Table 7a: Pre-CBM Conductivity and Sulfate, Rawhide Creek

Location	Date	Flow (cfs)	Conductivity (umhos/cm)	Sulfate (µg/l)
RHC Above Spring Draw	2/17/1983	0	2710	1510
RHC at East Mine Boundary	2/26/1988	0	2060	663
RHC Below Mine Access Road	2/26/1988	2.1	4920	2629
USGS at Hwy 14/16	3/6/1975	0.18	6100	4000
RHC Above Spring Draw	3/11/1981	0	5240	3440
RHC at East Mine Boundary	3/11/1981	0	3770	2410
RHC at West Mine Boundary	3/11/1981	1	5010	3280
RHC Above Spring Draw	3/24/1982	0	3050	1310
RHC at East Mine Boundary	3/24/1982	0	2180	969
RHC at West Mine Boundary	3/24/1982	0	4800	2850
RHC at East Mine Boundary	3/8/1984	0	4650	2240
RHC at East Mine Boundary	3/19/1985	0	3010	1470
RHC Below Mine Access Road	3/19/1985	0	3270	1720
RHC at East Mine Boundary	3/24/1986	0	3770	2090
RHC Below Mine Access Road	3/31/1987	1.6	4080	2960
USGS at Hwy 14/16	4/29/1976	0.6	5400	NA
RHC at West Mine Boundary	4/17/1979	0	4650	2920
RHC Above Spring Draw	4/18/1979	0	5010	3170
RHC at East Mine Boundary	4/18/1979	0	4750	3110
RHC Above Spring Draw	4/24/1980	0	5670	3720
RHC at East Mine Boundary	4/24/1980	0	5890	3840
RHC at West Mine Boundary	4/24/1980	0	5250	3250
RHC at East Mine Boundary	4/29/1987	0.73	2850	1460
RHC Below Mine Access Road	4/29/1987	0.87	5150	4260
RHC at East Mine Boundary	4/4/1988	1.31	4500	2239
RHC Below Mine Access Road	4/4/1988	1.42	6040	3008
USGS at Hwy 14/16	5/5/1976	1.3	6000	3800
USGS at Hwy 14/16	5/16/1978	3.5	5000	2500
RHC at East Mine Boundary	5/24/1982	0	4310	2730
RHC at West Mine Boundary	5/24/1982	0	4010	2870
RHC at East Mine Boundary	5/29/1984	0	4030	2190
RHC Below Mine Access Road	5/29/1984	0	5850	3440
RHC Above Spring Draw	6/22/1978	0	6075	3885
RHC at East Mine Boundary	6/22/1978	0	5830	3662
RHC at West Mine Boundary	6/28/1978	0	6160	3872
RHC at West Mine Boundary	6/13/1979	0	7590	5600
RHC Above Spring Draw	6/14/1979	0	7060	4920
RHC Above Spring Draw	6/1/1980	0	6780	4380
RHC at East Mine Boundary	6/1/1980	0	1490	378
RHC at West Mine Boundary	6/1/1980	0	7520	4820
RHC Above Spring Draw	6/11/1981	0.005	5740	4060
RHC at East Mine Boundary	6/11/1981	0.002	5880	4100
RHC at West Mine Boundary	6/11/1981	0.01	5960	4280
RHC Above Spring Draw	6/24/1982	0	3600	2340
RHC at East Mine Boundary	6/24/1982	0	4100	2650
RHC at West Mine Boundary	6/24/1982	0	4760	3760
RHC at West Mine Boundary	6/13/1983	0	6570	4570

Table 7a: Pre-CBM Conductivity and Sulfate, Rawhide Creek (2 of 2)

Location	Date	Flow (cfs)	Conductivity (umhos/cm)	Sulfate (µg/l)
RHC Above Spring Draw	6/15/1983	0	2720	1380
RHC at East Mine Boundary	6/15/1983	0	2590	1240
RHC at East Mine Boundary	6/18/1985	0	1500	530
RHC Below Mine Access Road	6/18/1985	0	6520	5620
RHC at East Mine Boundary	6/16/1986	0	2500	1300
RHC Below Mine Access Road	6/16/1986	0	5890	4790
RHC Above Spring Draw	7/6/1981	0	7810	6010
RHC at East Mine Boundary	7/6/1981	0	6170	4570
RHC at West Mine Boundary	7/6/1981	0	7210	5350
USGS at Hwy 14/16	8/18/1976	6.7	1940	780
USGS at Hwy 14/16	8/16/1977		2900	2500
RHC at East Mine Boundary	8/30/1979	0	6670	5390
RHC at West Mine Boundary	8/30/1979	0	7040	4960
RHC Above Spring Draw	8/6/1982	0	2800	1610
RHC Above Spring Draw	9/18/1980	0	3530	2130
RHC at East Mine Boundary	9/18/1980	0	6400	4630
RHC at West Mine Boundary	9/18/1980	0	3860	2200
RHC Above Spring Draw	9/29/1982	0	2700	1030
RHC at East Mine Boundary	9/29/1982	0	3070	1410
RHC Below Mine Access Road	9/29/1982	0	6250	3950
RHC Above Spring Draw	9/16/1983	0	2660	1300
RHC at East Mine Boundary	9/16/1983	0	2690	1180
RHC at West Mine Boundary	9/16/1983	0	6910	3600
RHC at East Mine Boundary	9/12/1984	0	2700	1040
RHC Below Mine Access Road	9/12/1984	0	8130	4930
RHC at East Mine Boundary	9/6/1985	0	1120	147
RHC at East Mine Boundary	9/30/1986	0	1970	695
RHC at East Mine Boundary	9/30/1987	0.87	2170	909
RHC at East Mine Boundary	9/28/1988	0.37	1246	207
RHC at East Mine Boundary	10/26/1978	0	9100	6550
RHC at West Mine Boundary	10/26/1978	0	7780	5100
RHC at East Mine Boundary	10/29/1987	1.15	2210	654
RHC at East Mine Boundary	11/2/1977	0	4933	2987
RHC Above Spring Draw	12/9/1980	0	7010	5110
RHC at East Mine Boundary	12/9/1980	0	7450	5720
RHC Above Spring Draw	12/31/1981	0	5590	2440
RHC at East Mine Boundary	12/31/1981	0	4520	1970
RHC Above Spring Draw	12/30/1982	0	3700	1610
RHC at West Mine Boundary	12/30/1982	0	5700	3620
RHC at East Mine Boundary	12/6/1983	0	2830	975
RHC at West Mine Boundary	12/7/1983	0	7190	4740
RHC at East Mine Boundary	12/10/1984	0	1980	698
RHC Below Mine Access Road	12/13/1984	0	2080	879
RHC at East Mine Boundary	12/9/1985	0	3170	1800
RHC at East Mine Boundary	12/16/1986	0.65	2320	1050
RHC at East Mine Boundary	12/10/1987	0.97	1500	650
RHC Below Mine Access Road	12/10/1987	0.68	6830	4559

Table 7b: Comparison of Statistics on Sulfate (mg/L), during All Months and during the Irrigation Season

Sulfate - All Months		*Sulfate - Irrigation Season (April - September)*	
Mean	2854	Mean	3003
Median	2790	Median	3110
Mode	3440	Mode	2500
Standard Deviation	1598	Standard Deviation	1569
Sample Variance	2553190	Sample Variance	2461524
Kurtosis	1.009	Kurtosis	1.064
Skewness	0.214	Skewness	-0.048
Range	6403	Range	5863
Minimum	147	Minimum	147
Maximum	6550	Maximum	6010
Count	100	Count	65
85th Percentile	4748	85th Percentile	4802

Table 7c: Comparison of Statistics on Conductivity (umhos/cm), during All Months and during the Irrigation Season

Conductivity (umhos/cm) - All Months		*Conductivity (umhos/cm) - Irrigation*	
Mean	4610	Mean	4718
Median	4750	Median	5000
Mode	6100	Mode	5890
Standard Deviation	1898	Standard Deviation	1867
Sample Variance	3604031	Sample Variance	3487232
Kurtosis	1.014	Kurtosis	1.089
Skewness	0.055	Skewness	-0.191
Range	7980	Range	7010
Minimum	1120	Minimum	1120
Maximum	9100	Maximum	8130
Count	101	Count	6610
85th Percentile	6780	85th Percentile	6640

Table 7d: Pre-CBM Agricultural Water Quality, Rawhide Creek

Date of Sample	Specific Conductance (umhos/cm @ 25°C)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	Bicarbonate as HCO_3 (mg/l)	SAR	Sulfate (mg/l)
11/23/1977	4185	386.1	261.9	256	495	4.1	2,380
6/28/1978	6160	675	403	495	592	5.33	3,872
10/25/1978	7780	985	473	650	915	6.9	5,100
4/17/1979	4650	472	347	368	448	4.21	2,920
6/13/1979	7590	1033	382	704	475	7.25	5,600
8/30/1978	7040	884	512	616	697	6.23	4,960
4/24/1980	5250	530	415	408	549	4.43	3,250
6/1/1980	7520	996	462	587	769	7.25	4,820
9/18/1980	3860	435	204	310	489	4.48	2,200
12/9/1980	11170	1890	480	1256	1260	10.32	9,050
10/11/1995	4450	276	452	325	671	2.42	2,450
9/17/1996	1668	104	120	110	290	1.66	711
10/29/1998	4160	558	134	274	698	6.34	2,023
Count	**14**	**14**	**14**	**14**	**14**	**14**	**14**
Min	**1668**	**104**	**120**	**110**	**290**	**1.66**	**711**
Max	**11170**	**1890**	**512**	**1256**	**1260**	**10.32**	**9,050**
Median	**5250**	**558**	**403**	**408**	**592**	**5.33**	**3,250**
Average	**5806.4**	**709.5**	**357.4**	**489.2**	**642.2**	**5.5**	**3,795**
Std Dev	**2418.1**	**459.5**	**134.5**	**290.2**	**245.8**	**2.3**	**2142.02**

(Greystone 1999, see Section 8.0 for raw data)

[1] Samples taken at West Boundary, Triton Coal Company as part of monitoring requirements

Table 7e: Post CBM Agricultural Water Quality, Rawhide Creek

Date of Sample	Specific Conductance (umhos/cm @ 25º C)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/L)	SAR	Sulfate (mg/l)	Flow (cfs)
3/19/2001 10:35	3790	345	189	212	4.1		
4/12/2001 9:35	4830	507	300	315	4.9		
3/11/2003 10:40	4280	470	220	320		2400	
4/4/2003 10:30	4950	555	356	405	4.8	3000	0.67
4/7/2003 0:00	4950	555	356	405	4.8	3000	0.42
4/11/2003 10:35	5640	621	406	436	5.1	3400	0.12
4/18/2003 7:50	6290	653	404	457	5.3	4000	0.11
4/23/2003 9:45	5670	644	382	460	5.2	3400	0.08
4/30/2003 9:40	6660	766	427	491	6.0	4100	0.67
5/9/2003 9:25	6450	630	400	500	5.0		0.56
5/19/2003 9:00	6340	730	430	500	5.7	3500	0.21
5/23/2003 8:25	3690	480	160	210	5.8	1500	0.12
5/29/2003 10:30	6970	840	410	550	6.3	4400	0.09
6/6/2003 8:00	4660	620	220	340	6.1	2200	0.44
6/16/2003 15:30	5000	630	230	360	6.1	2800	0.08
6/19/2003 14:00	5080	640	210	360	6.2	3000	0.04
6/26/2003 6:30	3520	490	120	220	6.2	1600	0.21
9/10/2003 13:50	2400	362	56	104	6.6	695	0.40
9/16/2003 9:50	2620	433	76	130	7.0	865	0.11
9/26/2003 10:00	2980	412	80	150	6.3	1070	0.06
4/30/2004 10:30	3930	454	209	246	5.0		
5/28/2004 6:15	4640	558	218	309	5.7	2450	
Count	**22**	**22**	**22**	**22**	**21**	**18**	**17**
Min	**2400**	**345**	**56**	**104**	**4.1**	**695**	**0.0447**
Max	**6970**	**840**	**550**	**430**	**7**	**4400**	**0.6685**
Median	**4890**	**557**	**225**	**350**	**5.7**	**2,900**	**0.1232**
Average	**4788**	**563**	**266**	**340**	**5.6**	**2632**	**0.2586**
Std Dev	**1307**	**128**	**125**	**131**	**0.7**	**1123**	**0.2199**

(Greystone 1999, see Section 8.0 for raw data)

[1] Samples taken at West Boundary, Triton Coal Company as part of monitoring requirements

Table 7f: Mixing Analysis Parameters from Little Powder River above Dry Creek near Weston, WY, Station ID# 06324970

agency_cd	site_no	sample_dt	sample_tm	parameter_cd	parameter name	result_va
USGS	6324970	10/12/1979	8:15	61	Flow	0.01
USGS	6324970	10/12/1979	8:15	95	Conductivity	3000
USGS	6324970	10/12/1979	8:15	915	Calcium	140
USGS	6324970	10/12/1979	8:15	925	Magnesium	120
USGS	6324970	10/12/1979	8:15	930	Sodium	430
USGS	6324970	10/12/1979	8:15	940	Chloride	4.6
USGS	6324970	11/6/1979	13:00	61	Flow	0.01
USGS	6324970	11/6/1979	13:00	95	Conductivity	2740
USGS	6324970	11/6/1979	13:00	915	Calcium	150
USGS	6324970	11/6/1979	13:00	925	Magnesium	110
USGS	6324970	11/6/1979	13:00	930	Sodium	370
USGS	6324970	11/6/1979	13:00	940	Chloride	11
USGS	6324970	7/14/1980	15:10	61	Flow	0.01
USGS	6324970	7/14/1980	15:10	95	Conductivity	2630
USGS	6324970	7/14/1980	15:10	915	Calcium	130
USGS	6324970	7/14/1980	15:10	925	Magnesium	89
USGS	6324970	7/14/1980	15:10	930	Sodium	370
USGS	6324970	7/14/1980	15:10	940	Chloride	11
USGS	6324970	9/23/1980	14:15	61	Flow	0.01
USGS	6324970	9/23/1980	14:15	95	Conductivity	2540
USGS	6324970	9/23/1980	14:15	915	Calcium	120
USGS	6324970	9/23/1980	14:15	925	Magnesium	86
USGS	6324970	9/23/1980	14:15	930	Sodium	380
USGS	6324970	9/23/1980	14:15	940	Chloride	11
USGS	6324970	8/28/1981	10:45	61	Flow	0.01
USGS	6324970	8/28/1981	10:45	95	Conductivity	1920
USGS	6324970	8/28/1981	10:45	915	Calcium	109
USGS	6324970	8/28/1981	10:45	925	Magnesium	56
USGS	6324970	8/28/1981	10:45	930	Sodium	240
USGS	6324970	8/28/1981	10:45	940	Chloride	8.3
USGS	6324970	8/28/1981	10:45	90095	Flow	1910

http://nwis.waterdata.usgs.gov/wy/nwis/qwdata/?site_no=06324970&agency_cd=USGS

Data retrieved 6/4/2004

Devon Energy Production Company, L.P.
20 N. Broadway, Suite 1500
Oklahoma City, OK 73102

November 7, 2006

Ms. Jennifer Zygmunt
Wyoming Department of Environmental Quality
WYPDES Permit Section -CBM
122 W. 25th Street
Herschler Building 4W
Cheyenne, WY 82002

Subject: Devon Energy Production Company L.P.
Technical Deficiency Response
Renewal WY0039781, Rawhide Creek B

Dear Ms. Zygmunt:

Devon Energy Production Company, L.P. (Devon) received the Permit Completeness Review Status Tracking form dated 10/25/06, requesting supplemental information as part of the renewal application. Specific responses to identified questions are provided below in a question-answer format.

Since this facility has discharged, please provide this data, or explain why the permittee indicated.

The estimated discharge per well is 3108 gpd/well as shown in Table 8. The water balance may be reviewed in Tables 5A-1 through 5A-23 or 5B.

Please indicate the appropriate bonding authority for the reservoirs on this permit.

The WDEQ is the appropriate bonding authority for the two reservoirs constructed prior to September 1, 2005, and previously unbonded. Table 8 has been modified to reflect this information.

Please provide an electronic copy of Table 8a (please e-mail to jzygmu@state.wy.us).

This particular renewal application did not have a Table 8a, but we believe that you are seeking Table 7e, the table entitled Pre-CBM Conductivity and Sulfate. An Excel copy of Table 7e is attached on CD. This table was provided to Steve Schreck of Applied Hydrology for Devon's use by Eric Hargett, WDEQ permit writer, on 5/8/02.

Table 8d: Why was only the West Boundary mine data extracted and summarized? Is this data more representative than the other two mine monitoring stations? Please provide a Table 8d summary table for each of the other mine monitoring stations listed in Table 8a (East Mine Boundary and Above Spring Draw). For each individual sample in these tables, please indicate the respective flow at the time of sample collection. Also, please provide a simple diagram of where each of the mine monitoring points are in relation to the mine.

Rawhide Creek flows from west to east from Devon's development area, across Highway 14/16, along the south

side of the Buckskin Mine (WDEQ LQD Permit PT 0500), and east towards the Little Powder River. The West Boundary mine data was extracted and summarized as it was clear the upstream monitoring site for the Buckskin Mine, immediately below Devon's area of coal bed methane development, and reflective of baseline historic conditions prior to CBM development. The East Mine boundary is the downstream surface water monitoring location for the facility, and could have reflected impacts from the mine. Flow information was not available for many of the samples. Devon has expanded Table 8d per your request, but believes that the most representative historic water quality reflecting pre-CBM ranch uses is the West Boundary Mine data. Figure 1E is attached showing the location of these sites.

Have irrigation practices in this drainage changed since the original permits were issued? When and how is water diverted by the downstream irrigator? It is our understanding that the downstream irrigator is able to irrigate at any time when there is flow in the channel (i.e. there is not a threshold flow value that must be met before he is able to irrigate). Please confirm this. If this is not the case, indicate what threshold flow value must be achieved prior to irrigation being possible.

Devon met with Paul Rourke on Friday November 3, 2006. As shown on Figure 1E, the headgate for the Rawhide Ditch is located in southwest quarter of Section 26 T52N R72W. Mr. Rourke confirmed that when there is flow in Rawhide, he releases up to 0.1 cfs to irrigate a meadow he indicates is 100 acres in size. Water rights filings state the diversion ditch has a capacity to support 298 acres. There is no threshold flow value which must be met prior to diversion for irrigation. Mr. Rourke indicated he last irrigated from the irrigation ditch 4-5 years ago. In 2000 the field had been seeded with an alfalfa and grass mix. Currently the only crops are crested wheatgrass and smooth brome. Crested wheatgrass is moderately tolerant of salinity but smooth brome is moderately sensitive of salinity, as is alfalfa.

Since the initial permit application in 2006, Mr. Rourke has begun watering his stock with groundwater and is no longer using Rawhide Creek as a livestock water source. He has expressed no problems with the quality of water available to his stock, which is currently 225 to 245 head of cattle for his 8,000 – 10,000 acre ranch, which is also irrigated by the Little Powder River..

Devon appreciates WDEQ's willingness to re-examine the available historic data on salinity and SAR before establishing effluent limits protecting downstream users. According to Hanson (*Agricultural Salinity and Drainage*, 1999), irrigation waters with electrical conductivity of 2,000 S/m accommodate a SAR of up to 11.7 with no reduction in infiltration. We would respectfully encourage you to acknowledge that the impacts to agriculture from elevated SARs are mitigated by the elevated salinities when establishing outfall based limits. The data collected in conjunction with the permitting and construction of the Buckskin Mine are useful for determining the impact of irrigation water attributable to CBM effluent. Historically, salinity of the water in Buckskin Creek has been high, greater than that discharged by Devon. Devon contends that the salinity at these sites historically has been elevated compared to what is being discharged.

Please do not hesitate to call if you have any questions.

Sincerely,

R.W. Maxey

Randall W. Maxey
Senior Regulatory Specialist

Attachments:

Revised Permit Application with modifications
- Figure 1E
- Table 7
- Table 7 (CD)
- Rawhide Creek Section 20

Table 7a: Pre-CBM Conductivity and Sulfate, Rawhide Creek

Location	Date	Flow (cfs)	Conductivity (umhos/cm)	Sulfate (µg/l)
RHC Above Spring Draw	2/17/1983	0	2710	1510
RHC at East Mine Boundary	2/26/1988	0	2060	663
RHC Below Mine Access Road	2/26/1988	2.1	4920	2629
USGS at Hwy 14/16	3/6/1975	0.18	6100	4000
RHC Above Spring Draw	3/11/1981	0	5240	3440
RHC at East Mine Boundary	3/11/1981	0	3770	2410
RHC at West Mine Boundary	3/11/1981	1	5010	3280
RHC Above Spring Draw	3/24/1982	0	3050	1310
RHC at East Mine Boundary	3/24/1982	0	2180	969
RHC at West Mine Boundary	3/24/1982	0	4800	2850
RHC at East Mine Boundary	3/8/1984	0	4650	2240
RHC at East Mine Boundary	3/19/1985	0	3010	1470
RHC Below Mine Access Road	3/19/1985	0	3270	1720
RHC at East Mine Boundary	3/24/1986	0	3770	2090
RHC Below Mine Access Road	3/31/1987	1.6	4080	2960
USGS at Hwy 14/16	4/29/1976	0.6	5400	NA
RHC at West Mine Boundary	4/17/1979	0	4650	2920
RHC Above Spring Draw	4/18/1979	0	5010	3170
RHC at East Mine Boundary	4/18/1979	0	4750	3110
RHC Above Spring Draw	4/24/1980	0	5670	3720
RHC at East Mine Boundary	4/24/1980	0	5890	3840
RHC at West Mine Boundary	4/24/1980	0	5250	3250
RHC at East Mine Boundary	4/29/1987	0.73	2850	1460
RHC Below Mine Access Road	4/29/1987	0.87	5150	4260
RHC at East Mine Boundary	4/4/1988	1.31	4500	2239
RHC Below Mine Access Road	4/4/1988	1.42	6040	3008
USGS at Hwy 14/16	5/5/1976	1.3	6000	3800
USGS at Hwy 14/16	5/16/1978	3.5	5000	2500
RHC at East Mine Boundary	5/24/1982	0	4310	2730
RHC at West Mine Boundary	5/24/1982	0	4010	2870
RHC at East Mine Boundary	5/29/1984	0	4030	2190
RHC Below Mine Access Road	5/29/1984	0	5850	3440
RHC Above Spring Draw	6/22/1978	0	6075	3885
RHC at East Mine Boundary	6/22/1978	0	5830	3662
RHC at West Mine Boundary	6/28/1978	0	6160	3872
RHC at West Mine Boundary	6/13/1979	0	7590	5600
RHC Above Spring Draw	6/14/1979	0	7060	4920
RHC Above Spring Draw	6/1/1980	0	6780	4380
RHC at East Mine Boundary	6/1/1980	0	1490	378
RHC at West Mine Boundary	6/1/1980	0	7520	4820
RHC Above Spring Draw	6/11/1981	0.005	5740	4060
RHC at East Mine Boundary	6/11/1981	0.002	5880	4100
RHC at West Mine Boundary	6/11/1981	0.01	5960	4280
RHC Above Spring Draw	6/24/1982	0	3600	2340
RHC at East Mine Boundary	6/24/1982	0	4100	2650
RHC at West Mine Boundary	6/24/1982	0	4760	3760
RHC at West Mine Boundary	6/13/1983	0	6570	4570

Table 7a: Pre-CBM Conductivity and Sulfate, Rawhide Creek (2 of 2)

