



Dave Freudenthal,
Governor

Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.



John Corra,
Director

June 22, 2009

Mr. John Cash
Lost Creek ISR, LLC
Manager EHS and Regulatory Affairs
5880 Enterprise Drive, Suite 200
Casper, WY 82609

RE: LQD's second round of review comments on Lost Creek's responses to Amy Boyle's August 26, 2008 Memo reviewing Appendices D-5 and D-6, TFN: 4-6/268

Dear Mr. Cash,

The enclosed memorandum (from Amy Boyle and me) contains the WDEQ/LQD's second round of review comments on the aforementioned technical review.

Please reference TFN 4 6/268 in your response to this review and please summarize any changes to the permit via an Index Sheet.

Sincerely,

Melissa L. Bautz
Geologist
Lander WDEQ/LQD

Enclosure Memorandum Dated June 19, 2009- LQD's second round of review comments on Lost Creek's responses to Amy Boyle's August 26, 2008 Memo reviewing Appendices D-5 and D-6, TFN: 4 6/268

- Cc: Bill Boberg, Ur-Energy USA 10758 W. Centennial Rd., Suite 200, Littleton, CO 80127 (w/encl)
- Wayne Heili, Lost Creek ISR, 5880 Enterprise Dr. Suite 200, Casper, WY 82609 (w/encl)
- Mr. Alan Bjornsen, U. S. Nuclear Regulatory Commission , Federal and State Materials and Environmental Management Programs Mail Stop T-8F5, Washington D. C. 20555-0001(w/encl)
- Mr. Ron Burrows, U. S. Nuclear Regulatory Commission , Federal and State Materials and Environmental Management Programs Mail Stop T-8F5, Washington D. C. 20555-0001 (w/encl)
- Mark Newman, BLM Rawlins, P. O. Box 2407, Rawlins, WY 82301 (w/encl)
- Don McKenzie, LQD Administrator, Cheyenne (w/encl)
- Mark Moxley, LQD District 2 Supervisor, Lander (w/encl)
- Chron (w/encl)

Lander Field Office • 510 Meadowview Drive • Lander, WY 82520 • <http://deq.state.wy.us>

ABANDONED MINES
(307) 332-5085
FAX 332-7726

AIR QUALITY
(307) 332-6755
FAX 332-7726

LAND QUALITY
(307) 332-3047
FAX 332-7726

SOLID & HAZARDOUS WASTE
(307) 332-6924
FAX 332-7726

WATER QUALITY
(307) 332-3144
FAX 332-7726

MEMORANDUM

TO : Lost Creek ISR, Permit Application Review, TFN 4 6/268

FROM : Amy Boyle, Geologic Project Analyst - Lander *AB*
Melissa Bautz, Geologist - WYDEQ/LQD - Lander *MB*

DATE : June 19, 2009

SUBJECT : LQD's second round of review comments on Lost Creek's responses to Amy Boyle's August 26, 2008 Memo reviewing Appendices D-5 and D-6, TFN: 4 6/268

This memorandum provides the second round of Land Quality Division (LQD) review comments for the aforementioned submittal. On May 5, 2009, the WDEQ/LQD Lander office received Lost Creek ISR's (LC's) responses to Amy Boyle's comments summarized in a memorandum dated August 26, 2008. That memorandum provided review comments on Appendices D-5 and D-6 of LC's ISR Permit Application being handled under temporary filing number (TFN) 4 6/268.

The review is organized as follows. The original Land Quality Division (LQD) comment appears first in italicized font. A summary of Lost Creek's (LC's) response appears in regular type font. Then, LQD's review of that response appears in bold faced and/or underlined font. Some new comments have been generated as a result of the new information received. These are added at the end of the document and appear in bold text.

Section D-5 Geology

- Section D5.1.1, paragraph 2, Section D5.1.1 paragraph 1, and Table D5-1 (Permit Area Stratigraphy) state that within the permit area the Ft. Union Formation is 4,650 feet thick yet the Geologic Cross Section (Figure D5-2a) Schematic only illustrates the Ft. Union as being 1,000-2,000 feet thick. This is the same for other formation thicknesses (e.g. Battle Springs and Wasatch are said to be 6,200 feet thick, yet the cross section only shows them to be 4,000 feet thick). This discrepancy between Figure D5-2a, Table D5-1 and the text needs to be corrected.*

Figure D5-2a has been redrawn closer to scale. The 1973 cross section by R. E. Wellborn is not to an exact scale regarding relative thicknesses of the formations, as presented in Table D5-1, though the revised scale is an improvement. **This item is resolved.**

- Figure D5-1 is a Regional Geologic Map. This map indicates the faults in the area, but does not indicate the Lost Creek Fault within the permit area. This is a significant and well documented feature within the permit area, and should be indicated on the Figure.*

Figure D5-1 is only intended to depict major regional faults. Since the Lost Creek Fault zone is a minor fault system, it is not illustrated on the regional map. It is, however,

illustrated on the property-scale maps. **The legend on Figure D5-1 should be changed to read “Major regional faults”.**

3. *Section D5.1.2, paragraph 2. This section discusses the presence of the Lost Soldier Anticline to the northeast of the permit area. Looking at Figure D5-1 it is not readily apparent where the axis of this anticline is located. If possible, please delineate the Lost Soldier Anticline on Figure D5-1.*

A sentence has been added to the text indicating the location of the Lost Soldier Anticline, sixteen miles northeast of the permit area. Additionally, the map symbol for an anticline has been added to Figure D5-1. **This item is resolved.**

4. *Plates D5-1a – D5-1e. These plates provide one generalized and several detailed geologic cross sections down the centerline of the ore body, and across the centerline of the ore body. In addition, Figure D5-2a provides a very generalized geologic cross section across the northern portion of the permit area. LQD Non-Coal Rules, Chapter 11, Section 3(a)(viii) requires cross sections that show geologic features within the entire permit area, and how they relate to the production zone. Extending cross sections F, G, and H to the boundaries of the permit area with any available drill hole data, will help to provide this information.*

The cross sections have been updated with the information from new borings and wells completed in 2008. Plates D5-1b through D5-1e have been replaced and two new plates have been added (D5-1f and D5-1g). The references in the text to these plates have also been updated.

