Department of Environmental Quality

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

Dave Freudenthal, Governor

John Corra, Director

April 28, 2010

Mr. John Cash
Lost Creek ISR, LLC
5880 Enterprise Drive, Suite 200
Casper, WY 82609

RE: **Lost Creek ISR LLC, In-Situ Recovery Mine Unit 1 (MU1) Application Package Completeness Review, Second Round of Comments, TFN 4 6/268**

Dear Mr. Cash,
Enclosed please find the Wyoming Department of Environmental Quality – Land Quality Division's (WDEQ/LQD's) second round of comments to responses which were received by the (WDEQ/LQD) District II Field Office on March 29, 2010.

WDEQ/LQD is requesting that starting with responses to this set of comments, LC please combine responses to all outstanding comments for this ISR application. That is, currently there are two reviews of LC's ISR application occurring; one review of the Master Permit Document and one review (this review) of the MU1 Package. Because many of the comments for each review overlap, it has become increasingly difficult and confusing to keep track of which comment is being addressed where and when. To this end, LQD hopes that the next correspondence from LC regarding this application will be a combination of LC's responses to LQD's 3rd round of comments on the Master Permit Document and 2nd round of comments on the MU1 Package. LQD personnel are hopeful that a meeting among LQD and LC personnel tentatively scheduled for the week of May 10th can be utilized to consolidate comments and agree on a format for responses.

As you have done in the past, please provide all responses to comments following the Index Sheet format. Direction to proceed with Second Public Notice for this ISR application will not be given until the WDEQ/LQD receives a Letter of Application Approval / Concurrence from the Bureau of Land Management (landowner), as specified in the BLM/LQD Memorandum of Understanding (MOU) on locatable minerals. If you have specific questions regarding the enclosed review, it is suggested that you contact the individual reviewer for clarification. However, please feel free to contact me at (307) 332-3047 with any questions as well.

Respectfully,

Melissa L. Bautz, P.G.
District II Natural Resources Analyst

w/ enclosure, 2nd Round of Completeness Comments Memorandum for MU1 Package, dated April 28, 2010

Cc: Mr. Harold Backer, Ur-Energy USA, 10758 W. Centennial Rd. Suite 200, Littleton, CO 80127 (w/encl)
Mark Newman – BLM Rawlins, P. O. Box 2407, Rawlins, WY 82301 (w/encl)
Tanya Oxenberg, U.S. Nuclear Regulatory Commission, Federal and State Materials and Environmental Management Programs Uranium Recovery Licensing Branch, Mail Stop T-8F5, Washington, D.C. 20555-0001 (w/encl)
Don McKenzie - Cheyenne WDEQ/LQD→ TFN 4 6/268 Lost Creek ISR File (w/encl)
Mark Moxley - Lander WDEQ/LQD→ TFN 4 6/268 Lost Creek ISR File (w/encl)
Chron

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MEMORANDUM

File: Lost Creek ISR Application, TFN 4 6/268

Date: April 28, 2010

From: Melissa Bautz, Geologist, WDEQ/LQD Lander
Amy Boyle, Engineering Geologist, WDEQ/LQD Lander
Mark Moxley, District II Supervisor, WDEQ/LQD Lander
Brian Wood, Hydrologist, WDEQ/LQD Lander

Subject: Completeness Review of Mine Unit 1 (MU1) Package, TFN 4 6/268

Below is the Wyoming Department Environmental Quality - Land Quality Division (WDEQ/LQD) second round of review comments on Lost Creek ISR's (LC) Mine Unit 1 Package. The MU1 package was originally received on December 20, 2009. LQD provided completeness review comments on the MU1 package in a memorandum sent under cover letter dated February 19, 2010. LC submitted responses to those comments in a submittal dated March 26, 2010 (received at the Lander WDEQ/LQD office on March 29, 2010). Below is a review of that submittal. The original comment numbers have been retained for the sake of clarity and ease of review.

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1) LQD (2/10) - No map has been provided (in the Permit Application or the MU1 Package) depicting the following three items on the same map:
   All known historic drill holes within the mine unit and 500' beyond the monitor ring,
   the proposed first mine unit pattern area, and
   the proposed monitor well ring.
   A map depicting the above three features must be included with the Mine Unit Package.[4] **(MLB, BRW)**

   LC ISR, LLC (3/10) - Plate MU1 5-1 (Historic Drill Holes in Area of Mine Unit 1) has been added to the MU1 Application, and this plate provides the requested information on one map. Table MU1 5-1, which originally included information on the borings shown on Figure MU1 5-3 has been updated to also include information for the borings shown on Plate MU1 5-1.

   LQD (4/10) – This item is resolved– LC has provided the requested information on Plate MU1 5-1. Figure MU1 5-3 has been revised to include information concerning the wells outside the pattern area. **(BRW, MLB)**

2) LQD (2/10) - WDEQ/LQD NonCoal R&R, Chapter 11, Sec 3(a)(xiv) clearly requires that aquifer characteristics of all "aquifers which may be affected by the mining process" be provided. To date the only source of aquifer characteristics provided for the overlying and underlying aquifers comes from relatively short duration single well pump tests conducted by Hydro Engineering at the site in 2006 (see Volume 3A of the Main Permit, Table D6-8). The MU package provides no additional information about the characteristics of the overlying and underlying aquifers. In light of this omission and because the 2006 pump tests were single well tests, the current assessment of the overlying and underlying aquifers remains incomplete. Please provide a complete assessment of the over and underlying aquifer characteristics.[9] **(BRW)**

   LC ISR, LLC (3/10) - LC ISR, LLC understands that LQD has performed an initial review of the drawdown analysis presented in Sections OP 3.6.3.3 and OP 3.6.3.4. Based on that initial review, a

subsequent letter from LQD dated March 11, 2010, and a meeting held with LQD on March 18, LC ISR, LLC understands that LQD wishes to see an explanation as to how the analysis provided in the aforementioned sections of the Operations Plan are consistent with the aquifer properties measured by the single well pumping tests. That analysis is incomplete at this time but will be submitted in the near future.

LQD (4/10) – **This item is resolved**– As explained during various meetings and phone conversations, the intent of the comment was not just to provide the LQD with a number to fulfill a rule/regulation, but rather to have sufficient data analysis results with which the potential impact of the operation could be assessed. Pump tests conducted by Hydro Engineering in 2006 provided a range of transmissivity values that characterized the over and under lying aquifers. However, because the tests completed were based on a single well, no estimates of storativity were provided. In the reviewer's opinion, estimates of storativity have been traditionally assumed to be necessary in order to reasonably assess potential drawdown. Revisions to the Master Permit document received in February attempted to address potential drawdown in the over and under lying aquifers by other means which were found to be generally acceptable, however, some minor revisions were requested. As the principal intent of this comment is being addressed through Master Permit Comments, the response is declared acceptable. **(BRW)**

3) LQD (2/10) - The following comment was part of the permit application review, and the response from LC indicated that it would be addressed through the Mine Unit Package submittal. *Section OP 3.2 Mine Unit Design. The details for the Hydrologic Test Report for the first wellfield package should include a refined water balance based on the hydrologic information for the wellfield. Minimum, maximum and average pumping rates, as well as the capacity of the ion exchange units, injection well(s) and evaporation pond(s) should be included. (AB)* A refined water balance based on the MU1 specifications needs to be included in the Mine Unit package.[23] **(AB)**

LC ISR, LLC (3/10) - Per the discussion during the February 25, 2010 meeting between WDEQ-LQD and LC ISR, LLC, a statement was added to MU1 Section 5.1.1 (Operating Parameters and Procedures) indicating that hydrologic information obtained from the MU1 pump tests did not alter the assumptions used to develop the Lost Creek Project water balance.

LQD (4/10)- The water balance information presented in Section OP3.6.3.1 of the Permit application will reportedly be representative of the first mine unit, based on the pump test results. A water balance will need to be presented each year in the Annual Report document. **This item is resolved. (AB)**

4) LQD (2/10) - The following comment was part of the permit application review, and the response from LC indicated that it would be addressed through the Mine Unit Package submittal. *Figure OP-2a Site Layout: A much more detailed Mine Plan map will need to be included in the permit. It should indicate all roads, fencing, topsoil pile locations, stormwater diversion structures, chemical storage areas, lay down yards, easements, utilities, pipelines, monitor well locations, air and weather monitoring stations, etc. There should be one comprehensive map that indicates where any surface disturbance or feature is planned. (AB)* Figure MU1 1-3 Surface Facilities provides details for the Mine Unit, but greater detail is required as listed below:

- A larger scale map (e.g. 1" = 100')
- All pipelines, powerline, roads, fencelines, staging areas, culverts and topsoil stockpiles (some of these are already included)
- The proposed layout of the wellfield production and monitoring wells (The Division is interested in how the proposed wellfield layout will address the fault zone)

The wellfield layout should indicate which sand (UHJ, MHJ, or LHJ) is being mined or monitored based on screened interval)
The temporary vs. long term disturbances associated with the wellfield should be distinguished (well pad, header houses, pipelines, utilities)
The primary, secondary, and 2-track roads should be mapped out. (The Division is interested in how the proposed layout will minimize surface disturbances and travel ways) **(AB)**

LC ISR, LLC (3/10) - As outlined below, LC ISR, LLC believes that the information requested in this comment has been provided to WDEQ-LQD in: the main permit document; the original MU1 application; or the updates to MU1 per these responses. As outlined below, the rest of the information has been provided in as much detail as possible prior to installation of the production and injection wells. Therefore the requested map has not been included with this submittal.

Figure MU1 1-3 provided in the MU1 application shows the locations of the following items:

- The main wellfield trunkline (pipeline);
- Powerlines;
- The fence surrounding the wellfield;
- The main access road, roads located within the wellfield and existing two track roads inside the monitor well ring;
- Staging area;
- Culverts; and
- Topsoil stockpile locations.

