel Company LLC  
ADDR: Attn: Property Administration  
CityPlace One Suite 300  
St. Louis MO 63141

INTEREST: 100% REMARKS: c/o Ark Land Company

-----\*

FILED: 08/31/2005|PRIORITY: 08/31/2005|ADV BEGAN: |ADV

ENDED: |NEWSPAPER:

ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE

ACTION: [Approved]|ActionDate:08/31/2005|PROOF DUE:

EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:

|CERT/WUC: |LAP, ETC: 08/30/2006|LAPS LETTER:

RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:

[ ]  
Status: Lapsed

\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*H E R E T O F O R E\*\*\*\*\*  
\*\*\*\*\*H E R E A F T E R\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

|FLOW: 5.0 acre-feet  
||FLOW: 5.0 acre-feet

|SOURCE: Pace Canyon Creek  
||SOURCE: Pace Canyon Creek

|COUNTY: Carbon  
||COUNTY: Carbon COM DESC: 15 Miles NE of Wellington

Pine Canyon Quad

POD - DIVERTING WORKS: Portable pump  
and tank truck

The water will be used for Dugout  
Canyon Mine exploration drilling and dust  
suppression.

POINT(S) OF DIVERSION ----->

CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

Point Surface:

Point Surface:

(1) N 1280 ft W 1200 ft from SE cor, Sec 03, T 14S, R 12E, SLBM (1)  
N 3475 ft W 845 ft from SE cor, Sec 19, T 13S, R 13E, SLBM

Dvrting Wks:

Dvrting Wks:

Source:

Source:

N 2280 ft W 1300 ft from SE cor, Sec 19, T 13S, R 13E, SLBM

Dvrting Wks:

Source:

N 1050 ft W 890 ft from SE cor, Sec 20, T 13S, R 13E, SLBM

Dvrting Wks:

Source:

N 1075 ft E 2560 ft from SW cor, Sec 20, T 13S, R 13E, SLBM | (4)

Dvrting Wks: |

Source: |

|Stream Alt?: No |

PLACE OF USE ----->  
|CHANGED as follows: |

	NW¼	NE¼	SW¼	SE¼	
					N N S S   N N S S   N N S S   N N S S
					W E W E   W E W E   W E W E   W E W E
Sec 09 T 14S R 12E SLBM	*	:	:	:	** : : : ** : : : ** : : : ** :X:X:X*   Sec
17 T 13S R 13E SLBM	*	:	:	:	** : : : ** : : : ** :X: *
Sec 10 T 14S R 12E SLBM	*	:	:	:	X:X: **X: :X: **X:X:X** : : : *   Sec
18 T 13S R 13E SLBM	*	:	:	:	** : : : ** : : : ** : : :X*
Sec 15 T 14S R 12E SLBM	*	:	:	:	X: :X** : :X: ** :X:X:X**X: :X: *   Sec
19 T 13S R 13E SLBM	*	:	:	:	** : : : ** : : : ** :X: : *
Sec 22 T 14S R 12E SLBM	*	:	:	:	X:X:X:X** : : : ** : : : ** : : : *   Sec
20 T 13S R 13E SLBM	*	:	:	:	**X: : :X** :X: : *
21 T 13S R 13E SLBM	*	:	:	:	**X: : : ** : : : *   Sec

NATURE OF USE ----->  
|CHANGED as follows: |

SUPPLEMENTAL to Other Water Rights: Yes  
|SUPPLEMENTAL to Other Water Rights: No |

IRR: 645.8000 acs Sol/Sup: 121.3500 acs USED 04/01 - 10/01 |

STK: 810.0000 Cattle or Equivalent USED 04/01 - 10/01 |

OTHER: Exploration drilling USED 08/16 - 08/15 | | OTH:  
and dust supression | |  
|-----| |-----  
|-----|

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\*\*\*\*\*  
\*\*\*\*\* E N D O F D  
A T A\*\*\*\*\*  
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Select Related Information

**(WARNING: Water Rights makes NO claims as to the accuracy of this data.)** RUN DATE: 10/08/2007 Page 1

CHANGE: t31206 WATER RIGHT: 91-409 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-409

RIGHT EVIDENCED BY: 91-409(A9502) Cert. No. 2207

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [ ].

-----\*

NAME: Canyon Fuel Company LLC  
ADDR: Attn: Property Administration  
CityPlace One Suite 300  
St. Louis MO 63141

INTEREST: 100% REMARKS: c/o Ark Land Company

-----\*

FILED: 03/20/2006|PRIORITY: 03/20/2006|ADV BEGAN: |ADV  
ENDED: |NEWSPAPER:  
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE  
ACTION: [Approved]|ActionDate:03/23/2006|PROOF DUE:  
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:  
|CERT/WUC: |LAP, ETC: 03/31/2007|LAPS LETTER:  
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:  
[ ]

Status: Lapsed

\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*H E R E T O F O R E\*\*\*\*\*  
\*\*\*\*\*H E R E A F T E R\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

|FLOW: 9.0 acre-feet  
||FLOW: 9.0 acre-feet  
|-----|

|SOURCE: Pace Canyon Creek  
||SOURCE: Pace Canyon Creek  
|-----|

|COUNTY: Carbon  
||COUNTY: Carbon COM DESC: 11 Miles NW of Sunnyside  
|-----|

The water will be used for Dugout  
Canyon Mine exploration drilling and dust  
suppression.

Diverting Works: Portable pump & tank  
trucks.

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---

POINT(S) OF DIVERSION ----->  
CHANGED AS FOLLOWS: (Click Location link for WRPLAT)

Point Surface:  
Point Surface:  
(1) N 1280 ft W 1200 ft from SE cor, Sec 03, T 14S, R 12E, SLBM | (1)  
N 1070 ft W 1100 ft from SE cor, Sec 19, T 13S, R 13E, SLBM |  
Dvrting Wks: |  
Source: |  
Source: | (2)  
N 3500 ft W 850 ft from SE cor, Sec 19, T 13S, R 13E, SLBM |  
Dvrting Wks: |  
Source: | (3)  
N 1325 ft E 1400 ft from SW cor, Sec 20, T 13S, R 13E, SLBM |  
Dvrting Wks: |  
Source: | (4)  
N 1060 ft E 2590 ft from SW cor, Sec 20, T 13S, R 13E, SLBM |  
Dvrting Wks: |  
Source: | (5)  
N 1070 ft W 900 ft from SE cor, Sec 20, T 13S, R 13E, SLBM |  
Dvrting Wks: |  
Source: | (6)  
N 700 ft E 1970 ft from SW cor, Sec 21, T 13S, R 13E, SLBM |

Dvrting Wks:

Source:

N 1400 ft W 960 ft from SE cor, Sec 21, T 13S, R 13E, SLBM

Dvrting Wks:

Source:

Stream Alt?: No

PLACE OF USE ----->

CHANGED as follows:

	NW	NE	SW	SE	NW	NE	SW	SE
Sec 09 T 14S R 12E SLBM	*	:	:	:	:	:	:	:
17 T 13S R 13E SLBM	*	:	:	:	:	:	:	:
Sec 10 T 14S R 12E SLBM	*	:	:	:	:	:	:	:
19 T 13S R 13E SLBM	*	:	:	:	:	:	:	:
Sec 15 T 14S R 12E SLBM	*	:	:	:	:	:	:	:
20 T 13S R 13E SLBM	*	:	:	:	:	:	:	:
Sec 22 T 14S R 12E SLBM	*	:	:	:	:	:	:	:
21 T 13S R 13E SLBM	*	:	:	:	:	:	:	:

NATURE OF USE ----->

CHANGED as follows:

SUPPLEMENTAL to Other Water Rights: Yes

SUPPLEMENTAL to Other Water Rights: No

IRR: 645.8000 acs Sol/Sup: 121.3500 acs USED 04/01 - 10/01

STK: 810.0000 Cattle or Equivalent USED 04/01 - 10/01



Select Related Information

**(WARNING: Water Rights makes NO claims as to the accuracy of this data.)** RUN DATE: 10/08/2007 Page 1

CHANGE: t32919 WATER RIGHT: 91-409 CERT. NO.:

AMENDATORY? No

BASE WATER RIGHTS: 91-409

RIGHT EVIDENCED BY: 91-409(A9502)

CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [ ].

-----\*

NAME: Canyon Fuel Company LLC  
ADDR: Attn: Property Administration  
CityPlace One Suite 300  
St. Louis MO 63141

INTEREST: 100% REMARKS: c/o Ark Land Company

-----\*

FILED: 04/26/2007|PRIORITY: 04/26/2007|ADV BEGAN: |ADV  
ENDED: |NEWSPAPER: No Adv Required  
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE  
ACTION: [Approved]|ActionDate:05/01/2007|PROOF DUE:  
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:  
|CERT/WUC: |LAP, ETC: 05/01/2008|LAPS LETTER:  
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:  
[ ]

Status: Approved

\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*H E R E T O F O R E\*\*\*\*\*  
\*\*\*\*\*H E R E A F T E R\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

|FLOW: 12.0 acre-feet  
||FLOW: 12.0 acre-feet  
|-----|

|SOURCE: Pace Canyon Creek  
||SOURCE: Pace Canyon Creek  
|-----|

|COUNTY: Carbon  
||COUNTY: Carbon COM DESC: 11 Miles NE of Wellington  
|-----|

Additional Place of Use:

Sections 16, 17, 18, 19, 20, 21, and  
30 of T13S, R13E, SLB&M.

In addition to normal mining  
activities, the applicant seeks to use water for  
a drilling program incidental to coal  
mining including dust suppression, fire  
protection, and coal processing.

POINT(S) OF DIVERSION -----> || SAME  
AS HERETOFORE, AND IN ADDITION TO: (Click link for WRPLAT) |

Point Surface:

Point Surface:

(1) N 1280 ft W 1200 ft from SE cor, Sec 03, T 14S, R 12E, SLBM | (1)  
N 1070 ft W 1100 ft from SE cor, Sec 19, T 13S, R 13E, SLBM |

Dvrting Wks:

Dvrting Wks:

Source:

Source:

N 3500 ft W 850 ft from SE cor, Sec 19, T 13S, R 13E, SLBM | (2)

Dvrting Wks:

Source:

N 1325 ft E 1400 ft from SW cor, Sec 20, T 13S, R 13E, SLBM | (3)

Dvrting Wks:

Source:

N 1070 ft W 900 ft from SE cor, Sec 20, T 13S, R 13E, SLBM | (4)

Dvrting Wks:

Source:

N 1060 ft E 2590 ft from SW cor, Sec 20, T 13S, R 13E, SLBM

(5)

Dvrting Wks:

Source:

N 1400 ft W 960 ft from SE cor, Sec 21, T 13S, R 13E, SLBM

(6)

Dvrting Wks:

Source:

S 1011 ft E 1322 ft from NW cor, Sec 30, T 13S, R 13E, SLBM

(7)

Dvrting Wks:

Source:

Stream Alt?: No

PLACE OF USE ----->  
AS HERETOFORE, AND IN ADDITION TO:

SAME

---NW%---	---NE%---	---SW%---	---SE%---
N N S S	N N S S	N N S S	N N S S
W E W E	W E W E	W E W E	W E W E

17 T 13S R 13E SLBM \* : : : \*\* : : : \*\*X:X:X:X\*\* : : : \*

Sec

18 T 13S R 13E SLBM \* : : : \*\* : : : \*\* : : : \*\*X:X:X:X\*

Sec

19 T 13S R 13E SLBM \* : : : \*\*X:X:X:X\*\* : : : \*\*X:X:X:X\*

Sec

20 T 13S R 13E SLBM \*X:X:X:X\*\*X:X:X:X\*\*X:X:X:X\*\*X:X:X:X\*

Sec

21 T 13S R 13E SLBM \*X:X:X:X\*\* : : : \*\*X:X:X:X\*\* : : : \*

Sec



**APPENDIX 7-2**

Groundwater Monitoring Data

Canyon Fuel Company, LLC  
SCM/Dugout Canyon Mine

Mining and Reclamation Plan  
September 2008

Appendix 7-2

# SPRINGS 321 and 322

"321" Monitoring Data 2007

Date	Time	pH	Cond.	Temp.	Flow (gpm)	Comments
3/15/07	1220				NOA	Snow/Ice
5/18/07	1420	8.08	406	4	1.5	
6/21/07	1114	8.11	410	7.6	1.3	
7/24/07	834	7.38	469	8.5	0.75	
8/30/07	1205	7.42	471	8	0.7	

"322" Monitoring Data 2007

Date	Time	pH	Cond.	Temp.	Flow (gpm)	Comments
3/15/07	1220				NOA	Snow/Ice
6/21/07	905	7.84	704	7	18	
7/24/07	916	7.91	698	9	0.2	Livestock
8/30/07	1130	7.91	663	11	0.1	Livestock

### Soldier Creek Coal Company

Project ID:  
Sample ID: 321

ACZ Sample ID: L63413-01  
Date Sampled: 06/21/07 00:00  
Date Received: 06/25/07  
Sample Matrix: Ground Water

#### Inorganic Prep

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							06/27/07 19:18	erf

#### Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, dissolved	M200.7 ICP	77.5			mg/L	0.2	1	07/03/07 13:37	msh
Iron, dissolved	M200.7 ICP		U		mg/L	0.02	0.05	07/03/07 13:37	msh
Iron, total	M200.7 ICP	1.59		*	mg/L	0.02	0.05	07/05/07 22:24	djt
Magnesium, dissolved	M200.7 ICP	22.5			mg/L	0.2	1	07/03/07 13:37	msh
Manganese, dissolved	M200.7 ICP		U		mg/L	0.005	0.03	07/03/07 13:37	msh
Manganese, total	M200.7 ICP	0.024	B		mg/L	0.005	0.03	07/05/07 22:24	djt
Potassium, dissolved	M200.7 ICP	1.0	B		mg/L	0.3	2	07/03/07 13:37	msh
Sodium, dissolved	M200.7 ICP	9.2			mg/L	0.3	2	07/03/07 13:37	msh

#### Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		270			mg/L	2	20	06/26/07 0:00	lcp/jjf
Carbonate as CaCO3			U		mg/L	2	20	06/26/07 0:00	lcp/jjf
Hydroxide as CaCO3			U		mg/L	2	20	06/26/07 0:00	lcp/jjf
Total Alkalinity		270			mg/L	2	20	06/26/07 0:00	lcp/jjf
Cation-Anion Balance	Calculation								
Cation-Anion Balance		6.1			%			07/10/07 15:15	calc
Sum of Anions		5.4			meq/L	0.1	0.5	07/10/07 15:15	calc
Sum of Cations		6.1			meq/L	0.1	0.5	07/10/07 15:15	calc
Chloride	325.2 / SM4500Cl-E	3	B	*	mg/L	1	5	07/02/07 15:00	aml/jag
Residue, Filterable (TDS) @180C	160.1 / SM2540C	290			mg/L	10	20	06/28/07 15:50	jjf
Sulfate	SM4500 SO4-D		U	*	mg/L	10	50	07/03/07 9:20	aeh
TDS (calculated)	Calculation	275			mg/L	10	50	07/10/07 15:15	calc
TDS (ratio - measured/calculated)	Calculation	1.05						07/10/07 15:15	calc

**Soldier Creek Coal Company**

Project ID:  
Sample ID: 321

ACZ Sample ID: **L64797-01**  
Date Sampled: **08/30/07 12:05**  
Date Received: **09/04/07**  
Sample Matrix: **Ground Water**

**Inorganic Prep**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							09/05/07 14:15	bjl

**Metals Analysis**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, dissolved	M200.7 ICP	75.9			mg/L	0.2	1	09/06/07 3:00	djt
Iron, dissolved	M200.7 ICP	0.03	B		mg/L	0.02	0.05	09/06/07 3:00	djt
Iron, total	M200.7 ICP	0.24			mg/L	0.02	0.05	09/06/07 20:31	erf
Magnesium, dissolved	M200.7 ICP	22.1			mg/L	0.2	1	09/06/07 3:00	djt
Manganese, dissolved	M200.7 ICP	0.014	B		mg/L	0.005	0.03	09/06/07 3:00	djt
Manganese, total	M200.7 ICP	0.007	B		mg/L	0.005	0.03	09/06/07 20:31	erf
Potassium, dissolved	M200.7 ICP	1.1	B		mg/L	0.3	2	09/06/07 3:00	djt
Sodium, dissolved	M200.7 ICP	10.0			mg/L	0.3	2	09/06/07 3:00	djt

**Wet Chemistry**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		274			mg/L	2	20	09/06/07 0:00	lcp
Carbonate as CaCO3			U		mg/L	2	20	09/06/07 0:00	lcp
Hydroxide as CaCO3			U		mg/L	2	20	09/06/07 0:00	lcp
Total Alkalinity		274			mg/L	2	20	09/06/07 0:00	lcp
Cation-Anion Balance	Calculation								
Cation-Anion Balance		4.3			%			09/17/07 0:00	calc
Sum of Anions		5.5			meq/L	0.1	0.5	09/17/07 0:00	calc
Sum of Cations		6.0			meq/L	0.1	0.5	09/17/07 0:00	calc
Chloride	325.2 / SM4500Cl-E	2	B	*	mg/L	1	5	09/10/07 12:59	mls
Residue, Filterable (TDS) @180C	160.1 / SM2540C	290			mg/L	10	20	09/04/07 16:22	lcp
Sulfate	SM4500 SO4-D		U		mg/L	10	50	09/05/07 9:14	aeh
TDS (calculated)	Calculation	276			mg/L	10	50	09/17/07 0:00	calc
TDS (ratio - measured/calculated)	Calculation	1.05						09/17/07 0:00	calc

**Soldier Creek Coal Company**

Project ID:  
Sample ID: 322

ACZ Sample ID: **L64797-02**  
Date Sampled: 08/30/07 11:30  
Date Received: 09/04/07  
Sample Matrix: Ground Water

**Inorganic Prep**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							09/05/07 15:10	bjl

**Metals Analysis**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, dissolved	M200.7 ICP	91.6			mg/L	0.2	1	09/06/07 3:04	djt
Iron, dissolved	M200.7 ICP		U		mg/L	0.02	0.05	09/06/07 3:04	djt
Iron, total	M200.7 ICP	8.27			mg/L	0.02	0.05	09/06/07 20:35	erf
Magnesium, dissolved	M200.7 ICP	41.3			mg/L	0.2	1	09/06/07 3:04	djt
Manganese, dissolved	M200.7 ICP	0.014	B		mg/L	0.005	0.03	09/06/07 3:04	djt
Manganese, total	M200.7 ICP	0.512			mg/L	0.005	0.03	09/06/07 20:35	erf
Potassium, dissolved	M200.7 ICP	1.5	B		mg/L	0.3	2	09/06/07 3:04	djt
Sodium, dissolved	M200.7 ICP	25.7			mg/L	0.3	2	09/06/07 3:04	djt

**Wet Chemistry**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		390			mg/L	2	20	09/06/07 0:00	lcp
Carbonate as CaCO3		6	B		mg/L	2	20	09/06/07 0:00	lcp
Hydroxide as CaCO3			U		mg/L	2	20	09/06/07 0:00	lcp
Total Alkalinity		396			mg/L	2	20	09/06/07 0:00	lcp
Cation-Anion Balance	Calculation								
Cation-Anion Balance		2.8			%			09/17/07 0:00	calc
Sum of Anions		8.6			meq/L	0.1	0.5	09/17/07 0:00	calc
Sum of Cations		9.1			meq/L	0.1	0.5	09/17/07 0:00	calc
Chloride	325.2 / SM4500Cl-E	2	B	*	mg/L	1	5	09/10/07 13:01	mls
Residue, Filterable (TDS) @180C	160.1 / SM2540C	430			mg/L	10	20	09/04/07 16:23	lcp
Sulfate	SM4500 SO4-D	30	B		mg/L	10	50	09/05/07 9:19	aeH
TDS (calculated)	Calculation	432			mg/L	10	50	09/17/07 0:00	calc
TDS (ratio - measured/calculated)	Calculation	1.00						09/17/07 0:00	calc

# ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

## Inorganic Analytical Results

### Soldier Creek Coal Company

Project ID:  
Sample ID: 322

ACZ Sample ID: L63413-02  
Date Sampled: 06/21/07 00:00  
Date Received: 06/25/07  
Sample Matrix: Ground Water

#### Inorganic Prep

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							06/27/07 19:30	erf

#### Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, dissolved	M200.7 ICP	91.4			mg/L	0.2	1	07/03/07 13:40	msh
Iron, dissolved	M200.7 ICP		U		mg/L	0.02	0.05	07/03/07 13:40	msh
Iron, total	M200.7 ICP	0.69		*	mg/L	0.02	0.05	07/05/07 22:28	djt
Magnesium, dissolved	M200.7 ICP	43.8			mg/L	0.2	1	07/03/07 13:40	msh
Manganese, dissolved	M200.7 ICP	0.018	B		mg/L	0.005	0.03	07/03/07 13:40	msh
Manganese, total	M200.7 ICP	0.040			mg/L	0.005	0.03	07/05/07 22:28	djt
Potassium, dissolved	M200.7 ICP	1.5	B		mg/L	0.3	2	07/03/07 13:40	msh
Sodium, dissolved	M200.7 ICP	24.5			mg/L	0.3	2	07/03/07 13:40	msh

#### Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		380			mg/L	2	20	06/26/07 0:00	lcp/jjf
Carbonate as CaCO3			U		mg/L	2	20	06/26/07 0:00	lcp/jjf
Hydroxide as CaCO3			U		mg/L	2	20	06/26/07 0:00	lcp/jjf
Total Alkalinity		380			mg/L	2	20	06/26/07 0:00	lcp/jjf
Cation-Anion Balance	Calculation								
Cation-Anion Balance		5.1			%			07/10/07 15:15	calc
Sum of Anions		8.3			meq/L	0.1	0.5	07/10/07 15:15	calc
Sum of Cations		9.2			meq/L	0.1	0.5	07/10/07 15:15	calc
Chloride	325.2 / SM4500Cl-E	3	B	*	mg/L	1	5	07/02/07 15:02	aml/jag
Residue, Filterable (TDS) @180C	160.1 / SM2540C	420			mg/L	10	20	06/28/07 15:52	jf
Sulfate	SM4500 SO4-D	30	B	*	mg/L	10	50	07/03/07 9:23	ash
TDS (calculated)	Calculation	422			mg/L	10	50	07/10/07 15:15	calc
TDS (ratio - measured/calculated)	Calculation	1.00						07/10/07 15:15	calc

**APPENDIX 7-3**

Mayo and Associates Report

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Addendum to PHC  
July 2008

**PROBABLE HYDROLOGIC CONSEQUENCES  
ADDENDUM**

**OCTOBER 2007**  
Revised April 2008  
Revised July 2008

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### LIST OF FIGURES

- Figure X Annotated photograph showing fluvial channel and encasing lower-permeability fine-grained rocks in a road cut in the Colton Formation near Colton, Utah.
- Figure Y Annotated photograph showing surface erosional exposure of fluvial channels and encasing lower-permeability fine-grained rocks in the Colton Formation near Colton, Utah.

### ATTACHMENTS

#### Attachment 1

PHC Figure 1  
PHC Figure 2  
Table 1 Baseline Spring Field Data  
Baseline Water Quality Data for Springs 321, 322 and 323

#### Attachment 2

Palmer Hydrologic Drought Index, Region 6 and 7, 1991-2006  
Spring Flow Graphs for Dugout Canyon Mine Sites

#### Attachment 3

Palmer Hydrologic Drought Index, Region 6 and 7, 1991-2006  
Well Water Level Graphs for Dugout Canyon Mine

#### Attachment 4

Palmer Hydrologic Drought Index, Region 6 and 7, 1991-2006  
Surface Water Flow Graphs for Dugout Canyon Mine Sites

## 1.0 INTRODUCTION

This addition to the Dugout Canyon Mine (Dugout) PHC is being prepared in conjunction with expansion of the mine permit area to include approximately 240 additional acres to the northeastern portion of the permit area. This addition includes updates to the surface and ground water monitoring plan, updated flow and water quality information for selected monitoring sites, additional monitoring sites, and the probable hydrologic impacts of mining to the approximate 240 acres of added permit area. This addition to the PHC does not address all sections of the existing PHC, rather only those sections that either need updating with current information and are pertinent to the Dugout Mine or sections that include new data. While all sections of the existing PHC are listed in the text of this addition, the sections not changed are indicated by the text "No Changes Made".

## **2.0 ANALYSIS OF SURFACE AND GROUNDWATER SYSTEMS**

### **2.1 STUDY AREA**

Section 12 of T13S R12E and Sections 16, 17, 18, and 21 of T13S R13E have been added to the study area as a result of permit area expansion. Portions of the drainage areas that intersect these sections have also been added to the study area (PHC Update Figure 1). The addition to the study area includes portions of the headwaters of Pace and Dugout Canyons as well as a small portion of the headwaters of unnamed tributary (Section 17) to Cow Canyon, a tributary to Nine Mile Canyon. The expanded area lies almost exclusively within the exposed Tertiary-age Colton Formation.

### **2.2 METHODS OF INVESTIGATION**

Methods similar to the initial PHC investigation have been employed to determine possible hydrologic consequences due to proposed mining of the 240 acre expansion and in the updating of the existing Dugout Mine portion of the PHC. Also, measured flow and selected chemistry parameters have been reviewed for existing Dugout Mine monitoring sites to determine what, if any, impacts have occurred to surface and ground water resources. Baseline field data have been collected from surface and ground water sites in the expansion area and new monitoring sites have been selected to be added to the permit water monitoring schedule. Water quality samples have been obtained and analyzed for these selected sites.

### **2.3 DESCRIPTION OF DATA**

The 240 acre expansion sample locations are identified on Plate 7-1 and tables listing the measured field parameters are listed in PHC Update Table 1 and included in Attachment 1. Laboratory analysis results for the selected water monitoring sites in the expansion area are also included in Attachment 1. Graphs supporting the discussion regarding mining impacts to existing monitoring sites are included in Attachments 2, 3 and 4 of this document.

### **2.4 EXPLANATION OF CHEMICAL REPORTING UNITS AND TERMS**

No Changes Made

### **2.5 OVERVIEW OF MINE OPERATIONS**

#### **2.5.1 HISTORY OF MINE OWNERSHIP AND OPERATION**

In this PHC update, this section pertains to the operation of Dugout Canyon Mine. The Soldier Canyon Mine was idled in 1998 and has not been actively mined since that date. Future mine plans potentially include reopening the mine once the reserves at the Dugout Canyon Mine are depleted. Monitoring of the majority of the water monitoring sites associated with the Soldier Canyon Mine was

suspended in 2003.

As an update to the history of the mine ownership, a brief discussion of the ownership of the Solder Canyon and Dugout Mine properties is presented herein. Arco Coal purchased the Soldier Canyon and Dugout Mine properties from Coastal Corporation in 1996 and combined this property with the Sufco and Skyline mines to form Canyon Fuel Company, LLC. Itochu purchased from Arco a portion of Canyon Fuel Company, LLC. Arco sold its interest in Canyon Fuel Company, LLC to Arch Coal, LLC in 1998. Itochu sold its interest in the Canyon Fuel properties in 2004 to Arch Coal.

Dugout Canyon Mine was opened in 1998 when mining activities began in the Rock Canyon seam. Longwall mining moved from the Rock Canyon seam to the Gilson seam in February 2004 and has continued through 2007. It is anticipated mining will continue to occur in either the Rock Canyon or Gilson seams at this mine through at least 2013.

## **2.5.2 MINING TECHNIQUES AND LOCATIONS**

Since the Dugout Mine was opened, the primary method of coal extraction has been using longwall techniques supported by development mining using continuous mining equipment. Initial mining within the Rock Canyon seam began with typical two- or three-entry systems for the headgates and tailgates. However, difficulties in roof control and depth of cover forced the mine to develop longwall panels that were and currently are separated by thick coal barrier pillars. Most of the future panels will be separated by barrier pillars. Improved roof control has been obtained by using the barrier pillar technique and subsidence over those panels separated by the barriers is notably less than those panels lacking the barrier pillars.

### **2.5.2.1 Rock Dusting**

No Changes Made

### **2.5.2.2 Water management and discharge to Dugout and Pace Creeks**

Water is collected in the Dugout Mine from numerous roof drips, fractures and faults. The water is managed through a series of sumps that include flooded gob and abandoned workings. Discharge rates and total volumes have changed throughout the years since the mine opened in 1998. Overall, between 1998 and September 2007, the average discharge rate from the mine to Dugout Creek has increased from a few gallons per minute to a rate of about 1200 gpm, though recent (July 2007) discharge rates have occasionally been higher due to power failures and interception of additional ground water. Discharge to Pace Creek from the Pace Canyon Fan portals can also average as much as 700 gpm. Both discharge rates vary according to the volume of intercepted water, holding capacities within the sumps and gobs, and power availability.

Water discharged from the mine to both Dugout Creek and Pace Creek must be compliant with the limits of the mine's UPDES permit. The mine has a limit of one ton per day of Total Dissolved Solids (TDS) as part of its UPDES permit. Dugout frequently cannot meet this limit and has entered into

an agreement with the Utah Division of Water Quality to participate in a salinity reduction program within the Price River drainage. The agreement allows the mine to discharge additional tons of TDS provided the mine continues to participate in the salinity reduction program. The program was initiated in 2005 and will continue through at least 2013. Tons of TDS discharged from the mine has averaged between approximately one and nine tons per day.

#### **2.5.2.2 Methane Extraction**

Certain areas of the Dugout Mine contain methane gas. The gas is typically encountered at the mining face during both development and longwall mining. Methane gas is also released in the gob. To help reduce the volume of methane within the ventilation system of the mine, numerous methane drainage wells have been drilled and completed from the surface to above the coal seam in the developed longwall panels. The wells typically drain methane after the longwall has passed the well location. The methane drainage wells are operated until the methane concentration drops to a minimal level. The wells are then often shut in or abandoned.

Mining operations also have encountered hydrogen sulfide gases but not in the concentrations that methane gas has been encountered. Both the methane and hydrogen sulfide gasses appear to increase in volume as the depth of cover over the mined seam increases.

### **2.6 GEOLOGIC SETTING**

#### **2.6.1 GEOLOGY**

The geologic setting of the Dugout Canyon Mine is discussed in some detail in Chapter 6 of the M&RP. The original PHC briefly describes the geologic setting of the Soldier Canyon. Other than the description of the physical location of that mine, the general description can be applied to some extent to the Dugout Canyon Mine.

#### **2.6.2 BEDROCK FORMATIONS**

No Changes Made

#### **2.6.3 GEOLOGIC STRUCTURE**

Bedrock in the Dugout Canyon Mine generally dips to the north-northeast at an average of 8 degrees. Normal faults do occur in the mine area but typically have throws measured in feet and not tens of feet. Most faults encountered underground have little or no obvious surface expression. A few faults encountered underground have produced water from the floor and roof. Typically, the flow from the roof will diminish significantly over a short period of time while flow from the roof will also diminish but may persist for several months or even years.

Fractures are also encountered during the mining process and some can produce water similar to the faults. The majority of both the fault and fracture systems trend northwest to southeast. A few

fractures and faults trend east west in the Pace Canyon area.

#### **2.6.4 PHYSIOGRAPHY**

The description contained in the original PHC is adequate for the Dugout Canyon Mine. The same elements exist both at the Soldier Canyon and Dugout Canyon Mines.

### **2.7 HYDROLOGY**

#### **2.7.1 CLIMATE**

This section of the original PHC is adequate to describe the general climate of the Dugout Canyon Mine area.

#### **2.7.2 HYDROLOGY**

As described in the original PHC, Dugout Canyon Mine is located within the Price River Drainage. It currently operates within the Dugout Canyon, Pace Creek, Fish Creek, and Pine Creek drainages that are tributary to the Price River drainage. The 240 acre expansion will result in the mine operating within small portions of the unnamed tributary (Section 17) of Cow Canyon a tributary to Nine Mile Canyon. Both the Price River and Nine Mile drainages are tributary to the Green River.

The general description of the function and water chemistry of the ephemeral, intermittent, and perennial streams in this section of the original PHC is adequate to describe the conditions within the existing permit area. While the 240 acre expansion includes a small portion of the Cow Canyon drainage, the mining and related minor amounts of subsidence will not occur under or near perennial streams. The segments of drainages that will be undermined are ephemeral in nature. No significant surface disturbance that would impact the drainage are planned, except a pad for the drilling of a methane drainage well(s). Ground water samples have been obtained from a few springs within the drainage and are described in Section 2.8.2 of this addendum.

### **2.8 HYDROGEOLOGY**

No Changes Made

#### **2.8.1 CHEMICAL EVOLUTION OF GROUND WATERS**

No Changes Made

#### **2.8.2 DESCRIPTION OF GROUND WATER SYSTEMS**

This update to the PHC will concentrate on the physical characteristics of the spring locations and the flow volumes discharging from the springs associated with the Dugout Mine area. Since most of the monitored springs are currently located outside of the mining area, flow rates were chosen

to be the parameter that would most likely be impacted by mining activities. The general water chemistry of the monitored springs has not significantly changed since monitoring began.

### **Perched Groundwater Systems**

A general discussion of perched groundwater systems in the Colton, Flagstaff, North Horn, Price River, and the Castlegate Sandstone formations, follows.