- a) **The northern (left) edge of cross section F-F’, presented on Plate D5-1e appears to have 880 feet of extrapolation. What boring provides data for the northern extent of this cross section?**
- b) **The piezometric surfaces are indicated for the DE, LFG, HJ and UKM aquifers, though it is not clear if there are any monitoring wells on the cross sections from which the water tables were derived. Please designate any monitoring wells on the cross section, and indicate their screened intervals and water levels with date.**
- c) **Additional faults are indicated on the north/south trending cross sections. Please add these faults to the map key, as well as within the discussion of Section D5.2.2 the permit document. In addition, these faults should be indicated on all maps where the Lost Creek Fault is included, if they fall within the scale of the map.**
- d) **Section D5.2.1 Stratigraphy. Paragraph 3 references trends in stratigraphy relative to “the Fault”. This wording needs to be changed since it is now apparent that there are many faults within the permit area. Please specifically state the Lost Creek fault.**
- e) **No cross section has been provided for Section 16, which represents approximately 1/6 of the permit area. What is known about this section? Do the stratigraphic units extend to this part of the permit area? Are there any faults? Is there any potential mineral reserve? If not, why is this section**

included within the permit area? An additional cross section, which includes Section 16 should be added.

5. *Figure D5-2b and Figure D6-10. These figures show a stratigraphic column against a geophysical log, yet the type and scale for the log is not provided. Also the description is generalized and does not indicate the stratigraphic detail that should have been recorded in the field. It is requested that the Figure title be changed to read 'Generalized Stratigraphic column'.*

Figures D5-2b and D6-10 have been redrawn providing a much more comprehensive log and descriptions. The title on Figure D5-2b in the Table of Contents was also changed to be the same as the title on the figure. **This item is resolved.**

6. *Several of the Plates, beginning with Plate D5-1a indicate the mine unit boundaries, yet the proximity of Mine Unit 6 to the eastern boundary of the proposed permit area, will need to be changed to allow for the monitor well ring and aquifer exemption boundary to be within the permit boundary.*

The mine unit boundaries displayed on the figures and plates are conceptual and not intended to indicate the specific extent of either the "pattern area", monitor well ring, or aquifer exemption area for a given mine unit. The maps LC sends with each mine unit application will show the definitive boundaries, based on the specific physical conditions for that mine unit. **A comment explaining the conceptual nature of the mine unit boundaries must be added to the plates which indicate the conceptual boundaries. In addition, a disclaimer which states, "In order for the mine unit No. 6 boundary to be located as depicted, a permit boundary revision would be necessary."**

7. *Section D5.3.5 discusses the Short-Term Probabilistic Hazard Analysis, yet does not explain how the potential estimated accelerations would affect the well structure, pipelines or buildings on site. Please add this information to the text.*

Text was added near the end of Section D5.3.5 to explain the potential impacts. The added text explains how facility structures, pipelines, and well structures will be designed to sustain an intensity V earthquake. The added text also explains that observations of injection, production, and pipeline pressures and associated monitor well measurements, necessary for the in situ operation, will provide short term information about any unanticipated seismic impacts. **The text in this section must also include a discussion of reporting protocol that will be followed if such a seismic event occurs. The protocol should include inspection of all buildings, equipment pipelines and injection, production and monitoring wells, including monitoring well measurements. How soon after the seismic event such inspections and measurements will be made and how soon a report would be sent to LQD should be stated.**

8. *Section D5.2.2, Structure. This section discusses there being one minor fault, the Lost Creek Fault, within the permit area, yet the maps in this section indicate a second fault to*

the west of the Lost Creek fault, yet within the permit area. This fault should be discussed in detail.

The text in Section 5.2.2 has been updated to reflect the most current information (2008 exploration drilling). As additional information about the fault system is collected in the vicinity of a given Mine Unit, that information will be provided with the relevant Mine Unit Package. **Given that LQD is requiring Mine Unit 1 to be included in the application, it is expected that this information be provided for Mine Unit 1 at this time (prior to permit approval). It will be acceptable to submit fault information for future mine units (I.e. Mine Units 2 through 6) with the relevant mine unit packages. However, information that is currently known about other faults within the permit area, should be discussed within Section D5.2.2. (See comment 4(c)).**

9. *Plate D5-1a. On the cross sections please show the formations present to the total depth of the boring, i.e. if the boring (e.g. TE61, P2-19, TT40, LC3) crosses into the no name shale and or Middle KM horizon, and below, this should be indicated on the cross sections.*

The total depth of each boring has been added to the cross-section on Plates D5-1e through D5-1g, or cross section F-F', G-G', and H-H'. The A-E cross sections do not indicate total depth of each boring, though this information was not requested in the original comment nor necessary due to the elevation scale on each cross section. The stratigraphic interpretations at the lower zones was addressed adequately in the response noting that lack of information across the site at these depths would lead to too much interpretation. **This item is resolved.**

10. *Plates D5-1a through D5-1e. Geologic Cross Sections should be reviewed, approved and stamped by a licensed Wyoming Professional Geologist, as per the Wyoming Geologists Practice Act.*

Both the Lander and Cheyenne copies of the new maps and cross-sections submitted with these responses have been stamped by Mr. Cal Van Holland, Wyoming PG-2184. **This item is resolved.**