There will not be a chemical storage area, weather station, or air monitoring station within MU1.

Figures MU1 5-1 through MU1 5-4, which replace Figures MU1 5-1 and MU1 5-2, provide additional information on the proposed layout of the pattern areas and monitor wells, along with information on which sands are being mined and how the perimeter monitor wells are screened to monitor the those sands. Additionally, a discussion of the proposed pattern layout, which addresses monitoring across the Lost Creek Fault through the use of overlying and underlying monitor wells, has been added to Section 5.2.1 of the MU1 Application.

The information that has not and cannot be provided prior to the actual installation of the production and injection wells is the layout of travel ways within the pattern areas. The travel ways used for the construction and operation of the mine unit will be developed in accordance with the guidance provided in Section OP 2.6 (Roads) of the main permit document. This type of detailed information has never been presented in a mine unit package, before the wells are installed, simply because it is not possible to determine this amount of detail until the work begins. At that time, the engineers and geologists, actually walk the pattern area and stake well locations based on the most up-to-date surface and subsurface information. Even as the wells are installed, the information obtained from the early wells may influence the locations of the later wells. For this reason, LC ISR, LLC presented a generic wellfield layout on Figure OP-6b of the main permit document.

A discussion of topsoil management, which includes long-term and short-term topsoil protection, is provided in Section OP 2.5 (Topsoil Management) of the main permit document. Also, a discussion of vegetation protection during wellfield construction is provided in Section OP 2.7 (Vegetation Protection and Weed Control) of the main permit document. The amount of topsoil disturbance for the facilities shown on Figure MU1 1-3 is provided in Table MU1 3-1 of the Mine Unit 1 Application and is allocated by short-term and long-term stockpiles. Also provided in Table MU1 3-2 of the Mine

Unit 1 Application is the amount of vegetation disturbance for the facilities shown on Figure MU1 1-3.

LC ISR, LLC will not construct a sedimentation pond or other permanent structures as sediment control measures for MU1. LL ISR, LLC will use alternate sediment control measures in accordance with WDEQ-LQD Guideline #15. Since the area surrounding the mine site is relatively flat-lying, LC ISR, LLC will use sediment control features such as silt fences and hay bales appropriately placed for erosion control. The locations of these sediment control units will be determined during construction.

LQD (4/10) - **Response not acceptable.** Due to potential changes in the as-built lay out of the well field during construction, the operator is reluctant to provide the level of detail requested. Much of the layout indicating soil and vegetation disturbance is outlined in Figure OP -6b. This schematic does not provide a true picture of the disturbed area within a typical pattern area. Please revise the schematic to show the total disturbance associated with each drill site, not just the mud pit. In addition, the trench layout is shown as a line on the drawing yet the actual width of disturbance associated with a 3' wide trench is more likely 20' wide. (given a 3:1 angle of repose for the topsoil and subsoil piles, as opposed to vertical). The actual footprint of these disturbances should be indicated on a revised Figure OP-6b and the square footages and percentages of disturbance re-calculated.

The attached site map (enclosure) of Mine Unit One is representative of the disturbance prior to any header houses, roads or pipelines and is indicative of how significant the surface impacts will be. Although long and short term disturbances are broken out separately on Figure OP-6b, the reality is that even the short term disturbances will have long term impacts due to the time it takes to reach reclamation success.

The 1"=100' map indicating the proposed lay out of the well field and the disturbances associated within the wellfield is still requested. In addition to the proposed wellfield layout, the existing disturbances caused by the exploration holes will also need to be indicated on the map. This map will need to also include the fencing around the large staging area, and the 2-track around the monitor well ring. In addition, the current staging area on the eastern part of the mine unit already appears to have approximately an acre or more of disturbance, far greater an area than that depicted on Figure MU1 1-3. The justification for this was presented in the March 11, 2010 clarification of comment letter. The as-built version of this map will then need to be included in the Annual Report each year. **(AB)**

5) LQD (2/10) - WDEQ/LQD Non Coal R&R's Chapter 11 Sec 4(a)(x)(A-E) and (xi) requires a description of the proposed injection rates and pressures, fracture pressure, stimulation program, type of lixiviant, physical and chemical characteristics of the receiving strata fluids. There is no description in the submitted text for Mine Unit 1 or the initial permit application concerning the proposed injection pressure to be utilized, only that it will not exceed testing pressure. The only discussion concerning fracture pressure of the formation occurs in the Class 1 disposal well application. Furthermore, in the Class 1 disposal well application a literature value of fracture pressure for the Lance Formation is specified, rather than a site-specific value for the Battle Spring Formation. Please provide a discussion concerning the Fluid Pressure to be utilized during operations and the Fracture Pressure associated with the production as required by WDEQ/LQD Non Coal R&R's Chapter 11, Section 4 (a)(x).[17] **(BRW)**

LC ISR, LLC (3/10) - Section OP 3.4 discusses a mechanical integrity testing or (MIT). A typical MIT will begin at 150 psi for injection and production wells. The well will be required to maintain 95% of the pressure for 10 minutes. Section OP 3.6.1 discusses maximum injection pressure and has been revised to address WDEQ's comment.

LQD (4/10) – **Response not acceptable** – Thank you for providing revisions to the text in Section 3.6.1, which does answer the original comment. However, the statements in this section seem to conflict with those in Section OP 3.3 that indicate the maximum injection pressure will be governed by the fracture gradient and not, potentially, a function of MIT pressure or manufacturer's operating pressure specifications. Please revise the text in Section OP 3.3 to be in concert with the statements in Section 3.6.1. **(BRW)**

6) LQD (2/10) - Neither the mine permit application nor this first mine unit package provide a thorough assessment of the projected impact of the operation on regional water resources or plans to mitigate such impacts. Please reference comment no. OP-105 from the 11/20/09 review (W.S. §35-11-428(a)(ii)(B) and W.S. §35-11-428(a)(iii)(E)). Additionally, WDEQ/LQD Non Coal R&R's Chapter 11 Sec 4(a)(x)(F) requires the following to be provided in the Mine Unit Package: Expected changes in pressure, native groundwater displacement, direction of movement of injection fluid and a drawdown projection, including a map, which describes the extent of groundwater drawdown in the ore zone aquifer for the life of the first wellfield, through restoration. And the MU 1 package must address the ROI in overlying and underlying aquifers. Several comments in this review have addressed portions of these requirements. However, LQD expects the entire suite of requirements in Chapter 11, Sec 4(a)(x)(F) and W.S. §35-11-428(a)(ii)(B) and W.S. §35-11-428(a)(iii)(E)to be addressed in the MU1 Package.[18] **(MM, BRW)**

LC ISR, LLC (3/10) - Per the discussion during the February 25, 2010 meeting between WDEQ-LQD and LC ISR, LLC, LC ISR, LLC believes the Response to Comment V5, RP#5 and the associated changes to Section OP 3.6.3.3, submitted in February 2010, address this comment as well. LQD will review that information in relation to this comment.

LQD (4/10) – **Response partially acceptable.** The reviewers will await acceptable responses to Master Permit Comments OP-111 and RP-5. **(BRW)**

7) LQD (2/10) - Please provide a detailed Mine and Reclamation Plan schedule for Mine Unit 1.[26, 28] **(BRW)**

LC ISR, LLC (3/10) - Per the discussion during the February 25, 2010 meeting between WDEQ-LQD and LC ISR, LLC, a statement was added to MU1 Section 5.1.1 (Operating Parameters and Procedures) indicating that hydrologic information obtained from the MU1 pump tests did not alter the Lost Creek Project mine and reclamation schedule.

LQD (4/10) – **Response not acceptable** – Thank you for revising Section 5.1.1 to include statements that indicate the schedule for mining and reclamation in Mine Unit 1 remains as detailed in the Operations Plan of the Master Permit application. However, as discussed in Comment #25, the pore volume recalculation has resulted in an approximate 30% increase in fluid volume during the restoration phase. Without increasing the plant capacity, there is the potential to extend the restoration time beyond the forecasted schedule in the Master Permit document. Please see Comment #25 and make the appropriate changes to the Operations Plan Schedule. **(BRW)**

8) LQD (2/10) - Please provide a site development plan that demonstrates how impacts to soil and vegetation will be minimized per section OP 2.5 of the Main Permit and includes:
   - Stream crossing design criteria
   - Avoid placing wells in drainage bottoms
   - Sediment control measures to be implemented, designs, and locations **(BRW, MM)**

LC ISR, LLC (3/10) - Please see Response to Comment MU1 #4.

LQD (4/10) – Response not acceptable - Attachment OP-3 to the Master Permit contains the Storm Water Permit for the site. It does not appear that any site-specific Storm Water Pollution Prevention Plan has been developed with the exception of the drainage plan for the Main Facility and Access Road. It is understood that Mine Unit 1 is in a relatively flat area. However, based on the maps provided, there are several drainages that run through the well field.

Within LC's response it is stated that Alternate Sediment Control Measures (ASCM's) will be installed during well field construction, however no discussion of this issue could be found in the original submittal or in the latest application revisions. The maximum areal extent of the well field has already been defined by the monitoring well ring. This could be likened to the defined limits of a highway construction project. Before one of these construction projects goes to bid (in the design stage) a stormwater and drainage plan is developed and becomes part of the bid package because the contractor needs to know what is expected. In most instances, the specified controls must be in place prior to initiating construction. This seems contrary to what the reviewer has interpreted as LC's approach to sediment control.

It would certainly seem if the Highway Department can develop a plan prior to a project that since LC knows the boundary of a well field (as defined by the monitoring well ring) and general extent of the ore within the field that a plan can be developed. The plan should contain a schedule for inspection and cleaning. While the reviewer's observations of the Cameco Smith-Highland Ranch operation were some years ago and operations have probably changed, there are vivid memories of hay/straw bale check dams plugged full of sediment with no plan for cleaning and maintenance. This is obviously unacceptable.