The nature and occurrence of groundwater systems in the Wasatch Plateau and Book Cliffs coal fields are described in a Geological Society of America Bulletin publication (Mayo et al., 2003). The Dugout Canyon Mine permit and adjacent area is included in the study area for this publication. This publication describes active and inactive groundwater flow systems in stratified mountainous terrains. Mayo et al. describe groundwater systems in the Dugout Canyon Mine area as occurring in one of two fundamental groundwater flow regimes. These include "active" groundwater flow systems, and "inactive" groundwater flow systems. Active zone groundwater flow paths are continuous, and responsive to annual recharge and climatic variability. Active zone groundwater systems support springs discharging at the surface in the area. Inactive zone groundwater systems have extremely limited or no communication with annual recharge. Inactive zone groundwater systems may be partitioned, occur as discrete bodies, and may occur in hydraulically isolated regions that do not have hydraulic communication with each other (Mayo et al, 2003; See also Mayo and Morris, 2000).

In the vicinity of the Dugout Canyon Mine, discharge of groundwater from geologic formations overlying mining areas occurs primarily from localized perched groundwater systems (See Appendix 7-3 for further information on shallow groundwater systems). Perched groundwater systems in the near-surface bedrock formations overlying the Dugout Canyon Mine (including the region near the permit expansion area) were noted by Waddell et al. (1986). It is noteworthy that Waddell reports perched groundwater systems encountered in some drill holes, while perched groundwater systems were not encountered in some other nearby drill holes (See Figure 19 in Waddell et al., 1986). This condition demonstrates the lack of lateral continuity in the local perched groundwater systems present in the area and also highlights the fact that meaningful potentiometric surface maps cannot be constructed for these isolated perched groundwater systems.

The presence of local perched groundwater systems overlying unsaturated strata and the hydraulic disconnect between the shallow perched groundwaters and the deep Blackhawk Formation groundwater systems encountered during mining operations is fundamentally the result of the heterogeneity of the rock sequence in the region (Mayo et al, 2003). The flow of bedrock groundwater in quantities sufficient to support discharge to springs occurs primarily within permeable sandstone strata. Groundwater flow along fault planes, bedding planes, and through rocks with fracture-enhanced permeability also occurs locally. In the rock sequence overlying the Dugout Canyon Mine area, the permeable sandstone units commonly exist as discontinuous sandstone paleochannels. Annotated photographs showing sandstone fluvial channels in the Colton Formation near Colton, Utah are presented in Figures X and Y. Also shown on Figures X and Y are the fine-grained sediments with lower hydraulic conductivities that encase the more permeable

sandstone rocks in the fluvial channels. Because of the depositional environments in which these rocks were formed, the fluvial sandstone paleochannels are commonly encased both vertically and horizontally by low-permeability rocks (shales, mudstones, and claystones; Mayo et al., 2003). Although the permeability of individual sandstone bodies may be of aquifer quality, the overall ability of these rocks to transmit water horizontally over great distances is low because of the discontinuous nature of the sandstones (Mayo et al., 2003). The surrounding low-permeability rocks impede the outward migration of groundwater from permeable strata both vertically and horizontally. The abundant presence of low-permeability strata in the rock sequence, and the discontinuous character of permeable strata prevent the appreciable downward migration of groundwater from the perched systems into deeper horizons (or into the underground mine environment; Mayo et al., 2003). As indicated in Appendix 7-3 and based on drilling data (Appendix 6-1 and 7-4), large portions of the rock sequence overlying mining areas in the Dugout Canyon Mine area do not appear to be fully saturated in the vicinity of the Dugout Canyon Mine.

Unlike the Colton, Flagstaff, North Horn, and Price River formations, which consist largely of low-permeability rocks with interbedded sandstone strata, the Castlegate Sandstone is composed primarily of sandstone rocks. However, for several reasons, large aquifers do not form in the Castlegate Sandstone. The Castlegate Sandstone is not a uniform sand deposit. Rather, interbedded with the lenticular fluvial braided sandstone horizons are repeating sequences of mudstone drapes or depositional bounding surfaces (Mayo et al., 2003). The permeabilities of the mudstone drapes are typically many times lower than that of the surrounding sandstone. Consequently, although portions of the Castlegate Sandstone are sufficiently permeable to facilitate groundwater flow, the interbedded mudstone drapes partition and isolate these sandstone units such that the overall ability of the formation to transmit water both laterally and vertically over significant distances is poor (Mayo et al., 2003). Where Castlegate Sandstone discharge is present, it is most commonly associated with the presence of fracturing or jointing. Additionally, the potential for recharge to the Castlegate Sandstone is low. The pervasiveness of low-permeability strata in the geologic formations overlying the Castlegate prevents appreciable recharge to the formation from vertical leakage from the overlying formations. Additionally, because of the limited surface exposure of the Castlegate Sandstone in the area, the potential for groundwater recharge directly onto the Castlegate is low. As discussed above, the observation that the Castlegate Sandstone does not support many springs in the region and that much of the formation was dry when drilled supports these conclusions (See drilling data in Appendix 6-1 and Appendix 7-4). Because geologic and hydrogeologic conditions in the Castlegate Sandstone in the proposed expansion area are believed to be very similar to those in surrounding areas in the Book Cliffs coal field, it is considered probable that the hydrogeologic behavior of Castlegate Sandstone groundwater systems in the proposed expansion area will be consistent with the Castlegate Sandstone groundwater flow conditions described regionally by Mayo (2003).

It should be noted that although there appear to be large areas of unsaturated low-permeability rock surrounding the perched groundwater systems, saturated low-permeability strata are likely also present locally in the rock sequence. However, the rate of movement of water in the low permeability strata is commonly several orders of magnitude less than that in the permeable sandstone horizons (Mayo et al., 2003; Waddell, 1986). Consequently, groundwater in these

horizons likely exists mostly under relatively stagnant conditions and is not of much consequence to the hydrologic balance.

The shallow, perched groundwater systems in the Dugout Canyon Mine area are likely recharged where the up-dip ends of the sandstone beds or fractured bedrock strata are exposed at the land surface in wet areas, or where the beds are directly overlain by water-bearing alluvial or colluvial sediments. Recharge to the sandstones from overlying saturated shallow fractured bedrock may also occur. Recharge to the sandstone strata via direct vertical leakage from overlying, competent, low-permeability strata is probably low (Waddell, 1986).

Discharge rates from shallow, perched groundwater systems overlying mining areas in the Dugout Canyon Mine generally exhibit both seasonal and climatic variability (see Appendix 7-3 and flow information submitted to the Division's online hydrology database). Most springs discharging from perched systems respond rapidly to the annual snowmelt recharge event, followed by a rapid waning of discharge rates later in the year. These conditions are indicative of shallow groundwater systems that are in good hydraulic communication with shallow, active recharge sources (i.e., active zone groundwater systems). These conditions are not commonly observed in springs discharging from large aquifers with large storage volumes (Waddell, 1986).

Groundwater flow directions in the perched groundwater systems are constrained largely by the geometry of the permeable sandstone strata through which the groundwater is conveyed. In the general sense, it may be stated that perched groundwaters flow from up-dip recharge areas to topographically lower discharge areas. However, because the sinuous geometries and subsurface locations of individual three-dimensional sandstone paleochannels (or other fractured or permeable strata) are difficult to delineate in the subsurface, the determination of concise groundwater flow directions within these bodies is problematic.

Discharge from the perched groundwater systems commonly occurs where the down-dip ends of the permeable sandstones or bedrock fractures or bedding planes intersect the land surface (Waddell, 1986; Mayo et al., 2003). In some localities, the presence of bedrock fracturing or jointing within sandstone channels enhances the hydraulic conductivity locally. It is not uncommon for the spring discharge locations from perched groundwater systems to coincide with the occurrence of local bedrock fracturing (Mayo et al., 2003). Where fracturing of the bedrock is present at groundwater discharge locations, spring discharge locations are commonly focused into discrete spring locations rather than as diffuse seepage through porous rock.

#### Potentiometric Surface Maps

A fundamental assumption underlying the construction of a potentiometric surface contour map is that there is a continuously saturated, interconnected aquifer that is present over a substantial aerial extent. Because there are no identified aerially extensive groundwater regimes in the strata overlying coal mining areas in the Dugout Canyon Mine area (See Appendix 7-3), and the probable lack of connection between the individual small perched groundwater systems, it is not possible or scientifically correct to draw potentiometric surface contour maps for these groundwater systems

at a reasonable scale. While potentiometric surface contour maps of individual small, perched groundwater systems could conceivably be created at a local scale, it would be impractical and of limited value to do so. Consequently, potentiometric surface contour maps depicting groundwater conditions cannot be presented here.

#### Delineation of Likely Recharge Areas for Springs in the Expansion Area

While it is not possible to precisely delineate the recharge areas for individual springs using the existing hydrogeologic data, a determination of the most probable recharge area is possible using existing geologic, hydrogeologic, and topographic information. A discussion of the most probable recharge areas for springs in the expansion area is presented below.

Two springs (260 and 260A) have been identified within the boundaries of the expansion area that has the possibility of being impacted by subsidence. The Division of Water Rights (DWRi) has indicated two other springs are located in the eastern portion of Section 17, T 13 S R 13 E and within the permit expansion area. However, these springs were not found in the original seep and spring survey or subsequent surveys. Dugout has committed to take the water right owners to the DWRi mapped locations to verify whether or not these springs do indeed exist.

A few other springs, 261, 262, 262A, 263, 263A, have been identified in the nearby surrounding areas outside the permit area. These springs are outside the area where subsidence would potentially occur and are separated from the underlying coal seams by more than 2,000 feet of cover. Mining impacts to the recharge area of these springs will only occur in a very small portion of the recharge area and will likely be similar to spring 260. Because of this, the impacts to the springs outside the permit and subsidence area have not been considered individually. The potential for impacting these springs is considered negligible.

Spring 260 is part of the mine's water monitoring program and thus has several years of data that can be analyzed. Spring 260A is not part of the water monitoring program. Both springs appear to discharge from the same shallow groundwater system as they are in close proximity to one another and discharge at similar elevations. Therefore, it is assumed that mining induced impacts to these two springs would be similar in nature.

Spring 260 discharges from the east side of the canyon wall near the bottom of the local surface-water drainage. The spring discharges from the Colton Formation at an elevation of about 8600 feet above sea level. Because groundwater must recharge in an area topographically higher than the spring discharge location in order to provide driving hydraulic head, the recharge area for the spring must lie at an elevation greater than 8600 feet. As shown in Figure 2 and Plate 7-1, areas higher than 8600 feet in elevation that could potentially be recharge areas for spring 260 are present in the region to the southeast of the spring and also in the region to the northwest of the spring. Both of these areas are situated along the crest of the Book Cliffs escarpment and are truncated on both the north and south by incised drainages and escarpments.

Because of the considerable discharge from spring 260, which averaged 20.0 gpm between 2000

and 2007, it seems unlikely that sufficient recharge to support the spring could occur on the small surface area situated on the very steep slopes of the south-facing Book Cliffs escarpment above an elevation of 8600 feet immediately south of the spring area (Figure 2). Rather, it seems more likely that the relatively flat and broad high-elevation plateau surfaces above 8600 feet as depicted on Figure 2 and Plate 7-1 could provide recharge in sufficient quantities to support the observed discharge at the spring.

The sedimentary rocks in the vicinity of the Dugout Canyon Mine area dip at about 8 degrees to the north-northeast (Appendix 7-3). The strike of the rock formations in the area is approximately coincident with the trend of the Book Cliffs escarpment. Similarly, most minor fracture orientations in the coal seams and in the adjacent rock formations trend in roughly the same direction as the strike of the Book Cliffs escarpment (Appendix 7-3). Assuming a primarily northerly component to the bedrock dip in the area, the high-elevation area situated to the southeast of the spring seems more likely to be the recharge area for spring 260 than the high-elevation area to the northwest. This conclusion is based on the assumption that most of the northwest area would be stratigraphically down-dip of the spring area. The observation that spring 260 emanates from the east side of the canyon seems to support this conclusion. Consequently, the area to the southeast of spring 260 at an elevation above 8600 feet and stratigraphically up-dip of the spring location is considered the most likely recharge area for the spring (Figure 2). While the maximum lateral extent of the recharge area from the spring discharge location is not known, an arbitrary (and likely conservative) estimate of about 1.6 miles is delineated on Plate 7-1 and on Figure 2.

It is interesting to note that the maximum possible depth of circulation for the groundwater system that supports spring 260 is less than about 350 feet (maximum topographic elevation in the probable recharge area minus the spring discharge elevation). This observation supports the conclusion that spring 260 originates from a shallow, perched groundwater system and not from a large aquifer of regional extent.

It should be noted that although the spring discharges from the east side of the canyon, it is possible that the sandstone channel or fracture network that focuses discharge to the spring is continuous on both the east and west sides of the canyon near spring 260. Consequently, it is possible that the groundwater recharge area could also include portions of the high-elevation region to the northwest of the spring depicted on Figure 2, although this is considered a less likely scenario.

Spring 261 discharges from near the bottom of the canyon a short distance north of the expansion area boundary. As discussed above, the potential for impact to this spring is considered negligible and consequently a delineation of a most probable recharge area for this spring has not been performed. However, it is likely that this spring, as well as other similar nearby springs, recharge by mechanisms similar to that at spring 260. Like spring 260, the springs further north in the unnamed tributary of Cow Canyon (springs 261, 262 and 262A, Section 17) are likely not recharged from infiltration on the steep slopes of the north facing slopes of the Book Cliffs escarpment. Again, similar to spring 260, these springs probably receive recharge from broad upland areas to the east-southeast.

Surface runoff from the majority of the land surface in the expansion area drains to the Cow Canyon drainage. Discharges from the localized perched Colton Formation groundwater systems in the vicinity contribute baseflow discharge to streams in the expansion area and sustain discharges in portions of the drainage during the summer and fall months and during wet years. During the spring snowmelt event and in response to torrential precipitation events, streamflow in the drainages are augmented by surface runoff. After the spring runoff season is complete, there is typically not a sufficient contribution of groundwater to the surface water systems and many reaches of the stream drainages in the expansion area are dry. There is no discharge from a regional type aquifer system to the stream drainages in the expansion area. Consequently, because impacts to the localized perched Colton Formation groundwater systems are not anticipated, detrimental impacts to baseflow in the stream drainages are likewise not anticipated.

As shown on Plate 5-7 in Chapter 5 of the M&RP, the projected magnitude of subsidence in the area of the unnamed tributary to Cow Canyon Drainage in T13S, R13E, Section 17 is small (<1 foot). The thickness of the overburden above the coal seam to be mined in the vicinity of the drainage exceeds 2,000 feet. Because of the minimal projected subsidence and the thick overburden, the potential for large subsidence cracks to form at the surface is considered low. While subsidence cracking can occur along escarpment margins where confining pressures are low, the potential for large aperture subsidence cracks to form in the bottom of the stream channel is considered very low because of the confining pressures of the surrounding rock strata. Consequently, the potential for diminution of stream flow in the unnamed tributary of Cow Canyon due to direct interception of stream water into open subsidence cracks in the channel bottom is considered low.

Additionally, based on "rule-of-thumb" estimates for the height of upward propagation of fracturing above longwall mined areas commonly utilized in Utah coal mining areas, it is likely that a thick sequence of unfractured rock strata will persist above longwall mined areas after subsidence in the area is complete. As a conservative estimate, assuming a mining height of 10 feet and a 50:1 upward fracture propagation height to mining height ratio, it is estimated using these assumptions that the fractures overlying longwall mined areas would extend upward about 500 feet. Above this interval, rock strata (particularly the fine-grained shaley strata) tend to deform ductily (i.e., the rocks tend to bend rather than fracture). Based on visual inspection, it is commonly assumed that surface tension cracks that sometimes form at the land surface overlying longwall panels extend for only a few tens of feet below the land surface. Thus, it is estimated that there would likely be many hundreds of feet of in-tact rock strata overlying longwall mined areas with relatively uncompromised hydraulic properties which would minimize the potential for downward migration of fluids. Consequently, the potential for the loss of stream water in the unnamed tributary to the Cow Canyon drainage to deep strata or into the mine workings is considered remote.

As described above, the potential for significantly diminished discharge rates from the perched groundwater systems that support springs and provide baseflow to the unnamed Cow Canyon tributary in the proposed expansion area as a result of coal mining in the Dugout Canyon Mine is considered low. This is primarily because of the large thickness of overburden and the small projected subsidence magnitude in the area. Additionally, the abundant presence of low-permeability strata in the geologic sequence of the overburden minimizes the potential for

downward migration of surface-waters or groundwaters into deeper horizons. Accordingly, the potential for impacts to baseflow in the unnamed Cow Canyon tributary as a result of mining activities is considered low.

### **2.8.2.1 Colton Ground Water System**

The Colton Formation forms the plateau within the expansion area and contains the additional springs to be monitored as part of the expansion. The original text discusses two springs that have been evaluated in the Soldier Canyon area, G96 and #45. Two springs have been included in the Dugout Canyon Mine water monitoring plan and are designated as Springs SC-65 and 260. Figures contained in Attachment 2 illustrate the history of the flow monitored at springs SC-65 and 260. Spring SC-65 has been monitored since October 1995 while Spring 260 has been monitored since June 2000. Both springs and their recharge areas are located north and outside the areas that have been undermined and subsided by Dugout Mine. Both springs demonstrate seasonal flows. The variability of the flow from SC-65 appears to follow the pattern of drought and wet cycles as illustrated on the Palmer Hydrologic Drought Index figure included in Attachment 2. Flow from Spring 260 somewhat follows the cycle of drought and wet but not quite as clearly as SC-65.

Two new Colton springs have been added to the water monitoring plan for Dugout Mine. These two springs are 321 and 322. Spring 321 is located in the NE1/4 of Section 18 T13S R13E and Spring 322 is located in the NW1/4 of Section 22 T13S R13E. Both springs are located outside the area that is planned to be mined and subsided. Flows from these two springs were first gathered in May 2007 followed by measurements obtained in June, July, August, and October. Graphs of these flows are contained in Attachment 2. Measured flows appear to drop from a high following spring runoff to baseline conditions by August. During the third quarter 2008 a spring (324) was added to the mine's monitoring program, following a site visit to the spring with Gil Conover, the spring has a water right issued to the Conover Trust.

### **2.8.2.2 Flagstaff Ground Water Systems**

The Flagstaff Formation is present in the Dugout Canyon area and in the 600 acre expansion. However, the formation thins to the east and eventually pinches out near the eastern portion of the mine permit area. Currently, the mine monitors two springs in the Flagstaff Formation, SC-100 and SP-20. Spring SP-20 was monitored briefly between June 1976 and October 1979. Monitoring of the spring was resumed in August 1997 and has continued through the present (October 2007). Spring SC-100 has been monitored since 1995 and continues to the present.

The graph of measured flow for SP-20 clearly demonstrates seasonal flows that are impacted significantly by drought and wet cycles. This spring is located outside the area that has been undermined by Dugout Mine. The recharge area for this spring is also likely to be outside the area affected by current Dugout mining operations.

Spring SC-100 is located upstream of the mine operations in the Dugout Creek drainage. It issues from the side of a stream bank near the bottom of the channel. According to water monitoring

personnel, flows monitored between 1997 and 2002 may have included portions of the adjacent creek. Changes in the stream channel and spring discharge have allowed the flow of the spring to be monitored separately from the stream flow. The spring is located at least three fourths of a mile north of the current mine workings and is unlikely to have been impacted by mining operations.

No new monitoring sites are proposed for the Flagstaff Formation as part of the 240 acre expansion.

### **2.8.2.3 North Horn Ground Water Systems**

Dugout Mine currently monitors five springs discharging from the North Horn ground water system. These springs are SC-14, SC-116, SC-200, SC-203, 259, and spring 259A. Graphs illustrating the flow of the springs are located in Attachment 2. SC-14 was monitored briefly between 1976 and 1979. Dugout mine started monitoring the flows again in 1995 and the monitoring has continued through at least October 2007. Flows from the spring appear to be influenced by seasonal and climatic variations in precipitation. This spring is located north and west of the current Dugout Mine workings and flow data obtained from this spring does not indicate impacts due to mining.

Spring SC-116 flow was first monitored at this site in October 1995 with regular monitoring initiated in November 1998. This spring is located in a tributary to Pace Creek and overlies a longwall panel Dugout Mine is likely to mine in 2008-2009. Historical flows indicate ground water discharge volume from the spring is related to cycles of drought and wet. Between June 2001 and November 2004, flow volumes were less than 2 gpm. Through the wetter cycle of 2005, flows increased. Then in the drier period of 2006, the flows once again diminished.

Spring SC-200 is located in a tributary to Rock Creek and is located southeast of current mine workings. This spring typically has no flow or flows less than 1 gpm. The recharge area for this spring is likely located south and east of the current mine plan and is unlikely to be impacted by planned future mining. Lack of flow at this site makes it difficult to determine how it is impacted by changes in climatic cycles. This site is important, however, since it appears to be the only accessible and reliable source of ground water discharge in this drainage.

Spring SC-203 is located in Pace Canyon and is east and outside of current and future mine workings. It is a developed spring that is used to water cattle. The flow graph of the spring illustrates flows typically between 2.5 and 5 gpm with occasional flows slightly less or greater. Flow was measured in the spring of 2003 at more than 20 gpm but that rate appears to be anomalous to other recorded flows. Spring flows do not appear to typically be impacted by climatic changes.

Spring 259 is associated with a slump in a side drainage of Pace Canyon. In 2002, the monitored discharge location moved as a result of renewed slumping. Monitoring of the original discharge point was continued even though groundwater no longer discharged from this location. The ground water currently discharges from a point a few hundred feet downstream of the original monitoring point. The slump was probably reactivated as a result of saturation from natural causes. Ground water continues to flow from the as reported through field observations noted by personnel monitoring the original site. A new monitoring point, 259A, was added to the monitoring program in

July of 2007. This spring has been developed by the landowner for livestock watering and is located upstream of 259 and outside the slump area. Previous measurements of the discharge rates obtained in 2006 indicate the flow in early spring was about 1 gpm. The spring flows decrease by fall to approximately 0.25 gpm. In the 2007, the spring flows gradually decreased through the summer and by September, the flow essentially ceased. This spring and its recharge area have not been subsided to date. However, the area may be subsided in 2008.

#### **2.8.2.4 Price River Ground Water System**

The text of the original PHC includes the Castlegate Sandstone within the Price River Formation. For purposes of this text, the Castlegate Sandstone will continue to be included as part of the Price River Formation.

During early baseline studies of the Dugout Mine area two springs were reported to discharge from the Price River Formation, springs SC-80 and 227. Spring SC-80 was initially intended to be included in the mine ground water monitoring plan. However, subsequent visits to the site resulted in no spring being found. Therefore, the site was not added to the plan. Spring 227 has been monitored since 2000 but no flow has yet to be observed discharging at this location. The lack of flow is not surprising based on the data and observations presented in the original PHC.

#### **2.8.2.5 Blackhawk Ground Water Systems**

##### **2.8.2.5.1 Springs**

No Changes Made

##### **2.8.2.5.2 Blackhawk Formation Wells**

The format of the original PHC included most of the ground water wells in the Soldier Canyon Mine and Dugout Mine area within this section. However, several of the wells are completed in formations other than the Blackhawk. Two ground water wells in the immediate area of the mine are included in the Dugout Mine water monitoring plan. These two wells, GW-10-2 and GW-11-2, are located north and down dip of the current Dugout Mine workings.

The water level in GW-10-2, which is completed in the Castlegate Sandstone, has been monitored since June of 1987 as reported in the original PHC. Depth to water was initially 716.0 feet. Water level data presented in the original PHC indicate the level in the well more or less was dropping between June 1987 and May 1995. The last reading obtained in 1985 indicated a water level 726.5 feet below top of casing. Dugout Mine began reporting water levels in March 1998 when the water level was measured at 732.0 feet below top of casing. Data collected by the mine indicates the water level has continued its general decline to a low of 745.0 feet below top of casing in May 2007 (See graph in Attachment 3).

As discussed in the original PHC, the cause for the decline in water level is unknown. The relatively

steady rate of decline of the water level in the well does not appear to be relatable to the timing of underground mining and subsidence at the Dugout Canyon Mine. The rate of decline before mining appears to have continued after mining at Dugout commenced.

The water level in GW-11-2, a well completed in the Price River Formation, has been measured by Dugout Mine since August 1997. An earlier measurement, November 4, 1982, presented in the original PHC indicates the water level in the well to be 1127.39 feet below the top of casing. Dugout Mine's first reported water level on August 27, 1997 indicates the water level was 1120.90 feet below top of casing. By June 30, 1998 the water level had dropped to 1128.5 feet below top of casing. It remained within a few feet of that level until June 15, 2006 when the water level was measured at 1116.17 feet below top of casing. The cause of the fluctuations in the water level of about 12 feet is unknown.

#### Soldier Canyon Mine

The Soldier Canyon Mine was idled in 1998. The portals were temporarily backfilled with soil and mine water discharge ceased. No water has discharged from the mine since the portals were sealed.

#### Dugout Canyon Mine

Water is collected in the Dugout Mine from numerous roof drips, fractures and faults. Currently, the highest volume of water entering the mine appears to discharge from intercepted fractures and faults with minor offset. The majority of the water discharging to the mine from the fractures and faults flows up through the floor. Overall rates of inflow of ground water to the mine also increase, independently of the fracture flow, as longwall panels are mined. Often longwall mining will intercept isolated aquifers above the roof of the mine that discharge water at a few tens to a few hundred gallons per minute after the coal has been removed. The flows associated with these isolated aquifers typically are short lived and either cease flowing altogether or significantly diminish in rate. Inflows from faults or fractures also diminish over time but at a much slower rate.

The ground water entering the mine is managed through a series of sumps that include flooded gob and abandoned workings. Discharge rates have changed throughout the years since the mine opened in 1998. From 1998, all of the water discharged from the mine was directed into Dugout Creek. Overall, between 1998 and September 2007, the average discharge rate from the mine to Dugout Creek has increased from a few gpm to over 1200 gpm. Beginning in July of 2007, a portion of the mine water has been discharged to Pace Creek through the Pace Canyon Portals. Discharge to Pace Creek from the Pace Canyon Fan portals can also average 700 gpm or more. Both discharge rates vary according to the volume of intercepted water, holding capacities within the sumps and gobs, and power availability.

It is important to note that before the construction of the Dugout Canyon Mine, two abandoned mine workings within the Gilson Seam were flooded to near the mouth of their old portals. In fact, the old Gilson workings on the east side of the canyon actually discharged water at the surface at a few

gallons per minute to Dugout Creek. These workings were eventually drained by the mine for use as a sump. The flooded old Gilson seam workings on the west side of the canyon has also been used as a sump by the Dugout Canyon Mine.

#### **2.8.2.6 Star Point Sandstone Ground Water System**

As was observed and reported in the original PHC, no springs had been found discharging from the Star Point Sandstone in the Soldier Canyon and Dugout Canyon Mine areas. However, subsequent field studies found one spring, SC-64, that may be related to the Star Point Sandstone. This spring, however, is not part of the monitoring plan. Two samples were obtained from the site and field parameters were measured. The samples indicate the water has a slightly alkaline pH (7.5) and relatively high specific conductance (1011 -1112 mmho)

#### **2.8.2.7 Mancos Shale Ground Water System**

No Mancos Shale ground water discharge has been observed in the Dugout Mine permit area. As noted in the original PHC, typical TDS concentrations of water associated with the Mancos Shale are about 10,000 mg/L. Water this brackish has not been found within the mine therefore suggesting water sources discharging to the mine are unlikely to include the Mancos Shale.

### 3.0 PROBABLE HYDROLOGIC CONSEQUENCES

This section contains a description of the probable hydrologic consequences of operating the Dugout Canyon since 1997 and the additional 240 acres to be added to the mine area in 2008. The consequences are based on the observations and conclusions of the original PHC, observed reactions of surface and ground water to mining at Dugout Canyon Mine since 1997, and projected future potential impacts to these water systems due to mining.

#### 3.1 POTENTIAL ADVERSE IMPACTS TO THE HYDROLOGIC BALANCE (728.310)

Coal mining has the potential to impact the hydrologic balance by:

1. Decreasing creek flows and spring discharges by capturing surface or other ground waters,
2. Increasing creek flows and spring discharges by increasing discharge rate of ground water from the Blackhawk ground water system, and
3. increasing ground water recharge rates to overlying ground water systems.

##### 3.1.1 Potential for Decreasing Creek Flows and Spring Discharges

Coal mining has the potential to decrease creek flows and spring discharges by capturing water from these sources as a result of mine related subsidence, bedrock fracturing, and aquifer dewatering.

##### Decreasing Creek Flows

Generally, since subsidence began at the Dugout Canyon Mine, surface tension cracks have been noted in limited locations, typically on canyon rims that have been undermined. On the surface of the plateau overlying the mine and at the base of the drainages that bifurcate the plateau, cracks have been noted in the soils and alluvium covering bedrock. However, these cracks soon naturally heal and are no longer obvious. Surface runoff continuously entering subsidence cracks has not been observed in this area. Graphs illustrating the monitored flow volumes of the surface drainages in the Dugout Creek Mine area are included in Attachment 4.

Four surface water monitoring points have been established to record, on a quarterly basis, the flows in the Dugout, Pace, and Rock Canyon Creeks. DC-1 is located in the main stem of Dugout Creek below the mine site. DC-2 is located in the Left Fork just upstream of the mine site. DC-3 is located in the Right Fork just upstream of the mine site. Additionally, DC-4 and DC-5 have been established in the Left Fork of Dugout Creek and are monitored on a five year basis at permit renewal. Site PC-1A is located on Pace Creek upstream of currently planned mining activity and at the eastern permit boundary. PC-2 is located on Pace Creek downstream of planned mining activities and near the permit boundary. PC-3 is located in Pace Creek just downstream of the confluence of Pace Creek and an unnamed tributary in the south half of Section 20, Township 13 South, Range 13 East. This site was established in September 2007. RC-1 is located on Rock

Creek downstream of any planned mining activities and near the southeastern boundary of the permit area (Plate 7.1 of the MRP).

The monitored flows within the Dugout Creek drainage system will be discussed first followed by Pace Creek and then Rock Canyon Creek flows. Dugout Canyon Mine has subsided minor portions of the Right Fork of Dugout Creek with single seam mining in the Gilson seam. As stated earlier, DC-3 was established to monitor flows in the Right Fork. A graph of the monitored flows at DC-3 between August 1997 and May 2007 is included in Attachment 4. The peaks that occur in 1998 and 2001 appear to be flows measured during spring runoff. A short segment of the Right Fork of Dugout Creek was subsided when coal was extracted from the Gil 2 panel in April 2005. Flows in the stream appear to be impacted more from natural wet and drought cycles than by mining subsidence. No extra ordinary decreases in flow in the Right Fork were noted after mining and subsidence occurred.

The Left Fork of Dugout Creek has not been subsided. Flows measured at DC-2 appear to follow the drought-wet cycles noted in the Palmer Hydrologic Drought Index for this area.

The graph of Dugout Creek at site DC-1, which is located downstream of the mine, also does not show an abrupt change in flow volume at the time of subsidence in the Right Fork. However, it is important to note, the flow volume of Dugout Creek downstream of the mine is impacted by discharge from the mine to the creek at a point upstream of DC-1. Discharge from the mine began in March 2002.

Flows in Pace Creek have monitored on a quarterly basis at PC-1A and PC-2 since September 1999 and June 2000, respectively. Flow data was also collected at PC-2 from April 1978 to October 1979. Mining has not occurred upstream of PC-1A and no flow impacts from mining subsidence are anticipated. Flow measured at PC-2 also does not appear to have decreased as a result of mining and subsidence in the area. Mining and subsidence did not occur in the area upstream of this monitoring point until May 2005. Flows in Pace Creek at PC-2 currently appear to be controlled by the cycles of wet and drought. PC-3 was established at the time of the writing of this update and data will be collected at this site beginning in 1st quarter of 2007.

The flows in Rock Canyon Creek are monitored at site RC-1. The graph of the flows at site RC-1 illustrates the creek seldom contains water at this point. In fact, flows are typically seen in the creek bed at this site during significant snow melt runoff or after heavy precipitation events. No portions of the creek are currently planned to be subsided.

Surface runoff from the majority of the land surface in the expansion area drains to the Cow Canyon drainage. Discharges from the localized perched Colton Formation groundwater systems in the vicinity contribute baseflow discharge to streams in the expansion area and sustain discharges in portions of the drainage during the summer and fall months and during wet years. During the spring snowmelt event and in response to torrential precipitation events, streamflow in the drainages are augmented by surface runoff. After the spring runoff season is complete, there is typically not a sufficient contribution of groundwater to the surface water systems and many reaches of the stream

drainages in the expansion area are dry. There is no discharge from a regional type aquifer system to the stream drainages in the expansion area. Consequently, because impacts to the localized perched Colton Formation groundwater systems are not anticipated, detrimental impacts to baseflow in the stream drainages are likewise not anticipated.

