

## Drawdown Calculation Narrative Powder River Gas – Coal Creek POD

The predicted drawdown in each coal seam was calculated using regional aquifer characteristics. It is assumed that confined aquifer calculations will adequately address the drawdown in these aquifers since the clay rich layers in the Tongue River member of the Fort Union Formation are known to make the vertical hydraulic conductivity of this unit very low. These calculations also assume isotropy and homogeneity of the coal seam aquifers. Based upon the results of 370 aquifer tests Wheaton and Metesh (2002) have calculated that the geometric mean horizontal hydraulic conductivity value of the coal seam aquifers in the Fort Union Formation is 1.1 feet per day. The geometric mean horizontal hydrologic conductivity less one standards deviation is  $9.8 \times 10^{-2}$  feet per day, and the horizontal hydrologic conductivity plus one standards deviation is 13 feet per day. Mean storativity values of these coals are approximately  $9 \times 10^{-4}$  (storativity is unitless) (Wheaton and Metesh, 2002). The average thickness of the produced coal seams from the POD application are as follows: Wall = 55'; Flowers-Goodale = 20'. The number of wells to be produced in each seam under each alternative for both the direct and cumulative analysis are as follows. This assumes that if these wells are productive they will eventually be produced. :

**Table 1: Number Of Direct And Cumulative CBNG Wells By Alternative**

	<b>Coal Seam</b>	<b>Alternative A No Action</b>	<b>Alternative B No Federal Action</b>	<b>Alternative C Proposed Action</b>
<b>Direct</b>	Wall	0	5	9
	Flowers-Goodale	0	5	9
<b>Cumulative</b>	Wall	0	13	23
	Flowers-Goodale	0	13	23

Using the Theis Equation, the distance that drawdown will extend from the produced wells was estimated. It is felt that this is an appropriate analysis for this project given the uncertainty associated with the variable nature of the hydrologic properties of the coal seams in this area. These calculations assume that the coal seam aquifer is isotropic and homogenous, and that the aquifer is confined. VanVoast and Reiten (1988) have shown that faults are typically no flow boundaries in this area. It is known that faults are present in this area, however the precise locations of all of these faults are not known. In cases where the drawdown cone intersects a fault the radius of the drawdown is not anticipated to extend past the fault, however the cone would extend asymmetrically away from the fault to make up for the flow lost from the fault side. It is felt that the assumption that the coal aquifers may be estimated to be confined is valid since it has been shown that drawdown associated with coal mining has not caused drawdown in overlying units. Drawdown is calculated by assuming that all wells finished in each coal seam can be approximated by one well that produces water at the same rate that all wells finished in that seam would produce on average over the period of time being analyzed. As a conservative step, this distance of drawdown was then applied to the exterior boundary of the POD. The distance that the 20 foot drawdown contour extends from the POD boundary was the criteria used in this analysis to describe the area potentially impacted

by drawdown. As discussed in the MT-CBM-EIS (BLM, 2003) the 20 foot contour is an appropriate threshold since it is a realistic indicator of actual impacts (requiring resetting of pumps or drilling of new wells), and it can be modeled with a reasonable degree of certainty. The distance that the 20 foot contour extends was determined for both of the produced coal seams after 6 weeks of pumping at 25 gpm per well (the duration and magnitude of pumping proposed for this action). 1 year, 5 years, 10 years, and 20 years of production were also calculated in order to consider potential cumulative future development. These cumulative calculations were conducted using the appropriate number of wells from Table 1. The extent of the 20 foot drawdown was also calculated for horizontal hydrologic conductivity values of  $9.8 \times 10^{-2}$ , 1.1, and 13 feet per day. The results of this analysis for the No Federal Action alternative, and the Proposed Action alternative are shown in Tables 2 and 3 below. No Action by any agency would not result in any drawdown. Charts of the calculated drawdown cones which result when K is assumed to be 1.1 ft/day (the geometric mean from Wheaton and Metesh, 2002) are also included. The drawdown map shown below and in the Figures section of this report uses the maximum radius of drawdown calculated under each scenario. The wells and springs which are located within the potential drawdown areas are listed on Table 4.

Once the wells and springs located within the potential areas of drawdown were known, it needed to be determined if the produced coals were the sources of water for these features. Only those wells which are finished within the coal seams being developed, or springs which emit from these coal seams, would be anticipated to be severely affected by CBNG related drawdown due to the low vertical hydrologic conductivity in these units (see Wheaton and Metesh, 2002).

Based upon recent geologic mapping of this area (Vuke et al., 2001) the nearest outcrop of the Wall coal, which is stratigraphically the highest seam being developed, is approximately 11 miles to the northeast, near Wall Creek. For this reason it is not believed that any of the springs which are located within the potential groundwater drawdown areas, under either the direct or cumulative scenarios, emit from the produced coal seams. Thus none of these springs would be anticipated to be affected by the groundwater drawdown resulting from this project.

#### **Direct Impacts to Wells and Springs:**

##### No Action:

Under the No Action Alternative there would be no impacts to groundwater levels, and so no wells or springs would be affected.

##### No Federal Action:

Under the No Federal Action Alternative it is calculated that after 6 weeks of pumping from 5 wells per coal seam the 20 foot drawdown contour may extend up to approximately 0.36 miles from the development area.

According to MBMG's GWIC database (<http://mbmggwic.mtech.edu/>), 1 well, and no springs exist within this potential drawdown area. As shown on Table 4 this is the Bill Musgrave well in T8S, R41E, Section 7. Based upon the reported well depth (146 feet),

and the elevation of this site based upon topographic maps (3,700 ft-amsl), this well is finished at an elevation of approximately 3,554 ft-amsl. The top of the Wall coal in this area is at approximately 3,200 ft-amsl. As such it is not anticipated that this well will be affected by this project.