Finally, no generic designs for ASCM's or drainage crossings were provided as requested in the original comment. Please also see the response to Comment #4. Please respond to the original as requested. **(BRW)**

9) LQD (2/10) Contrary to normal protocol, Lost Creek never submitted a hydrologic testing proposal to LQD prior to the installation of the monitor well ring. To be consistent with what has been required of other operators in Districts II and III that have followed normal protocol, the following comment is made. Proper selection of well construction materials along with proper completion and development techniques are crucial aspects of a successful ISL operation. Accordingly, I respectfully request that LC provide very detailed well completion procedures (ref: WDEQ/LQD Non Coal R&R's, Chapter 11, Section 6(a)(i) and NUREG-1569, Sec. 3.1.2, pg. 3-1) as formal permit commitments in the permit document. These procedures at a minimum should specifically address the following:

   a) Type of drilling rig and specifications
   b) Drilling mud composition (trade names, additives, loss of circulation material, etc.) and weight
   c) Hole geophysical logging procedure
   d) Casing (include type, manufacture name, manufactures specification, I.D., O.H, wall thickness, burst pressure, collapse pressure)
   e) Cement slurry (composition, mix water quality and slurry weight and yield)
   f) Cements thickening time @ 70-degrees at 4hrs., 48hrs., 72hrs.
   g) Casing cementing hardware (centralizers, float shoe, wiper plug)
   h) Hole conditioning practice prior to cementing in the casing
   i) Cement slurry mix procedures and equipment.
   j) Procedure used to displace cement from casing to annulus.

k) Time waiting for cement to cure before re-entering casing
l) Casing/well under-reaming (equipment, tools, procedure)
m) Screens (include type, manufacture name, manufactures specifications, I.D., O.H, slot opening, burst pressure, collapse pressure)
n) Gravel packing procedure (sand specifications)
o) Packer assemblies (include type, manufacture name, manufactures specifications) [19] **(BRW)**

LC ISR, LLC (3/10) - Installation of the monitor well ring was discussed with LQD staff during a meeting on June 25, 2008. The discussion included details of how the perimeter monitor wells would be screened to monitor specific mining zones within the HJ Horizon, the appropriate distances from the mining patterns, and the distances between the perimeter monitor wells. LQD staff indicated that the monitor well plan would suffice as a hydrologic testing proposal. The requested information in this comment was presented to LQD staff in the Lost Creek ISR, LLC Mine Unit 1 Monitor Well Plan, which was submitted for approval on August 4, 2008. The approval of the Plan was included with the approval of the Revision to Update 4 for Drilling Notification No. 334DN which was received on October 23, 2008. The cover letter including the submittal of the Mine Unit 1 Monitor Well Plan and the plan are included in the Mine Unit 1 Application as Attachment MU1 1-1.

LQD (4/10) – **This item is resolved**– LC has incorporated the requested information as Attachment MU1 1-1 in the Mine Unit 1 submittal. The intricacies regarding the processing of the Hydrologic Monitoring Plan were discussed in the LQD's letter of March 11, 2010 to LC. The intent of this comment was to have LC document the well completion methods and materials utilized, which the submitted material has accomplished. However, the submitted plan (Attachment MU1 1-1) did not detail how a hydrologic test would be performed to assess the adequacy of the ring. With that said, please keep in mind though the response to this comment is declared acceptable, the LQD still has concerns of the monitoring ring's ability to detect excursions in some of the areas where multiple sands within the HJ Horizon will be mined; yet the closest monitoring well is only completed within a single sand. Please see Comment #22 and #26 regarding the adequacy issue and the ring's detection ability. **(BRW)**

10) LQD (2/10) - Please provide geologic cross sections and maps to illustrate the lateral and vertical extent of the ore horizons to be developed in the first mine unit. In particular, the location and extent of those portions of the mine unit containing multiple ore horizons should be clearly identified.[1,2] **(MM)**

LC ISR, LLC (3/10) - Two new maps have been added to Section 5.0 of the MU1 application, and the text has been revised to provide additional information about the lateral and vertical extent of the ore horizons (see Response to Comment MU1 #23). In addition, the original cross sections submitted with Attachment MU1 2-1 have been revised to provide a clearer picture of the ore zones.

LQD (4/10) – This item is resolved. (MM)

11) LQD (2/10) Section OP 3.2.2.2 in the main permit discusses the use of observation wells in situations where multiple ore horizons will be produced. No observation wells are described in this mine unit package, even though there are several locations where multiple ore horizons are being developed. Please address. **(MM)**

LC ISR, LLC (3/10) - LC ISR, LLC will incorporate existing wells HJMU-101 and HJMU-110 into the MU1 monitor well system as observation wells. These wells will be used as observation wells by taking water level measurements at a frequency as discussed in Attachment OP-8 of the main permit document. The data will be reported to the WDEQ-LQD. The locations of these wells are shown on

Figure MU1 4-1, and initial water levels are shown on Table MU1 4-3. A discussion of the use of these wells has been included in Section 5.2.1 of the MU1 Application (see Response to Comment MU1 #23).

LQD (4/10) - **Response not acceptable.** Lost Creek makes brief reference to the use of observation wells and permanent piezometers in section 1.2.3 in Attachment OP-2, Summary of Engineering Controls. However, aside from the two pre-existing wells mentioned in the above response, there are no definite plans provided for any such wells to be installed in mine unit #1. LQD has repeatedly expressed concerns regarding issues of confinement and control of production fluids. It is incumbent on Lost Creek to demonstrate how engineering controls will be used to prevent the movement of production fluids into unauthorized zones. Specific commitments for the installation and use of observation wells and permanent piezometers would be helpful in this demonstration. This is particularly true in areas where there are stacked ore zones and the monitor well ring wells are not monitoring all of the appropriate zones. See comment no. 33 for further discussion. **(MM)**

12) LQD (2/10) - Sections 2.2.1 and 2.2.3.1: The role of the fault with regard to its effects on transmissivity and its role in hydraulic connectivity among the various horizons within the Mine Unit must be more consistently described. There are several places within the text of the Mine Unit Package as well as Attachment MU1 2-1 that provide contradicting assessments of the fault. For example, the last sentence of the second to last paragraph in Section 2.2.1 (on Page MU 1-9) states "The fault does not appear to impede groundwater flow within the UKM Sand, as there is little or no displacement in the potentiometric surface across the fault." However, the last sentence in the second paragraph of Section 2.2.3.1 (Page MU1-10) reads "...it appears that the fault is a significant barrier to groundwater flow within MU1, although there does appear to be some leakage." The fault is interpreted as a non-barrier and then a barrier. Please explain the variable interpretations of the fault.[9] **(MLB)**

LC ISR, LLC (3/10) - Based on the water level and hydrologic test data collected to date, the hydrologic nature of the Lost Creek Fault is variable between the HJ Horizon and the UKM Sand. As stated in the Mine Unit 1 Application, there is structural offset throughout all of the geologic zones of interest (the FG, HJ and KM Horizons). The potentiometric data clearly show several feet of offset across the Fault in the LFG and HJ Horizons (Attachment MU1 2-1, Figures 4-2 and 4-1, respectively). However, potentiometric surface data from the UKM Sand show little, if any displacement across the Lost Creek Fault or the fault splay (Attachment MU1 2-1, Figure 4-3).

Hydrologic tests conducted on the north and south sides of the Lost Creek Fault have shown that the Fault impedes groundwater flow within the HJ Horizon. Under large hydraulic stresses, some leakage does occur across the Fault within the HJ Horizon. The Lost Creek Fault acts as a partial barrier to groundwater flow within the HJ Horizon. Hydrologic testing within the UKM Sand has shown that the Fault does impede groundwater flow within that unit when large hydraulic stresses are applied. The explanation for the different behavior of the Fault under natural and stressed conditions within the UKM Sand is not clear.

Cross sections constructed across the Fault (Attachment MU1 2-1, Figures 2-7 through 2-9 and 2-12) indicate that sands within the HJ Horizon are directly juxtaposed across the Fault. The maximum throw on the Fault is on the order of 80 feet and the thickness of the HJ Horizon is approximately 120 feet. The displacement across the Fault is not great enough to disconnect the HJ Horizon along its entire thickness. Therefore, the sealing properties of the Fault with respect to groundwater flow within the HJ Horizon are not directly related to offset and displacement of the HJ Horizon. The sealing nature of the fault is more likely related to smearing or shearing of horizontal bedding planes that were the primary flowpaths for groundwater movement.

The Fault impedes groundwater flow within the HJ Horizon, however, it is not impermeable to flow. To clarify this concept, the text of Attachment MU1 2-1 has been revised to replace the term "significant" with "partial" when describing the hydraulic barrier properties of the Lost Creek Fault (Executive Summary, 3rd bullet; the last paragraphs in Sections 6.3.1 and 6.3.2; and Section 8.0, 1st bullet).

LQD (4/10) - This item is resolved. (MLB)

13) LQD (2/10) - Sections 2.2. The section states that the pump tests were conducted to determine the hydrologic characteristics of the Production Zone Aquifer. In addition, WDEQ/LQD NonCoal R&R, Chapter 11, Section 3(a)(xiv) requires that all aquifers that may be affected by the mining process be characterized. Aquifer characteristics are presented in Appendix D-6, Table D6-11 of the Permit Application. Has the additional information provided by the 2008 pump tests refined these values? Please reference Table D6-11 within the discussion in this section and update Table D6-11 as appropriate. [9] **(AB)**

LC ISR, LLC (3/10) - A discussion comparing data results from the MU1 pump tests versus the information presented in Appendix D-6 of the main permit document has been added to MU1 Section 2.2 (Summary of Hydrogeologic Pump Tests).