As shown on Plate 5-7 in Chapter 5 of the M&RP, the projected magnitude of subsidence in the area of the unnamed tributary to Cow Canyon Drainage in T13S, R13E, Section 17 is small (<1 foot). The thickness of the overburden above the coal seam to be mined in the vicinity of the drainage exceeds 2,000 feet. Because of the minimal projected subsidence and the thick overburden, the potential for large subsidence cracks to form at the surface is considered low. While subsidence cracking can occur along escarpment margins where confining pressures are low, the potential for large aperture subsidence cracks to form in the bottom of the stream channel is considered very low because of the confining pressures of the surrounding rock strata. Consequently, the potential for diminution of stream flow in the unnamed tributary of Cow Canyon due to direct interception of stream water into open subsidence cracks in the channel bottom is considered low.

Additionally, based on "rule-of-thumb" estimates for the height of upward propagation of fracturing above longwall mined areas commonly utilized in Utah coal mining areas, it is likely that a thick sequence of unfractured rock strata will persist above longwall mined areas after subsidence in the area is complete. As a conservative estimate, assuming a mining height of 10 feet and a 50:1 upward fracture propagation height to mining height ratio, it is estimated using these assumptions that the fractures overlying longwall mined areas would extend upward about 500 feet. Above this interval, rock strata (particularly the fine-grained shaley strata) tend to deform ductily (i.e., the rocks tend to bend rather than fracture). Based on visual inspection, it is commonly assumed that surface tension cracks that sometimes form at the land surface overlying longwall panels extend for only a few tens of feet below the land surface. Thus, it is estimated that there would likely be many hundreds of feet of in-tact rock strata overlying longwall mined areas with relatively uncompromised hydraulic properties which would minimize the potential for downward migration of fluids. Consequently, the potential for the loss of stream water in the unnamed tributary to the Cow Canyon drainage to deep strata or into the mine workings is considered remote.

As described above, the potential for significantly diminished discharge rates from the perched groundwater systems that support springs and provide baseflow to the unnamed Cow Canyon tributary in the proposed expansion area as a result of coal mining in the Dugout Canyon Mine is considered low. This is primarily because of the large thickness of overburden and the small projected subsidence magnitude in the area. Additionally, the abundant presence of low-permeability strata in the geologic sequence of the overburden minimizes the potential for downward migration of surface-waters or groundwaters into deeper horizons. Accordingly, the potential for impacts to baseflow in the unnamed Cow Canyon tributary as a result of mining activities is considered low.

As described in the original PHC, the water intercepted underground during mining is likely moving north toward the Uinta Basin and eventually toward the Green River. The mine is currently removing only a small portion of the ground water contained in the overall regional system that would

discharge to the Green River. Once mining is complete, it is likely the mine workings will flood to an elevation at or slightly below the mine portals, similar to the flooding of the old Gilson workings located in Dugout Canyon. Ground water in the Dugout Mine area will continue to migrate north and down dip toward the Uinta Basin.

#### Decreasing Spring Flows

As described in preceding sections of this PHC Update, flows in monitored springs do not appear to have been measurably decreased by mining activities. Two spring monitoring sites have recorded changes in flows: spring SC-100 as erosion has moved the stream channel away from the ground water discharge point allowing more accurate flow measurements and spring SC-259 as a result of reactivated movement of the slump from which it discharges. Neither of these two springs have been subsided nor has their likely recharge areas. Spring 227 was undermined in April 2007 but flow records of this spring indicate it is typically dry.

Mining will include subsiding springs in the Pace Canyon, Dugout Canyon, and Cow Canyon drainages (Plate 7.1 of the PHC). The majority of these springs are located in the same drainages as monitored springs. The potential exists that flow from these springs may be decreased for a short period of time or their discharge points moved. The springs generally discharge from the North Horn, Flagstaff or Colton Formation. The depth of cover between the spring discharge locations and their recharge area and the mine workings themselves exceed at least 1000 feet. While subsidence fracturing associated with mining at these depths does occur at the surface, it typically has not resulted in creating pathways from the surface to the mine workings. Typically, surface cracks only extend a few tens of feet into the bedrock before attenuating. Below that depth, the bedrock will typically react more plastically and bend, rather than break, as the ground over the mine longwall panels subside. The North Horn, Flagstaff, and Colton Formations contain significant beds of fine grained material, such as shale, siltstone, and claystone that will tend to heal if fractured. This healing process would likely stop or restrict rapid downward migration of water either from the surface or from aquifers.

Subsidence of a portion of the aquifers that feed these springs may cause recharge to temporarily "pool" in the subsided portion, thus temporarily decreasing discharge. Surface cracking of the aquifer may also result in the discharge point of the spring moving either laterally or vertically downward a few feet. While this phenomenon has not been noted in this area, it has been observed at other mine sites within the Book Cliffs area and the Wasatch Plateau. However, it is not anticipated there will be a loss of water to the Pace Canyon drainage system.

Springs within the Dugout Canyon drainage that may be undermined discharge from either the North Horn or Flagstaff Formations. As with the springs located in the Pace Canyon drainage, decreased flow or changes in discharge locations are possible. However as discussed in the preceding paragraphs, permanent decreases in flow volumes are unlikely and over all discharge of ground water volumes in the drainage are unlikely.

Several springs discharge from the Colton Formation north and east of the current permit area and

the 240 acre expansion area within the Cow Canyon drainage. Spring 260 is currently part of the Dugout Canyon Mine water monitoring program. The monitored flows are included in graphic form in Attachment 2 of this document. Discharges of this flow show a strong relationship to seasonal variations in precipitation. The springs in the Cow Canyon drainages appear to be stratigraphically controlled. That is, they appear to discharge at the down dip end of an exposed stratigraphic unit within the Colton Formation. Because the Colton Formation contains interbedded sandstones, siltstones, and shales, it is likely these springs discharge at the base of a sandstone overlying a less permeable unit such as shale or siltstone. This observation is generally supported by the topography of the spring areas. The springs appear to discharge at a break in topography where there is change from a relatively steep slope to a more gentle slope. There is also a potential for some of the springs to be both stratigraphically and structurally controlled. In other words, the springs discharge from a fracture within a permeable layer overlying a less permeable layer. Unfortunately, the thick soil mantle in the area precludes observation of structure near the discharge location.

Mining in the northeastern most portion of the permit area and within the 240 acre expansion area could decrease flows at or alter the discharge location for spring 260 and 260A. It appears the recharge area for these springs is to the south/southeast and overlies a small portion of one panel. However, interruption of spring flow volume would likely be short-lived. Where Dugout Mine has designed longwall panels separated by thick barrier pillars, surface expressions of subsidence have been much less than where barrier pillars are not left in place. Projected surface subsidence at the spring locations is likely to be less than one foot. The recharge area is more than 2000 feet above the projected mine workings. Any interruption of flow would likely be temporary as the subsidence created low areas within the aquifer itself filled with recharge. Because of the fine-grained nature of the bedrock units, diversion of water from the aquifer into underlying bedrock units is unlikely. If the spring discharges are also structurally controlled, new surface fractures related to subsidence may move the springs a few tens of feet either laterally or vertically. Overall, continued flow from the springs will continue to enter the Cow Canyon drainage.

Two new springs will be added to the Dugout water monitoring plan, 321 and 322 (Plate 7.1 of the MRP). Spring 321 is located north east of 260 in a small tributary to Cow Canyon. Spring 322 is located southeast of 260 and 321 in a tributary drainage of Cow Canyon. Tributary containing 322 runs roughly parallel to the tributary that contains 260 and 321. Some development work has been performed at spring 321. Both springs are outside of the area to be subsided. Since all of the springs, with the exception of 260 and 260A, within the Cow Canyon drainage lie outside of the area to be mined and subsided, and the limited portions of the recharge area for the majority of the springs will be subsided, it seems unlikely a decrease in ground water discharge will occur. Also, it is unlikely discharge points will move for these springs as a result of mining.

### **3.1.2 Potential for Increasing Creek Flows and Spring Discharges**

#### Increasing Creek Flows

Dugout Canyon Mine discharges mine water to both Dugout Creek and Pace Creek at permitted

UPDES discharge points. Increases in stream flows are likely to be limited to Dugout Creek and Pace Creek, the mine has no other discharge points planned at this time. In the original PHC, Mayo and Associates estimated the maximum ground water discharge rate from Dugout Canyon Mine would be approximately 800 gpm. That estimate was based on the assumption that Dugout Canyon Mine would produce about 1.0 million tons of coal per year. However, the mine has produced and currently is planned to produce between three and four million tons per year. That is three to four times the initial rate of production described in the original PHC.

In the summer of 2007, the Dugout Canyon Mine has discharged at a rate between 1900 and 2800 gpm through its UPDES discharge points. The rate at which the mine discharges water is based upon the volume of water intercepted, water contained in the sumps and old workings, and the reliability of electrical power delivered to the mine. Early in the mining of the Rock Canyon and Gilson seams, ground water generally discharged from perched aquifers encountered in the Blackhawk Formation. As mining has progressed down dip, water discharging from fractures encountered in the mine floor, and to a lesser degree the mine roof, have become more prominent. It is estimated that more than half the total inflow to the mine is currently associated with flows moving through fractures or faults.

For the next several years as mining progresses north and down dip in the coal seams and deeper into the potentiometric surface of the underlying aquifers that discharge through the floor of the mine, inflow rates are likely to increase. However, as mining is then shifted to the southeast portion of the permit area (between Pace and Rock Canyons) and up dip in the coal seams, inflow rates from sources below the mine will likely be much less. Inflows to the mine at that time will be more likely dominated by inflows from isolated perched aquifers in the overlying Blackhawk Formation.

#### Increasing Spring Flows

Temporary increases of spring flows may be noted as the aquifers are compressed during subsidence. This is typically a transient phenomenon that ceases once the compressive and tensional forces within the subsided bedrock become static. In a few cases, spring flows may experience more long term increases if fracturing in the aquifer allows additional stored ground water to discharge at the spring location.

### **3.1.3 Potential for Increasing the Ground Water Recharge to Overlying Ground Water Systems**

No Changes Made

### **3.2 IMPACTS OF PROPOSED COAL MINING AND RECLAMATION OPERATION (728.330)**

#### **3.2.1 Whether Acid-forming or Toxic Forming Materials Are Present that Could Result in the Contamination of Surface or Ground Water Supplies (728.331)**

The original PHC did not anticipate the construction, operation, reclamation of the Dugout Wasterock Site. However, subsequent revisions to the permit addressed the probable hydrologic consequences of creating the wasterock site. This issue is addressed in the document attached to the MRP titled "Refuse Pile Amendment, February 2003".

The remainder of this section has not been changed.

#### **3.2.2 Impact on Acidity, Total Suspended and Dissolved Solids and Other Important Water Quality Parameters of Local Impact (728.332)**

Mining in the Dugout Mine area should not affect the water quality of adjacent ground waters or springs since the ground water system in the mine layers is locally compartmentalized both vertically and horizontally.

Total Suspended Solids (TSS) above background concentration may increase in areas where road building or facilities construction may occur. Additionally, where subsidence occurs, down cutting may result and increase sediment load in the stream flow. It is also likely that subsidence will result in low areas where deposition of sediments will occur. TSS measured in the mine water discharge is typically at or near background levels.

Water discharged from the mine to Dugout Creek, and recently to Pace Creek, has contained total dissolved solid (TDS) concentrations ranging between 830 and 2440 mg/L. The concentration of TDS in the mine water is dependant upon the quality of the ground water encountered and residence time within the sumps and abandoned. It is apparent that the longer water is held underground in sumps and old workings, the higher the TDS values rise. Therefore, the mine has tried to balance the need for storage time to allow for the settlement of suspended solids while limiting the amount of time water stays in contact with the coal and overburden in the gob or abandoned flooded workings. Total iron concentrations in the water can either increase or decrease with the amount of oxygenation the mine water is subjected to or contact time the water has with exposed coal.

Initially in 2002 when mine water discharge began, Dugout mine discharged water with TDS concentrations between 1300 and 1500 mg/l at rates between 40 and 250 gpm with occasional higher spikes. Over time, the TDS concentration increased until the end of 2006. Since that time, discharge rates have nearly tripled but the TDS concentration has dropped to less than 1000 mg/l. The drop in TDS concentration is related in part to an increase in mine inflows and a reduction in residence time of the water.

The TDS level of the water discharged from the mine is currently about twice what the concentration

in Dugout Creek was prior to mine water being discharged. However, it is important to note, prior to mine discharge, it was not uncommon for the creek to quit flowing within a few miles downstream of the mine location by mid to late summer. The water that was available was diverted a few miles downstream of the mine site east into the Pace Canyon drainage and used to grow alfalfa crops. The remaining water left the cultivated fields and flowed downstream across the Mancos Shale before eventually discharging to Grassy Trail Creek and then to the Price River. TDS concentrations in the stream, as it flowed downstream, continued to increase. Dugout Creek did not and currently does not contain a known fishery. Water in the stream is still used for cultivation of alfalfa. Wildlife and cattle also use the stream as a source of drinking water. The current TDS concentration of the water discharged from the mine is within the range established by the Utah Division of Water Quality for use by livestock.

Dugout Mine began discharging water to Pace Creek in the area of the mine's Pace Canyon Fan Portal. This water has been similar in quality to the mine water discharged at Dugout Creek. The water, when discharged from the mine, enters Pace Creek and eventually is diverted to water the same alfalfa fields as Dugout Creek waters. At this time, it is unknown if the mine will increase, decrease, or maintain the current discharge rates at the two locations.

To mitigate discharging into Dugout and Pace Creeks increased TDS volumes greater than one ton per day allowed by its UPDES permit, tributaries to the Colorado River System, the mine has participated in a salinity reduction program. To allow the mine to participate in the program, a cost per removal of a ton of TDS from the Price River Basin was determined by the appropriate State and Federal agencies. The mine determined the total projected life of the mine, the average tons of TDS per month over that period, and multiplied the total tons by the cost per ton of removal. That amount was then paid in three equal annual installments to the Utah Division of Water Quality. The money was then made available to pay for projects that would remove tons of TDS from the Price River equivalent to the tons of TDS the mine discharged in excess of one ton per day. To the best of the mine's knowledge, this program overall has been successful in reducing the TDS concentration in the upper Colorado River Basin.

Total iron concentrations with the mine discharge waters have on occasion been measured at levels higher than background numbers obtained from Dugout and Pace Creek. However, under normal operating conditions total iron concentrations in the mine water is less than 1 mg/l, the UPDES limit for the mine water discharge.

### **3.2.3 Impact on Ground Water and Surface Water Availability (728.334)**

As described in Sections 3.1 and 3.2, it is anticipated that continued mining in the Dugout Canyon Mine and the 240 acre expansion will not affect the availability of ground water. However, mining will increase the baseflow of both Dugout Creek and Pace Creek. There should be no sustained increase of the surface water flows in Cow Canyon.

#### **4.0 CONCLUSIONS**

No significant changes are proposed for this section since the basic conclusions reached in the original PHC, only an addition of text. Monitoring of springs and surface waters in the Dugout Canyon Mine area since 1998 has indicated there is no hydraulic connection between the mine and surface waters. Also, except for increasing the baseflow in Dugout and Pace Creeks, the effects of coal mining in the Dugout Canyon Mine within the Blackhawk Formation on overlying springs and surface water is and should continue to be negligible.

## **5.0 RECOMMENDATIONS**

### **5.1 SOLDIER CANYON MINE**

No Changes Made

### **5.2 DUGOUT CANYON MINE**

#### **5.2.1 Monitoring Wells**

No new monitoring wells are proposed for the Dugout Canyon Mine at this time. It is recommended the wells included in the monitoring plan continue to be measured.

#### **5.2.2 Streams**

A new stream monitoring point, 323, associated with the 240 acre expansion area is proposed in Section 18, T13S R 13E for the Dugout Canyon Mine. It is recommended the stream be monitored as per the surface water monitoring plan contained in Chapter 7 of the MRP.

#### **5.2.3 Springs**

Two new spring monitoring points are proposed for the Dugout area. The springs are located adjacent to the 240 acre expansion in the northeast portion of the permit area and within the Cow Canyon drainage. The springs are designated as sites 321 and 322. It is recommended these springs be monitored as per the ground water monitoring plan contained in Chapter 7 of the MRP.

## 6.0 REFERENCES CITED

Mayo, A.L., Morris, T.H., Peltier, S., Petersen, E.C., Payne, K., Holman, L.S., Tingey, D., Fogel, T., Black, G.J., and Gibbs, T.D., 2003, Active and inactive groundwater flow systems: Evidence from a stratified, mountainous terrain, GSA Bulletin: December 2003: V. 115: no. 12; p. 1456-1472.

Mayo, A.L., and Morris, T.H., 2000, Conceptual model of groundwater flow in stratified mountainous terrain, Utah, USA in Groundwater: Past achievements and future Challenges, Sililo et al. ed: Proceeding XXX IAH Congress on Groundwater, Capetown South Africa, 26 November – 1 December, 2000, p. 225-229.

Waddell, K.M., Dodge, J.E., Darby, D.W., and Theobald, S.M., 1986, Hydrology of the Price River Basin, Utah with emphasis of selected coal-field areas, U.S. Geological Survey Water-Supply Paper 2246.

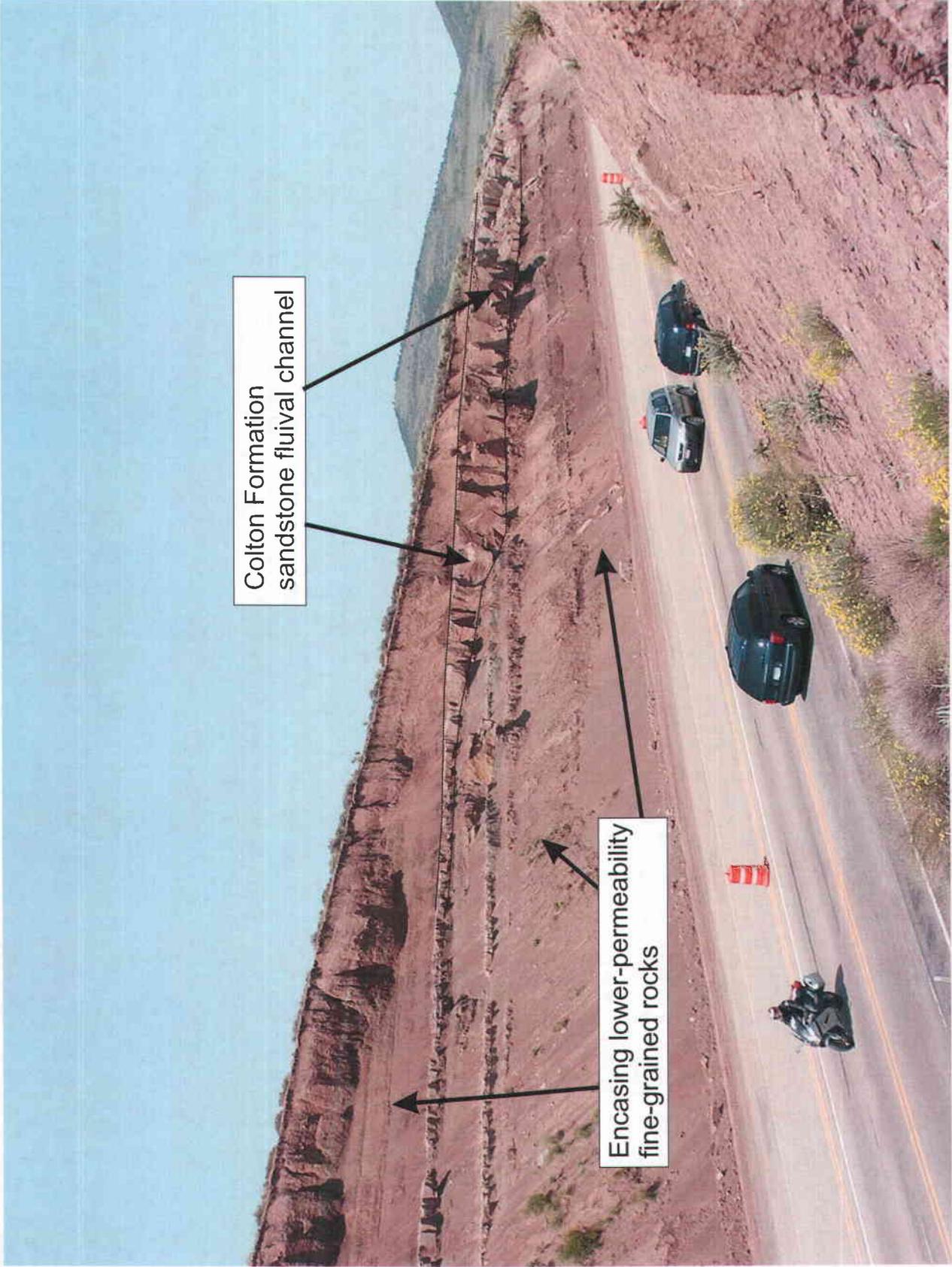
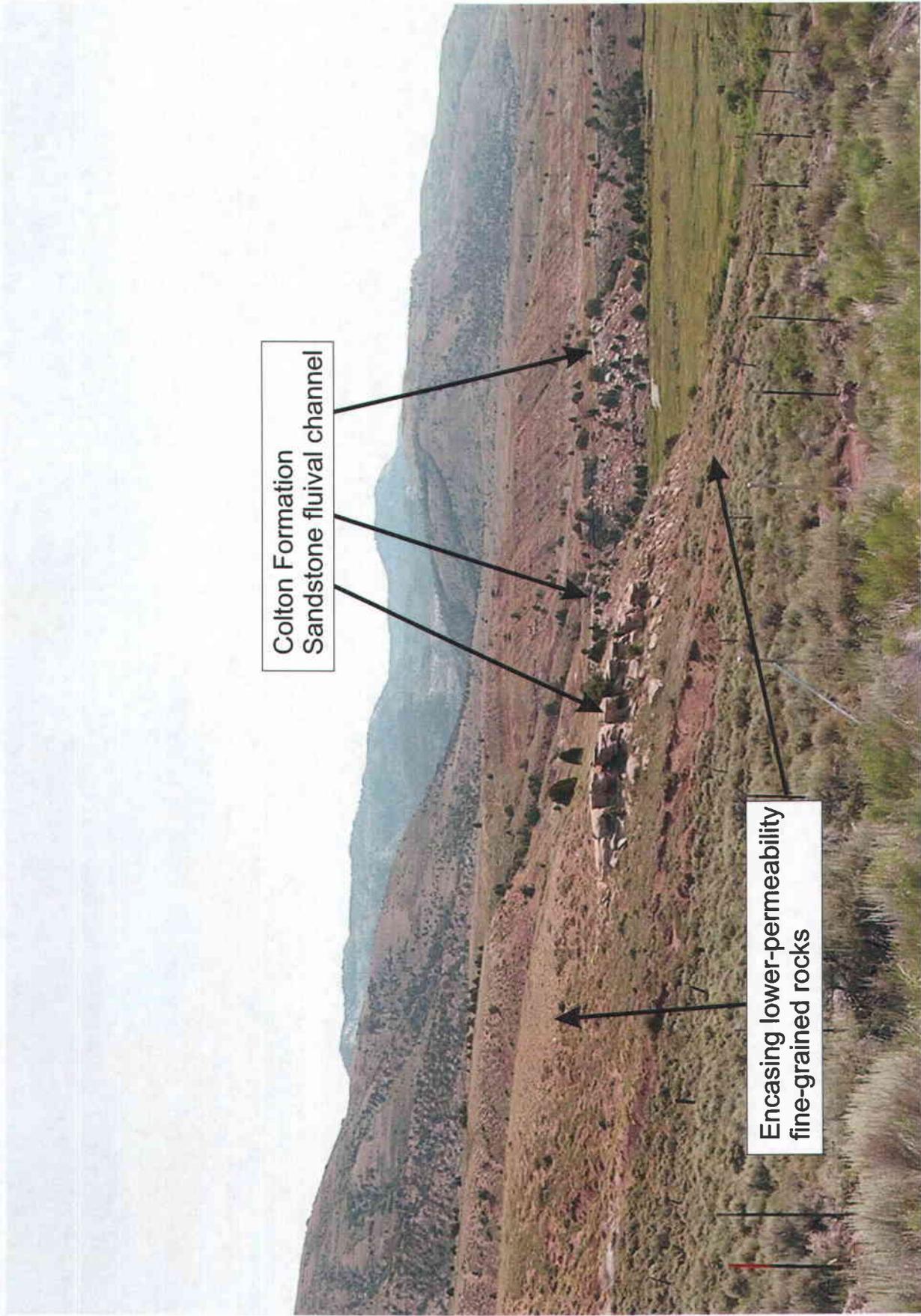


Figure X Annotated photograph showing fluvial channel and enclosing lower-permeability fine-grained rocks in a road cut in the Colton Formation near Colton, Utah.



Colton Formation  
Sandstone fluvial channel

Encasing lower-permeability  
fine-grained rocks

Figure Y Annotated photograph showing surface erosional exposure of fluvial channels and encasing lower-permeability fine-grained rocks in the Colton Formation near Colton, Utah.

**ATTACHMENT 1**

PHC Update Figure 1  
Recharge Area Figure 2  
Table 1 600 Acre Baseline Spring Field Data  
Baseline Water Quality Data for Springs 321, 322 and 323

"321" Monitoring Data 2007

Date	Time	pH	Cond.	Temp.	Flow (gpm)	Comments
3/15/07	1220				NOA	Snow/Ice
5/18/07	1420	8.08	406	4	1.5	
6/21/07	1114	8.11	410	7.6	1.3	
7/24/07	834	7.38	469	8.5	0.75	
8/30/07	1205	7.42	471	8	0.7	

"322" Monitoring Data 2007

Date	Time	pH	Cond.	Temp.	Flow (gpm)	Comments
3/15/07	1220				NOA	Snow/Ice
6/21/07	905	7.84	704	7	18	
7/24/07	916	7.91	698	9	0.2	Livestock
8/30/07	1130	7.91	663	11	0.1	Livestock

"323 (Junction)" Monitoring Data 2007

Date	Time	pH	Cond.	Temp.	Flow (gpm)	Comments
3/15/07	1220				NOA	Snow/Ice
5/18/07	1340	7.80	591	11	17	
6/21/07	1220	7.9	621	12.5	20.5	
8/30/07	1345	8.4	675	14	13	Livestock Use

SPRING 211				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/11/2007	693	8.01	3	1.5
6/15/2007	653	7.8	7.6	0.62

SPRING 211A				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/11/2007	527	7.63	2	2.5
6/15/2007	538	7.73	9.3	0.48

SPRING 213				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/11/2007	499	7.55	10	SEEP
6/15/2007				NO FLOW

SPRING 214				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/11/2007	561	7.34	5	0.5
6/15/2007				NO FLOW

SPRING 262				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/18/2007	411	7.98	5	7
6/21/2007	359	8.04	8.1	7
8/30/2007	422	8.18	11	7

SPRING 262A				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
6/21/2007	401	7.82	7.8	10.5
8/30/2007	413	7.9	8	6

SPRING 263				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/18/2007	390	7.17	4	1.5
6/21/2007	408	7.69	11.7	0.75
8/30/2007	-	-	-	NO FLOW

SPRING 263A				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
6/21/2007	403	7.91	8.1	0.6
8/30/2007	-	-	-	NO FLOW

SPRING 300				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/11/2007	496	7.92	10	0.25
6/15/2007	449	8.23	11.2	0.22

SPRING 301				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/11/2007	469	7.48	5	0.5
6/15/2007				NO FLOW

SURFACE WATER 320				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/18/2007	550	7.7	12	10

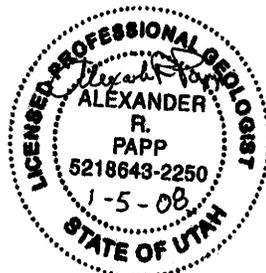
SPRING 260A				
Date	Conductivity mmhos	pH	Temperature C	Flow gpm
5/18/2007	369	7.64	5	6
6/21/2007	358	8.09	8.6	2.5
8/30/2007	400	8.1	8	0.8

**MEMORANDUM**  
COALGEO, LLC

**Date:** January 5, 2008  
**Subject:** Fracture Control of Springs in the central part of Section 17, T13S, R13E  
**To:** Vicky Miller (Dugout Canyon Mine)  
**From:** Alex Papp (Coalgeo, LLC)

Based upon review of available geologic information and mining experience at Dugout Canyon Mine, it is my opinion that the groundwater flowing at the springs located in the central part of Section 17, T13S, R13E originate from faults and/or major fractures. The geographical location of the springs, the significant amount of flow, the apparent thin alluvium/colluvium, the small restricted catchment area, and documented faults and/or major fractures within the vicinity leads me to this conclusion.

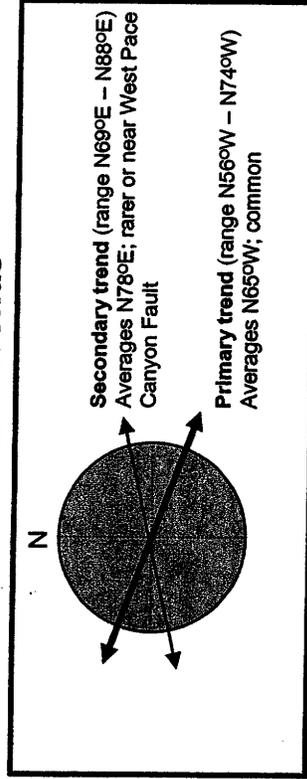
The major fracture orientation within this area of the Dugout Canyon Mine averages N65°W (295°) and is based on a substantial database of underground and surface measurements (See Attachment, Structural Framework). IntraSearch, Inc. produced a photogeologic map in 2005 that depicts faults and/or major fractures within the vicinity of the drainage where the springs are located (See Attachment; IntraSearch Photogeologic Map). The orientations are consistent with that measured at the Dugout Canyon Mine. Other geologic investigations also support the orientation and occurrence of faulting specific to the drainage where the springs are located (See Attachment: Doelling, H.H., 1970; Central Utah Coalfields). Faults and fractures commonly serve as conduits for groundwater flow and are well documented at the Dugout Canyon Mine.