Location	Date	Flow (cfs)	Conductivity (umhos/cm)	Sulfate (µg/l)
RHC Above Spring Draw	6/15/1983	0	2720	1380
RHC at East Mine Boundary	6/15/1983	0	2590	1240
RHC at East Mine Boundary	6/18/1985	0	1500	530
RHC Below Mine Access Road	6/18/1985	0	6520	5620
RHC at East Mine Boundary	6/16/1986	0	2500	1300
RHC Below Mine Access Road	6/16/1986	0	5890	4790
RHC Above Spring Draw	7/6/1981	0	7810	6010
RHC at East Mine Boundary	7/6/1981	0	6170	4570
RHC at West Mine Boundary	7/6/1981	0	7210	5350
USGS at Hwy 14/16	8/18/1976	6.7	1940	780
USGS at Hwy 14/16	8/16/1977		2900	2500
RHC at East Mine Boundary	8/30/1979	0	6670	5390
RHC at West Mine Boundary	8/30/1979	0	7040	4960
RHC Above Spring Draw	8/6/1982	0	2800	1610
RHC Above Spring Draw	9/18/1980	0	3530	2130
RHC at East Mine Boundary	9/18/1980	0	6400	4630
RHC at West Mine Boundary	9/18/1980	0	3860	2200
RHC Above Spring Draw	9/29/1982	0	2700	1030
RHC at East Mine Boundary	9/29/1982	0	3070	1410
RHC Below Mine Access Road	9/29/1982	0	6250	3950
RHC Above Spring Draw	9/16/1983	0	2660	1300
RHC at East Mine Boundary	9/16/1983	0	2690	1180
RHC at West Mine Boundary	9/16/1983	0	6910	3600
RHC at East Mine Boundary	9/12/1984	0	2700	1040
RHC Below Mine Access Road	9/12/1984	0	8130	4930
RHC at East Mine Boundary	9/6/1985	0	1120	147
RHC at East Mine Boundary	9/30/1986	0	1970	695
RHC at East Mine Boundary	9/30/1987	0.87	2170	909
RHC at East Mine Boundary	9/28/1988	0.37	1246	207
RHC at East Mine Boundary	10/26/1978	0	9100	6550
RHC at West Mine Boundary	10/26/1978	0	7780	5100
RHC at East Mine Boundary	10/29/1987	1.15	2210	654
RHC at East Mine Boundary	11/2/1977	0	4933	2987
RHC Above Spring Draw	12/9/1980	0	7010	5110
RHC at East Mine Boundary	12/9/1980	0	7450	5720
RHC Above Spring Draw	12/31/1981	0	5590	2440
RHC at East Mine Boundary	12/31/1981	0	4520	1970
RHC Above Spring Draw	12/30/1982	0	3700	1610
RHC at West Mine Boundary	12/30/1982	0	5700	3620
RHC at East Mine Boundary	12/6/1983	0	2830	975
RHC at West Mine Boundary	12/7/1983	0	7190	4740
RHC at East Mine Boundary	12/10/1984	0	1980	698
RHC Below Mine Access Road	12/13/1984	0	2080	879
RHC at East Mine Boundary	12/9/1985	0	3170	1800
RHC at East Mine Boundary	12/16/1986	0.65	2320	1050
RHC at East Mine Boundary	12/10/1987	0.97	1500	650
RHC Below Mine Access Road	12/10/1987	0.68	6830	4559

Table 7b: Comparison of Statistics on Sulfate (mg/L), during All Months and during the Irrigation Season

Sulfate - All Months		*Sulfate - Irrigation Season (April - September)*	
Mean	2854	Mean	3003
Median	2790	Median	3110
Mode	3440	Mode	2500
Standard Deviation	1598	Standard Deviation	1569
Sample Variance	2553190	Sample Variance	2461524
Kurtosis	1.009	Kurtosis	1.064
Skewness	0.214	Skewness	-0.048
Range	6403	Range	5863
Minimum	147	Minimum	147
Maximum	6550	Maximum	6010
Count	100	Count	65
85th Percentile	4748	85th Percentile	4802

Table 7c: Comparison of Statistics on Conductivity (umhos/cm), during All Months and during the Irrigation Season

Conductivity (umhos/cm) - All Months		*Conductivity (umhos/cm) - Irrigation*	
Mean	4610	Mean	4718
Median	4750	Median	5000
Mode	6100	Mode	5890
Standard Deviation	1898	Standard Deviation	1867
Sample Variance	3604031	Sample Variance	3487232
Kurtosis	1.014	Kurtosis	1.089
Skewness	0.055	Skewness	-0.191
Range	7980	Range	7010
Minimum	1120	Minimum	1120
Maximum	9100	Maximum	8130
Count	101	Count	6610
85th Percentile	6780	85th Percentile	6640

Table 7d: USGS Monitoring Site at Highway 14/16

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)
3/6/1975	6100					4000	0.18
4/29/1976	5400						0.6
5/5/1976	6000					3800	1.3
8/16/1977	2900					2500	
8/18/1976	1940					780	6.7
5/16/1978	5000					2500	3.5
Count	6					5	5
Min	1940					780	0.18
Max	6100					4000	6.7
Median	5200					2500	1.3
Average	4556.67					2716.00	2.46
Std Dev	1729.99					1290.84	2.70

Table 7e: Rawhide Creek at West Mine Boundary

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)
4/19/1976		673	317	408	4.55	3470	0
6/3/1976		595	420	480	3.66	3898	0
6/28/1978	6160	675	403	495	4.12	3872	0
10/26/1978	7780	985	473	650	5.30	5100	0
4/17/1979	4650	472	347	368	3.29	2920	0
6/13/1979	7590	1033	382	704	5.47	5600	0
8/30/1979	7040	884	512	616	4.83	4960	0
4/24/1980	5250	530	415	408	3.48	3250	0
6/1/1980	7520	996	462	587	5.60	4820	0
9/18/1980	3860	435	204	310	3.42	2200	0
12/9/1980							
3/11/1981	5010	543	375	391	3.67	3280	1
6/11/1981	5960	711	415	508	4.28	4280	0.01
7/6/1981	7210	1010	435	669	5.41	5350	0
3/24/1982	4800	445	348	346	3.18	2850	0
5/24/1982	4010	466	324	365	3.28	2870	0
6/24/1982	4760	633	438	450	3.98	3760	0
9/29/1982	6100	948	482	631	5.16	5090	0
12/30/1982	5700	606	435	462	3.77	3620	0
2/17/1983	3320	297	220	230	2.61	1800	0
6/13/1983	6570	803	465	588	4.51	4570	0
9/16/1983	6910	964	472	713	5.00	3600	0
12/7/1983	7190	863	331	712	4.59	4740	0
Count	20	22	22	22	22	22	22
Min	3320	297	204	230	2.61	1800	0
Max	7780	1033	512	713	5.60	5600	1
Median	6030	674	415	487.5	4.20	3816	0
Average	5869.50	707.59	394.32	504.14	4.23	3904.55	0.05
Std Dev	1356.72	224.73	80.65	143.12	0.87	1040.18	0.21

Table 7f: Rawhide Creek below Mine Access Road

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)
9/29/1982	6250	694	371	479	4.33	3950	0
3/9/1984	6160	494	411	417	3.22	3220	0
5/29/1984	5850	522		370		3440	0
9/12/1984	8130	724		663		4930	0
12/13/1984	2080	337		103		879	0
3/19/1985	3270	265	237	206	2.41	1720	0
6/18/1985	6520	988	367	725	5.18	5620	0
6/16/1986	5890	738	367	647	4.06	4790	0
3/31/1987	4080	467	338	386	3.20	2960	1.6
4/29/1987	5150	694	421	568	3.99	4260	0.87
12/10/1987	6830	799	443	592	4.50	4559	0.68
2/26/1988	4920	498	210	319	3.86	2629	2.1
4/4/1988	6040	488	371	366	3.38	3008	1.42
Count	13	13	10	13	10.00	13	13
Min	2080	265	210	103	2.41	879	0
Max	8130	988	443	725	5.18	5620	2.1
Median	5890	522	369	417	3.93	3440	0
Average	5474.62	592.92	353.60	449.31	3.81	3535.77	0.51
Std Dev	1592.34	200.20	75.46	184.95	0.79	1338.55	0.75

Table 7g: Rawhide Creek Above Spring Draw

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)
6/22/1978	6075	651	422	503	3.93	3885	0
10/26/1978							
4/18/1979	5010	513	392	380	3.48	3170	0
6/14/1979	7060	842	482	654	4.51	4920	0
4/24/1980	5670	625	431	457	3.91	3720	0
6/1/1980	6780	711	479	585	3.99	4380	0
9/18/1980	3530	299	289	287	2.34	2130	0
12/9/1980	7010	819	514	737	4.16	5110	0
3/11/1981	5240	574	371	428	3.74	3440	0
6/11/1981	5740	506	472	553	2.91	4060	0.005
7/6/1981	7810	1050	362	799	5.28	6010	0
12/31/1981	5590	813	196	366	5.98	2440	0
3/24/1982	3050	354	162	195	3.44	1310	0
6/24/1982	3600	467	199	327	3.60	2340	0
8/6/1982	2800	275	233	216	2.46	1610	0
9/29/1982	2700	327	137	128	3.81	1030	0
12/30/1982	3700	424	210	205	3.92	1610	0
2/17/1983	2710	297	195	188	2.86	1510	0
6/15/1983	2720	398	115	182	4.10	1380	0
9/16/1983	2660	386	112	148	4.34	1300	0
Count	19	19	19	19	19	19	19
Min	2660	275	112	128	2.34	1030	0
Max	7810	1050	514	799	5.98	6010	0.005
Median	5010	506	289	366	3.91	2440	0
Average	4708.16	543.74	303.84	386.21	3.83	2913.42	0.00
Std Dev	1763.04	221.76	139.36	206.76	0.88	1517.49	0.00

Table 7h: Rawhide Creek at East Mine Boundary

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)
4/19/1976		713	339	368	4.98	3793	0
6/2/1976		595	420	480	3.66	3898	0
11/2/1977	4933	472	360	315	3.48	2987	0
6/22/1978	5830	591	411	477	3.65	3662	0
10/26/1978	9100	1200	484	815	5.87	6550	0
4/18/1979	4750	504	347	396	3.41	3110	0
6/14/1979	6800	791	458	606	4.39	4700	0
8/30/1979	6670	848	415	682	4.52	5390	0
1/25/1980							
4/24/1980	5890	668	433	487	4.07	3840	0
6/1/1980	1490	237	48	50	4.47	378	0
9/18/1980	6400	825	377	557	4.83	4630	0
12/9/1980	7450	883	572	791	4.31	5720	0
3/11/1981	3770	400	275	299	3.10	2410	0
6/11/1981	5880	669	402	524	3.99	4100	0.002
7/6/1981	6170	740	418	575	4.24	4570	0
12/31/1981	4520	562	229	272	4.61	1970	0
3/24/1982	2180	233	282	40	3.15	969	0
5/24/1982	4310	500	292	343	3.65	2730	0
6/24/1982	4100	542	244	353	3.98	2650	0
9/29/1982	3070	362	187	185	3.53	1410	0
12/30/1982	4000	435	231	228	3.82	1790	0
6/15/1983	2590	373	137	150	4.09	1240	0
9/16/1983	2690	380	110	129	4.52	1180	0
12/6/1983	2830	347	127	130	4.05	975	0
3/8/1984	4650	406	275	287	3.20	2240	0
5/29/1984	4030	403		251		2190	0
9/12/1984	2700	320		97		1040	0
12/10/1984	1980	279		83		698	0
3/19/1985	3010	255	207	173	2.52	1470	0
6/18/1985	1500	277	52	62	4.76	530	0
9/6/1985	1120	228	25	17	6.97	147	0
12/9/1985	3170	412	222	244	3.54	1800	0
3/24/1986	3770	420	262	259	3.46	2090	0
6/16/1986	2500	347	119	162	3.74	1300	0
9/30/1986	1970	311	60	83	4.69	695	0
12/16/1986	2320	364	158	110	4.39	1050	0.65
3/31/1987	3370	400	250	270	3.26	2100	4.19
4/29/1987	2850	391	142	205	3.76	1460	0.73
9/30/1987	2170	380	97	102	5.03	909	0.87
10/29/1987	2210	307	73	74	4.75	654	1.15
12/10/1987	1500	322	76	68	5.12	650	0.97
2/26/1988	2060	257	93	78	3.78	663	0
4/4/1988	4500	420	269	271	3.39	2239	1.31
9/28/1988	1246	228	31	22	6.17	207	0.37
12/14/1988	2226	242	164	102	2.98	889	0

Table 7h: Rawhide Creek at East Mine Boundary

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)
Count	43	45	42	45	42	45	45
Min	1120	228	25	17	2.52	147	0
Max	9100	1200	572	815	6.97	6550	4.19
Median	3170	400	237.5	244	4.02	1800	0
Average	3727.33	463.09	242.21	272.71	4.14	2214.96	0.23
Std Dev	1883.15	212.35	143.14	209.06	0.88	1616.73	0.69

Table 7i: Pre-CBM & Pre-Mining Agricultural Water Quality, Rawhide Creek

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)	Site Description
9/29/1982	6250	694	371	479	4.33	3950	0	Below access rd
3/9/1984	6160	494	411	417	3.22	3220	0	Below access rd
5/29/1984	5850	522		370		3440	0	Below access rd
9/12/1984	8130	724		663		4930	0	Below access rd
12/13/1984	2080	337		103		879	0	Below access rd
3/19/1985	3270	265	237	206	2.41	1720	0	Below access rd
6/18/1985	6520	988	367	725	5.18	5620	0	Below access rd
6/16/1986	5890	738	367	647	4.06	4790	0	Below access rd
3/31/1987	4080	467	338	386	3.20	2960	1.6	Below access rd
4/29/1987	5150	694	421	568	3.99	4260	0.87	Below access rd
12/10/1987	6830	799	443	592	4.50	4559	0.68	Below access rd
2/26/1988	4920	498	210	319	3.86	2629	2.1	Below access rd
4/4/1988	6040	488	371	366	3.38	3008	1.42	Below access rd
6/22/1978	6075	651	422	503	3.93	3885	0	SD pre mine
4/18/1979	5010	513	392	380	3.48	3170	0	SD pre mine
6/14/1979	7060	842	482	654	4.51	4920	0	SD pre mine
4/24/1980	5670	625	431	457	3.91	3720	0	SD pre mine
6/1/1980	6780	711	479	585	3.99	4380	0	SD pre mine
9/18/1980	3530	299	289	287	2.34	2130	0	SD pre mine
12/9/1980	7010	819	514	737	4.16	5110	0	SD pre mine
4/19/1976		713	339	368	4.98	3793	0	E mine pre mining
6/2/1976		595	420	480	3.66	3898	0	E mine pre mining
11/2/1977	4933	472	360	315	3.48	2987	0	E mine pre mining
6/22/1978	5830	591	411	477	3.65	3662	0	E mine pre mining
10/26/1978	9100	1200	484	815	5.87	6550	0	E mine pre mining
4/18/1979	4750	504	347	396	3.41	3110	0	E mine pre mining
6/14/1979	6800	791	458	606	4.39	4700	0	E mine pre mining
8/30/1979	6670	848	415	682	4.52	5390	0	E mine pre mining
4/24/1980	5890	668	433	487	4.07	3840	0	E mine pre mining
6/1/1980	1490	237	48	50	4.47	378	0	E mine pre mining
9/18/1980	6400	825	377	557	4.83	4630	0	E mine pre mining
12/9/1980	7450	883	572	791	4.31	5720	0	E mine pre mining

Table 7i: Pre-CBM & Pre-Mining Agricultural Water Quality, Rawhide Creek

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)	Site Description
4/19/1976		673	317	408	4.55	3470	0	W mine (wier)
6/3/1976		595	420	480	3.66	3898	0	W mine (wier)
6/28/1978	6160	675	403	495	4.12	3872	0	W mine (wier)
10/26/1978	7780	985	473	650	5.30	5100	0	W mine (wier)
4/17/1979	4650	472	347	368	3.29	2920	0	W mine (wier)
6/13/1979	7590	1033	382	704	5.47	5600	0	W mine (wier)
8/30/1979	7040	884	512	616	4.83	4960	0	W mine (wier)
4/24/1980	5250	530	415	408	3.48	3250	0	W mine (wier)
6/1/1980	7520	996	462	587	5.60	4820	0	W mine (wier)
9/18/1980	3860	435	204	310	3.42	2200	0	W mine (wier)
3/11/1981	5010	543	375	391	3.67	3280	1	W mine (wier)
6/11/1981	5960	711	415	508	4.28	4280	0.01	W mine (wier)
7/6/1981	7210	1010	435	669	5.41	5350	0	W mine (wier)
3/24/1982	4800	445	348	346	3.18	2850	0	W mine (wier)
5/24/1982	4010	466	324	365	3.28	2870	0	W mine (wier)
6/24/1982	4760	633	438	450	3.98	3760	0	W mine (wier)
9/29/1982	6100	948	482	631	5.16	5090	0	W mine (wier)
12/30/1982	5700	606	435	462	3.77	3620	0	W mine (wier)
2/17/1983	3320	297	220	230	2.61	1800	0	W mine (wier)
6/13/1983	6570	803	465	588	4.51	4570	0	W mine (wier)
9/16/1983	6910	964	472	713	5.00	3600	0	W mine (wier)
12/7/1983	7190	863	331	712	4.59	4740	0	W mine (wier)
Count	50	54	51	54	51	54	54	
Min	1490	237	48	50	2.34	378	0	
Max	9100	1200	572	815	5.87	6550	2.1	
Median	6000	670.5	411	480	4.06	3856	0	
Average	5780.16	667.81	389.88	491.83	4.10	3848.85	0.14	
Std Dev	1517.94	218.58	91.55	169.19	0.80	1227.83	0.44	

Table 7j: Agricultural Water Quality, Rawhide Creek, Downstream of Mining

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)	Site description
3/11/1981	5240	574	371	428	3.74	3440	0	SD post mining
6/11/1981	5740	506	472	553	2.91	4060	0.005	SD post mining
7/6/1981	7810	1050	362	799	5.28	6010	0	SD post mining
12/31/1981	5590	813	196	366	5.98	2440	0	SD post mining
3/24/1982	3050	354	162	195	3.44	1310	0	SD post mining
6/24/1982	3600	467	199	327	3.60	2340	0	SD post mining
8/6/1982	2800	275	233	216	2.46	1610	0	SD post mining
9/29/1982	2700	327	137	128	3.81	1030	0	SD post mining
12/30/1982	3700	424	210	205	3.92	1610	0	SD post mining
2/17/1983	2710	297	195	188	2.86	1510	0	SD post mining
6/15/1983	2720	398	115	182	4.10	1380	0	SD post mining
9/16/1983	2660	386	112	148	4.34	1300	0	SD post mining
3/11/1981	3770	400	275	299	3.10	2410	0	E mine post mining
6/11/1981	5880	669	402	524	3.99	4100	0.002	E mine post mining
7/6/1981	6170	740	418	575	4.24	4570	0	E mine post mining
12/31/1981	4520	562	229	272	4.61	1970	0	E mine post mining
3/24/1982	2180	233	282	40	3.15	969	0	E mine post mining
5/24/1982	4310	500	292	343	3.65	2730	0	E mine post mining
6/24/1982	4100	542	244	353	3.98	2650	0	E mine post mining
9/29/1982	3070	362	187	185	3.53	1410	0	E mine post mining
12/30/1982	4000	435	231	228	3.82	1790	0	E mine post mining
6/15/1983	2590	373	137	150	4.09	1240	0	E mine post mining
9/16/1983	2690	380	110	129	4.52	1180	0	E mine post mining
12/6/1983	2830	347	127	130	4.05	975	0	E mine post mining
3/8/1984	4650	406	275	287	3.20	2240	0	E mine post mining
5/29/1984	4030	403		251		2190	0	E mine post mining
9/12/1984	2700	320		97		1040	0	E mine post mining
12/10/1984	1980	279		83		698	0	E mine post mining
3/19/1985	3010	255	207	173	2.52	1470	0	E mine post mining
6/18/1985	1500	277	52	62	4.76	530	0	E mine post mining
9/6/1985	1120	228	25	17	6.97	147	0	E mine post mining

Table 7j: Agricultural Water Quality, Rawhide Creek, Downstream of Mining

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)	Site description
12/9/1985	3170	412	222	244	3.54	1800	0	E mine post mining
3/24/1986	3770	420	262	259	3.46	2090	0	E mine post mining
6/16/1986	2500	347	119	162	3.74	1300	0	E mine post mining
9/30/1986	1970	311	60	83	4.69	695	0	E mine post mining
12/16/1986	2320	364	158	110	4.39	1050	0.65	E mine post mining
3/31/1987	3370	400	250	270	3.26	2100	4.19	E mine post mining
4/29/1987	2850	391	142	205	3.76	1460	0.73	E mine post mining
9/30/1987	2170	380	97	102	5.03	909	0.87	E mine post mining
10/29/1987	2210	307	73	74	4.75	654	1.15	E mine post mining
12/10/1987	1500	322	76	68	5.12	650	0.97	E mine post mining
2/26/1988	2060	257	93	78	3.78	663	0	E mine post mining
4/4/1988	4500	420	269	271	3.39	2239	1.31	E mine post mining
9/28/1988	1246	228	31	22	6.17	207	0.37	E mine post mining
12/14/1988	2226	242	164	102	2.98	889	0	E mine post mining
Count	45	45	42	45	42	45	45	
Min	1120	228	25	17	2.46	147	0	
Max	7810	1050	472	799	6.97	6010	4.19	
Median	2850	380	195.5	188	3.81	1460	0	
Average	3317.38	408.51	196.98	221.84	4.02	1756.78	0.23	
Std Dev	1421.15	160.90	106.57	160.62	0.95	1186.33	0.69	

Table 7k: Mixing Analysis Parameters from Little Powder River above Dry Creek near Weston, WY, Station ID# 06324970

agency_cd	site_no	sample_dt	sample_tm	parameter_cd	parameter name	result_va
USGS	6324970	10/12/1979	8:15	61	Flow	0.01
USGS	6324970	10/12/1979	8:15	95	Conductivity	3000
USGS	6324970	10/12/1979	8:15	915	Calcium	140
USGS	6324970	10/12/1979	8:15	925	Magnesium	120
USGS	6324970	10/12/1979	8:15	930	Sodium	430
USGS	6324970	10/12/1979	8:15	940	Chloride	4.6
USGS	6324970	11/6/1979	13:00	61	Flow	0.01
USGS	6324970	11/6/1979	13:00	95	Conductivity	2740
USGS	6324970	11/6/1979	13:00	915	Calcium	150
USGS	6324970	11/6/1979	13:00	925	Magnesium	110
USGS	6324970	11/6/1979	13:00	930	Sodium	370
USGS	6324970	11/6/1979	13:00	940	Chloride	11
USGS	6324970	7/14/1980	15:10	61	Flow	0.01
USGS	6324970	7/14/1980	15:10	95	Conductivity	2630
USGS	6324970	7/14/1980	15:10	915	Calcium	130
USGS	6324970	7/14/1980	15:10	925	Magnesium	89
USGS	6324970	7/14/1980	15:10	930	Sodium	370
USGS	6324970	7/14/1980	15:10	940	Chloride	11
USGS	6324970	9/23/1980	14:15	61	Flow	0.01
USGS	6324970	9/23/1980	14:15	95	Conductivity	2540
USGS	6324970	9/23/1980	14:15	915	Calcium	120
USGS	6324970	9/23/1980	14:15	925	Magnesium	86
USGS	6324970	9/23/1980	14:15	930	Sodium	380
USGS	6324970	9/23/1980	14:15	940	Chloride	11
USGS	6324970	8/28/1981	10:45	61	Flow	0.01
USGS	6324970	8/28/1981	10:45	95	Conductivity	1920
USGS	6324970	8/28/1981	10:45	915	Calcium	109
USGS	6324970	8/28/1981	10:45	925	Magnesium	56
USGS	6324970	8/28/1981	10:45	930	Sodium	240
USGS	6324970	8/28/1981	10:45	940	Chloride	8.3
USGS	6324970	8/28/1981	10:45	90095	Flow	1910

http://nwis.waterdata.usgs.gov/wy/nwis/qwdata/?site_no=06324970&agency_cd=USGS

Data retrieved 6/4/2004

Section 3.0

Certification of Compliance with Chapter One, Section 20 of the Wyoming Water Quality Rules and Regulations for Devon Energy Production Company L.P. (Devon) CBM Discharge Permits within Rawhide Creek Watershed

3.1 Introduction

Rawhide Creek (RC), a tributary to the Little Powder River (LPR), has several tributaries in the Kitty Oil and Gas Field area northwest of Gillette, Wyoming. This permit is located on a tributary of Rawhide Creek at a point where there is approximately 1 square mile of upland watershed. The land use within the Little Powder River drainage has been mining and dry land ranching, with a small amount of conventional oil and gas development. This semi-arid region receives between 11 and 16 inches of precipitation per year. There are flood-irrigated lands found along the floodplain of Rawhide Creek at the confluence with the Little Powder River. The predominant rangeland plant species within the drainage include alfalfa hay, mixed brome-alfalfa hay, crested wheat grass hay and native hay.

