COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

1313 Sherman Street, Room 215
Denver, CO 80203

Interoffice Memorandum

June 20, 2016

From: Leigh Simmons
To: Mike Boulay

Subject: King Coal Mine (Permit No. C-1981-035)
Hay Gulch water monitoring review

Per your request, I have reviewed the King Coal Mine Permit Application Packet (PAP) with respect to surface water and groundwater monitoring along Hay Gulch.

In addition to maps and documents from the approved PAP, I reviewed:

- Correspondence to the Division from Luke Danielson (Danielson correspondence)
- The 2015 Annual Hydrology Report (AHR) submitted by the operator
- Colorado Division of Water Resources (DWR) well application data, from the Colorado Information Marketplace
- The National Hydrography Dataset (NHD)
- The King I & II Coal Mine Area Hydrologic Study, by Resource Hydrogeologic Services, Inc. (Resource Study)

(Complete references are provided at the end of this document)

With his letter of May 26, 2016, Mr. Danielson cited and included a letter from Carl Mount, dated May 11, 2016. To paraphrase Messrs. Danielson and Mount, the suggestions made were that the Division should:

- Stop further placement of uncharacterized mine waste on the waste pile
- Characterize the waste material using standardized tests, to determine static and kinetic levels of waste solubility
- Implement a water monitoring system that monitors quantity and quality of surface water runoff or leachate from the waste pile, and evaluate waste pile design
- Clarify where mine waste is being stored or disposed of

I have not attempted to address the procedural or legal issues raised in the Danielson correspondence, but have focused on the technical and scientific basis for their concerns.

Additionally, my review does not take into account changes to the PAP proposed, but not yet approved, with permitting actions currently in progress (Technical Revisions 20, 24 and 26).

Physical context

Hay Gulch is an eroded stream channel, tributary to the La Plata River, which runs generally from north-east to south-west across the King Coal Mine permit area. The region is arid (average annual precipitation is estimated to be less than 20 inches), and the area of the Hay Gulch watershed is small (on the order of 10 square miles, upstream of the mine); the gulch does not hold any mapped perennial or intermittent stream, according to the NHD. Hay Gulch does bear the Hay Gulch Irrigation Ditch however, which diverts water from the La Plata River upstream of the permit area. Downstream, the Red Mesa Ward Reservoir (also known as the Mormon Reservoir) is built in Hay Gulch approximately five miles south of the point where it exits the permit area. The reservoir discharges back into the La Plata River.

Figure 1 shows a digitized approximation of the King Coal Mine permit boundary in pink, superimposed on an aerial image from September 2013. Stream segments for the La Plata River and the Hay Gulch Irrigation Ditch, downloaded from the NHD, are shown in blue and turquoise respectively. The Red Mesa Ward Reservoir is visible at the bottom of the figure. The image depicts an area approximately 7 miles from east to west.

In the southern part of the permit area, the old King I Mine portals and facilities are directly above Hay Gulch, on its southern side. In a small unnamed drainage above and to the east of the facilities pad is a historic (pre-law) refuse pile, and above that is the currently approved refuse pile.

Figure 2 is centered on the King I Mine facilities bench. The image is approximately a third of a mile across. Hay Gulch is visible at the top, and the refuse pile is on the right hand side, towards the middle.

Water Monitoring in Hay Gulch

The King Coal Mine water monitoring plan is subject to revision under permitting actions that are currently in progress, so a detailed analysis of the plan is not provided here. In the 2015 AHR, monitoring data is provided from three wells constructed in the Hay Gulch alluvium, as well as a surface monitoring point in the Hay Gulch Irrigation Ditch. The three wells are known as the Wiltze well, King II up-gradient well and King II down-gradient well. Quarterly samples have been taken from all three wells and submitted to the Division in the AHR, in accordance with the approved permit. The suite of water quality parameters analyzed for is also in accordance with the approved permit, but is less than ideal (as previously stated, this is currently under revision). This is not intended to be an in depth AHR review, however some general comments are made about the monitoring data following a description of each well.

The Wiltze well is not permitted (according to the DWR database). Its location is shown on Map King II-004 as just down-gradient of the King I disturbance (approximately on the left edge of figure 2). No well construction information is available. The well has been monitored by the operator since 1982. Although