## Structural Framework Current Longwall Area (Gil 5 – Gil 8)

- **Strike of coal seam – N57°W (303°); Dip – 6.9° (12%)**
- **Low to moderate fault frequency**  
West Pace Canyon Fault; orientation N79°E (079°); downthrown on North; maximum displacement 22'; normal; delineated by underground drilling  
East Pace Canyon Fault orientation N74°W (286°); downthrown on South; Maximum displacement 12.5'; normal; evidence of lateral movement; intercepted in mine
- **Primary joint and major cleat orientation averages N65°W (295°)**  
High cleat frequency, parallels joint trend  
Joints difficult to distinguish in mine roof; spacing not well defined  
Joints/faults appear to be important conduits/reservoir for gas and groundwater

### Fracture Trends





# ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

## Inorganic Analytical Results

### Soldier Creek Coal Company

Project ID:  
Sample ID: 320

ACZ Sample ID: **L62749-02**  
Date Sampled: 05/18/07 12:55  
Date Received: 05/22/07  
Sample Matrix: Surface Water

#### Inorganic Prep

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							05/29/07 12:24	erf

#### Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, dissolved	M200.7 ICP	58.4			mg/L	0.2	1	06/01/07 7:37	djt
Iron, dissolved	M200.7 ICP		U		mg/L	0.02	0.05	06/01/07 7:37	djt
Iron, total	M200.7 ICP	1.08			mg/L	0.02	0.05	06/01/07 20:02	msh
Magnesium, dissolved	M200.7 ICP	28.4			mg/L	0.2	1	06/01/07 7:37	djt
Manganese, dissolved	M200.7 ICP		U		mg/L	0.005	0.03	06/01/07 7:37	djt
Manganese, total	M200.7 ICP	0.025	B		mg/L	0.005	0.03	06/01/07 20:02	msh
Potassium, dissolved	M200.7 ICP	1.0	B		mg/L	0.3	2	06/01/07 7:37	djt
Sodium, dissolved	M200.7 ICP	14.5			mg/L	0.3	2	06/01/07 7:37	djt

#### Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		227			mg/L	2	20	05/31/07 0:00	cas
Carbonate as CaCO3		16	B		mg/L	2	20	05/31/07 0:00	cas
Hydroxide as CaCO3			U		mg/L	2	20	05/31/07 0:00	cas
Total Alkalinity		243		*	mg/L	2	20	05/31/07 0:00	cas
Cation-Anion Balance	Calculation								
Cation-Anion Balance		5.4			%			06/07/07 0:00	calc
Sum of Anions		5.3			meq/L	0.1	0.5	06/07/07 0:00	calc
Sum of Cations		5.9			meq/L	0.1	0.5	06/07/07 0:00	calc
Chloride	325.2 / SM4500Cl-E	3	B		mg/L	1	5	05/30/07 14:05	jif
Residue, Filterable (TDS) @180C	160.1 / SM2540C	290			mg/L	10	20	05/24/07 8:56	lcp
Residue, Non-Filterable (TSS) @105C	160.1 / SM2540C		U	*	mg/L	5	20	05/25/07 15:00	cas
Sulfate	SM4500 SO4-D	20	B	*	mg/L	10	50	05/30/07 9:52	seb
TDS (calculated)	Calculation	278			mg/L	10	50	06/07/07 0:00	calc
TDS (ratio - measured/calculated)	Calculation	1.04						06/07/07 0:00	calc

**Soldier Creek Coal Company**

Project ID:

Sample ID: 320

ACZ Sample ID: **L62749-02**

Date Sampled: 05/18/07 12:55

Date Received: 05/22/07

Sample Matrix: *Surface Water***Oil & Grease, Total Recoverable**Analysis Method: **1664A - Gravimetric**

Extract Method:

Workgroup: WG225514

Analyst: tam

Extract Date:

Analysis Date: 05/29/07 13:40

Compound	CAS	Result	QUAL	Dilution	XQ	Units	MDL	PQL
Oil and Grease			U	1.031		mg/L	2	10

**Soldier Creek Coal Company**

Project ID:  
 Sample ID: 321

ACZ Sample ID: **L63413-01**  
 Date Sampled: 06/21/07 00:00  
 Date Received: 06/25/07  
 Sample Matrix: Ground Water

**Inorganic Prep**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							06/27/07 19:18	erf

**Metals Analysis**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, dissolved	M200.7 ICP	77.5			mg/L	0.2	1	07/03/07 13:37	msh
Iron, dissolved	M200.7 ICP		U		mg/L	0.02	0.05	07/03/07 13:37	msh
Iron, total	M200.7 ICP	1.59		*	mg/L	0.02	0.05	07/05/07 22:24	djt
Magnesium, dissolved	M200.7 ICP	22.5			mg/L	0.2	1	07/03/07 13:37	msh
Manganese, dissolved	M200.7 ICP		U		mg/L	0.005	0.03	07/03/07 13:37	msh
Manganese, total	M200.7 ICP	0.024	B		mg/L	0.005	0.03	07/05/07 22:24	djt
Potassium, dissolved	M200.7 ICP	1.0	B		mg/L	0.3	2	07/03/07 13:37	msh
Sodium, dissolved	M200.7 ICP	9.2			mg/L	0.3	2	07/03/07 13:37	msh

**Wet Chemistry**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		270			mg/L	2	20	06/26/07 0:00	lcp/jjf
Carbonate as CaCO3			U		mg/L	2	20	06/26/07 0:00	lcp/jjf
Hydroxide as CaCO3			U		mg/L	2	20	06/26/07 0:00	lcp/jjf
Total Alkalinity		270			mg/L	2	20	06/26/07 0:00	lcp/jjf
Cation-Anion Balance	Calculation								
Cation-Anion Balance		6.1			%			07/10/07 15:15	calc
Sum of Anions		5.4			meq/L	0.1	0.5	07/10/07 15:15	calc
Sum of Cations		6.1			meq/L	0.1	0.5	07/10/07 15:15	calc
Chloride	325.2 / SM4500Cl-E	3	B	*	mg/L	1	5	07/02/07 15:00	aml/jag
Residue, Filterable (TDS) @180C	160.1 / SM2540C	290			mg/L	10	20	06/28/07 15:50	jif
Sulfate	SM4500 SO4-D		U	*	mg/L	10	50	07/03/07 9:20	aeh
TDS (calculated)	Calculation	275			mg/L	10	50	07/10/07 15:15	calc
TDS (ratio - measured/calculated)	Calculation	1.05						07/10/07 15:15	calc

**Soldier Creek Coal Company**

Project ID:

Sample ID: 321

ACZ Sample ID: **L64797-01**

Date Sampled: 08/30/07 12:05

Date Received: 09/04/07

Sample Matrix: Ground Water

**Inorganic Prep**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							09/05/07 14:15	bjl

**Metals Analysis**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, dissolved	M200.7 ICP	75.9			mg/L	0.2	1	09/06/07 3:00	djt
Iron, dissolved	M200.7 ICP	0.03	B		mg/L	0.02	0.05	09/06/07 3:00	djt
Iron, total	M200.7 ICP	0.24			mg/L	0.02	0.05	09/06/07 20:31	erf
Magnesium, dissolved	M200.7 ICP	22.1			mg/L	0.2	1	09/06/07 3:00	djt
Manganese, dissolved	M200.7 ICP	0.014	B		mg/L	0.005	0.03	09/06/07 3:00	djt
Manganese, total	M200.7 ICP	0.007	B		mg/L	0.005	0.03	09/06/07 20:31	erf
Potassium, dissolved	M200.7 ICP	1.1	B		mg/L	0.3	2	09/06/07 3:00	djt
Sodium, dissolved	M200.7 ICP	10.0			mg/L	0.3	2	09/06/07 3:00	djt

**Wet Chemistry**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		274			mg/L	2	20	09/06/07 0:00	lcp
Carbonate as CaCO3			U		mg/L	2	20	09/06/07 0:00	lcp
Hydroxide as CaCO3			U		mg/L	2	20	09/06/07 0:00	lcp
Total Alkalinity		274			mg/L	2	20	09/06/07 0:00	lcp
Cation-Anion Balance	Calculation								
Cation-Anion Balance		4.3			%			09/17/07 0:00	calc
Sum of Anions		5.5			meq/L	0.1	0.5	09/17/07 0:00	calc
Sum of Cations		6.0			meq/L	0.1	0.5	09/17/07 0:00	calc
Chloride	325.2 / SM4500Cl-E	2	B	*	mg/L	1	5	09/10/07 12:59	mls
Residue, Filterable (TDS) @180C	160.1 / SM2540C	290			mg/L	10	20	09/04/07 16:22	lcp
Sulfate	SM4500 SO4-D		U		mg/L	10	50	09/05/07 9:14	aeh
TDS (calculated)	Calculation	276			mg/L	10	50	09/17/07 0:00	calc
TDS (ratio - measured/calculated)	Calculation	1.05						09/17/07 0:00	calc

**Soldier Creek Coal Company**

Project ID:  
Sample ID: 322

ACZ Sample ID: **L64797-02**  
Date Sampled: 08/30/07 11:30  
Date Received: 09/04/07  
Sample Matrix: Ground Water

**Inorganic Prep**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							09/05/07 15:10	bjl

**Metals Analysis**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, dissolved	M200.7 ICP	91.6			mg/L	0.2	1	09/06/07 3:04	djt
Iron, dissolved	M200.7 ICP		U		mg/L	0.02	0.05	09/06/07 3:04	djt
Iron, total	M200.7 ICP	8.27			mg/L	0.02	0.05	09/06/07 20:35	erf
Magnesium, dissolved	M200.7 ICP	41.3			mg/L	0.2	1	09/06/07 3:04	djt
Manganese, dissolved	M200.7 ICP	0.014	B		mg/L	0.005	0.03	09/06/07 3:04	djt
Manganese, total	M200.7 ICP	0.512			mg/L	0.005	0.03	09/06/07 20:35	erf
Potassium, dissolved	M200.7 ICP	1.5	B		mg/L	0.3	2	09/06/07 3:04	djt
Sodium, dissolved	M200.7 ICP	25.7			mg/L	0.3	2	09/06/07 3:04	djt

**Wet Chemistry**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		390			mg/L	2	20	09/06/07 0:00	lcp
Carbonate as CaCO3		6	B		mg/L	2	20	09/06/07 0:00	lcp
Hydroxide as CaCO3			U		mg/L	2	20	09/06/07 0:00	lcp
Total Alkalinity		396			mg/L	2	20	09/06/07 0:00	lcp
Cation-Anion Balance	Calculation								
Cation-Anion Balance		2.8			%			09/17/07 0:00	calc
Sum of Anions		8.6			meq/L	0.1	0.5	09/17/07 0:00	calc
Sum of Cations		9.1			meq/L	0.1	0.5	09/17/07 0:00	calc
Chloride	325.2 / SM4500Cl-E	2	B	*	mg/L	1	5	09/10/07 13:01	mls
Residue, Filterable (TDS) @180C	160.1 / SM2540C	430			mg/L	10	20	09/04/07 16:23	lcp
Sulfate	SM4500 SO4-D	30	B		mg/L	10	50	09/05/07 9:19	aeH
TDS (calculated)	Calculation	432			mg/L	10	50	09/17/07 0:00	calc
TDS (ratio - measured/calculated)	Calculation	1.00						09/17/07 0:00	calc

**Soldier Creek Coal Company**

Project ID:  
Sample ID: 322

ACZ Sample ID: **L63413-02**  
Date Sampled: 06/21/07 00:00  
Date Received: 06/25/07  
Sample Matrix: Ground Water

**Inorganic Prep**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							06/27/07 19:30	erf

**Metals Analysis**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Calcium, dissolved	M200.7 ICP	91.4			mg/L	0.2	1	07/03/07 13:40	msh
Iron, dissolved	M200.7 ICP		U		mg/L	0.02	0.05	07/03/07 13:40	msh
Iron, total	M200.7 ICP	0.69		*	mg/L	0.02	0.05	07/05/07 22:28	djt
Magnesium, dissolved	M200.7 ICP	43.8			mg/L	0.2	1	07/03/07 13:40	msh
Manganese, dissolved	M200.7 ICP	0.018		B	mg/L	0.005	0.03	07/03/07 13:40	msh
Manganese, total	M200.7 ICP	0.040			mg/L	0.005	0.03	07/05/07 22:28	djt
Potassium, dissolved	M200.7 ICP	1.5		B	mg/L	0.3	2	07/03/07 13:40	msh
Sodium, dissolved	M200.7 ICP	24.5			mg/L	0.3	2	07/03/07 13:40	msh

**Wet Chemistry**

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		380			mg/L	2	20	06/26/07 0:00	lcp/jif
Carbonate as CaCO3			U		mg/L	2	20	06/26/07 0:00	lcp/jif
Hydroxide as CaCO3			U		mg/L	2	20	06/26/07 0:00	lcp/jif
Total Alkalinity		380			mg/L	2	20	06/26/07 0:00	lcp/jif
Cation-Anion Balance	Calculation								
Cation-Anion Balance		5.1			%			07/10/07 15:15	calc
Sum of Anions		8.3			meq/L	0.1	0.5	07/10/07 15:15	calc
Sum of Cations		9.2			meq/L	0.1	0.5	07/10/07 15:15	calc
Chloride	325.2 / SM4500Cl-E	3		B *	mg/L	1	5	07/02/07 15:02	aml/jag
Residue, Filterable (TDS) @180C	160.1 / SM2540C	420			mg/L	10	20	06/28/07 15:52	jif
Sulfate	SM4500 SO4-D	30		B *	mg/L	10	50	07/03/07 9:23	ash
TDS (calculated)	Calculation	422			mg/L	10	50	07/10/07 15:15	calc
TDS (ratio - measured/calculated)	Calculation	1.00						07/10/07 15:15	calc

# SOLDIER / DUGOUT CANYON MINES OPERATIONAL WATER MONITORING PROGRAM

Sample Identification	321	322	0F001
Sample Date	7/24/2007	7/24/2007	7/24/2007
Laboratory Protocol	2	2	
Time	834	916	1104
<i>Handwritten signature</i>			
<b>Laboratory Analyses</b>			
Total Dissolved Solids mg/l	X	X	X
Total Suspended Solids mg/l	-	-	X
Oil and Grease mg/l	-	-	-
Bicarbonate mg/l	X	X	-
Carbonate mg/l	X	X	-
Calcium (Dissolved) mg/l	X	X	-
Chloride mg/l	X	X	-
Iron (Dissolved) mg/l	X	X	X
Iron (Total) mg/l	X	X	X
Magnesium (Dissolved) mg/l	X	X	-
Manganese (Dissolved) mg/l	X	X	-
Manganese (Total) mg/l	X	X	-
Potassium (Dissolved) mg/l	X	X	-
Sodium (Dissolved) mg/l	X	X	-
Sulfate mg/l	X	X	-
Cations meq/l	X	X	-
Anions meq/l	X	X	-
Total Hardness (CaCO3) mg/l	X	X	-

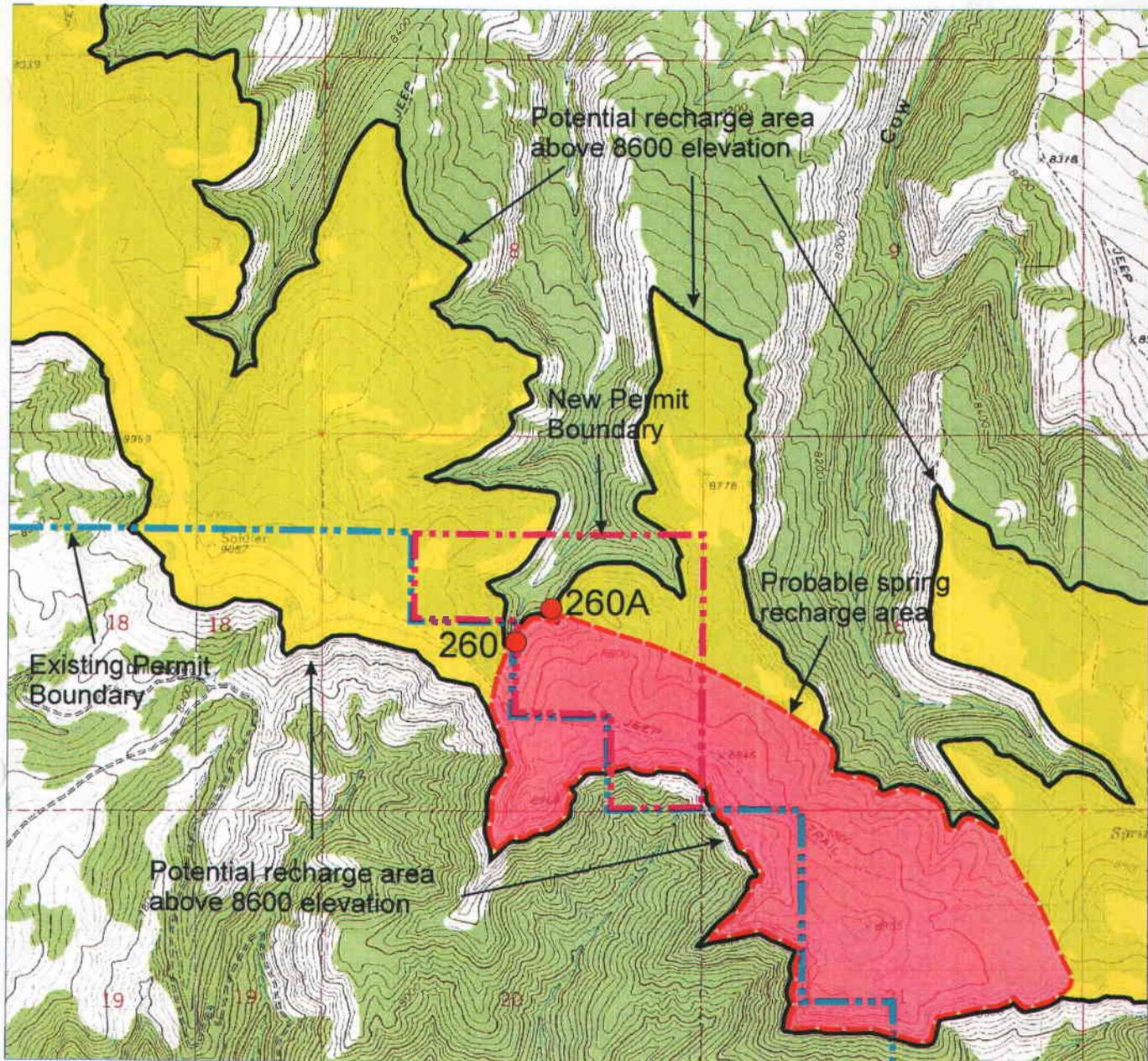
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME

Sampled by Amanda Richard - 4 bottles enclosed for each sample

- Protocol Identification -
- 1 - Dugout Canyon Mine (Surface Water)
  - 2 - Dugout Canyon Mine (Ground Water)
  - 3 - Soldier Canyon Mine (Surface Water) - 1st, 2nd & 4th Quarters
  - 4 - Soldier Canyon Mine (Surface Water) - 3rd Quarter Only
  - 5 - Soldier Canyon Mine (Ground Water) - 1st, 2nd & 4th Quarters
  - 6 - Soldier Canyon Mine (Ground Water) - 3rd Quarter Only
  - 7 - Banning Loadout (Ground Water)

- Bottles - U, W, G, R, O
- Bottles - U, W, G, R
- Bottles - U, W, G, O
- Bottles - U, W, G, R & O
- Bottles - U, W, G
- Bottles - U, W, G, R
- Bottles - U, W, G, R





**PETERSEN HYDROLOGIC, LLC**

recharge.cdr 11 April 2008

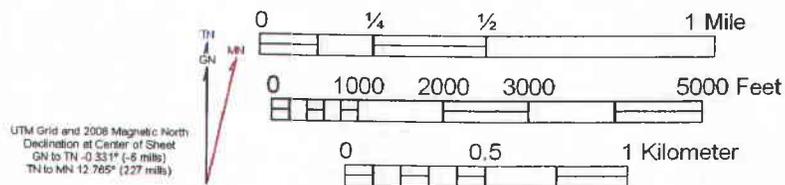
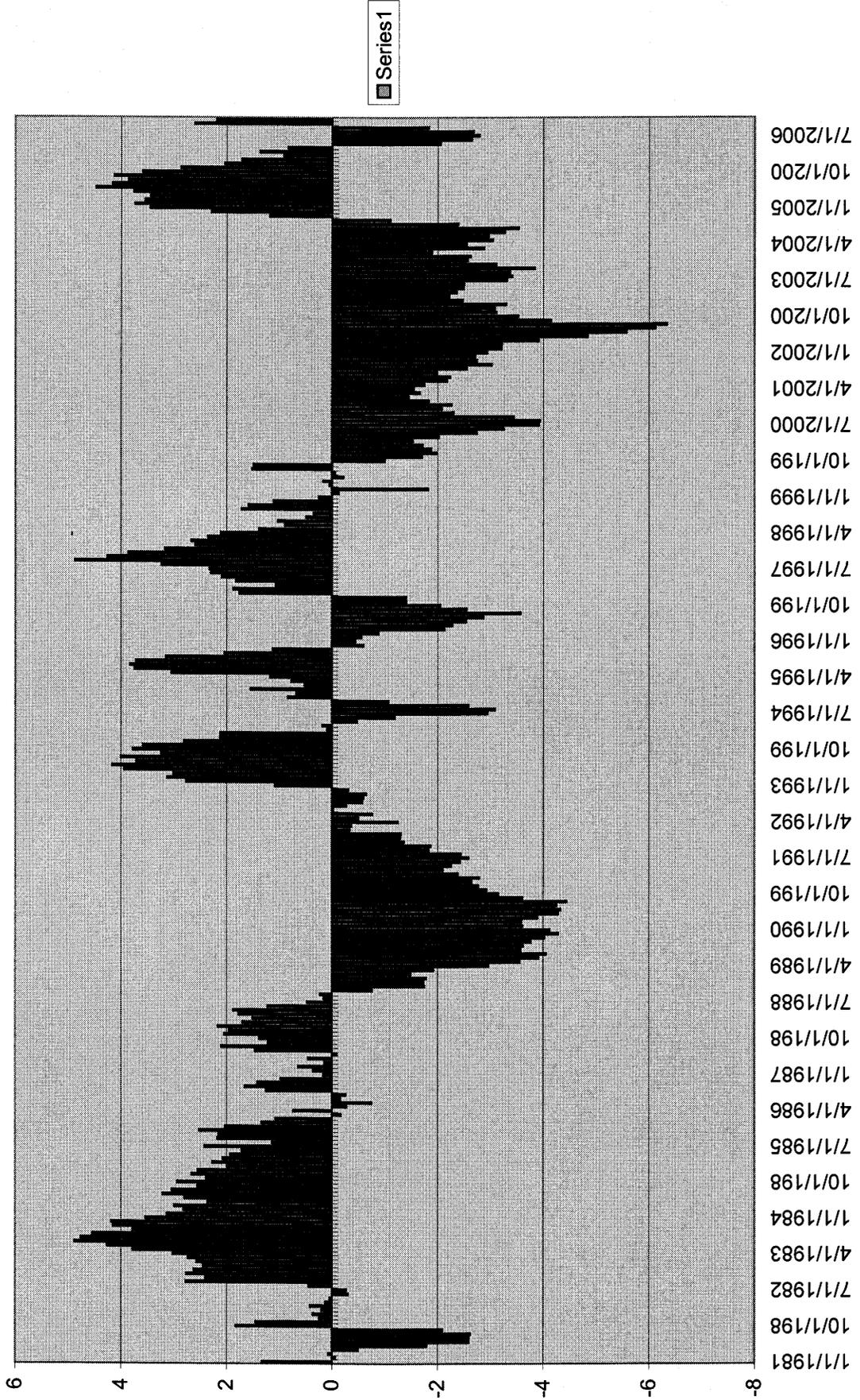


Figure 2 Probable recharge area for springs 260 and 260A.

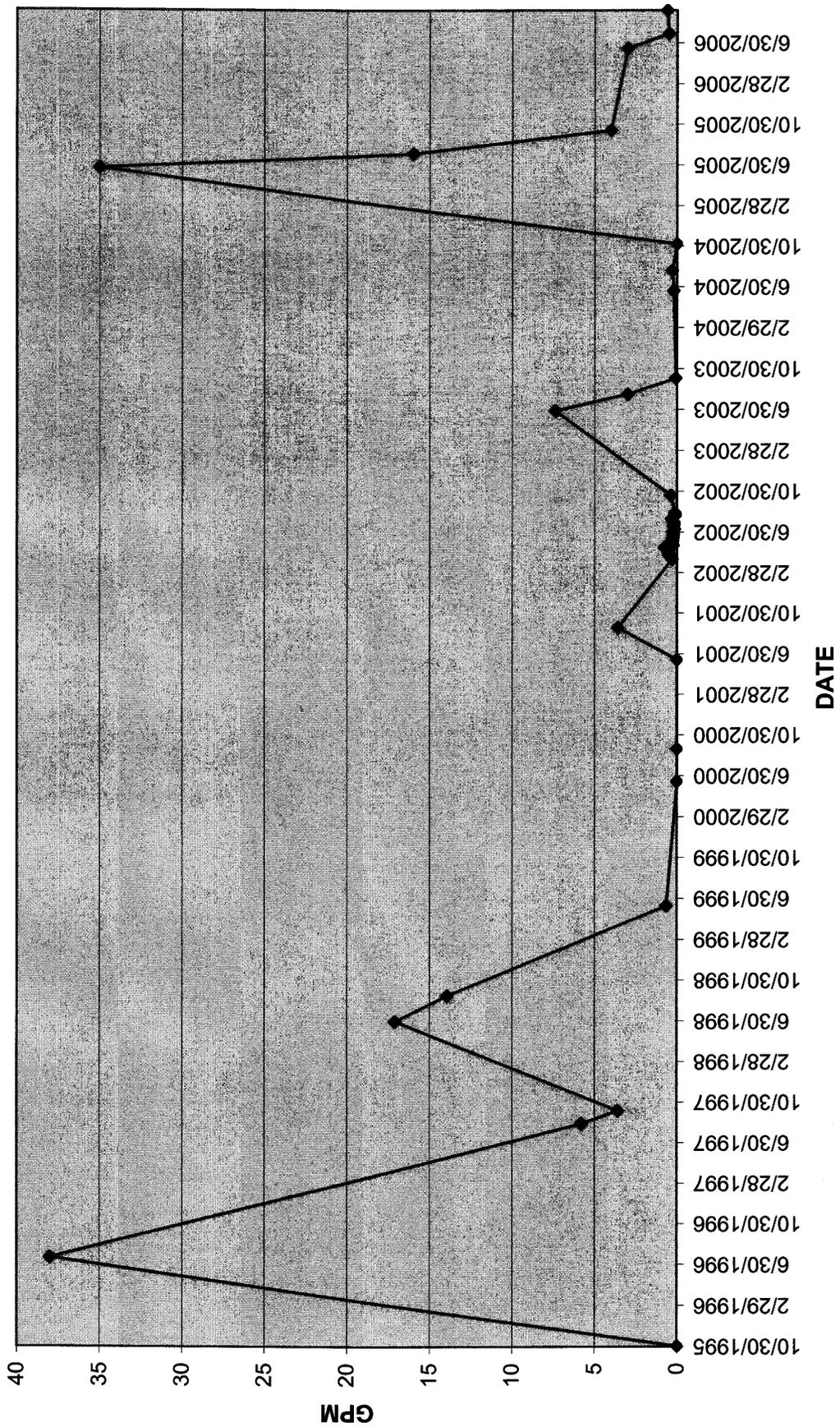
**ATTACHMENT 2**

Palmer Hydrologic Drought Index, Region 6 and 7, 1991-2006  
Spring Flow Graphs for Dugout Canyon Mine Sites