Proposed Action:

Under the Proposed Action Alternative it is calculated that after 6 weeks of pumping from 9 wells per coal seam the 20 foot drawdown contour may extend up to approximately 0.48 miles from the development area.

According to MBMG's GWIC database (<http://mbmoggwic.mtech.edu/>), only the Musgrave well is located within this drawdown area. As discussed above it is not anticipated that this well will be affected by this project.

**Cumulative Impacts to Wells and Springs:**

Under the cumulative analysis it is assumed that if these wells prove to be productive the leases will be fully developed. This would require a total of 13 wells to be installed under the No Federal Action alternative, and 23 total wells to be installed under the Proposed Action.

No Action:

Under the No Action Alternative there would be no impacts to groundwater levels, and so no wells or springs would be affected.

No Federal Action:

Under the No Federal Action Alternative it is calculated that after 20 years of pumping from 13 wells per coal seam the 20 foot drawdown contour may extend up to approximately 3.6 miles from the development area.

According to MBMG's GWIC database (<http://mbmoggwic.mtech.edu/>), 32 wells, and 13 springs, in addition to those from the Direct Proposed Action alternative, exist within this potential drawdown area. These wells and spring are listed on Table 4. As discussed above these springs would not be anticipated to be affected by drawdown since they do not emit from the coal seams being drawndown. These wells would only be impacted if they are finished in the same coal seams being developed for CBNG. Based upon the reported well depths (10 to 620 feet), and the elevations of these sites based upon topographic maps, these wells are finished at elevations between approximately 2,950 and 3,792 ft-amsl. The top of the Wall coal in this area is at approximately 3,200 ft-amsl, and it is approximately 55' thick. The top of the Flowers-Goodale coal is at approximately 2,300 ft-amsl and it is approximately 20' thick. Assuming a potential 25 foot error in these calculations for the elevation at which the well is finished, and the elevation of the coal bed, two well fall into the elevation range where they have the potential to be finished in the coal seams being developed. These are the Kinnison and Legge wells. According to the well logs in the GWIC database the Legge well is finished in a sand. Lithology information is not available from the GWIC database for the

Kinnison well. As such the Kinnison well may be finished in the Wall coal seam, and may be affected by this project.

Proposed Action:

Under the Proposed Action Alternative it is calculated that after 20 years of pumping from 23 wells per coal seam the 20 foot drawdown contour may extend up to approximately 4.7 miles from the development area.

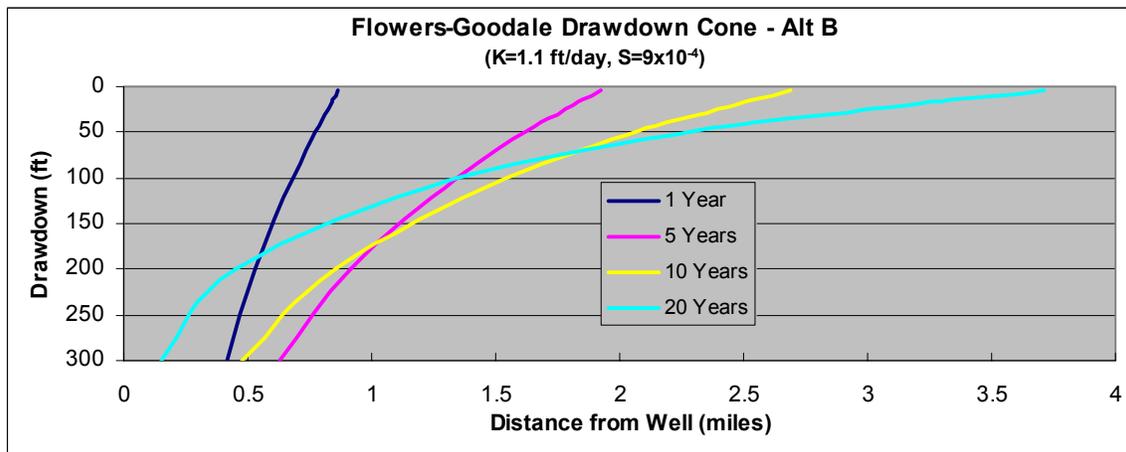
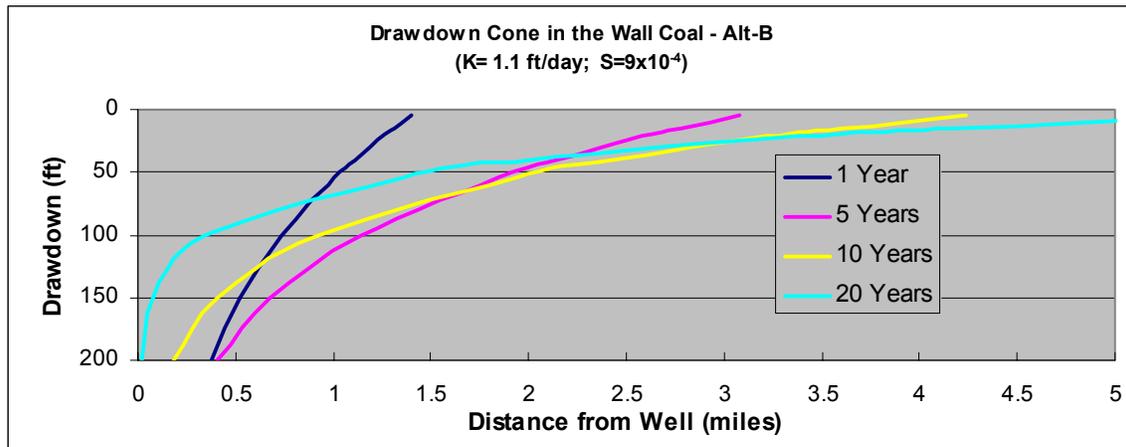
According to MBMG's GWIC database (<http://mbmaggwic.mtech.edu/>), 26 more wells, and 6 more springs, in addition to those from the Cumulative No Federal Action alternative, exist within this potential drawdown area. These wells and spring are listed on Table 4. As discussed above these springs would not be anticipated to be affected by drawdown since they do not emit from the coal seams being drawdown. These wells would only be impacted if they are finished in the same coal seams being developed for CBNG. Based upon the reported well depths (21 to 553 feet), and the elevations of these sites based upon topographic maps, these wells are finished at elevations between approximately 2,897 and 3,904 ft-amsl. The top of the Wall coal in this area is at approximately 3,200 ft-amsl, and it is approximately 55' thick. The top of the Flowers-Goodale coal is at approximately 2,300 ft-amsl and it is approximately 20' thick. Assuming a potential 25 foot error in these calculations for the elevation at which the well is finished, and the elevation of the coal bed, three wells fall into the elevation range where they would have the potential to be finished in the coal seams being developed; the Petre Preston domestic well (3,212 ft-amsl), the Preston Pete \* 10 MI SW Birney Montana domestic well (3216 ft-amsl), and the Decker Coal Co. monitoring well (3,249 ft-amsl). Based upon the well logs in the GWIC database both of these domestic wells are finished in the alluvial aquifer adjacent to the Tongue River. The Decker monitoring well is completed in a coal seam. Thus the domestic wells would not be anticipated to experience drawdown since they are not finished in the aquifer being drawdown. The monitoring well has the potential to be drawdown under the cumulative Proposed Action Alternative.