LQD (4/10) - Response not acceptable. Within Mine Unit 1, Section 2.2, a discussion has been added. Yet in comparing the tables, an error was noted in Table D6-11, where the units for Transmissivity are listed as gallons per day/foot, as opposed to gallons/ft/day. Please provide a revised Table. **(AB)**

14) LQD (2/10) - Section 2.2.1, Paragraph 3. The statement is made that "The hydraulic gradient on the north side of the fault was approximately 0.006 ft/ft and 0.0054 ft/ft." Please correct the sentence to indicate which number represents the gradient on the south side of the fault. [9] **(AB)**

LC ISR, LLC (3/10) - The typographic error has been corrected.

LQD (4/10) This item is resolved. (AB)

15) LQD (2/10) - Section 2.2.2 Paragraph 3 states that there were 98 monitoring wells for the north pump test and paragraph 5 states that there were 100 monitoring wells for the south pump test, yet Figures 6-1 through 6-16 in Attachment MU1 2-1 only present the drawdowns for those wells that were monitored with a LevelTROLL device. Please add a statement that distinguishes the number of wells that were monitored 'continuously' with LevelTROLL monitors versus the number of wells that were monitored once every 24 hours with electronic water level meters. In addition, please also differentiate in the discussion how the information from each type of monitoring well was utilized to determine drawdown, ROI, and aquifer characteristics. [9] **(AB)**

LC ISR, LLC (3/10) - Attachment MU1 2-1 provides the details of the hydrologic testing that was performed on the north and south sides of the Lost Creek Fault. The following statements found in Section 4.2.1 and 4.2.2 of Attachment MU1 2-1 have also been added to the MU1 Section 2.2.2 for clarity:

"Water levels in 53 wells (including the pumping well, 28 HJ Horizon observation wells, and 24 wells in the overlying and underlying aquifers) were measured and recorded with In-Situ Level TROLL® pressure transducer dataloggers for the north test." and

"Water levels in 52 wells (including the pumping well, 31 HJ Horizon observation wells, and 20 wells in the overlying and underlying aquifers) were measured and recorded with In-Situ Level TROLLs® for the south test."

Section 4.2.1 of Attachment MU1 2-1 also states that "In addition to the wells continuously monitored using the Level TROLLS®, numerous other wells were periodically measured for depth to water using a manual electronic water level meter. This allowed for a more extensive assessment of the potentiometric surface before, during, and after the pump test." Only wells that were monitored continuously using the LevelTROLL devices were used to develop aquifer characteristics and calculate drawdown and ROI. These statements have also been added to the MU1 Application under Section 2.2.2.

LQD (4/10) The requested clarification was provided. **This item is resolved. (AB)**

16) LQD (2/10) - Section 2.2.4 HJ Horizon Aquifer Properties. The north and south pump tests were of 48 hour and 70 hour duration respectively, and did not achieve steady state conditions. The radius of influence (ROI) presented based on the north pump test was 3,000 to 3,500 feet, and for the south pump test 3,200 to 3,700 feet. Please provide the rationale and calculations for how these radii were determined. [8] **(AB)**

LC ISR, LLC (3/10) - It is unlikely that steady state could be achieved under the conditions observed at the Lost Creek site (including heterogeneity, potential leakage from underlying and overlying units, termination of the fault with distance), or at any ISR project. In general, most pump tests do not reach steady state, and the reference to non-steady state conditions was included as an indication of the aquifer analyses that were appropriate (see e.g., Page 36 in R. Heath, "Basic Ground-Water Hydrology," USGS Water Supply Paper 2220, 1983 [available on line at http://pubs.er.usgs.gov/djvu/WSP/wsp_2220.pdf] or Section 11.8 in M. Kasenow, Applied Ground-Water Hydrology and Well Hydraulics, Water Resources Publications, LLC, 2001).

The hydrologic testing was run long enough to achieve all of the stated objectives:

- Determine hydrologic characteristics of the Production Zone aquifer,
- Demonstrate hydrologic communication between the Production Zone pumping well and the surrounding Production Zone monitor wells;
- Assess the presence of hydrologic boundaries within the Production Zone aquifer over the area evaluated by the pump test; and
- Evaluate the degree of hydrologic communication between the Production Zone and the overlying and underlying aquifers in the vicinity of the pumping well.

There was no technical advantage to continuing to run the test beyond the achievement of the stated objectives.

The ROIs for the north and south tests were based on distance-drawdown plots for the tests. These plots were not originally included in Attachment MU1 2-1 but have been included in the revised version under Appendix F.

LQD (4/10) - Given the number of boundary conditions associated with the site, a longer term pump test which adequately stressed the system should have been performed. A 5-day test would have been standard given the boundary conditions at the site. Any future pump tests should be approved in writing by the LQD prior to being initialized. The ROI distance- drawdown plots were added as Appendix F of Attachment MU1 2-1. **This item is resolved. (AB)**

17) LQD (2/10) - Section 3.2 and 3.4.1 Soil Conditions and Soils. Twenty-four inches of topsoil stripping was used as a conservative estimate in order to determine the volume of topsoil to be stockpiled, yet is inaccurate. Attachment MU1 3-1 Section 4.0 indicates a topsoil depth of 19 to 24 inches for the Poposhia Loam (10% of the Study Area), six to 12 inches for the Teagulf Sandy Loam (15% of the Study Area), and 14 to 18 inches for the Pepal Sandy Loam (75% of the Study Area). Please definitively identify a recommended salvage depth for each soil series and revise Section 3.4.1, topsoil depths, topsoil stockpile volumes as appropriate. In addition, please provide a map showing topsoil suitability/stripping depths and revise table MU1 3-1 to include the depth and volume of soils to be salvaged from each of the various areas. Also, include a description of how the disturbed areas were calculated for roads and header houses.[16 6] **(BRW, MM)**

LC ISR, LLC (3/10) - Table MU1 3-1 and Figure MU1 3-1 have been updated to include more site-specific information. The topsoil stockpile locations shown on Figure MU1 1-3 were not updated because those locations represent the most conservative case, i.e., the most disturbance that could be associated with topsoil stockpiles. The dimensions used for the calculations are discussed in the first paragraph in Section 3.4.

LQD (4/10) – Response not acceptable – Table MU1 3-1 and Figure MU1 3-1 have been revised. However, Table MU1 3-1 Page 2 of 2 makes absolutely no sense; it is unknown what is being represented here, total volumes or ?. Figure MU1 3-1 contains numerous colors that do not correspond to anything in the legend. This is probably due to the overlapping of various features on the map. It is assumed that several of the submittal maps are part of a site GIS where various "layers" are turned on dependent of what the map is intended to depict. As a result, colors are generated that are not represented in the legend, thus, for example, it would be prudent to make the "MU1 Proposed Pattern Area" "Hollow (with a border)" such that the soil series mapping and associated stripping depths, the principle interest of this Figure, are actually clear. The soils depths listed in the table and on the map are incorrect. Please make the appropriate revisions to the Table and Figure to present a clear picture of projected soil salvage. **(BRW, MM)**

18) LQD (2/10) - Section 4.0: LC has provided the water quality analysis results for four sampling periods, but has not provided any water level data. The only water level data presented is associated with the various pump tests. Water level monitoring is essential to proper operation of an ISL operation. This critical piece of the monitoring program seems to have been overlooked in this mine unit package. Water levels are to be recorded as part of every well sampling event. The results should be reported and tracked as the operation moves forward. Please provide the data collected to date.[5,13] **(BRW, MM)**

LC ISR, LLC (3/10) - Table MU1 4-3 has been added to the MU1 Application, and this table provides the requested water level information.

LQD (4/10) – This item is resolved– water level information has been provided. **(BRW, MM)**

19) LQD (2/10) - Section 4.1: The second paragraph (p. MU1-16), states that each monitor well is subject to a mechanical integrity test (MIT). Please provide the results of mechanical integrity testing for the wells that have been installed to date.[19] **(MM)**

LC ISR, LLC (3/10) - Table MU1 4-1b has been added to the MU1 Application, and this table provides the requested MIT information.

LQD (4/10) – This item is resolved: (MM)

20) LQD (2/10) - Please describe how water level monitoring data will be collected and evaluated in the various operational situations. For example:

a. Section 5.1.2, Process Instrumentation (p. MU1-24) makes reference to Section OP 3.6 in the main permit document. There is no specific description in Section OP 3.6 of the use of any instrumentation for monitoring water levels. How will water level data be collected? **(MM, BRW)**

LC ISR, LLC (3/10) - Water level data will be collected as described in Section V(A) of Attachment OP-8 of the main permit document. This information has been included in Section 4.2 of the MU1 Application.

LQD (4/10) – **This item is resolved**– The text in Section 4.2 of the Mine Unit application contains a statement that refers to Attachment OP-8 of the Master Permit Operations Plan that details the procedure for procuring water level measurements. **(BRW)**

b. Section OP 3.6.3 in the main permit document states: "The water level changes, including both the drawdown and mounding from production and injection, respectively, will be evaluated to minimize interference among the mine units and to determine cumulative drawdown." How will the data be evaluated? **(MM, BRW)**

LC ISR, LLC (3/10) - Water level data will be evaluated using a "rose" diagram as discussed in Section 1.2.3 of Attachment OP-2 to evaluate interference among mine units.

LQD (4/10) - Response not acceptable – LC indicates that water level data will be evaluated using a Rose Diagram. However, the text provided does not give an indication as to the frequency at which the evaluation will be performed and what magnitude of change triggers a reassessment of and associated readjustment of injection and production rates. Please also see Comment #33. **(BRW)**

c. Section 5.1.1 (p. MU1-23) states: "As part of the start-up procedure, LC will monitor the water levels in the overlying and underlying monitor wells nearest to the header house as the house is brought on line." How will this data be collected and evaluated? **(MM, BRW)**

LC ISR, LLC (3/10) - The water level data will be collected as described in Section V(A) of Attachment OP-8 of the main permit document. Please see Section 1.2.3 of Attachment OP-2 for further discussion on how the data will be evaluated.