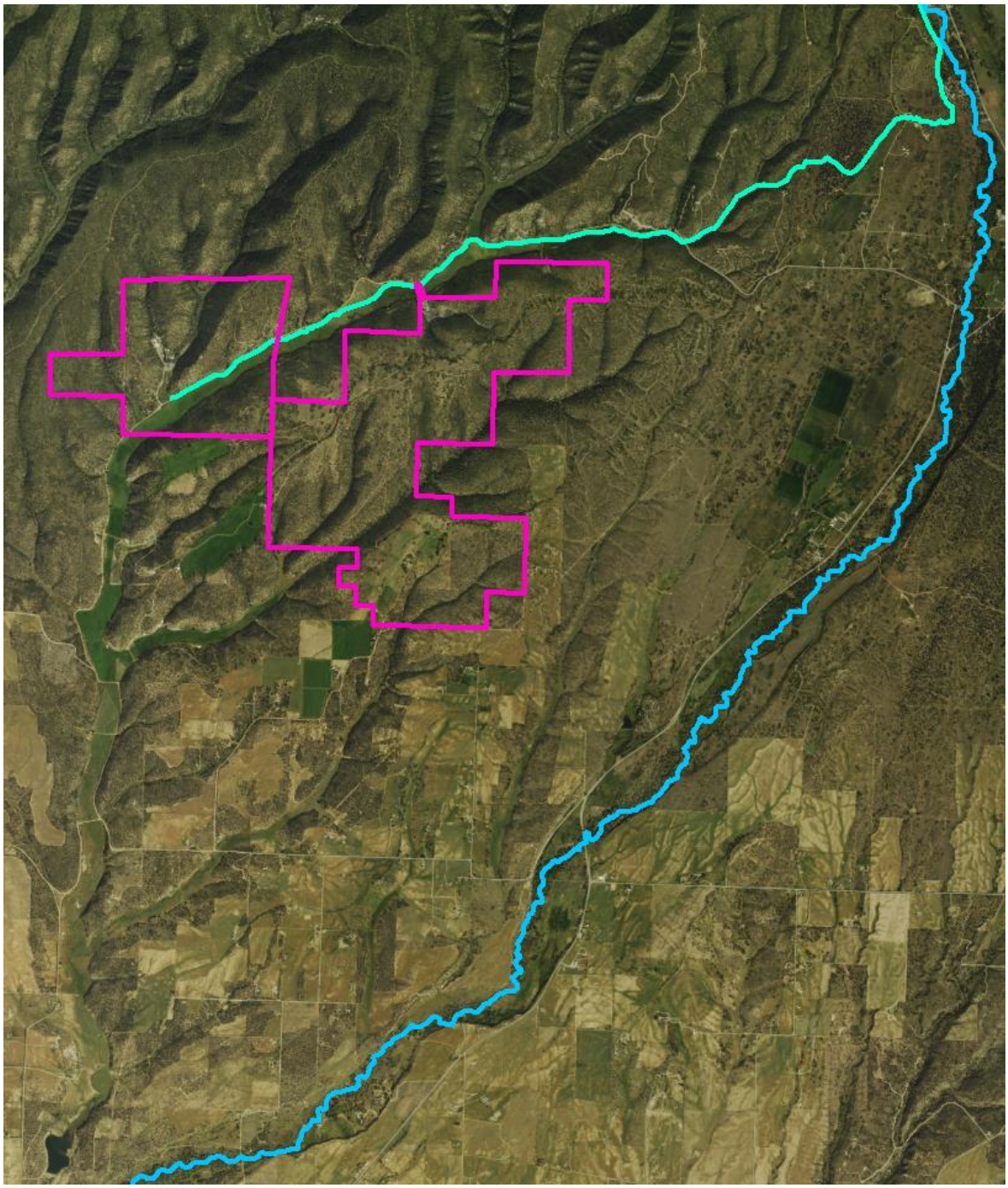

Figure 1: King Coal Mine general area

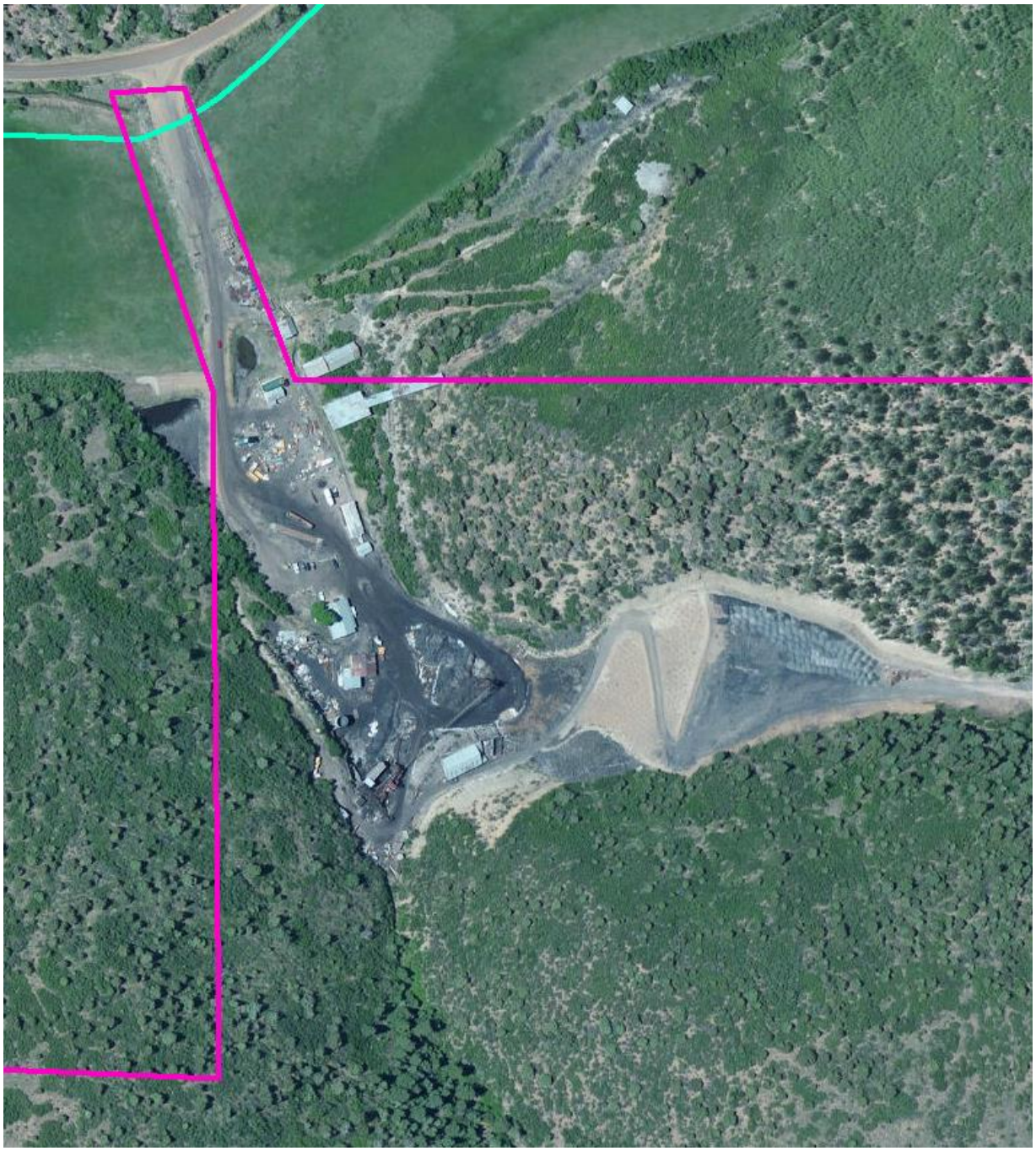

Figure 2: King I Mine facilities bench, with Hay Gulch and the refuse pile

there is a long data record, it is of limited value given the lack of information about the well. The depth to water is frequently reported as “zero”, and there is a great deal of variation in many of the parameter values. The strongest statement I would make based on the data is that the samples taken are of neutral pH water that is of moderately poor quality and notably high in Manganese.

The King II up-gradient well has permit number 210372. It appears to have been constructed in 1998, and is owned by the Ute Mountain Ute Tribe. No well construction information is available, although the DWR database does give the driller’s name and address. Its location is shown on Map King II-004 as immediately adjacent to the Hay Gulch Irrigation Ditch, on the south side of the ditch, approximately one mile down-gradient of the King I disturbance. The well has been monitored by the operator since 2005, although as with the Wiltze well, the data is of limited value given the lack of information about the well. It is worth noting that the data shows weakly basic pH values, trending down, which suggests possible contamination of the well with an alkaline grout.

The King II down-gradient well has permit number 260656 (incorrectly labelled on Map King II-004 as 262656). It was constructed in December 2004 by Lambert and Associates (geotechnical engineering consultants). The well is located on the down-gradient edge of the permit area, approximately 2 miles down-gradient of the King I disturbance and to the south of the Hay Gulch Irrigation Ditch. No well construction information is currently available from the DWR database or the PAP, however following my inquiry Tom Bird forwarded a packet of information directly to me which included a letter from Lambert and Associates describing the well construction (the information packet is included as Appendix A). The letter reports that the well was constructed in soft silt and clay soil, with water encountered at a depth of 6 ft. It describes well 260656 as follows:

- An 18ft deep boring with 2in schedule 40 PVC pipe installed to the bottom
- Approximately 2ft of plain casing extends above the ground surface
- The lower 10ft of casing is slotted
- Pea gravel was packed from the bottom of the well to 6ft below ground surface
- The upper 6ft was backfilled with powdered bentonite
- A 6in shroud was placed over the monitoring well

There is no information in the packet about the thickness of the alluvium at the location of the well.

The construction information suggests that the well has value as a groundwater monitoring point, and could provide meaningful data if sampled correctly. Despite the limitations of the monitoring program mentioned above, 11 years of quarterly monitoring data for important parameters such as Total Dissolved Solids, Iron, Manganese and Sulfate are available, and are indicative of neutral pH water of reasonably good quality (TDS generally in the range 400-600mg/L) but with potentially elevated levels of some parameters.

Refuse pile

The King Coal Mine PAP is organized into sections by rule (which is common), but each section is duplicated, occurring once in a volume entitled "King I Mine" and again in a volume entitled "King II Mine"; the refuse pile is briefly described in section 2.05.3 of both volumes of the PAP text, in almost, but not quite, identical language. The currently approved refuse pile is built on top of a historic refuse pile and is above the old King I Mine portal and facilities area. Two sediment ponds are below (visible in figure 2). The design of the pile is provided in the volume entitled "King I Mine", Appendix 10(1), in a document with the title "Waste Bank Design Summary Report", authored by Don R. May, P.E., in 1997, (the report is included with this document as Appendix B).

The design of the drainage system at the King I site is provided in Appendix 11(1), in a document with the title "Hydrologic and Hydraulic Design of Sedimentation Ponds and Other Drainage Features for National King Coal Mine", also authored by Don R. May, P.E., in 1995, and most recently revised in January 1998, (the report is not included with this document).

The waste bank report documents the process that was used in the design of the refuse pile and states the assumptions that were made. On page 7, under the heading "Groundwater", it is made clear that there is no significant potential for groundwater to seep into the refuse pile. The underdrain was therefore designed to transport infiltrating precipitation and snowmelt, which is appropriate. The report states estimated parameter values for precipitation (6.38 inches per month, based on the mean of observed maximum monthly values), infiltration rate (50% of precipitation) and hydraulic conductivity, and specifies the geometry of the pile. It also states specific dimensions for the underdrain. The calculations that were used to arrive at the appropriate drain specifications are not included.

The estimated infiltration rate and hydraulic conductivity (K) values were based on text book values for similar materials, although no reference is quoted.