3.2 Inventory of Flood Irrigation or Subirrigation

Irrigation surface water filings were acquired in September 2000, from the WSEO, and are tabulated in **Table 4.1** and plotted on **Map 1.** Filings were acquired from the development area, downstream along Rawhide Creek to the Little Powder River. The WSEO filings suggest there are 1424 acres of permitted irrigated lands along the drainage channel below the CBM wells proposed to discharge to Rawhide Creek.

Figure 4.1 is an infrared image of Rawhide Creek to the Little Powder River taken in September 1974. Potential irrigated areas are outlined in yellow. The locations of irrigated areas in **Figure 4.1** were obtained from the GIS coverage for irrigated agricultural areas from the Spatial Data Visualization Center (SDVC) at the University of Wyoming. The SDVC dataset for croplands of Wyoming was interpreted from 1:58,200-scale National High Altitude Program (NHAP) color infrared aerial photography. The photos, which were taken in 1980-1982, were interpreted and land use designations were hand-drawn onto plots produced at the same scale as the photos, using a light table. The plots were then digitized as polygons into ARC/INFO 7.0.2. The coverages were field checked in only two counties, both outside the Powder River Basin.

Approximately half of the mapped irrigated areas do not correspond with the red (dense live vegetation) areas in the color infrared satellite imagery plotted with it. Spot-checking of a few locations indicate that many of the areas identified as irrigated are actually upland cropland. The comparison of mapped irrigation areas with the red (dense live vegetation) areas in color infrared satellite imagery is considerably better along the main stem streams. Nevertheless, these comparisons indicate that the irrigation layer generally shows more area as irrigated or subirrigated than in the color infrared photos. Mapped irrigated areas within the Rawhide Creek watershed are located exclusively at the confluence of Rawhide Creek and the Little Powder River, consistent with the irrigation filings.

Map 2 is a composite orthophoto acquired from aerial photos taken in October 1994 of the drainage. Dark areas along the creek bottom suggest zones of sub-irrigation or irrigation. These areas were compared with the current filings in **Table 4.1** from the WSEO. Orthophotos, conversations with landowners and ground survey indicate active flood irrigation using Rawhide Creek water in only one area.

The Rourke Ranch, located at the confluence of Rawhide Creek with the Little Powder River, is actively irrigated using an extensive system of ditches. This ranch is located 13.1 stream miles downstream of Devon's proposed development area. There are 656 acres permitted by WSEO for irrigation in Sections 14, 23, 26, 27, 34 and 35 of T52N R72W. Currently, 298 acres of the Rourke Ranch are irrigable by Rawhide Ditch with Rawhide Creek water. Water from Rawhide Creek is diverted into a ditch in the SW corner of Section 26. This diversion ditch irrigates 1.5 to 2 miles of fields before joining a tributary of the Little Powder River in Section 23. Irrigated crops include crested wheatgrass and smooth brome. Mr. Rourke seeded these crops, along with alfalfa, seven years ago but the alfalfa did not germinate due to lack of water. Due to the drought of recent years, the area has not been irrigated by the irrigation ditch in over 4 years. Mr. Rourke's current yield of crested wheatgrass and smooth brome is estimated at 1 ton/acre. Approximately 225-245 head of cattle are raised on the 8,000 to 10,000 acre ranch, which includes lands irrigated by the Little Powder.

3.3 Soils

Soils found within the irrigated area on the Rourke Ranch have been evaluated by BKS Environmental Associates. This study includes results of six soil samples taken within the irrigated area and descriptions

of soils. The locations of these soil samples have been plotted on **Map 1**. This study has been included as **Section 5.0**.

Available yield and permeability data specific to these soils are provided in **Table 4.2**. Yield data from the Farm Bureau's of Campbell, Sheridan and Johnson counties are also provided in **Table 4.3**. These data show the great variability in crop yield throughout the region and by reporting source.

3.4 Agricultural Suitability of CBM Discharge Water

In the unlikely event that CBM water does reach the irrigated lands, these waters will not have an adverse effect on agricultural productivity.

CBM waters anticipated for discharge are pH variable (pH 6.3 – 8.3) sodium bicarbonate waters with total dissolved solids from 495 to 1690 mg/l, specific conductance from 661 to 2500 micromhos/cm and SAR values ranging from 2.3 to 14.1. CBM water quality is presented in **Table 6 (37613 & 39781) or Table 3(36277)** of the permit application form **(Section 2.0)**. CBM water quality data, as related to agricultural suitability of CBM waters, are summarized in **Table 4.6**.

Water flow and quality in Rawhide Creek near the Rourke Ranch are largely dependent upon storage discharge from an upstream coal mine. The Rawhide Mine is located east of Highway 14/16 along the eastern border of the Kitty area, in Sections 31, 32 and 33 of T52N R72W and Sections 4, 5 and 6 of T51N R72W. Rawhide Creek joins the Little Powder River approximately two linear miles downstream from the eastern monitoring point of the Rawhide Mine. Due to the presence of this mine, water quality of Rawhide Creek has been monitored for many years. Data collected at the western boundary of the mine (above mine activity influence) are presented in **Table 4.5**. Rawhide Creek waters are slightly alkaline, saline (specific conductance ranging from 1,668 to 11,170 μmhos/cm), sodium sulfate waters SAR values range from 1.66 to 10.32 for thirteen samples with an average of 5.5. Salinity and sulfate values exceed standard water quality criteria for irrigation.

Tables 6A in WY0037613 and WY0039781 and **Table 3** in WY0036277 are mixing analyses that provide a projection of downstream water quality. As the conductivity rises, no impact, SAR thresholds will be easier to achieve. It is anticipated that as water flows down the channel, salinity will increase, thus minimizing the potential for decreased infiltration.

The infiltration capacity is more sensitive to the SAR and specific conductance in the irrigation water than is the soil permeability. The exchangeable sodium percentage (ESP) in the soil is typically used to evaluate effects on soil permeability and crop production. Hanson et al. (1999) gives the relationship between SAR and ESP in the soil as:

$$ESP = (1.475*SAR) / (1+0.0147*SAR)$$

Using this relationship and a maximum adjusted SAR for CBM water discharge of 14.9 (the highest value observed to date), an ESP of 18.02 is calculated for soils irrigated or sub irrigated entirely with CBM discharge water. Comparison of the estimated ESP with tolerance levels of various crops in **Table 4.5** shows that alfalfa hay, mixed brome-alfalfa hay, crested wheatgrass hay, and native hay grown on the Rourke Ranch would not be affected by direct use of CBM discharge water due to their tolerant status. Sodium and SAR tolerance values for these crops were not available however; ESP has been shown to be an effective measure of the potential for soil swelling (Hanson 1999).

To further demonstrate that saturation of agricultural soils with CBM water will not adversely influence the soil infiltration potential, additional analysis was performed. Devon retested the soil samples from the Rourke Ranch after saturation with undiluted CBM water collected from the Greater Kitty area. The chemical analysis of the water used to saturate these soils is presented as **Table 4.9**. The results of this testing are presented in **Table 4.10** and shown visually in **Figure 4.3**. This figure shows that saturation of these soils with CBM water will not adversely affect the vast majority of soils present on the Rourke Ranch. This demonstration does not take into account that as CBM water flows down the channel, salinity will increase, thus minimizing the potential for decreased infiltration.

3.5 Compliance and Monitoring Points

To ensure that agricultural lands are not adversely influenced by CBM water, Devon requests that irrigation compliance monitoring be conducted at a point downstream of Devon's lowest reservoir within the Kitty field on a weekly basis. This point is located on Rawhide Creek in T51NR72W6NWSW. This Irrigation Monitoring Point (IMP) is shown on **Figure 2.1** of the permit application. It is labeled IMR (RC2). Devon proposes a limit of 6.0 on SAR and a limit of 5000 umhos/cm for specific conductance. These limits are comparable to the average natural water quality as shown in **Tables 4.4 and 4.5**.

The WDEQ was also requested that three water quality monitoring stations be included within this permit; one on Rawhide Creek at the mouth and two on the Little Powder River above and below Rawhide Creek. Devon's proposed points are listed in the table below and shown on the attached **Map 1**. These points shall be monitored should discharge from Devon's lowest containment units occur from Devon's Greater Kitty facilities discharging to the Rawhide Creek drainage.

3.6 Conclusions

Flood irrigation is practiced 13 miles downstream of the CBM discharge, on the Rourke Ranch. Other landowners with water rights were unaware of the WSEO filings and do not practice flood irrigation. Soils in the fields range from loam near the irrigation head gates to fine grained clay loams in the downstream portions of the fields.

Natural water quality of Rawhide Creek is very saline, moderately sodic, sodium sulfate water, unsuitable according to standard range management guidelines for irrigation. The CBM waters are moderately saline, moderately sodic, sodium bicarbonate water (Hanson 1999). Work with saline waters with elevated sodium contents suggests that SAR values are less detrimental to infiltration as salinity values rise.

There are two potential scenarios where CBM water will be used all or in part to irrigate downstream agricultural lands:

If there is a downstream call for water from downstream irrigators, Devon commits to comply with this request and open low-level gated discharge pipes on its reservoirs. Devon will attempt to manage this controlled release of CBM water with natural runoff from storms or snowmelt. Water of salinity greater than 2200 μmhos/cm is preferable for irrigation and Devon will test all water before release. Devon will also work with the ranch manager in testing of water, irrigated soils, and productivity of agricultural lands. Devon is unable to control reservoirs which exist downstream of this development area.
Discharge will not detrimentally influence agricultural production downstream either short term or long-term. There are two areas of irrigation between the discharge points and the Powder River. These areas grow hay and alfalfa that are tolerant of saline water.

3.8 References

Applied Hydrology Associates (AHA). 2000. "Evaluation of CBM Water Discharges for Compliance with Agricultural Use Water Quality Main Stem Study Tier 1 Report". Denver, CO.

Applied Hydrology Associates (AHA). 2000b. "Section 20 Tributary Evaluation, LX Bar Creek, Campbell County, WY". Denver, CO.

Art O'Hayre Ph.D. 2002. Unpublished Tributary Monitoring Data for PAW. Applied Hydrology Associates.

BKS Environmental Associates, Inc. August 2000. "Devon Irrigation/ Soil Suitability Investigations for Rawhide Creek." Gillette, WY.

Greystone Consultants, Inc. November 1999. "Supporting Water Quality Data for Characterization of Coal Bed Methane Discharge and Receiving Waters, Kitty Field, Little Powder River Drainage". Englewood, CO.

Hanson, B., S. R. Grattan, and A. Fulton. 1999. "Agricultural Salinity and Drainage." Division of Agriculture and Natural Resources Publication 3375, University of California, Davis. 180 pages.

Lowham, H. W. 1988. "Stream Flows in Wyoming" Cheyenne, WY. U.S. Geological Survey Water Resources Investigations Report 88-4045.

Rourke, Paul. Personal communication with Brenda Schladweiler of BKS Environmental Associates Inc. June 10, 2000.

Suarez, D.L. 1981. "Relation between pH and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters." Journal of the Soil Science Society of America, Vol. 45. Pp. 469 – 475.

United States Department of Agriculture, Soil Conservation Service. 1939. "Soil Survey (reconnaissance) Campbell County Wyoming. Series 1939, No. 22

United States Department of Agriculture, Soil Conservation Service. 1986. "Soil Survey of Sheridan County Area, Wyoming."

United States Geological Survey. Water Resources Data System Water Quality Database. Available at http://www.wrds.uwyo.edu/wrds/dbms/hydro/stcty-1.html

Wyoming Spatial Data Clearinghouse. http://wgiac.state.wy.us/wsdc
Wyoming Oil and Gas Conservation Commission Coal Bed Methane Field Production by Drainage. Available at http://wogcc.state.wy.us/crmsprod.cfm

Table 4.1. WSEO Irrigation Listings, August 2000, Tributaries of Rawhide Creek to Rawhide Creek to Little Powder River

PFnm	APPkey	PermitNo	Tns	Rng	Sec	Qtr/Qtr	Qtr/Qtr	Landowner	Acres	Status	Name1	Use	FacilityName	Applicant	Amt	Unit
		P11276D	51	72	3	5	NENW		8	ADJ	NAMING ERRORS	IRR	ROUGH	WM. D. ROONEY	0.59	CFS
		P11276D	51	72	3	6	NWNW		13.5	ADJ	NAMING ERRORS	IRR	ROUGH	WM. D. ROONEY	0.59	CFS
		P11276D	51	72	4	1	NENE		10.2	ADJ	NAMING ERRORS	IRR	ROUGH	WM. D. ROONEY	0.59	CFS
		P11276D	51	72	4	2	NWNE		10	ADJ	NAMING ERRORS	IRR	ROUGH	WM. D. ROONEY	0.59	CFS
5735	T5735D	C13/044A	52	72	14	1	NENE	Paul Rourke	19	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	14	2	NWNE	Paul Rourke	30	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	14	3	SWNE	Paul Rourke	30	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	14	4	SENE	Paul Rourke	16	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	14	8	SENW	Paul Rourke	1	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	14	9	NESW	Paul Rourke	4	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	14	13	NESE	Paul Rourke	8	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	14	14	NWSE	Paul Rourke	30	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	14	15	SWSE	Paul Rourke	30	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	14	16	SESE	Paul Rourke	4	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	23	1	NENE	Paul Rourke	19	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	23	2	NWNE	Paul Rourke	9	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
11988	P6887D	C34/179A	52	72	23	3	SWNE	Paul Rourke	31	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
5735	T5735D	C13/044A	52	72	23	4	SENE	Paul Rourke	20	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	23	4	SENE	Paul Rourke		ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	23	5	NENW	Paul Rourke	1	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
11988	P6887D	C34/179A	52	72	23	8	SENW	Paul Rourke	10	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
11988	P6887D	C34/179A	52	72	23	9	NESW	Paul Rourke	14	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
11988	P6887D	C34/179A	52	72	23	12	SESW	Paul Rourke	20	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
5735	T5735D	C13/044A	52	72	23	13	NESE	Paul Rourke	20	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
11988	P6887D	C34/179A	52	72	23	13	NESE	Paul Rourke	7	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
11988	P6887D	C34/179A	52	72	23	14	NWSE	Paul Rourke	39	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
11988	P6887D	C34/179A	52	72	23	15	SWSE	Paul Rourke	40	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
5735	T5735D	C13/044A	52	72	23	16	SESE	Paul Rourke	25	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
11988	P6887D	C34/179A	52	72	23	16	SESE	Paul Rourke	6	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
5735	T5735D	C13/044A	52	72	26	1	NENE	Paul Rourke	30	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
5735	T5735D	C13/044A	52	72	26	2	NWNE	Paul Rourke		ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
11988	P6887D	C34/179A	52	72	26	2	NWNE	Paul Rourke	30	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
11988	P6887D	C34/179A	52	72	26	3	SWNE	Paul Rourke	5	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
5735	T5735D	C13/044A	52	72	26	4	SENE	Paul Rourke	28	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
11988	P6887D	C34/179A	52	72	26	5	NENW	Paul Rourke	32	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
11988	P6887D	C34/179A	52	72	26	5	NENW	Paul Rourke		ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
11988	P6887D	C34/179A	52	72	26	7	SWNW	Paul Rourke	24	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
11988	P6887D	C34/179A	52	72	26	8	SENW	Paul Rourke	28	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
11988	P6887D	C34/179A	52	72	26	10	NWSW	Paul Rourke	12	ADJ	RAWHIDE CREEK	IRR	RAWHIDE DITCH	LYDIA H. ELMORE	4.25	CFS
14419	P2971E	C38/038A	52	72	26	11	SWSW	Paul Rourke	4	ADJ	RAWHIDE CREEK	IRR	ENL RAWHIDE DITCH	LYDIA H. ELMORE	0.16	CFS
14424	P12472D	C38/043A	52	72	26	11	SWSW	Paul Rourke	2.5	ADJ	RAWHIDE CREEK	IRR	RAWHIDE #2 DITCH	LYDIA H. ELMORE	0.36	CFS
5735	T5735D	C13/044A	52	72	26	13	NESE	Paul Rourke	2	ADJ	LITTLE POWDER RIVER	IRR	PRESTON DITCH	MIKE ELMORE	6.07	CFS
14419	P2971E	C38/038A	52	72	27	16	SESE	Paul Rourke	2	ADJ	RAWHIDE CREEK	IRR	ENL RAWHIDE DITCH	LYDIA H. ELMORE	0.16	CFS
14424	P12472D	C38/043A	52	72	34	1	NENE	Paul Rourke	11	ADJ	RAWHIDE CREEK	IRR	RAWHIDE #2 DITCH	LYDIA H. ELMORE	0.36	CFS
14419	P2971E	C38/038A	52	72	34	2	NWNE	Paul Rourke	5	ADJ	RAWHIDE CREEK	IRR	ENL RAWHIDE DITCH	LYDIA H. ELMORE	0.16	CFS
14419	P2971E	C38/038A	52	72	34	3	SWNE	Paul Rourke		PUD	RAWHIDE CREEK	IRR	ENL RAWHIDE DITCH	LYDIA H. ELMORE	0.16	CFS
14424	P12472D	C38/043A	52	72	34	4	SENE	Paul Rourke	7.5	ADJ	RAWHIDE CREEK	IRR	RAWHIDE #2 DITCH	LYDIA H. ELMORE	0.36	CFS
11987	P734R	C34/178A	52	72	34	13	NESE	Paul Rourke		PU	RAWHIDE CREEK	IRR	RAWHIDE RES	LYDIA H. ELMORE	514	ACFT
14420	P2681R	C38/039A	52	72	34	13	NESE	Paul Rourke		PU	RAWHIDE CREEK	IRR	ENL RAWHIDE RES	LYDIA H. ELMORE	41.8	ACFT
14420	P2681R	C38/039A	52	72	34	14	NWSE	Paul Rourke		PU	RAWHIDE CREEK	IRR	ENL RAWHIDE RES	LYDIA H. ELMORE	41.8	ACFT
14420	P2681R	C38/039A	52	72	35	7	SWNW	Paul Rourke		PU	RAWHIDE CREEK	IRR	ENL RAWHIDE RES	LYDIA H. ELMORE	41.8	ACFT
14420	P2681R	C38/039A	52	72	35	10	NWSW	Paul Rourke		PU	RAWHIDE CREEK	IRR	ENL RAWHIDE RES	LYDIA H. ELMORE	41.8	ACFT
13956	P12746D	C37/343A	51	73	2	11	SWSW	Twenty-Mile Land Co.	19	ADJ	BOX DRAW	IRR	DEEP DRAW SUPPLY DITCH	ELZORA BLAKE	0	CFS
		P12746D	51	73	2	11	SWSW	Twenty-Mile Land Co.		ADJ	BOX DRAW	RES,IRR	DEEP DRAW SUPPLY	WILFRED TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0	CFS
		P11608D	51	73	2	11	SWSW	Twenty-Mile Land Co.		ADJ	DEEP	IRR,DOM	DEEP DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ALZORA BLAKE		
13958	P11608D	C37/345A	51	73	2	11	SWSW	Twenty-Mile Land Co.		ADJ	DEEP DRAW	IRR	DEEP DRAW DITCH	MINNIE E. TOWNSEND	0.86	CFS
13956	P12746D	C37/343A	51	73	2	12	SESW	Twenty-Mile Land Co.	21	ADJ	BOX DRAW	IRR	DEEP DRAW SUPPLY DITCH	ELZORA BLAKE	0	CFS
		P12746D	51	73	2	12	SESW	Twenty-Mile Land Co.		ADJ	BOX DRAW	RES,IRR	DEEP DRAW SUPPLY	WILFRED TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0	CFS

Table 4.1. WSEO Irrigation Listings, August 2000, Tributaries of Rawhide Creek to Rawhide Creek to Little Powder River

PFnm	APPkey	PermitNo	Tns	Rng	Sec	Qtr/Qtr	Qtr/Qtr	Landowner	Acres	Status	Name1	Use	FacilityName	Applicant	Amt	Unit
		P11608D	51	73	2	12	SESW	Twenty-Mile Land Co		ADJ	DEEP	IRR,DOM	DEEP DRAW	WINIFRED D. TOWNSEND**MINNIE E TOWNSEND**ALZORA BLAKE		
13958	P11608D	C37/345A	51	73	2	12	SESW	Twenty-Mile Land Co		ADJ	DEEP DRAW	IRR	DEEP DRAW DITCH	MINNIE E. TOWNSEND	0.86	CFS
13956	P12746D	C37/343A	51	73	2	15	SWSE	Twenty-Mile Land Co	10	ADJ	BOX DRAW	IRR	DEEP DRAW SUPPLY DITCH	ELZORA BLAKE	0	CFS
		P12746D	51	73	2	15	SWSE	Twenty-Mile Land Co		ADJ	BOX DRAW	RES,IRR	DEEP DRAW SUPPLY	WILFRED TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0	CFS
		P11608D	51	73	2	15	SWSE	Twenty-Mile Land Co		ADJ	DEEP	IRR,DOM	DEEP DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ALZORA BLAKE		
13958	P11608D	C37/345A	51	73	2	15	SWSE	Twenty-Mile Land Co		ADJ	DEEP DRAW	IRR	DEEP DRAW DITCH	MINNIE E. TOWNSEND	0.86	CFS
		P2058R	51	73	3	10	NWSW	Twenty-Mile Land Co		ADJ	BOX DRAW	IRR	BOX DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	33	ACFT
13952	P2058R	C37/339A	51	73	3	10	NWSW	Twenty-Mile Land Co		PU	BOX DRAW	IRR	BOX DRAW RES	MINNIE E. TOWNSEND	33	ACFT
		P2058R	51	73	3	11	SWSW	Twenty-Mile Land Co		ADJ	BOX DRAW	IRR	BOX DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	33	ACFT
13954	P11610D	C37/341A	51	73	3	11	SWSW	Twenty-Mile Land Co		PUD	BOX DRAW	IRR	BOX DRAW DITCH	W. D. TOWNSEND	0.3	CFS
13955	P11610D	C37/342A	51	73	3	11	SWSW	Twenty-Mile Land Co		PUD	BOX DRAW	IRR	BOX DRAW DITCH	ELZORA BLAKE	0.43	CFS
13952	P2058R	C37/339A	51	73	3	11	SWSW	Twenty-Mile Land Co		PU	BOX DRAW	IRR	BOX DRAW RES	MINNIE E. TOWNSEND	33	ACFT
13952	P2058R	C37/339A	51	73	3	11	SWSW	Twenty-Mile Land Co		PUO	BOX DRAW	IRR	BOX DRAW RES	MINNIE E. TOWNSEND	33	ACFT
13956	P12746D	C37/343A	51	73	3	11	SWSW	Twenty-Mile Land Co		PUD	BOX DRAW	IRR	DEEP DRAW SUPPLY DITCH	ELZORA BLAKE	0	CFS
		P11609D	51	73	3	11	SWSW	Twenty-Mile Land Co	5	ADJ	BOX DRAW	IRR,DOM	#1	WINIFRED TWONSEND**MINNIE E. TOWNSEND**ELZORA BLACKE		
		P11610D	51	73	3	11	SWSW	Twenty-Mile Land Co		ADJ	BOX DRAW	IRR,DOM	BOX DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0.9	CFS
		P12746D	51	73	3	11	SWSW	Twenty-Mile Land Co		ADJ	BOX DRAW	RES,IRR	DEEP DRAW SUPPLY	WILFRED TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0	CFS
13953	P11609D	C37/340A	51	73	3	12	SESW	Twenty-Mile Land Co	5	ADJ	BOX DRAW	IRR	#1 DITCH	ELZORA BLAKE	0.07	CFS
		P11608D	51	73	3	14	NWSE	Twenty-Mile Land Co		ADJ	DEEP	IRR,DOM	DEEP DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ALZORA BLAKE		
13958	P11608D	C37/345A	51	73	3	14	NWSE	Twenty-Mile Land Co		PUD	DEEP DRAW	IRR	DEEP DRAW DITCH	MINNIE E. TOWNSEND	0.86	CFS
13959	P11608D	C37/346A	51	73	3	14	NWSE	Twenty-Mile Land Co		PUD	DEEP DRAW	IRR	DEEP DRAW DITCH	ELZORA BLAKE	0.14	CFS
		P2429R	51	73	3	14	NWSE	Twenty-Mile Land Co		PU	DEEP DRAW	IRR,DOM	DEEP DRAW	WINIFRED D. & MINNIE E. TOWNSEND**ELZORA BLAKE	8	ACFT
		P2429R	51	73	3	14	NWSE	Twenty-Mile Land Co		PUO	DEEP DRAW	IRR,DOM	DEEP DRAW	WINIFRED D. & MINNIE E. TOWNSEND**ELZORA BLAKE	8	ACFT
13960	P11608D	C37/347A	51	73	3	14	NWSE	Twenty-Mile Land Co		PUD	DEEP DRAW	IRR,DOM	DEEP DRAW DITCH	W. D. TOWNSEND	0.28	CFS
13957	P2429R	C37/344A	51	73	3	14	NWSE	Twenty-Mile Land Co		PU	DEEP DRAW	IRR,DOM	DEEP DRAW RES	ELZORA BLAKE	8	ACFT
13957	P2429R	C37/344A	51	73	3	14	NWSE	Twenty-Mile Land Co		PUO	DEEP DRAW	IRR,DOM	DEEP DRAW RES	ELZORA BLAKE	8	ACFT
13955	P11610D	C37/342A	51	73	3	15	SWSE	Twenty-Mile Land Co	5	ADJ	BOX DRAW	IRR	BOX DRAW DITCH	ELZORA BLAKE	0.43	CFS
		P11610D	51	73	3	15	SWSE	Twenty-Mile Land Co		ADJ	BOX DRAW	IRR,DOM	BOX DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0.9	CFS
13956	P12746D	C37/343A	51	73	3	16	SESE	Twenty-Mile Land Co	10	ADJ	BOX DRAW	IRR	DEEP DRAW SUPPLY DITCH	ELZORA BLAKE	0	CFS
		P12746D	51	73	3	16	SESE	Twenty-Mile Land Co		ADJ	BOX DRAW	RES,IRR	DEEP DRAW SUPPLY	WILFRED TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0	CFS
		P11608D	51	73	3	16	SESE	Twenty-Mile Land Co		ADJ	DEEP	IRR,DOM	DEEP DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ALZORA BLAKE		
13959	P11608D	C37/346A	51	73	3	16	SESE	Twenty-Mile Land Co		ADJ	DEEP DRAW	IRR	DEEP DRAW DITCH	ELZORA BLAKE	0.14	CFS
15301	P2634R	C39/362A	51	73	9	15	SWSE	Twenty-Mile Land Co		PU	NINE-A-BAR CREEK	IRR	GIVEN RES	H. H. GIVEN	37.8	ACFT
		P2634R	51	73	9	15	SWSE	Twenty-Mile Land Co		PU	NINE-A-BAR CREEK	IRR,DOM	GIVEN	H. H. GIVEN	37.8	ACFT
15299	P12361D	C39/360A	51	73	9	16	SESE	Twenty-Mile Land Co	5	ADJ	NINE-A-BAR CREEK	IRR	GIVEN #1 DITCH	H. H. GIVEN	0.28	CFS
15299	P12361D	C39/360A	51	73	9	16	SESE	Twenty-Mile Land Co		PUD	NINE-A-BAR CREEK	IRR	GIVEN #1 DITCH	H. H. GIVEN	0.28	CFS
15300	P12362D	C39/361A	51	73	9	16	SESE	Twenty-Mile Land Co		PUD	NINE-A-BAR CREEK	IRR	GIVEN #2 DITCH	H. H. GIVEN	0.07	CFS
15301	P2634R	C39/362A	51	73	9	16	SESE	Twenty-Mile Land Co		PU	NINE-A-BAR CREEK	IRR	GIVEN RES	H. H. GIVEN	37.8	ACFT
15301	P2634R	C39/362A	51	73	9	16	SESE	Twenty-Mile Land Co		PUO	NINE-A-BAR CREEK	IRR	GIVEN RES	H. H. GIVEN	37.8	ACFT
		P2634R	51	73	9	16	SESE	Twenty-Mile Land Co		PU	NINE-A-BAR CREEK	IRR,DOM	GIVEN	H. H. GIVEN	37.8	ACFT
		P2634R	51	73	9	16	SESE	Twenty-Mile Land Co		PUO	NINE-A-BAR CREEK	IRR,DOM	GIVEN	H. H. GIVEN	37.8	ACFT
		P12361D	51	73	9	16	SESE	Twenty-Mile Land Co	5	ADJ	NINE-A-BAR CREEK	IRR,DOM	GIVEN 3DITCH #1	H.H. GIVEN		
		P12362D	51	73	9	16	SESE	Twenty-Mile Land Co		ADJ	NINE-A-BAR CREEK	IRR,DOM	GIVEN DITCH #2	H.H. GIVEN		
13956	P12746D	C37/343A	51	73	10	1	NENE	Twenty-Mile Land Co	5	ADJ	BOX DRAW	IRR	DEEP DRAW SUPPLY DITCH	ELZORA BLAKE	0	CFS
		P12746D	51	73	10	1	NENE	Twenty-Mile Land Co		ADJ	BOX DRAW	RES,IRR	DEEP DRAW SUPPLY	WILFRED TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0	CFS

