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**OTTER CREEK MINE**  
**BASELINE REPORT 304C**  
**GEOLOGIC, SCENIC AND TOPOGRAPHIC FEATURES**

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**1.0 INTRODUCTION**

This report describes and documents the geologic, scenic, and topographic features of the prospective Otter Creek Mine area. The mining area is in Otter Creek Tract 2, which lies east of Otter Creek in T.4S, R.45E, and encompasses portions of Sections 10, 11, 12, 13, 14, 15, 22, 23, 24, 25 and 26. The objectives of this report are:

- Describe the geologic, topographic and scenic characteristics of the mine plan area;
- Document and provide a photographic record of land forms and features;
- Document the location and extent of slopes steeper than 2h:1v as a basis for possible use of bluff extensions in final pit closure;
- Document pre-mining erosion features; and
- Address ARM 17.24.304(1)(c), which requires “a comprehensive listing, location and description of significant or unique scenic and/or geological formations or sites”.

**2.0 METHODS**

As part of the mine planning process, Otter Creek Coal, LLC (OCC) commissioned an aerial orthographic photo and topographic map of the project area, which was completed in October, 2010. Plate 1 is an aerial photograph showing the permit area and Tract 2 mine plan area. Plate 2 is a topographic map of the same area with a five-foot contour interval on which steep slope areas are highlighted. Steep slopes are defined as 2h:1v (50%; 27 degrees) and greater; this slope range is separated into ranges of 2:1 to 1.5:1, 1.5:1 to 1:1, and steeper than 1:1. Slopes equal to or greater than 3h:1v and less than 2h:1v are also shown. This map was used as a guide in photographing land forms on the ground; photo locations are shown.

Field work was completed on July 27, 2011, and May 15-17, 2012. Photographs organized by section are included as Appendix A.

Acreages of steep slopes are presented as a measure of pre-mining slopes to serve as a baseline for possible utilization of bluff extensions and highwall remnants in final reclamation. Linear extent of deeply eroded drainageways scaled from the map provides an indication of erosional status prior to mining.

### **3.0 GENERAL DESCRIPTION**

Based on topography and landscape position, the permit area can be divided into five zones in ascending order of elevation.

- •Otter Creek Valley Bottom (includes major tributaries)
- •Knobloch Burn, or clinker zone
- •Lower Slope Bench
- •Upper Slope Foothills/Badlands
- •Upland Plateau

These zones are described in detail below.

#### **3.1 OTTER CREEK VALLEY BOTTOM**

Otter Creek is a meandering perennial prairie stream with a well-developed alluvial flood plain ranging from approximately 2000 to 3000 feet in width. Tributary drainages Home Creek, Threemile Creek and Tenmile Creek also have moderately developed flood plains in some reaches up to 1000 feet in width. The majority of the Otter Creek valley bottom is farmed, with grass hay the predominant crop. Portions of the tributary valley bottoms are also used for hay production, with significant areas remaining as undeveloped range land. Drainage channels are dominated by box elder trees, with cottonwood and green ash conspicuously absent, probably due to saline water and soil conditions.

Mining will not extend into valley bottoms, although small portions of the Otter Creek valley bottom will be traversed by linear facilities, access roads and conveyors. Because mining will not extend into the valley bottom, it is not examined in detail.

### **3.2 KNOBLOCH BURN/CLINKER**

In significant areas along the valley margins, particularly in Section 10, the Knobloch coal burned in place baking and altering the overlying rock. In some areas, the heat was sufficiently intense to fuse the overlying rock, resulting in resistant “clinker” outcrops. These formations dominate portions of Section 10.

The dominant vegetation is grassland and grassland-shrub, primarily sagebrush, with ponderosa pine in some areas along upper north-facing slopes along the south flank of Threemile Creek. Deciduous shrubs, primarily skunkbush sumac, occur on the margins of clinker outcrops, and to a limited extent, along drainage channels.