**Summary:**

One domestic well has the potential to be cumulatively drawdown by this project. This is the Tom Kinnison well. This well would be within the cumulative drawdown area under both action alternatives. No springs are anticipated to be affected by drawdown as a result of this project.

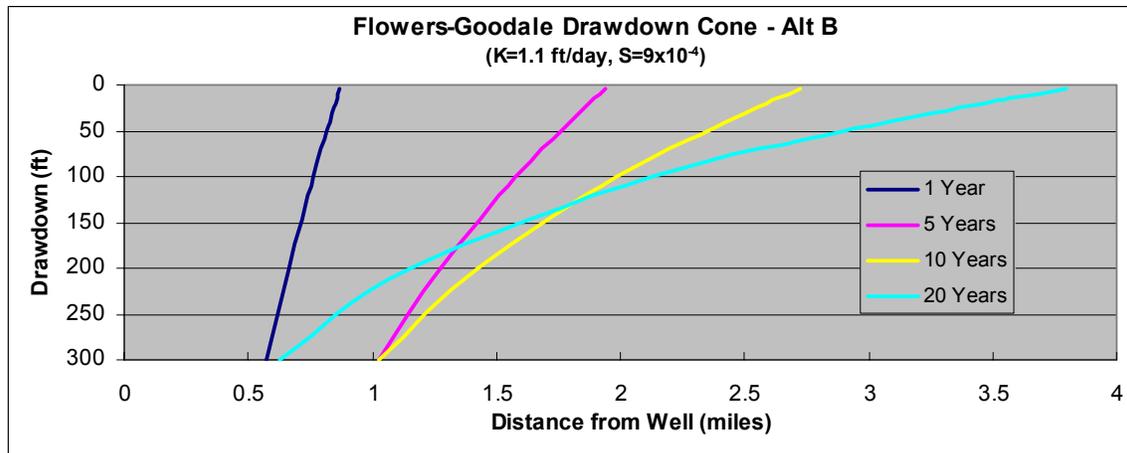
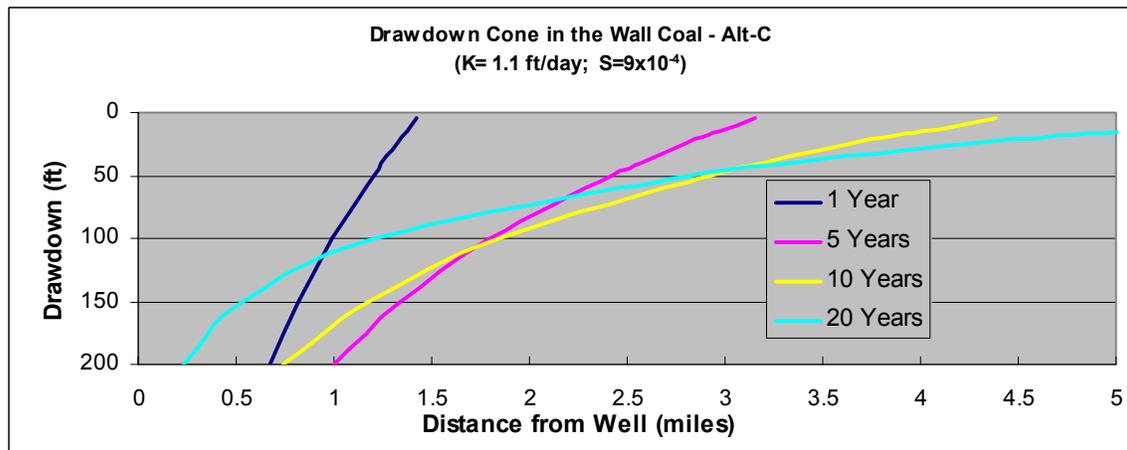
**Table 2: Summary of Predicted 20 Foot Drawdown from the PRG - Coal Creek CBNG Project - Alternative B - No Federal Action**

