EXPERT REPORT IN THE MATTER OF BIG HORN COAL COMPANY V. BROOK MINE

Prepared for Big Horn Coal Company, Sheridan, Wyoming

Prepared by Paul J. Gerlach, PG, President, Aqua Terra Consultants, Inc., Sheridan, Wyoming

March 28, 2017

INTRODUCTION.

My name is Paul (Joe) Gerlach. I am a registered Professional Geologist in the state of Wyoming (PG 83), and the co-founder and President of Aqua Terra Consultants, Inc., a S-Corporation in Sheridan, Wyoming. I am an expert in the field of hydrogeology, also known as groundwater hydrology. I am a former employee of Peter Kiewit Sons Company, former owner of Big Horn Coal Company, and I have frequently provided professional services to Big Horn Coal Company since leaving that employment. During the past 40 years, I have testified as an expert witness in two states and have never been denied qualification as an expert. I have not testified as an expert witness in the last four years. I have not published any documents in the past 10 years. A true and correct copy of my *curriculum vitae* is shown at Attachment 1 to this report. My fee Schedule and Policies is shown at Attachment 2 to this report.

MY INVOLVEMENT IN THIS MATTER.

I was initially retained in this matter on January 6, 2017 by Mr. Jordan Sweeney of Lighthouse Resources Inc., owner of Big Horn Coal Company. I was retained to review and render opinions about the adequacy of the Brook Mine permit application in identifying and assessing potential hydrologic and other impacts associated with Brook Mine's proposed coal mining operation within and in the vicinity of the Big Horn Coal Mine.

Since the date of my retention, I have reviewed certain materials provided (see next section of this report for details), corresponded via telephone and email with Mr. Sweeney and with Mr. Clayton Gregersen and Ms. Lynne Boomgaarden, attorneys with Crowley Fleck, PLLP, and reviewed technical literature related to underground coal mine fires within and adjacent to the Brook Mine permit area.

MATERIALS PROVIDED AND OBTAINED.

I have been provided with or obtained the materials itemized below:

- Copies of digital files from the Wyoming Department of Environmental Quality, Land Quality Division provided to a representative of Big Horn Coal Company on December 12, 2016, which allowed review of specified relevant portions of Brook Mine's most recent and accurate permit application
- Objections to the Brook Mine permit application from various landowners, the Powder River Basin Resource Council and Big Horn Coal Company posted on-line (htpps://eqc.wyo.gov/Public/Dockets.aspx) by the Wyoming Environmental Quality Council on January 30, 2017 under Docket 17-4801.
- Text and drawings from Big Horn Coal Company's mine permit No. 213 relating to the Reclamation Plan and relating to geologic descriptions contained in Appendix D5.

- The report "Effects of Coal Mine Subsidence in the Sheridan, Wyoming, Area", 1980, US Geological Survey Professional Paper 1164
- Wyoming State Engineer's Office on-line website database of water rights records, groundwater well completion data and geologic logs
- Big Horn Coal Company Reclamation History, Vol. 2, Section 6.2, Permit 213-T5 Change #9, Big Horn Mine Groundwater Restoration Demonstration, Approved August 8, 2002

EXHIBITS CREATED IN SUPPORT OF MY OPINIONS

I created the following exhibits that support and are formative to the opinions that I have developed. In all cases, the exhibits are intact original materials or selected sets of components of original materials available in the public domain as taken from the Brook Mine permit application, the Big Horn Coal Mine permit application, published professional reports, and groundwater rights files of the Wyoming State Engineer's Office.

C1-Objection Exhibit A: *Exhibit MP.4-1 Coal Removal Sequence* (original material from Brook Mine application).

C1-Objection Exhibit B: *Figure MP-6.1-1 Showing Brook Mine Proposed Trenches and Highwall Mining Panels* (original material from Brook Mine application).

C1-Objection Exhibit C: This drawing has no formal title and is a collection of materials copied from the Brook Mine application (location of geologic cross section K-K' and locations of Brook Mine panels), and materials copied from the Big Horn Coal Mine application (location of geologic cross section D-D', area of reclaimed Big Horn Coal Mine backfill, and area of shallow water table conditions within Brook Mine TR-1 mining area).

C1-Objection Exhibit D: *Pit One Truck-Shovel Operation Geologic Cross-Section D-D'* (original material from Big Horn Coal Mine application with line added to denote the shallow groundwater table elevation 3600 feet across the section).