LQD (4/10) – **This item is resolved**– LC has added Attachment OP-2 which describes the procedures to be employed from a monitoring and operational standpoint to control the lixiviant. **(BRW)**

d. Section 5.1.3 (page MU1-24) describes excursion monitoring and states: "The prevention of horizontal excursions in the perimeter monitor well ring is possible by reviewing the water quality data in concert with the water level data." Specifically, how will the water level data be evaluated? **(MM, BRW)**

LC ISR, LLC (3/10) - Please see Section 1.2.3 of Attachment OP-2.

LQD (4/10) – **This item is resolved**– LC has added Attachment OP-2 which describes the procedures to be employed from a monitoring and operational standpoint to control the lixiviant. **(BRW)**

e. Section 5.1.3 (page MU1-25) states: "Sudden increase in water levels in overlying and underlying aquifers may be an indication of casing failure in a production, injection or monitor well." Are there other possible explanations, such as improperly plugged drill holes? Please describe the likely scenarios and how these will be addressed if increases in water levels are detected.[5,13,21] **(MM, BRW)**

LC ISR, LLC (3/10) - LC ISR, LLC does not believe that a sudden increase in water levels in overlying and underlying monitor wells would generally be caused by an improperly plugged drill hole. It is more likely that steady increases in water levels would occur due to an improperly plugged borehole. Therefore, LC ISR, LLC believes that the only credible scenario that would result in a sudden increase in water levels is a casing failure in a production, injection or monitor well. Increased water levels in overlying and underlying monitor wells, regardless of perceived cause or how suddenly it occurred, would result in an investigation to determine the cause. Please see Section 1.2.3 of Attachment OP-2 for a response to changes in water levels in overlying and underlying monitor wells.

LQD (4/10) - Response not acceptable – LC has provided several courses of action that maybe implemented to reverse water level changes that indicate that the potential for excursion exists. All of the procedures presented appear to be valid approaches to rectify the problem. The reviewers realize that there are a host of potential causes to water level rise and there is some "trial and error" associated with rectification, but it would seem that a more systematic approach to the solution would make the most sense. In other words, a particular condition is the most common cause of problems with water level rise, so this becomes the starting point for the effort. Please take the solutions presented in Section 1.2.3 of Attachment OP-2 and develop a systematic approach for the remediation of changes in water levels. Please also see Comment #20b. **(BRW, MM)**

21) LQD (2/10) - Section 5.1.4: The second to the last paragraph in Section 5.1.4 states that the "relatively uniform drawdown pattern in the perimeter monitor wells…indicates that significant channeling with the HJ horizon does not occur…" It appears that the sole basis for concluding the absence of channeling within the HJ is based upon two pump tests (the North and South pump tests of late 2008). This reviewer's observations of the nature of the Battle Spring Formation in the Great Divide Basin (from the walls of open pits at various sites) has revealed that paleochannels pervade the formation. To summarily dismiss the potential presence of paleochannels based on the radius of influence (ROI) pattern of two pump tests, that did not reach steady-state, seems a little premature. Additionally, a more detailed discussion of the existence of anisotropies such as paleochannels in the Mine Unit must be provided.[8,9,10] **(MLB)**

LC ISR, LLC (3/10) - The statement in question has been revised to address paleochannels. (The results of the earlier pump tests [Appendix D-6 of the main permit document] support a similar conclusion.) Additional discussion of the duration of the pump tests (i.e., whether they reached steady state or not) and anisotropy is included in the Responses to Comments MU1 #16 and #30, respectively.

LQD (4/10) – This item is resolved. (MLB)

22) LQD (2/10) - Section 5.1.4: This section explains that the monitoring well ring distance was chosen to be 500' in the fall of 2008 because it was considered industry standard. Subsequent to the construction of the monitor well ring, the November and December 2008 pump tests were conducted. The results of the pump tests showed a minimum ROI after two days of pumping of approximately 2,600 feet (North Pump Test). The conclusion was essentially that any ROI greater than 500 feet would render the 500' monitor well ring viable. However, Guideline 4 asks that the location of the monitoring wells be based on gradient considerations, dispersivity of recovery fluids, the initial excursion recovery measures employed by the operator, the normal mining operational flare, and the recoverability with the allowable regulatory time frame. Monitor well locations should be based on a groundwater flow model or other technically justified methods. Please provide a scientific, site specific justification for the monitor well spacing.[10] **(MLB, AB)**

LC ISR, LLC (3/10) - As discussed in Response to Comment MU1 #9, installation of the monitor well ring, including well spacing, was discussed with LQD staff during a meeting on June 25, 2008. The approval to install the monitor wells was received and bond posted prior to installation (see Update 3 of DN334 which was approved on May 14, 2008 in a letter from Don McKenzie). Approval of the plan was included with the approval of the Revision to Update 4 for Drilling Notification No. 334DN which was received on October 23, 2008. Therefore, based on this approval, the perimeter monitor wells were installed. At that time, two regional pump tests had been conducted; therefore, information on aquifer characteristics and anticipated well responses was available.

The MU1 pump tests confirm that the well spacing is appropriate in that all of the wells responded to pumping, as discussed in Response to Comment MU1 #16. (In some cases, the response was greater than required for other ISR operations.) Based on the discussion in Section 5.1.4 of the Mine Unit 1 Application concerning the radius of influence and the lack of the influence on groundwater flow due to paleochannels within the HJ Horizon LC ISR, LLC believes that the spacing of the monitor wells is appropriate for MU1.

LQD (4/10) - Response not acceptable. The LQD refers LC personnel to LQD's clarification letter dated March 11, 2010 with regard to the pertinence and applicability of LQD's approval of revisions to DN 334 as a mechanism for approval of monitor well ring wells. LC is directed to the original question which, restated, is as follows: Please provide a scientific, site specific justification for the monitor well spacing. The justification should include Guideline 4, Section III C, 5(b), requirements listed above in the original comment. **(AB and MLB)**

23) LQD (2/10) - Section 5.2.1: This section addresses monitoring of the LFG and UKM sands across the fault. Figures MU1 5-1 and MU1 5-2 depicts pattern areas in the UHJ and LHJ respectively that are juxtaposed with either the LFG or UKM sands on the opposite side of the fault. Those figures also depict monitoring wells in the LFG or UKM sands to demonstrate that LC will be able to readily detect cross-fault excursions of lixiviant during solution mining. The depiction of the UHJ and LHJ pattern areas in Figures MU1 5-1 and 5-2 implies that there are also middle HJ (MHJ) pattern areas in the Mine Unit. Assuming there are MHJ pattern areas, they should be discussed in this section and they should be depicted on an additional figure to demonstrate that they, too, will be adequately monitored across the fault.

Lastly, to more clearly depict pattern areas near the fault, please provide a localized cross section at each of the pattern areas near the fault to indicate the known displacement and juxtaposition of the sands across the fault. Along cross section A-A' on Attachment MU1 2-1, Figure 2-7, there is connection of the HJ horizon north of the fault with the FG Horizon south of the fault, and connection with the HJ horizon south of the fault with the KM horizon north of the fault. Regardless of whether

the production zone is in the upper, middle or lower HJ with the entire aquifer under production and under pressure the possibility of an excursion either direction outside the production zone exists and needs to be presented and discussed. Please review all possible connections between upper and lower aquifers and the production zone, and present the engineering controls for avoiding an excursion, and the additional monitoring wells to be used to ensure that a cross formation excursion does not occur.[11] **(MLB, AB)**

LC ISR, LLC (3/10) - The requested review has been completed by LC ISR, LLC and Section 5.2.1 has been revised to include a discussion of the MHJ Sands. Additional maps showing the possible cross fault connections have been provided in the Mine Unit 1 Application, and an additional cross section has been included in the Attachment MU1.2-1. LC ISR, LLC staff also met with LQD staff in the WDEQ Lander office on March 18, 2010 and presented a detailed discussion on these issues. Please see Response to Comment MU1 #33 regarding engineering controls.

LQD (4/10) – Response not acceptable. As noted in a March 24th email from the Division to John Cash, the information presented during the March 18th meeting in Lander was helpful, but additional information was requested for submittal in the Mine Unit package:

- To better demonstrate LC's ability to detect excursions in the overlying and underlying aquifers, the 21 'cross stitches' and map showing the stitch locations relative to the HJ production zones should be included in the MU package. All screened intervals in the monitoring wells should be indicated on the cross sections, so that it is clear that the well is screened appropriately to detect an excursion from a production zone juxtapositioned across the fault. In addition, please provide a Table which presents each of the potential juxtaposition scenarios, the production zone interval versus the monitoring well intervals, the distance from the fault of the nearest monitoring well, and the Figure No. which illustrates the juxtaposition.

- We learned in the meeting that there was an occasional loss of circulation when drilling through the fault. Additional characterization of the fault zones will be needed to demonstrate whether they are smear or rubblized zones, and whether there is a presence of any voids within the fault zones. During the meeting it was indicated that coring would not be effective in characterizing the fault zone due to the poor competency of the sands. What other means could be used to better characterize the fault(s)? Have geophysical surveys, down hole cameras or additional pump tests been considered? Some additional testing may be necessary to provide a better characterization of the fault zones which are a major hydrologic concern regarding the ability of the facility to prevent the migration of fluids into unauthorized aquifers.

- How has the angle of the fault been determined? The position of the fault within the production zone needs to be determined and presented in the discussion and on the Figures and Plates. For example a 15 degree fault at 400 foot depth would be 100 feet offset from its surface representation. How does this effect the ore zone located in the graben block between the two faults? The location at depth should be indicated on any map that represents the operation and monitoring of the wellfield.