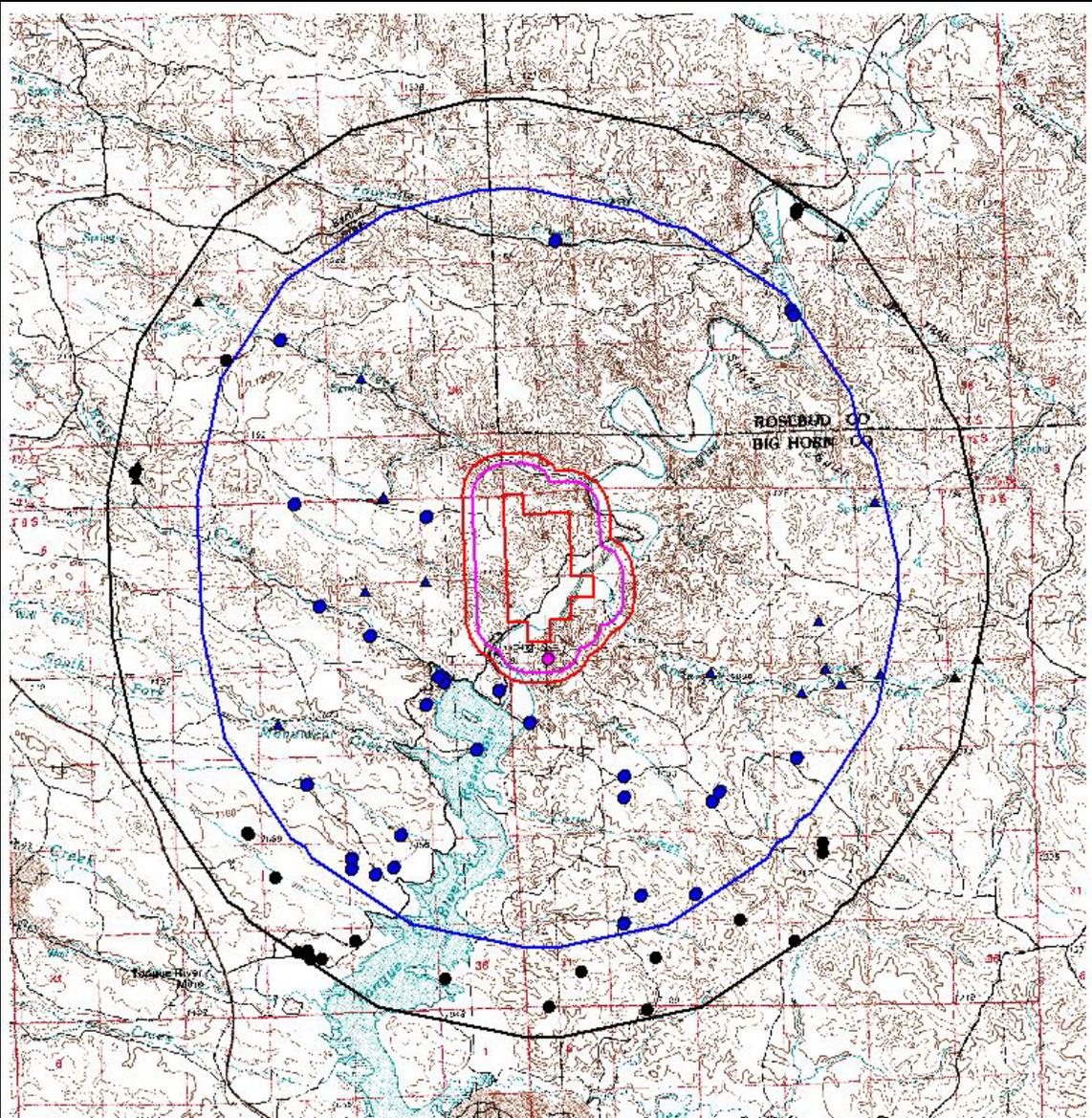
Time Pumped	Average Pumping Rate per Well (gpm)	Number of Wells per Seam	Average Pumping Rate per Coal Seam (gpm)	Coal Seam	Hydrologic Conductivity (K)		
					9.8x10 <sup>-2</sup> ft/day	1.1 ft/day	13 ft/day
6 weeks	25	5	125	Wall	0.14	0.36	0.04
				Flowers-Goodale	0.09	0.26	0.26
1 Year	22.4	13	291	Wall	0.43	1.27	1.00
				Flowers-Goodale	0.26	0.83	1.68
5 Years	14.6		190	Wall	0.95	2.63	0.95
				Flowers-Goodale	0.58	1.81	2.74
10 Years	9.5		123	Wall	1.33	3.33	0.35
				Flowers-Goodale	0.82	2.46	2.38
20 Years	5.1		67	Wall	1.84	3.59	0.02
				Flowers-Goodale	1.15	3.16	1.05



**Table 3: Summary of Predicted 20 Foot Drawdown from the Coal Creek CBNG Project - Alternative C - Proposed Action**

Time Pumped	Average Pumping Rate per Well (gpm)	Number of Wells per seam	Average Pumping Rate per Coal Seam (gpm)	Coal Seam	Hydrologic Conductivity (K)		
					9.8x10 <sup>-2</sup> ft/day	1.1 ft/day	13 ft/day
6 weeks	25	9	225	Wall	0.14	0.41	0.21
				Flowers-Goodale	0.09	0.28	0.48
1 Year	22.4	23	516	Wall	0.43	1.34	2.01
				Flowers-Goodale	0.26	0.85	2.16
5 Years	14.6		336	Wall	0.96	2.88	2.77
				Flowers-Goodale	0.57	1.88	4.05
10 Years	9.5		218	Wall	1.35	3.83	1.83
				Flowers-Goodale	0.80	2.59	4.35
20 Years	5.1		118	Wall	1.88	4.64	0.43
				Flowers-Goodale	1.11	3.47	3.19