11. *Plates D5-1b – D5-1e show many places where the Sage Brush Shale has mineralized zones of ore, e.g. TG19-20, TG68-20, TG12-20, TG58-20, TG2-10, TG9-17, TG10-17, and TG11-17. The presence of mineralized zones within the Sage Brush Shale brings to question the ability of this unit to act as an adequate aquitard between the LHJ and UKM sands. The Sage Brush Shale is defined as a fine sand and shale unit. How fine is the sand if it had enough transmissivity to be a receiving unit for the Uranium? The overlying Lost Creek Shale also has some minimal mineralization within it. What is the likelihood that these shales could leach out Uranium altering the integrity of the unit. It is requested that the MKM be fully characterized for baseline, north and south of the fault, as it may end up being the underlying aquifer that needs to be protected during mining of both the HJ horizon and potentially the UKM horizon.*

Given the nature of the Battle Spring Formation LC maintains that aquicludes and aquitards (e.g. the Lost Creek or Sage Brush Shales) have lithologies dominated by mudstones and claystones; but may also include substantial amounts of siltstone and fine-grained sands. Given the extremely low concentration of uranium mineralization in the shale, even if the uranium were removed through mining, it would not result in any noticeable alteration of the shale's integrity. Also, the uranium mineralization is epigenetic so the structural integrity of the shale was established prior to the emplacement of uranium and is therefore independent of the uranium. The shale layers in question are strongly reduced which will largely prevent the oxidation and subsequent of dissolution of uranium mineralization even if mining solutions were to come in contact with the uranium [in the shales]. The response provides greater detail in describing that the 'lithologies provide considerable lateral facies changes and interfingering, and are often transitional to the aquifers above or below. As a result, dramatic thickening and thinning of the aquicludes can occur locally. In addition, their upper and lower boundaries are often gradational. Aquicludes may even exhibit localized occurrences of mineralization in the vicinity of lithologic interfingering and facies changes with mineralized sands.' **The description in the response about the gradational and interfingering characteristics of the aquitards and aquicludes, as well as the cross section illustrating the character of the aquitards and aquicludes, provides a more detailed description of the nature of the stratigraphy at the site. Please incorporate this information into Section D5.2 Site Geology. In addition, it is understood that due to the epigenetic nature of the mineralized zones the structural integrity of the strata will not be impacted, yet a discussion of how mining will affect the storativity and transmissivity of the mineralized zones within the aquitards needs to be presented.**

12. *Plate D5-2a, and D5-2c Isopach Maps of the Lost Creek Shale and Sagebrush Shale (respectively). For areas where the isopachs indicate the unit thickness is less than ten feet thick, please indicate at specific drill hole sites, what the thickness is at that location, so the reviewer knows how much less than ten feet in thickness the aquitard is at a given location.*

Isopach maps have been updated with the information from new borings and wells completed in 2008, and the actual unit thicknesses have been added where the thicknesses are less than 10 feet. **There are a number of borings within the <10 ft. zone where no data is provided, in addition, the footage and the drill hole location overlap in many places on Plate D5-2c making them un-readable. Also, a statement should be added to Section D5.2.1 Stratigraphy, regarding the minimum known thickness of each of these aquitards. Please revise accordingly.**

13. *Section D5.2.4 Historic Uranium Exploration Activities, and Plate AD5-2a-c Location Map of Historical Drill Holes. It is stated that there are at least 560 exploration holes in the area, and Attachment D5-2 lists the holes northing and easting, year drilled and ID. Please also include depth of hole and discuss further the efforts made to locate the old drill holes, and whether or not it was confirmed that the hole had been properly abandoned. If the hole was abandoned through recent efforts, the plugging procedure and date should be indicated as well. The map should be updated to indicate the status of each drill hole location. Once*

operations commence, it is important that these historic drill holes do not provide a pathway for production fluids to migrate to underlying or overlying aquifers.

Section D5.2.4 has been renamed (Subsurface Exploration Activities) because more than just historic uranium exploration is discussed in the section. It has also been divided into two subsections. The first subsection describes uranium exploration and the second summarizes other exploration. The first subsection has been further expanded to include: The results of efforts to obtain information about the known historic holes, including hole depths; descriptions of re-abandonment efforts that have been needed to date; and steps that will be taken to identify any improperly abandoned drill holes in the mine units. Table D5-2 (Abandonment Information for Historic Exploration Holes and Attachment D5-3 (Communication with WDEQ LQD related to Drill Hole Abandonment) have also been added.

Attachment D5-3 and the updating of Table D5-2 are welcome additions to the permit document.

However, essential to LQD's review is an understanding of the location of historic drill holes and their status as related to the location of proposed mine units. For this reason, Plates AD5-2a, AD5-2b, and AD5-2c (in Attachment D5-2) must include the location of the proposed mine units, a topographic layer, and the status of each known hole via a legend.

The efforts made by Tg in the early 80's were extensive, yet many holes were unlocatable, many holes had caps which had fallen downhole, and were therefore not probed, and the majority of holes probed had standing water. Yet, only those holes found with 200 ft. or more of water above the mud seal, were re-sealed.

The efforts made in 2006 by UR Energy to provide sealing of drill holes due to a localized pump test only involved fifteen wells, three could not be located. Twelve wells were reamed out down to 600-650 feet and then grouted. It seems that the majority of holes may be open from the concrete cap to 200 ft. depth. (As noted in the January 2009 review comments, the LQD has concerns about the lack of these old drill holes being sealed to the surface.)

The information in Attachment D5-3 presented for the Tg NOV illustrates the significance of the problem created by historic drill holes. Due to the site conditions the majority of the drill holes were not sealed to the surface, and were also not sealed to a point above the first aquifer.

Texasgulf drill hole summary in response to LQD NOV

	No. of holes inspected	No. of holes recapped	No. of holes w/ standing water	No. of dry holes	Holes resealed	No. of holes unable to locate	Holes with cap slipped down hole, unable to probe
1982	79	79	79				
1983	269	111		21	10	noted but not tallied	?
1984	427	371	213	72	27	56 (13%)	86 (20%)
TOTAL	775	561 (72%)					

- 775 Total holes exceeds total Tg holes reported in Table D5.2, possibly due to holes outside the Lost Creek proposed permit area.