Table 4.1. WSEO Irrigation Listings, August 2000, Tributaries of Rawhide Creek to Rawhide Creek to Little Powder River

PFnm	APPkey	PermitNo	Tns	Rng	Sec	Qtr/Qtr	Qtr/Qtr	Landowner	Acres	Status	Name1	Use	FacilityName	Applicant	Amt	Unit
		P11608D	51	73	10	1	NENE	Twenty-Mile Land Co		ADJ	DEEP	IRR,DOM	DEEP DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ALZORA BLAKE		
13960	P11608D	C37/347A	51	73	10	1	NENE	Twenty-Mile Land Co		ADJ	DEEP DRAW	IRR,DOM	DEEP DRAW DITCH	W. D. TOWNSEND	0.28	CFS
13955	P11610D	C37/342A	51	73	10	2	NWNE	Twenty-Mile Land Co	25	ADJ	BOX DRAW	IRR	BOX DRAW DITCH	ELZORA BLAKE	0.43	CFS
		P11610D	51	73	10	2	NWNE	Twenty-Mile Land Co		ADJ	BOX DRAW	IRR,DOM	BOX DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0.9	CFS
13954	P11610D	C37/341A	51	73	10	4	SENE	Twenty-Mile Land Co	11	ADJ	BOX DRAW	IRR	BOX DRAW DITCH	W. D. TOWNSEND	0.3	CFS
		P11610D	51	73	10	4	SENE	Twenty-Mile Land Co		ADJ	BOX DRAW	IRR,DOM	BOX DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0.9	CFS
		P12362D	51	73	10	10	NWSW	Twenty-Mile Land Co.	5	ADJ	NINE-A-BAR CREEK	IRR,DOM	GIVEN DITCH #2	H.H. GIVEN		
15299	P12361D	C39/360A	51	73	10	11	SWSW	Twenty-Mile Land Co.	5	ADJ	NINE-A-BAR CREEK	IRR	GIVEN #1 DITCH	H. H. GIVEN	0.28	CFS
		P12361D	51	73	10	11	SWSW	Twenty-Mile Land Co.		ADJ	NINE-A-BAR CREEK	IRR,DOM	GIVEN 3DITCH #1	H.H. GIVEN		
15300	P12362D	C39/361A	51	73	10	12	SESW	Twenty-Mile Land Co.	5	ADJ	NINE-A-BAR CREEK	IRR	GIVEN #2 DITCH	H. H. GIVEN	0.07	CFS
13956	P12746D	C37/343A	51	73	11	5	NENW	Twenty-Mile Land Co	16	ADJ	BOX DRAW	IRR	DEEP DRAW SUPPLY DITCH	ELZORA BLAKE	0	CFS
		P12746D	51	73	11	5	NENW	Twenty-Mile Land Co		ADJ	BOX DRAW	RES,IRR	DEEP DRAW SUPPLY	WILFRED TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0	CFS
		P11608D	51	73	11	5	NENW	Twenty-Mile Land Co.		ADJ	DEEP	IRR,DOM	DEEP DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ALZORA BLAKE		
13958	P11608D	C37/345A	51	73	11	5	NENW	Twenty-Mile Land Co.		ADJ	DEEP DRAW	IRR	DEEP DRAW DITCH	MINNIE E. TOWNSEND	0.86	CFS
13956	P12746D	C37/343A	51	73	11	6	NWNW	Twenty-Mile Land Co	15	ADJ	BOX DRAW	IRR	DEEP DRAW SUPPLY DITCH	ELZORA BLAKE	0	CFS
		P12746D	51	73	11	6	NWNW	Twenty-Mile Land Co		ADJ	BOX DRAW	RES,IRR	DEEP DRAW SUPPLY	WILFRED TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0	CFS
		P11608D	51	73	11	6	NWNW	Twenty-Mile Land Co.		ADJ	DEEP	IRR,DOM	DEEP DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ALZORA BLAKE		
13960	P11608D	C37/347A	51	73	11	6	NWNW	Twenty-Mile Land Co		ADJ	DEEP DRAW	IRR,DOM	DEEP DRAW DITCH	W. D. TOWNSEND	0.28	CFS
13954	P11610D	C37/341A	51	73	11	7	SWNW	Twenty-Mile Land Co	10	ADJ	BOX DRAW	IRR	BOX DRAW DITCH	W. D. TOWNSEND	0.3	CFS
		P11610D	51	73	11	7	SWNW	Twenty-Mile Land Co		ADJ	BOX DRAW	IRR,DOM	BOX DRAW	WINIFRED D. TOWNSEND**MINNIE E. TOWNSEND**ELZORA BLAKE	0.9	CFS
15299	P12361D	C39/360A	51	73	15	5	NENW	Twenty-Mile Land Co.	5	ADJ	NINE-A-BAR CREEK	IRR	GIVEN #1 DITCH	H. H. GIVEN	0.28	CFS
		P12361D	51	73	15	5	NENW	Twenty-Mile Land Co		ADJ	NINE-A-BAR CREEK	IRR,DOM	GIVEN 3DITCH #1	H.H. GIVEN		
15299	P12361D	C39/360A	51	73	15	6	NWNW	Twenty-Mile Land Co.	5	ADJ	NINE-A-BAR CREEK	IRR	GIVEN #1 DITCH	H. H. GIVEN	0.28	CFS
		P12361D	51	73	15	6	NWNW	Twenty-Mile Land Co.		ADJ	NINE-A-BAR CREEK	IRR,DOM	GIVEN 3DITCH #1	H.H. GIVEN		
12751	P9873D	C35/475A	51	73	15	9	NESW	Twenty-Mile Land Co.	5	ADJ	RAWHIDE CREEK	IRR,DOM	DALY DITCH	JOHN T. DALY	0.37	CFS
12751	P9873D	C35/475A	51	73	15	11	SWSW	Twenty-Mile Land Co.	15	ADJ	RAWHIDE CREEK	IRR,DOM	DALY DITCH	JOHN T. DALY	0.37	CFS
12751	P9873D	C35/475A	51	73	15	12	SESW	Twenty-Mile Land Co	6	ADJ	RAWHIDE CREEK	IRR,DOM	DALY DITCH	JOHN T. DALY	0.37	CFS
		P12713D	50	73	17	7	SWNW	John J. Hines Living Trust	9.2	UNA	RAWHIDE CREEK	IRR	EAGLE DITCH	KATE M. EAGLE	0.76	CFS
16597	P12713D	C41/489A	50	73	17	8	SENW	John J. Hines Living Trust	1.5	ADJ	RAWHIDE CREEK	IRR	EAGLE DITCH	KATE M. EAGLE	0.76	CFS
16597	P12713D	C41/489A	50	73	17	9	NESW	John J. Hines Living Trust	29	ADJ	RAWHIDE CREEK	IRR	EAGLE DITCH	KATE M. EAGLE	0.76	CFS
16597	P12713D	C41/489A	50	73	17	10	NWSW	John J. Hines Living Trust	8.7	ADJ	RAWHIDE CREEK	IRR	EAGLE DITCH	KATE M. EAGLE	0.76	CFS
16597	P12713D	C41/489A	50	73	17	12	SESW	John J. Hines Living Trust	14.3	ADJ	RAWHIDE CREEK	IRR	EAGLE DITCH	KATE M. EAGLE		
		P3394R	50	73	17	16	SESE	John J. Hines Living Trust		PU	Missouri River	STO,IRR	TIGG	JOHN HINES	2.31	ACFT
		P3394R	50	73	17	16	SESE	John J. Hines Living Trust		PUO	Missouri River	STO,IRR	TIGG	JOHN HINES	2.31	ACFT
16597	P12713D	C41/489A	50	73	20	2	NWNE	John J. Hines Living Trust		ADJ	RAWHIDE CREEK	IRR	EAGLE DITCH	KATE M. EAGLE	41	ACFT
16596	P2735R	C41/488A	50	73	20	2	NWNE	John J. Hines Living Trust		PU	RAWHIDE CREEK	IRR	EAGLE RES	KATE M. EAGLE	41	ACFT
		P2735R	50	73	20	2	NWNE			PU	EAST PRONG LITTLE RAWHIDE CREEK	IRR	EAGLE	KATE M. EAGLE	41	ACFT
		P2735R	50	73	20	2	NWNE			PUO	EAST PRONG LITTLE RAWHIDE CREEK	IRR	EAGLE	KATE M. EAGLE	41	ACFT
16596	P2735R	C41/488A	50	73	20	2	NWNE			PU	EAST PRONG LITTLE RAWHIDE CREEK	IRR	EAGLE RES	KATE M. EAGLE	41	ACFT
16596	P2735R	C41/488A	50	73	20	2	NWNE			PUO	EAST PRONG LITTLE RAWHIDE CREEK	IRR	EAGLE RES	KATE M. EAGLE	41	ACFT
16596	P2735R	C41/488A	50	73	20	3	SWNE	John J. Hines Living Trust		PU	RAWHIDE CREEK	IRR	EAGLE RES	KATE M. EAGLE	41	ACFT
		P2735R	50	73	20	3	SWNE			PU	EAST PRONG LITTLE RAWHIDE CREEK	IRR	EAGLE	KATE M. EAGLE	41	ACFT
16596	P2735R	C41/488A	50	73	20	3	SWNE			PU	EAST PRONG LITTLE RAWHIDE CREEK	IRR	EAGLE RES	KATE M. EAGLE	41	ACFT
15307	P13798D	C39/368A	51	73	20	3	SWNE		0.2	ADJ	RAWHIDE CREEK	IRR	DALY #6 DITCH	LENORA J. DALY	0.07	CFS
15307	P13798D	C39/368A	51	73	20	3	SWNE			PUD	RAWHIDE CREEK	IRR	DALY #6 DITCH	LENORA J. DALY	0.07	CFS
15308	P13799D	C39/369A	51	73	20	3	SWNE		5	ADJ	RAWHIDE CREEK	IRR	DALY #7 DITCH	LENORA J. DALY	0.1	CFS
15308	P13799D	C39/369A	51	73	20	3	SWNE			PUD	RAWHIDE CREEK	IRR	DALY #7 DITCH	LENORA J. DALY	0.1	CFS

Table 4.1. WSEO Irrigation Listings, August 2000, Tributaries of Rawhide Creek to Rawhide Creek to Little Powder River

PFnm	APPkey	PermitNo	Tns	Rng	Sec	Qtr/Qtr	Qtr/Qtr	Landowner	Acres	Status	Name1	Use	FacilityName	Applicant	Amt	Unit
15309	P13800D	C39/370A	51	73	20	3	SWNE		0.75	ADJ	RAWHIDE CREEK	IRR	DALY #8 DITCH	LENORA J. DALY	0.01	CFS
15309	P13800D	C39/370A	51	73	20	3	SWNE			PUD	RAWHIDE CREEK	IRR	DALY #8 DITCH	LENORA J. DALY	0.01	CFS
		P13798D	51	73	20	3	SWNE		0.2	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #6	LENORA DALY	0.06	CFS
		P13799D	51	73	20	3	SWNE		5	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #7	LENORA DALY	0.09	CFS
		P13800D	51	73	20	3	SWNE		0.75	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #8	LENORA DALY	0.01	CFS
15306	P13797D	C39/367A	51	73	20	4	SENE		0.91	ADJ	RAWHIDE CREEK	IRR	DALY #5 DITCH	LENORA J. DALY	0.04	CFS
15306	P13797D	C39/367A	51	73	20	4	SENE			PUD	RAWHIDE CREEK	IRR	DALY #5 DITCH	LENORA J. DALY	0.04	CFS
15307	P13798D	C39/368A	51	73	20	4	SENE		4.07	ADJ	RAWHIDE CREEK	IRR	DALY #6 DITCH	LENORA J. DALY	0.07	CFS
15308	P13799D	C39/369A	51	73	20	4	SENE		1.41	ADJ	RAWHIDE CREEK	IRR	DALY #7 DITCH	LENORA J. DALY	0.1	CFS
		P13797D	51	73	20	4	SENE		0.91	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #5	LENORA DALY	0.04	CFS
		P13798D	51	73	20	4	SENE		4.07	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #6	LENORA DALY	0.06	CFS
		P13799D	51	73	20	4	SENE		1.41	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #7	LENORA DALY	0.09	CFS
16596	P2735R	C41/488A	50	73	20	5	NENW	John J. Hines Living Trust		PU	RAWHIDE CREEK	IRR	EAGLE RES	KATE M. EAGLE		
		P2735R	50	73	20	5	NENW			PU	EAST PRONG LITTLE RAWHIDE CREEK	IRR	EAGLE	KATE M. EAGLE	41	ACFT
16596	P2735R	C41/488A	50	73	20	5	NENW			PU	EAST PRONG LITTLE RAWHIDE CREEK	IRR	EAGLE RES	KATE M. EAGLE	41	ACFT
15302	P13793D	C39/363A	51	73	21	6	NWNW		2.2	ADJ	RAWHIDE CREEK	IRR	DALY #1 DITCH	LENORA J. DALY	0.03	CFS
15302	P13793D	C39/363A	51	73	21	6	NWNW			PUD	RAWHIDE CREEK	IRR	DALY #1 DITCH	LENORA J. DALY	0.03	CFS
15303	P13794D	C39/364A	51	73	21	6	NWNW		1.8	ADJ	RAWHIDE CREEK	IRR	DALY #2 DITCH	LENORA J. DALY	0.06	CFS
15310	P13801D	C39/371A	51	73	21	6	NWNW		1	ADJ	RAWHIDE CREEK	IRR	DALY #9 DITCH	LENORA J. DALY	0.01	CFS
15310	P13801D	C39/371A	51	73	21	6	NWNW			PUD	RAWHIDE CREEK	IRR	DALY #9 DITCH	LENORA J. DALY	0.01	CFS
		P13793D	51	73	21	6	NWNW		2.2	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #1	LENORA DALY	0.03	CFS
		P13794D	51	73	21	6	NWNW		1.8	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #2	LENORA DALY	0.06	CFS
		P13801D	51	73	21	6	NWNW		1	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #9	LENORA DALY	0.01	CFS
15303	P13794D	C39/364A	51	73	21	7	SWNW		2	ADJ	RAWHIDE CREEK	IRR	DALY #2 DITCH	LENORA J. DALY	0.06	CFS
15303	P13794D	C39/364A	51	73	21	7	SWNW			PUD	RAWHIDE CREEK	IRR	DALY #2 DITCH	LENORA J. DALY	0.06	CFS
15304	P13795D	C39/365A	51	73	21	7	SWNW		3	ADJ	RAWHIDE CREEK	IRR	DALY #3 DITCH	LENORA J. DALY	0.04	CFS
15304	P13795D	C39/365A	51	73	21	7	SWNW			PUD	RAWHIDE CREEK	IRR	DALY #3 DITCH	LENORA J. DALY	0.04	CFS
15305	P13796D	C39/366A	51	73	21	7	SWNW		6.14	ADJ	RAWHIDE CREEK	IRR	DALY #4 DITCH	LENORA J. DALY	0.09	CFS
15305	P13796D	C39/366A	51	73	21	7	SWNW			PUD	RAWHIDE CREEK	IRR	DALY #4 DITCH	LENORA J. DALY	0.09	CFS
15306	P13797D	C39/367A	51	73	21	7	SWNW		1.87	ADJ	RAWHIDE CREEK	IRR	DALY #5 DITCH	LENORA J. DALY	0.04	CFS
		P13794D	51	73	21	7	SWNW		2	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #2	LENORA DALY	0.06	CFS
		P13795D	51	73	21	7	SWNW		3	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #3	LENORA DALY	0.04	CFS
		P13796D	51	73	21	7	SWNW		6.14	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #4	LENORA DALY	0.09	CFS
		P13797D	51	73	21	7	SWNW		1.87	ADJ	RAWHIDE CREEK	IRR	DALY DITCH #5	LENORA DALY	0.04	CFS
12754	P11693D	C35/478A	51	73	22	3	SWNE	Twenty-Mile Land Co.	5	ADJ	BRANCH RAWHIDE CREEK	IRR	EAST DITCH	BRIDGET RICKS	0.43	CFS
12753	P11692D	C35/477A	51	73	22	5	NENW	Twenty-Mile Land Co.	30	ADJ	BRANCH RAWHIDE CREEK	IRR	HARVEY DITCH	HAROLD A. HARVEY	1.32	CFS
12753	P11692D	C35/477A	51	73	22	8	SENW	Twenty-Mile Land Co.	30	ADJ	BRANCH RAWHIDE CREEK	IRR	HARVEY DITCH	HAROLD A. HARVEY	1.32	CFS
12753	P11692D	C35/477A	51	73	22	9	NESW	Twenty-Mile Land Co.	23	ADJ	BRANCH RAWHIDE CREEK	IRR	HARVEY DITCH	HAROLD A. HARVEY	1.32	CFS
12753	P11692D	C35/477A	51	73	22	12	SESW	Twenty-Mile Land Co.	10	ADJ	BRANCH RAWHIDE CREEK	IRR	HARVEY DITCH	HAROLD A. HARVEY	1.32	CFS
12754	P11693D	C35/478A	51	73	22	14	NWSE	Twenty-Mile Land Co.	13	ADJ	BRANCH RAWHIDE CREEK	IRR	EAST DITCH	BRIDGET RICKS	0.43	CFS
12752	P2453R	C35/476A	51	73	27	2	NWNE	Twenty-Mile Land Co.		PU	BRANCH RAWHIDE CREEK	IRR,DOM	HARVEY RES	BRIDGET RICKS	15.2	ACFT
12752	P2453R	C35/476A	51	73	27	2	NWNE	Twenty-Mile Land Co.		PUO	BRANCH RAWHIDE CREEK	IRR,DOM	HARVEY RES	BRIDGET RICKS	15.2	ACFT
12753	P11692D	C35/477A	51	73	27	2	NWNE	Twenty-Mile Land Co.		PUD	BRANCH RAWHIDE CREEK	IRR	HARVEY DITCH	HAROLD A. HARVEY	1.32	CFS
10785	P9144D	C31/441A	51	73	27	3	SWNE	Twenty-Mile Land Co.	5	ADJ	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #1 DITCH	JAMES B. RICKS	1	CFS
12754	P11693D	C35/478A	51	73	27	3	SWNE	Twenty-Mile Land Co.		ADJ	BRANCH RAWHIDE CREEK	IRR	EAST DITCH	BRIDGET RICKS	0.43	CFS
12755	P11694D	C35/479A	51	73	27	3	SWNE	Twenty-Mile Land Co.		PUD	BRANCH RAWHIDE CREEK	IRR	RIX DITCH	JAMES B. RICKS	0.07	CFS
		P13012D	51	73	27	3	SWNE	Twenty-Mile Land Co.	3	ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
		P13012D	51	73	27	3	SWNE	Twenty-Mile Land Co.	4	ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	27	3	SWNE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	27	3	SWNE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS

Table 4.1. WSEO Irrigation Listings, August 2000, Tributaries of Rawhide Creek to Rawhide Creek to Little Powder River