GWIC Data			Proposed Direct Buffer
	SPRING		No Fed Cumulative Buffer
	WELL		Proposed Cumulative Buffer
	No Fed Direct Buffer		



**Potential Drawdown Areas  
PRG-Coal Creek POD**

**Table 4: Wells and Springs Potentially Affected by Drawdown Under Each Alternative  
Powder River Gas - Coal Creek Project**

Site Name	Township	Range	Section	Type	Total Depth	~Ground Surface Elevation	Finish Elevation
<b>Wells and Springs Potentially Affected by the Direct No Federal Action Alternative</b>							
MUSGRAVE BILL	08S	41E	7	WELL	146	3700	3554
<b>Additional Wells and Springs Potentially Affected by the Direct Proposed Action Alternative</b>							
None							
<b>Additional Wells and Springs Potentially Affected by the Cumulative No Federal Action Alternative</b>							
MONTAYLOR	08S	40E	15	SPRING	NA	---	---
LEE * 2.2 MI NW GAGING ST. TONGUE R. RES.	08S	40E	2	SPRING	NA	---	---
LOWER DUGOUT	08S	41E	16	SPRING	NA	---	---
RUZRIKE JOE * 4.2 M NW TONGUE RIVER DAM	07S	40E	35	SPRING	NA	---	---
THREE MILE SPRINGS	08S	40E	2	SPRING	NA	---	---
ASPEN SPRINGS	08S	40E	12	SPRING	NA	---	---
INDIAN SPRING	08S	40E	11	SPRING	NA	---	---
SPRING GULCH SPRING	08S	41E	2	SPRING	NA	---	---
HORSESHOE SPRING	08S	41E	10	SPRING	NA	---	---
HILLSIDE SPRING	08S	41E	15	SPRING	NA	---	---
MIDDLE DUGOUT	08S	41E	15	SPRING	NA	---	---
UPPER DUGOUT	08S	41E	16	SPRING	NA	---	---
UPPER ANDERSON CREEK SPRING	08S	41E	14	SPRING	NA	---	---
PETER KIEWIT SONS CO * GN2104-80	08S	40E	26	WELL	620	3570	2950
LEGGE KELLY & ROBIN	08S	40E	14	WELL	300	3500	3200
KINNISON TOM	08S	40E	13	WELL	200	3424	3224
TRUSSLER BILL	08S	40E	13	WELL	200	3450	3250
USGS OBS WELL	08S	40E	26	WELL	172	3460	3288
MONTAYLOR *SEWER SITE	08S	40E	23	WELL	176	3465	3289
CADY RICK	08S	40E	13	WELL	100	3424	3324
PETERSON RACINE * 13.75 M S BIRNEY MT	07S	41E	27	WELL	20	3370	3350
PETERSON RACINE * 5.8 M NE TONGUE R.DAM	07S	41E	27	WELL	20	3370	3350
DECKER COMMUNITY CENTER	08S	40E	27	WELL	200	3560	3360
BOUSQUET MAURICE E & LILLIAN	08S	40E	13	WELL	50	3424	3374
TONGUE RIVER - PEE WEE POINT	08S	40E	26	WELL	127	3520	3393
PETER KIEWIT SONS'CO * EP2090-80	08S	41E	22	WELL	300	3700	3400
STATE WATER CONSERVATION BOARD	08S	41E	18	WELL	42	3450	3408
PETER KIEWIT SONS' CO * EP 2096-80	08S	41E	29	WELL	340	3750	3410
PENSON CHARLES AND GREGG	08S	41E	32	WELL	199	3635	3436
MONTAYLOR *TOWNSITE	08S	40E	22	WELL	162	3600	3438