Dry holes could indicate that hole was properly abandoned above uppermost aquifer, or hole had caved or bridged

As previously stated, the Division will require that these holes be located and sealed to the surface, as per ASTM D-5299-99 standards, in order to ensure that these historic holes do not compromise the confinement of the production zone during mining.

In order to clarify which historic holes are located in or near which mine units, a column should be added to Table D5-2 that indicates which proposed mine unit (if any) each historic drill hole is located in. This approach would eliminate confusion and provide clarity to the efforts LC has made in addressing historic drill holes at the site. Attachment D5-2 Plates AD5-2a, 2b, and 2c should be cross referenced to the Table, and need to include topography, the mine unit boundaries, and the proposed permit boundary.

Section D-6 Hydrology

14. Section D-6. Detailed stratigraphic and well completion logs should be provided within the permit document for all monitoring wells. It is preferable if this information can be compiled on one log form. Notation of each horizon within the stratigraphic column would also be helpful. LQD Guideline 8, Appendix 5 describes the information to be included for each well.

A new attachment has been added with the well completion logs for the permit area monitoring wells. Existing Attachment D6-3 has been renumbered to D6-4 and Attachment D6-3 now contains Well Completion Logs. Cross references have been added to Section D6.2.2 of the text in Attachment D6-2a. Because of the size of the new Attachment (D6-3, Well Completion Logs), Volume 3 of the application has been divided into two binders; Volumes 3a and 3b. **The following comments have been generated from a review of the well logs:**

- a. **Volume 3b of 5, which now contains the well completion logs, needs to be added to the Table of Contents for each volume.**
- b. **Figure D6-9, Lost Creek Monitoring Wells, should include all monitoring well locations. There are 85 monitoring wells included in Attachment D6-3, and listed on Table D6-5, Monitoring Well Data, yet Figure D6-9 only has 46 monitoring wells shown. All 85 monitoring wells should be shown. Figure D6-9 should also be at a scale so that all well locations are clearly defined.**

- c. **Figure D6-9 includes 1982 monitoring wells with the designation M-25-92-18-1S. These wells were abandoned by Tg in 1985, and should not be included in a Figure titled 'Lost Creek Monitoring Wells'.**
- d. **Well Completion Log HJMU-104 is incorrectly labeled as HMJU-104.**
- e. **A number of wells indicate no well development efforts, yet there is water in the hole. (e.g. LC29M, LC31M, LC21M, LC25M, LC27M...) Chapter 11, Section 6(f) requires that the wells be developed and LQD Guideline 8, Appendix 5 discusses efficiency testing during well development. Development of these wells should be documented and submitted as part of the application.**
- f. **If airlifting produced poor yields, were any additional efforts made to develop these wells?**
- g. **Wells MB01, MB07 and MB10 all state there was no water, and the well was not logged, yet the log indicates 67 ft, 17 ft, and 22 ft of water respectively, and the wells were airlifted with poor yield. Please explain.**
- h. **Wells MB01, MB07, and MB10 have substitute well logs with the well construction diagram superimposed on it. If these wells were logged for stratigraphy, then it would be clearer to show the well construction with the stratigraphy for that hole, as opposed to superimposing another hole. The proximity of these superimposed drill holes is not noted.**
- i. **There are many wells where there is additional footage between the base of the well screen and the bottom of the hole, yet it is not indicated on the well diagram (e.g. LC29M, MB01, MB07, MB10, HJMO-105, HJMO-106, HJMO-112, HJMO-113, MB-02, MB-05, MB-08, HJMP-101, HJMP-102, HJMP-109, HJT-102, MB-06, MB-09, HJMU-105, HJMU-113, HJMU-114, UKMP-102, UKMP-103, MB-04, UKMU-101, UKMU-103). Please indicate on the schematic if the boring caved into this level, if there is a sump below the screen, or if it is an open hole.**
- j. **There are a number of holes where the bottom of the well screen (or under reamed interval) is deeper than the total depth recorded for the drill hole. (e.g. HJMP-105, UKMO-101, UKMO-103, HJMU-101, HJMU-104, HJMU-107, UKMP-101). Please correct the well logs accordingly.**
- k. **When well screen was used, it was placed below a K-packer, and telescoped from the SDR17 4.5 " ID to a 3" Screen. This narrow a screen may preclude the use of a pump within the screened interval for required bailing. LQD Non-Coal Chapter 11, Section 6(d) requires that the monitoring well casing be designed to allow for sampling.**

15. *Figure D6-10, Site Hydrostratigraphic Units. Please indicate the well ID for the geophysical log presented. Also please indicate the type and scale of the log on the figure. Also, the actual geophysical logs for all monitoring wells should be included as part of the permit application.*

Figure D6-10 has been revised to include a more representative log. See response to Comment 14.

16. *Figure D6-27a, Piper Diagram – Average Water Quality at Individual Monitoring Wells. The legend designates which well is represented by which symbol, and the wells are grouped by color, yet it does not indicate which horizon the wells are monitoring. Please add the horizon noted by each color. (The colors are not consistent with which formation they represent, i.e. other Figures use green to indicate the DE horizon wells, whereas the Piper diagrams use red).*

The figure has been revised to clearly indicate which horizon each well is monitoring. **There are 27 baseline monitoring wells, yet the two Piper Diagrams are only based on data from 17 wells. Please add the additional baseline information to the diagram, or provide an explanation as to why certain wells were not included.**

17. *Figures D6-6 through D6-28b (maps), Figures in Attachment D6-2a and D6-2b. Petrotek maps. Please add a layer of topography to these maps.*

Surface topography has been added to the figures as requested. **This item is resolved.**