PFnm	APPkey	PermitNo	Tns	Rng	Sec	Qtr/Qtr	Qtr/Qtr	Landowner	Acres	Status	Name1	Use	FacilityName	Applicant	Amt	Unit
16413	P13012D	C41/116A	51	73	27	3	SWNE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	27	3	SWNE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
10785	P9144D	C31/441A	51	73	27	5	NENW	Twenty-Mile Land Co.	11	ADJ	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #1 DITCH	JAMES B. RICKS	1	CFS
12755	P11694D	C35/479A	51	73	27	5	NENW	Twenty-Mile Land Co.	5	ADJ	BRANCH RAWHIDE CREEK	IRR	RIX DITCH	JAMES B. RICKS	0.07	CFS
16414	P3122E	C41/117A	51	73	27	5	NENW	Twenty-Mile Land Co.	10	ADJ	BRANCH RAWHIDE CREEK	IRR	ENL RIX #1 DITCH	JAMES B. RICKS	1.06	CFS
		P13012D	51	73	27	5	NENW	Twenty-Mile Land Co.	16	ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	27	5	NENW	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	27	5	NENW	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	27	5	NENW	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	27	5	NENW	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
10785	P9144D	C31/441A	51	73	27	8	SENW	Twenty-Mile Land Co.	5	ADJ	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #1 DITCH	JAMES B. RICKS	1	CFS
16414	P3122E	C41/117A	51	73	27	8	SENW	Twenty-Mile Land Co.	30	ADJ	BRANCH RAWHIDE CREEK	IRR	ENL RIX #1 DITCH	JAMES B. RICKS	1.06	CFS
		P13012D	51	73	27	8	SENW	Twenty-Mile Land Co.	1	ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	27	8	SENW	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	27	8	SENW	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
16416	P3685E	C41/119A	51	73	27	9	NESW	Twenty-Mile Land Co.	21	ADJ	BRANCH RAWHIDE CREEK	IRR	ENL RIX #1 DITCH	BRIDGET RICKS	0.3	CFS
10785	P9144D	C31/441A	51	73	27	12	SESW	Twenty-Mile Land Co.	5	ADJ	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #1 DITCH	JAMES B. RICKS	1	CFS
16414	P3122E	C41/117A	51	73	27	12	SESW	Twenty-Mile Land Co.	30	ADJ	BRANCH RAWHIDE CREEK	IRR	ENL RIX #1 DITCH	JAMES B. RICKS	1.06	CFS
10785	P9144D	C31/441A	51	73	27	14	NWSE	Twenty-Mile Land Co.	8	ADJ	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #1 DITCH	JAMES B. RICKS	1	CFS
		P13012D	51	73	27	14	NWSE	Twenty-Mile Land Co.	3	ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
		P13012D	51	73	27	14	NWSE	Twenty-Mile Land Co.	5	ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	27	14	NWSE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	27	14	NWSE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	27	14	NWSE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	27	14	NWSE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
12754	P11693D	C35/478A	51	73	27	15	SWSE	Twenty-Mile Land Co.	12	ADJ	BRANCH RAWHIDE CREEK	IRR	EAST DITCH	BRIDGET RICKS	0.43	CFS
		P13012D	51	73	27	15	SWSE	Twenty-Mile Land Co.	2	ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
		P13012D	51	73	27	15	SWSE	Twenty-Mile Land Co.	6	ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	27	15	SWSE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	27	15	SWSE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	27	15	SWSE	Twenty-Mile Land Co.	2	ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	27	15	SWSE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
		P13294D	51	73	30	15	SWSE		8	ADJ	RAWHIDE CREEK	IRR	CRANE DITCH	LEE CRANE	0.36	CFS
13951	P13294D	C37/338A	51	73	30	15	SWSE			ADJ	RAWHIDE CREEK	IRR	CRANE DITCH	LEE CRANE	0.36	CFS
		P13294D	51	73	31	2	NWNE		11	ADJ	RAWHIDE CREEK	IRR	CRANE DITCH	LEE CRANE	0.36	CFS
13951	P13294D	C37/338A	51	73	31	2	NWNE			ADJ	RAWHIDE CREEK	IRR	CRANE DITCH	LEE CRANE	0.36	CFS
		P13294D	51	73	31	3	SWNE		6	ADJ	RAWHIDE CREEK	IRR	CRANE DITCH	LEE CRANE	0.36	CFS
13951	P13294D	C37/338A	51	73	31	3	SWNE			ADJ	RAWHIDE CREEK	IRR	CRANE DITCH	LEE CRANE	0.36	CFS
13951	P13294D	C37/338A	51	73	31	3	SWNE			PUD	RAWHIDE CREEK	IRR	CRANE DITCH	LEE CRANE	0.36	CFS
10785	P9144D	C31/441A	51	73	34	2	NWNE	Twenty-Mile Land Co.	7	ADJ	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #1 DITCH	JAMES B. RICKS	1	CFS
10786	P9145D	C31/442A	51	73	34	2	NWNE	Twenty-Mile Land Co.	18	ADJ	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #2 DITCH	JAMES B. RICKS	0.25	CFS
		P13012D	51	73	34	2	NWNE	Twenty-Mile Land Co.	4	ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
		P13012D	51	73	34	2	NWNE	Twenty-Mile Land Co.		ADJ	RIX	IRR	SUNRIS	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	34	2	NWNE	Twenty-Mile Land Co.	2	ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	34	2	NWNE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	34	2	NWNE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
16413	P13012D	C41/116A	51	73	34	2	NWNE	Twenty-Mile Land Co.		ADJ	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0.27	CFS
16413	P13012D	C41/116A	51	73	34	2	NWNE	Twenty-Mile Land Co.		PUD	RIX DRAW	IRR	SUNRISE DITCH	JAMES B. RICKS	0	CFS
10784	P1559R	C31/440A	51	73	34	5	NENW	Twenty-Mile Land Co.		PU	BRANCH RAWHIDE CREEK	IRR,DOM	RIX RES	JAMES B. RICKS	72	ACFT

Table 4.1. WSEO Irrigation Listings, August 2000, Tributaries of Rawhide Creek to Rawhide Creek to Little Powder River

PFnm	APPkey	PermitNo	Tns	Rng	Sec	Qtr/Qtr	Qtr/Qtr	Landowner	Acres	Status	Name1	Use	FacilityName	Applicant	Amt	Unit
10784	P1559R	C31/440A	51	73	34	5	NENW	Twenty-Mile Land Co.		PUO	BRANCH RAWHIDE CREEK	IRR,DOM	RIX RES	JAMES B. RICKS	72	ACFT
10785	P9144D	C31/441A	51	73	34	5	NENW	Twenty-Mile Land Co.	9.6	ADJ	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #1 DITCH	JAMES B. RICKS	1	CFS
10785	P9144D	C31/441A	51	73	34	5	NENW	Twenty-Mile Land Co.		PUD	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #1 DITCH	JAMES B. RICKS	1	CFS
10786	P9145D	C31/442A	51	73	34	5	NENW	Twenty-Mile Land Co.		PUD	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #2 DITCH	JAMES B. RICKS	0.25	CFS
16414	P3122E	C41/117A	51	73	34	5	NENW	Twenty-Mile Land Co.	4	ADJ	BRANCH RAWHIDE CREEK	IRR	ENL RIX #1 DITCH	JAMES B. RICKS	1.06	CFS
16414	P3122E	C41/117A	51	73	34	5	NENW	Twenty-Mile Land Co.		PUD	BRANCH RAWHIDE CREEK	IRR	ENL RIX #1 DITCH	JAMES B. RICKS	1.06	CFS
16415	P3123E	C41/118A	51	73	34	5	NENW	Twenty-Mile Land Co.		ADJ	BRANCH RAWHIDE CREEK	IRR	ENL RIX #2 DITCH	JAMES B. RICKS	0.06	CFS
16415	P3123E	C41/118A	51	73	34	5	NENW	Twenty-Mile Land Co.		PUD	BRANCH RAWHIDE CREEK	IRR	ENL RIX #2 DITCH	JAMES B. RICKS	0.06	CFS
16416	P3685E	C41/119A	51	73	34	5	NENW	Twenty-Mile Land Co.		PUD	BRANCH RAWHIDE CREEK	IRR	ENL RIX #1 DITCH	BRIDGET RICKS	0.3	CFS
10785	P9144D	C31/441A	51	73	34	15	SWSE	Twenty-Mile Land Co.	20	ADJ	BRANCH RAWHIDE CREEK	IRR,DOM	RIX #1 DITCH	JAMES B. RICKS	1	CFS
								Total Acres	1424							

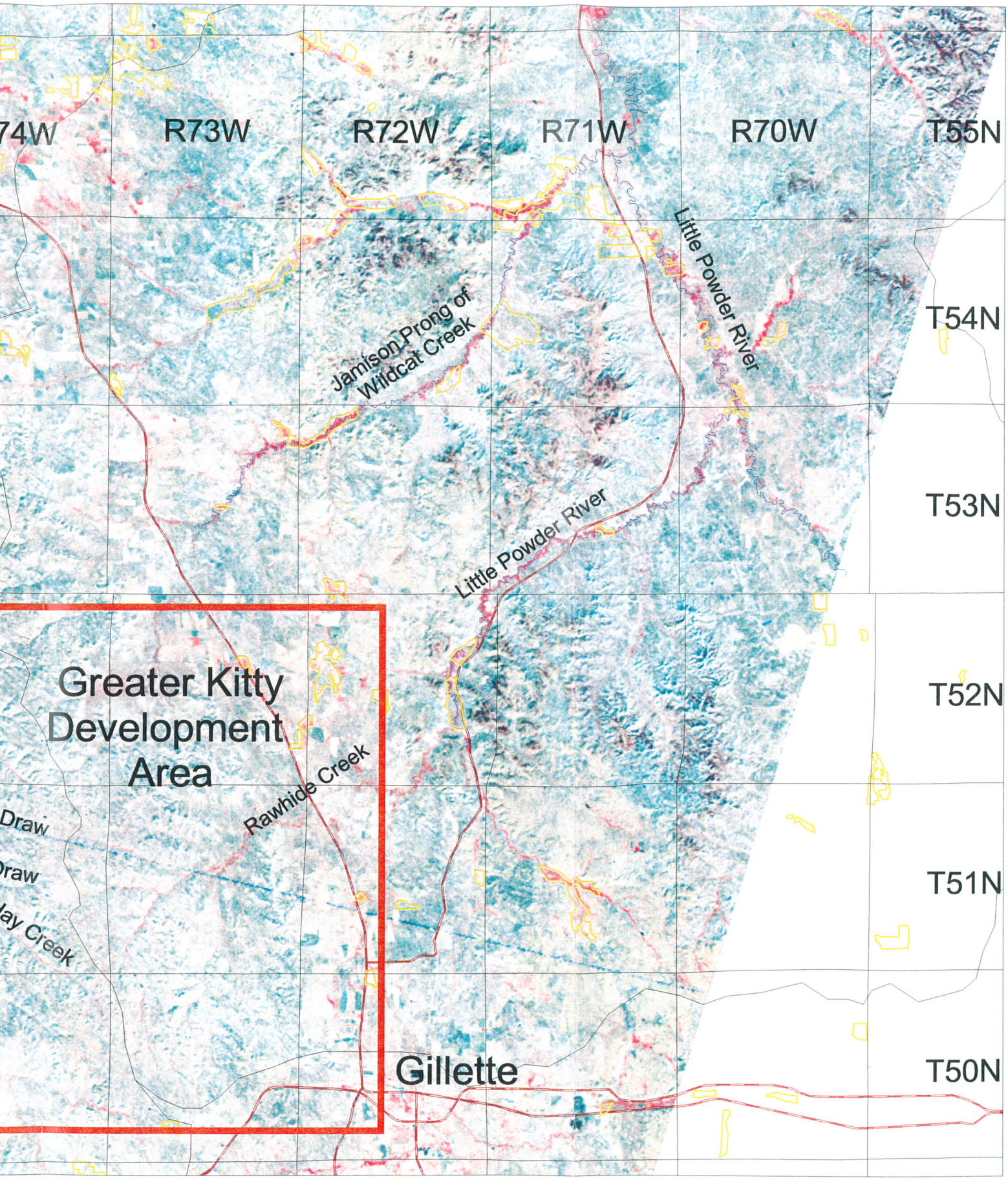


Figure 4.1: Potential Locations of Irrigated Areas along the Wild Horse Creek, Wildcat Creek, and Rawhide Creek.

*Drainage, mainstem, and township/range coverages were taken from Wyoming DEQ/WQD CD.
**Irrigated lands coverage and Landsat Multi-Spectral Scanner (MSS) Image (9/17/74) were taken from the SDVC website. http://www.sdvc.uwyo.edu/wbn/mss.html
***Note: light red color on MSS Image represents high-density, live vegetation.

Applied Hydrology Associates, Inc.

Table 4.2 Land Capability,

Yields (tons) per Acre of Crops and Pasture and Permeability

Soil Name	Grass Hay (irrigated)	Alfalfa Hay (irrigated)	Permeability
Limon silty clay loam	Not available	Not available	Not available
Fine Textured Entisol (location-Rawhide-2)	Not available	Not available	Not available
Fine Textured Entisol (location-Rawhide-3)	Not available	Not available	Not available
Kishona Loam (location-Rawhide-4)	3	4.5	0.6 – 2.0 in/hr
Kishona Loam (location-Rawhide-6)	3	4.5	0.6 – 2.0 in/hr
Torrifluvent	Not available	Not available	Not available

Source: BKS Study & Sheridan County Soil Survey

Table 4.3 Historical irrigated crop yield for Campbell County.

Crop	Year	Harvested	Yield	Production
		Acres	Tons	Tons
Alfalfa Hay	1975	1,500	2.20	3,300
	1976	500	1.80	900
	1977	1,000	1.70	1,700
	1978	1,500	2.00	3,000
	1979	2,000	2.20	4,400
	1980	3,500	2.80	9,800
	1981	3,000	2.80	8,400
	1982	2,000	2.95	5,900
	1983	1,500	2.60	3,900
	1984	2,000	3.00	6,000
	1985	1,000	1.76	1,760
	1986	1,000	2.00	2,000
	1987	1,000	1.80	1,800
	1988	2,000	1.70	3,400
	1989	1,000	1.60	1,600
	1990	1,000	2.00	2,000
	1991	1,000	2.00	2,000
	1992	2,000	2.50	5,000
	1993	6,000	2.70	16,200
	1994	4,000	2.70	10,800
	1995	4,000	2.40	9,700
	1996	3,000	2.50	7,500
	1997	NR	NR	NR
	1998	3,000	3.00	9,000
High		6,000	3.00	16,200
Low		500	1.60	900
Average		2,109	2.29	5,220

NR=Not Reporting

Table 4.3 Historical irrigated crop yield for Campbell County.

Crop	Year	Harvested	Yield	Production
		Acres	Tons	Tons
Other Hay	1975	500	1.30	650
	1976	500	1.30	650
	1977	500	1.20	600
	1978	900	2.30	2,070
	1979	500	2.00	1,000
	1980	800	0.80	620
	1981	700	0.90	630
	1982	1,500	1.20	1,800
	1983	5,500	1.27	7,000
	1984	8,500	1.62	13,800
	1985	5,800	1.39	8,090
	1986	4,000	1.25	5,000
	1987	4,000	1.20	4,800
	1988	6,500	1.20	7,800
	1989	2,000	0.90	1,700
	1990	1,000	0.90	900
	1991	1,000	1.50	1,500
	1992	4,000	1.80	7,000
	1993	1,500	2.00	3,000
	1994	1,000	1.20	1,200
	1995	1,000	2.20	2,200
	1996	1,000	1.60	1,600
	1997	NR	NR	NR
	1998	2,000	2.00	4,000
High		8,500	2.30	13,800
Low		500	0.80	600
Average		2,378	1.44	3,374

NR=Not Reporting

Table 4.3 Historical irrigated crop yield for Campbell County.

Crop	Year	Harvested	Yield	Production
		Acres	Tons	Tons
Oats	1975	0	0	0
	1976	0	0	0
	1977	0	0	0
	1978	100	52	5,200
	1979	0	0	0
	1980	0	0	0
	1981	0	0	0
	1982	300	61	18,300
	1983	200	55	11,000
	1984	0	0	0
	1985	0	0	0
	1986	0	0	0
	1987	0	0	0
	1988	100	61	6,100
	1989	100	50	5,000
	1990	200	50	10,000
	1991	1,700	53	90,200
	1992	600	65	39,000
	1993	400	52	20,800
	1994	100	67	6,700
	1995	0	0	0
	1996	600	68	41,000
	1997	0	0	0
	1998	0	0	0
High		1,700	68	90,200
Low		0	0	0
Average		400	58	23,027

NR=Not Reporting

Table 4.3 Historical irrigated crop yield for Sheridan County.

Crop	Year	Harvested	Yield	Production
		Acres	Tons	Tons
Alfalfa Hay	1975	28,000	2.65	74,100
	1976	24,000	2.30	55,200
	1977	27,000	2.20	59,400
	1978	31,000	2.70	83,850
	1979	32,000	2.29	73,400
	1980	25,500	2.20	56,100
	1981	28,000	3.40	95,200
	1982	27,000	2.80	75,600
	1983	29,000	2.70	78,300
	1984	26,500	3.00	79,500
	1985	21,000	2.20	46,000
	1986	27,000	2.40	65,600
	1987	25,000	3.10	78,600
	1988	24,000	2.40	57,000
	1989	25,000	2.60	63,800
	1990	27,000	2.50	67,500
	1991	27,000	2.40	65,000
	1992	24,000	3.20	76,000
	1993	38,000	2.70	102,700
	1994	37,000	2.90	106,500
	1995	37,000	3.10	113,000
	1996	36,000	3.10	112,000
	1997	32,000	3.80	120,500
	1998	25,000	3.00	75,000
High		38,000	3.80	120,500
Low		21,000	2.20	46,000
Average		28,458	2.74	78,327

NR=Not Reporting

Table 4.3 Historical irrigated crop yield for Sheridan County.

Crop	Year	Harvested	Yield	Production
		Acres	Tons	Tons
Other Hay	1975	8,500	1.60	13,600
	1976	9,500	1.54	14,670
	1977	5,200	1.80	9,360
	1978	5,400	1.60	8,640
	1979	9,000	1.60	14,360
	1980	8,000	1.23	9,800
	1981	9,800	1.85	18,170
	1982	13,800	2.20	30,400
	1983	6,000	1.70	10,200
	1984	7,500	2.00	15,000
	1985	12,000	1.10	12,600
	1986	15,000	1.40	20,300
	1987	10,500	1.70	18,300
	1988	14,500	1.50	22,400
	1989	8,500	1.70	14,500
	1990	8,000	1.80	14,400
	1991	8,000	2.20	17,500
	1992	12,000	2.00	24,000
	1993	5,500	2.10	11,500
	1994	9,000	2.50	22,500
	1995	8,000	1.90	15,200
	1996	9,000	1.30	12,100
	1997	9,000	1.90	17,500
	1998	5,000	1.80	9000
High		15,000	2.50	30,400
Low		5,000	1.10	8,640
Average		9,029	1.75	15,957

NR=Not Reporting

Table 4.3 Historical irrigated crop yield for Sheridan County.

Crop	Year	Harvested	Yield	Production
		Acres	Tons	Tons
Oats	1975	2,100	60.00	126,000
	1976	1,600	63.00	100,800
	1977	2,700	50.70	136,900
	1978	1,900	62.00	117,800
	1979	1,500	51.80	77,700
	1980	1,200	70.00	84,000
	1981	600	72.50	43,500
	1982	1,800	61.00	109,800
	1983	700	64.00	44,800
	1984	1,100	64.00	70,400
	1985	700	64.60	45,200
	1986	1,300	77.00	100,100
	1987	1,900	78.90	149,900
	1988	700	33.00	23,100
	1989	1,900	61.00	115,900
	1990	1,400	68.80	96,300
	1991	600	58.00	34,800
	1992	1,700	66.00	112,200
	1993	900	64.00	57,600
	1994	800	55.00	44,000
	1995	1,200	85.00	102,000
	1996	700	60.00	42,000
	1997	1,000	65.00	65,000
	1998	500	78.00	39,000
High		2,700	85	149,900
Low		500	33	23,100
Average		2,773	64	176,255

NR=Not Reporting

Table 4.3 Historical irrigated crop yield for Johnson County.

Crop	Year	Harvested	Yield	Production
		Acres	Tons	Tons
Alfalfa Hay	1975	26,000	2.40	62,400
	1976	21,500	2.34	50,400
	1977	29,000	2.22	64,300
	1978	28,000	2.10	58,800
	1979	32,000	2.70	86,400
	1980	23,000	2.40	55,200
	1981	24,000	2.50	60,000
	1982	23,000	2.60	59,800
	1983	24,500	2.60	63,700
	1984	21,500	2.70	58,000
	1985	25,000	1.80	44,800
	1986	28,000	2.20	60,400
	1987	23,500	2.30	55,000
	1988	24,000	1.70	40,600
	1989	6,000	1.20	7,000
	1990	25,000	2.60	65,800
	1991	20,000	2.60	51,000
	1992	16,000	2.20	35,000
	1993	24,000	2.50	60,000
	1994	21,000	2.30	48,300
	1995	22,000	2.50	56,000
	1996	20,000	2.40	48,000
	1997	23,000	3.10	71,100
	1998	NR	NR	NR
High		32,000	3.10	86,400
Low		6,000	1.20	7,000
Average		23,043	2.35	54,870

NR=Not Reporting

Table 4.3 Historical irrigated crop yield for Johnson County.

Crop	Year	Harvested	Yield	Production
		Acres	Tons	Tons
Other Hay	1975	5,200	1.43	7,440
	1976	4,700	1.50	7,050
	1977	4,000	1.51	6,050
	1978	4,300	1.40	6,030
	1979	3,000	1.70	5,100
	1980	2,600	1.40	3,640
	1981	3,000	1.90	5,700
	1982	5,000	1.80	9,000
	1983	3,000	2.00	6,000
	1984	4,000	1.40	5,600
	1985	5,500	1.00	5,700
	1986	6,000	1.30	7,500
	1987	5,000	1.50	7,300
	1988	4,500	1.40	6,200
	1989	6,000	1.60	9,800
	1990	5,000	1.30	6,500
	1991	9,000	1.80	16,000
	1992	8,000	2.80	22,000
	1993	9,000	2.40	21,600
	1994	6,500	1.40	9,100
	1995	7,000	1.90	13,300
	1996	6,000	1.50	9,200
	1997	6,000	1.90	11,500
	1998	NR	NR	NR
High		9,000	2.80	22,000
Low		2,600	1.00	3,640
Average		5,317	1.65	9,013

NR=Not Reporting

Table 4.3 Historical irrigated crop yield for Johnson County.

