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United States Department of the Interior

OFFICE OF SURFACE MINING
Reclamation and Enforcement
BROOKS TOWERS
1020 15TH STREET
DENVER, COLORADO 80202

August 22, 1983

Mr. Rob Wiley
Environmental Engineer
Price River Coal Co.
76 S. Main Street
Helper, UT 84526

Dear Mr. Wiley:

Enclosed is the Draft Technical Environmental Analysis (TEA) of the Groundwater Hydrological Balance for Price River mine. I am also forwarding a draft copy to Vaughn Hansen Associates in Salt Lake City. This draft TEA will be the topic of discussion at the proposed meeting early next week at Vaughn Hansen Associates between representatives of OSM, Richardson Associates, Vaughn Hansen Associates, UDOGM, and Price River Coal Company.

At this meeting preliminary discussions on a groundwater monitoring plan for the Price River mine will commence. The meeting will provide an opportunity for all parties to comment on the Draft TEA for Groundwater Hydrological Balance. Please keep in mind that this Draft TEA does not represent a finalized format or plan.

Should you have any questions, please contact me at (303) 837-3807.

Sincerely yours,

Dave Maxwell
Project Leader

cc: Marvin Allen, Vaughn Hansen Associates
Ben Young (OSM)
Walter Swain (OSM)
Tom Tetting, UDOGM ✓

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OSM COMMENTS.

HYDROLOGIC BALANCE - GROUND WATER

A. Description of the Existing Environment

Regional Geology

The Price River Mine Plan Area is located in the northwestern portion of the Book Cliffs coal field in Central Utah. The coal bearing rocks of the Book Cliffs Coal Field consist of approximately 1,400 feet of Upper Cretaceous sandstones and siltstones with minor amounts of shales, mudstones, and clays. These rocks comprise the Blackhawk Formation of the Mesa Verde Group. In the area of the Price River mine complex, several rock formations are of interest. In ascending order, these rock formations include the Mancos shale, the Star Point sandstone, the coal-bearing Blackhawk Formation, the Castlegate Sandstone, the Price River Formation, the North Horn Formation, and the Flagstaff Limestone. The Flagstaff Limestone forms most of the ridge tops in the region, and is generally covered by 0 to 50 feet of unconsolidated colluvial/alluvial material. Solution channels and fractures are present within the Flagstaff Limestone. The Flagstaff is about 500 feet thick in the Price River Canyon area.

The North Horn Formation consists of a series of shale, sandstone, conglomerate and limestone beds, and is up to 2,500 feet thick in the area. The Price River Formation consists of medium grained sandstone and shaley sandstone, and is up to 1000 feet thick in the area. Beneath the Price River Formation lies the Castle Gate Sandstone, which is about 500 feet thick in the area. The Castle Gate is the predominant cliff-former in the Price River Canyon, is easily recognizable and serves as a marker bed in the area.

The Blackhawk Formation, as mentioned previously, contains the

significant coal beds of the region. The Blackhawk ranges from 900 to 1300 feet thick in the Price River Canyon, with the predominant coal beds assembled in the lower 500 feet. The alternating sandstones and shales of the Blackhawk comprise the majority of the Formation. The largest sandstone member is the Aberdeen Sandstone, which is about 170 feet thick in the vicinity of the Price River Canyon.

Beneath the Blackhawk Formation lies the Star Point Sandstone. The Star Point is several hundred feet thick in the area, and consists of three predominant sandstone tongues, representing a transgressive-regressive sequence, which are separated by gray marine shales of the Mancos shale. The sandstone tongues are cliff-formers in the Spring Canyon, located in the lower portion of the mine plan and adjacent area.

The basal unit of interest in the region is the Mancos Shale. It typically is several thousand feet thick, and contains a number of sandstone tongues in the vicinity of the mine plan area. The shales of the Mancos are generally nonresistant, forming flat desert surfaces and badlands in the area.

The strata present in the region strike northwest to west, and dip 3 to 6 degrees to the north into the Uinta Basin. As a result of the dipping nature of the formations, and the highly eroded characteristics of the land surface, all the formations of interest outcrop in a progressively southward fashion within the mine plan and adjacent areas.

Unconsolidated alluvial material is found along the canyon bottoms of streams in the area. This material is generally several tens of feet thick, and is up to several thousand feet in width along major perennial drainages such as the Price River.