18. *Figures D6-11a through D6-11c. The potentiometric surface maps are limited in scope and only represent a small portion of the permit area. The potentiometric surface maps should be representative of the entire permit area. Also given the barrier nature of the fault, both sides of the fault need to be adequately characterized. Additional baseline groundwater monitoring wells with adequate distribution across the permit area will need to be installed for this purpose.*

Ten additional baseline ground water monitoring wells were installed in the fall of 2008. The new wells are identified by the prefix MB in the well name. The locations of the new wells are shown on revised Figures D6-9 and D6-24, and Table D6-5 has been revised to include the new well completion information. The water levels were measured in the new wells in December 2008 and that information was used to generate potentiometric surface maps of the DE, LFG, JG and UKM horizons (Figures D6-11e through D6-11h). These maps are discussed in Section D6.5.2.2 of the text. **The potentiometric maps for UKM, HJ, LFG, and DE are based on data from 6 - 7 monitoring points. According to the new monitoring well information, presented in Table D6-5, Monitoring Well Data, and Attachment D6-3, Well Completion Logs, there is water level data available for 24 monitoring wells in the UKM aquifer, 29 monitoring wells in the HJ aquifer, 19 monitoring wells in the LFG aquifer (plus 2 in the FG), and 8 monitoring wells in the DE aquifer. These additional data points should be used to provide a more detailed map of the potentiometric surface for these aquifers.**

19. *Figures D6-11a through D6-11c. No potentiometric surface map for the DE horizon has been provided. All potentially affected aquifers are to be characterized, and the potentiometric surface for the aquifers should be presented for the entire permit area, both north and south of the fault. Additional monitoring wells will be necessary to obtain this information.*

Additional monitor wells were installed in the DE horizon in the fall of 2008. Water levels measured in December 2008 from those new wells and the pre-existing DE wells (LC29M, LC30M, and LC31M) were used to generate a potentiometric surface map of the DE horizon across the permit area. The potentiometric surface map for the DE horizon is included as Figure D6-11e and is discussed in Section D6.5.2.2 of the text. **See Comment 18.**

20. *Section D6.2.2.1, Hydrostratigraphic Units, HJ Horizon. If the UKM sand ends up being mined, it is stated that the LHJ sand will be the overlying aquifer. Yet for the purposes of protecting the overlying and underlying aquifers, if the UKM becomes a mineable unit, after the HJ unit has been impacted, then the relative overlying aquifer to be protected would be the LFG, and the underlying aquifer would be the MKM.*

Based on discussions among LC and LQD personnel during a meeting held in Lander on September 22, 2008, it was agreed that additional characterization of the MKM is not required. This is because it is not proposed to be mined at this time, nor is it an underlying aquifer. LC understands the MKM horizon will need to be fully characterized in an Amendment if mining of the UKM were to occur. **This item is resolved.**

21. *Section D6.2.2.2, page D6-14, paragraph 2 references Figure D6-11d, as indicating the differences in water levels across the fault based on 1982 and 2006 data. It goes on to state that the data is insufficient. It is not clear what is gained by this figure since Figure D6-11a clearly shows the difference in water level within the HJ Horizon and across the fault zone.*

Figure D6-11d demonstrates that the water level difference within the HJ has persisted for over 25 years. The data indicate that ground water flow across the fault within the HJ horizon is, and has been, negligible under normal static conditions, otherwise the water levels on both sides of the fault would be at similar elevations. Also, the similarity in water levels from 1982 to 2006 between wells that are located on the same side of the fault shows that there has been little change in the hydrogeologic system during that period, indicating that it is unlikely that there has been significant hydraulic communication or leakage between horizons. These data suggest that historic boreholes in this area do not appear to be providing a significant pathway for groundwater to move between horizons, at least under static, non pumping conditions. **Historic drilling pre-dated the 1982 data. As one example, the 775 drill holes revisited by Tg in 1982-1984 dated back to 1976, so without pre-drill hole groundwater data, there is no way to know if the historic drill holes had any effect on the potentiometric surfaces. This item is resolved.**

22. *Section D6.2.2.2, Potentiometric Surface, Groundwater Flow Direction and Hydraulic Gradient, page D6-14. Although hydraulic gradient is the change in head over distance between two wells, for the sake of the permit application, the hydraulic gradient across the potentiometric surface needs to be determined. As stated in comments 18 and 19, the potentiometric surface of each aquifer needs to be established, on both sides of the fault, and then the hydraulic gradient of this surface calculated with a minimum of three wells.*

The potentiometric surface should be representative of the permit area, and not just the area in the center of the permit area, adjacent to the fault zone. It seems possible that the gradient may be more generally to the south, yet when the fault zone is encountered, it changes to parallel this hydrologic barrier. Additional groundwater monitoring wells will need to be installed to obtain this information.

The new monitoring wells installed in the fall of 2008 provide more complete coverage across the permit area. Potentiometric surface maps were generated from water level data obtained from the new wells and previously existing baseline wells. Hydraulic and vertical hydraulic gradients have been calculated from the 1982 Conoco well data and the 2006-2007 data and are included in revised Tables D6-7 and D6-8, which have been renumbered as Tables D6-7a and D6-7b. The additional well locations confirm that the predominant ground water flow direction is to the southwest, generally parallel to the Lost Creek Fault System. **If the potentiometric surface maps change significantly, then the horizontal gradient calculations (Table D6-7a, page 3 of 3) will need to be revised accordingly.**

23. *Section D6.2.2.3, Aquifer Properties, Page D6-16. The 1982 Pump tests were performed by Hydro-Search, the 2006 Pump tests were performed by Hydro-Engineering. Please reference who (Petrotek) conducted the 2007 Pump tests.*

The first sentence of the 2007 pump test discussion has been modified to indicate that Petrotek conducted the tests. **This item is resolved.**