PETER KIEWIT SONS' CO * EP2091-80	08S	41E	22	WELL	250	3700	3450
PETER KIEWIT SONS' CO * EP-3097-80	08S	41E	29	WELL	299	3750	3451
PETER KIEWIT SONS' CO * EP 2075-80	08S	41E	20	WELL	176	3650	3474
LEE R. * 13.5 M NW DECKER MT	08S	40E	11	WELL	14	3490	3476
PETER KIEWIT SONS' COMPANY	08S	41E	20	WELL	160	3650	3490
DECKER COAL CO	08S	41E	29	WELL	225	3740	3515
PENSON CHAS. & GREG	08S	41E	21	WELL	125	3725	3600
CARLAT ROBERT * 12 M NE DECKER MT *	08S	41E	21	WELL	99	3733	3634
MBMG RESEARCH WELL WRE-22	09S	41E	5	WELL	56	3710	3654
RUZRIKE JOE * 5 M NW TONGUE RIVER DAM	07S	40E	27	WELL	10	3745	3735
PETER KIEWIT SONS CO.	08S	40E	3	WELL	33	3825	3792
FOREST DUNNING	08S	40E	1	WELL	NR	---	---
HOSFORD R.S. * 16.3 M W BIRNEY MONTANA	07S	41E	19	WELL	NR	---	---
LEAF ROCK SPRINGS	08S	40E		WELL	NR	---	---
<b>Additional Wells and Springs Potentially Affected by the Cumulative Proposed Action Alternative</b>							
MONTAYLOR *CROSSROADS	07S	40E	28	SPRING	NA	---	---
MONTAYLOR *LEAF ROCK HOUSE ORCHARD PASTURE	07S	40E	32	SPRING	NA	---	---
MONTAYLOR *LEAF ROCK HOUSE	07S	40E	32	SPRING	NA	---	---
MOUTH OF HARRIS CREEK	07S	41E	23	SPRING	NA	---	---
WEBSTER RANCH	08S	41E	13	SPRING	NA	---	---
FLOREY SPRING	08S	41E	13	SPRING	NA	---	---
KUKUCHKA * 1.25 MI NE TONGUE RIVER MINE.	08S	40E	34	WELL	553	3450	2897
PETRE PRESTON	07S	41E	22	WELL	43	3255	3212
PRESTON PETE * 10 MI SW BIRNEY MONTANA	07S	41E	22	WELL	44	3260	3216
DECKER COAL CO	09S	41E	5	WELL	366	3615	3249
DECKER COAL CO #3203-97	08S	40E	28	WELL	201	3500	3299
KUCHKUKA	08S	40E	34	WELL	98	3435	3337
PETER KIEWIT SON'S CO.	09S	41E	5	WELL	271	3615	3344
PETER KIEWIT AND SONS CO.	09S	41E	5	WELL	269	3615	3346
DECKER COAL CO * 79710	08S	40E	28	WELL	201	3550	3349
DECKER COAL COMPANY * 3180-92	08S	40E	34	WELL	65	3455	3390
DEPT OF FISH-WILDLIFE AND PARKS	08S	40E	35	WELL	46	3445	3399
KUKUCHKA	08S	40E	34	WELL	40	3440	3400
PETER KIEWIT SONS' INC * EH 2128-81	08S	41E	34	WELL	301	3705	3404
DECKER COAL CO #3204-97	08S	40E	28	WELL	82	3500	3418
MBMG RESEARCH WELL WRN-02	08S	40E	33	WELL	90	3510	3420
KUKUCHKA WILLIAM	08S	40E	34	WELL	98	3540	3442
PETER KIEWIT SONS CO * EH -2175-81	08S	41E	31	WELL	253	3695	3442
DECKER COAL CO * 79711	08S	40E	28	WELL	82	3550	3468
PETER KIEWIT SONS' CO * EH 2171-81	08S	41E	32	WELL	331	3805	3474
PETER KIEWIT SONS' CO * EH 2172-81	08S	41E	32	WELL	289	3805	3516

PETER KIEWIT SONS INC * EH-2126-81	08S	41E	31	WELL	176	3710	3534
PETER KIEWIT SONS' CO * EP 2086-80	08S	41E	27	WELL	312	3875	3563
MONTAYLOR *LEAF ROCK HOUSE	07S	40E	32	WELL	119	3770	3651
PETER KIEWIT SONS' CO * EP 2098-80	08S	41E	33	WELL	242	3930	3688
PETER KIEWIT SONS'CO * EP 2084-80	08S	41E	27	WELL	205	3930	3725
RUZICKA JOSEPH	07S	40E	28	WELL	21	3925	3904

Yellow Highlighted indicates potentially finished in a produced Coal based on Elevation (first cut)

Blue Highlighted indicates well potentially finished in a coal, and not disproved by well log.

NA = Not Applicable

NR = Not Reported

Montana Bureau of Mines and Geology Ground-Water Information Center Site Report LEGGE KELLY & ROBIN	 <a href="#">this site on a topographic map</a>
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**Location Information**

GWIC Id:	185486	Source of Data:	LOG
Location (TRS):	08S 40E 14 AD	Latitude (dd):	45.1336
County (MT):	BIG HORN	Longitude (dd):	-106.7870
DNRC Water Right:		Geomethod:	TRS-TWN
PWS Id:		Datum:	NAD27
Block:		Altitude (feet):	
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

**Well Construction and Performance Data**

Total Depth (ft):	300.00	How Drilled:	ROTARY
Static Water Level (ft):	100.00	Driller's Name:	POWDER RIVER
Pumping Water Level (ft):	250.00	Driller License:	
Yield (gpm):	7.00	Completion Date (m/d/y):	8/30/2000
Test Type:	PUMP	Special Conditions:	
Test Duration:		Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):	1.00	Geology/Aquifer:	Not Reported
Recovery Time (hrs):	0.50	Well/Water Use:	DOMESTIC
Well Notes:			

<b>Hole Diameter Information</b> <table border="1"> <thead> <tr> <th>From</th> <th>To</th> <th>Diameter</th> </tr> </thead> <tbody> <tr> <td>0.0</td> <td>60.0</td> <td>15.0</td> </tr> <tr> <td>60.0</td> <td>100.0</td> <td>9.0</td> </tr> <tr> <td>100.0</td> <td>300.0</td> <td>7.0</td> </tr> </tbody> </table>			From	To	Diameter	0.0	60.0	15.0	60.0	100.0	9.0	100.0	300.0	7.0	<b>Casing Information<sup>1</sup></b> <table border="1"> <thead> <tr> <th>From</th> <th>To</th> <th>Dia</th> <th>Wall Thickness</th> <th>Pressure Rating</th> <th>Joint Type</th> </tr> </thead> <tbody> <tr> <td>3.0</td> <td>300.0</td> <td>4.0</td> <td></td> <td>220.00</td> <td>PVC</td> </tr> </tbody> </table>					From	To	Dia	Wall Thickness	Pressure Rating	Joint Type	3.0	300.0	4.0		220.00	PVC
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<b>Annular Seal Information</b> <table border="1"> <thead> <tr> <th>From</th> <th>To</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0.0</td> <td>40.0</td> <td>BENTONITE</td> </tr> <tr> <td>282.0</td> <td>282.0</td> <td>NEOPRENE</td> </tr> </tbody> </table>			From	To	Description	0.0	40.0	BENTONITE	282.0	282.0	NEOPRENE	<b>Completion Information<sup>1</sup></b> <table border="1"> <thead> <tr> <th>From</th> <th>To</th> <th>Dia</th> <th># of Openings</th> <th>Size of Openings</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>283.0</td> <td>300.0</td> <td>6.0</td> <td></td> <td></td> <td>1/4X1/4 DRILL</td> </tr> </tbody> </table>					From	To	Dia	# of Openings	Size of Openings	Description	283.0	300.0	6.0			1/4X1/4 DRILL			
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283.0	300.0	6.0			1/4X1/4 DRILL																										