- K for the underdrain is estimated at 10^{-3} – 10^{-1} ft/s (approx. $3x10^{-2}$ – 3 cm/s) , which is broadly in accordance with Fetter's [3] estimate for well-sorted gravel (10^{-2} – 1 cm/s)
- K for the waste material is estimated at 10^{-5} ft/s (approx. $3x10^{-4}$ cm/s)

The report states that water infiltrating the pile will "…*make its way either to 1) the natural ground-waste pile interface where it will continue to move down to the groundwater table or 2) …move to the underdrain located at the bottom and center of the waste pile*." Although both of these pathways are possible, it is important to note that infiltrating water is far more likely to travel to the underdrain than the "natural ground": according to the report the top 20 ft of natural material "*consists of silty and slightly sandy clay with some gravel.*" Fetter estimates K for unconsolidated clay at 10^{-9} – 10^{-6} cm/s; even at the conservative end of this range the natural ground may be expected to be one to two orders of magnitude less conductive than the waste material, therefore water will preferentially travel through the waste material, and ultimately the underdrain. Based on the available data, the probability of water

infiltrating the pile and then traveling to the groundwater table underneath the pile should thus be considered insignificant.

The report does not include any chemical characterization of the material in the pile, or of the leachate that could be expected to drain from it. The design does not specify any equipment to monitor the saturation of the pile or quality of water coming from the drain. The report does not describe where the pile is designed to drain to (neither does the detail drawing, filed as Map King I-015).

The drainage report describes how contaminated runoff, including the refuse pile drainage, is routed to the west sediment pond. It gives designs for the various structures involved, including the ponds themselves. The report does not specify whether or not the ponds are lined (so I assume that they are not).

Comments

1. **Groundwater quality monitoring**

Despite later comments concerning inadequacies in the PAP, it is clear from publicly available information that Hay Gulch contains alluvial groundwater. It is also clear that permitted activity at the King Coal Mine has the potential to impact this water. Given these two statements of fact, the King Coal Mine is subject to regulations developed under the Colorado Water Quality Control Act.

The Colorado Water Quality Control Act (C.R.S. Title 25, Article 8) established the Water Quality Control Commission (WQCC or Commission), and assigned to it the duty to develop and maintain a comprehensive and effective program for the prevention, control, and abatement of water pollution, and for water quality protection throughout the state of Colorado. Within its general remit, three of the specific responsibilities of the commission are to:

- Classify state water
- Promulgate water quality standards
- Promulgate control and permit regulations

The Water Quality Control Division (WQCD) is the agency responsible for implementing and enforcing the standards and regulations adopted by the Commission. The WQCD also provides staff support to the Commission. Both the Commission and WQCD are within the Colorado State Department of Public Health and Environment (CDPHE).

The Act was amended in 1989 with Senate Bill 181 (SB 89-181), to clarify the role of other state agencies, including DRMS, with specific responsibilities in the area of water quality control for certain industries or activities, and to designate them as “implementing agencies”. A Memorandum of Agreement (MOA) was entered into by the agencies in order to fully implement the amendments made under SB 89-181. The most recent version of the MOA was signed on December 14, 2010, and supersedes any prior agreement.

The MOA clarifies the roles and responsibilities of DRMS, WQCD and WQCC, and may be summarized as follows:

- WQCC is solely responsible for the adoption of water quality standards and classifications
- WQCD is solely responsible for issuance and enforcement of permits authorizing all point source discharges to surface waters, as well as enforcing any control or permit regulation adopted by WQCC
- DRMS is responsible for implementing standards and classifications for discharges, other than point source discharges to surface water, through its own regulatory programs after consultation with WQCC and WQCD

It is important to stress that **DRMS does not have the authority to classify groundwater or to set standards for groundwater quality, however it does have the authority (and indeed the legal obligation) to establish points of compliance at which those standards set by the WQCC must be met**. In order to satisfy this obligation DRMS must: (i) determine whether the permitted activity has the potential to impact groundwater – this has already been established; (ii) if so, determine the applicable standards; and (iii) locate one or more point of compliance where water quality can be measured and assessed against those standards.

Two of the regulations promulgated by the WQCC under the Colorado Water Quality Control Act are pertinent to this situation:

- Regulation No. 41 – The Basic Standards for Groundwater (Reg. 41)
- Regulation No. 42 – Site-specific Water Quality Classifications and Standards for Groundwater (Reg. 42)

Reg. 42 contains a complete description of the groundwater to which the WQCC has specifically assigned use classifications and water quality standards. At the time of writing there is no classified groundwater anywhere in La Plata County, which means that Reg. 42 is not relevant to the King Coal Mine; instead the permitted activity is subject to the state-wide standards described in Reg. 41.

Since data presented in the AHR shows that Total Dissolved Solids (TDS) in all three monitoring wells are well below 10,000mg/L, the Interim Narrative Standard applies.

The Interim Narrative Standard is described completely in section 41.5(C)(6) of Reg. 41, and is simply stated as follows:

> **Groundwater quality shall be maintained for each parameter at whichever of the following levels is less restrictive:**
>
> **(A) Existing ambient quality as of January 31, 1994, or**

(B) That quality which meets the most stringent criteria set forth in Tables 1 through 4 of "The Basic Standards for Ground Water."

In practice, the Division must apply the most stringent criteria set forth in Tables 1 through 4 of "The Basic Standards for Ground Water" unless the operator provides sufficient data and documentation demonstrating that: (i) ambient levels of applicable analytes exceeded table values prior to January 31, 1994; or (ii) data collected after January 31, 1994, which shows water quality parameters in excess of table values is representative of pre-1994 conditions, and that there have been no new or increased sources of groundwater contamination in the area since. It is the operator's burden to provide sufficient data and documentation to the Division to demonstrate to the Division's satisfaction that any proposed "pre-94" site-specific exemption from table values is appropriate for the King Coal Mine site. (A copy of Tables 1 through 4 is included as Appendix C).

DRMS protocol for establishing points of compliance is given in Section 4.05.13(1) of the Coal Rules. Well 260656 would appear to be ideally located for a point of compliance.
In addition to the requirements of Reg. 41 the Coal Rules require that monitoring be sufficient to determine the effects of mining activities on the quantity and quality of water in groundwater systems in the permit area and adjacent areas; and the effect of surface mining activities on the recharge capacity of reclaimed lands.

In summary, I suggest that:

a. A downgradient point of compliance should be established in Hay Gulch. Well 260656 may be considered for the purpose, and appears to be ideally located, although the saturated thickness of the alluvium must be better characterized before its suitability can be assessed. (Note also that the monitoring data presented in the AHR suggests that the water sampled at that well may exceed the table values for one or more water quality parameters; this is a matter that the operator should address immediately).
b. A new monitoring well should be constructed in the Hay Gulch alluvium, upgradient of any mine related disturbance.
c. In the absence of any well construction information, the Wiltze well should be replaced with a new monitoring well. This well should be immediately downgradient of the King I disturbance, with the aim of detecting the impacts of that disturbance. If the new well were constructed near to the Wiltze well, and both wells were monitored for a period of time, it may be possible to correlate the monitoring data of the two wells to make use of the historical record (although this is by no means certain).
d. The Hay Gulch alluvium should be characterized as thoroughly as possible. The characterization should include data from any new drilling, and tests should be conducted on new wells to estimate aquifer properties.

e. Well 210372 should continue to be monitored for the time being. Every effort should be made to discover information regarding its construction (including contacting the driller and the previous owner, and investigating the borehole directly with a probe or borehole camera).
f. Construction information for all monitoring wells should be added to the PAP as an Appendix and summarized in a table in the main body of the text, (as well as submitted to the DWR).
g. New wells should be permitted with the DWR, and constructed according to the standards required by DWR rules [7], and by a licensed contractor. Appropriate site specific well placement and construction details should be recorded and approved by a qualified professional, before being submitted to DRMS.
h. As the monitoring program is revised by permitting actions currently in progress, attention should be paid to ensure that the suite of water parameters analyzed for is sufficient, at a minimum, to satisfy the requirements of the Interim Narrative Standard.