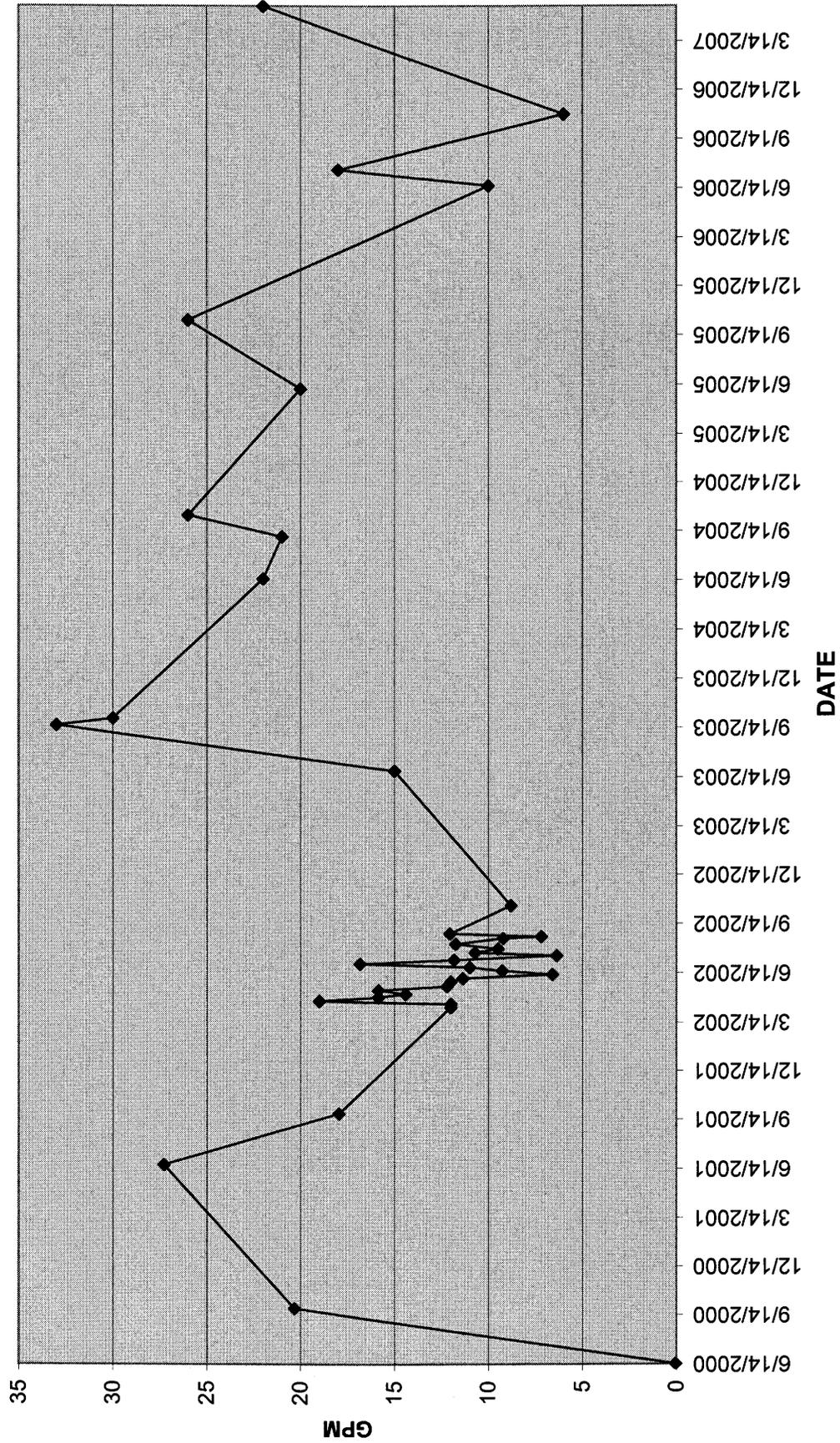
PHDI  
1981 - 2006



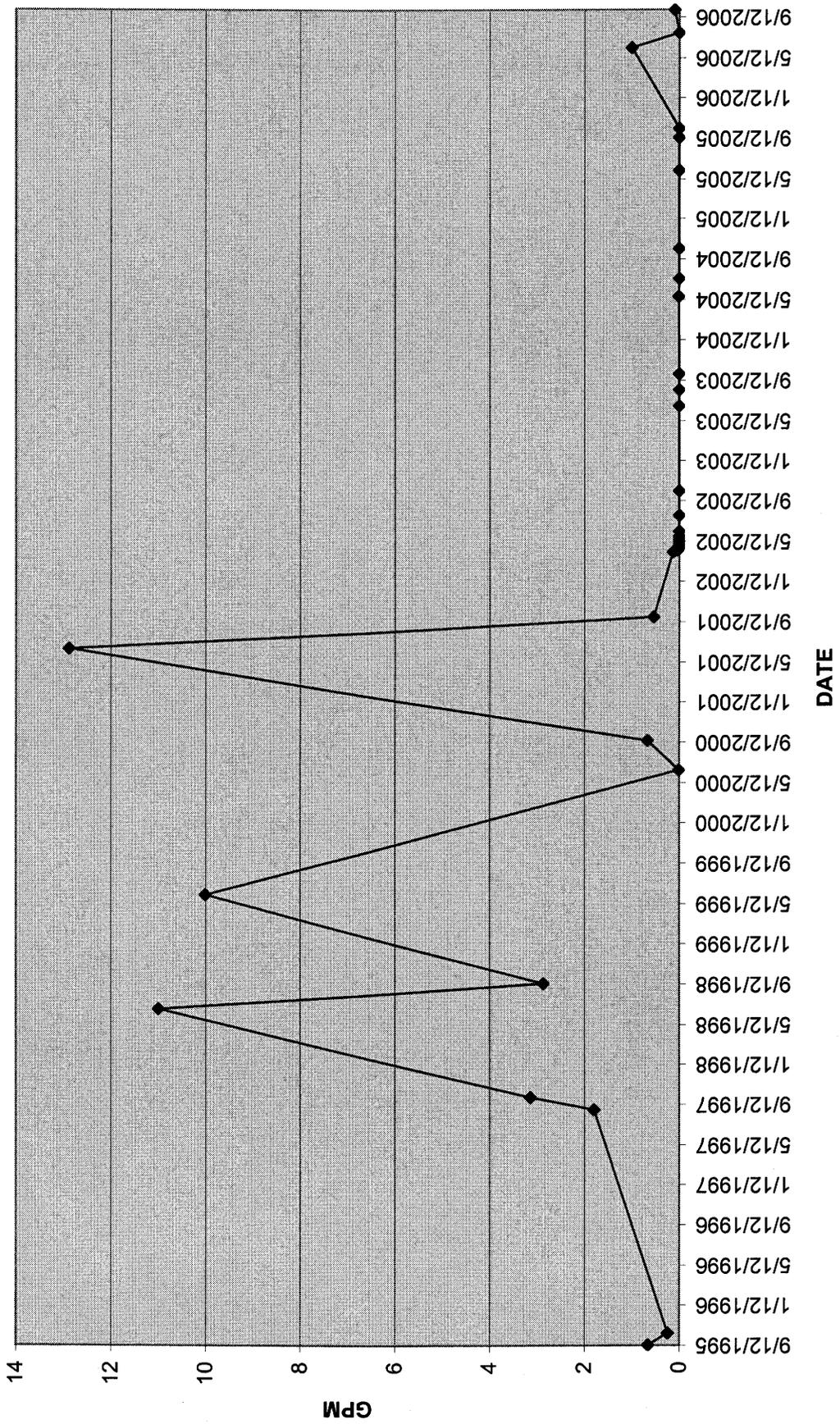
Spring SC-65  
Flow



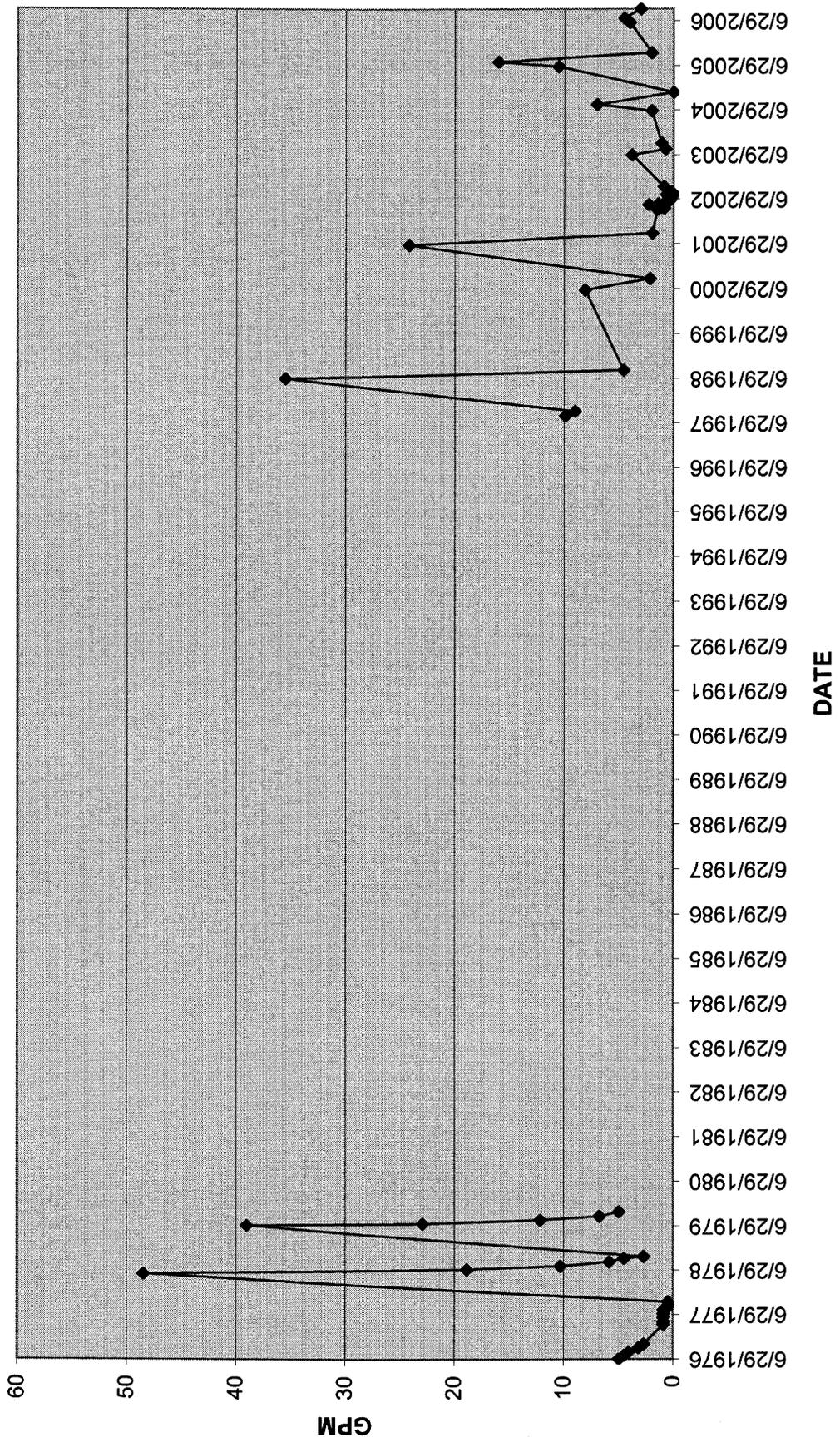
# Spring 260 Flow



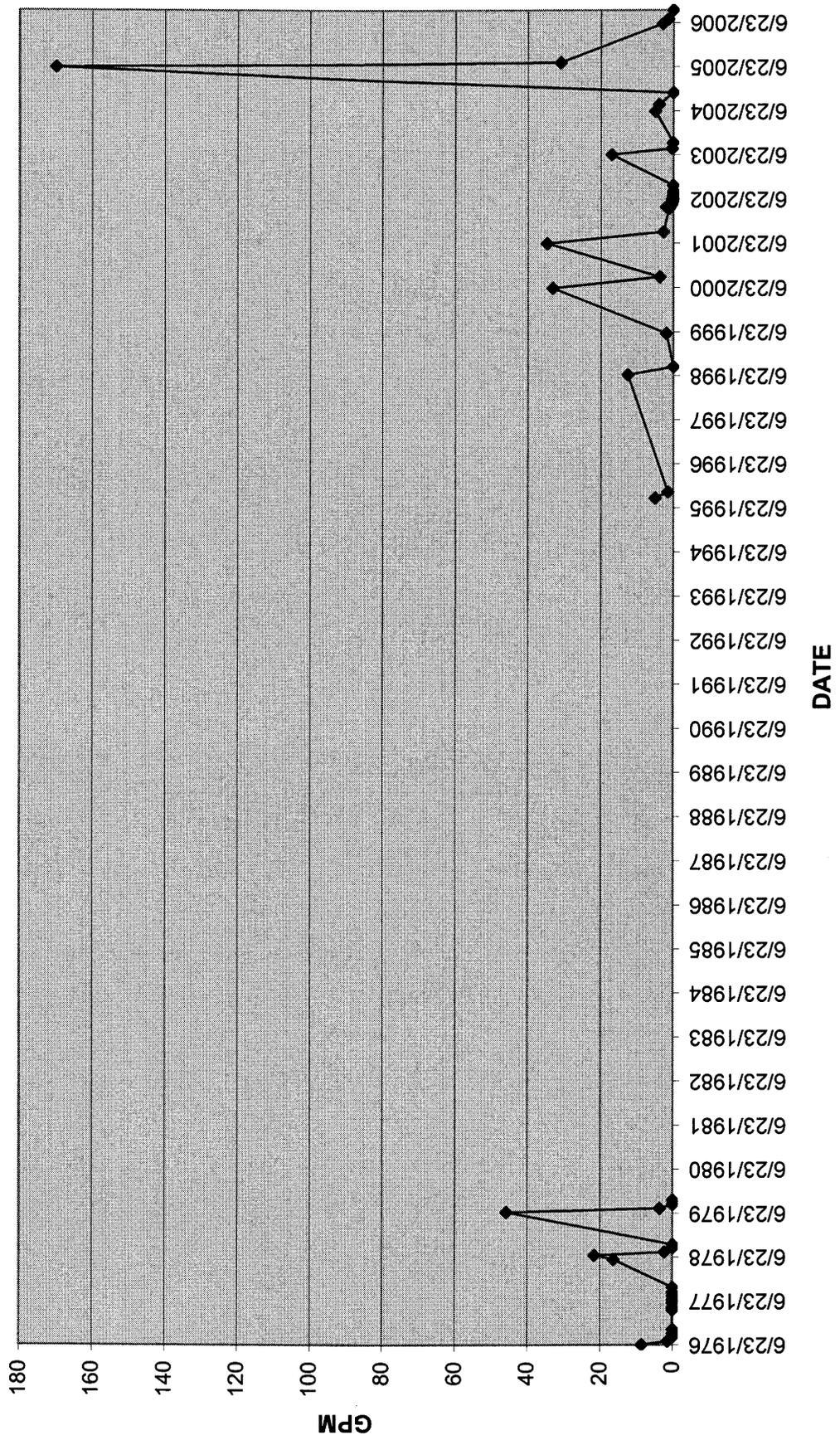
# Spring SC-100 Flow



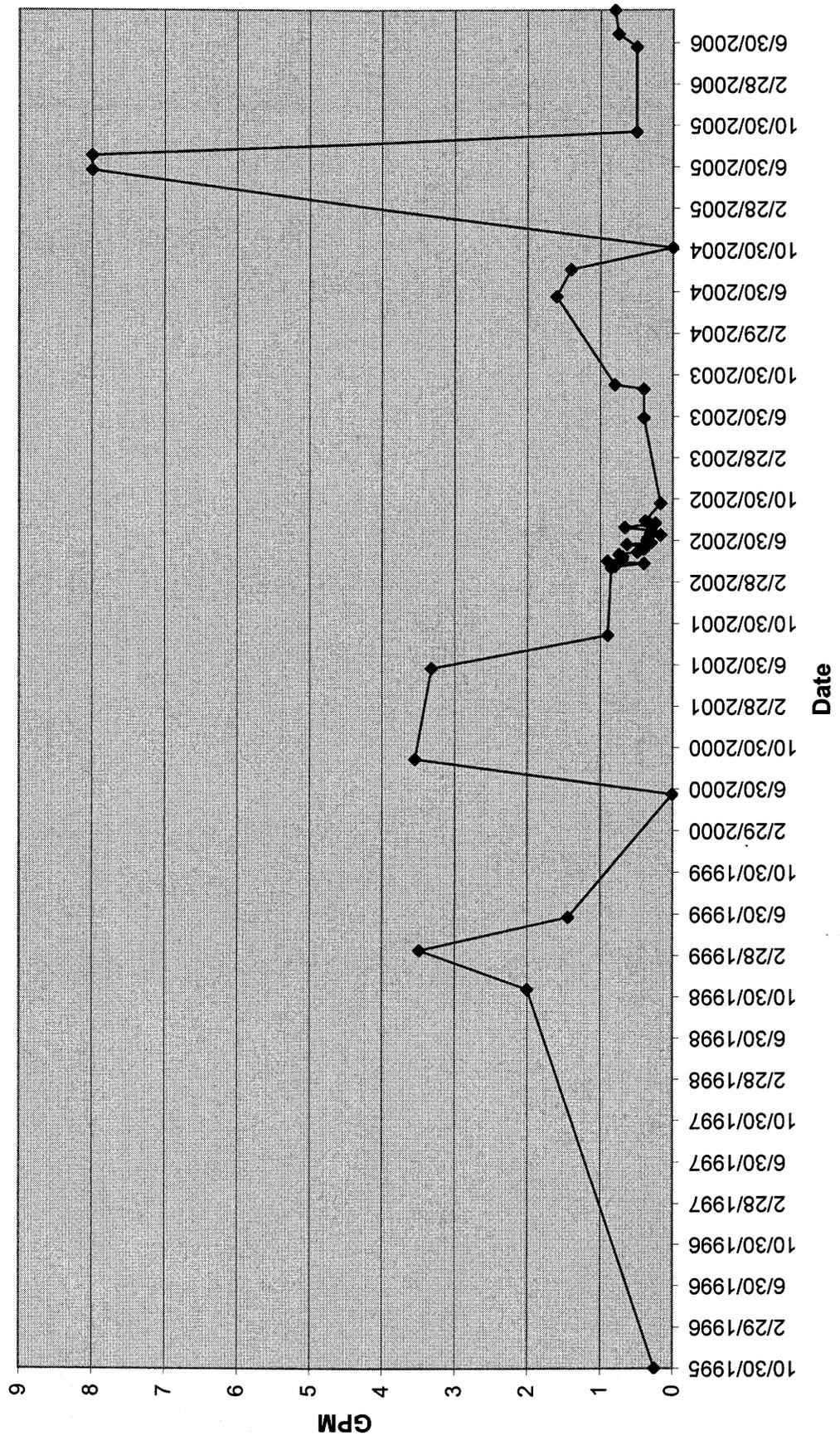
# Spring SP-20 Flow



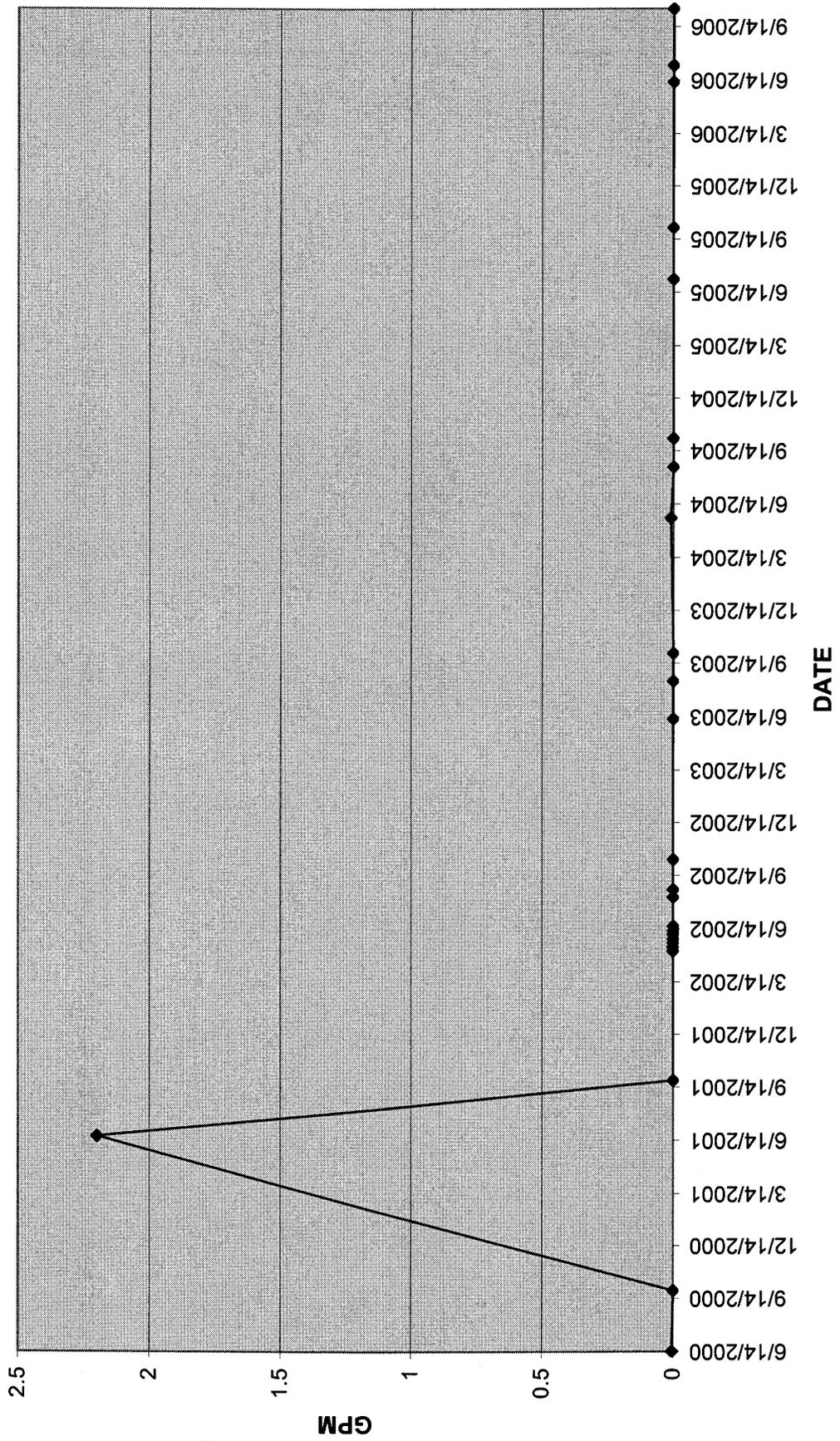
# Spring SC-14 Flow



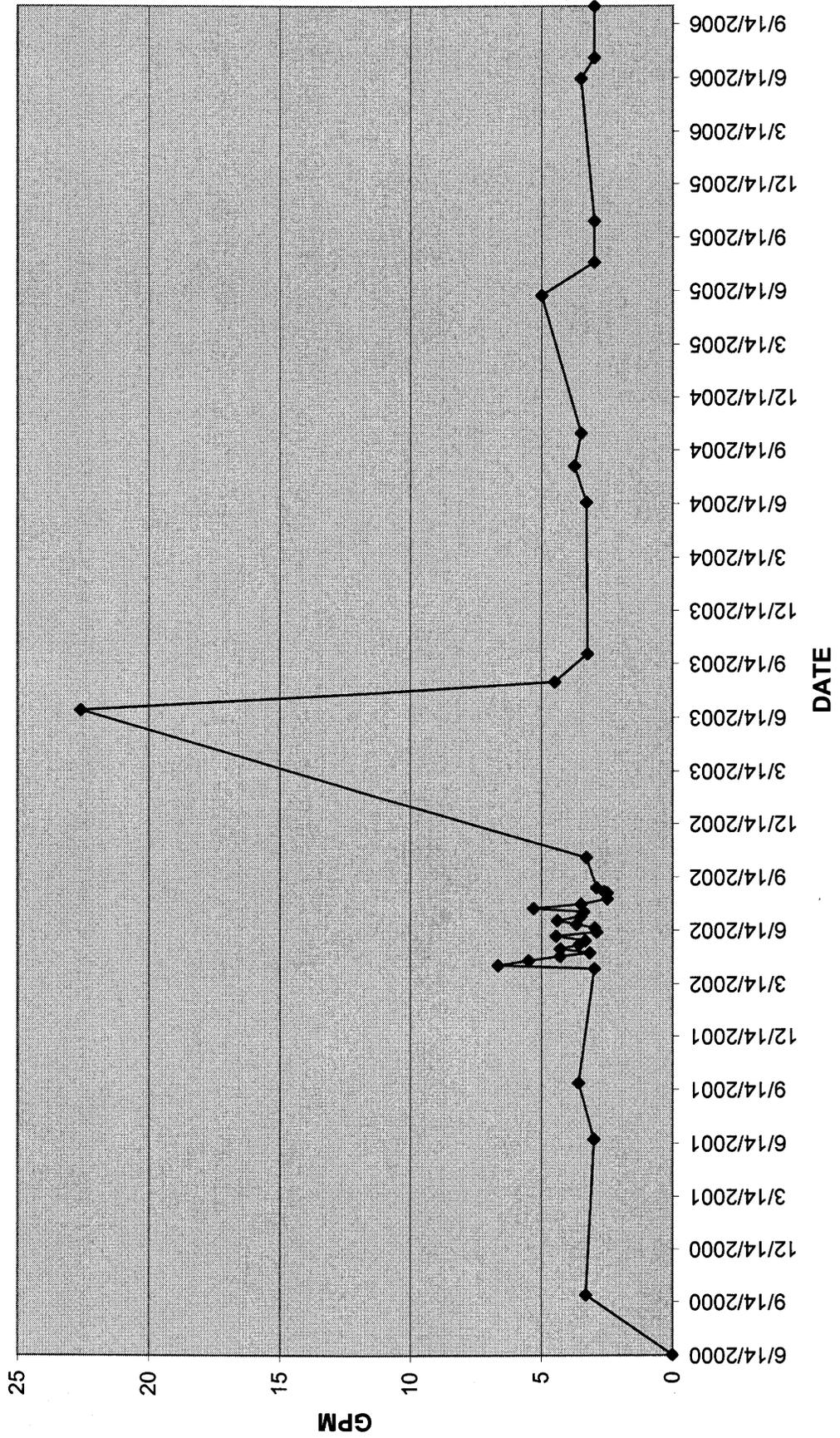
# Spring SC-116 Flow



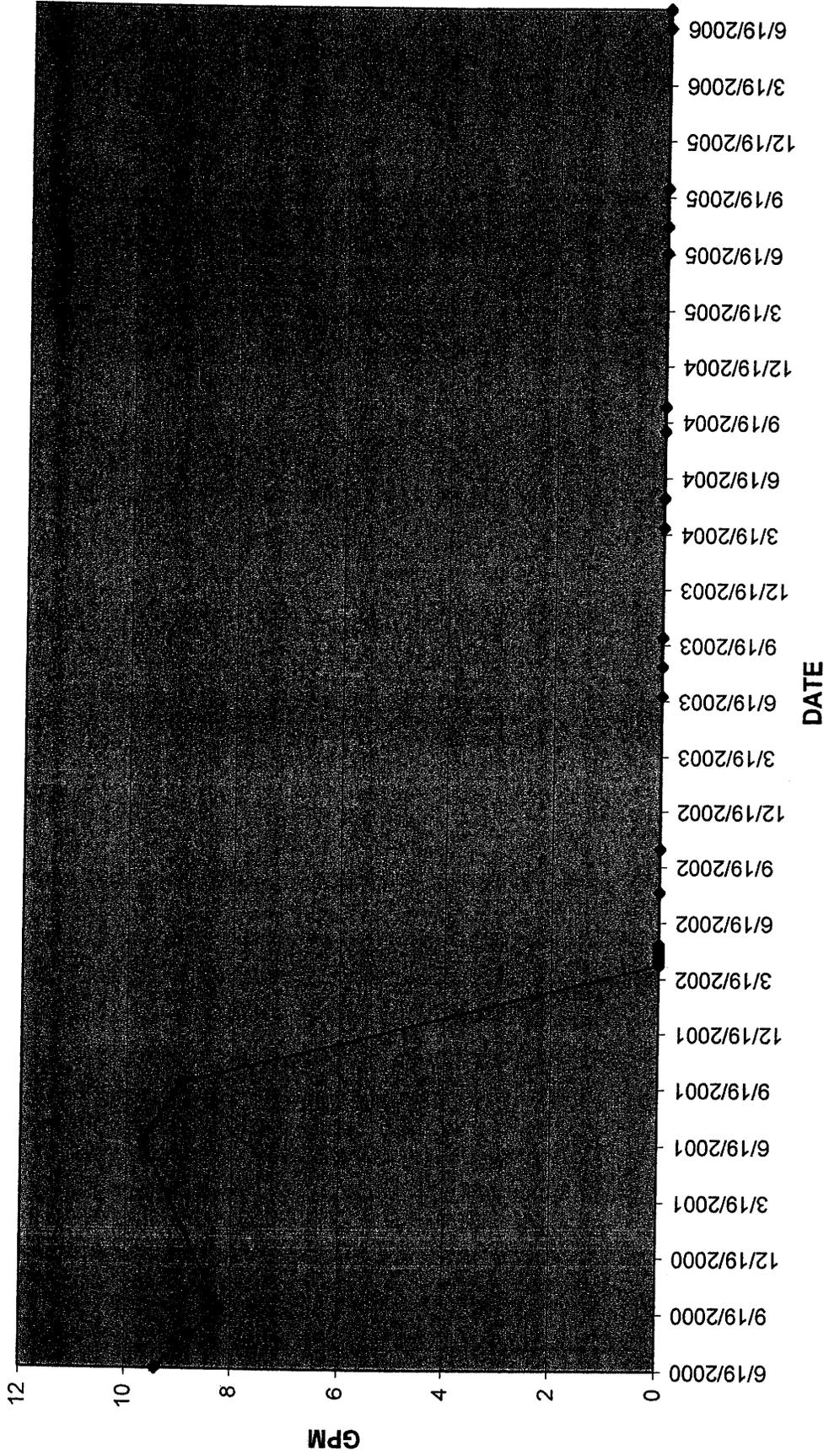
# Spring SC-200 Flow



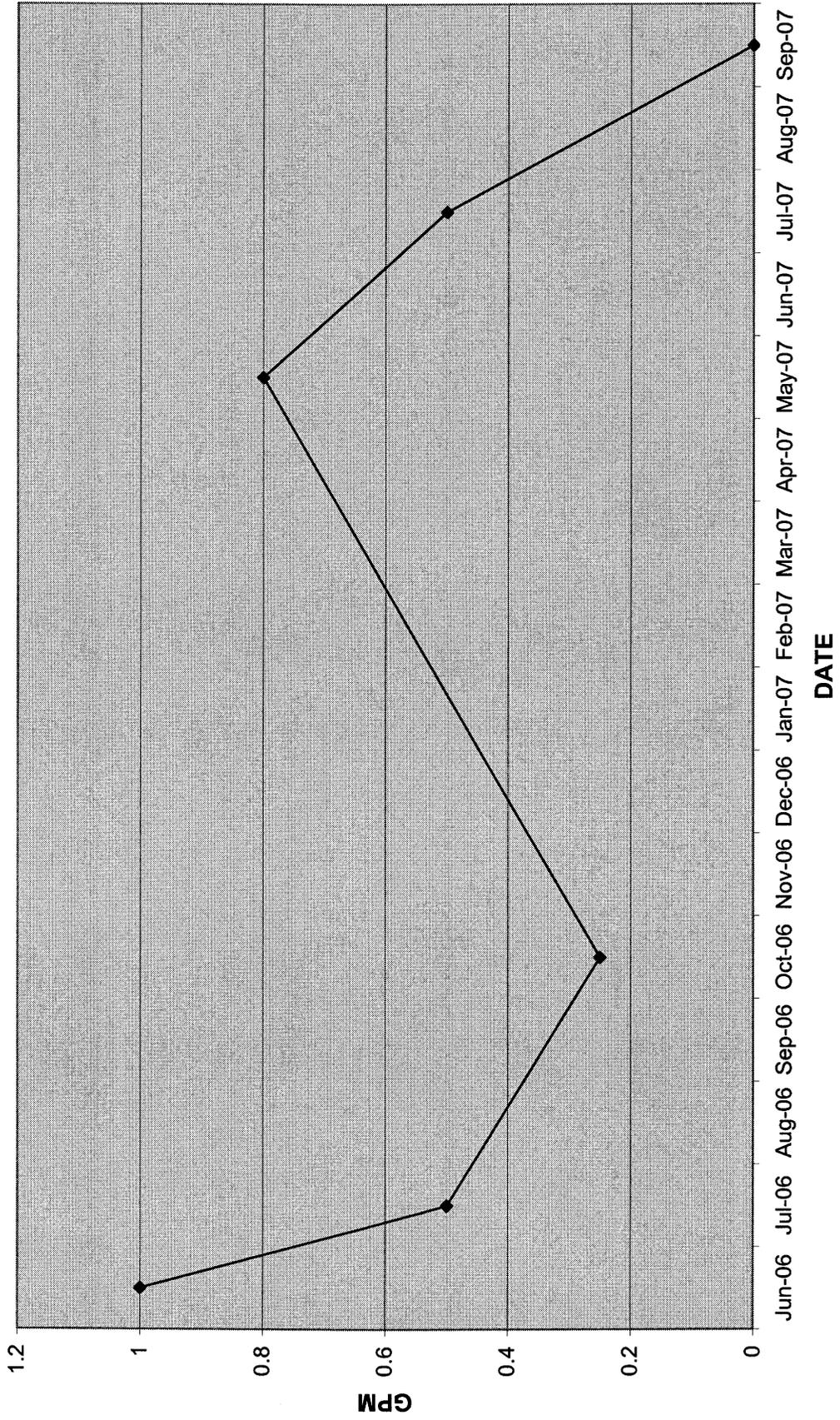
# Spring 203 Flow



# Spring 259 Flow



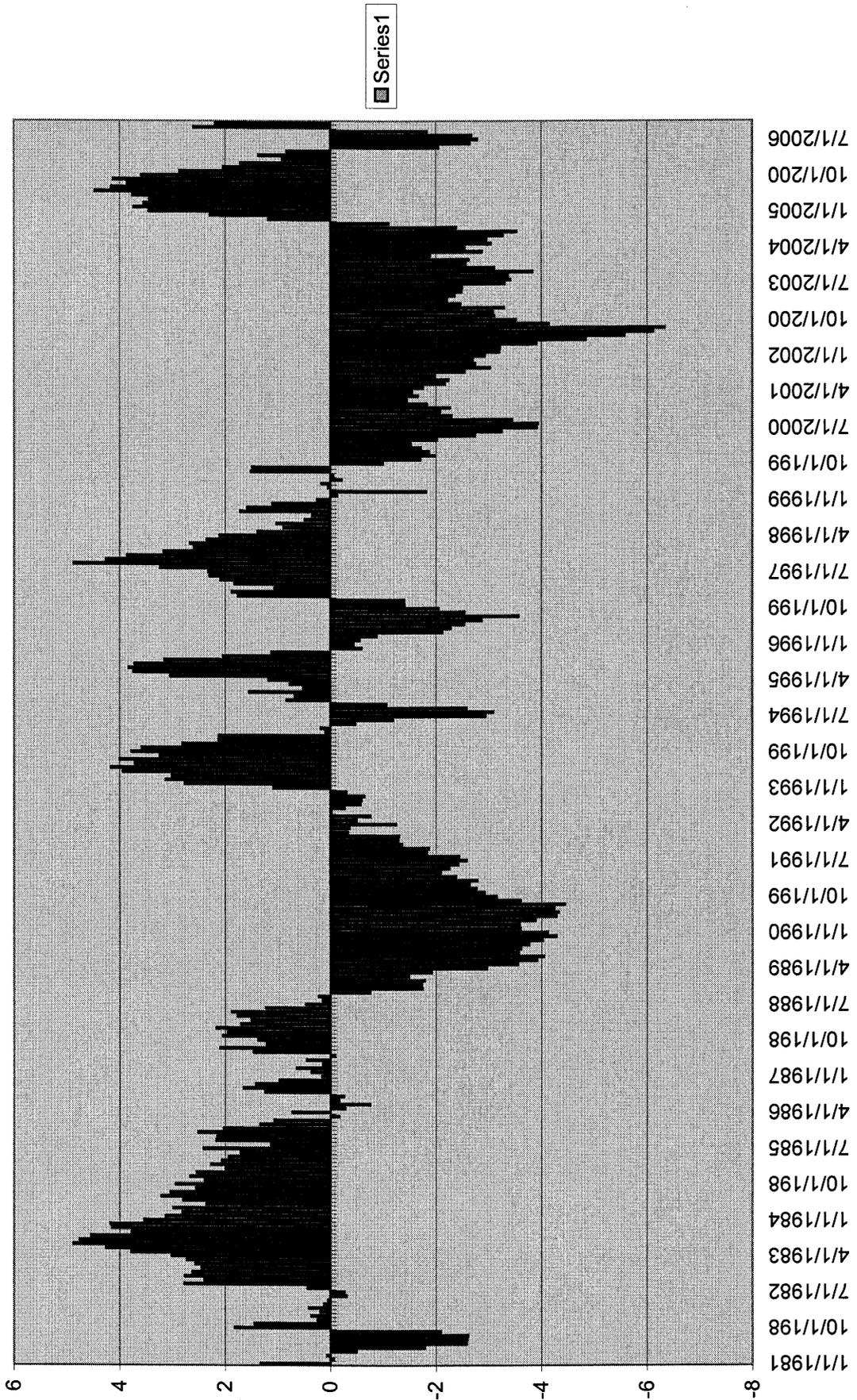
# Spring 259A Flow



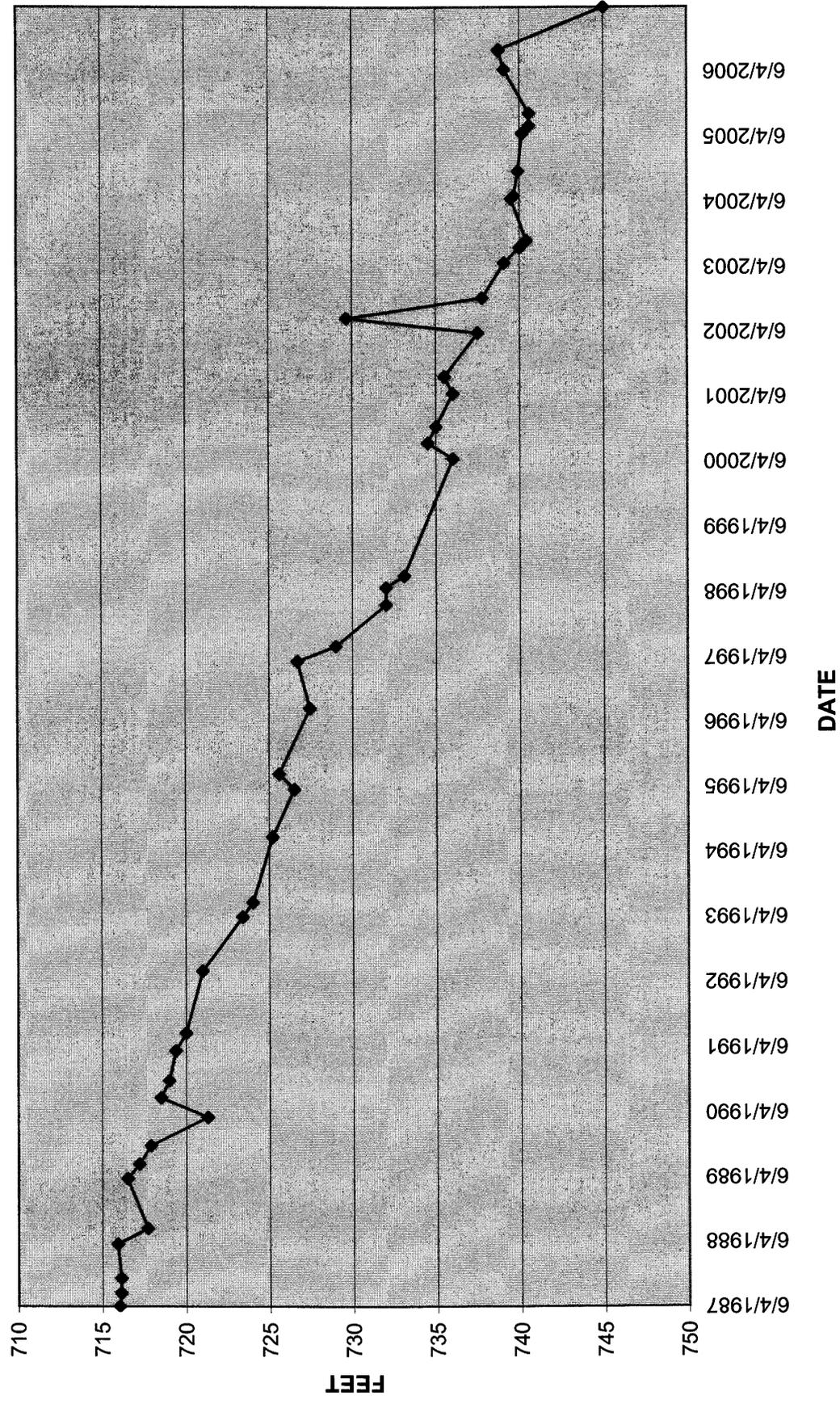
**ATTACHMENT 3**

Palmer Hydrologic Drought Index, Region 6 and 7, 1991-2006  
Well Water Level Graphs for Dugout Canyon Mine