C1-Objection Exhibit E: *Addendum D5-3 Exhibit 2 Geologic Cross Section K-K'* (original material from Brook Mine application with line added to denote the shallow groundwater table elevation 3600 feet across the section).

C1-Objection Exhibit F: *Big Horn Coal Company Big Horn Mine Groundwater Restoration Demonstration* (original material from Big Horn Coal Reclamation History, Vol. 2, Section 6.2).

C2-Objection Exhibit A: *Figure 4.9-11. Domestic Well and Alluvial Target Locations* (original material from Brook Mine application).

C2-Objection Exhibit B: *Maximum Modeled Well Drawdown Relative to Well Completion Aquifers* (original material taken from Table 4.9-1 of Brook Mine application combined with information downloaded from the groundwater rights files of the Wyoming State Engineer's Office).

C3-Objection Exhibit A: This drawing has no formal title and is a collection of materials copied from the Brook Mine application (mine panel locations showing years and months of proposed mining), copied from the Big Horn Coal Mine application (areas of reclaimed backfill, Pit 3 Subsidence Dump area and notes identifying miscellaneous areas of subsidence hole reclamation), and copied from US Geological Survey Professional Paper 1164 (areas of underground coal fires).

OPINIONS.

Based on my review of the materials listed above, my previous experiences studying the hydrogeology of the Big Horn Mine area, and discussions with individuals knowledgeable of the mine's reclamation and hydrologic monitoring data, I have developed the following opinions:

1. Brook Mine Permit Application – Section MP.4; Exhibit MP.4-1; Section MP.5; Section MP.13; Addendum MP-6

   Section MP.4 and Exhibit MP.4-1 (see C1-Objection Exhibit A) provide plans for the development of a highwall mining trench through, and the development of highwall mining panels beneath, reclaimed backfill of BHCC Pits 1 and 2 adjacent to Goose Creek and the Tongue River in the southeastern portion of the Brook Mine permit area. The trench would penetrate through the bottom of the backfill to allowing mining of Carney coal found about 70 feet beneath the backfill. The backfill of the proposed trench area averages about 90 feet thick. The northeast corner of the highwall panel area appears on Exhibit MP.4-1 to be equivalent to the Brook Mine permit boundary, and would be less than 100 feet from the bank of the Tongue River. On Figure MP-6.1-1 of Addendum MP-6-11 (see C1-Objection Exhibit B), the highwall mining panels are shown even nearer to the Tongue River channel, and the reason for the disparity between the figure and Exhibit MP.4-1 is unexplained. There are off-site impact risks associated with the permit's disturbance, affected and permit boundaries all being equivalent to the mining panel boundary in this most environmentally sensitive area adjacent to the bank of the Tongue River. The affected area boundary shown on Exhibit MP.4-1 around the other proposed mining panels typically extends well beyond the disturbance boundary for reasons unexplained in the Mine Plan.

   Mine Plan Section MP.4, together with all Mine Plan text inclusive of Section MP.13 and Addendum MP-6, are silent on the subject of the special textural and hydrologic characteristics of the proposed southeastern highwall mining area in Sections 15 and 22, T57N, R84W. The area is unique in that the strata overlying the coal to be mined includes a thick layer of unconsolidated, saturated backfill exhibiting shallow groundwater elevations of 20 feet or less below ground surface where existing ground elevations are 3600 feet MSL and lower (see C1-Objection Exhibit C, C1-Objection Exhibit D and C1-Objection Exhibit E). The water surface in BHCC's postmining Reservoir 14 in the SESE Sec. 15 is an expression of the