- The cross sections that were provided with the March Mine Unit submittal have generated the following comments:

  Figure 2-6: MU-109 shown on cross section A-A' is not designated on Figure 2-6.

  Figure 2-7: The screened interval for monitoring wells should be indicated on the cross sections. In addition, when there are nested wells, please indicate their presence and screened intervals on the cross section, so that it is clear which zones are being monitored across the fault relative to the ore zones.

Figure MU1 5-3 and MU1 5-4: The monitoring wells designated on the north side of the Lost Creek fault to detect the excursion of fluid from the middle or lower HJ ore zone south of the Lost Creek fault are designated as HJMU-101 and HJMU-110. These wells are 300-400 feet north of the fault, whereas the other cross fault monitoring wells are within 50-75 feet of the fault, which seems more appropriate for early detection. The Division is requesting that new monitoring wells be installed at these locations to provide early detection of a problem. (The response to this comment may be impacted by the previous bullet, regarding the actual fault zone at depth relative to the ore zones and monitoring wells.)
Figure MU1 5-3: Well MU-104 appears to be the monitoring well that would serve as a cross fault monitor, yet is not designated in RED on the Figure.
Figure MU1 14-1: The location of the HJMU-101 and HJMU-110 wells is different from the location designated on other maps in this series.
Completion Log MU-109: The screened interval elevation incorrectly reads 6407-6487. It should read 6407-6387. **(AB)**

24) LQD (2/10) - Section 5.3 The role of historic drill holes needs to be addressed in far greater detail than is currently provided. The late 2008 pump test results show that the upper KM (UKM) and the lower FG (LFG) sands are hydraulically connected to the HJ horizon. The drawdown observed in the UKM and LFG monitoring wells during the north and south pump tests was noted in Attachment MU1 2-1 as being an order of magnitude less than what was observed in the observation wells completed in the HJ horizon (ore zone) monitoring wells. The implication was that an order of magnitude less (in the vertical versus the horizontal) is somehow not a concern. It would seem that, during a pump test, one should expect the drawdown observed in an overlying or underlying unit to be substantially lower than the drawdown observed within the formation being pumped. Therefore, simply dismissing the significance of the observed drawdown as an "order of magnitude" less is not acceptable.

The reality at the LC site is that the overlying and underlying aquifers are in communication with the HJ. This is a considerable concern because it implies that protection of the overlying and underlying aquifers is untenable. It is unclear to this reviewer whether the cause of communication between the HJ and its overlying and underlying aquifers is due to:

1) cross fault communication,
2) void space in historic drill holes functioning as vertical conduits,
3) gaps in the Sagebrush or Lost Creek Shales, or
4) a combination of all three above factors.

Given the above doubts about the possibility of protecting the overlying and underlying aquifers during the proposed solution mining at the LC project, LC must take greater steps to address the above listed three concerns in the Mine Unit Package. The most glaring concern (of the three listed above) is the role of historic drill holes functioning as vertical conduits.

The attached table (Table 1) provides a comparison of overlying and underlying wells (that had one foot or greater drawdown during the pump tests) with their proximity to 1) the fault and 2) historic drill holes. Table 1 indicates that there are at least 30 instances in which historic drill holes have the potential to be affecting the drawdown observed (I.e. where the historic drill hole may be functioning as a conduit for vertical communication between the HJ horizon and the LFG and UKM horizons).

Moreover, Table 1 indicates two instances, involving monitoring well MO-106, where 1 foot of drawdown was observed but the fault is a significant distance away (480') from the well. There are two historic drill holes that are 50 feet (TG8-18) and 160 feet (TG15-18) from the MO-106. Both

historic drill holes (TG8-18 and TG15-18) are open holes in the same depth where MO-106 is screened. No discussion of the potential for TG8-18 and TG15-18 functioning as conduits for vertical communication was provided in Attachment MU1 2-1. It is expected that the role of historic drill holes be more thoroughly addressed in the context of the drawdown observed during the late 2008 pump tests.[11] **(MLB, BRW)**

LC ISR, LLC (3/10) - There are select locations where responses greater than one foot of drawdown have been observed at overlying or underlying monitor wells during the north and south hydrologic tests. LC ISR, LLC is continuing to investigate each of those locations to determine if the cause of hydraulic communication is likely to be a historic borehole or local thinning of a confining unit. To date, there is no direct evidence that an abandoned borehole has created an artificial pathway at the Lost Creek site. Two wells installed by LC ISR, LLC that were determined to have been damaged may have resulted in temporarily establishing hydraulic communication between the Production Zone and overlying or underlying units (e.g. Well MU-108). Those wells have been abandoned. LC ISR, LLC has also committed to attempt to locate and abandon all historic boreholes within MU1 (as well as the entire Permit Area). Many historic boreholes have already been abandoned.

Regardless of the cause of the hydraulic communication, LC ISR, LLC will conduct adequate monitoring during ISR operations to ensure that a vertical excursion into the overlying or underlying aquifers is promptly detected and that appropriate corrective actions are applied to prevent loss of fluids and impacts to overlying and underlying aquifers. Should an excursion be detected, LC ISR, LLC will engage in recovery and restoration operations, as required to return water quality in the affected aquifer to pre-mining conditions.

The 6th bullet under the Executive Summary of Attachment MU1 2-1 was revised to read:

> "Responses in the overlying and underlying aquifers were minor and an order of magnitude lower than responses observed in the HJ Horizon. Additional evaluation as to the cause of the responses is being conducted. LC ISR is pursuing the proper plugging and abandonment of historic wells to mitigate the potential for communication through improperly abandoned wells."

The following statement was also added as the 4th bullet in Section 8.0 of Attachment MU1 2-1:

> "LC ISR is conducting a program of locating, plugging and abandonment of historic wells within MU1 to mitigate the potential for hydraulic communication through improperly abandoned wells."

LQD (4/10) – Response not acceptable - In the near future, if not already done, LC will be submitting an application for an aquifer exemption for the proposed production zone, the HJ horizon, within the permit area boundary. The exemption would allow for the temporary degradation of water quality within the production zone. Aquifers outside the exemption boundaries must be protected from diminution of water quality; more succinctly the measures LC will employ to prevent excursions from occurring in fulfillment of the requirements described in the LQD NonCoal R&R's, Chapter 11, Section 4 (a)(xx) must be described.

As expressed during meetings and through comments, containment can be achieved geologically and/or operationally. The intent of this comment was to clarify that complete geological containment does not appear possible, based upon the geological and hydrogeological investigations performed to date. At the time of the initial review, specific to achieving operational containment, the only information/statements provided by LC were (paraphrased) "through the use of engineering controls

similar to those that have been used successfully by other ISR operations." In the reviewers' minds, this statement does not fulfill the requirements of the above cited regulation, which brings us to the present.

Thank you for providing a commitment to perform an additional evaluation of the potential causes for communication between the production and the over and under lying aquifers and initiating a program to locate and properly/completely abandon historic drill holes. As discussed in the reviewer's response to Comment #32, this effort to locate and properly/completely abandon historic drill holes should assist in reducing the degree of communication between the production and over and under lying aquifers.

Below are the 3 outstanding issues (labeled a – c) pertaining to this comment and comment #32 which has been combined with this comment. The bold faced print is the action/response expected for each issue (a – c).

a. There appears to be some disparities in LC's response that indicates many historic boreholes (plural) have already been abandoned, yet Table MU1 5-1 only indicates one hole (TT96) that was located and abandoned. **Please clarify and update Table MU1 5-1.** Also, please note that the TT96 abandonment date in the table needs to be corrected.

b. LC's response indicates "to date, there is no direct evidence that an abandoned borehole has created an artificial pathway at the Lost Creek site." At Cameco's Smith-Highland Ranch operation – Well Field J, Cameco located and abandoned several historic boreholes and conducted pre and post abandonment pump tests to assess success. While communication between the production zone and overlying aquifers was not completely eliminated as a result of this effort, there was a noticeable decline in the degree to which it existed. As stated at meetings and within submittal comments, LC must demonstrate control over their fluid to prevent contamination of over and under lying aquifers. This can be done geologically and/or operationally. It only works to an operator's advantage where the more geologic control that can be in place, the easier fluid management becomes.

   As stated during several meetings and in correspondence, the LQD is not requesting that LC perform an up-front ground inventory of historic exploration holes for the entire permit area, but rather the inventory could be accomplished on a well field basis. Thus, as verbally committed to during the meeting in Casper on February 25, 2010, **please provide a commitment to conduct an aquifer test(s) to assess the impact of the historic borehole location and abandonment efforts on communication between the production zone and over and under lying aquifers. An updated Table MU1 5-1 and the results of the pump test will need to be submitted as part of the Mine Unit package.**

c. There are still concerns with the role of the fault as well as potential thinning of the shale layer that acts as an aquitard; I.e. geologic conditions that cannot be mitigated must be dealt with from an operational standpoint. The engineering controls discussion in Attachment OP-2 does not provide the needed level of technical confidence that production fluids will be controlled, given the fault, questionable confining layers, and presence of historic drill holes (ones that are not located during LC's field inventory and abandonment effort).