2. <u>Refuse pile monitoring</u>

Rule 2.05.3(8)(a)(i)(C) requires that the design for a coal mine waste bank shall…

"*Contain preliminary hydrologic and geologic information required to assess the hydrologic impact of the structure*"

The rule is necessarily somewhat vague, and requires judgement on the part of qualified individuals to see that it is satisfied. I am reluctant to second guess the judgement of the individuals involved in the permitting of this waste pile at the time that it was designed and approved. I would say, however, that the lack of chemical characterization of the material in the pile means that the potential for formation of toxic or acidic leachate has not been fully addressed. Furthermore no provision has been made to monitor the pile to test the veracity of the predictions that are implicit in its design.

Rule 4.05.13(1)(c) requires that:

"*When surface or underground mining activities may effect groundwater systems on or off the permit area, ground water levels and groundwater quality shall be periodically monitored. Monitoring shall include measurements from a sufficient number of wells or other ground water sources as approved by the Division and mineralogical and chemical analyses of aquifer, overburden, and spoil that are adequate to reflect changes in ground water quantity and quality resulting from those activities. Monitoring shall be adequate to plan for modification of surface or underground mining activities, if necessary to minimize disturbance of the prevailing hydrologic balance.*"

I suggest that:

a. The operator should update the permit text to describe the journey taken by water infiltrating the refuse pile.
b. The refuse material should be chemically characterized to assess its potential to form toxic leachate (acidic leachate is not likely, but should be considered also).

c. The quantity and quality of leachate draining from the pile should be measured directly, or quantified from other measurements. This may involve the installation of (a) monitoring well(s) or piezometer(s) in the pile to monitor saturation.
d. The Division should evaluate (when the necessary analyses have been provided) whether or not drainage of the refuse pile into an unlined sediment pond is protective of the hydrologic balance.

3. <u>Deficiencies in the PAP</u>

As briefly described above, the King Coal Mine PAP is unusually structured, which makes information difficult to find and verify, and in some places appears to conceal deficiencies. Firstly, the PAP is organized into sections by rule (which is common), but each section is duplicated, occurring once in a volume entitled "King I Mine" and again in a volume entitled "King II Mine"; while this structure is not unprecedented, it is problematic as it often leads to either redundancy or contradiction. Secondly, and more importantly, the main body of the text is rather brief and lacking in necessary detail. The text refers to appendices for critical information, but often the references are inadequate and sometimes they are inaccurate. For example, in the volume entitled "King I Mine", section 2.04.7, page 2, paragraph 1, states:

> *"Hydrologic data… show that the mining operation has had only a mild impact on water sources of Hay Gulch (See Appendix 4)."*

This is a powerful statement that should be elucidated in the text. Instead the reader is referred to a large appendix made up of 9 sub-sections, many of which are irrelevant. In this case Appendix 4(7) happens to be a two page statement, without any attribution besides a footer giving the date as February 1997, of probable hydrologic consequences. The determination of probable hydrological consequences is fundamental to the Division's ability to make a finding as to the potential impacts of any proposed activity. This critical statement would normally be made in section 2.05.6(3) under the heading Protection of Hydrological Balance; instead that section is made up of a cursory 3 lines, stating:

> *"Information required by 2.05.6(3) concerning protection of hydrological balance is addressed in a report by Don May, P.E., which is included in Appendix 11. See also Map King I-007 and Map King I-004."*

In fact, Appendix 11(1) is a drainage design, and Appendix 11(2) is a one page letter concerning a Small Area Exemption; the appendix does not adequately address rule 2.05.6(3) at all.

"King I Mine", section 2.04.6 – General Geology Description, refers to Map King I-004. The map shows areas of quaternary alluvium, however no mention is made of these surficial deposits in the text. The following section 2.04.7 – General Hydrology Description, mentions the Hay Gulch alluvium tangentially but no substantive characterization, or even basic description, is provided. I would expect the PAP to contain a thorough description of the physical properties of the alluvium, and the hydrologic properties

of the alluvial aquifer, including but not necessarily limited to: depth, width, water level, transmissivity/hydraulic conductivity, water quality, water users/water rights.

Map King I-007, Operation Plan & Surface Features, shows the disturbed area boundary, but not the permit boundary, to a high level of detail around the King I facilities area. Other maps in the PAP which show the permit boundary (e.g. Map King I-001, Permit & Adjacent Areas) are drawn at a much larger scale, making small details difficult to see; nevertheless it appears as though the west sediment pond, which receives water draining from the refuse pile, is outside of the permit boundary, (see figure 2).

I suggest that:

a. Sections 2.04.5, 2.04.6, 2.04.7, 2.05.3 and 2.05.6 of the PAP should be completely revised and significantly expanded. If the multi-volume approach is retained the text in one volume should simply refer to the relevant section in the other volume where possible. Information in appendices should be summarized in the text, and explained where appropriate.
b. The permit boundary should be verified and must include all mine related disturbance. Maps should be updated to include the permit boundary layer, in accordance with rule 2.10.1(3).

References:

[1] Colorado Department of Public Health and Environment, Water Quality Control Commission, 2013. *Regulation No. 41*, Available at: https://www.colorado.gov/pacific/sites/default/files/41_2013%2801%29hdr.pdf

[2] Colorado Department of Public Health and Environment, Water Quality Control Commission, 2014. *Regulation No.42*, Available at: https://www.colorado.gov/pacific/sites/default/files/42_2014%2807%29withmaps.pdf

[3] Colorado Division of Water Resources, Well Permit Search. Available at: http://www.dwr.state.co.us/WellPermitSearch/default.aspx

[4] Colorado Mined Land Reclamation Board, 2005. *Regulations of the Colorado Mined Land Reclamation Board for Coal Mining*, Available at: http://mining.state.co.us/SiteCollectionDocuments/CoalRegulations91405.pdf

[5] C.W. Fetter, *Applied Hydrogeology*, 4th ed. Prentice Hall.

[6] Danielson, L.J., 2016. Waste Disposal and Groundwater Pollution King II Coal Mine Class II Permit #2012-0089 PETITION FOR CEASE AND DESIST ORDER AND REQUEST FOR HEARING.

[7] Division of Water Resources Board of Examiners of Water Well Construction and Pump Installation Contractors, *Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation and Monitoring and Observation Hole/Well Construction*, Available at: http://water.state.co.us/DWRIPub/Documents/Proposed%20Construction%20Rules%20-%20Final%202%2012%2016%20Clean.pdf

[8] King Coal Mine, *Annual Hydrology Report 2015*

[9] Resource Hydrogeologic Services, Inc., 2016. *King I & II Coal Mine Area Hydrologic Study La Plata County, Colorado*

[10] USGS, National Hydrography Dataset. Available at: http://nhd.usgs.gov/data.html

Appendix A: Packet of information sent by Tom Bird concerning well 260656

STATE OF COLORADO

Simmons - DNR, Leigh <leigh.simmons@state.co.us>

King Coal well permit 260656

Bird Tom <tbird@gcc.com> Thu, Jun 9, 2016 at 7:24 AM
To: "savageandsavage@earthlink.net" <savageandsavage@earthlink.net>, "Leigh\"Simmons - DNR,Leigh\"" <leigh.simmons@state.co.us>
Cc: Landon Beck <lbeck@resourcehydrogeologic.com>, Peterson Trent <tpeterson@gcc.com>, "Dan Hernandez (daniel.hernandez@state.co.us)" <daniel.hernandez@state.co.us>, "Robin Reilley (robin.reilley@state.co.us)" <robin.reilley@state.co.us>

Leigh,

Attached is the Owner's Notice of Constructed Well that I sent to DWR on 10/3/05. For whatever reason, it didn't take, so I re-sent 11/21/06. A year or so ago when I was updating the well data for TR-24, I noticed this wasn't on the DWR website. So, I hand delivered it to the local DWR office, where they assured me that this time they would get it right. It would appear that they didn't.