groundwater table. The groundwater throughout Pits 1 and 2 is directly connected to and recharged by Goose Creek and the Tongue River, as documented in Big Horn Mine's Reclamation History, Groundwater Restoration Demonstration (GRD) approved by the WDEQ/LQD as Change No. 9 to Permit 213-T5 on August 8, 2002 (see C1-Objection Exhibit F, pages 4, 5, 13, 14 and 35, and Exhibit 1 of the GRD). C1-Objection Exhibit E (Brook Mine geologic cross section K-K'-) fails to show the groundwater table elevation in the BHC mine backfill adjacent to and recharged by Goose Creek and Tongue River, and is thereby very misleading in suggesting that groundwater is found only in the Carney and Masters coal seams. The GRD verifies that the Pits 1 and 2 backfill resaturated very rapidly, indicative of unconsolidated, porous material connected to perennial stream recharge sources nearby. Mine Plan Section MP.4 is silent on the subject of managing massive sloughing that may occur in the saturated and nonsaturated backfill of the southeastern highwall mining area as the highwall mining trenches are excavated through the backfill, Monarch-Carney interburden and the Carney coal. These facts considered, the Brook Mine permit application inadequately addresses the requirements of Wyoming Coal Rules and Regulations Chapter 2, Section 2(v)(A)(I)(1.), Chapter 2, Section 4(a)(xii)(A), Chapter 2, Section 5(a)(i)(D)(VII) and Chapter 4, Section 2(s). Section MP-5 of the Brook Mine Plan also fails to present an alternative water management and treatment plan to be followed should groundwater inflow volumes exceed infrastructure design capacities.

The assessment of potential land subsidence and the remediation plan presented for land subsidence in Addendum MP-6 is inadequate relative to protecting the value and function of adjacent lands, particularly for protecting the stability of the Tongue River and the quality of shallow groundwater connected to the river. Addendum MP-6 does not absolutely discount the possibility of land subsidence above the highwall miner holes, nor does it provide a plan for the discontinuation of any southeastern area highwall mining should subsidence occur in the lowlands contiguous to Tongue River or Goose Creek. The environmental implications of subsidence developing adjacent to Tongue River and Goose Creek are so severe as to warrant, at a minimum, a permit commitment to temporarily or permanently cease all mining throughout all of the southeastern highwall mining area should any subsidence develop in any of the area at any time. The permit's plan for "backfilling will commence within 12 months of a subsidence location being identified if self-healing is not providing sufficient remediation" (Section MP-6.4, Addendum MP-6) is environmentally unacceptable for the southeastern highwall (TR-1) mining area because: 1) the stability and alignment of Goose Creek and Tongue River could be jeopardized should subsidence occur, and; 2) any groundwater quality impacts associated with underground coal fires developing in mine openings would have direct and essentially immediate access to Goose Creek and Tongue River via the shallow groundwater table. Section MP-6.4 and Addendum MP-6 of the Brook Mine permit application inadequately address the requirements of Wyoming Coal Rules and Regulations Chapter 2, Section 2(a)(v)(A)(I)(1.) and Chapter 4, Section 2(r)(i)(C). As opposed to the requirements of Coal Rules and Regulations Chapter 7, Section 2(b)(v), the TR-1 area mine plan

does not avoid exchange of groundwater between an aquifer used for domestic and agricultural uses (Tongue River and Goose Creek alluvium) and other strata.

2. Brook Mine Permit Application – Section MP.5.9; Section MP.6.2; Addendum MP-3; Section MP.8

The groundwater model of Addendum MP-3 was improperly constructed and executed because the model does not recognize the unique textural and hydraulic characteristics of saturated backfill in BHCC's Pits 1 and 2, but instead simulates the backfill in the same fashion as native overburden strata (see Section 4.0 of Addendum MP-3). Section 2.5.1 of Addendum MP-3 states "no site-specific hydraulic conductivity information is available for the alluvial areas and over/interburden (model) layers". In fact, hydraulic conductivity data are available for the alluvium in the Big Horn Mine permit document, and hydraulic conductivity data are available for backfill from former monitor wells in the Pit 1 and Pit 2 area and for the Plachek Pit backfill. The backfill data are provided in the GRD referenced under Objection No. 1 above. Hydraulic conductivity values assigned to the spoils together with all other "overburden" strata in the model are very small relative to those shown for nearly all backfill wells in the GRD. The groundwater model ignores determination of the spatial extent of drawdown in the water table of Pit 1 and Pit 2 backfill that is connected to the water table in Tongue River and Goose Creek alluvium, which in turn is supplied by flows in both streams. The text of Section MP.6.2.3 states "Drawdowns of the overburden were not modeled and only isolated sands where encountered are expected to be affected".