   The use of groundwater monitoring to detect and react to an excursion is not considered an engineering control to prevent an excursion. Rather the idea is to utilize the instantaneous flow and pressure data being collected and sent to a central control room to establish and maintain a balanced well field in real time. In addition, the water level data collected from interior monitoring and monitor ring wells must be used to make adjustments to production and injection

flow rates as changes in water level should be detected in advance of changes in quality. **Attachment OP-2 will need to provide a more in depth discussion regarding the control of fluids within the production zone.** Please also see Comment #33. **(BRW and MLB)**

25) LQD (2/10) - Section 6.1.1: Please provide an updated pore volume calculation specific to Mine Unit #1, including an evaluation of all of the inputs and assumptions used in the calculation, based on currently available information. Particular attention should be focused on the thickness and spatial distribution of the ore horizons and calculation of an appropriate flare factor. The MU1 PV calculation in section 6.1.1 assumes an average ore zone thickness of 12 feet. This does not appear to be an appropriate value given that the average screened interval in the 13 ore zone monitor wells (MP wells, which will be utilized as injection and production wells) is 17 feet. It is also noted that section OP 1.2 in the mine permit document (bottom of page OP-3) states that the MHJ mineralized zone is about 30 ft. thick. Data should be provided to define the ore zone thickness in mine unit #1. Additionally, it should be noted that the mine-unit-specific water balance and mining/restoration schedule may be affected by a change in pore volume.[22,28] **(MM)**

LC ISR, LLC (3/10) -The surety estimate submitted to WDEQ-LQD in February 2010 (Table RP-4) totaled $7,532,329 and included the most current estimate of the number of MU1 patterns and size of that pattern area at that time. It was also based on complete installation of MU1 within the first year. Table RP-4 of the main permit document and Section OP 6.1.1 have been updated to reflect the most recent information. As outlined below under the discussion of 'Area', the number of patterns has changed, and the approach to determining the size of the pattern area has also been changed to better account for stacked ore zones. In addition, it has been determined that only half of MU1 could be installed within the first year.

Area: is the area of the patterns projected to the ground surface. It is used in the pore volume calculations, but because of the presence of 'stacked' ore, it must be adjusted in those calculations to account for pattern overlap. The surety estimate was originally based on 180 patterns at 9,000 sq. ft. per pattern or 1,620,000 sq. ft. total. However, the pattern overlap within the HJ Sand was not taken into account in this approach. The updated estimate includes 241 patterns, and the actual surface area is 1,611,720 sq. ft. However, to account for pattern overlap in the pore volume calculations, it is has been assumed that the area is larger, i.e., the area of each pattern is taken into account in the pore volume calculation, even if it is stacked with another pattern. With this approach, the total MU1 total area has been revised to 2,115,594 sq. ft. The surety estimate and schedule will be modified on an annual basis, and the estimated areal extent will be updated as necessary.

Thickness: is estimated to be 12 feet based on preliminary estimates for pattern completions. The average completion thickness for the MP monitor wells in MU1 is 17 feet. The MP monitor wells completions are considered 'gross' completions and are designed to capture all the ore in the immediate production horizon. The MP monitor wells also tend to be in the thickest part of the ore to insure water quality samples indicative of the ore zone. Therefore, these monitor well completion intervals are expected to be thicker than many of the actual production and injection well completions because many of the production and injection wells are located on the 'fringes' of the ore where the ore thickness is less. Because of the range of ore thicknesses, LC ISR, LLC maintains that the original estimate of 12 feet 'average' completion thickness is valid. Further, the surety estimate will be modified on an annual basis and the estimated ore thickness will be replaced with actual ore thickness as the production and injection wells are installed.

'Stacked Ore' in MU1: The HJ Sand is the production zone of interest in MU1. Production is planned from four horizons (UHJ, MHJ1, MHJ2 and LHJ) within the Sand. Production patterns will

be completed with separate wells in each of these horizons and produced simultaneously regardless of whether they overlie each other or not. The surety estimate accounts for horizontal flare equal to 20% of each pattern's area and vertical flare equal to 20% of each pattern's thickness. This is regardless of continuity with other patterns either vertically or horizontally. Therefore, every pattern is fully accounted for in the surety estimate.

LQD (4/10) – **Response partially acceptable.** With these responses the stacked ore zones have been properly accounted for (i.e. the area of each ore zone has been summed, instead of simply looking at a vertical projection). This has increased the mine unit pore volume by 31%. Please incorporate the above discussion into section 6.1.1. Also, as noted in the original comment, please address what impact this may have on the water balance and the mine/reclamation schedule.

A revised bond estimate (Table RP-4) was provided, apparently to account for the revised mine unit development schedule and revised pore volume calculation. Review of the bond calculation will be deferred to the main permit document since there are a number of outstanding comments related to the bond calculation contained in LQD's review dated 3/26/10. **(MM)**

26) LQD (2/10) - Figure MU1 4-1 Mine Unit 1 Monitor Well Locations Attachment MU1 2-1, Appendix A, Well Completion reports. Given the MU1 Proposed Pattern Area for the various sands the spacing of the monitoring well ring needs to be justified, and each of the sands should be monitored individually. The current M wells are sometimes only screened in the Middle HJ, and would not identify an excursion in the Upper or Lower HJ. [eg the west (down gradient) end of the monitoring well ring (M-114, M-115, and M-116) are screened in the MHJ sand only, yet the pattern area to the east contains proposed production zones in the Upper, Middle and Lower HJ sands]. In addition there are M wells that have screened intervals within each of the sands which would dilute any excursion within one of the zones.

The footprints of the Upper and Lower HJ ore bearing zones are significantly smaller than the footprint of the Middle HJ, and therefore the distance from the edge of the ore zone to the current monitoring well ring is substantially more than the proposed 500 ft. distance. The monitor well ring wells were installed in the summer of 2008, under a drilling notification, prior to any discussion with or approval by the Division. A revised monitoring network should be proposed and discussed with the Division prior to installation. [20] **(AB)**

LC ISR, LLC (3/10) - Please see Response to Comment MU1 #22.

LQD (4/10) - **Response not acceptable.** Please refer to the clarification letter dated March 11, 2009. Although the Division is willing to accept the spacing of the monitoring ring wells provided scientific justification is provided within the Mine Unit Package Section 5.1.4, (Comment 22) the issue regarding the screened interval of the monitor well ring wells inadequately detecting an excursion remains. Please respond directly to the comment originally listed. **(AB)**

27) LQD (2/10) - Figure MU1 1-2 Location of MU1 within Permit Areas. The footprint of Mine Unit 1 does not coincide with the footprint of Mine Unit 1 in the Operations Plan (Figure OP-2a) or Plate OP-1 Site Layout. It appears to now be part of what was originally described as Mine Units 1, 2, and 4. Figure OP-2a and Plate OP-1 (and any other effected Figure) will need to be updated accordingly. **(MM)**

LC ISR, LLC (3/10) - Pursuant to the discussions held during the February 25, 2010 meeting, a summary of the Project Development has been provided in the Adjudication volume. This summary explains how the project has evolved from discovery through permitting and how knowledge has

changed through that process. The summary also describes how the areal extent of MU1 has moved from conceptual in the original Permit Application to a refined area in the MU1 Data Package. Both Plate OP-1 and Figure OP-2a have been revised to show how the refined MU1 area overlays the conceptual mine unit area.

LQD (4/10) – **Response partially acceptable.** The project overview explains the evolution of the project and the reasons why the mine unit boundaries have changed. As agreed in the 2/25/10 meeting, LQD will not require that all maps in the permit be updated to reflect the revised mine unit boundary, however Chapter 11, section 4.(a)(ii) and section 5.(a)(i) clearly require mining and reclamation schedules, including maps that show the mining and reclamation sequence for the proposed wellfields. Accordingly, Plates OP-1 and Figs. OP-2a and RP-2 will all need to be revised to show the future mine units and their mining and reclamation sequence. **(MM)**

28) LQD (2/10) - Attachment MU 1 2-1, Section 4.3: The data analysis presented concerning vertical gradients in the Mine Unit 1 suggests that there is no communication between the overlying, production, and underlying aquifers. While outside of the proposed mine unit, analysis of water levels in the southwest corner of the permit area would suggest otherwise (reference Volume 3A of the main permit, Table D6-7b). The reviewer concedes that the data being analyzed for the Mine Unit 1 submittal does not infer communication; however, data are available to the contrary. Please revise statements in the text appropriately. [8] **(BRW)**

LC ISR, LLC (3/10) - The discussion in Section 4.3 of Attachment MU1 2-1 is specific to MU1. All of the figures and tables referenced in the discussion are specific to MU1. Additional references to MU1 have been placed throughout the discussion in Section 4.3 to ensure that the reader understands that the interpretation of the data applies to MU1 and not other portions of the Permit Area. Data indicating that there may be hydraulic communication in areas other than MU1 is provided in the appropriate place within Appendix D6 of the Permit to Mine Application. A statement has also been added to the second to last paragraph in Section 4.3 that reads:

> "There is at least one location in the southwest corner of the permit area (approximately 12,000 feet from MU1) where the potentiometric head in the HJ Horizon is slightly greater than the potentiometric head in the overlying EFG Sand, indicating an upward vertical gradient at that location."

LQD (4/10) – **This item is resolved**– LC has made revisions to Section 4.3 of Attachment MU1 2-1 to acknowledge the existence of an area where the FG and HJ horizons appear to coalesce and placed qualifiers where needed to indicate that statements are specific to the Mine Unit 1 area. **(BRW)**

29) LQD (2/10) - Attachment MU 1 2-1, Section 7.1, Analytical Methods: On page 25 in the third to the last paragraph of this section, it states "The criterion for terminating the MU1 pump tests was observation of measurable drawdown at each of the perimeter "ring" monitor wells. This case was met before steady state was reached..." The termination of the pump test prior to achieving steady state brings into question the thoroughness of the pump tests. Specifically, in the absence of achieving steady state, what are the implications for 1) the regional radius of influence (ROI) of the proposed mining operation and 2) the preferred pathways due to variable transmissivity values (anisotropies) within the production zone.

Specifically, one of the purposes of the pump test is to enable a simulation of "mine-induced drawdown of the regional potentiometric surface using an appropriate groundwater flow model" (Guideline 4, Attachment II). It is unclear to this reviewer how such a simulation can be deduced

from a pump test that did not reach steady state. Additionally, the MU package does not provide analysis of a regional potentiometric surface using pump-test-specific data.