**Lithology Information**

From	To	Description
0.0	65.0	MIXED ROCK & SCORIO
65.0	160.0	GRAY SHALE
160.0	175.0	COAL
175.0	282.0	GRAY SHALE
282.0	300.0	BROWN SANDSTONE (AQUIFER)

<sup>1</sup> - All diameters reported are **inside** diameter of the casing.

These data represent the contents of the GWIC databases at the Montana Bureau of Mines and Geology at the time and date of the retrieval. The information is considered unpublished and is subject to correction and review on a daily basis. The Bureau warrants the accurate transmission of the data to the original end user. Retransmission of the data to other users is discouraged and the Bureau claims no responsibility if the material is retransmitted. Note: non-reported casing, completion, and lithologic records may exist in paper files at GWIC.

Montana Bureau of Mines and Geology Ground-Water Information Center Site Report KINNISSON TOM	 <a href="#">View this site on a topographic map</a>
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**Location Information**

GWIC Id:	180307	Source of Data:	LOG
Location (TRS):	08S 40E 13 CD	Latitude (dd):	45.1261
County (MT):	BIG HORN	Longitude (dd):	-106.7773
DNRC Water Right:	C11054-00	Geomethod:	TRS-TWN
PWS Id:		Datum:	NAD27
Block:		Altitude (feet):	
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

**Well Construction and Performance Data**

Total Depth (ft):	200.00	How Drilled:	ROTARY
Static Water Level (ft):	94.00	Driller's Name:	HIGGINS
Pumping Water Level (ft):		Driller License:	WWC012
Yield (gpm):	20.00	Completion Date (m/d/y):	9/7/1999
Test Type:	AIR	Special Conditions:	
Test Duration:	1.00	Is Well Flowing?:	
Drill Stem Setting (ft):	160.00	Shut-In Pressure:	
Recovery Water Level (ft):	100.00	Geology/Aquifer:	Not Reported
Recovery Time (hrs):	0.17	Well/Water Use:	DOMESTIC
Well Notes:			

<b>Hole Diameter Information</b>			<b>Casing Information<sup>1</sup></b>					
<b>From</b>	<b>To</b>	<b>Diameter</b>	<b>From</b>	<b>To</b>	<b>Wall Thickness</b>	<b>Pressure Rating</b>	<b>Joint</b>	<b>Type</b>
0.0	55.0	8.0	-2.0	55.0	6.0			STEEL
55.0	200.0	6.0	8.0	200.0	4.0			PVC
<b>Annular Seal Information</b>			<b>Completion Information<sup>1</sup></b>					
<b>From</b>	<b>To</b>	<b>Description</b>	<b>From</b>	<b>To</b>	<b>Dia</b>	<b># of Openings</b>	<b>Size of Openings</b>	<b>Description</b>
0.0	155.0	BENTONITE	160.0	200.0	4.0			.030X4 HAND SLOTTED

**Lithology Information**

No Lithology Records currently in GWIC.

<sup>1</sup> - All diameters reported are **inside** diameter of the casing.

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Montana Bureau of Mines and Geology Ground-Water Information Center Site Report PETRE PRESTON	 <a href="#">this site on a topographic map</a>
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**Location Information**

GWIC Id:	104990	Source of Data:	
Location (TRS):	07S 41E 22 ACDC	Latitude (dd):	45.2154
County (MT):	ROSEBUD	Longitude (dd):	-106.6939
DNRC Water Right:		Geomethod:	TRS-TWN
PWS Id:		Datum:	NAD27
Block:		Altitude (feet):	3260.00
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

**Well Construction and Performance Data**

Total Depth (ft):	43.00	How Drilled:	CABLE TOOL
Static Water Level (ft):	18.00	Driller's Name:	RITOLA
Pumping Water Level (ft):	35.00	Driller License:	WWC133
Yield (gpm):	5.00	Completion Date (m/d/y):	4/24/1967
Test Type:	BAILER	Special Conditions:	
Test Duration:	2.00	Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	110ALVM
Recovery Time (hrs):		Well/Water Use:	DOMESTIC
Well Notes:			

**Hole Diameter Information**

From	To	Diameter
0.0	43.0	6.0

**Annular Seal Information**

No Seal Records currently in GWIC.

**Casing Information<sup>1</sup>**

From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type
0.0	43.0	6.0				18 LB. CASING

**Completion Information<sup>1</sup>**

From	To	Dia	# of Openings	Size of Openings	Description
28.0	43.0	6.0		1/4X6	SLOTS

**Lithology Information**

From	To	Description
0.0	20.0	GRAVEL WATER BEARING
20.0	23.0	BLUE SHALE

<sup>1</sup> - All diameters reported are **inside** diameter of the casing.