Because the Knobloch coal is burned out, mining will not extend into burn areas. However, the area will be used for storage of spoil and topsoil, and for roads and associated facilities. Although some clinker outcrops will be affected, the most prominent area of such outcrops in the northern portion of Section 10 will be minimally affected.

### **3.3 LOWER SLOPE BENCH**

The lower slope bench is the area of predominantly gentle rolling topography bounded by the Otter Creek valley bottom and the Knobloch burn on the west and the foothills/badlands zone to the east. It is the primary area of planned mining where overburden to coal ratios are most favorable. The most conspicuous topographic features are ephemeral drainageways that in many cases are deeply eroded and isolated, gumbo knobs, conical buttes, sandstone outcrops and finger ridges that are remnants of the upland plateau and badlands that have eroded away over geologic time.

The most significant wildlife habitat features are several stock ponds that have been constructed to provide livestock water. Pond 1 in Section 11 is the largest and has obviously been in place for some time. The pond margin is dominated by heavy growth of cattail, with

woody vegetation conspicuously absent. Pond 2 in Section 23 is silted in and dry with heavy growth of willow and cottonwood on the margins and in what was the pool area. Ponds in Sections 12 and 13 have significant woody vegetation on their margins, and linear wetlands below the dams no doubt arise from seepage; Pond 1 also displays a seepage effect below the dam.

Vegetation is predominantly grassland and grassland shrub. Ponderosa pine occurs in scattered locations. Deciduous riparian vegetation is generally poorly developed along drainageways, particularly in lower reaches, presumably due to soil characteristics. Upper reaches in many cases have significant growth of juniper.

There are numerous eroded areas that are devoid of surface soil. Such areas are characterized by exposed hard pan and minimal vegetation.

The lower slope bench is an area of minimally diverse topography and vegetation. Such conditions combined with favorable overburden depth are conducive to surface mining and reclamation operations.

### **3.4 FOOTHILLS/BADLANDS**

The foothills/badlands zone is a transition area between the lower slope bench and the upland plateau. It is characterized by deeply eroded headwater drainages and numerous gumbo knobs, steep ridges and conical buttes, which combine to form a very rugged and diverse topography. Outcrops include shale, sandstone and altered bedrock, indicating a burned coal seam or seams. Traverse by vehicle is impossible in most areas.

Vegetation is variable and includes areas of grassland and grassland-shrub types in gentler sloped areas, with ponderosa pine and juniper where soils and exposure are conducive. Many areas are devoid of soil with sparse vegetation.

The foothills/badlands zone dominates the northern portion of the mine plan area in parts of Sections, 11, 13 and 14, along the east boundary of Section 23 and in the southwest quarter of Section 24.

Although overburden to coal ratios are high and pre-stripping will be required to set up a suitable operating elevation for the dragline, foothill/badlands areas are included in the mine plan to square it up and maximize recovery while maintaining an economic average ratio.

### 3.5 UPLAND PLATEAU

The upland plateau zone is characterized by steep slopes and cliffs grading upward to generally flat topography on the hilltops adjacent to the Custer National Forest. Ponderosa pine and juniper comprise the dominant vegetation, with grassland on the flat hilltops.

Overburden depths are extreme, and mining will extend into the upland plateau zone only minimally under the currently proposed mine plan due to uneconomic ratios under current market conditions. The most significant wildlife habitat features are the numerous and extensive cliffs that form the margins of this zone. Cliff features in the upland plateau zone will not be affected by mining.