I will contact Rusty Crangle at DWR and follow up on the status.

I don't have any info on the other wells we use for monitoring. The Wiltse well was had been in place for quite some time when I came to work here in 1982. It has been sampled quarterly since 1982, but I was an underground electrician at the time and didn't have anything to do with wells and such until the mid-90s.

The #1 Upgradient well was apparently installed by the Ute Mountain Ute Tribe on State Land Board land (within our current Permit Boundary) but the well completion report apparently wasn't filed (or it suffered the same fate as Well 260656) and the trailer house that it served was moved away decades ago. I started collecting samples there at the same time we began sampling Well #260656, with the full knowledge of the Division.

Give a call if you have questions,

Tom

Tom Bird

GCC Energy, LLC

6473 County Road 120

Hesperus, CO 81326

970.385.4528 x 6503

970.769.1160 cell

From: savageandsavage@earthlink.net [mailto:savageandsavage@earthlink.net]
Sent: Thursday, June 09, 2016 5:56 AM
To: Leigh"Simmons - DNR,Leigh" <leigh.simmons@state.co.us>
Subject: Re: King Coal well permit 260656

[Quoted text hidden]

Monitor Well 260656 Owner's Notice of Constructed Well 2004 12 20.pdf
367K

0532066

STATE OF

RE-SENT
U.S. MAIL
11/21/06

OFFICE OF THE STATE ENGINEER
Division of Water Resources
Department of Natural Resources

1313 Sherman Street, Room 818
Denver, Colorado 80203
Phone (303) 866-3581
FAX (303) 866-3589

www.water.state.co.us

Thursday, November 02, 2006

NATIONAL KING COAL INC
4424 CR 120

HESPERUS CO 81326-

RE: Well Permit Number 260656 Owner's Designation HAY GULCH ALLUVIAL 2
Located in the SW 1/4, of the SW 1/4, Section 36, Township 35 N, Range 12 W, N P.M.

NOTICE

This permit to construct a well was issued on 12/1/2004 under Section 37-92-602(3), Colorado Revised Statutes. The expiration date of the permit is 12/1/2006. In order for the permit to remain valid, the well must be constructed and the Well Construction and Test Report must be received from the water well driller, the authorized individual, or you as the owner who constructed your own well. The Report must be submitted within 60 days after construction of the well is completed, or within seven (7) days after the expiration date of the permit. As of this date, a Well Construction and Test report has not been received by the Division of Water Resources. It is not necessary that the pump be installed for the permit to remain valid.

If the well will not be constructed prior to the expiration, the well owner may request, in writing by letter, or on form GWS-64, General Request for Extension of Well Permit Expiration Date, a one year extension of the expiration date. The request, including the well permit number, must be received by the Division of Water Resources prior to the expiration date of the permit and must provide a reason or reasons for not having the well constructed, and why the expiration date should be extended for an additional year. The extension request and other forms are available on our website at http://www.water.state.co.us/pubs/forms.asp.

The intent of the permit is to construct a well. If it appears the well will not be constructed, the request for extension may not be approved. The State Engineer may extend the expiration date of the permit only for good cause shown. If the expiration date has already been extended once for one year, the statute does allow successive extensions, again for good cause shown. If the request for extension is not approved, you may apply for a new permit as described below.

If the well will not be constructed and a request for extension has not been received, the permit will automatically expire and be of no force or effect after the expiration date. If you still desire to construct a well on this property, it will be necessary for you to obtain a new well permit by submitting a completed application along with a $100.00 (one hundred dollar) filing fee to the Division of Water Resources."

Should you have any questions, please contact any of the Division Field Offices in your area, or the Ground Water Information Desk in Denver at (303) 866-3587 between the hours of 9:00 a.m. and 4:00 p.m., Monday through Friday. Thank-you for your immediate attention.

Form No. GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LIC

WELL PERMIT NUMBER 260656 - - -
DIV. 7 WD 33 DES. BASIN MD

APPLICANT

NATIONAL KING COAL INC
4424 CR 120
HESPERUS, CO 81326-

(970) 385-4528

APPROVED WELL LOCATION
LA PLATA COUNTY
SW 1/4 SW 1/4 Section 36
Township 35 N Range 12 W New Mex P.M.

DISTANCES FROM SECTION LINES
50 Ft. from South Section Line
700 Ft. from West Section Line

UTM COORDINATES (NAD83)
Easting: Northing:

PERMIT TO CONSTRUCT A WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
5) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
6) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
7) The owner shall mark the well in a conspicuous place with well permit number(s) and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
8) This well must be constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules. If non-standard construction is anticipated, a variance request must be submitted in accordance with Rule 18 and approved prior to well construction.
9) A Well Construction and Test Report (Form GWS-31), including lithologic log must be submitted by the individual authorized to construct the well. For non-standard construction, the report must include an as-built drawing showing details such as depth, casing, perforated zones, and a description of the grouting type and interval.
10) This well shall be constructed not more than 200 feet from the location specified on this permit.

NOTE: This well is known as Hay Gulch Alluvial 2.

DW 1 DEC 04

APPROVED
DDW

Hal D. Simpson
State Engineer

Don Watt
By

Receipt No. 0532066 DATE ISSUED 12-01-2004 EXPIRATION DATE 12-01-2006

Lambert and Associates
CONSULTING GEOTECHNICAL ENGINEERS AND MATERIALS TESTING

January 10, 2005

National King Coal
P.O. Bx 2905
Durango, Colorado 81302

Attention : Mr. Tom Bird

D04007DR

Subject: Installation of Water Monitoring Well
National King Coal Mine Expansion Project
Hesperus, Colorado

Mr. Bird,

This letter presents the subsurface soil and water conditions encountered, and details regarding the installation of the monitoring well for the subject project. We installed the monitoring well in a location designated by you. We have not been contacted to perform geotechnical engineering services for the subject project.

We encountered soft silt and clay soil material from the ground surface to the bottom of the installation boring. Subsurface free water was encountered at a depth of approximately six (6) feet below the ground surface. The installation boring was advanced to a depth of eighteen (18) feet below the ground surface.

The water monitoring well consisted of two (2) inch diameter, schedule 40 PVC pipe installed to the bottom of the boring at eighteen (18) feet below the ground surface. The bottom approximate ten (10) feet was slotted. Approximately two (2) feet of PVC well casing extends above the adjacent ground surface. Pea gravel was packed from the bottom of the well to approximately six (6) feet below the ground surface. The upper six (6) feet of the well was then backfilled with powdered bentonite material. A six (6) inch well shroud was then placed over the monitoring well.

Please contact us if your have any questions, or if we may be of additional service.

Respectfully Submitted
LAMBERT AND ASSOCIATES

Jonathan P. Butler, P.E.
Staff Engineer

Reviewed by,

David L. Trautner, P.E.
Durango Office Manager

P.O. BOX 3986
GRAND JUNCTION, CO
(970) 245-4605

P.O. Box 0045
MONTROSE, CO 81402
(970) 249-2154

214 Bodo Drive
DURANGO, CO. 81301
(970) 259-5095

Send to: **Division of Water Resources**
1313 Sherman Street, Room 818
Denver, Colorado 80203

Fax: 303-866-3589
Phone: 303-866-3581

OWNER'S NOTICE OF CONSTRUCTED WELL

Construction of my well under **Permit No.** 260656 was

completed on DECEMBER 20 (month) (day), 2004 (year).

The well was constructed by: LAMBERT AND ASSOCIATES (drilling contractor).

If the pumping equipment has been installed.....

The pump was installed in my well by: _____ (pump contractor)

on _____ (month) (day), _____ (year).

Signed: _____

Date: 10/3/05 **Phone:** (970) 385-4528 x 14

The well must be constructed and pump installed by licensed water well construction and pump installation contractors, OR

PLEASE BE ADVISED that, pursuant to section 37-91-106(3), C.R.S. (2003), any person who intends to construct his/her own well or to install pumping equipment in a well as a "private driller" of "private pump installer" **must first successfully complete an examination** prescribed by the Board of Examiners of Water Well Construction and Pump Installation Contractors. (Contact the Division of Water Resources for details.)