Section 4.9 and Figure 4.9-11 of Addendum MP-3 (see C2-Objection Exhibit A) shows where the groundwater model was used to predict water table drawdown in Tongue River valley alluvium at "alluvial target" points distributed over about a three-mile reach of the valley floor. Section 4.9 states that "the actual drawdown in the alluvial targets induced from mining is estimated to be less than 0.5 feet". The same text goes on to explain "maximum impacts are expected to occur in areas where the overburden is thin (near coal seam outcrops) and are of short duration". Clearly, the groundwater model causes drawdown in Tongue River alluvium only as a result of the model simulating drawdown in the upper Carney coal through Masters coal stratigraphic sequence, and not as a result of excavating through BHCC's reclaimed saturated backfill of the Pits 1 and 2 area (Brook Mine TR-1 mining area). The alluvial target points are positioned well upstream of the Brook Mine TR-1 mining area, and thereby avoid showing alluvial water table drawdown in the TR-1 area especially if the model were properly executed to include mining of the saturated backfill in BHCC's Pits 1 and Pits 2. Neither does the groundwater model explore potential permanent groundwater elevation changes associated with the highwall mining panels acting as collector drains to the backfill and alluvial water table via the backfilled highwall trench pits.

Table 4.9-1 of the Brook Mine groundwater model (Addendum MP-3) identifies maximum drawdown values predicted by the model at existing stock and domestic wells. Well locations are shown on Figure 4.9.11 (see C2-Objection Exhibit A).

C2-Objection Exhibit B provides much of the same information as shown on Table 4.9-1 for three of the wells, but also provides the stratigraphic descriptions of the aquifers supplying each well as copied from the water rights files of the Wyoming State Engineer's website. All three wells are positioned near Tongue River, and all three stratigraphic descriptions are typical of alluvium. Table 4.9-1 indicates that the maximum drawdown at these wells will range from 0.5 feet to 1.5 feet, but the drawdown is assigned to layer 4 of the groundwater model, which is lower Carney coal and not model layer 1 overburden inclusive of alluvium. If the maximum drawdown predicted at these wells is truly intended to represent what will happen in these wells, then the predictions conflict with the statement on page MP-3-5 of Addendum MP-3 that "estimated impacts within the Tongue River alluvium will be minor and in most places not measurable". If, on the other hand, the maximum predicted drawdowns are not intended to represent drawdowns that will occur in the wells but in model layer 4 instead, then Table 4.9-1 is very misleading and it would thereby appear that the groundwater model does not attempt to predict drawdown that will occur within existing supply wells.

Table 4.9-2 of Addendum MP-3 tracks model-predicted groundwater inflow rates to Brook Mine, and shows that inflow rates will be greatest, from 65.4 gpm to 74.5 gpm, during the first two years of mining (TR-1 area). Text describing Table 4.9-2 suggests that the inflow rates will be relatively high in the TR-1 area because the coal there is fully saturated. The text is silent, however, on drawing any connection between inflow rates and mining through the saturated backfill of BHCC Pits 1 and 2. Section MP.8 of the Mine Plan states "It is estimated that the total water use will be approximately 120 million gallons per year (approximately 328,200 gallons per day) with an expected variability of plus or minus 20 percent." Mine Plan Table MP.8-1 lists "pit inflows" and "surface water rights" as being the two primary sources of water for the mine, but no specific surface water right is identified and no information is provided as to whether or not the State of Wyoming has approved any transfer of an existing surface water right to industrial uses. Table MP.8-1 and Section MP.8 do not identify the specific mining areas or strata sources that will supply the groundwater, but presumably it would be the TR-1 area which will be reclaimed late in the mine life. As stated earlier, the Brook Mine groundwater model does not simulate groundwater inflow from BHCC's saturated backfill of the TR-1 area; consequently, any consumptive groundwater losses from that aquifer source are not included in the groundwater drawdown predictions.

The Brook Mine Plan is devoid of a hydrologic budget identifying specific groundwater sources targeted for consumptive mine uses, and the determination of what would remain of groundwater and surface water supplies while the mine supplies its industrial water needs. The value of the existing surface estate and future options for developing the surface estate could be marginalized by Brook Mine's consumptive water uses. The Brook Mine permit application fails to identify alternative surface and groundwater supply sources, and thereby does not comply with the requirements of Wyoming Coal Rules and Regulations Chapter 2, Section 5(a)(ix)(E) and Chapter 2, Section 5(a)(xi). The Brook Mine permit application fails

to adequately describe the surface water and groundwater and related geology in the permit area sufficient to assess the probable hydrologic consequences (PHC) as required under Coal Rules and Regulations Chapter 2, Section 4(a)(xiv). The Brook Mine permit application does not provide a complete PHC determination required under Coal Rules and Regulations Chapter 2, Section 5(a)(x) and Chapter 2, Section 5(a)(xi). The Brook Mine permit application does not provide sufficient information on hydrologic changes which may be reasonably expected as a result of its operation as necessary for the Administrator to determine the probable cumulative hydrologic impacts on surface and groundwater systems, as required by Coal Rules and Regulations Chapter 19, Section 2.