24. *There are 14 potentially active groundwater wells within 0.5 miles of the permit area, and many more historic groundwater wells within the permit boundary or 0.5 mile perimeter with abandoned or canceled permits. What is the status of the abandoned and cancelled wells? Is their proper abandonment documented? If not, are there well completion logs for these wells to indicate if they have a specific screened interval? The current status of these wells needs to be clearly defined to ensure that they are not a potential pathway between aquifers.*

Responses to Comments #13, #25, #30, and #33 address this comment. **Refer to responses for Comment 13, 15, and 30.**

25. *Section D6.3, Table D6-12a. There are numerous Kennebecott, Tg and BLM/Tg groundwater permits within or adjacent to the permit area. The status is listed as adjudicated, abandoned, or cancelled. Further discussion regarding the status of these permits needs to be included in Section D6.3 and Table D6-12a. Were wells drilled under all of the permits listed? Are there abandonment records for any of the wells? Has any effort been made to locate these wells and verify their status? There needs to be assurances that these wells will not act as a potential conduit for the movement of production fluids between aquifers.*

Tables D6-12a and D6-12b have been modified (as well as the associated Plates D6-1a and D6-1b) for clarification between a well and a point of use. Additionally, LC's responses to Comments #13 and #30 address the concerns about efforts to locate drill holes and wells and

the potential for wells outside the Permit Area to act as conduits for movement of production fluid.

- a. Plate D6-1a does not have a location for well ID 1.
- b. Well ID 21 is shown on Plate D6-1a, but is not listed in Table D6-12a.
- c. The addition of Well 6b to Table D6-12a, seems to have resulted in the following errors:
 - Plate D6-1a shows well ID 7 as a potentially active permit in T25N R92W, Section 30, yet Table D6-12a lists it as an abandoned well in Section 20.
 - Well ID 20 is shown on Plate D6-1a in T25N R93W, Section 24, yet is listed on Table D6-12a as being in T25N R93W, Section 13.
 - Well ID 10 is shown on Plate D6-1a as being in T25N R92W, Section 20, yet on Table D6-12a the location is T25N R92W Section 19.
 - Well ID 13 is shown on Plate D6-1a as being in T25N R92W, Section 19, yet on Table D6-12a the location is T25N R92W, Section 18.
 - Well ID 16 is shown on Plate D6-1a as being in T25N R92W, Section 18, yet on Table D6-12a the location is T25N R92W, Section 17.
 - Well ID 19 is shown on Plate D6-1a as being in T25N R92W, Section 17, yet on Table D6-12a the location is T25N R92W, Section 24.
- d. Wells shown at one location have overlapping symbols. They need to be designated differently on Plate D6-1a and Plate D6-1b so that their status can be ascertained.

26. *Section D6.3, Page D6-21. Will the public and private wells near the permit area be impacted by mining operations? Will they be within the zone of influence of the pumping operations? If they are within or near the zone of influence, and the completion details of the well are unknown, these wells should be replaced by the operator, prior to mining. Otherwise these wells could become a conduit for the movement of production water between aquifers.*

Refer to response to Comment #30.

27. *Table D6-14, Baseline Water Quality Monitoring Parameters. Please indicate on the table whether the analysis is for Total or Dissolved. For Iron, both total and dissolved analysis must be performed.*

Iron was analyzed for both total and dissolved fractions. Table D6-14 has been modified to indicate that the analyses for trace constituents were analyzed for dissolved concentrations, with the exception of iron and manganese, which were analyzed for total and dissolved concentrations. Table D6-15 (which is now Table D6-15a, see response to Comment #37) has been updated to include both the total and dissolved concentrations. **This item is resolved.**

28. *In addition to Table D6-14, the permit application must provide the Groundwater Monitoring Program for the site. It should include a list of the monitoring wells, sampling*

frequency, sampling protocol, QA / QC procedures etc. As new monitoring wells are added in the future, the permit will be revised by a Non-Significant revision to the permit to add or drop monitoring wells.

A copy of the Groundwater Monitoring Program is attached. Rather than incorporate it into the baseline portion of the permit application, LC will incorporate it into the Operations Plan, which is currently being revised in response to LQD comments of January 2009.

LQD will review the Groundwater Monitoring Program with LC's forthcoming responses to LQD's January 2009 technical comments.

29. *Section D6.3 Groundwater Use. Paragraph 4 references the East Eagle Nest Draw Well, it should be made clear if this is the fourth BLM well. In addition, although not officially permitted, the fourth BLM well and/or Eagle Nest Draw well should be documented in Table D6-12a, and Plate D6-1a.*

The fourth paragraph in Section D6.3 has been modified to indicate that the East Eagle Nest Draw Well is the fourth BLM well. **This item is resolved.**

30. *Section D6.3, Page D6-21, last paragraph states that throughout the phases of the project the operator will correspond with BLM to ensure the wells that provide stock water are not adversely impacted. Since it is not clear where any of these wells are screened [Well 4775 (at 280 ft. depth), and 4777 (at 200 ft. depth), 4451 at 900 ft. depth, and the Eagles Nest Draw well (at 370 ft. depth)], it may be necessary to replace these water supplies prior to mining operations, to ensure that they are clearly isolated from any mining influence.*

As a precaution the BLM wells will be periodically monitored to determine if mining from the proposed ISR has impacted the wells. The technically sound and legally mandated safeguards of installing a monitor ring for excursion detection and of excursion control are sufficient to ensure the wells noted by the reviewer are not impacted by mining lixiviant. Pursuant to the discussion during the September 22, 2008 meeting with WDEQ LQD in Lander, these wells will not need to be preemptively replaced. **Monitoring of the BLM wells must be included in the permit's Groundwater Monitoring Plan. In addition, please add a statement to the last paragraph of Section D6.3 that if the mining operations adversely impact these wells, that Lost Creek ISR, LLC, will work with the BLM and replace the wells if required. LQD understands LC plans to submit the Groundwater Monitoring Plan with the responses to LQD's January 2009 comments.**

31. *Tables D6-12a and D6-12b, Groundwater Permits: These tables list Map ID and therefore need to cross reference Plates D6-1a, and D6-1b and vice or versa.*

Cross references were added to both the Tables and the Plates. This item is resolved.