Purpose of the "Owners Notice of Constructed Well"

It is necessary that your well permit remains valid to allow you and future owners of the property to withdraw ground water from the well for use and to have the well worked on by licensed contractors. First and foremost in maintaining your well permit valid and in good standing is the submittal of the **Well Construction and Test Report** and the **Pump Installation and Test Report** (work reports) that licensed contractors (or you, if you constructed the well as a "private driller" or installed the pump as a "private pump installer") are required to submit to the Division of Water Resources. Without the submittal of a work report to show that the well was constructed in conformance with the Water Well Construction Rules and that it is in compliance with the conditions of approval of the well permit, the permit will expire on the expiration date indicated on the permit.

Reinstatement of your permit after it has expired or obtaining a new permit for your well will require that you show that the well was constructed by a licensed water well construction contractor (or private driller) and that it meets the required standards of the Water Well Construction Rules. It is much easier and efficient to maintain the valid status of your original well permit than it is to try to have it reinstated after it has expired or to obtain a new permit for the existing structure.

Because it is not always easy to confirm that the required reports have been submitted to DWR, this "**Owner's Notice of Constructed Well**" is provided for your use. Do not give the notice to your contractor to submit. The notice is to be completed by you and mailed or faxed to the Division of Water Resources so that the Division is advised that your well has been constructed. If the required work reports are not then filed within a reasonable period of time, the Board of Examiners can initiate its procedures for obtaining the reports and thereby assist you in keeping your well permit valid.

Appendix B: Waste Bank Design Summary Report

[redacted]
999
[redacted]

Waste Bank Design
Summary Report

(1997 Waste Bank Enlargement Project)

National King Coal Mine
No. C-81-035
Durango, Colorado

prepared by;

Don R. May, P.E.
735 East 7th Avenue
Durango, CO 81301

November 1993
revised July 1997
revised November 1997
revised December 1997

January 1998

1. General Plan and Scope

This document combines all previous reports on the waste pile into one report. Detailed documentation is not included herein. Please refer to the original reports for complete documentation and other details. The previous reports are titled Waste Bank Design, Technical Revision 1, April 1991 and Waste Bank Design Technical Revision, September 1991.

According to stipulation No. 07 issued by the Division of Minerals and Geology of the State of Colorado, the design of the permanent coal waste bank at National King Coal Mine must satisfy the requirements stated in mine regulations 2.05(8), 2.50(9), 2.05(10), 4.10 and 4.11. This document attempts to address these regulations in a manner appropriate to the scale and scope of the National King Coal mine site.

The coal refuse will be mine waste rock extracted over the life of the mine. The material is composed of dense, medium grained sandstone with occasional shale and carbonaceous shale partings. With the addition of the proposed wash plant the production of waste rock will increase with an estimated ultimate volume of one million cubic yards.

The waste bank will be a valley fill type pile located in the east drainage. The existing coal waste bank, approximately 25,000 cubic yards, will be modified to meet the design specifications stated in this report and will be incorporated into the permanent structure.

A limit equilibrium static analysis was performed using effective stresses to assure long term stability of the bank. The face of the bank will have a surface slope of 2.5:1 or less. The east side drainage will diverted around the pile on the north side and will be tied into the clear water diversion system. An intercept channel will be constructed on the south side of the bank to collect contaminated runoff from the pile and runoff from adjacent areas and route it to the sedimentation ponds. An underdrain system will be constructed beneath fill and will also drain into the ponds.

The mine is located in a geologically stable area that rates low in seismic activity. Because the waste bank lies below the mining levels, there will be no subsidence effect.

2. Detailed Design

Waste Material Properties

As stated, the coal refuse is mine waste rock composed of dense, medium-grained sandstones. This material comes from the Menefee Formation, Mesa Verde Group, Upper Cretaceous age. The sandstone is a quartz sandstone with

calcareous to slightly ferruginous cement and minor argillaceous and carbonaceous shale partings. Based on analysis of material removed from the mine the following particle size distribution was obtained.

Size Distribution	
Material above 6"	20% by weight
Material above 4"	30% by weight
Material above 2"	30% by weight
Material above #4 mesh*	10% by weight
Material above #10 mesh*	5% by weight
Material above #40 mesh*	< 5% by weight
Material above #200 mesh*	<5% by weight

*U.S. Series equivalent screen size
This information was provided by National King Coal

The following table summarized material properties for the waste rock.

Material Strength
Approx. dry density = 86 pcf
Maximum dry density = 91 pcf
Optimum moisture content = 12.0%
Internal angle of friction = 32°
Cohesion = 2.8 psi
Relative toughness = 1.5
Ft-lb/ft^2 of fracture = 312.4
Compressive strength, 9500 psi (no partings)
Compactive 12.5%
Compressive strength, 8400 psi (partings)
This data was supplied by King Coal

Coal Waste Pile Configuration

The criteria used in designing the waste pile were 1) to be structurally stable, 2) provide 1,000,000 cubic yards of storage volume and 3) to provide adequate surface and subsurface drainage. Please refer to design drawing sheets 1 and 2 for details.

The waste pile will begin at the toe of the existing waste bank, across the access road from the coal storage pile and extend up valley about 1600 ft. The waste pile will have a front face slope of 2.5:1, extend across the valley from side to side and have a maximum thickness of 200 ft at the top of the front face. It will slope upvalley at 1% and will have a cross slope of 2% with the high side on the north.

Waste rock will be transported to the top of the pile via conveyor and will be spread with heavy equipment that will access the top of the pile from existing roads leading to the top of the mesa from the northeast. A constructed road that traverses the pile and the north hillside and terminates on the top of the waste pile will provide access for light duty vehicles. The road will initially be constructed as shown up to the point where it attains its highest elevation on the north hillside. Then it will gradually drop back down toward the valley floor as it heads east, upvalley. As the pile volume increases in elevation it will progressively cover this portion of the road until the maximum volume is reached and the road will appear as shown on the plans. This will give continuous access as the pile grows with time.

Stability Analysis

A limit equilibrium analysis for plane surfaces was used to assess the stability of the design configuration. The analysis is appropriate for simple geometries with plane failure surfaces. Because of the very shallow depth to bedrock a circular failure plane is unlikely and a plane failure surface parallel to the bedrock is expected. Static equilibrium equations were derived for the specific geometry occurring at this site.

The limit equilibrium stability analysis is dependent on three soil properties: effective cohesion, effective friction angle and the unit weight of the material. To determine field estimates of these properties, soil samples and testing were completed by Lambert and Associates, Inc. (Consulting Geotechnical Engineers and Material Testing). A hollow stem auger was used to drill through the entire thickness of the existing pile. Samples were extracted at various depths and used to estimate the soil properties.

Direct shear tests were performed to determine the effective cohesion and friction angle. The result of these tests covered an exceptionally wide range and thus a triaxial shear test was performed to confirm the appropriate values. The unit weight of the material was determined during compaction tests. Test results are reported in the properties table shown above.

Safety factors computed using these parameters were from 1.5 to 2. The analyses included pore water effects, which lowers the safety factor resulting in a conservative estimate. The required safety factor must be equal to or greater than 1.5.

Construction

The waste pile will be constructed in stages, progressively extending up the drainage as needed. Prior to development of a new stage, the topsoil will be removed and stockpiled. All vegetation will be removed prior to stripping of the topsoil.

The mine waste material shall be put in place in lifts that optimally should be between 12-18 inches and in no case shall exceed 24 inches. The density of each lift should meet state regulations, which require that waste material be compacted to at least 90% of the maximum dry density.

A Proctor Test was run on soil samples from the existing waste pile to determine the maximum dry density and the optimum moisture content of that material. The tests conformed to the required AASHTO T99-74 standard procedure. The maximum dry density was 91.0 pcf and the optimum moisture content was12%.

Ongoing Density Measurements:

As construction of the pile progresses, periodic density measurements of the compacted fill material shall be performed. The following guidelines should be used.