Local Hydrologic Regime

Within the mine plan and adjacent area, three distinct aquifer

systems have been identified by the applicant. These systems include a perched aquifer system(s) within the Price River, North Horn and Flagstaff Limestone Formation; the regional aquifer system, which is postulated to originate in the Blackhawk Formation and extends into the underlying formations below; and several alluvial aquifer systems which exist along the major stream courses in the area.

Perched aquifer system. The perched aquifer system is described in the permit application as consisting of small, discontinuous ground water bodies which receive natural recharge from local precipitation and discharge as small seeps and springs. The seeps and springs are located generally at a sandstone-shale interface, and many flow only seasonally. Recharge to this system is postulated to be less than 5 percent of annual precipitation; recharge typically occurs in the higher plateau ridgetop location.

Regional aquifer system. The regional aquifer system in the mine plan area is postulated to be first encountered in the Blackhawk Formation and extends down into the Starpoint and Mancos Shale Formations. Recharge to the regional system is thought to occur along exposed surfaces in areas where the Blackhawk forms the surface formation. Some limited recharge may also occur form overlying beds above. Discharges from the regional aquifer system in the study area include springs, principal water-courses including Spring Canyon Creek, Willow Creek and the Price River, and inflow into abandoned mine workings in the area.

Values for hydraulic conductivity and transmissivity were calculated for the regional aquifer system from two test wells which penetrate the Blackhawk Formation. Hydraulic conductivities were in the range of 10^{-9} to 10^{-7} ft/sec, and, transmissivities were on the order of 17 to 65 gpd/ft

over the thickness zones tested. The zones were tested over 808 and 651 feet, respectively. Total saturated thickness of the regional system is not known. Transmissivity and hydraulic conductivity values for the coal were found, through similar testing, to be within the same magnitude as the other portions of the formation. The transmissivity values obtained for the Blackhawk Formation indicate that the formation would classify as having poor well development potential (U.S. Bureau of Reclamation, 1977).

A potentiometric surface map for the regional aquifer could not be constructed by the applicant, due to the limited number of wells situated in the formation and the fact that the system has been altered by past mining disturbance. As a result, the regional flow system is not understood. Fifty or more mines have operated within the limits of the study area, some dating back as far as 85 years. Fourty eight of the mines are now abandoned. Abandoned mine workings extend a distance of about 14 miles across the mine plan area. Discharge from the water bearing zone(s) in the Blackhawk Formation is speculated to be accumulating in these old mine workings.

Alluvial aquifer system. Alluvial aquifers are found along the Price River, Willow Creek, and Spring Canyon Creek. Published information indicates that the aquifers are quite permeable and that flows of up to 500 gpm can be expected for wells completed in the alluvial deposits. The regional aquifer system and the alluvial systems are thought to be interconnected. Although the mechanism of recharge for the alluvial system in the study area has not been investigated, it is postulated that recharge may come from the discharge of the regional aquifer, and possibly, from perennial streamflow in the watercourses.

Springs and Seeps in the Area

A records and information search by the applicant has revealed the

presence of 61 springs in the study area. 48 of the springs were found to be issuing from formations overlying the Blackhawk Formation, 3 were located issuing from the Blackhawk, and 10 springs were located issuing from formations underlying the Blackhawk. The springs identified by the applicant have water rights appropriated to them; in most instances, the designated use is stockwatering. Several of the springs have designated uses of domestic or irrigation purposes. Most notably, Crystal and Goat Springs, located in the Spring Creek Canyon just south of the permit area, supply the domestic needs for three homes and, when sufficient supply is available, for irrigating a small orchard. A third spring in the Spring Creek Canyon, Gravel Spring, is owned by Price River Coal and supplies industrial water to the #5 Mine. All three of these springs are thought to issue from the Mancos Shale. No water wells in the study are were indicated to exist by the applicant.

Ground Water Quality

Baseline ground water quality data have been assembled at the study site by the applicant over the time period 1977 to 1981. A total of six monitoring wells and three springs were utilized in the program at one time or another. Also, during 1977 and 1978, several water samples were obtained from water accumulating in the abandoned Royal Mine, and in 1978 two samples were obtained from mine #3 discharge. A complete listing of the analytical results can be found in Appendix 7-A of the permit application; only the salient features will be discussed here.