32. *Section D6.3 and Table D6-12a. An explanation should be provided when there are two or more line items for the same permit number. For example there are two listing for the BLM Battle Springs Draw Well No. 4451, yet the only distinction is that one listing is indicated as*

a headgate outlet well, and one listing is 'Information not provided by the WSEO database.' Figure D6-19 appears to be a photo of the well, yet the table and Plate D6-1a, seem to indicate there are two wells. Please clarify how the wells are designated on the table and map.

Please see response to Comment #25. **This item is resolved.**

33. *Section D6.4.2.1 Groundwater Monitoring Network and Parameters. Paragraph one references 12 wells within the permit area that were installed by Conoco prior to 1982. This is the first mention of these wells. What is the status of these wells? Why are they not included in Table D6-12a? Are there well completion logs available? If they were abandoned, are there any abandonment records? Have these wells been located to determine their status? Table D6-12a should be a comprehensive source of information of any well that is known to once exist within or near the permit area, regardless of whether there is a SEO permit on file.*

The 12 wells discussed in Section D6.4.2.1 and shown in Figure D6-23 were installed as part of a joint venture between Conoco and Texasgulf Inc. The wells are shown in Table D6-12a as being drilled by Texasgulf Inc. Each of the 12 wells was abandoned as documented in a September 16, 1987 letter from Texasgulf Inc. to the State Engineer's Office. According to the letter, each of the 12 wells was filled with concrete. The letter, which constitutes all of the historic knowledge pertaining to these wells, is included in Attachment D5-3 of the application for LQD review. The above information is also summarized at the end of the first paragraph in Section D6.4.2.1. **1982 Era pump test and hydraulic gradient information from these 'M-25' wells are included in Table D6-8 and Table D6-7a, but as noted in Comment 14c, these abandoned wells need to be removed from the monitoring well map, Figure D6-9. This item is resolved.**

34. *Table D6-13 Lost Creek Project Groundwater Permits. In addition to this table, a separate table should be presented which is the comprehensive groundwater monitoring network wells. If viable information is available from historic monitoring wells (e.g. the Conoco wells), i.e. the screened interval is known, then these wells can be presented as a subset of the table. If the water supply wells are going to be sampled they should also be included. Table D6-13, as originally submitted, included all of the LC wells in the comprehensive ground water network; however, the table has been re-arranged for clarity. All those permits for which wells have been drilled, including monitoring and supply wells, are included at the beginning of the table. Those permits for which wells have not yet been drilled are included at the end of the table. Future information about wells will be included in the mine unit applications. As noted in the response to Comment #33, the information about the Conoco wells is included in Table D6-12a. The information about the LC permit (Table D6-13) was purposely separated from the information about permits granted to other entities because LC has control over the content and quality of the information and construction related to its permits, but does not have similar control over information or construction related to other permits. **The response states that permits that have yet to be drilled are listed at the end of the Table. These wells appear to be on Page 8 of 8 under***

the subheading of 'Other Wells' and have 'Priority dates' of 2008. Please add a subheading for the wells that have permits but have not been installed. In addition, pertinent well information for Mine Unit 1 is expected to be submitted prior to permit approval.

35. *Section D6.4.2 Site Groundwater Quality. The majority of the baseline groundwater monitoring wells are located within the footprint of the mineralized zone and the mine units. Additional baseline groundwater monitoring wells need to be established outside the mine unit, up gradient and downgradient of the mine units, and north and south of the fault(s).*

Additional baseline water quality wells have been installed, as described in the responses to Comments #18, #19, and #22. The new wells will be sampled for the same constituents as the previously installed baseline monitor wells. At least four sampling events will be conducted at each well. Results of the sampling events will be provided when available. As suggested [by LQD] 10 additional regional monitor wells were installed to collect data outside the mineralized zone; Wells MB-01 through MB-10. The installation of these wells brings the total number of regional wells to 27. The revised data included in this response includes the hydrologic information gained from the additional wells. Pumps will be installed this spring so baseline water quality may also be determined over the course of a year. As discussed during the September 22, 2008 meeting with WDEQ-LQD and LC personnel, the results of sampling will be provided to LQD upon completion of the sampling program. **Table D6-15a will be updated with the additional baseline well monitoring data once it becomes available. This comment will remain until the Table is revised.**

36. *Section D6.4.2.2 Groundwater Quality Sampling Results. Page D6-26, paragraph 3 states that "there is no significant difference in major water chemistry between the production zone and overlying and underlying aquifers". The next paragraph explains some constituents that exceeded WQD Class I standards at individual wells. Please provide a separate section for each aquifer (similar to Section D6.2.2.1) which discusses their individual water quality, based on the baseline monitoring.*

A separate section discussing the water quality of the production zone and overlying and underlying aquifers has been prepared and is included in Section D6.4.2.2. **Once the additional data is obtained from the 2009 sampling of the MB wells, this section may need to be revised to include the information from the additional baseline data.**

37. *Table D6-15. Analytical Results of Baseline Monitoring. If an analyte has exceeded the WQD Class I standard please flag that value within the table, noting the designation with a footnote.*

Table D6-15 has been replaced with Tables D6-15a and D6-15b. Table D6-15a includes the analytical results, with the flags to indicate which concentrations exceeded WQD and/or EPA criteria, and Table D6-15b lists the WQD and EPA criteria. The references in the text to Table D6-15 have also been updated to include both Table D6-15a and D6-15b. **When**

the 2009 analytical data for the MB wells becomes available, Table D6-15a will need to be revised.