1. The density of all waste material placed on the pile shall be at least 90% of the maximum dry density.
2. A Standard Proctor Test (AASHTO T99-74) shall be performed near the beginning of construction to establish baseline parameters. Subsequent test can be performed using a nuclear density gage.
3. A random test shall be performed during each of the first five years of construction and at least every other year after that.
4. If at any point during the construction of the waste pile, the consistency of the waste material changes, another Standard Proctor Test shall be performed to verify the validity of the current baseline parameters.
5. If the results of a random density test fail to meet the required 90% compaction one or more follow up tests shall be performed until the site engineer is confident that compaction standards are being met.
6. The site engineer shall determine the number of measurements and location of tests. Both of these will vary as the waste pile increases in size.

Topsoil and Fill Cover Material:

Final reclamation of the waste pile requires that there be 3.5 feet of cover and 6 inches of topsoil on top of the waste pile. The fill material may consist of naturally occurring soil and rock removed from the site and stockpiled in preparation of placement of waste fill. All vegetative material should be removed prior to stockpiling the cover material. Material appropriate for topsoil should be kept in a separate pile. Cover material stockpiles should be located near the five, ten and fifteen year estimated elevations of the waste pile (or at other logical intervals which will reduce the transport cost during fill placement).

The unit weight and composition (percent topsoil, rock, other soil etc.) of cover material should be periodically estimated during the clearing process. This

can be accomplished using the mine scales and the known volume of a front end loader bucket. This information can then be used in establishing the bond estimate. In addition to the physical properties, a chemical analysis of the topsoil must be performed to determine the quantity of fertilizer that will be needed to assure successful growth of vegetation during final reclamation.

Five Year Waste Pile

A revised estimate of 5000 cubic yards of waste rock production annually was used in estimating the elevation of the 5-year waste pile. Beginning with the existing waste rock volume, approximately 25,000 cubic yards, and adding the annual increment, results in a required 5-year volume of 50,000 cubic yards. This corresponds to a pile height of 75 feet (elevation 7490). The boundary of the 5-year pile is shown on the accompanying design drawing. In addition, the volume of cover material (fill and topsoil) for the 5-year pile was estimated at 7000 cubic yards. Of this, the mine operator estimated that they currently have enough cover stockpiled to accommodate the existing pile (about 4800 cubic yards of cover). A location for the 5-year cover storage pile (7000 cubic yards) is shown on the plan drawing.

Drainage Features

Enlargement of the waste pile will require modification of the drainage intercept ditches on both the north and south side of the pile. In addition the sedimentation ponds will be altered to accommodate the increased contaminated runoff volumes. All ditches and pipes are sized for the 100 year event and the ponds for the 10 year event. Please refer to the drainage report (revised July 1997), and the accompanying design drawings for details.

The Eastside drainage channel will be moved from its existing location, to the north against the natural hill slope. As the waste bank increases in elevation the ditch will move up the hillside. At the top of the sloping pile faced the channel will intersect an armored channel that will flow down the front face of the waste pile. These two ditches will route uncontaminated water to the clear water diversion system.

A similar set of intercept ditches on the south side of the pile will collect contaminated runoff from the pile and some clear water from the adjacent hillside and route it to the sedimentation ponds. Please refer to the design drawings and the drainage report for details.

Underdrain

An underdrain system for the waste pile is required by the regulations. The purpose is to intercept water which originates either form precipitation infiltration through the waste pile surface or from the interception of groundwater at the pile-

ground interface. Sizing of the underdrain should consider both of these water sources. No detailed guidelines for determining the size are provided by the state. The following factors were used in setting the underdrain size.

Groundwater:

Two observation wells were augered to determine if the groundwater table was near the surface in the area of the proposed waste pile. The first well was located just upvalley of the top of the 2.5:1 slope on the face of the pile. It was centered in the valley. The boring log showed that the top 22 feet of natural material consists of silty and slightly sandy clay with some gravel. Water was encountered at a depth of 20 ft. and bedrock at 22 ft. The second boring was located approximately 600 ft. upvalley of the first. The top 22 ft consisted of the same material as in the first bore. From 22 ft. to 36 ft. the material is siltstone and sandstone. No water was encountered. The total depth was 36 feet.

In addition to the augering, a detailed search of both sides of the drainage from bottom to top was completed for signs of seeps, springs or other indications of groundwater at the surface. None was found. This supports historic observations from routine inspections made over the last several years. Based on these results it is concluded that groundwater does not significantly contribute to the water within the waste bank.

Underdrain Size:

Precipitation falling directly on the pile and snowmelt are the primary sources of water reaching the pile. A portion of this water will infiltrate the surface and make its way either to 1) the natural ground-waste pile interface where it will continue to move down to the groundwater table or 2) it will move to the underdrain located at the bottom and center of the waste pile. The underdrain should be sized to adequately transport this latter portion out of the waste pile.

The size of the underdrain was estimated based on a rough approximation of the hydraulic routing of water through the pile. The next table shows the geometric, hydraulic and hydrologic parameters used in the analysis.

The first component is the design precipitation. NOAA climatologic data for Durango were reviewed and the maximum monthly total for each month was selected from the 97 years of record. These were averaged over the 12 months to get a maximum average monthly value of 6.38 inches. This depth was spread out over 15 days instead of 31 to reflect the discontinuous nature of local rainfall. The resulting rate was used as the precipitation input for all drain sizing estimates.

The waste pile was divided into five equal zones along its length. Routing of the infiltrated precipitation through each zone was approximated based on the geometry of that zone. Once the flow moves vertically through the zone it enters the drain. Note that the hydraulic conductivity of the gravel used to fill the drain is

100 to 1000 time larger than that of the waste material. This indicates that the water will move much faster through the drain than through the pile. Because of this fact and the relative steep slope of the valley floor (drain slope) compared to the pile surface, each zone drains approximately independently, in time, of the others. This is the routing effect and means that only a portion of the pile will be contributing flow to the drain during any given time interval of the design event.

Physical Properties

geometry

valley slope = 0.1265
pile face slope = 0.4000
pile top slope = 0.0100
pile length = 1600 ft

Average pile dimensions for five equal length segments (ft)
(bottom of pile upvalley to top of pile →)

length	320	320	320	320	320
width	320	500	420	380	200
thickness	44	131	102	65	27

hydraulic

hydraulic conductivity, K
gravel (drain fill) material
range of Ku = 0.0010 ft/s to 0.1024 ft/s
average Ku = 0.0132 ft/s
waste rock material
Kw = 1.086×10^{-5} ft/s

hydrologic

gross infiltration rate = 50% of long term precipitation
precipitation - mean max. month = 6.38 in. (period of record)

note: hydraulic conductivities and the infiltration are coarse estimates based on reported text book values for similar materials.

After balancing the estimated inflow to the drain with the flow capacity of the drain and adding a safety factor a size was estimated. It is reasonable to assume that the drain size should decrease as you move upvalley and have less volume and surface area contributing to it.

The lower portion (approximately 400 ft.) will be serviced by the existing drain constructed for the original waste pile. The new drain was designed in three sections of 400 feet.

Underdrain Size

Reach	Length (ft. bottom to top)	Drain size (width x depth in ft)
1	0 to 400	existing 3x3, square
2	400 to 800	7x4, rectangular
3	800 to 1200	5x4, rectangular
4	1200 to 1600	3x3, rectangular

The new portion of the drain should be connected to the existing drain at its terminus. Because the existing drain is not sized to handle all flow generated above it an 8" drain pipe (schedule 40 pvc in bedding) should be connected at

this junction to help transport flow to the yard (sediment ponds) and away from the pile. See the design drawings for details.

In addition to the main, central drain it is recommended that French drains be constructed on both sides at 100-foot intervals for the 800 ft of reaches 2 and 3. These French drains should consist of 4" perforated pipe centered in a bedding zone 24" x 24", trenched into the natural surface. The bedding should be a well graded gravel with a maximum rock size of ¾ ". The finger drains should extend through the side of the underdrain filter liner and into the drain. Laterally they should extend across the valley floor to the breakpoint in the slope with the valley side walls.