Crop	Year	Harvested	Yield	Production
		Acres	Tons	Tons
Oats	1975	1,900	49.90	94,800
	1976	2,200	55.00	121,000
	1977	1,500	49.00	73,500
	1978	1,300	78.00	101,400
	1979	4,500	60.00	78,000
	1980	4,000	65.00	110,500
	1981	3,100	50.00	100,000
	1982	3,300	64.50	90,300
	1983	1,100	55.50	61,000
	1984	1,600	57.40	91,800
	1985	1,100	43.00	47,300
	1986	1,400	66.00	92,400
	1987	1,300	58.00	75,400
	1988	900	54.20	48,800
	1989	700	50.00	35,000
	1990	1,200	56.00	67,200
	1991	600	65.00	39,000
	1992	1,300	70.00	91,000
	1993	1,000	63.00	63,000
	1994	900	45.00	40,500
	1995	600	73.00	44,000
	1996	NR	NR	NR
	1997	700	66.00	46,000
	1998	NR	NR	NR
High		4,500	78	121,000
Low		600	43	35,000
Average		3,291	59	146,536

NR=Not Reporting

Table 4.4 Tributary Monitoring Data and Corresponding CBM Wells Flowing to Rawhide Creek

Stream Station/Segment	Station/ Drainage Designation.	Monitoring Program	Date	Cumulative Monthly Flow, All CBM Wells (bbl)	Cumulative Monthly Flow, All CBM Wells (cfs)	Cumulative Monthly Flow, Devon CBM wells (bbl)	Cumulative Monthly Flow, Devon CBM wells (cfs)	Flow at Monitoring Station cfs	TDS (180o) mg/l	SC (lab) umhos/cm	SC (field) umhos/cm	SAR	Ba mg/l	Na mg/l	Ca mg/l	Mg mg/l
Rawhide Creek near mouth	LPR1-RC	Tributary	1/26/01	3433947	7.20	1235112	2.59	0								
			2/27/01	3193844	7.41	1011410	2.35	0								
			3/22/01	3555083	7.45	976255	2.05	3	2730	2650	3060	2.5	<0.5	214	203	208
			4/26/01	3574682	7.74	905654	1.96	~0.01	4940	4680	4210	3.9	<0.01	435	343	351
			5/23/01	3335571	6.99	890370	1.87	~1.5	4980	4570	4550	3.8	<0.1	435	374	362
			6/21/01	3344774	7.25	860727	1.86	0								
			7/23/01	3237535	6.79	800125	1.68	0								
			8/21/01	3796499	7.96	802469	1.68	0								
			9/22/01	3276837	7.10	819098	1.77	0								
			10/23/01	4041975	8.47	880643	1.85	0								
			11/20/01	3207196	6.95	791031	1.71	0								
			12/19/01	not available	not available	787946	1.65	0								

Source: http://wogcc.state.wy.us/crmsprod.cfm, Art O'Hayre (Applied Hydrology Associates) and Devon Energy Production Database as of 1/15/02

Table 4.5 Natural Water Quality, Rawhide Creek

Date of Sample	Specific Conductance (umhos/cm @ 25°C)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	Bicarbonate as HCO_3 (mg/l)	SAR	Sulfate (mg/l)	Boron (mg/l)
11/23/77	4185	386.1	261.9	256	495	4.1	2,380	0.15
6/28/78	6160	675	403	495	592	5.33	3,872	0.3
10/25/78	7780	985	473	650	915	6.9	5,100	0.2
4/17/79	4650	472	347	368	448	4.21	2,920	0.4
6/13/79	7590	1033	382	704	475	7.25	5,600	0.6
8/30/78	7040	884	512	616	697	6.23	4,960	0.4
4/24/80	5250	530	415	408	549	4.43	3,250	0.2
6/1/80	7520	996	462	587	769	7.25	4,820	0.2
9/18/80	3860	435	204	310	489	4.48	2,200	0.1
12/9/80	11170	1890	480	1256	1260	10.32	9,050	0.3
10/11/95	4450	276	452	325	671	2.42	2,450	0.44
9/17/96	1668	104	120	110	290	1.66	711	0.09
10/29/98	4160	558	134	274	698	6.34	2,023	0.14
Count	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**
Min	**1668**	**104**	**120**	**110**	**290**	**1.66**	**711**	**0.09**
Max	**11170**	**1890**	**512**	**1256**	**1260**	**10.32**	**9,050**	**0.6**
Median	**5250**	**558**	**403**	**408**	**592**	**5.33**	**3,250**	**0.2**
Average	**5806.4**	**709.5**	**357.4**	**489.2**	**642.2**	**5.5**	**3,795**	**0.3**
Std Dev	**2418.1**	**459.5**	**134.5**	**290.2**	**245.8**	**2.3**	**2142.02**	**0.2**

(Greystone 1999, see Section 8.0 for raw data)

[1] Samples taken at West Boundary, Triton Coal Company as part of monitoring requirements

Table 4.6 Water Analysis for the Kitty Area CBM Wells

Parameter	Units	Anderson Coal Daly TFU 23A-1513	Canyon Coal 20 Mile 41C-2213	Average
Specific conductance	umhos/cm	1660	1890	1775
Sodium	mg/l	315	330	322.5
Magnesium	mg/l	23	36	29.5
Calcium	mg/l	47	58	52.5
Potassium	mg/l	10	15	12.5
Chloride	mg/l	12	10	11
Sulfate	mg/l	1	1	1
Bicarbonate	mg/l	1130	1370	1250
Specific conductance	dS/m	1.66	1.89	1.78
Sodium[2]	meq/l	13.70	14.36	14.03
Magnesium[2]	meq/l	1.89	2.96	2.43
Calcium[2]	meq/l	2.35	2.89	2.62
Potassium[2]	meq/l	0.26	0.38	0.64
Chloride[2]	meq/l	0.34	0.28	0.31
Sulfate[2]	meq/l	0.02	0.02	0.02
Bicarbonate[2]	meq/l	18.53	22.47	41
Ratio of $[HCO_3]/[Ca]$[2]	meq/l	7.90	7.76	15.66
Calculated SAR[2]	unitless	9.40	8.40	8.90
Adjusted SAR[2]	unitless	12.27	10.75	11.51
Exchangeable Sodium Percentage[2]	%	15.34	13.7	14.5

[1] Agricultural Values used in creation of Figure 4.2

[2] Value calculated

Table 4.8 Tolerance of Various Crops to Exchangeable-Sodium Percentage (Hanson 1999)		
Tolerance to ESP (Range at which affected)	**Growth Responsible Under Field Conditions**	**Crop**
Sensitive ESP = 10-20	Stunted growth at low ESP values although soil condition is good	Beans
Moderately tolerant ESP = 20-40	Stunted growth due to both nutritional factors and adverse soil conditions	Clover Oats Tall fescue Dallis grass
Tolerant ESP = 40-60	Stunted growth usually due to adverse physical conditions of soil	Wheat Alfalfa Barley Beets
Most tolerant ESP >60	Stunted growth usually due to adverse physical conditions of soil	Crested and Fairway wheatgrass Tall wheatgrass Rhodes grass

Table 4.9 Laboratory results for Devon CBM water taken from 002BP2 (WY0039799)[1]

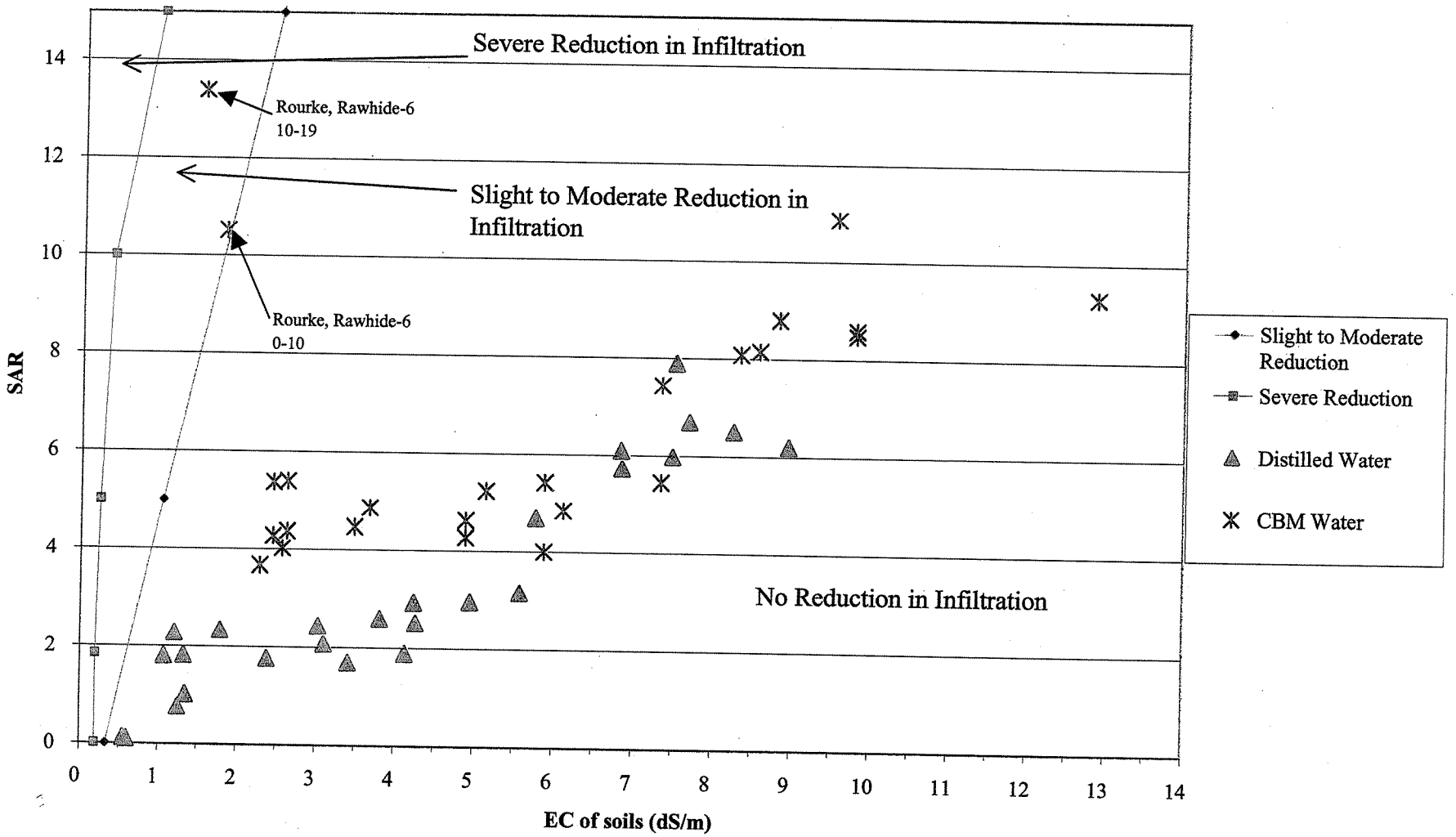
	Constituent	Units	Sampled 9/17/01
Major Ions	Chloride	mg/L	9
	Sulfate	mg/L	1.4
	Calcium	mg/L	77.6
	Magnesium	mg/L	44.5
	Iron	mg/L	0.11
	Potassium	mg/L	17.3
	Sodium	mg/L	371
	Total Dissolved Solids @ 180°C	mg/L	1240
	Specific Conductance @ 25°C	umhos/cm	2020
Non Metals	pH	std. units	7.7
	Total Alkalinity as $CaCO_3$	mg/L	1190
	Sodium Absorption Ratio (SAR)	unitless	8.31
	Boron, dissolved	ug/l	< 0.1
	Cation/Anion Balance	%	.18

[1] water used to model effect of saturation of Rourke soils

Table 4.10 Comparison of Salinity and SAR values run with Distilled and CBM Waters for Rourke Ranch Soils

		Distilled Water						CBM Water				
Soil Sample ID	Depth (in)	pH, Saturated Paste	Elec. Conductivity, Saturated Paste	Calcium	Magnesium	Sodium	SAR	Elec. Conductivity, Saturated Paste	Calcium	Magnesium	Sodium	SAR
Rourke, Rawhide-1	0-15	8.30	1.26	8.25	4.92	1.93	0.75	2.30	7.40	8.92	10.5	3.68
Rourke, Rawhide-1	15-32	8.10	4.15	21.1	28.75	9.4	1.88	5.90	23.9	38.33	22.4	4.01
Rourke, Rawhide-1	32-54	8.00	8.98	18.6	73.5	42.0	6.20	12.9	21.7	118.3	78	9.3
Rourke, Rawhide-1	54-60	8.10	7.51	19.0	53.3	35.9	5.97	9.8	22.4	71.7	58	8.5
Rourke, Rawhide-2	0-16	8.40	1.36	8.1	5.0	2.6	1.01	2.58	10.8	9.6	12.9	4.0
Rourke, Rawhide-2	16-30	8.20	3.13	17.9	14.8	8.3	2.07	4.9	20.9	24.1	22.0	4.6
Rourke, Rawhide-2	30-54	7.90	3.84	22.30	17.50	11.6	2.59	5.16	21.00	25.42	25.2	5.2
Rourke, Rawhide-2	54-60	7.80	4.29	21.6	26.0	12.3	2.51	6.14	21.9	35.0	25.9	4.85
Rourke, Rawhide-3	0-10	8.30	1.34	4.6	6.5	4.3	1.82	2.64	6.9	12.8	13.7	4.37
Rourke, Rawhide-3	10-22	8.20	3.05	14.2	14.50	9.2	2.43	3.69	12.5	20.0	19.6	4.86
Rourke, Rawhide-3	22-33	8.30	4.26	21.9	21.00	13.6	2.93	5.90	22.7	29.2	27.6	5.42
Rourke, Rawhide-3	33-54	8.10	4.98	20.70	34.75	15.57	2.96	6.76	21.2	44.2	31.7	5.55
Rourke, Rawhide-3	54-60	7.90	5.60	20.15	42.42	17.65	3.16	7.37	20.40	55.08	33.5	5.45
Rourke, Rawhide-4	0-13	8.20	1.08	2.94	5.05	3.60	1.80	2.46	6.25	11.58	12.8	4.28
Rourke, Rawhide-4	13-36	8.30	1.22	3.78	4.75	4.70	2.27	2.46	5.05	9.75	14.6	5.37
Rourke, Rawhide-4	36-46	8.10	2.40	13.80	10.75	6.17	1.76	3.50	13.25	16.33	17.2	4.48
Rourke, Rawhide-4	46-60	8.10	3.43	22.6	15.75	7.39	1.69	4.91	22.25	23.08	20.4	4.28
Rourke, Rawhide-5	0-20	8.30	8.28	19.4	58.83	40.65	6.50	9.83	21.45	70.25	58.3	8.60
Rourke, Rawhide-5	20-37	8.20	7.72	19.00	52.50	40.00	6.69	8.85	19.75	58.83	55.2	8.81
Rourke, Rawhide-5	37-44	8.10	6.88	19.40	45.58	32.61	5.72	8.60	20.50	55.83	50.4	8.2
Rourke, Rawhide-5	44-54	8.30	5.80	20.1	37.08	25.04	4.68	7.37	20.0	48.2	43.5	7.45
Rourke, Rawhide-5	54-60	8.30	6.86	18.70	44.42	34.22	6.09	8.36	20.9	51.4	48.7	8.10
Rourke, Rawhide-6	0-10	8.40	0.61	4.20	1.99	0.16	0.09	1.82	69.5	38.9	77.4	10.51
Rourke, Rawhide-6	10-19	8.50	0.57	3.84	1.54	0.19	0.11	1.54	41.3	32.33	81.3	13.40
Rourke, Rawhide-6	19-34	8.30	1.80	7.10	6.95	6.17	2.33	2.64	7.40	9.83	15.8	5.4
Rourke, Rawhide-6	34-47	8.10	7.55	20.20	42.83	44.35	7.90	9.58	19.45	52.50	65.2	10.9
Rourke, Rawhide-6	47-60	8.00	5.86	20.40	34.42	25.52	4.87	7.13	20.35	38.92	38.0	7.0

Figure 4.3 Comparison of Salinity and SAR Values Run with Distilled and CBM Waters for Rourke Ranch Soils



Devon Irrigation/Soil Suitability Investigations for Rawhide Creek

Submitted to:

Applied Hydrology Assoc.
1200 S. Parker Rd., Suite 100
Denver, CO 80231

Submitted by:

BKS Environmental Associates, Inc.
P.O. Box 3467
Gillette, WY 82717

August 9, 2000

TABLE OF CONTENTS

Devon Irrigation/Soil Suitability Investigations for Rawhide Creek

INTRODUCTION

The following portions of drainages that contain permitted irrigation rights within Devon leases were evaluated to: 1) document existing irrigated areas for agricultural use by man-made objects such as spreader dikes or actual irrigation ditching systems that were on record at the Wyoming State Engineer's Office; and 2) document the baseline condition of the soils within these areas and their potential for continued use with direct application of CBM water. Surveyed drainage portions included: Rourke - Rawhide Creek.

METHODOLOGY

Prior to fieldwork, landowner maps were obtained from the Campbell County Assessor's office and forwarded to Applied Hydrology in order for them to contact various landowners for access permission. This landowner information was transferred to irrigation permit maps compiled by Applied Hydrology to visualize the extent of required landowner access.

The applicable USGS 7.5 minute quads were: Rawhide Creek - Rawhide School, Moyer Springs, Lone Tree Creek, and Weston SW. Existing NRCS mapping for those quads was generally not available; the largest available mapping was for the Lone Tree Creek quad which was approximately one-half completed. The Weston SW quads had minor portions mapped by the NRCS.

The following general methodology was utilized during the field investigation:

1. Areas were generally scoped on June 7, 2000 to determine overall presence of spreader dikes within accessible areas which could be viewed from county roads or which access had been granted.

2. Major soil series were sampled, based on field observation of extend and possible impact by irrigation water. Soil cores were obtained with a truck-mounted Giddings soil sampler.

3. Prior to drilling, a general site photograph was taken, in conjunction with a closeup of the vegetation at the drill hole before drilling commenced.

4. The soil was cored to five feet or less, depending upon overall hardness of the soil, and field descriptors such as approximate texture and calcium carbonate content was used to determine horizonation.

5. A photograph of the core was taken in which the zero end was in the upper left of the photograph.

6. Latitude and longitude of the sample site was obtained, if possible.

7. Dominant plant species present near the drill hole were recorded.

8. Other pertinent vegetative, soil, or hydrology descriptors were recorded.

9. The hole was filled in with loose soil to prevent subsidence and possible damage to livestock.

10. Sampled horizons were placed in plastic bags that were labeled by landowner, drainage/hole number, depth and date. If possible, soil horizons were combined wherever possible based on overall soil texture, horizon designation, and approximate calcium carbonate content.

11. The irrigation permit number was put on the field form, wherever possible.

Samples were taken to Energy Laboratories in Casper on June 10, 2000. Requested analysis included pH, EC, Ca, Mg, Na, SAR, lime content, and texture. No nearby coalbed methane water was available to run with the soil analysis; therefore, standard laboratory procedures with distilled water was utilized.

Each sample point for laboratory analysis was labeled with a number designation on the map. If a location was described without drilling and/or laboratory analysis, that location was labeled on the map and in field notes with an "A", "B", "C", etc.

Historical information was obtained from landowners, wherever possible, on the type of cropping, when seeded, extent of irrigation, etc.

RESULTS

Rawhide Creek

Characteristics or results unique to the Rourke section include:

- large reservoir constructed in the early 1900's with dam that breached during 50 year flood event (unclear on date)

- large "spillway" or diversion ditch that extends from the west side of the former reservoir above the base of the ridges and hills on the western side of the valley, downstream approximately 1.5 to 2 miles
- smaller diversion ditch with headgate approximately 1.5 miles downstream from former reservoir that extends downstream approximately 1.5 to 2 miles
- extensive use of active irrigation practices, i.e., water is frequently tested by Rourke during irrigation
- irrigation ditch that is likely from the Little Powder feeds the downslope fields, i.e., ditch at wooden crossing
- soils change from loamy in the upper reaches toward the former reservoir to clayey at the northern third of the area that was evaluated
- no saturated soils were found, although moist soil could be found at depth
- fields included alfalfa hay, mixed brome-alfalfa hay, crested wheatgrass hay, and native hay
- silver sagebrush terraces were common in the upper reaches toward the former reservoir
- one small patch of greasewood was noted in an area where the soils changed form loamy to clayey

DISCUSSION

Water flow and quality in Rawhide Creek is dependent upon storage discharge from upstream coal mines. Within the reach of this survey, current water quality did not appear to be a problem although the landowner does monitor the salinity level in the stream throughout the season and will not release water to fields if quality is poor.

The ditching system on Paul Rourke's is one of the most elaborate in Campbell County but is not extensive. Soils along the ditching system vary from north to south along the ridge to the west. Hay cropping systems are somewhat extensive but are not reported or tracked by the Farm Service Agency.

Soil analyses indicate fine textured soils that contain possibility of salt loading if irrigation water is used extensively. Electrical conductivity values for soils are currently somewhat elevated.

TABLE 1. SOIL ANALYSIS

Limon
(Location Rawhide-1)

Mechanical Analysis

Depth (inches)	Sand %	Silt %	Clay %	Texture
0-15	19	49	32	SiCL
15-32	32	39	29	CL
32-54	22	43	35	CL
54-60	39	37	24	L

Saturation Extract

Depth (inches)	pH S.U.	Lime $CaCO_2$	Elect. Cond.	Cations Ca	Mg	Na	SAR
				---------meq/liter----------			
0-15	8.30	2.33	1.26	8.25	4.92	1.93	0.75
15-32	8.10	3.54	4.15	21.1	28.8	9.39	1.88
32-54	8.00	4.14	8.98	18.6	73.5	42.0	6.20
54-60	8.10	3.35	7.51	19.0	53.3	35.9	5.97

Marginal values were found for EC in the 32-54 range.

TABLE 1. SOIL ANALYSIS

Fine Textured Entisol
(Location Rawhide-2)

Mechanical Analysis

Depth (inches)	Sand %	Silt %	Clay %	Texture
0-16	29	44	27	CL
16-30	15	54	31	SiCL
30-54	13	52	35	SiCL
54-60	14	47	39	SiCL

Saturation Extract

Depth (inches)	pH S.U.	Lime $CaCO_2$	Elect. Cond.	Cations Ca	Mg	Na	SAR
				---------meq/liter----------			
0-16	8.40	4.56	1.36	8.05	5.03	2.58	1.01
16-30	8.20	4.84	3.13	17.9	14.8	8.35	2.07
30-54	7.90	4.00	3.84	22.3	17.5	11.6	2.59
54-60	7.80	2.09	4.29	21.6	26.0	12.3	2.51

TABLE 1. SOIL ANALYSIS

Fine Textured Entisol
(Location Rawhide-3)

Mechanical Analysis

Depth (inches)	Sand %	Silt %	Clay %	Texture
0-10	17	40	43	SiC
10-22	10	51	39	SiCL
22-33	15	52	33	SiCL
33-54	36	41	23	L
54-60	34	41	25	L

Saturation Extract

Depth (inches)	pH S.U.	Lime $CaCO_2$	Elect. Cond.	Cations Ca	Mg	Na	SAR
				---------meq/liter----------			
0-10	8.30	1.16	1.34	4.55	6.53	4.29	1.82
10-22	8.20	3.26	3.05	14.2	14.5	9.22	2.43
22-33	8.30	6.05	4.26	21.9	21.0	13.6	2.93
33-54	8.10	4.51	4.98	20.7	34.8	15.6	2.96
54-60	7.90	4.51	5.60	20.2	42.4	17.7	3.16

Marginal values for texture were found in the 0-10 range.

TABLE 1. SOIL ANALYSIS

Kishona
(Location Rawhide-4)

Mechanical Analysis

Depth (inches)	Sand %	Silt %	Clay %	Texture
0-13	28	39	33	CL
13-36	12	55	33	SiCL
36-46	18	52	30	SiCL
46-60	14	53	33	SiCL

Saturation Extract

Depth (inches)	pH S.U.	Lime $CaCO_3$	Elect. Cond.	Cations			
				Ca	Mg	Na	SAR
				meq/liter			
0-13	8.20	0.92	1.08	2.94	5.05	3.60	1.80
13-36	8.30	4.58	1.22	3.78	4.75	4.70	2.27
36-46	8.10	4.82	2.40	13.8	10.8	6.17	1.76
46-60	8.10	4.34	3.43	22.6	15.8	7.39	1.69

TABLE 1. SOIL ANALYSIS

Torrifluvent
(Location Rawhide-5)

Mechanical Analysis

Depth (inches)	Sand %	Silt %	Clay %	Texture
0-20	23	40	37	CL
20-37	75	14	11	SL
37-44	49	32	19	L
44-54	38	40	22	L
54-60	72	17	11	SL

Saturation Extract

Depth (inches)	pH S.U.	Lime $CaCO_2$	Elect. Cond.	Cations			
				Ca	Mg	Na	SAR
				----------meq/liter----------			
0-20	8.30	4.05	8.28	19.4	58.8	40.7	6.50
20-37	8.20	2.03	7.72	19.0	52.5	40.0	6.69
37-44	8.10	3.57	6.88	19.4	45.6	32.6	5.72
44-54	8.30	4.63	5.80	20.1	37.1	25.0	4.68
54-60	8.30	2.80	6.86	18.7	44.4	34.2	6.09

Marginal values were found for EC in the 0-20 range.

TABLE 1. SOIL ANALYSIS

Kishona
(Location Rawhide-6)

Mechanical Analysis

Depth (inches)	Sand %	Silt %	Clay %	Texture
0-10	52	33	15	L
10-19	60	27	13	SL
19-34	48	36	16	L
34-47	34	43	23	L
47-60	75	12	13	SL

Saturation Extract

Depth (inches)	pH S.U.	Lime $CaCO_2$	Elect. Cond.	Cations Ca	Mg	Na	SAR
				----------meq/liter----------			
0-10	8.40	1.25	0.61	4.20	1.99	0.16	0.09
10-19	8.50	3.13	0.57	3.84	1.54	0.19	0.11
19-34	8.30	3.76	1.80	7.10	6.95	6.17	2.33
34-47	8.10	3.86	7.55	20.2	42.8	44.3	7.90
47-60	8.00	3.57	5.86	20.4	34.4	25.5	4.87

Marginal values were found for pH in the 10-19 range.

TABLE 2. OVERALL SUITABILITY RECOMMENDATIONS FOR IRRIGATION AND SUBIRRIGATION.

Location	Irrigation Only
Rawhide-1	e
Rawhide-2	e
Rawhide-3	e
Rawhide-4	e
Rawhide-5	e
Rawhide-6	e

[a] Suitable based on field observations only.
[b] Suitable based on laboratory analysis.
[c] Unsuitable based on field observations only.
[d] Unsuitable based on laboratory analysis.
[e] Marginal based on field observations only; recommend further laboratory analysis prior to application.