PHDI  
1981 - 2006

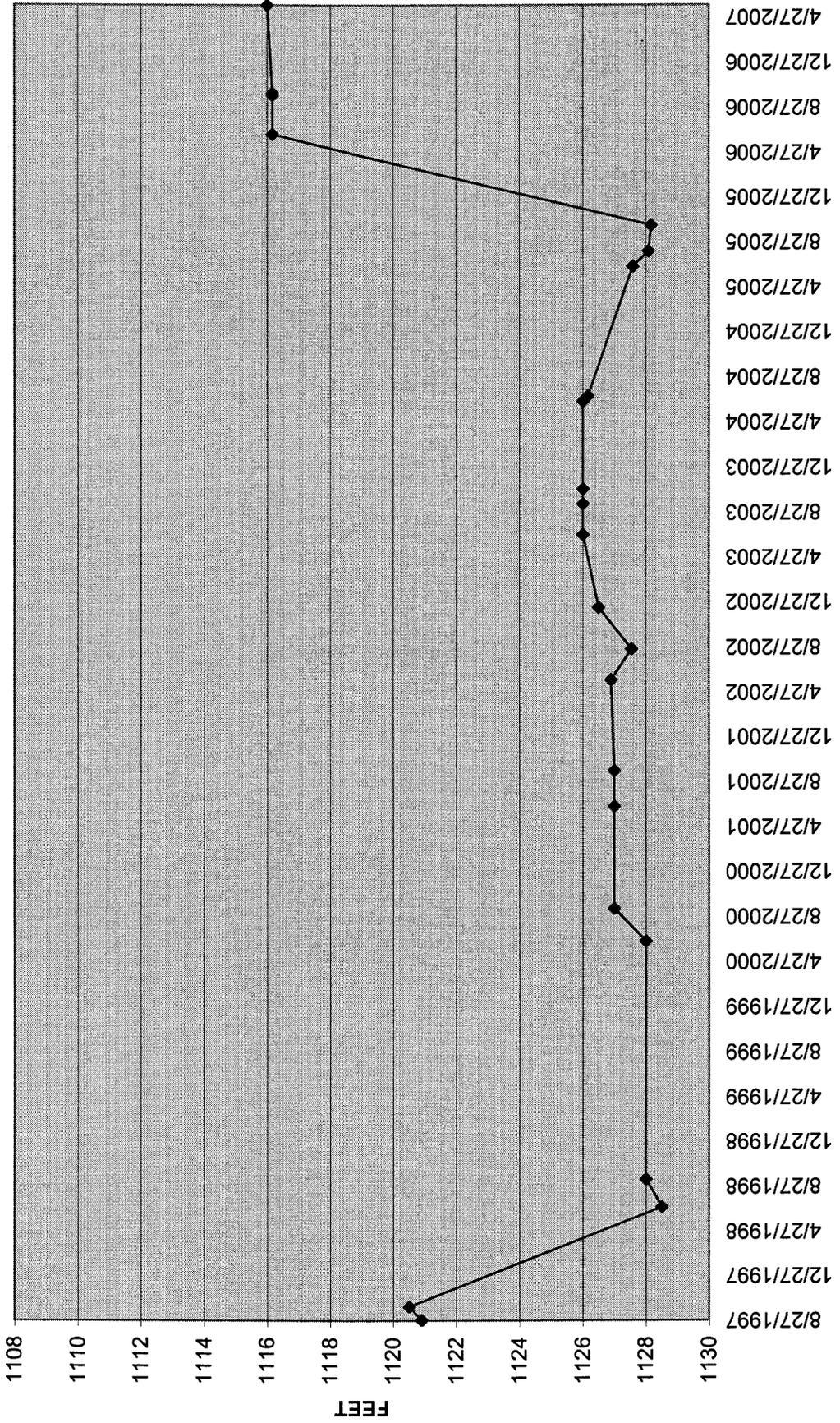


Well GW-10-2



Well GW-11-2

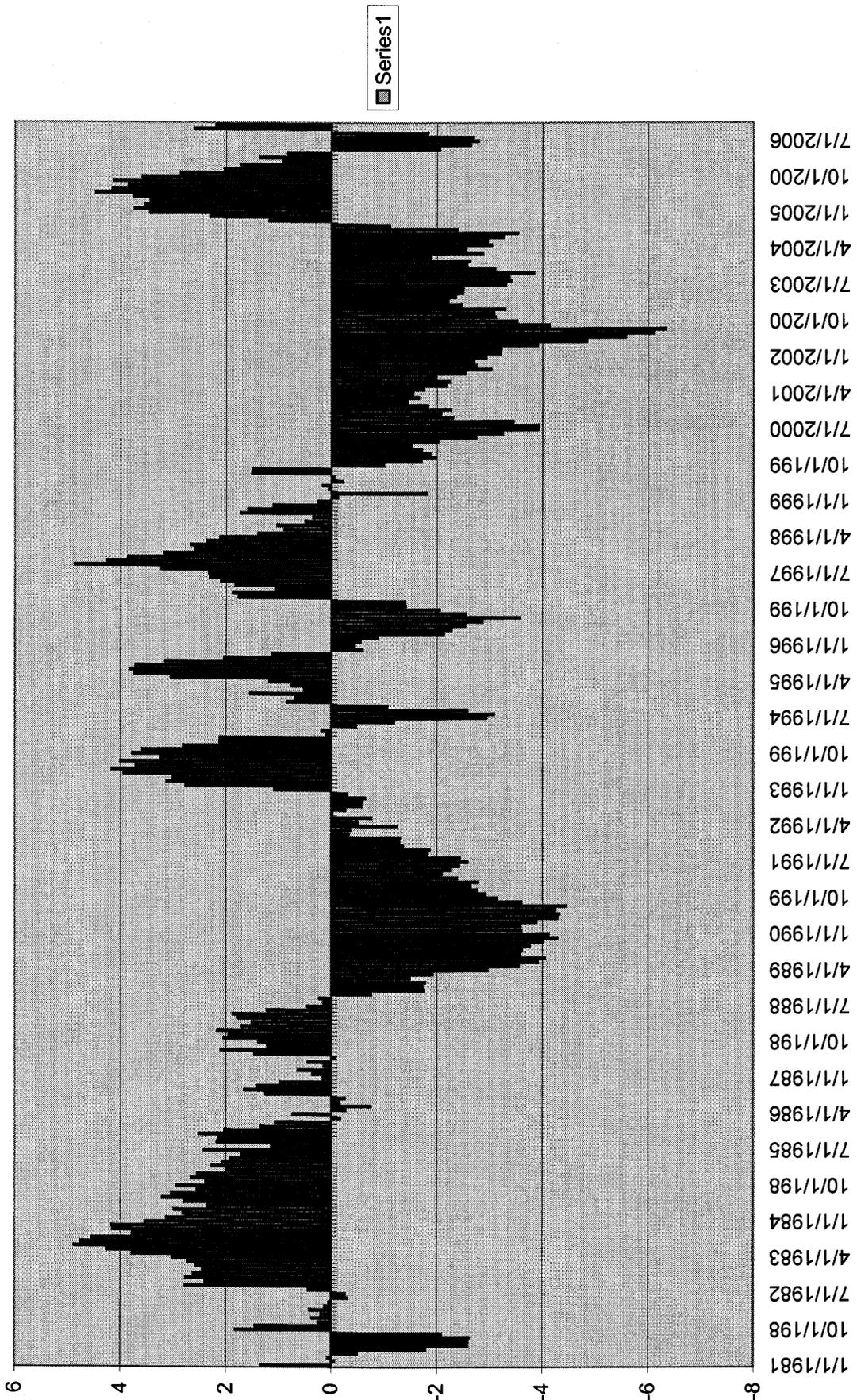
DATE



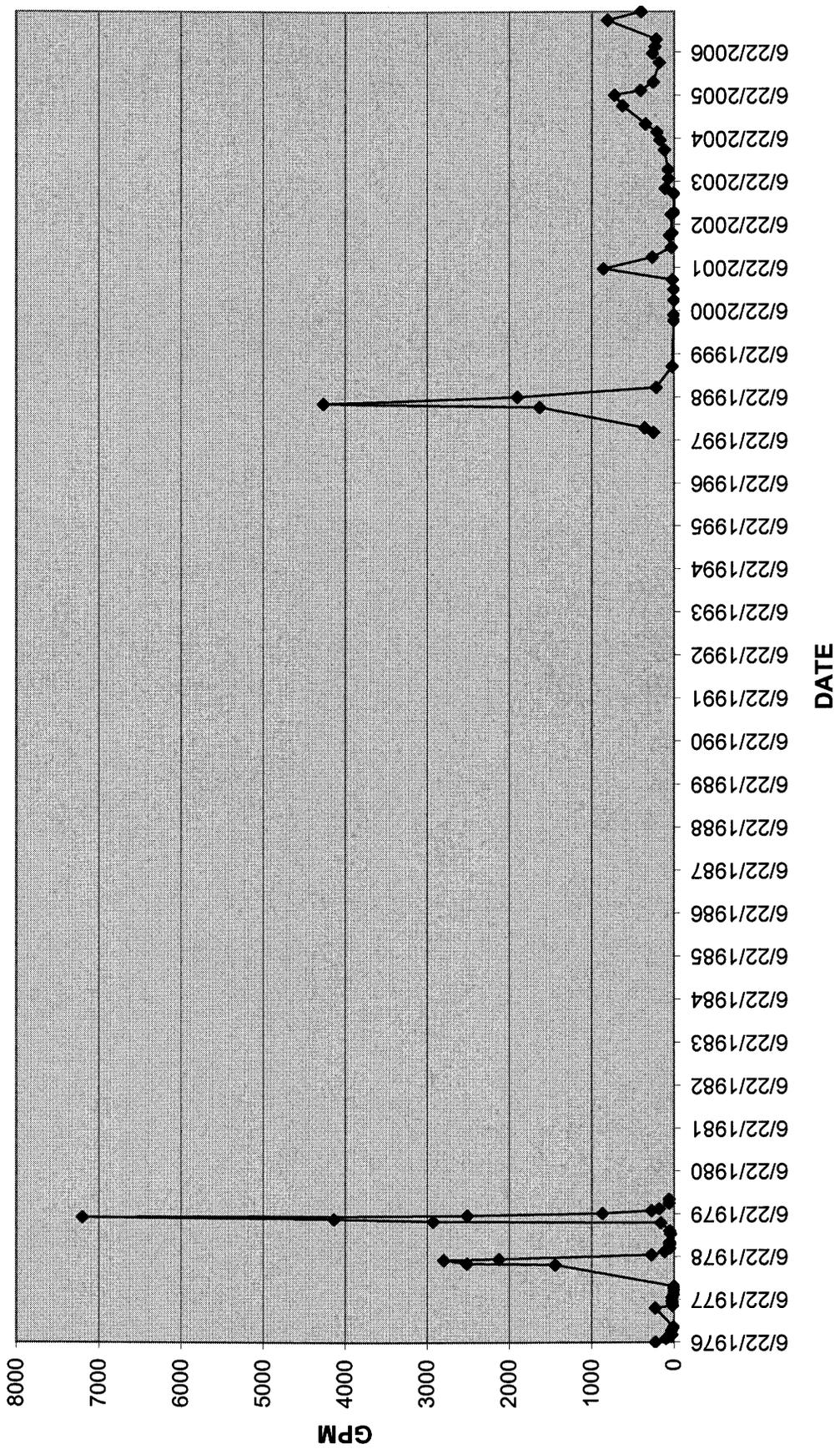
**ATTACHMENT 4**

Palmer Hydrologic Drought Index, Region 6 and 7, 1991-2006  
Surface Water Flow Graphs for Dugout Canyon Mine Sites

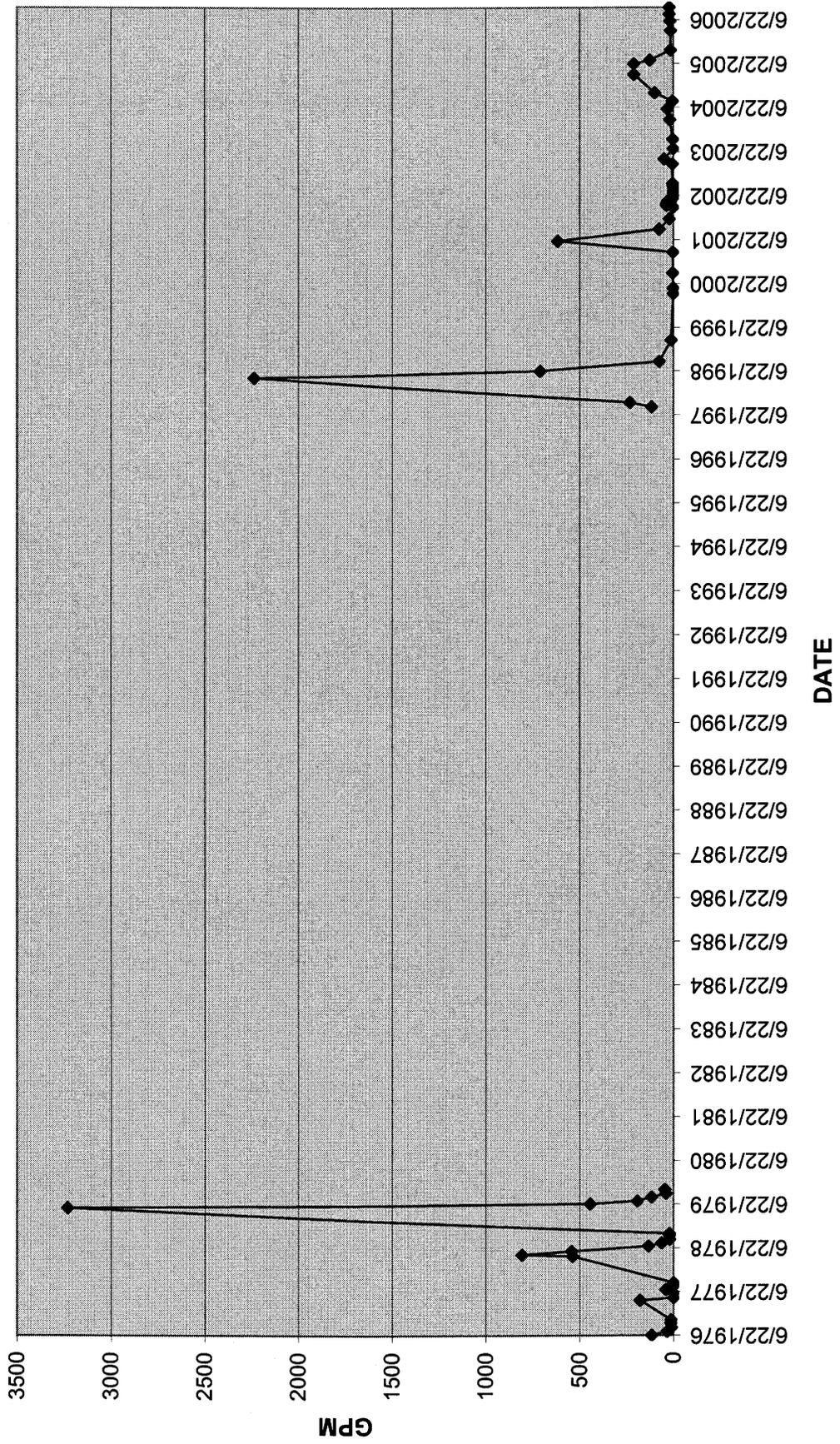
PHDI  
1981 - 2006



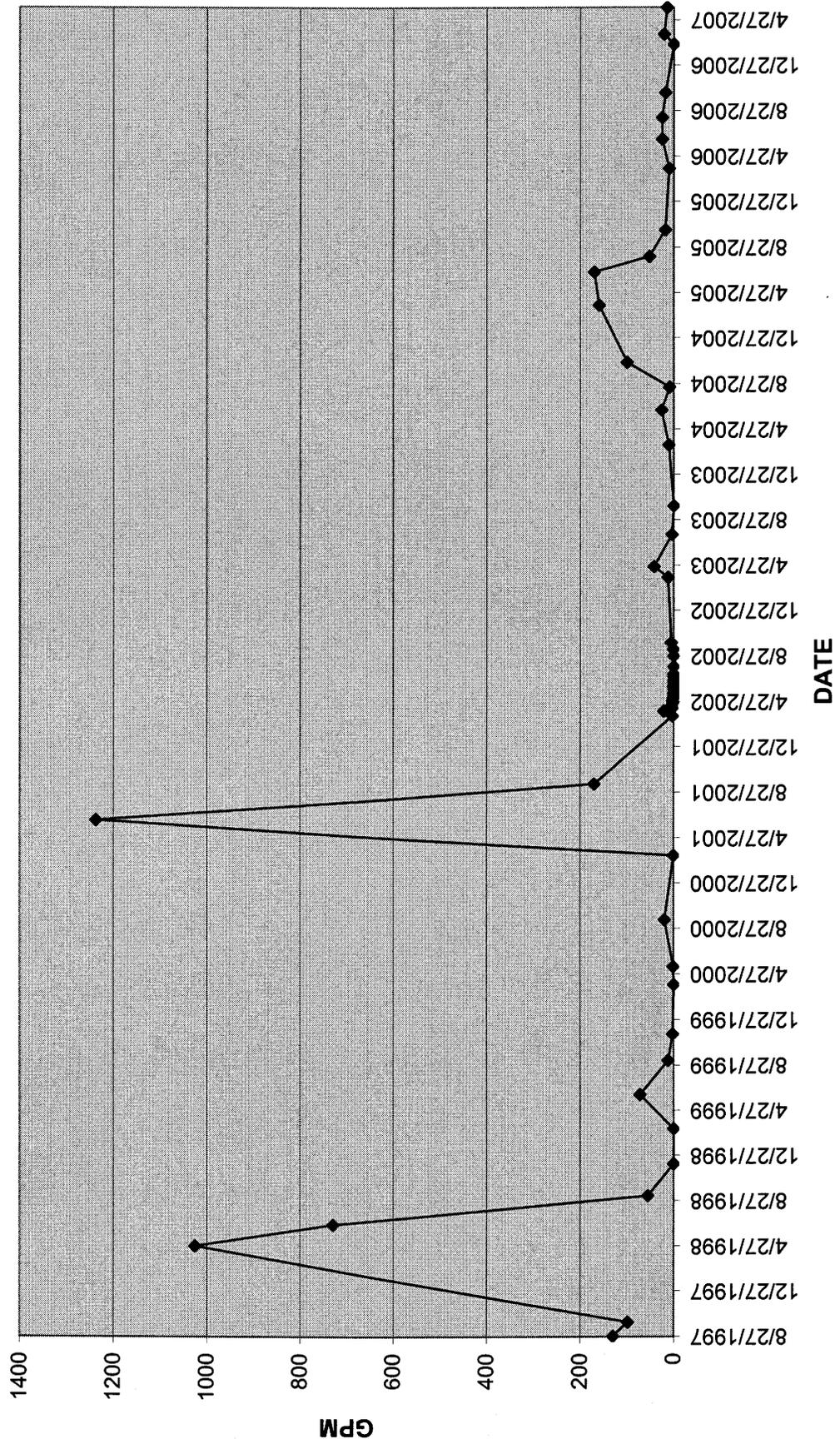
# Dugout Creek Flow DC-1



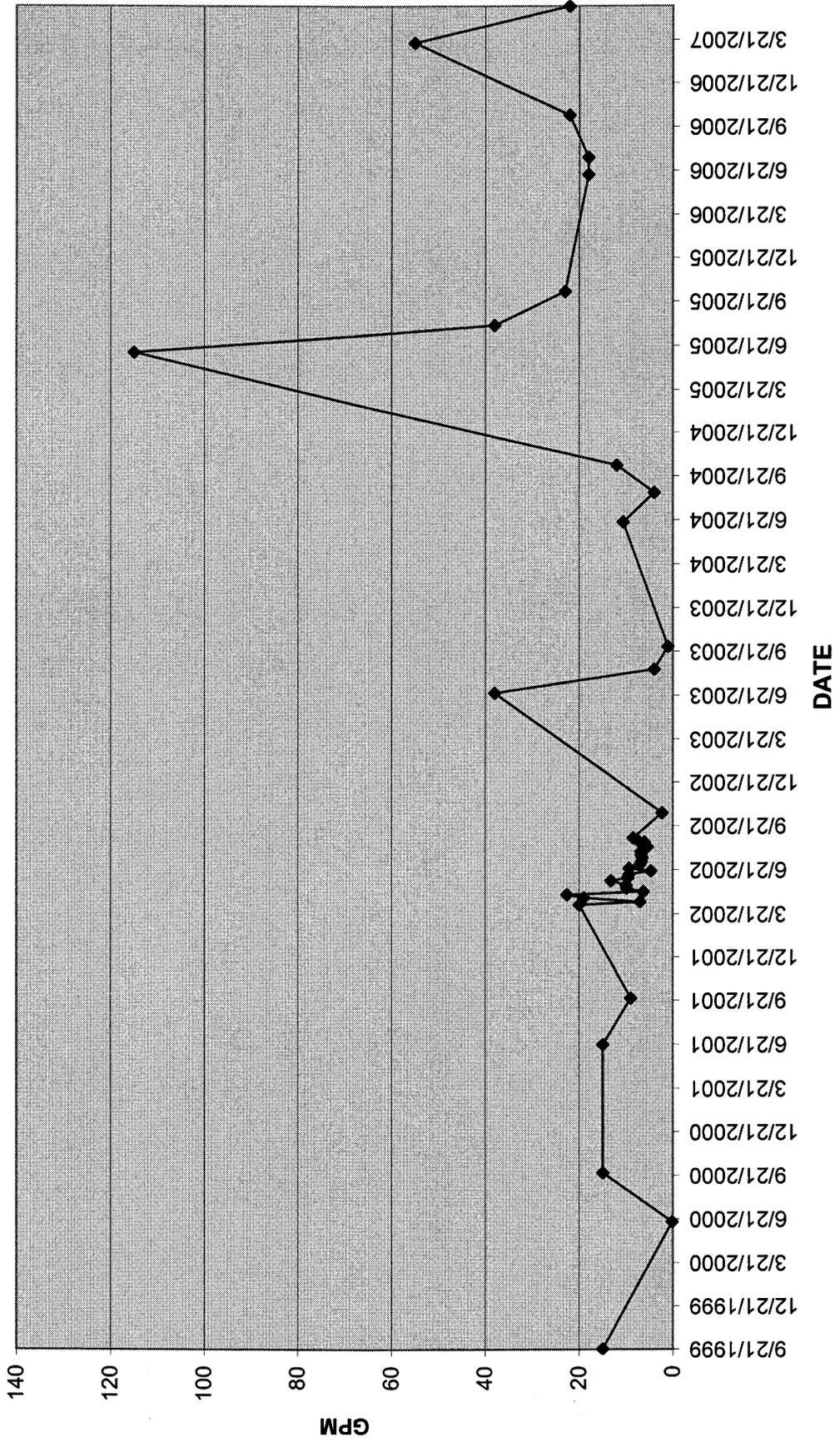
# Dugout Creek Flow - Left Fork DC-2



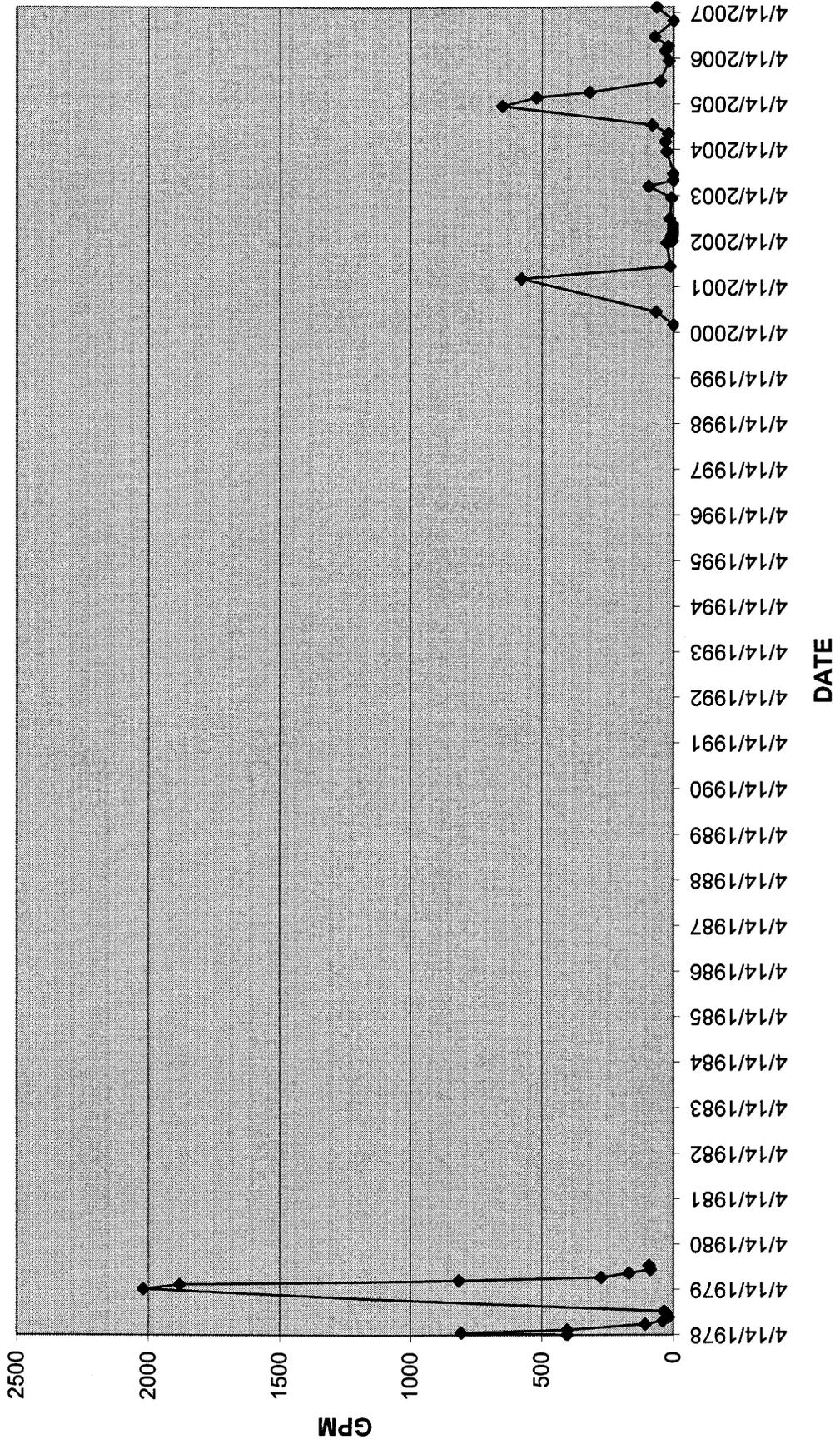
# Dugout Creek Flow - Right Fork DC-3



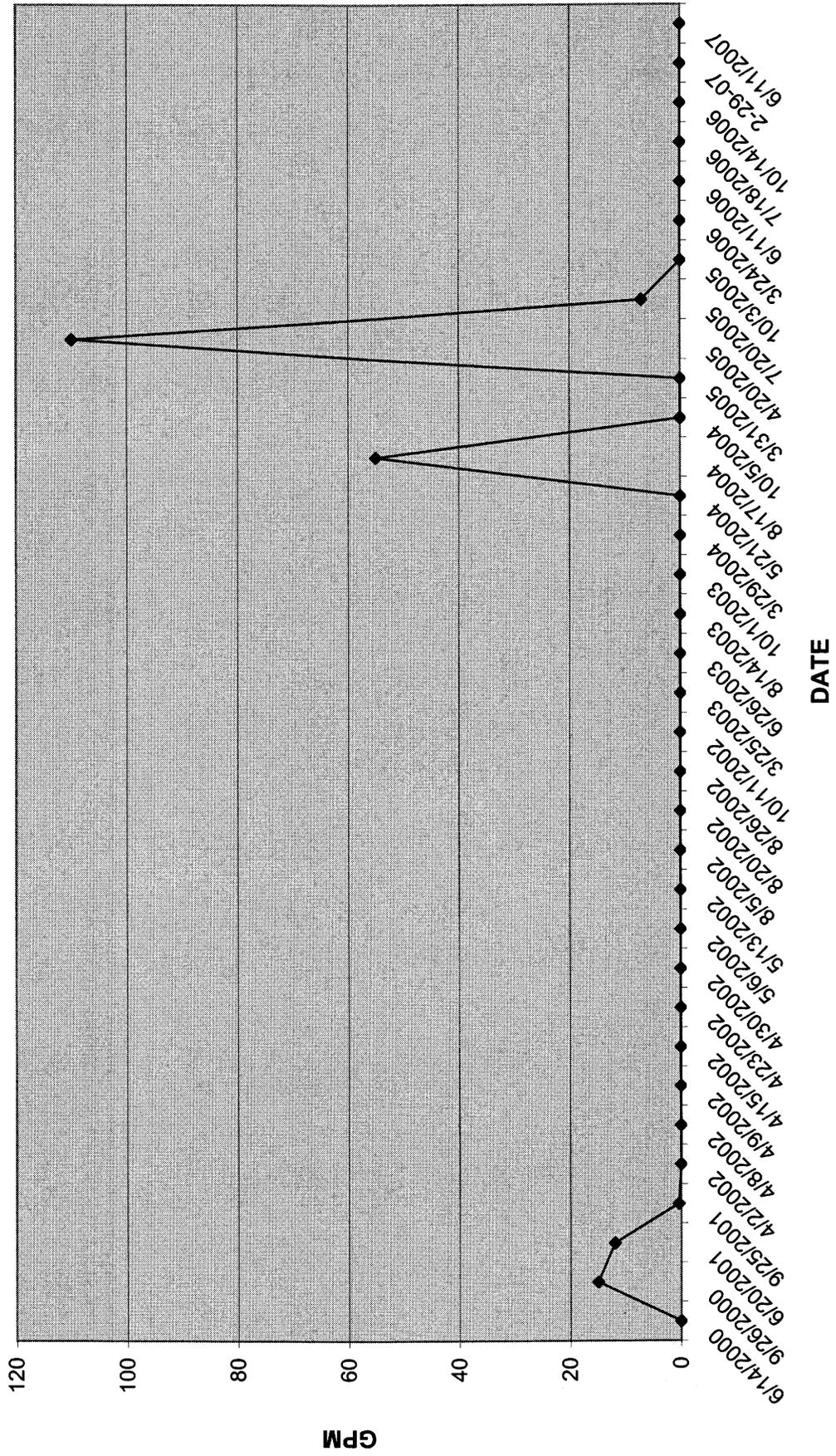
# Pace Creek Flow PC-1A



# Pace Creek Flow PC-2



# Rock Creek Flow RC-1



**APPENDIX 7-4**

Monitoring Well Water-Level Data  
and Well Logs

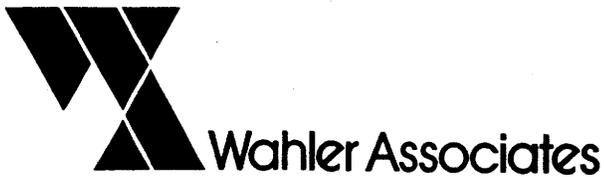
**SAGEPOINT/DUGOUT CANYON  
BASIC HYDROGEOLOGIC DATA REPORT**

**Prepared for:**

**SUNEDCO COAL COMPANY  
7401 W. MANSFIELD AVENUE  
LAKEWOOD, COLORADO 80235**

**WAHLER ASSOCIATES  
12477 W. CEDAR DRIVE, SUITE 206  
LAKEWOOD, COLORADO 80228**

**December 15, 1982**



Wahler Associates

Geotechnical and Water Resources Engineering

December 15, 1982  
SED102

Mr. Charles W. Durrett  
Environmental Coordinator  
Sunedco Coal Company  
7401 W. Mansfield Ave.  
Lakewood, Colorado 80235

Dear Mr. Durrett:

Wahler Associates (WA) is pleased to submit with this letter a summary of work performed at Sunoco Energy Development Co.'s (Sunedco) Sage Point/Dugout Canyon property in Carbon County, Utah. The work performed is to be used in support of Sunedco's application (ACT/007/007) entitled Sage Point/Dugout Canyon Project, SMCRA Permit Application Chapter IV-B, Hydrology. The scope of work included the performance of static water levels, falling head tests, preparation and presentation of test results, and the preparation of a ground water potentiometric map for each of the aquifers on the property. Soldier Canyon Mine, which is adjacent to Sunedco's property, ground water data were also evaluated.

#### PROJECT OVERVIEW

The field work was directed by Mr. Joel Siegel, WA staff water resources engineer. The field work was initiated November 1, 1982. Water data were collected from five monitoring well locations (Figure 1) described below:

Mr. Charles W. Durrett  
December 15, 1982  
Page 2

<u>Well Number</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Top of Casing Elevation In Feet Above Sea Level</u>
5-1	394315	1103548	7186
10-2	384254	1103333	6626
11-2	394221	1103205	8204
19-1	394112	1103022	8254
24-1	394046	1103055	8416

The wells were established by Eureka Energy Co. (Eureka), the prior property owner, between 1976 and 1979. These wells are further described in Sunedco's application noted above.

Water level data were collected from all five wells. Only well 19-1 was found dry (Table 1). These data were used in conjunction with data previously collected by Eureka (Table 1) in developing the potentiometric level map (Figure 1) for the property.

Falling head tests were performed at three of the five wells. Wells 19-1 and 24-1 were not accessible owing to poor weather and road conditions.