The highest level of total dissolved solids reported during the monitoring period occurred for the August 9, 1978 Mine #3 discharge sample. The value was 4420 mg/l TDS. A second sample, obtained on August 23, 1978, showed a value of 1400 mg/l TDS. These were the only samples collected at

the station. Total dissolved solids levels for samples obtained from the abandoned Royal Mine (22 samples, total) ranged from 700 to 1350 mg/l. Total dissolved solids for the monitoring wells situated in the Blackhawk Formation (wells MC 203, 205 and 207) ranged from a low of 1195 mg/l for MC 205 to a high of 1887 mg/l for MC 207. Results for a total of nine samples (1 for MC 205 and 4 each for MC 206 and 207) were reported. On January 19, 1983, a single sample was obtained from the abandoned Kennilworth Mine, and a TDS value of 1210 mg/l was reported.

Total dissolved solids levels for the three springs monitored during the baseline investigation (Crandall Canyon Spring, Mathis Canyon Spring and Dry Canyon Spring) ranged from 770 to 1068 mg/l and 255 to 380 mg/l, respectively.

Other constituents identified by the applicant as noteworthy include phenols (which maybe associated with the coal, especially in natually burned areas), sulfate, and oil and grease. A review of the appliant's ground water quality data also indicates that total iron values are noteworthy in well MC 206 (a high value of 264 mg/l reported) and in a Royal Mine sampling station (a high value of 16.4 mg/l reported). A maximum dissolved iron value of 23.6 mg/l for well MC 206 has also been reported. Well MC 206 is located in the Blackhawk Formation, adjacent to the abandoned Carbon Fuel #3 Mine, and the abandoned Rolapp #2 mine.

B. Description of the Applicant's Proposal

The applicant proposes that ground water impacts as a result of mining will be minimal. Impacts to the perched aquifer system will be negligable on the basis of the great thickness (1500) of overburden separating the aquifer and its associated springs, from the coal seams to be mined. Minimal subsidence impacts to this aquifer are therefore anticipated.

Impacts to the regional aquifer system are also proposed by the

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applicant to be minimal. Although seepage into the mines is to be expected (as evidenced by past water accumulations in abandoned mine workings) the overall impact is postulated by the applicant to be inconsequential. Inflow rates measured in the #3 Mine and the #5 Mine range from 3.5 to 33.4 gallons per minute. These rates correspond to a discharge per unit area of disturbance of 0.015 to 0.04 gpm/acre. Measurements made in several of the abandoned mines (Aberdeen, Utah Fuel #1, Royal and Kennilworth) range from 0.004 to 0.024 gpm per acre of disturbance. Converted to inches per year of recharge, these measurements correspond to 0.08 in/year to 0.046 in/year of recharge. For the Price River Coal #3 and #5 Mines, the values are 0.29 to 0.70 in/year, respectively. The applicant concludes that these values are of a low enough nature to not warrant concern; the values are very near the expected annual recharge rate for the regional aquifer.

During active mining, the discharge rate into the mine is expected to be in excess of the natural recharge to the aquifer system, indicating that water is being removed from aquifer storage. As mining ceases, the inflow rates are expected to be reduced until equilibrium is established between recharge and discharge rates. The applicant speculates that once abandoned, the mines which lie below the regional water table will gradually fill until either equilibrium is reached within the mine, or as is conceivable, discharge occurs at the land surface via an access portal. Many of the abandoned mine workings are interconnected via rock tunnels, and it is possible that the tunnels may serve as spillways or overflows to other underground areas as the mines fill.

The applicant further proposes that ground water quality impacts (as evidenced by total dissolved solids levels) will be minimal, based on a comparison of values obtained from the Blackhawk monitoring wells with

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those seen in samples collected from the abandoned mine workings. A concern, however, does exist for oil and grease, as mine waters have been shown to contain elevated levels for the parameter. The applicant proposes to physically remove all accumulations of oil and grease prior to discharging any mine drainage into surface waters (Vaughn Hansen Associates, May 1983, p.34).

The applicant also proposes that disturbance to the regional aquifer has occurred during the past 85 years over which extensive historical mining has taken place, with little, if any, measurable impact to water resources in the area. Impacts are proposed to be only of local as opposed to regional scope.

In regard to impacts to the alluvial aquifer systems, the applicant proposes that any reduction of flow to the Price River system as a result of intercepting water in the mines, will be on the order of 14 gpm. This value is calculated on the basis that if 0.28 in/year of recharge is intercepted by a disturbed area equivalent to the Price River Coal #3 and #5 existing mines, the flow rate is approximately 14 gpm. This value represents a reduction of about 0.03 percent of the historical average flow of the Price River.