### 4.0 STEEP SLOPES AND CLIFF FEATURES

Steep slopes are associated with finger ridges, buttes, gumbo knobs and similar land forms, primarily in the upper slope/badlands zone, although there are significant steep slopes associated with isolated features in the lower slope bench zone as well. The slopes summarized include some cliff features, although these dominate in only a few limited areas. Following is a summary of steep slope areas within the projected mining area

<b>SLOPE</b> (Ratio h:v)	<b>LOWER SLOPE</b> (ACRES)	<b>BADLANDS</b> (ACRES)	<b>UPLAND PLATEAU</b> (ACRES)	<b>TOTAL</b> (ACRES)	<b>CUMULATIVE</b> (ACRES)
<1	2.1	1.8	0.04	4	4
1-1.5	14.9	23.1	0.59	39	43
1.5-2	41.0	58.3	1.98	101	144
2-3	214.4	30.3	5.16	250	394
>3	272.3	113.5	7.78	394	

As noted above, cliff features of 1:1 slope or steeper are of limited occurrence in the mining area comprising just 4 acres, while slopes exceeding 2:1 comprise 144 acres.

## 5.0 EROSION FEATURES

The landscape on Otter Creek Tract 2 includes multiple erosion features. The most prominent are deeply eroded drainage bottoms with banks exceeding 2h:1v. Depths vary from five feet to as much as 25 feet (Plate 2). Following is a summary by section within the mine plan area:

<b>Section:</b>	<b>Cumulative Length &gt;2h:1v (ft)</b>
11	8870 ft
12	6000
13	2500
14	15540
22	400
23	3900
24	3050
25	4300
26	7800
<b>Total</b>	<b>52360 feet (9.9 miles)</b>

Deeply eroded drainageways are most prominent in headwaters of the upper slope/badlands zone and the lower portion of the lower slope bench near Otter Creek, and in both cases are often associated with deep head cuts. The intermediate reaches are generally less incised but are quite variable, often with discontinuous cut banks. Numerous photos show eroded coulees in the area; photos 11-7 and 11-8 are perhaps the most striking.

Other indicators of active soil erosion include sparsely vegetated slopes in badland areas (photos 11-22, 24 and 25) and significant areas of exposed hard pan shown in numerous photos; see in particular photos 12-14 and 14-12. Eroded cow paths are frequently encountered, often to a depth of several feet (photos 11-6 and 15-4).



## 6.0 CONCLUSION

ARM 17.24.304(1)(c) requires “a comprehensive listing, location and description of significant or unique scenic and/or geological formations or sites”. According to Webster’s Dictionary, the most relevant definition of “significant” is “important in effect or meaning”. “Unique” means “the single one of its kind”, although it may also mean “highly unusual or rare but not the single instance”.

None of the scenic and/or geological formations or sites on the Otter Creek Tract 2 permit area meets the high standard of significant or unique contemplated by this subsection. The scenic and geologic attributes of the Otter Creek Tract 2 permit area include the following:

- Upland badlands, cliffs and hills are the dominant scenic features. These are at elevations higher than the area to be mined, and extend into the Custer National Forest east of Tract 2 and west of Tract 3. Representative photos include 10-22 looking west and 24-2 and 26-2 looking east.
- Scoria outcrops occur primarily in Section 10; representative photos include 10-1 through 10-6, which were taken as a panorama from the same point.
- Petrified stumps occur in a cluster in Section 11 (photos 11-11 through 11-14). Photo 11-9 shows a petrified stump that has disintegrated into a pile of petrified wood fragments. Petrified stumps appear to be composed of siltstone and are quite friable. Petrified wood fragments are common through the area of the lower slope bench and foothills/badlands transition.
- A dominant sandstone outcrop (photo 26-5) occurs in the northeast quarter of Section 26; additional outcrops occur on the ridge line just to the south outside of the mining area. Similar sandstone formations are common in the region, often as pillars, caprocks and similar forms carved by wind and water erosion.

These scenic and geologic attributes are typical of large areas of eastern Montana where the surficial geologic unit is the coal bearing Tongue River Member of the Fort Union

Formation. No significant or unique scenic and/or geologic formations, or sites within the context of ARM 17.24.304(1)(c) exist in Otter Creek Tract 2.

## **APPENDIX A PHOTOGRAPHS**