If at anytime during salvaging of topsoil or any other construction activity, a spring or seep is encountered, an additional lateral French drain shall be installed from the seep to the underdrain. It shall be constructed as described above.

The underdrain is wrapped in a porous filter cloth (designed to allow water to enter but keep out fine sediment) and filled with rock. No more than 10% of the rock may be less than 12" in size and no single rock may be larger than 25% of the depth of the drain. Flow from the drain will enter the lower intercept channel and subsequently be diverted to the ponds for settling.

Appendix C: Copy of Tables 1 through 4 of “The Basic Standards for Ground Water”

TABLE 1 Domestic Water Supply – Human Health Standards	
Parameter	**Standard[1]**
Biological	
Total Coliforms (30 day average)	2.2 [a]org/100ml
Total Coliforms (max in 30 days)	23org/10 ml
Inorganic	
Antimony(Sb)[d, M]	0.006mg/l
Asbestos[M]	7,000,000fibers/l
Arsenic (As)[d, M]	0.01mg/l
Barium (Ba)[d, M]	2.0mg/l
Beryllium (Be)[d, M]	0.004mg/l
Cadmium (Cd)[d, M]	0.005mg/l
Chromium (Cr)[c, d, M]	0.1mg/l
Cyanide [Free] (CN)[M]	0.2mg/l
Fluoride (F)[d, M]	4.0mg/l
Lead (Pb)[d]	0.05mg/l
Mercury (inorganic) (Hg)[d,M]	0.002mg/l
Molybdenum (Mo)[d]	0.21mg/l
Nickel (Ni)[d]	0.1mg/l
Nitrate (NO_3)[d, M]	10.0mg/l as N
Nitrite (NO_2)[d, M]	1.0mg/l as N
Total Nitrate+Nitrite (NO_2+NO_3-N)[d, f]	10.0mg/l as N
Selenium (Se)[d, M]	0.05mg/l
Silver (Ag)[d]	0.05mg/l
Thallium (Tl)[d, M]	0.002mg/l
Uranium (U)[d, 2]	0.0168 to 0.03[M]mg/l
Radiological[b, d]	
Gross Alpha Particle Activity[j, M]	15pCi/l
Beta and Photon Emitters[e]	4mrem/year

TABLE 2 Domestic Water Supply Drinking Water Standards	
Parameter	**Standard**
Chlorophenol	0.0002mg/l
Chloride(Cl)[d]	250mg/l
Color	15 color units
Copper (Cu)[d]	1mg/l
Corrosivity	Noncorrosive
Foaming Agents	0.5mg/l
Iron (Fe)[d]	0.3mg/l
Manganese (Mn)[d]	0.05mg/l
Odor	3threshold odor numbers
pH	6.5 - 8.5
Phenol	0.3mg/l
Sulfate (SO_4)[d]	250mg/l
Zinc (Zn)[d]	5mg/l

TABLE 3 Agricultural Standards	
Parameter	**Standard**
Aluminum (Al)[d, f]	5mg/l
Arsenic (As)[d]	0.1mg/l
Beryllium (Be)[d]	0.1mg/l
Boron (B)[d, g]	0.75mg/l
Cadmium (Cd)[d]	0.01mg/l
Chromium (Cr)[d]	0.1mg/l
Cobalt (Co)[d]	0.05mg/l
Copper (Cu)[d]	0.2mg/l
Fluoride (F)[d]	2mg/l
Iron (Fe)[d]	5mg/l
Lead (Pb)[d, f]	0.1mg/l
Lithium (Li)[d, h]	2.5mg/l
Manganese (Mn)[d, j]	0.2mg/l
Mercury (Hg)[d, f]	0.01mg/l
Nickel (Ni)[d]	0.2mg/l
Nitrite (NO_2-N)[d, f]	10mg/l as N
Nitrate+Nitrite (NO_2+NO_3-N)[d, f]	100mg/l as N
Selenium (Se)[d]	0.02mg/l
Vanadium (V)[d]	0.1mg/l
Zinc (Zn)[d]	2mg/l
pH	6.5 – 8.5

TABLE 4 TDS Water Quality Standards	
Background TDS Value (mg/l)	**Maximum Allowable TDS Concentrations**
0 - 500	400mg/l or 1.25 times the background level, whichever is least restrictive
501 - 10,000	1.25 times the background value
10,001 or greater	No limit

[1] Chronic or 30-day standard based on information contained in EPA's Integrated Risk Information System (IRIS) using a 10^{-6} incremental risk factor.

[2] Whenever a range of standards is listed and referenced to this footnote, the first number in the range is a strictly health-based value, based on the Commission's established methodology for human health-based standards. The second number in the range is a maximum contaminant level, established under the federal Safe Drinking Water Act that has been determined to be an acceptable level of this chemical in public water supplies, taking treatability and laboratory detection limits into account. The Commission intends that control requirements for this chemical be implemented to attain a level of ambient water quality that is at least equal to the first number in the range except as follows:

- Where ground water quality exceeds the first number in the range due to a release of contaminants that occurred prior to September 15, 2012, (regardless of the date of discovery or subsequent migration of such contaminants) clean-up levels for the entire contaminant plume shall be no more restrictive than the second number in the range or the ground water quality resulting from such release, whichever is more protective.
- Wherever the Commission has adopted alternative, site-specific standards for the chemical, the site-specific standards shall apply instead of these statewide standards.

The Commission does not intend the adoption of this range of standards to result in changes to clean-up requirements previously established by an implementing agency, unless such change is mandated by the implementing agency pursuant to its independent statutory authority.

[a] When the Membrane Filter Technique is used for analysis, the average of all samples taken within thirty days must be less than 1 organism per 100 milliliters of sample. When the Multiple Tube Fermentation Method is used for analysis, the limit is less than 2.2 org/100 ml.

[b] If the identity and concentration of each radionuclide in a mixture are known, the limiting value would be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit specified. The sum of such ratios for all radionuclides in the mixture shall not exceed "1" (i.e. unity). A radionuclide may be considered as not present in a mixture if the ratio of the concentration to the limit does not exceed 1/10 and the sum of such ratios for all radionuclides considered as not present in the mixture does not exceed 1/4.

[c] The chromium standard is based on the total concentration of both trivalent and hexavalent forms of dissolved chromium.

[d] Measured as dissolved concentration. The sample water shall be filtered through a 0.45 micron membrane filter prior to preservation. The total concentration (not filtered) may be required on a case-by-case basis if deemed necessary to characterize the pollution caused by the activity.

[e] If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem per year. Except for Tritium and Strontium 90 the concentration of man-made radionuclides causing 4 mrem total body or organ dose equivalents shall be calculated on the basis of a 2 liter per day drinking water intake using the 168-hour data listed in "Maximum Permissible Body Burden and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," NBS Handbook 69, as amended, August 1963, US Department of Commerce.

[f] These more stringent levels are necessary to protect livestock watering. Levels for parameters without this footnote are set to protect irrigated crops at the same level. Where a party can demonstrate that a livestock watering use of ground water is not reasonably expected, the applicable standard for lead is 5.0 mg/l.

[g] This level is set to protect the following plants in ascending order of sensitivity: Pecan, Black Walnut, Persian (English) Walnut, Jerusalem Artichoke, Navy Bean, American Elm, Plum, Pear, Apple, Grape (Sultanina and Malaga), Kadota Fig, Persimmon, Cherry, Peach, Apricot, Thornless Blackberry, Orange, Avocado, Grapefruit, Lemon. Where a party can demonstrate that a crop watering use of ground water is not reasonably expected, the applicable standard for boron is 5.0 mg/l.

[h] This level protects all crops, except citrus which do not grow in Colorado and therefore a more stringent level of protection is not required.

[i] The Gross Alpha Activity standard excludes alpha activity due to Radon and Uranium.

[j] This standard is only appropriate where irrigation water is applied to soils with pH values lower than 6.0.

[M] Drinking water MCL.