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<b>Montana Bureau of Mines and Geology</b> <b>Ground-Water Information Center Site Report</b> <b>PRESTON PETE * 10 MI SW BIRNEY MONTANA</b>	 <a href="#">this site on a topographic map</a> <a href="#">View Water Quality for this Site</a>
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**Location Information**

GWIC Id:	7999	Source of Data:	
Location (TRS):	07S 41E 22 ACDC	Latitude (dd):	45.2147
County (MT):	ROSEBUD	Longitude (dd):	-106.6941
DNRC Water Right:		Geomethod:	MAP
PWS Id:		Datum:	NAD27
Block:		Altitude (feet):	3260.00
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

**Well Construction and Performance Data**

Total Depth (ft):	44.00	How Drilled:	
Static Water Level (ft):	18.00	Driller's Name:	
Pumping Water Level (ft):		Driller License:	
Yield (gpm):	5.00	Completion Date (m/d/y):	
Test Type:		Special Conditions:	
Test Duration:		Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	110ALVM
Recovery Time (hrs):		Well/Water Use:	DOMESTIC
Well Notes:			

<p><b>Hole Diameter Information</b></p> <p>No Hole Diameter Records currently in GWIC.</p>	<p><b>Casing Information<sup>1</sup></b></p> <table border="1"> <thead> <tr> <th>From</th> <th>To</th> <th>Dia</th> <th>Wall Thickness</th> <th>Pressure Rating</th> <th>Joint</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>0.0</td> <td>0.0</td> <td>6.0</td> <td></td> <td></td> <td></td> <td>STEEL</td> </tr> </tbody> </table>	From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type	0.0	0.0	6.0				STEEL
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<p><b>Annular Seal Information</b></p> <p>No Seal Records currently in GWIC.</p>	<p><b>Completion Information<sup>1</sup></b></p> <table border="1"> <thead> <tr> <th>From</th> <th>To</th> <th>Dia</th> <th># of Openings</th> <th>Size of Openings</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>28.0</td> <td>43.0</td> <td>0.0</td> <td></td> <td></td> <td>PERFORATED CASING</td> </tr> </tbody> </table>	From	To	Dia	# of Openings	Size of Openings	Description	28.0	43.0	0.0			PERFORATED CASING		
From	To	Dia	# of Openings	Size of Openings	Description										
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**Lithology Information**

No Lithology Records currently in GWIC.

<sup>1</sup> - All diameters reported are **inside** diameter of the casing.

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<b>Montana Bureau of Mines and Geology</b> <b>Ground-Water Information Center Site Report</b> <b>DECKER COAL CO</b>	 <a href="#">this site on a topographic map</a>
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**Location Information**

GWIC Id:	167453	Source of Data:	LOG
Location (TRS):	09S 41E 05 BAA	Latitude (dd):	45.0804
County (MT):	BIG HORN	Longitude (dd):	-106.7367
DNRC Water Right:		Geomethod:	TRS-TWN
PWS Id:		Datum:	NAD27
Block:		Altitude (feet):	
Lot:		Certificate of Survey:	
Addition:		Type of Site:	WELL

**Well Construction and Performance Data**

Total Depth (ft):	366.00	How Drilled:	ROTARY
Static Water Level (ft):		Driller's Name:	DECKER COAL CO.
Pumping Water Level (ft):		Driller License:	WWC190
Yield (gpm):	10.00	Completion Date (m/d/y):	10/2/1997
Test Type:		Special Conditions:	
Test Duration:		Is Well Flowing?:	
Drill Stem Setting (ft):		Shut-In Pressure:	
Recovery Water Level (ft):		Geology/Aquifer:	Not Reported
Recovery Time (hrs):		Well/Water Use:	MONITORING
Well Notes:	WASHED & JETTED TO DEVELOP PERFS AND SAND PACK BLOWS 10 GPM		

<b>Hole Diameter Information</b>  <table border="1"> <thead> <tr> <th>From</th> <th>To</th> <th>Diameter</th> </tr> </thead> <tbody> <tr> <td>0.0</td> <td>366.0</td> <td>9.0</td> </tr> </tbody> </table>			From	To	Diameter	0.0	366.0	9.0	<b>Casing Information<sup>1</sup></b>  <table border="1"> <thead> <tr> <th>From</th> <th>To</th> <th>Dia</th> <th>Wall Thickness</th> <th>Pressure Rating</th> <th>Joint</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>0.0</td> <td>366.0</td> <td>5.0</td> <td></td> <td></td> <td></td> <td>PLASTIC</td> </tr> </tbody> </table>						From	To	Dia	Wall Thickness	Pressure Rating	Joint	Type	0.0	366.0	5.0				PLASTIC	
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**Lithology Information**

<b>From</b>	<b>To</b>	<b>Description</b>
0.0	3.0	RESIDUAL SOIL
3.0	22.0	SANDSTONE FINE MED HARD
22.0	35.0	SHALE GRAY HARD
35.0	46.0	SANDSTONE FINE SOFT
46.0	48.0	SILTSTONE VERY HARD
48.0	110.0	SHALE MED HARD
110.0	135.0	SHALE SILTY HARD
135.0	156.0	COAL DRY
156.0	158.0	SHALE GRAY MED HARD
158.0	168.0	SANDSTONE VERY FINE HARD
168.0	169.0	SHALE GRAY
169.0	191.0	COAL WET
191.0	198.0	SHALE GRAY SILTY
198.0	224.0	SANDSTONE FINE SOFT
224.0	237.0	SHALE GRAY SOFT
237.0	256.0	COAL WET
256.0	312.0	SHALE GRAY MED HARD
312.0	315.0	SANDSTONE GRAY VERY HARD
315.0	345.0	SHALE GRAY MED HARD
345.0	365.0	COAL WET
365.0	366.0	SHALE GRAY HARD

<sup>1</sup> - All diameters reported are **inside** diameter of the casing.

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