#### TEST PROCEDURES

A 2000 gallon clean water truck, provided by Western Exploration, was used to carry water to each of the monitoring wells. Static water levels were taken at the wells, after which an additional head was applied to the aquifer. This was done via the injection of water into the wells from the water truck. Water level measurements were taken prior to and during all tests using an Olympic well probe. The levels were measured frequently during the early stages of the test, and several hours apart after a few hours had passed.

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Because the representative value of elapsed time from which transmissivity values were calculated from the data is on the order of 1000 minutes, the significance of early time data is less than what was anticipated at the time of testing.

Wells 10-2 and 11-2 were filled to within 100 feet of the ground surface. Well 5-1 was filled to approximately 20 feet below ground surface. Time was allowed for each well to settle, which generally occurred 5 to 10 minutes after filling. Response of the Price River formation aquifer was slow at both test locations (wells 10-2 and 11-2).

Well 5-1 displayed a very slow decline in head. Therefore, the time between measurements was increased from minutes to hours after test initiation. This test was in the coal members of the Blackhawk formation.

#### DATA ANALYSIS

The basic equation for the residual head in a well, to which an initial excess is applied, was modified in order to determine the transmissivity of the Price River formation. Assumptions implicit in the analysis are that water levels in the formation are affected by the recharge only in the immediate vicinity of the well, and that the storativity is small. These assumptions are applicable for the Price River formation. This type of analysis does not allow for the determination of aquifer storativity.

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December 15, 1982  
Page 4

Attachment I includes all data in tabular form for each of the 3 tests, and time-residual head plots for the Price River formation (wells 10-2 and 11-2). A simplified analysis for determining Blackhawk formation coal (well 5-1) transmissivity is included in Attachment I, as well as a description of the graphical procedures applied to the data from the Price River formation. All field test data is given in Attachment II.

### RESULTS

The transmissivity of the Price River formation aquifer at the locations tested on the Sage Point/Dugout Canyon property is 1 gallon per day per foot (gpd/ft). This value is a reliable order of magnitude estimate. The transmissivity of the formation apparently decreased with time during falling head tests at wells 10-2 and 11-2. The stated confidence in the results is well within the normally expected range for falling head tests.

A simple analytical procedure for determining the coupled transmissivity of the Sunnyside and Rock Canyon coal members of the Blackhawk formation is described in Attachment I-C. The conclusion that can be drawn from well 5-1 data is that the coals of the Blackhawk formation are near-impermeable. The transmissivity is 0.009 gpd/ft.

The results of the aquifer tests indicate that the strata of the Price River formation and the coal seams of the Blackhawk formation have limited aquifer potential. The calculated transmissivities of the strata are so low that water development would be uneconomical,

Mr. Charles W. Durrett  
December 15, 1982  
Page 5

even for domestic or stock-watering uses. Therefore, the strata of the Price River and Blackhawk formations should not be considered aquifers.

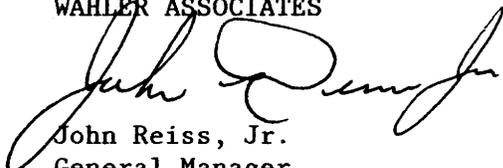
POTENTIAL HEAD DATA AND MAP

Table 2 summarizes potential head data with reference to both ground elevation and mean sea level for all wells monitored by WA during the time period November 1-5, 1982. Figure 1 is a potentiometric map for the Price River formation, and was based upon data from Table 2.

WA is confident that the content of this report, inclusive of data and backup calculations, is sufficient for presentation to the Office of Surface Mining and Utah Division of Oil, Gas and Mining as a base-line hydrologic report for the Sage Point/Dugout Canyon property. Please call if we can be of any further assistance.

Sincerely,

WAHLER ASSOCIATES



John Reiss, Jr.  
General Manager  
Rocky Mountain Region

JR:br

TABLE 1  
 WATER LEVEL DATA COLLECTED BY EUREKA ENERGY CO. \*

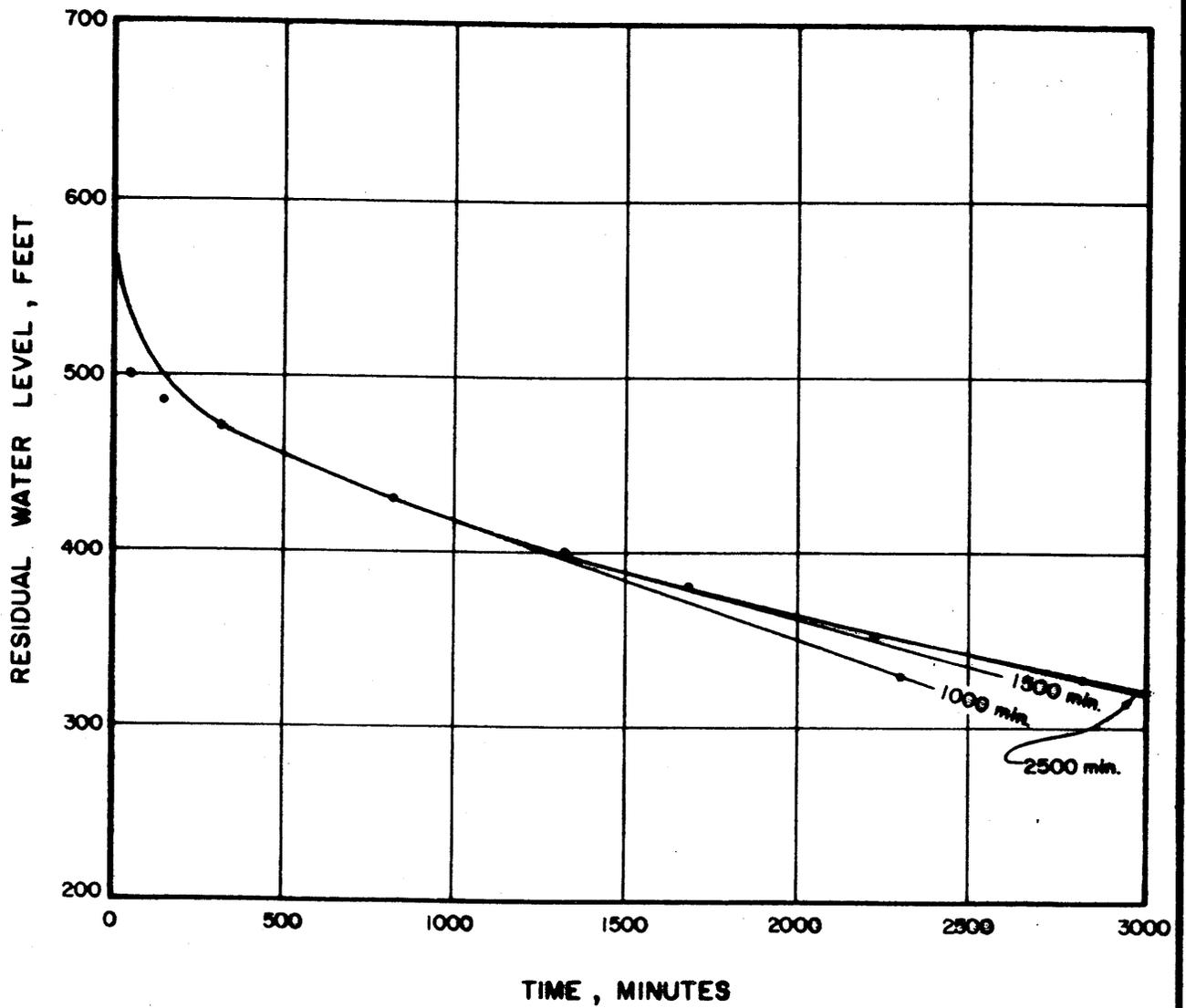
DATA	MONITORING WELLS				
	5-1 Sunnyside & Rock Canyon Coal	10-2 Middle Castlegate Sandstone	11-2 Price River	19-1 North Horn	24-1 Lower Castle gate Sandstone (PR)
Collar Altitude (FT MSL)	7186.38	7727.39	8203.79	8254	8416
Dates Sampled (ft below land surface)					
November, 1979		--		--	--
16					
23					
24					
26	139.90				
27		348.44			759.75
December, 1979					
12	159.91	640.62	1119.65	312.26	895.72
January, 1980					
10		709.03	1123.51		
19	180.77				
24				311.40	
February, 1980					
14			1123.32		
15	197.72	711.86			
March, 1980					
17	208.29	710.60			
18			1121.25	296.95	1019.92
April, 1980					
9	215.15	710.46	1121.15	228.29	1024.41
April, 1981					
1	275.92	711.23	1119.17		

\* Data provided by Sunoco Energy Development Co.

TABLE 2  
 WATER LEVEL SUMMARY  
 SAGE POINT/DUGOUT CANYON PROPERTY  
 NOVEMBER, 1982

WELL NUMBER	GEOLOGIC FORMATION	TOP OF CASING ELEVATION IN FEET ABOVE MEAN SEA LEVEL	STATIC WATER LEVEL BELOW TOP OF CASING IN FEET	STATIC WATER LEVEL IN FEET ABOVE MEAN SEA LEVEL	DATE OF MEASUREMENT
5-1	Sunnyside and Rock Canyon Coals	7186	304.9	6881.1	11-4-82
10-2	Price River Formation	7727	715.8	7011.2	11-3-82
11-2	Price River Formation	8204	1127.6	7076.4	11-4-82
19-1	North Horn Formation	8254	Dry <sup>1</sup>	—	11-2-82
24-1	Price River Formation	8416	1020	7396	11-2-82

<sup>1</sup>Used two probes to depths of 750 feet; both verified as working; well has no water.



**Wahler Associates**

**SUNEDCO COAL COMPANY**

**RESIDUAL HEAD VS. TIME,  
WELL 10-2**

PALO ALTO • NEWPORT BEACH • DENVER

PROJECT NO.

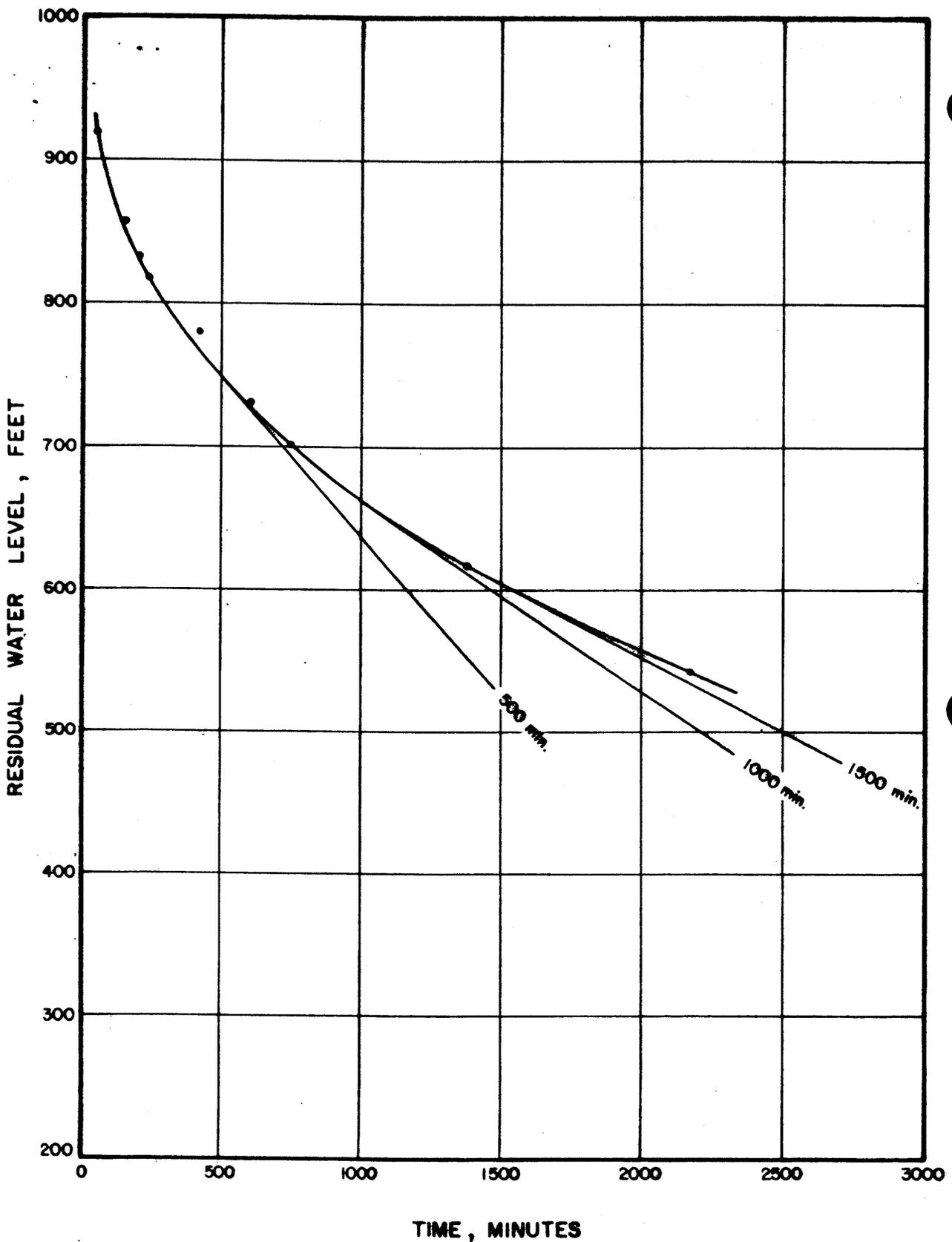
SED-102A

DATE

NOVEMBER 1982

FIGURE NO.

1-1



**Wahler Associates**

**SUNEDCO COAL COMPANY**

**RESIDUAL HEAD VS. TIME,  
WELL 11-2**

PALO ALTO • NEWPORT BEACH • DENVER

PROJECT NO.

DATE

FIGURE NO.

SED-102A

NOVEMBER 1982

1-2

ATTACHMENT I  
GENERAL EQUATIONS

## ATTACHMENT I

### A. General Equation for the Residual Head in a Well

Theis (1935) presented the equation for the drawdown in an instantaneous vertical line source.<sup>1</sup> The equation provides a useful method for estimating the transmissivity of a formation in the vicinity of a well, which is a physical approximation of the theoretical vertical line source. Ideally, a "slug" of water is injected into a fully developed well at time  $t=0$ . The well theoretically penetrates the full length of the aquifer in question, a condition met by each well, 10-2 and 11-2. The equation for the residual head is then written as:

$$s = \frac{Q \exp(-r^2S/4Tt)}{4\pi Tt} \quad [1]$$

where

- s = residual water level after injection of the water, measured with respect to the original water table.
- r = distance from the injection well to an observation point
- t = time since injection of the slug
- Q = volume of the slug
- T = aquifer transmissivity
- S = aquifer storativity

Generally, only a small volume of water is injected into a well. For this reason, the reaction to the injected slug usually is not measurable in the aquifer beyond the immediate vicinity of the well. Therefore, the water-level measurements are made only in the injection well; the distance is then the radius of the well. For values of  $r$  as small as the well radius, especially where  $S$  is small (as for artesian aquifers), the argument of the exponential in equation 1 approaches zero as  $t$  becomes large and the value of the exponential terms approaches unity. Then, for a consistent set of units, transmissivity can be represented as:

$$T = \frac{Q}{4\pi st} \quad [2]$$

A plot of  $s$  versus  $1/t$  should be a straight line which passes through the origin. Any coordinate of the line should thus yield a value for  $T$ .

### B. Specific Technique for Transmissivity Determination from test Data of Wells 11-2 and 10-2

Observed data for wells 11-2 and 10-2 did not plot on a straight line, nor was there a trend for any of the locally straight segments on either plot to pass through the origin. This may be attributed

<sup>1</sup>Theis, C.V., 1935, The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage: Amer. Geophys. Union Trans., 16th Ann. Mtg., pt.2, p. 519-524

to poor well construction techniques. The water levels in both wells were asymptotic not to the original static level, but to levels more than 200 feet higher. WA has speculated that all of the additional excess head was indeed necessary to force water into the formation and to overcome head loss associated with the perforations in the casing. At later time, the residual excess head in the well was not great enough to overcome severe head loss, through the perforations, thus causing a relatively slow decline in the water level and a correspondingly low apparent transmissivity.

Assuming that the water levels were displaced by some constant value due to well inefficiency during the tests, WA has employed a differential form of equation 2 to determine transmissivity from the graphs of Figures I-1 and I-2, which represent time-residual head data for wells 10-2 and 11-2 respectively. The key to the analysis is that T is determined from the predicted rate of fall of the water level rather than its actual position at various times during the test. Consequences of the analysis is that the apparent transmissivity of the formation is found at various points in time, with the gradual decrease being attributed more and more to poor well completion. In addition, the trend for the water table not to return to static is removed from the analysis.

Equation 2 is rearranged as:

$$T = \frac{-Q}{4\pi(ds/dt)t^2} \quad [3],$$

and the slope of the time-residual head curve (always negative) is measured at various values of time, t. Table 1 summarizes the values of transmissivity for the Price River formation as obtained by equation 3. Using 1000 as a time during the test for which T is representative, the transmissivity of the Price River formation aquifer is approximately 1 gpd/ft.

#### C. Coal Transmissivities as Derived from Well 5-1 Data

An estimate of the transmissivity of the coal members of the Blackhawk formation is possible by applying Darcy's law to the observed data for well 5-1. This is done by calculating the volume of water lost to the formation from the well over a given time, and dividing it by the average gradient in the immediate vicinity of the well during the time period. As water is not likely to have penetrated too far radially into the formation, the assumption that the formation gradient is equal to the average excess head during the time period of interest is reasonable. Therefore,

$$T = Q/i\Delta t\pi d \quad [4],$$

where:

- Q = volume of water lost to formation during time  $\Delta t$
- i = average excess head during time  $\Delta t$
- $\pi d$  = the "width" of well screen, if unfolded, normal to the flow.

For well 5-1, use  $i = 280.2$  ft/ft between times of 2 and 1922 minutes. Then  $\Delta t = 1.33$  days, and  $Q = 4.5$  feet ( $7.48$  gallons/ft<sup>3</sup>) ( $\pi d^2/4$ ), or 4.6 gallons. Then:

$$T = 4.6 \text{ gallons} / (280.2)(1.33 \text{ days}) \pi(.417 \text{ ft})$$

$$T = 0.009 \text{ gpd/ft}$$

TABLE I-1  
SUMMARY OF TRANSMISSIVITY VALUES FROM  
PRICE RIVER FORMATION AQUIFER TESTS

A. Well 10-2<sup>\*</sup>

time t (min)	slope ds/dt (ft/min)	transmissivity T (gpd/ft) <sup>***</sup>
1000	90/1300	1.04
1500	30/550	0.59
2500	42/1000	0.27

B. Well 11-2<sup>\*\*</sup>

time t (min)	slope ds/dt (ft/min)	transmissivity T (gpd/ft) <sup>***</sup>
500	110/500	2.19
1000	40/300	0.91
1500	30/300	0.54

\* Volume of slug =  $Q = (\pi d^2/4)(\text{initial excess head})(7.48 \text{ gal/ft}^3)$   
= 627 gallons

\*\* Volume of slug =  $Q = (\pi d^2/4)(\text{initial excess head})(7.48 \text{ gal/ft}^3)$   
= 1053 gallons

\*\*\*  $T = 114.6Q/(ds/dt)t^2$ , for units used.

ATTACHMENT II  
FIELD TEST DATA



# FIELD PERMEABILITY TEST

## FALLING HEAD

PROJECT SAGE POINT/DUGOUT CANYON  
 PROJECT NO. SED102A  
 BORING NO. 10-2

TESTED BY JOEL SIEGEL DATE 11-3-82  
 CALCULATED BY Joel Siegel DATE 11-9-82  
 CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

DIAMETER OF BORING N/A  
 DIAMETER OF CASING 5 INCH PERMEABILITY, K \_\_\_\_\_  
 HEIGHT OF CASING (REF. LEVEL) \_\_\_\_\_  
 ABOVE GROUND SURFACE 2.3 FT. PUMPING FROM: \_\_\_\_\_ TO \_\_\_\_\_  
 PERFORATED CASING FROM: \_\_\_\_\_ TO \_\_\_\_\_  
 TYPE OF PERFORATION: \_\_\_\_\_  
 DEPTH TO GROUND WATER \_\_\_\_\_  
 FROM TOP OF CASING (STATIC) 715.8 FT PUMPING RATE: \_\_\_\_\_

DATE AND TIME	ELAPSED TIME (MIN)	DEPTH TO WATER (ft)	S.W.L.-DEPTH TO WATER (ft) H	H/H <sub>0</sub>	INVERSE TIME (MIN <sup>-1</sup> )
11-3-82 8:31	0	715.8 *	—	—	—
9:06	0	101.0	614.8	1	—
9:09	3	125.4	590.4	.96	33.3 × 10 <sup>-2</sup>
9:11	5	139.6	576.2	.94	20.0 × 10 <sup>-2</sup>
9:13	7	146.5	569.3	.93	14.3 × 10 <sup>-2</sup>
9:15	9	149.7	566.1	.92	11.1 × 10 <sup>-2</sup>
9:18	12	150.8	565.0	.92	8.33 × 10 <sup>-2</sup>
9:23	17	182.6	533.2	.87	5.88 × 10 <sup>-2</sup>
9:27	21	195.3	520.5	.85	4.76 × 10 <sup>-2</sup>
9:39	33	212.4	503.4	.82	3.03 × 10 <sup>-2</sup>
9:47	41	213.8	502.0	.82	2.44 × 10 <sup>-2</sup>
10:00	54	215.8	500.0	.81	1.85 × 10 <sup>-2</sup>
10:34	88	220.6	495.2	.81	1.14 × 10 <sup>-2</sup>
11:12	126	225.2	490.6	.80	0.79 × 10 <sup>-2</sup>
11:39	153	229.5	486.3	.79	0.65 × 10 <sup>-2</sup>
12:03	177	231.1	484.7	.79	0.56 × 10 <sup>-2</sup>
12:41	215	235.0	480.8	.78	0.46 × 10 <sup>-2</sup>
13:19	253	238.8	477.0	.78	0.39 × 10 <sup>-2</sup>
14:26	320	245.1	470.7	.77	0.31 × 10 <sup>-2</sup>
15:18	372	249.8	466.0	.76	0.27 × 10 <sup>-2</sup>
20:13	667	273.2	442.6	.72	0.15 × 10 <sup>-2</sup>
22:49	823	284.1	431.7	.70	0.12 × 10 <sup>-2</sup>
11-4-82 07:14	1328	315.6	400.2	.65	0.075 × 10 <sup>-2</sup>
13:12	1686	335.0	380.8	.62	0.059 × 10 <sup>-2</sup>

COMMENTS: \* STATIC LEVEL .



# FIELD PERMEABILITY TEST

## FALLING HEAD

PROJECT SAGE POINT/DUGOUT CANYON  
 PROJECT NO. SED102A  
 BORING NO. 11-2

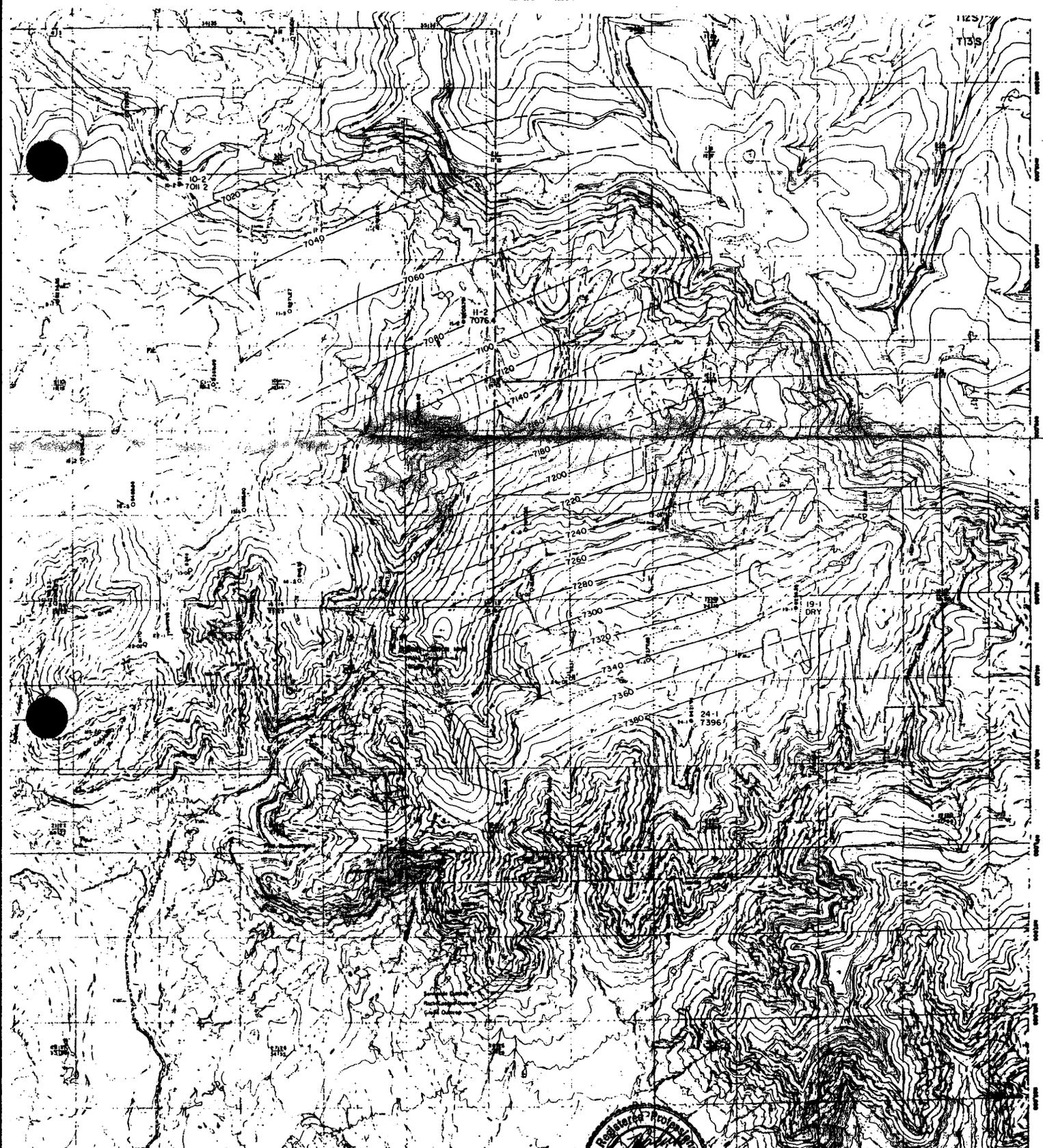
TESTED BY JOEL SIEGEL DATE 11-4-  
 CALCULATED BY joel siegel DATE 11-9-  
 CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

DIAMETER OF BORING N/A  
 DIAMETER OF CASING 5 INCH PERMEABILITY, K \_\_\_\_\_  
 HEIGHT OF CASING (REF. LEVEL)  
 ABOVE GROUND SURFACE 2.4 FT. PUMPING FROM: \_\_\_\_\_ TO \_\_\_\_\_  
 PERFORATED CASING FROM: \_\_\_\_\_ TO \_\_\_\_\_  
 TYPE OF PERFORATION: \_\_\_\_\_  
 DEPTH TO GROUND WATER  
 FROM TOP OF CASING (STATIC) 1127.6 FT PUMPING RATE: \_\_\_\_\_

DATE AND TIME	ELAPSED TIME (MIN)	DEPTH TO WATER (ft)	S.W.L.-DEPTH TO WATER (ft) H	H/H <sub>0</sub>	INVERSE TIME (MIN <sup>-1</sup> )
11-4-82 7:40	0	1127.6 *	—	—	—
8:53	0	95.3	1032.3	1	—
8:56	3	119.2	1008.4	.98	$33.3 \times 10^{-2}$
9:01	8	130.0	997.6	.97	$12.5 \times 10^{-2}$
9:02	9	143.4	984.2	.95	$11.1 \times 10^{-2}$
9:06	13	172.1	955.5	.93	$7.69 \times 10^{-2}$
9:09	16	184.1	943.5	.91	$6.25 \times 10^{-2}$
9:15	22	187.9	939.7	.91	$4.55 \times 10^{-2}$
9:21	28	193.7	933.9	.90	$3.57 \times 10^{-2}$
9:28	35	198.9	928.7	.90	$2.86 \times 10^{-2}$
9:41	48	208.0	919.6	.89	$2.08 \times 10^{-2}$
10:00	67	221.3	906.3	.88	$1.49 \times 10^{-2}$
10:22	89	234.0	893.6	.87	$1.12 \times 10^{-2}$
10:45	112	247.9	879.7	.85	$0.89 \times 10^{-2}$
11:25	152	270.6	857.0	.83	$0.66 \times 10^{-2}$
11:48	175	281.3	846.3	.82	$0.57 \times 10^{-2}$
12:16	203	294.2	833.4	.81	$0.49 \times 10^{-2}$
12:40	227	303.5	824.1	.80	$0.44 \times 10^{-2}$
12:58	245	309.7	817.9	.79	$0.41 \times 10^{-2}$
15:00	427	349.3	779.3	.75	$0.23 \times 10^{-2}$
16:53	480	372.1	755.5	.73	$0.21 \times 10^{-2}$
18:52	599	397.1	730.5	.71	$0.17 \times 10^{-2}$
21:23	750	425.5	702.1	.68	$0.13 \times 10^{-2}$
11-5-82 07:53	1380	512.3	615.3	.60	$0.072 \times 10^{-2}$
21:08	2175	584.6	543.0	.53	$0.046 \times 10^{-2}$

COMMENTS: \* STATIC LEVEL

END OF TEST

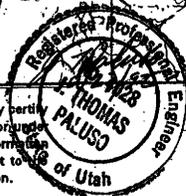


LEBTD

- Outline of Sunoco
- Measured Section of Outcrop
- Mead Out Area
- Outcrop
- Proposed Road
- Proposed Railroad
- Oil & Gas Test Well

- Surface Elevation
- 11-2 7076.4 Drill Hole Number
- 7100 Static Water Level Elevation
- Price River Formation
- Equal Potential Contour
- 5 to 10 Feet Above Mean
- Sea Level, Dashed
- Where Merged

I, being a professional engineer hereby certify that this map was prepared by me or under my direct supervision and that all information contained thereon is true and correct to the best of my knowledge and information.