Subsidence impacts to the alluvial aquifers are also proposed to be minimal, on the basis of the 600 to 800 feet of cover separating the mines from the land surface.

C. Evaluation of Compliance

The applicant has complied, through collection of baseline data and statement of intent regarding future actions, with applicable parts of Section 817.41 of the Permanent Regulatory Program. However, There are a number of uncertainties regarding the assumptions and data base utilized by the applicant in projecting the probable hydrologic consequences of mining.

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These uncertainties are not viewed as significant enough in nature to disapprove their permit application; however it is impossible, as a result of the uncertainty, the limited data base, and the complex nature of the hydrogeologic system to accurately quantify the incremental hydrogeologic impacts resulting from the proposed mining. For example, the timing, location, and quantity of future potential surface discharge of intercepted mine water remains unclear. Likewise, the reduction in overall potentiometric head in the regional aquifer, as groundwater is intercepted by the mines and water is removed from aquifer storage, is unknown. Similarly, the projections of water quality impacts by the applicant, although supported by the limited number of total dissolved solids analyses of mine waters, are not statistically verified; factors such as contact time may prove to alter the applicant's contention over the long-term. The range of values in total dissolved solids observed for mine waters to date (700 to 4420 mg/l; 25 samples total) indicates that the water quality issue is not yet fully defined.

Since the natural hydrogeologic regime has been altered by past mining activities, and the regional aquifer system is apparently penetrated by only three wells, it is impossible with the information available to establish flow gradients and directions in the study area. Hence the incremental impact of the proposed mining on these aquifer parameters in unclear.

The applicant has provided sufficient information to demonstrate that impacts to the perched aquifer system, and the 48 springs associated with the perched system, will be negligible. Impacts associated with the proposed mining will be limited to the regional aquifer system and its associated discharge areas.

Given the uncertainties regarding the characterization of the complex hydrogeologic conditions present in the regional aquifer, it is impossible to verify the applicant's contention of inconsequential future impact without implementing a comprehensive operational monitoring plan. Past observations seem to support, on a broad scale, the contention of the applicant that past mining has had limited effect on the water resources of the area. However, in order to measure incremental impacts, and to expand the data base so that future mining proposals in the area can be evaluated properly (primarily in terms of cumulative hydrologic impact), operational monitoring, coupled with statistical treatment of the data, is necessary.

It is uncertain, based on the information assembled to date, whether future treatment of mine water discharges or other alternative mitigative measures will be nesessary. Such measures may include proper sealing of mine openings, etc. A larger data base, capable of statistical treatment, will aid in the future review of such measures.

Therefore, it is considered imperative that a comprehensive operational monitoring plan be established prior to the onset of additional mining under the areas both east and west of the Price River. The greatest insight regarding future impacts can best be gleaned by accurately monitoring past and present mining activities.

D. Environmental Impacts of the Proposed Departmental Action.

Potential effects in the mine plan area and adjacent area are four fold including: (1) decrease in the hydrostatic head of the regional aquifer system, coupled with diminution of flow to any of the 13 identified springs interconnected with the system; (2) decrease in the quantity of water discharged to the Price River and tributaries; (3) incremental increases in dissolved constituent loads to receiving waters; and (4) subsidence impacts. The duration and magnitude of the first three

potential impacts are unquantified at this time. Further monitoring will be necessary to measure incremental impact. Speculation, based on past mining activities in the area, indicates that the impacts will not be severe; rather, they will be of local significance.

However, mine water can be expected to accumulate following cessation of mining as evidenced by past operations. The Castle Gate #2 mine as of 1968 contained over 428 million gallons of water (1,313 AF) and the Castle Gate #3 mine, 128 million gallons (392 AF). The Kenilworth A seam mine as of 1968 contained 165 million gallons (506 AF). The ultimate effects of such accumulations in both the proposed mines, and the abandoned workings are unclear at this time. Impacts relating to subsidence are discussed in another section of this TEA.

REFERENCES

(1) Vaughn Hansen Associates (May,1983), Ground Water Hydrology - Carbon County Mines, submitted to Price River Coal Company.

(2) U.S. Bureau of Reclamation (1977), Ground Water Manual. U.S. Government Printing Office, Washington, D.C.