3. Brook Mine Permit Application – Section MP.11; Addendum MP-5

The fire control plan referenced in Section MP.11 and presented in Addendum MP-5 describes measures to be taken to prevent and control fires in the mine pits, fires in the mine's processing and shop facilities, equipment fires and rangeland fires. Remarkably, Addendum MP-5 fails to acknowledge the existence of historic underground coal mine fires in some of the proposed panel mining areas. The Mine Plan and Addendum MP-5 do not provide plans to control and extinguish new subsurface coal fires that may develop or existing subsurface coal fires that may become rekindled or enlarged as a result of the highwall mining panels that will be opened outboard of the highwall trench openings.

C3-Objection Exhibit A is a drawing showing the approximate extent of underground coal mine fires in the area of proposed highwall mining in Sections 10 and 15, T57N, R84W, as reported by the U.S. Geological Survey in 1980. The fires in this particular area originated with mining of the Monarch coal. This and other nearby historic underground mines have long been known to exhibit numerous subsidence features and underground coal mine fires, and in the late 1980s BHCC received approval from the WDEQ/LQD to permanently place nearly 10 million bank cubic yards of overburden over the area shown on C3-Objection Exhibit A in an attempt to reclaim the subsidence and control the fire. That unique reclamation feature is known as the Pit 3 Subsidence Dump in Big Horn Mine's reclamation history. The proposed highwall mining will develop mine openings in the Carney and Masters coal seams beneath the Monarch seam in areas that are known to still exhibit evidence of underground coal fires. Plumes of steam and smoke have been observed again over the general area of Sections 10 and 15 this winter of 2016-2017. These observations indicate that, in places, the perimeter of the historic subsurface coal seam fires has expanded notable distances from the referenced 1980 boundary delineation.

The subsidence control plan of Addendum MP-6 does little to guarantee the long-term protection of the surface estate especially where highwall mining panels will be driven beneath underground coal mine fires having a long history of activity. Section MP-6.2 of Addendum MP-6 provides numerical calculations for subsidence chimney heights, but there is no investigation of the potential that the historic mine fires may have compromised the structural integrity of strata

underlying the fires and overlying the coals targeted for highwall panel mining (the interburden), leaving the interburden more prone to subside than normal. Highwall mining beneath or adjacent to pre-existing underground mine fires is particularly problematic because of the potential for oxygen and water to be transmitted from the highwall mining openings to "hotspots" in the seams already burning via highwall trenches or via fractured or subsided interburden above the panel openings. There is no legitimacy with the plan stated in Section MP-6.4 of Addendum MP-6 which states "Backfilling will also be performed if it is determined that the introduction of water and oxygen could contribute to spontaneous ignition of the remaining coal not extracted from the highwall mining operations". It is common knowledge in the mining industry that oxygen and water are key catalysts in causing spontaneous combustion in coal, whether the coal be in mine openings or in stockpiles. The introduction of additional water and air to a coal seam already on fire is especially problematic.

Section MP-6.3 of Addendum MP-6 commits to maintaining highwall mining mapping and subsidence documentation in a subsidence report that will be available for inspection. The Mine Plan does not commit to freely submitting the highwall mining mapping and subsidence documentation report to all owners of surface estate within the Brook Mine permit area. The Subsidence Monitoring and Assessment reporting of Section MP-6.3 does not include mapping, photographing and describing all evidence of surface or underground coal fires occurring within the Brook Mine permit area whenever such evidence becomes available throughout the life of the mining and post-mining periods. Those having surface estate adjacent to Brook Mine operations may experience greater risk of damages caused by the development of underground coal fire conditions whose reporting is not available in the public domain.

The above facts considered, this report contends that the Brook Mine permit application falls far short of addressing requirements of Coal Rules and Regulations Chapter 2, Section 5(a)(iv), Chapter 7, Section 4, Chapter 2, Section 2(a)(v)((A)(I)(c.), Chapter 4, Section 2(h)(ii), and Chapter 4, Section 2(w).

I declare under penalty of perjury that the foregoing is true and correct.

Paul J. Gerlach
President
Aqua Terra Consultants, Inc.