ADDENDUM 1
SOIL ANALYSES
(Collected June 10, 2000)

LABORATORY ANALYSIS REPORT

Client: BKS ENVIRONMENTAL
Sample Matrix: Solid, Soil
Date Received: 06-10-00
Report Date: July 10, 2000

Laboratory ID	Sample ID	Sample Date/Time	pH, Saturated Paste	Elec. Conductivity, Saturated Paste	Lime, $CaCO_3$	Calcium	Magnesium	Sodium	SAR	ESP[1]	Sand	Silt	Clay	Texture
00-33417-22	Rourke, Rawhide-1 0-15	Not Provided	8.30	1.26	2.33	8.25	4.92	1.93	0.75	1.1	19	49	32	Silty Clay Loam
00-33417-23	Rourke, Rawhide-1 15-32	Not Provided	8.10	4.15	3.54	21.1	28.8	9.39	1.88	2.7	32	39	29	Clay Loam
00-33417-24	Rourke, Rawhide-1 32-54	Not Provided	8.00	8.98	4.14	18.6	73.5	42.0	6.20	8.4	22	43	35	Clay Loam
00-33417-25	Rourke, Rawhide-1 54-60	Not Provided	8.10	7.51	3.35	19.0	53.3	35.9	5.97	8.1	39	37	24	Loam
00-33417-26	Rourke, Rawhide-2 0-16	Not Provided	8.40	1.36	4.56	8.05	5.03	2.58	1.01	1.5	29	44	27	Clay Loam
00-33417-27	Rourke, Rawhide-2 16-30	Not Provided	8.20	3.13	4.84	17.9	14.8	8.35	2.07	3.0	15	54	31	Silty Clay Loam
00-33417-28	Rourke, Rawhide-2 30-54	Not Provided	7.90	3.84	4.00	22.3	17.5	11.6	2.59	3.7	13	52	35	Silty Clay Loam
00-33417-29	Rourke, Rawhide-2 54-60	Not Provided	7.80	4.29	2.09	21.6	26.0	12.3	2.51	3.6	14	47	39	Silty Clay Loam
00-33417-30	Rourke, Rawhide-3 0-10	Not Provided	8.30	1.34	1.16	4.55	6.53	4.29	1.82	2.6	17	40	43	Silty Clay
00-33417-31	Rourke, Rawhide-3 10-22	Not Provided	8.20	3.05	3.26	14.2	14.5	9.22	2.43	3.5	10	51	39	Silty Clay Loam
00-33417-32	Rourke, Rawhide-3 22-33	Not Provided	8.30	4.26	6.05	21.9	21.0	13.6	2.93	4.1	15	52	33	Silty Clay Loam
00-33417-33	Rourke, Rawhide-3 33-54	Not Provided	8.10	4.98	4.51	20.7	34.8	15.6	2.96	4.2	36	41	23	Loam
00-33417-34	Rourke, Rawhide-3 54-60	Not Provided	7.90	5.60	4.51	20.2	42.4	17.7	3.16	4.4	34	41	25	Loam
00-33417-35	Rourke, Rawhide-4 0-13	Not Provided	8.20	1.08	0.88	2.94	5.05	3.60	1.80	2.6	28	39	33	Clay Loam
00-33417-36	Rourke, Rawhide-4 13-36	Not Provided	8.30	1.22	4.42	3.78	4.75	4.70	2.27	3.2	12	55	33	Silty Clay Loam
00-33417-37	Rourke, Rawhide-4 36-46	Not Provided	8.10	2.40	4.65	13.8	10.8	6.17	1.76	2.5	18	52	30	Silty Clay Loam
00-33417-38	Rourke, Rawhide-4 46-60	Not Provided	8.10	3.43	4.19	22.6	15.8	7.39	1.69	2.4	14	53	33	Silty Clay Loam
00-33417-39	Rourke, Rawhide-5 0-20	Not Provided	8.30	8.28	3.77	19.4	58.8	40.7	6.50	8.8	23	40	37	Clay Loam
00-33417-40	Rourke, Rawhide-5 20-37	Not Provided	8.20	7.72	1.79	19.0	52.5	40.0	6.69	9.0	75	14	11	Sandy Loam
00-33417-41	Rourke, Rawhide-5 37-44	Not Provided	8.10	6.88	3.30	19.4	45.6	32.6	5.72	7.8	49	32	19	Loam
00-33417-42	Rourke, Rawhide-5 44-54	Not Provided	8.30	5.80	4.33	20.1	37.1	25.0	4.68	6.5	38	40	22	Loam
00-33417-43	Rourke, Rawhide-5 54-60	Not Provided	8.30	6.86	2.55	18.7	44.4	34.2	6.09	8.2	72	17	11	Sandy Loam
00-33417-44	Rourke, Rawhide-6 0-10	Not Provided	8.40	0.61	1.04	4.20	1.99	0.16	0.09	0.1	52	33	15	Loam
00-33417-45	Rourke, Rawhide-6 10-19	Not Provided	8.50	0.57	2.87	3.84	1.54	0.19	0.11	0.2	60	27	13	Sandy Loam
00-33417-46	Rourke, Rawhide-6 19-34	Not Provided	8.30	1.80	3.49	7.10	6.95	6.17	2.33	3.3	48	36	16	Loam
00-33417-47	Rourke, Rawhide-6 34-47	Not Provided	8.10	7.55	3.58	20.2	42.8	44.3	7.90	10.4	34	43	23	Loam
00-33417-48	Rourke, Rawhide-6 47-60	Not Provided	8.00	5.86	3.30	20.4	34.4	25.5	4.87	6.7	75	12	13	Sandy Loam
Reporting Limit:		-	0.01	0.01	0.01	0.01	0.01	0.01		1	1	1	1	
Units:		std. units	mmhos/cm	%	meq/L	meq/L	meq/L	-		%	%	%	%	
Extraction / Analytical Method:		ASA 9, 10-3.2	ASA 9, 10-3.3	USDA Hndbk No. 60, Mthd 23c	USDA Hndbk No. 60, Mthd 20b / 200.7	USDA Hndbk No. 60, Mthd 20b / 200.7	USDA Hndbk No. 60, Mthd 20b / 200.7	USDA Hndbk No. 60, Mthd 20b / 200.7		ASA 9, Part 1, 15-5	ASA 9, Part 1, 15-5	ASA 9, Part 1, 15-5	ASA 9, Part 1, 15-5	
Analyst:		dj	dj	dj	dj / jal	dj / jal	dj / jal	dj / jal		dj	dj	dj	dj	
Extraction / Analytical Date:		06-27-00	06-27-00	06-27-00	-27-00 / 07-03-	-27-00 / 07-03-	6-27-00 / 07-03-0	-27-00 / 07-03-00		07-06-00	07-06-00	07-06-00	07-06-00	

[1] Calculated by AHA

dmc: r:\reports\clients2000\bks_environmental\solids\soils\33417-1-87.xls

ENERGY LABORATORIES, INC.
P.O. BOX 3258 • CASPER, WY 82602 • 2393 SALT CREEK HIGHWAY • CASPER, WY 82601
PHONE (307) 235-0515 • FAX (307) 234-1639

LABORATORY ANALYSIS REPORT

Client: BKS ENVIRONMENTAL
Sample Matrix: Solid, Soil
Date Received: 06-10-00
Report Date: July 10, 2000

Laboratory ID	Sample ID	Sample Date/Time	pH, Saturated Paste	Elec. Conductivity, Saturated Paste	Lime, $CaCO_3$	Calcium	Magnesium	Sodium	SAR	Sand	Silt	Clay	Texture
00-33417-1	Hall_Wildcat-1 0-14	Not Provided	8.20	4.64	2.70	21.9	16.9	24.5	5.56	24	44	32	Clay Loam
00-33417-2	Hall_Wildcat-1 14-28	Not Provided	8.10	12.3	3.95	17.2	63.3	97.8	15.4	38	28	34	Clay Loam
00-33417-3	Hall_Wildcat-1 28-45	Not Provided	8.00	8.90	4.10	17.4	41.8	63.5	11.7	37	41	22	Loam
00-33417-4	Hall_Wildcat-1 45-60	Not Provided	8.00	6.26	3.37	18.3	29.7	37.3	7.62	50	2	48	Sandy Clay
00-33417-5	Hall_Wildcat-2 0-15	Not Provided	8.10	1.75	2.22	6.30	4.53	8.96	3.85	14	40	46	Clay
00-33417-6	Hall_Wildcat-2 15-28	Not Provided	7.80	9.01	3.23	18.2	46.9	63.0	11.1	12	70	18	Silty Loam
00-33417-7	Hall_Wildcat-2 28-46	Not Provided	7.80	8.41	1.98	19.4	45.3	54.3	9.55	60	22	18	Sandy Loam
00-33417-8	Hall_Wildcat-2 46-60	Not Provided	7.80	4.96	2.60	20.0	26.6	23.0	4.76	66	6	40	Sandy Clay
00-33417-9	Hall_Wildcat-3 0-9	Not Provided	8.20	4.29	2.27	6.90	4.55	35.8	15.0	16	58	26	Silty Loam
00-33417-10	Hall_Wildcat-3 9-25	Not Provided	7.90	13.8	4.19	17.9	33.8	133	26.2	25	40	35	Clay Loam
00-33417-11	Hall_Wildcat-3 25-35	Not Provided	8.00	15.9	3.86	16.5	45.8	157	28.1	34	39	27	Clay Loam
00-33417-12	Hall_Wildcat-3 35-60	Not Provided	8.20	17.4	3.91	17.2	54.5	172	28.7	31	43	26	Loam
00-33417-13	Hall_Wildcat-4 0-10	Not Provided	8.30	1.55	1.35	4.86	7.10	6.70	2.74	29	37	34	Clay Loam
00-33417-14	Hall_Wildcat-4 10-25	Not Provided	8.20	2.55	2.70	12.2	10.4	9.57	2.84	11	51	38	Silty Clay Loam
00-33417-15	Hall_Wildcat-4 25-30	Not Provided	8.20	3.70	1.98	19.9	10.7	18.1	4.63	61	22	17	Sandy Loam
00-33417-16	Hall_Wildcat-4 30-44	Not Provided	8.10	3.74	3.23	20.4	12.3	16.1	3.98	51	30	19	Loam
00-33417-17	Hall_Wildcat-4 44-60	Not Provided	8.10	2.93	2.56	12.1	12.3	11.8	3.39	63	21	16	Sandy Loam
00-33417-18	Hall_Wildcat-5 0-6	Not Provided	8.30	4.85	2.51	12.6	15.4	31.6	8.43	14	51	35	Silty Clay Loam
00-33417-19	Hall_Wildcat-5 6-24	Not Provided	8.30	13.5	3.44	17.0	58.3	111	18.1	15	48	37	Silty Clay Loam
00-33417-20	Hall_Wildcat-5 24-38	Not Provided	8.00	13.0	3.95	17.0	45.1	111	20.0	22	45	33	Clay Loam
00-33417-21	Hall_Wildcat-5 38-60	Not Provided	8.30	9.75	3.95	18.0	37.9	74.8	14.1	31	40	29	Clay Loam
00-33417-22	Rourke_Rawhide-1 0-15	Not Provided	8.30	1.26	2.33	8.25	4.92	1.93	0.75	19	49	32	Silty Clay Loam
00-33417-23	Rourke_Rawhide-1 15-32	Not Provided	8.10	4.15	3.54	21.1	28.8	9.39	1.88	32	39	29	Clay Loam
00-33417-24	Rourke_Rawhide-1 32-54	Not Provided	8.00	8.98	4.14	18.6	73.5	42.0	6.20	22	43	35	Clay Loam
00-33417-25	Rourke_Rawhide-1 54-60	Not Provided	8.10	7.51	3.35	19.0	53.3	35.9	5.97	39	37	24	Loam
00-33417-26	Rourke_Rawhide-2 0-16	Not Provided	8.40	1.36	4.56	8.05	5.01	2.58	1.01	29	44	27	Clay Loam
00-33417-27	Rourke_Rawhide-2 16-30	Not Provided	8.20	3.13	4.84	17.9	14.8	8.35	2.07	15	54	31	Silty Clay Loam
00-33417-28	Rourke_Rawhide-2 30-54	Not Provided	7.90	3.84	4.60	22.3	17.5	11.6	2.59	13	52	35	Silty Clay Loam
00-33417-29	Rourke_Rawhide-2 54-60	Not Provided	7.80	4.29	2.09	21.6	26.0	12.3	2.51	14	47	39	Silty Clay Loam
00-33417-30	Rourke_Rawhide-3 0-10	Not Provided	8.30	1.34	1.16	4.55	6.53	4.29	1.82	17	40	43	Silty Clay
00-33417-31	Rourke_Rawhide-3 10-22	Not Provided	8.20	3.05	3.26	14.2	14.5	9.22	2.43	10	51	39	Silty Clay Loam
00-33417-32	Rourke_Rawhide-3 22-33	Not Provided	8.30	4.26	6.05	21.9	21.0	13.6	2.93	15	52	33	Silty Clay Loam
00-33417-33	Rourke_Rawhide-3 33-54	Not Provided	8.10	4.98	4.51	20.7	34.8	15.6	2.96	36	41	23	Loam
00-33417-34	Rourke_Rawhide-3 54-60	Not Provided	7.90	5.60	4.51	20.2	42.4	17.7	3.16	34	41	25	Loam

LABORATORY ANALYSIS REPORT

Client: BKS ENVIRONMENTAL
Sample Matrix: Solid, Soil
Date Received: 06-10-00
Report Date: July 10, 2000

Laboratory ID	Sample ID	Sample Date/Time	pH, Saturated Paste	Elec. Conductivity, Saturated Paste	Lime, $CaCO_3$	Calcium	Magnesium	Sodium	SAR	Sand	Silt	Clay	Texture
00-33417-35	Rourke, Rawhide-4 0-13	Not Provided	8.20	1.08	0.92	2.94	5.05	3.60	1.80	28	39	33	Clay Loam
00-33417-36	Rourke, Rawhide-4 13-36	Not Provided	8.30	1.22	4.58	3.78	4.75	4.70	2.27	12	55	33	Silty Clay Loam
00-33417-37	Rourke, Rawhide-4 36-46	Not Provided	8.10	2.40	4.82	13.8	10.8	6.17	1.76	18	52	30	Silty Clay Loam
00-33417-38	Rourke, Rawhide-4 46-60	Not Provided	8.10	3.43	4.34	22.6	15.8	7.39	1.69	14	53	33	Silty Clay Loam
00-33417-39	Rourke, Rawhide-5 0-20	Not Provided	8.30	8.28	4.05	19.4	58.8	40.7	6.50	23	40	37	Clay Loam
00-33417-40	Rourke, Rawhide-5 20-37	Not Provided	8.20	7.72	2.03	19.0	52.5	40.0	6.69	75	14	11	Sandy Loam
00-33417-41	Rourke, Rawhide-5 37-44	Not Provided	8.10	6.88	3.57	19.4	45.6	32.6	5.72	49	32	19	Loam
00-33417-42	Rourke, Rawhide-5 44-54	Not Provided	8.30	5.80	4.63	20.1	37.1	25.0	4.68	38	40	22	Loam
00-33417-43	Rourke, Rawhide-5 54-60	Not Provided	8.30	6.86	2.80	18.7	44.4	34.2	6.09	72	17	11	Sandy Loam
00-33417-44	Rourke, Rawhide-6 0-10	Not Provided	8.40	0.61	1.25	4.20	1.99	0.16	0.09	52	33	15	Loam
00-33417-45	Rourke, Rawhide-6 10-19	Not Provided	8.50	0.57	3.13	3.84	1.54	0.19	0.11	60	27	13	Sandy Loam
00-33417-46	Rourke, Rawhide-6 19-34	Not Provided	8.30	1.80	3.76	7.10	6.95	6.17	2.33	48	36	16	Loam
00-33417-47	Rourke, Rawhide-6 34-47	Not Provided	8.10	7.55	3.86	20.2	42.8	44.3	7.90	34	43	23	Loam
00-33417-48	Rourke, Rawhide-6 47-60	Not Provided	8.00	5.86	3.57	20.4	34.4	25.5	4.87	75	12	13	Sandy Loam
00-33417-49	Col 1, Wildcat 0-2	Not Provided	8.60	1.31	0.90	7.35	6.08	0.77	0.30	18	44	38	Silty Clay Loam
00-33417-50	Col 1, Wildcat 2-6	Not Provided	8.80	0.71	1.09	3.17	2.70	1.69	0.98	24	40	36	Clay Loam
00-33417-51	Col 1, Wildcat 6-24	Not Provided	7.80	0.77	1.71	6.30	5.37	9.57	3.96	14	49	37	Silty Clay Loam
00-33417-52	Col 1, Wildcat 24-50	Not Provided	7.70	5.47	2.33	20.7	30.5	25.1	4.96	10	50	40	Silty Clay
00-33417-53	Col 2, Wildcat 0-2	Not Provided	8.00	1.88	0.71	4.06	2.55	11.6	6.36	N/R	N/R	N/R	N/R
00-33417-54	Col 2, Wildcat 2-4	Not Provided	7.90	3.86	1.00	10.7	7.40	23.0	7.66	10	38	52	Clay
00-33417-55	Col 2, Wildcat 4-24	Not Provided	7.80	6.43	1.43	17.8	20.0	37.8	8.70	8	43	49	Silty Clay
00-33417-56	Col 2, Wildcat 24-50	Not Provided	7.80	5.76	2.38	18.3	21.7	30.1	6.73	14	46	40	Silty Clay
00-33417-57	Col 3, Wildcat 0-2	Not Provided	8.20	2.10	0.95	11.1	6.72	6.13	2.05	12	45	43	Silty Clay
00-33417-58	Col 3, Wildcat 2-5	Not Provided	8.30	0.54	0.29	2.53	1.18	0.94	0.69	20	44	36	Silty Clay Loam
00-33417-59	Col 3, Wildcat 5-8	Not Provided	8.30	0.65	0.48	2.47	1.18	2.50	1.85	23	41	36	Clay Loam
00-33417-60	Col 3, Wildcat 8-40	Not Provided	8.30	1.07	1.24	1.06	0.67	7.57	8.14	10	42	48	Silty Clay
00-33417-61	Col 3, Wildcat 40-48	Not Provided	7.70	9.13	1.09	17.7	23.9	72.6	15.9	10	42	48	Silty Clay
00-33417-62	Col 4, Wildcat 0-2	Not Provided	7.50	8.88	0	4.24	3.08	0.80	0.42	N/R	N/R	N/R	N/R
00-33417-63	Col 4, Wildcat 2-8	Not Provided	7.50	0.44	0.05	1.90	1.43	0.92	0.71	33	42	25	Loam
00-33417-64	Col 4, Wildcat 8-30	Not Provided	7.50	0.26	0.14	1.05	0.79	0.78	0.81	50	28	22	Sandy Clay Loam
00-33417-65	Col 4, Wildcat 30-40	Not Provided	7.40	0.50	0.09	1.58	1.35	1.49	1.23	44	32	24	Loam
00-33417-66	Col 4, Wildcat 40-48	Not Provided	7.40	0.91	0	1.91	2.10	4.07	2.87	50	25	25	Sandy Clay Loam

N/R = Not Requested

LABORATORY ANALYSIS REPORT

Client: BKS ENVIRONMENTAL
Sample Matrix: Solid, Soil
Date Received: 06-10-00
Report Date: July 10, 2000

Laboratory ID	Sample ID	Sample Date/Time	pH, Saturated Paste	Elec. Conductivity, Saturated Paste	Lime, $CaCO_3$	Calcium	Magnesium	Sodium	SAR	Sand	Silt	Clay	Texture
00-33417-67	Daly 1, Jamison Prong 0-2	Not Provided	7.30	0.59	0.71	3.31	1.80	0.16	0.10	N/R	N/R	N/R	N/R
00-33417-68	Daly 1, Jamison Prong 2-8	Not Provided	8.00	0.66	1.19	4.31	2.04	0.16	0.09	19	53	28	Silty Clay Loam
00-33417-69	Daly 1, Jamison Prong 8-32	Not Provided	8.00	0.52	2.76	2.99	1.92	0.28	0.18	32	44	24	Loam
00-33417-70	Daly 1, Jamison Prong 32-48	Not Provided	7.70	3.87	2.20	21.0	16.3	3.37	0.78	25	45	30	Clay Loam
00-33417-71	Daly 1, Jamison Prong 48-60	Not Provided	7.70	7.23	4.00	48.6	35.4	4.33	0.67	24	42	34	Clay Loam
00-33417-72	Daly 2, Jamison Prong 0-2	Not Provided	8.40	0.77	2.90	6.55	1.80	0.08	0.04	28	42	30	Clay Loam
00-33417-73	Daly 2, Jamison Prong 2-20	Not Provided	8.30	0.54	3.50	4.39	1.16	0.18	0.11	34	36	30	Clay Loam
00-33417-74	Daly 2, Jamison Prong 20-30	Not Provided	8.30	0.85	3.65	7.20	2.09	0.63	0.29	26	38	36	Clay Loam
00-33417-75	Daly 2, Jamison Prong 30-60	Not Provided	7.90	2.97	3.65	28.7	7.51	1.32	0.31	29	39	32	Clay Loam
00-33417-76	Daly 3, Jamison Prong 0-3	Not Provided	8.30	1.13	2.30	7.70	3.37	0.07	0.03	23	45	32	Clay Loam
00-33417-77	Daly 3, Jamison Prong 3-12	Not Provided	8.30	0.88	2.75	5.35	2.09	0.10	0.05	22	50	28	Clay Loam
00-33417-78	Daly 3, Jamison Prong 12-28	Not Provided	8.40	0.77	2.45	5.15	2.29	0.55	0.28	22	48	30	Clay Loam
00-33417-79	Daly 3, Jamison Prong 28-36	Not Provided	8.10	0.29	2.40	22.5	10.8	2.14	0.52	26	42	32	Clay Loam
00-33417-80	Kretschman 1, Wildcat 0-2	Not Provided	8.20	1.06	0.55	3.65	3.70	3.37	1.76	26	24	50	Clay
00-33417-81	Kretschman 1, Wildcat 2-24	Not Provided	8.30	0.99	0.85	2.45	1.92	4.91	3.32	24	28	48	Clay
00-33417-82	Kretschman 1, Wildcat 24-40	Not Provided	7.90	6.43	2.30	17.1	20.7	16.5	8.40	22	42	36	Clay Loam
00-33417-83	Kretschman 1, Wildcat 40-60	Not Provided	8.00	5.21	3.25	16.3	15.7	27.8	6.96	18	52	30	Silty Clay Loam
00-33417-84	Kretschman 2, Wildcat 0-2	Not Provided	8.20	1.60	0.75	4.27	5.30	6.43	2.94	N/R	N/R	N/R	N/R
00-33417-85	Kretschman 2, Wildcat 2-8	Not Provided	8.30	1.29	0.75	3.10	3.82	5.43	2.92	24	20	56	Clay
00-33417-86	Kretschman 2, Wildcat 8-20	Not Provided	8.20	0.87	0.35	1.71	1.95	3.73	2.76	20	32	48	Clay
00-33417-87	Kretschman 2, Wildcat 20-31	Not Provided	8.30	1.07	1.00	2.47	2.62	4.91	3.08	22	42	36	Clay Loam
Reporting Limit				0.01	0.01	0.01	0.01	0.01	0.01	1	1	1	1
Units			std. units	mmhos/cm	%	meq/L	meq/L	meq/L	-	%	%	%	%
Extraction / Analytical Method			ASA 9, 10-3.3	ASA 9, 10-3.3	USDA Hndbk No. 60, Mthd 23c	USDA Hndbk No. 60, Mthd 206 / 200.7	USDA Hndbk No. 60, Mthd 206 / 200.7	USDA Hndbk No. 60, Mthd 206 / 200.7	USDA Hndbk No. 60, Mthd 206 / 200.7	ASA 9, Part 1, 15-5	ASA 9, Part 1, 15-5	ASA 9, Part 1, 15-5	ASA 9, Part 1, 15-5
Analyst			dj	dj	dj	dj / jal	dj / jal	dj / jal	dj / jal	dj	dj	dj	dj
Extraction / Analytical Date			06-27-00	06-27-00	06-27-00	06-27-00 / 07-03-00	06-27-00 / 07-03-00	06-27-00 / 07-03-00	06-27-00 / 07-03-00	07-06-00	07-06-00	07-06-00	07-06-00

N/R = Not Requested

Report Approved By: Roger Gaskins, Laboratory Supervisor

Reviewed By: Sheryl Harling, Administrative Supervisor

ADDENDUM 2
MAP UNIT DESCRIPTIONS

1044 - Limon - Moorhead clay loam, 0-6 percent slopes
(formerly Echeta - Moorhead)

The Limon clay loam mapping unit consists of deep, well-drained, slowly permeable soils that formed in relatively uniform alluvial deposits derived principally from clay and shale. It occurs on flood plains or alluvial fans.