38. *Section D6.5.2 Site Groundwater Conceptual Model. LQD Non-Coal Rules, Chapter 11, Section 3(xiv) regulations require that the following parameters be described for each potentially affected aquifer: aquifer thickness, velocity and direction of groundwater movement, storage coefficients or specific yield, transmissivity or hydraulic conductivity, direction of preferred flow under hydraulic stress, extent of hydraulic connection between the receiving strata and overlying and underlying aquifers, and hydraulic characteristics of any influencing boundaries in or near the propose well field area. The attached table indicates information that has been presented in the application, and where there are gaps in the aquifer characteristics required.*

A table (D6-11) has been developed that incorporates much of the data required under LQD Non-Coal Rules, Chapter 11 Section 3(xiv). The table has been incorporated into the permit as Table D6-11 – Summary of Aquifer Characteristics. It is referenced at the end of the next to last paragraph in Section 6.2.2.3. **This item is resolved.**

39. *Section D6.5.2.2 Potentiometric Surface and Hydraulic Gradients. Paragraph one provides the hydraulic gradient for the HJ Horizon. As mentioned in previous comments, the Division is requesting that both sides of the fault be characterized separately.*

Horizontal and vertical hydraulic gradients have been calculated for both sides of the fault and are included in revised Tables D6-7a and D6-8. The text in this section of the permit application has also been revised with the updated gradient information. Tables D6-7a and D6-7b were previously numbered Tables D6-7 and D6-8, but were renumbered to allow for addition of Table D6-1 without renumbering all the tables in the section. Tables D6-9, D6-10a, and D6-10b, and D6-11a and D6-11b were also renumbered to D6-8, D6-9a and D6-9b, and D6-10a and D6-10b, respectively.

- a. **Table D6-9b and Table D6-10b are both titled '2007 LC16M Long Term Pump Test Monitor Wells'. The top and bottom of the underreamed zone in the Table D6-9b version do not correspond to the well completion log data, though the Table D6-10b version appears to be correct. Please determine the correct version, and address the change in an Index Sheet.**
- b. **Table D6-11b, 2007 LC16M Long Term Pump Test Results (from the original submittal) seems to have been inadvertently eliminated with the second version of LC16M Long Term Pump Test Monitoring Wells. Please resubmit the LC16M Pump Test Results.**

40. *Section D.5.2.2 Potentiometric Surface and Hydraulic Gradients. Paragraph one states that from the pump tests the communication between the HJ aquifer and the overlying and underlying aquifers may be through historic boreholes that were improperly abandoned, leakage through the confining shale units, or contact of sands juxtaposed across the fault. All work done to relocate and either verify proper abandonment or re-abandon old drill holes, should be included within the permit application. Any additional work completed to*

better define the cause for the communication must be submitted as a revision to the permit document.

Table D5-2 was generated for inclusion into the application in response to this comment as well as Comment #13. The table summarizes the re-abandonment work conducted by LC of historic holes. Additional pump tests will be performed in the future to further characterize ore zone confinement. Text has been added to Section D6.5.2.2 to provide a cross-reference to the discussion in Section D5.2.4.1 about abandonment work. **Mine Unit 1 characterization and demonstration of ore zone confinement is required prior to approval of the application. Additionally, Table D5-2 must include a column indicating which Mine Unit (MU-1, MU-2...), if any, a given Abandoned Drill Hole is located within. The addition of Table D5-1 and Attachment D5-3 are welcome additions to the permit application, yet does not address the need to re-abandon historic drill holes in order to obtain confinement of the production zone.**

41. *Section D6.5.2.3 Aquifer Properties. The second paragraph states that additional long term multi-well pump tests were to be performed in the fall of 2007. These tests would provide more data on overlying and underlying aquifer characteristics. If this information is now available, it should be submitted for review as part of the permit application.*

The pump test in question was used to further characterize the UKM aquifer and therefore, pursuant to discussions at the September 22, 2008 meeting with WDEQ-LQD and LC personnel, is not required for permitting of the HJ aquifer. **The Section referenced by LQD (D6.5.2.3) was incorrect on the first review and has been corrected. The last sentence of the second paragraph states, "Long-term multi-well pump tests will be performed in the fall of 2007 to collect additional data regarding aquifer properties of the overlying and underlying aquifers." This seems to be referring to the Petrotek pump tests of LC16 and LC19 and should therefore state that, and cross reference Attachments D6-2a and D6-2b.**

42. *Attachment D6-2a, Figures 6-2, 6-6, 6-8, and 6-10. The y-axis titles are backwards, the Pumping Well (PW) elevation should be on the right handed axis. Please correct and replace the Figures.*

Figures 6-2, 6-6, 6-8, and 6-10 in Attachment D6-2a have been changed as requested. **This item is resolved.**

43. *Attachment D6-2a, Figure 7-1 is the Theis curve for the LC16M pumping well, yet this attachment is the evaluation of the LC19M pump test.*

The figure was intended to be the Theis curve match for the response of Well HJT-104 during the LC19M pump test. The correct figure is included in this submittal. **This item is resolved.**

44. *Attachment D6-2a, Appendix A. As stated in Comment 14, please provide well completion details, boring logs, and any geophysical logs for all monitoring wells. If the information is not inserted into Appendix A, its location should be referenced.*

A cross reference to the new Attachment D6-3 (Well Completion Forms) has been added to Page 6 of Attachment D6-2a. **This item is resolved.**

45. **Section D.5.1 Structure.** The newly submitted north/south trending cross sections F-F', G-G', and H-H' (Plates D5-1e through D5-1g) indicate additional faults north and south of the Lost Creek Fault. These faults need to be discussed within this section of the permit application. The extent of the faults, displacement, relative age, and any potential groundwater communication across them should be presented.
46. **Section D.5.2 Site Geology.** The last sentence of the paragraph states that Attachment D5-1 contains copies of typical geophysical logs from the permit area. Please also reference Attachment D6-3 which contains the geophysical logs for all the monitoring wells.

END OF MEMORANDUM