**REVISED**  
SEP 08 1992



**Wahler Associates**  
PALO ALTO • NEWPORT BEACH • DENVER

SUNEDCO COAL COMPANY  
SAGE PT. - DUGOUT CANYON PROJECT

GENERALIZED PRICE RIVER FORMATION  
POTENTIOMETRIC LEVEL MAP

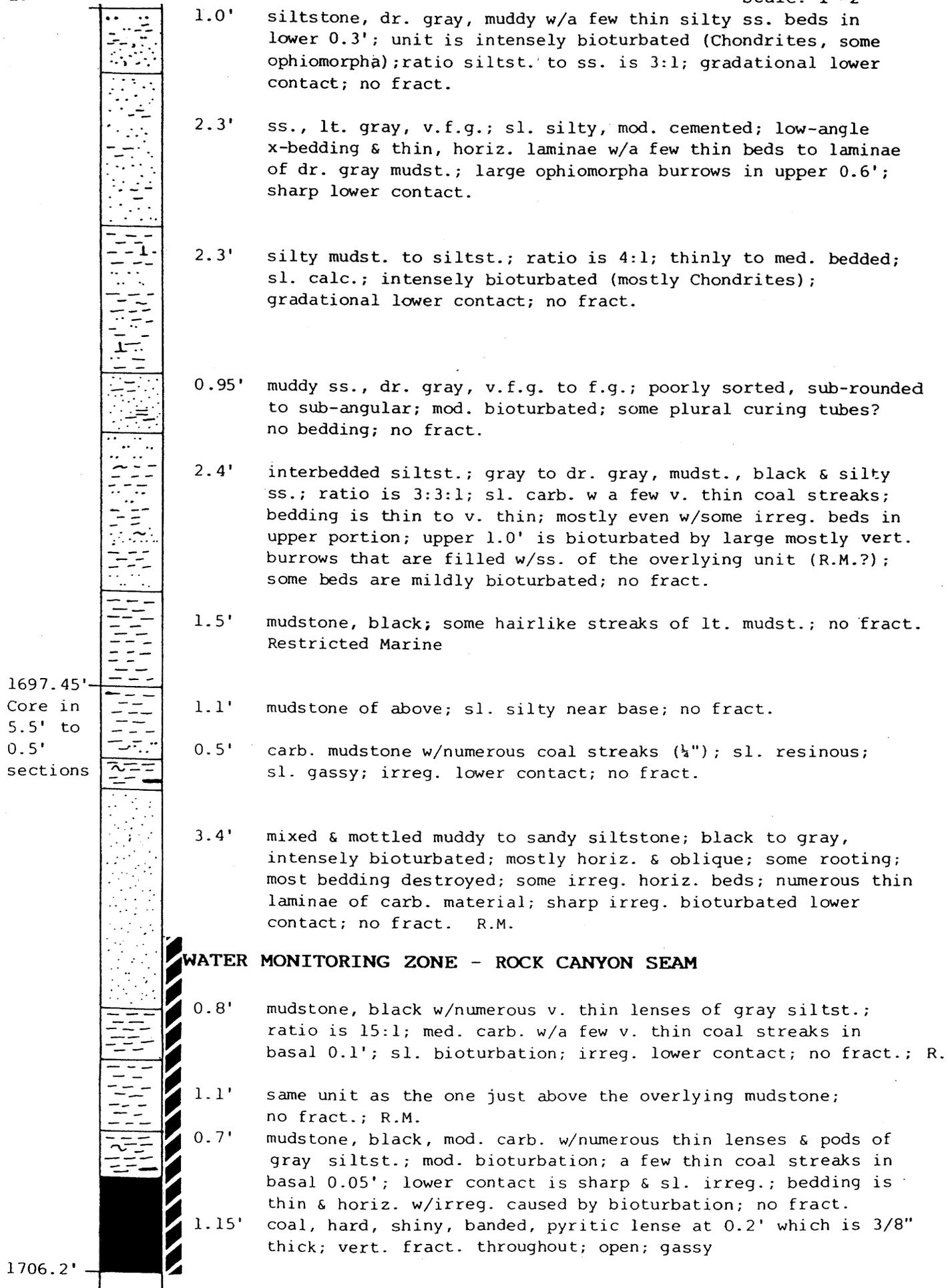
PROJECT NO	SED-102	FIGURE NO	1
SCALE:	1" = 2000	DATE	NOVEMBER 1982

GEOLOGIC LOGS  
WATER LEVEL MONITORING WELLS

WELL 5-1



	0.35'	carb. mudstone; thin, numerous coal streaks; sl. resinous; no fract.
	0.4'	bone coal; sl. resinous; hard; vert. fract. throughout; closed; numerous coal streaks
	0.5'	carb. mudstone, sl. resinous; numerous thin coal streaks; no fract.
	0.55'	coal, hard, shiny; resinous; gassy, vert. fract. throughout; clos
	0.25'	bone coal; resinous w/coal streaks; vert. fract. throughout; closed, gassy
	0.35'	high-ash coal, resinous; small vert. fract. throughout; closed
	5.75'	coal, hard, shiny; sl. resinous; gassy, small vert. & oblique closed fract. (cleat); 0.05' pyrite streak at 0.0'; Sunnyside coal seam
	<b>WATER MONITORING ZONE - SUNNYSIDE SEAM</b>	
1567.7' Core in 3.9' to 1.1' sections	3.85'	coal, as above; thin, closed cleat; fract. throughout, open vert. fract. from 1.5' to 3.7'; Sunnyside, sharp lower contact
	0.3'	carb. mudstone, sl. resinous; numerous v. thin coal streaks & plant frag.; sl. sandy; no fract.
	1.45'	sandstone, lt. gray to gray, v.f.g.; sub-rounded, mod. to well sorted; sl. calc.; mod. cementing; semi-porous; gassy; contains a few thin irreg. laminations of carb. mat. & a rare thin coal streak; lower contact is break in core-sharp; vert. fract. from 0.25' to end; closed; calcite filled
	1.2'	sandy siltst., lt. gray, sl. calc., ss. is v.f.g. as above; unit fines toward base; contains a few thin discont. lenses of dr. carb. mudst., thin coal streak at base; tr. pyrite; vert. fract. throughout; closed & calcite filled
	2.35'	interbedded sandy siltst.; sandstone of two units above & mudst., dr. gray to carb.; ratio is 3:3:2; sl. calc.; unit is v. thinly & mostly reg. horiz. bedded; finest units from 1.0' to 1.6'; upper 1.0' and lower 0.45' are semi-porous & gassy; unit is sl. bioturbated horiz. & vert.; vert. fract. from 0.0' to 0.4'; closed & calcite filled
	0.35'	mudstone, black. sl. carb.; w/thin lentils of lt. gray siltst; vert. fract. from 0.1' to end-open
1578.05' Core in 2.4' to 0.2' sections	0.85'	interbedded, mixed & mottled, sandstone, v.f.g. to f.g.; sub-angular to sub-rounded; poorly sorted; "salt & pepper"; mod. cem. semi-porous & mudst. gray to black; occasionally sl. carb.; ratic is 3:2; bedding is thin & irreg.; mottling is caused by intense bioturbation (horiz. & vert.); washover R.M.; vert. fract. 0.0' to 0.3', open.
		Plugged to next core pt.



1706.2'  
Core in  
3.6' to  
broken  
sections

10.0' coal, hard, shiny, a rare thin streak of resin; vert. open fract. from 0.0' to 1.0'; 1.3' to 1.9'; 3.3' to end; (50% lost from 8.7' to 10.0') coal is broken in this zone and sl. pyritic; gassy

**WATER MONITORING ZONE - ROCK CANYON SEAM**

1716.2'  
Core in  
5.4' to  
broken  
sections

1.7' coal, as above; sl. pyritic; banded; gradational lower contact; vert. open fract. throughout & broken; exact thickness is in question; gassy

0.65' bone coal; hard, banded, numerous coal streaks; sl. resinous; sl. pyritic; vert. open fract. from 0.0' to 0.3'

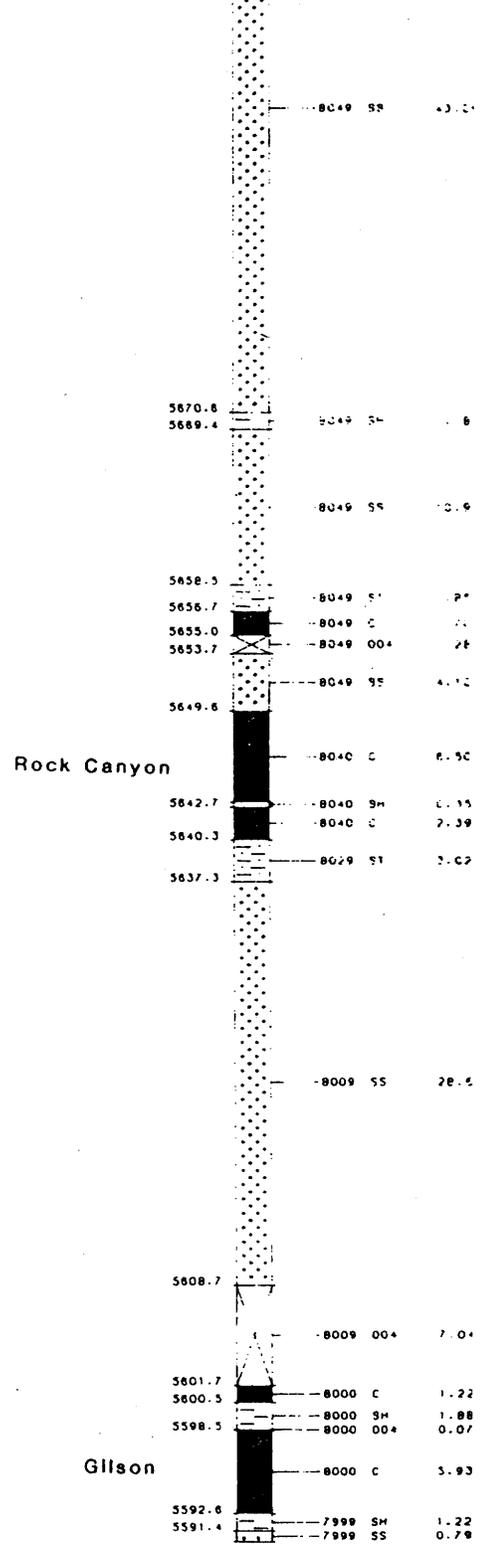
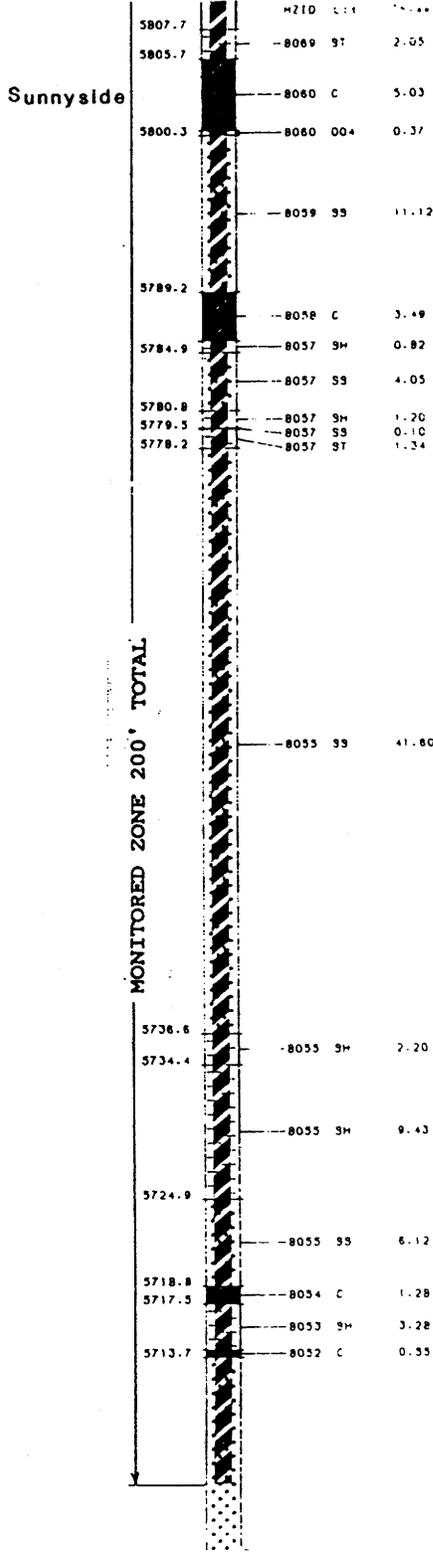
0.5' mudstone, carb. silty, black, a few v. thin coal streaks; irreg. grad. lower contact; no fract.

6.0' interbedded, mixed & mottled, sandy siltst.; lt. gray v.f.g.; silty to carb. mudstone; ratio is 1:1; bedding is mostly convoluted w/some thin horiz. bedding w/carb. laminae; sharp erosional contacts on sandy beds at 2.3' & at base of unit; some mottling caused by mod. bioturbation; lowest section contains some small clay intraclasts; unit is calc. below 3.0'; ve: fract.(open) from 0.5' to end; two major sets running through the core; polished break at 1.8' & 4.0'

1.95' ss., gray, v.f.g., mod. sorting, sub-rounded to sub-angular; friable, calc.; semi to non-porous; upper  $\frac{1}{2}$  is x-bedded; lower portion is mostly horiz.; bedding planes contain (cont. next page)

WELL 6-1

# DRILL HOLE 6-1-89



WELL 10-2

1483'

Core #1 1483'-1486'; rec. 3'

2' ss., gray, v.f.g.; well sorted; sub-rounded; numerous interbedded laminations of carb. material

1486'

1' same as above w/o carb. material.

Core #2 1486'-1495.5'; rec. 5.5'

1' ss., med. gray, med. grained; subangular to subrounded; well sorted w/common carb. laminae, esp. heavy at 86.5'; lt. to dr. banded 1" (lam. perpendicular to core indicating flat bedding).

1487'-1492'

5' ss, med. gray; subang. to subrounded; well sorted; fair porosity w/occ. streaks black carb. lam. at 10° to 30° to core indicating x-lam.; core parting on 30° thin carb. lam. at 1489'; at 1488.5' top of vert. fract. running to 92.3'; fract. is partly healed in top with druzy white, crystalline quartz open voids ¼" to ½"; core badly broken along vert. fract. at 90' to 92'; ss. is mod. friabl

1486-1489' solid core; no breaks

1489-1492' badly fract; vert. fract. partly open w/ subhedral quartz lining.

1492-1496.5' solid core; no breaks

1492'-1493.5'

1.5' ss., med. gray, med. grained; well sorted subang.; tr. muscovite; w/scattered black, rounded granules of carbon (check out under binocs) massive or indistinctly lam.

1493.5'-1494.5'

1.0' ss, as above; being faintly to distinctly lam. w/ carb. partings at 80° to 85° to core (est. 5-10° from horiz.) in irreg. small-scale x-lam. trough sets.

2.0' ss., as above; being slightly coarser grained to est. .3 to .4 mm (maximum) w/tr. angular chert or stained quartz, micas as above; sl. carb. w/faint lam. perpendicular to core; tr. white cherty infilling; fair to good porosity; faint sulfur odor on fresh break.

1496.5'

WATER MONITORING ZONE - 1400' TO 1650'

WELL 32-1



DUGOUT CANYON MINE  
MDW G18A

COLLAR START POINT  
X=93320.1  
Y=86414.3  
ELEV.=8354'

14' CASING  
CEMENTED WITH 4  
SUPER SACKS  
PORTLAND CEMENT  
AND 4 - 50#  
SACKS OF CALCIUM  
CHLORIDE

19' SURFACE HOLE TO 60'

14' SURFACE CASING SET AT 59.6'

9 $\frac{1}{2}$ ' CASING CEMENTED WITH 14  
SUPER SACKS OF PORTLAND CEMENT  
THRU THE TREMMIE AND 6 SUPER  
SACKS OF PORTLAND DOWN THE  
ANNULUS. 3-50# SACKS OF CALCIUM  
CHLORIDE WERE MIXED WITH THE  
ANNULUS SLURRY.  
48-50# SACKS OF HOLE PLUG WAS  
POURED DOWN THE ANNULUS.

WATER ENCOUNTERED AT 1830'

7' BLANK CASING SET FROM \_\_\_\_\_  
TO \_\_\_\_\_

9 $\frac{1}{2}$ ' CASING SET AT 1956.55'

12 $\frac{1}{4}$ ' HOLE DRILLED TO 1987'

7' SLOTTED CASING SET FROM \_\_\_\_\_  
TO 2245'

END OF HOLE  
X=93105.1  
Y=86387.7  
ELV.=6127.2'  
TVD= 2226.75'

8.875' HOLE DRILLED TO 2246'

NOTE: NOT TO SCALE

~25 TO GILSON SEAM

GILSON SEAM

DUGOUT CANYON MINE  
MDW G31A

COLLAR START POINT  
X=84681.1  
Y=92982.8  
ELEV.=8168.2'

14' CASING  
CEMENTED WITH 1  
SUPER SACK  
PORTLAND CEMENT  
AND 1 50# SACK OF  
CALCIUM CHLORIDE

19' SURFACE HOLE TO 20'

14' SURFACE CASING SET AT 20'

9 $\frac{5}{8}$ ' CASING CEMENTED WITH 15  
SUPER SACKS OF PORTLAND CEMENT  
THRU THE TREMMIE AND 5 SUPER  
SACKS OF PORTLAND DOWN THE  
ANNULUS. 4-50# SACKS OF CALCIUM  
CHLORIDE WERE MIXED WITH THE  
ANNULUS SLURRY.  
52-50# SACKS OF HOLE PLUG WAS  
POURED DOWN THE ANNULUS.

WATER ENCOUNTERED 1044'

7' BLANK CASING SET FROM 1665.38'  
TO 1709.97'

9 $\frac{5}{8}$ ' CASING SET AT 1719.9'

12 $\frac{1}{4}$ ' HOLE DRILLED TO 1727'

7' SLOTTED CASING SET FROM 1709.97'  
TO 1954'

END OF HOLE  
X=84867.1  
Y=93068.8  
ELV.=6239.0'

8.875' HOLE DRILLED TO 1954'

NOTE: NOT TO SCALE

~25' TO GILSON SEAM

GILSON SEAM

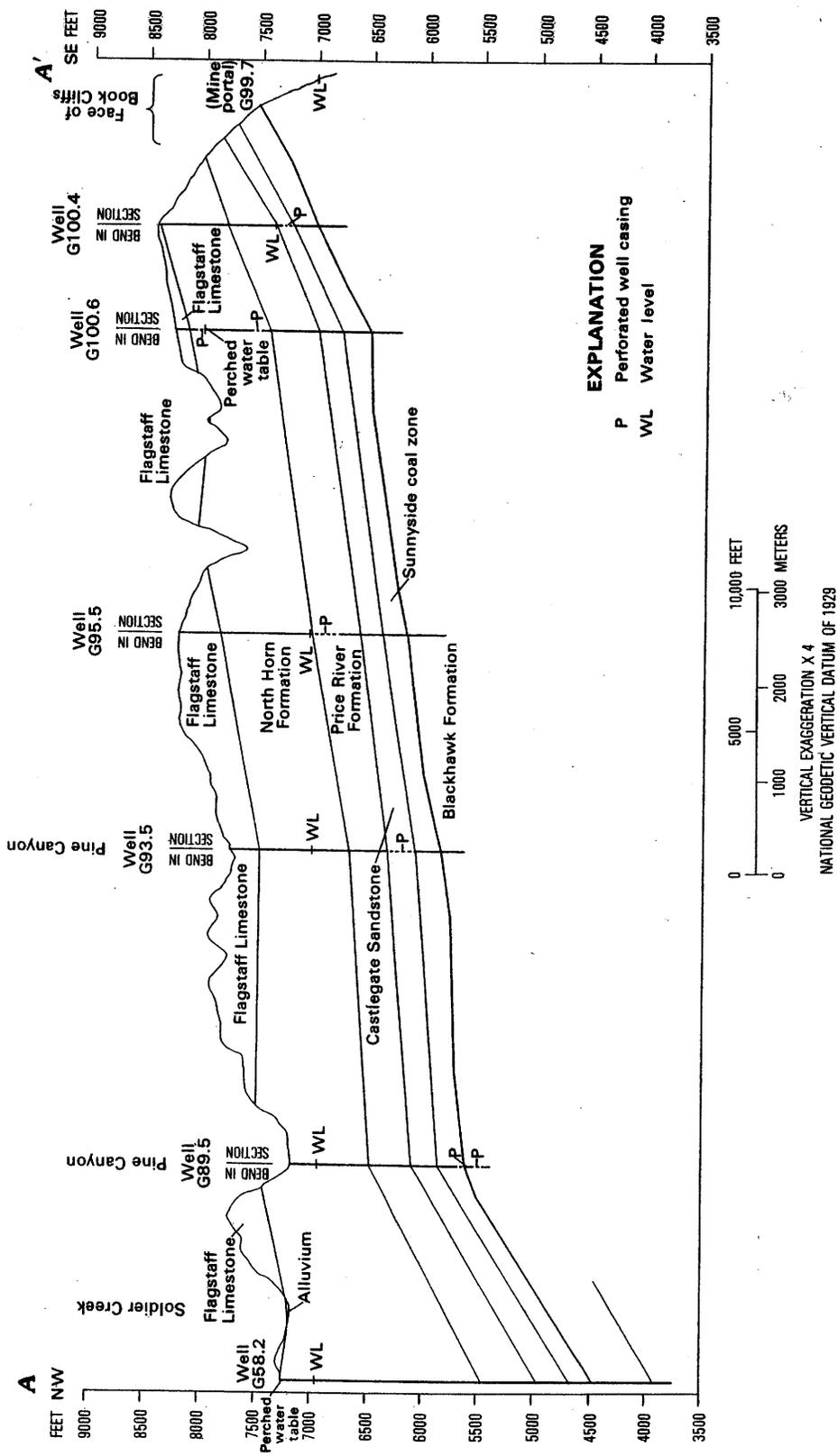
Hydrology of the  
Price River Basin, Utah  
with emphasis on  
Selected Coal-Field Areas

By K. M. Waddell, J. E. Dodge,  
D. W. Darby, *and* S. M. Theobald

Prepared in cooperation with the  
U.S. Bureau of Land Management

PORTIONS ONLY OF PAPER

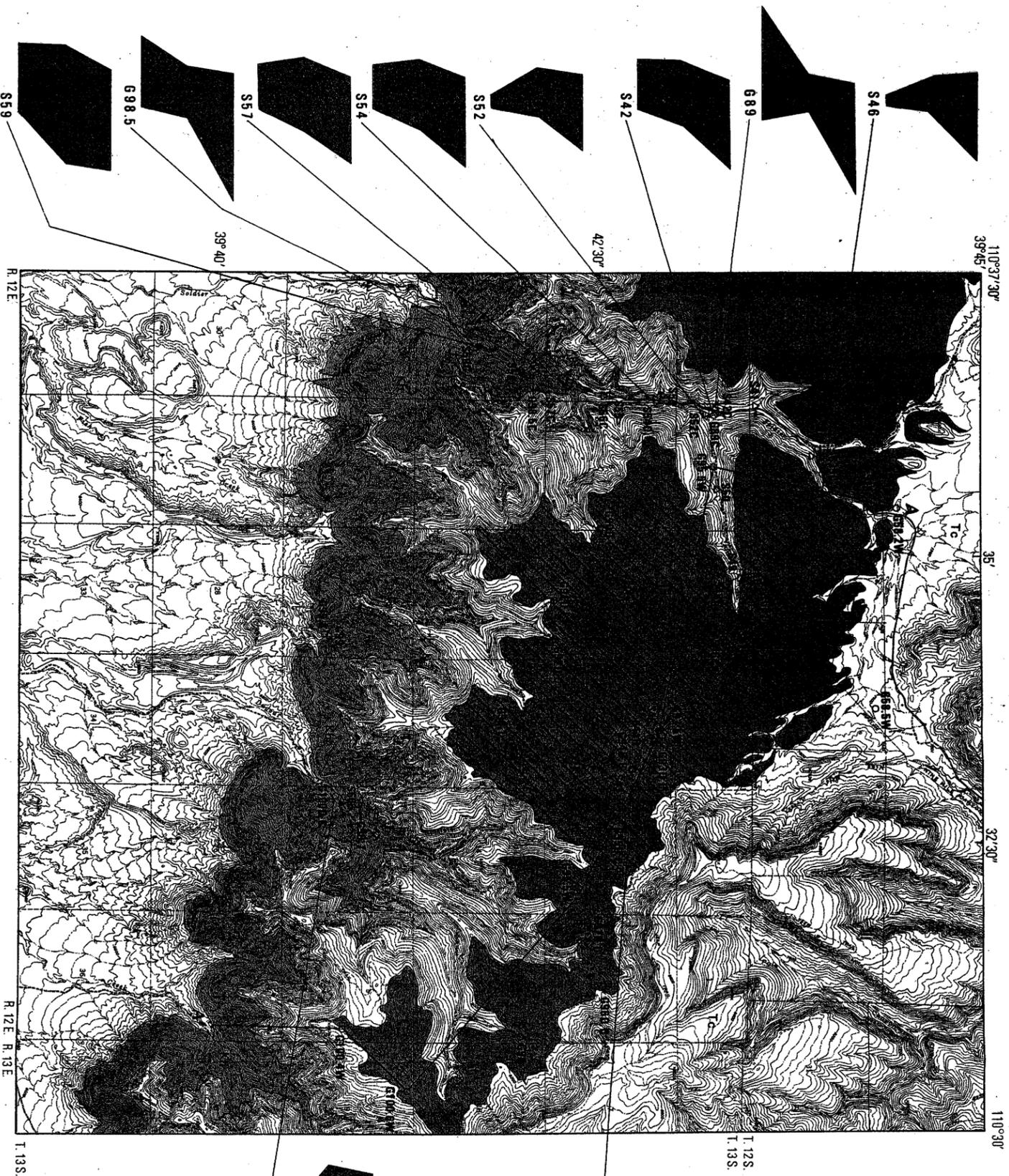
U.S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 2246



**Figure 19.** Generalized geologic section showing water levels in wells and a mine in the Soldier Creek area in the Book Cliffs, 1980. See plate 1 for line of section.

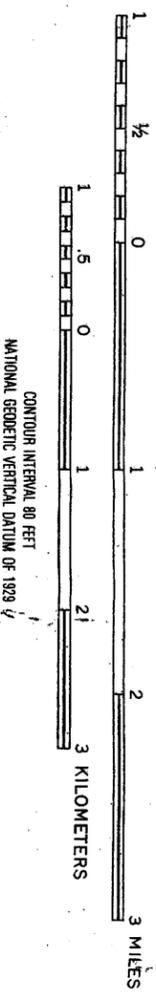
Wells G95.5, G100.6 and G100.4 shown on this drawing (Figure 19) are located within the 2008 permit boundary of the Dugout Canyon Mine. Refer to "Map Showing Geology and Data-Collection Sites for Ground Water, 1979 - 80 and Insert Showing Geology, Water Quality, and Hydrology Data-Collection Sites in a Part of the Soldier Creek Area, which follow this drawing.

INSET SHOWING GEOLOGY, WATER QUALITY, AND HYDROLOGIC DATA-COLLECTION SITES IN A PART OF THE SOLDIER CREEK AREA



Base from U.S. Geological Survey  
 Scaled, 1:24,000, 1979

SCALE 1:50 000



**EXPLANATION**

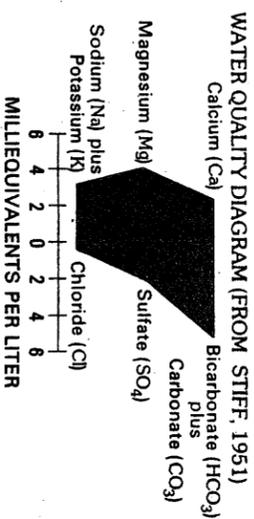
QUATERNARY	Qa	ALLUVIUM
TERTIARY	Tc	COLTON FORMATION
	Tkh	FLAGSTAFF LIMESTONE
	Tkn	NORTH HORN FORMATION
	Kp	PRICE RIVER FORMATION
CRETACEOUS	Kc	CASTLEGATE SANDSTONE
	Kb	BLACKHAWK FORMATION

— CONTACT

■ AREA USED FOR ESTIMATING RECHARGE TO FLAGSTAFF LIMESTONE

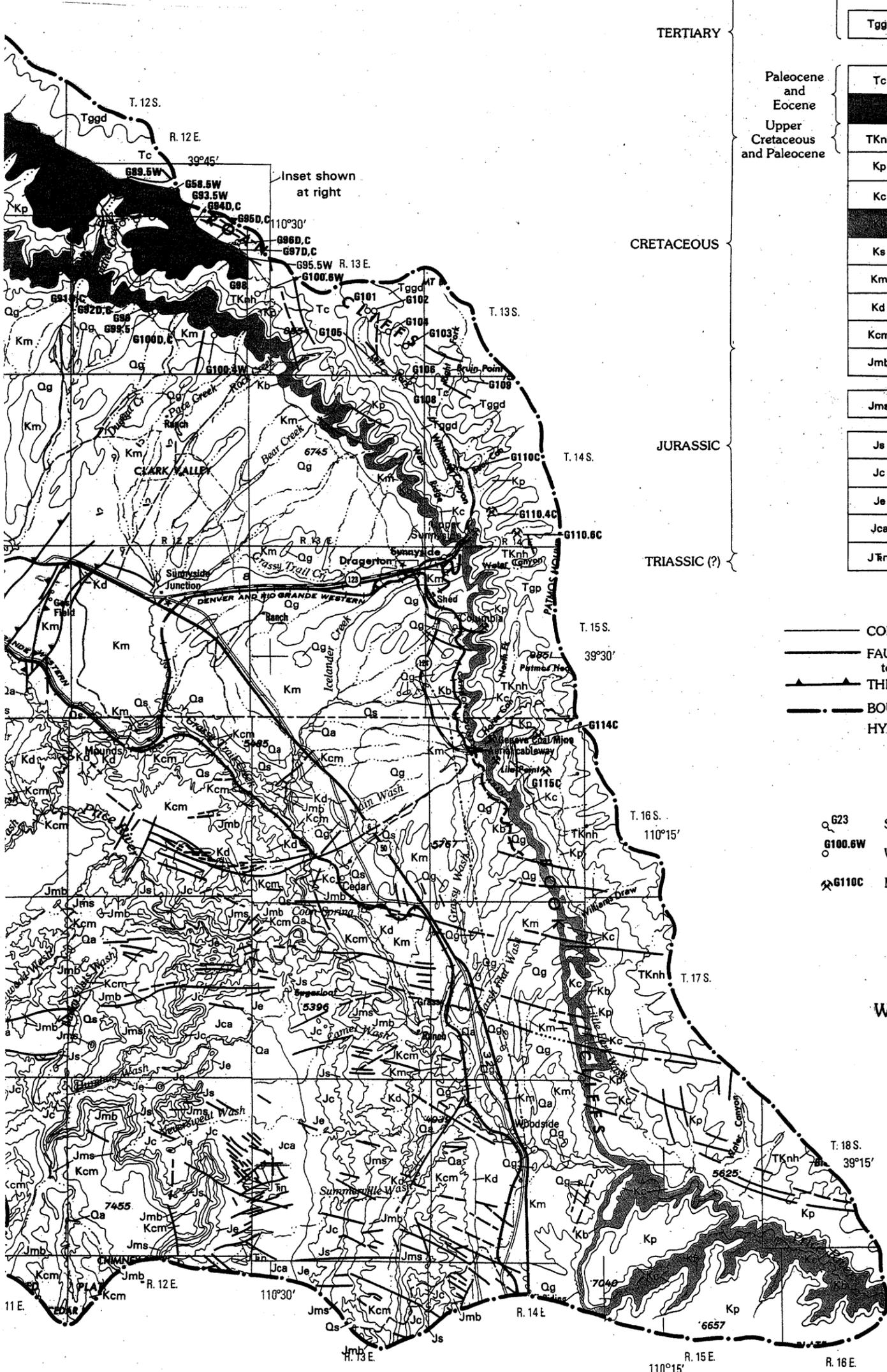
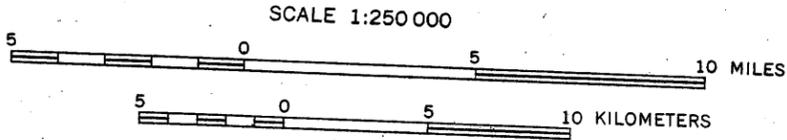
**HYDROLOGIC DATA SITE AND NUM.**  
 BER—# preceding number indicates a ground water site; S preceding number indicates a surface-water site; c, chemical analysis; D, discharge measurement; W, water level and records of wells and test holes

- ⊗ 699.7 MINE
- ⊙ 697D.C SPRING
- 695.5W WELL
- ▲ 680 GAGING STATION
- △ 655 SEEPAGE-STUDY SITE
- A—A' TRACE OF SECTION SHOWN IN FIGURE 19



WATER-SUPPLY PAPER 2246  
 PLATE 1

# MAP SHOWING GEOLOGY AND DATA-COLLECTION SITES FOR GROUND WATER, 1979-80



EXPLANATION		
QUATERNARY	Of the same age	<b>Qa</b> ALLUVIAL DEPOSITS—Chiefly along active streams
		<b>Qg</b> GRAVEL SURFACES—Mainly on pediments and terraces
		<b>Qs</b> COVERING DEPOSITS—Chiefly wind-blown silts lacking dune form, includes some alluvium
TERTIARY	Eocene	<b>Tgp</b> LOWER UNIT OF PARACHUTE CREEK MEMBER OF GREEN RIVER FORMATION
		<b>Tggd</b> GARDEN GULCH AND DOUGLAS CREEK MEMBERS OF THE GREEN RIVER FORMATION
CRETACEOUS	Paleocene and Eocene	<b>Tc</b> COLTON FORMATION
	Upper Cretaceous and Paleocene	<b>TKnh</b> NORTH HORN FORMATION
		<b>Kp</b> PRICE RIVER FORMATION
	Mesa Verde group	<b>Kc</b> CASTLEGATE SANDSTONE
		<b>Ks</b> STAR POINT SANDSTONE
		<b>Km</b> MANCOS SHALE
		<b>Kd</b> DAKOTA SANDSTONE
		<b>Kcm</b> CEDAR MOUNTAIN FORMATION
		<b>Jmb</b> BRUSHY BASIN MEMBER OF MORRISON FORMATION
		<b>Jms</b> SALT WASH SANDSTONE MEMBER OF MORRISON FORMATION
<b>Je</b> SUMMERVILLE FORMATION		
JURASSIC	<b>Jc</b> CURTIS FORMATION	
	<b>Je</b> ENTRADA SANDSTONE	
	<b>Jca</b> CARMEL FORMATION	
	TRIASSIC (?)	<b>Jrn</b> NAVAJO SANDSTONE

- CONTACT
  - - - FAULT—Dashed where approximately located; dotted where concealed
  - ▲ THRUST FAULT—Barbs on side of thrust plate
  - BOUNDARY OF PRICE RIVER DRAINAGE BASIN
- HYDROLOGIC DATA SITES—Number by symbol indicates site number in data tables in Waddell and others (1982). Letter by symbol indicates type of data: C, Chemical analysis; D, Discharge measurement; W, Water level and records of wells and test holes.
- G23 SPRING
  - G100.6W WELL OR TEST HOLE
  - ⚡ G110C MINE

WATER-SUPPLY PAPER 2246  
PLATE 1

Geology from Stokes, 1964

**APPENDIX 7-7**

Surface-Water Monitoring Data

Appendix 7-7

# SURFACE WATER MONITORING LOCATION 323

"323 (Junction)" Monitoring Data 2007

Date	Time	pH	Cond.	Temp.	Flow (gpm)	Comments
3/15/07	1220				NOA	Snow/Ice
5/18/07	1340	7.80	591	11	17	
6/21/07	1220	7.9	621	12.5	20.5	
8/30/07	1345	8.4	675	14	13	Livestock Use