The average annual precipitation ranges from 15 to 17 inches. The average annual air temperature is approximately 47-53 degrees Fahrenheit.

Slopes range from 0 to 6 percent. Included in this unit are small areas of Nuncho and Leiter. These inclusions comprise less than 15-25 percent of the total acreage within this map unit.

A typical profile contains a 3 inch clay loam surface layer. The transition subsoil, if present, is clay loam to clay and is approximately 20 inches thick. The substratum is clay, and extends to 60 inches in depth.

Permeability within the Limon soil is slow. The available water capacity is high. The effective rooting depth is 60 plus inches. Runoff is medium, and the erosion hazard is slight.

This mapping unit is a fair source of topsoil to a maximum of 60 inches.

214 - Theedle - Kishona loam, 0-6 percent slopes

The Kishona loam mapping unit consists of very deep, well-drained soils that formed in alluvium derived from mixed sources. It occurs within small ephemeral drainages at elevations from 4,100 to 5,200.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45-49 degrees Fahrenheit, and the average frost-free season is approximately 110-130 days.

Slopes range from 0 to 6 percent. Included in this unit are small areas of Cambria loam, Cushman loam, Forkwood loam, and Turnercrest sandy loam. These inclusions comprise less than 20 percent of the total acreage within this map unit.

Typically, the surface layer is pale brown loam about 5 inches thick. The upper 28 inches of the subsoil is light gray clay loam. The lower part of the so\ubsoil is light gray loam to 60 inches or more.

Permeability within the Kishona soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow to medium, and the erosion hazard is slight to moderate. The hazard of wind erosion is moderate.

The Kishona soil is moderately will suited for stockwater ponds. The main limitation is the moderate seepage potential. This unit is well suited for mechanical range renovation. This unit is moderately well suited for range seeding. The main limitations are the hazard of wind erosion during reseeding, adequate residue must be maintained on the surface at all times until the seeding is established. Tilled areas must remain narrow and at right angles to the wind. The low annual precipitation should be of concern when reseeding.

ADDENDUM 3
SOIL SERIES DESCRIPTIONS

Limon

Soil Mapping Unit 1044
Typical Pedon: Limon silty clay loam - grassland.
(Colors are for dry soil unless otherwise indicated)

The Limon map unit consists of deep, well drained, slowly permeable soils that formed in relatively uniform alluvial deposits derived principally from clay and shale. Slopes are 0 to 12 percent. The mean annual precipitation is about 15 inches, and the mean annual temperature is 48 degrees F.

Ap - 0-8 inches; silty clay loam; weakly effervescent; moderately alkaline (pH 8.3).

Ac - 8-15 inches; silty clay loam; moderately effervescent; moderately alkaline (pH 8.3).

Ck1 - 15-32 inches; clay loam; strongly effervescent; moderately alkaline (pH 8.1).

Ck2 - 32-54 inches; clay loam; strongly effervescent; moderately alkaline (pH 8.0).

Ck3 - 54-60 inches; loam; massive; strongly effervescent; moderately alkaline (pH 8.1).

Type Location - Rawhide - 1

Taxonomic Class - Fine, smectitic, calcareous, mesic Ustertic Torriorthents

Fine Textured Entisol

Typical Pedon: Fine Textured Entisol, on flat areas with 0 percent utilized as rangeland
(Colors are for dry soil unless otherwise indicated)

The Fine Textured Entisol map unit consists of deep well drained soils. Slopes are 0 to 30 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is 46 degrees F.

Ap - 0-7 inches; clay loam; weakly effervescent; strongly alkaline (pH 8.4).

Ac - 7-16 inches; clay loam; weakly effervescent; strongly alkaline (pH 8.4).

Ck1 - 16-30 inches; silty clay loam; moderately effervescent; moderately alkaline (pH 8.2).

Ck2 - 30-54 inches; silty clay loam; moderately effervescent; weakly alkaline (pH 7.9).

Ck3 - 54-60 inches; silty clay loam; massive; moderately effervescent; weakly alkaline (pH 7.8).

Type Location - Rawhide-2

Fine Textured Entisol

Typical Pedon: Fine Textured Entisol, on flat areas with 0 percent utilized as rangeland
(Colors are for dry soil unless otherwise indicated)

The Fine Textured Entisol map unit consists of deep well drained soils. Slopes are 0 to 30 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is 46 degrees F.

Ap - 0-10 inches; silty clay; noneffervescent; moderately alkaline (pH 8.3).

Bw - 10-22 inches; silty clay loam; moderately effervescent; moderately alkaline (pH 8.2).

Ck1 - 22-33 inches; silty clay loam; strongly effervescent; moderately alkaline (pH 8.3).

Ck2 - 33-54 inches; loam; moderately effervescent; moderately alkaline (pH 8.1).

Ck3 - 54-60 inches;loam; massive; moderately effervescent; weakly alkaline (pH 7.9).

Type Location - Rawhide-3

Kishona

Soil Mapping Unit 214
Typical Pedon: Kishona loam, within ephemeral drainage of 0 percent utilized as rangeland
(Colors are for dry soil unless otherwise indicated)

The Kishona loam map unit consists of very deep well drained soils formed in alluvium on fans aprons and terraces. Permeability is moderate. Slopes are 0 to 30 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is 46 degrees F.

Ap - 0-9 inches; clay loam; weak fine and very fine granular structure; noneffervescent; moderately alkaline (pH 8.2).

AC - 9-13 inches; clay loam; noneffervescent; moderately alkaline (pH 8.2).

Ck1 - 13-36 inches; silty clay loam; massive; moderately effervescent; moderately alkaline (pH 8.3).

Ck2 - 36-46 inches; silty clay loam; massive; strongly effervescent; moderately alkaline (pH 8.1).

Ck3 - 46-60-45 inches; silty clay loam; massive; moderately effervescent; moderately alkaline (pH 8.1).

Type Location - Rawhide-4

Taxonomic Class - Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents.

Torrifluvent

Soil Mapping Unit 628
Typical Pedon: Torrifluvent, on a lower terrace with 0 percent utilized as rangeland
(Colors are for dry soil unless otherwise indicated)

The Torrifluvent map unit consists of very deep, well to somewhat excessively drained soils. Slopes are 2 to 20 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is 46 degrees F.

A - 0-3 inches; clay loam; noneffervescent; moderately alkaline (pH 8.3).

Cn1 - 3-20 inches; clay loam; weakly effervescent; moderately alkaline (pH 8.3).

C2 - 20-37 inches; sandy loam; weakly effervescent; moderately alkaline (pH 8.2).

C3 - 37-44 inches; loam; weakly effervescent; moderately alkaline (pH 8.1).

C4 - 44-54 inches; loam; massive; weakly effervescent; moderately alkaline (pH 8.3).

C5 - 54-60 inches; sandy loam; weakly effervescent; moderately alkaline (pH 8.3).

Type Location - Rawhide - 5

Kishona

Soil Mapping Unit 214
Typical Pedon: Kishona loam, within ephemeral drainage of 0 percent utilized as rangeland
(Colors are for dry soil unless otherwise indicated)

The Kishona loam map unit consists of very deep well drained soils formed in alluvium on fans aprons and terraces. Permeability is moderate. Slopes are 0 to 30 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is 46 degrees F.

A - 0-3 inches; loam; weak fine and very fine granular structure; noneffervescent; strongly alkaline (pH 8.4).

AC - 3-10 inches; loam; noneffervescent; strongly alkaline (pH 8.4).

C1 - 10-19 inches; sandy loam; massive; moderately effervescent; strongly alkaline (pH 8.5).

C2 - 19-34 inches; loam; massive; moderately effervescent; moderately alkaline (pH 8.3).

Ck3 - 34-47 inches; loam; massive; moderately effervescent; moderately alkaline (pH 8.1).

C4 - 47-60 inches; sandy loam; massive; moderately effervescent; moderately alkaline (pH 8.0).

Type Location - Rawhide-6

Taxonomic Class - Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents.

ADDENDUM 4
MAP OF SAMPLE POINTS

SEE MAP #1

R75E R74E R73E R72E R71E

T52N T51N T50N T49N

US 14/16

RAWHIDE CREEK IRRIGATION AREA

RAWHIDE CREEK

LITTLE POWDER

KINGSBURY CREEK

36277 37613 39781

GILLETTE

90

0 40,000'
SCALE IN FEET

R72W

T52N

Grant Spring

N Fk Hay Creek

N Fork Hay Creek

S Hay Creek

Little Powder River

JEEP TRAIL

PIPELINE

BM 4020

T5735D (C13/044A)

Rourke Rawhide #1

P6887D (C34/179A)

WQMS (Below RC)

DIVERSIONFOR FLOOD IRRIGATION

Ditch

Rourke Rawhide #2

Rourke

Rourke Rawhide #3

Rourke Rawhide #4

Rourke Rawhide #5

WQMS (RC)

Rourke Rawhide #6

Approximate Headgate Location

P2971E (C38/038A)
P12472D (C38/043A)

Gravel Pit

Drill Hole

Franey Rock

BUCKSKIN MINE
TRITON COAL CO.

Rough Draw

Road Draw

Eastern Mine Boundary

P11276D ADJ

Rawhide Creek

Little Rawhide Creek

Elmore Mine

LEGEND

WATER RIGHT

WQMS

SOIL SAMPLING LOCATION

2000' 0 2000'
SCALE IN FEET

MAP 1
RAWHIDE CREEK IRRIGATION
ROURKE RANCH

Campbell County, WY

devon
ENERGY PRODUCTION COMPANY L.P.

Nov 08, 2006 - 2:29pm U:\DEVON\Rawhide Creek\Greater Kitty.dwg

ADDENDUM 5
SOIL PHOTOS

Rawhide Creek Photo Raw-1
Rourke Ranch
General

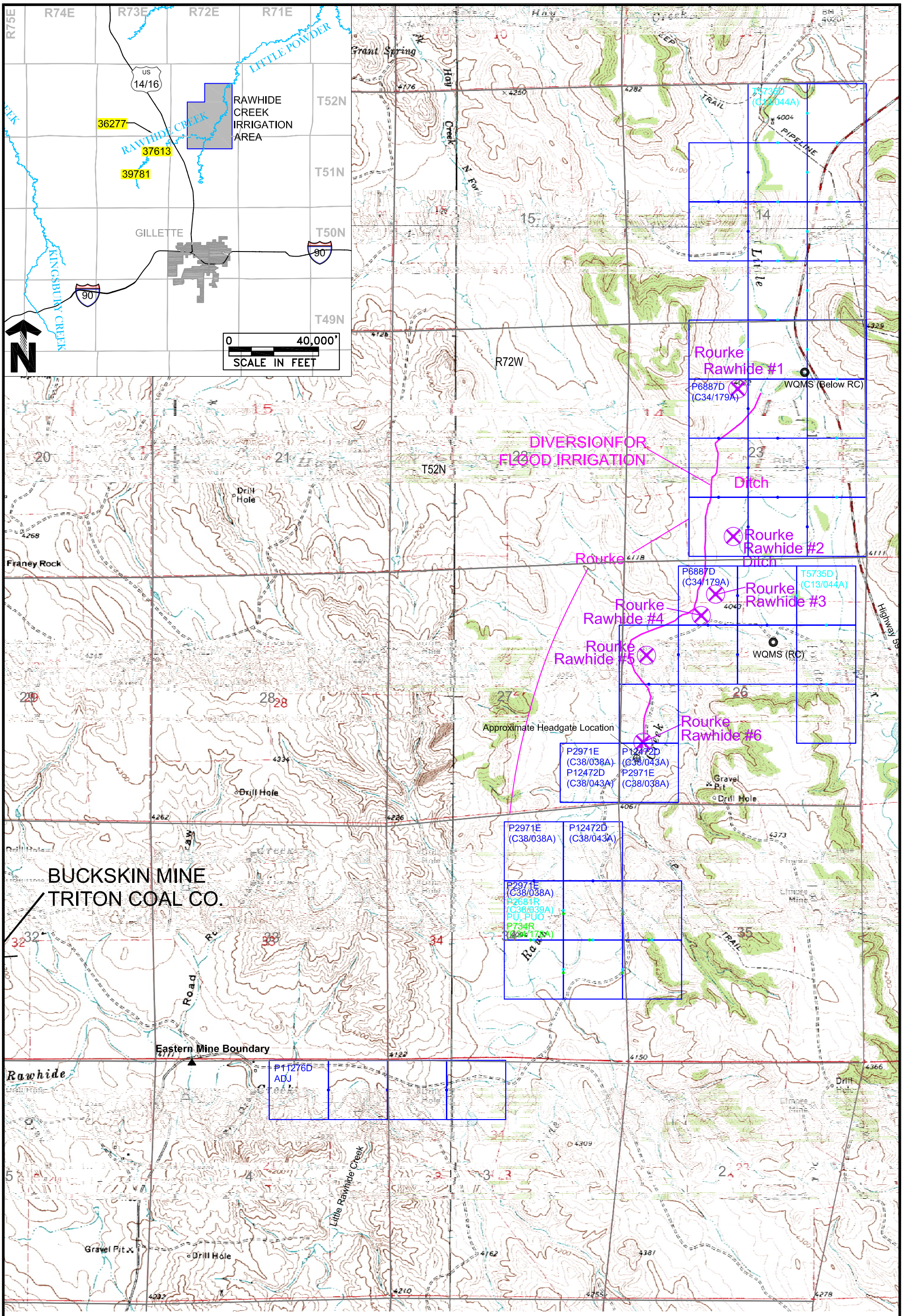
Rawhide Creek Photo Raw-2
Rourke Ranch
Vegetation

Rawhide Creek Photo Raw-3
Rourke Ranch
Core

Rawhide Creek Photo Raw-4
Rourke Ranch
General

Rawhide Creek Photo Raw-5
Rourke Ranch
Zones

Rawhide Creek Photo Raw-6
Rourke Ranch
General



LEGEND

- WATER RIGHT
- WQMS
- SOIL SAMPLING LOCATION

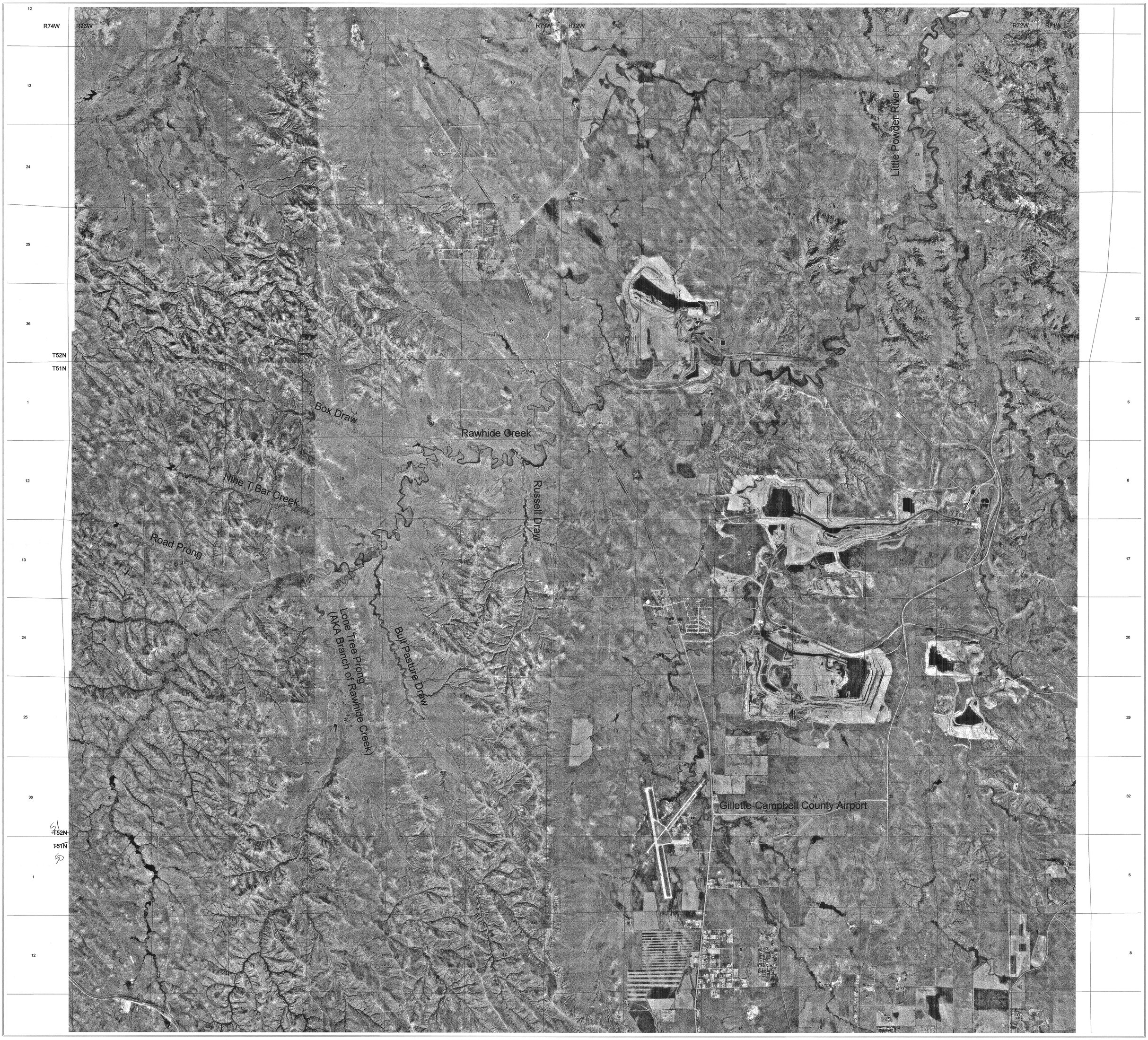
2000' 0 2000'
SCALE IN FEET

MAP 1
RAWHIDE CREEK IRRIGATION
ROURKE RANCH

Campbell County, WY

devon
ENERGY PRODUCTION COMPANY L.P.

Nov 08, 2006 - 2:29pm U:\DEVON\Rawhide Creek\Greater Kitty.dwg



Map 2. Orthophotos of Rawhide Creek to Little Powder River

N
W E
S

0.5 0 0.5 1 1.5 Miles

Orthophotos obtained from the SDVC Clearinghouse at the website: http://www.sdvc.uwyo.edu/clearinghouse/All.html. Date of pictures June, 1994.

NORWEST
Applied Hydrology

File: c:\mydocuments\projects\arcviewimages\rawhidetolittlepowder.apr
Date: 3/19/01

Table 7j: Agricultural Water Quality, Rawhide Creek, Downstream of Mining

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)	Site description
3/11/1981	5240	574	371	428	3.74	3440	0	SD post mining
6/11/1981	5740	506	472	553	2.91	4060	0.005	SD post mining
7/6/1981	7810	1050	362	799	5.28	6010	0	SD post mining
12/31/1981	5590	813	196	366	5.98	2440	0	SD post mining
3/24/1982	3050	354	162	195	3.44	1310	0	SD post mining
6/24/1982	3600	467	199	327	3.60	2340	0	SD post mining
8/6/1982	2800	275	233	216	2.46	1610	0	SD post mining
9/29/1982	2700	327	137	128	3.81	1030	0	SD post mining
12/30/1982	3700	424	210	205	3.92	1610	0	SD post mining
2/17/1983	2710	297	195	188	2.86	1510	0	SD post mining
6/15/1983	2720	398	115	182	4.10	1380	0	SD post mining
9/16/1983	2660	386	112	148	4.34	1300	0	SD post mining
3/11/1981	3770	400	275	299	3.10	2410	0	E mine post mining
6/11/1981	5880	669	402	524	3.99	4100	0.002	E mine post mining
7/6/1981	6170	740	418	575	4.24	4570	0	E mine post mining
12/31/1981	4520	562	229	272	4.61	1970	0	E mine post mining
3/24/1982	2180	233	282	40	3.15	969	0	E mine post mining
5/24/1982	4310	500	292	343	3.65	2730	0	E mine post mining
6/24/1982	4100	542	244	353	3.98	2650	0	E mine post mining
9/29/1982	3070	362	187	185	3.53	1410	0	E mine post mining
12/30/1982	4000	435	231	228	3.82	1790	0	E mine post mining
6/15/1983	2590	373	137	150	4.09	1240	0	E mine post mining
9/16/1983	2690	380	110	129	4.52	1180	0	E mine post mining
12/6/1983	2830	347	127	130	4.05	975	0	E mine post mining
3/8/1984	4650	406	275	287	3.20	2240	0	E mine post mining
5/29/1984	4030	403		251		2190	0	E mine post mining
9/12/1984	2700	320		97		1040	0	E mine post mining
12/10/1984	1980	279		83		698	0	E mine post mining
3/19/1985	3010	255	207	173	2.52	1470	0	E mine post mining
6/18/1985	1500	277	52	62	4.76	530	0	E mine post mining
9/6/1985	1120	228	25	17	6.97	147	0	E mine post mining

Table 7j: Agricultural Water Quality, Rawhide Creek, Downstream of Mining

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)	Site description
12/9/1985	3170	412	222	244	3.54	1800	0	E mine post mining
3/24/1986	3770	420	262	259	3.46	2090	0	E mine post mining
6/16/1986	2500	347	119	162	3.74	1300	0	E mine post mining
9/30/1986	1970	311	60	83	4.69	695	0	E mine post mining
12/16/1986	2320	364	158	110	4.39	1050	0.65	E mine post mining
3/31/1987	3370	400	250	270	3.26	2100	4.19	E mine post mining
4/29/1987	2850	391	142	205	3.76	1460	0.73	E mine post mining
9/30/1987	2170	380	97	102	5.03	909	0.87	E mine post mining
10/29/1987	2210	307	73	74	4.75	654	1.15	E mine post mining
12/10/1987	1500	322	76	68	5.12	650	0.97	E mine post mining
2/26/1988	2060	257	93	78	3.78	663	0	E mine post mining
4/4/1988	4500	420	269	271	3.39	2239	1.31	E mine post mining
9/28/1988	1246	228	31	22	6.17	207	0.37	E mine post mining
12/14/1988	2226	242	164	102	2.98	889	0	E mine post mining
Count	45	45	42	45	42	45	45	
Min	1120	228	25	17	2.46	147	0	
Max	7810	1050	472	799	6.97	6010	4.19	
Median	2850	380	195.5	188	3.81	1460	0	
Average	3317.38	408.51	196.98	221.84	4.02	1756.78	0.23	
Std Dev	1421.15	160.90	106.57	160.62	0.95	1186.33	0.69	

WDEQ Summary of EC effluent limit calculation

Date of Sample	Specific Conductance (umhos/cm @ 25° C)	Sodium mg/L	Calcium mg/L	Magnesium mg/L	SAR calculated	Sulfate mg/L	Flow (cfs)	Site description
6/11/1981	5880	669	402	524	3.99	4100	0.002	E mine post mining
6/11/1981	5740	506	472	553	2.91	4060	0.005	SD post mining
9/28/1988	1246	228	31	22	6.17	207	0.37	E mine post mining
12/16/1986	2320	364	158	110	4.39	1050	0.65	E mine post mining
4/29/1987	2850	391	142	205	3.76	1460	0.73	E mine post mining
9/30/1987	2170	380	97	102	5.03	909	0.87	E mine post mining
12/10/1987	1500	322	76	68	5.12	650	0.97	E mine post mining
10/29/1987	2210	307	73	74	4.75	654	1.15	E mine post mining
4/4/1988	4500	420	269	271	3.39	2239	1.31	E mine post mining
3/31/1987	3370	400	250	270	3.26	2100	4.19	E mine post mining
Count	10	10	10	10	10	10	10	
Min	1246	228	31	22	2.908083	207	0.002	
Max	5880	669	472	553	6.169836	4100	4.19	
Median	2585	385.5	150	157.5	4.191976	1255	0.8	
Average	**3178.60**	398.70	197.00	219.90	4.28	1742.90	1.02	
Std Dev	1666.48	120.22	148.23	188.05	1.01	1386.17	1.20	

SUPPLEMENTAL