Speaking to the second point above (about preferred pathways), in the absence of steady state, it is questionable whether the system was adequately stressed during the late 2008 pump test. The MU1 Package must more accurately identify the boundary conditions and aquifer characteristics and all preferred pathways (due to variable transmissivites).[8,9,10] **(MLB)**

LC ISR, LLC (3/10) - As previously described under the Response to Comment #16, it is unlikely that true steady state conditions could be achieved during a pump test at the Lost Creek site. The objectives of the hydrologic tests are stated in LQD Guideline 4 and were all achieved. Running the test for a longer period of time would have served no useful purpose. All of the wells within the monitor ring had adequate response to indicate hydraulic connection to the pumping well. There were no observation wells located beyond the monitor ring; therefore continuing the pump test would not have provided additional data with respect to the ROI or regional impacts.

Preferred pathways within MU1 would not have become more apparent from conducting a longer test. The distribution of drawdown would remain similar to that shown in Attachment MU1 2-1 Figures 6-17 (north) and 6-18 (south), only the amount of drawdown would increase with continued pumping.

Prior to conducting the MU1 hydrologic tests, hydrologic tests were conducted on the north (July 2007) and south (November 2007) sides of the fault within the HJ Horizon. Both tests were run for over 5½ days. Aquifer properties determined from those earlier tests were very comparable to the results calculated from the MU1 tests. The aquifer properties estimated from the four HJ Horizon hydrologic tests are representative of site conditions and have been used in analytical models to project long-term impacts to groundwater resources under the Operations Plan and Reclamation Plan of the Lost Creek Permit to Mine Application.

The reference to steady state has been removed from Attachment MU1 2-1 to avoid additional confusion over this issue.

LQD (4/10) - This item is resolved. The LQD understands that true steady state is not realistic or achievable in nature. However, it was expected that the north and south pump tests would be run longer. It is still the opinion of this reviewer that preferred pathways could have been revealed by a longer duration pump test. That is, as the radius of influence migrates outward from the pumping well, changes in lithology could/would be detected. However, in light of LC's response to comment #21 (which also addressed paleochannels and anisotropies), LC's response to this comment is considered acceptable. **(MLB)**

30) LQD (2/10) - Attachment MU 1 2-1, Section 7.3, Transmissivity Distribution: This section states that "A quantitative analysis of directional transmissivity was not conducted..." Qualitatively, two main preferred pathways were described in this section of Attachment MU1 2-1: one trending west-southwest and another trending east-southeast. This reviewer is concerned that the monitor well ring may be insufficient to detect excursions following either 1) one of the two preferred pathways identified in Section 7.3 or 2) a preferred pathway not yet defined because the quantitative analysis was not done. A quantitative analysis of directional transmissivity is essential in order to fulfill requirements of WDEQ/LQD NonCoal R&R, Ch. 11, Sec 3 (a)(xiv).[9] **(MLB)**

LC ISR, LLC (3/10) - First it should be noted that Attachment MU1 2-1, Section 7.3 did not describe "preferred pathways" but indicated "preferred orientation of T" implied from the drawdown data.

The description of the text in Attachment MU1 2-1, Section 7.3 has been revised to more clearly state the observed conditions as follows:

"The distribution of transmissivity calculated from the MU1 north and south pump tests are presented on Figures 7-2 and 7-3, respectively. For consistency, only transmissivity values determined from the Theis drawdown method are posted. The overall range of transmissivity determined from the north and south tests is relatively small (51 to 129 ft^2/d) relative to typical fluvial depositional systems.

The presentation of the distribution of transmissivity (provided in Attachment MU1 2-1, Figures 7-2 and 7-3), indicates a slight directional bias in transmissivity. A southwest decrease in transmissivity observed on the north side of the Fault appears to be correlative with a slight reduction in the thickness of the HJ Horizon. The HJ Horizon thins west of the pumping well PW-102 (Figure 2-3), which generally corresponds to the decreasing trend observed in T values (Figure 7-2). On the south side of the Fault there is an area of slightly lower transmissivity that trends along wells M-106, M105 and M104 to the southeast. This southeast trend of low transmissivity correlates with the elliptical shape of the drawdown observed on the south side of the Fault during hydrologic testing. Transmissivity appears to increase closer to the Fault in the area of the fault splay (wells UKMO-101, HJT 105 and M-127). This increase in transmissivity may be partially the result of impacts of the fault splay during the south hydrologic test in reducing the drawdown in wells located in the downthrown fault block. This would not be considered a "preferred pathway."

As further described in Attachment MU1 2-1, the Lost Creek Fault strongly affects the analysis of the drawdown data. Analytical results only provide an "effective" transmissivity because of the hydraulic barrier created by the Fault. During the hydrologic tests, the Fault reduces the available aquifer by almost half. This is demonstrated in Appendix OP1 of the Operations Plan. One of the key assumptions in using the Papadopulos method for directional transmissivity (or any other analytical method) is that the aquifer is infinite acting, that is there are no significant hydraulic boundaries. Because of the impact of the fault, a quantitative analysis of directional transmissivity could provide misleading and incorrect results.

One of the two "preferred pathways" referenced in the comment is actually a reflection of the orientation of the fault. Regardless of transmissivity, because of the hydraulic barrier effect of the Lost Creek Fault, groundwater within the HJ Horizon on the north side of the fault will generally move parallel to subparallel to the Fault (toward the southwest). This is demonstrated by the potentiometric surface maps presented in Attachment MU1 2-1, Figures 4-1, 4-2 and 4-3. The exception to this might occur if large hydraulic stress (pumping) is applied to the south side of the Fault, which may, at least temporarily induce flow more toward the south.

The other "preferred pathway" the elliptical shape of the drawdown contours on the south side of the fault, is manifested by a slight decrease in transmissivity. A zone of lower transmissivity would obviously not be a preferred pathway for groundwater migration.

As described in response to comment 21, results of the north and south hydrologic tests indicate hydraulic communication between the entire HJ Horizon across MU1. The monitor ring circumscribes the entire Mine Unit. Additional information regarding directional axis of transmissivity would only identify a possible orientation to groundwater flow, not the exact location. Furthermore, operational rates proposed for the Lost Creek ISR will be sufficient to overcome any directional component of transmissivity.

LQD (4/10) – This item is resolved. The new text provided in Section 7.3 of Attachment MU1 2-1 adequately addresses and explains the variability of T values in the Mine Unit and their relation to the

existence/absence of preferred pathways in the Mine Unit. Additionally, the text provides T values and analysis that constitutes a quantitative analysis of directional transmissivity as required by WDEQ/LQD NonCoal R&R, Ch. 11, Sec 3 (a)(xiv). **(MLB)**

31) LQD (2/10) - Attachment MU 1 2-1, Section 7.5 This section references a Table which is on Page 29. This is a duplicate page no. and within the Table, PW-101 for the South Test is mislabeled as PW-102. **(AB)**

LC ISR, LLC (3/10) - The duplicate page number has been corrected and Well PW-101 has been properly labeled in the table.

LQD (4/10) - Response not acceptable. The duplicate page no. was not corrected. Page 29 contains Section 8.0, and then the Summary Table page should be labeled 30, and subsequently the reference page no. will need to be revised as well. The error on the Table was corrected to read 'PW-101'. **(AB)**

32) LQD (2/10) - Attachment MU1 2-1, Section 8.0, Summary and Conclusions, Bullet 1: In the first bullet in the list in this section, the report concludes that the late 2008 pump test revealed "minor communication" across the fault but that communication was an "order of magnitude" smaller than the communication observed within the HJ pumping and observation wells. The conclusion was that the minor communication rendered the fault a "significant barrier to groundwater flow". If this is true, then LC ISR must explain the 3.8' of drawdown observed in MU-109 during the South Pump test.

Monitoring well MU-109, completed in the UKM sand, is located 40 feet from the fault and 80 feet from the nearest historic drill hole (see attached Table 1) on the opposite side of the fault. If the fault is functioning as a significant barrier to (horizontal) ground water flow, why were 3.8 feet of drawdown observed in MU-109? Was the drawdown due to historic drill hole TG15-19 80 feet away? Was the drawdown due to a discontinuity in the Sagebrush Shale? The reviewers have similar questions for MO-114 and MW-106 which saw 2 and 1.4 feet of drawdown, respectively, during the North Pump Test. The role of the fault and/or historic drill holes in these locations must be addressed in far greater detail than provided. [9,11] **(MLB, BRW)**

LC ISR, LLC (3/10) - The drawdown at Well MU-109 of 3.8 feet cited by the reviewer actually occurred during the South Test. The MU-109 drawdown during the North Test was 0.8 ft. Attachment MU1 2-1 Figures 6-20 and 6-21 and Tables 4-3 and 4-4 show and list the drawdown data. Nevertheless, it is acknowledged that there are select locations where responses greater than one foot of drawdown have been observed at overlying or underlying monitor wells during the north and south hydrologic tests. LC ISR, LLC is investigating each of those areas to determine if the cause of hydraulic communication is likely to be an historic borehole or thinning of a confining unit. To date, there is no direct evidence that abandoned boreholes have created an artificial pathway at Lost Creek. Two recent wells that were determined to have been damaged may have resulted in establishing hydraulic communication between the Production Zone and overlying or underlying units. Those wells have been abandoned. LC ISR has also committed to attempt to locate and abandon all historic boreholes within the MU1 area. Many such boreholes have already been abandoned.

As described under the Response to Comment MU1 #24, the Lost Creek Fault appears to act as a partial hydraulic barrier to groundwater flow in the HJ Horizon and LFG Sand but not in the UKM Sand, based on potentiometric and hydrologic test data. The cause of this variable behavior is not fully understood. Recognition of this phenomenon will assist in the design and performance of adequate monitoring to ensure that a vertical excursion into the overlying or underlying aquifers is promptly detected and that appropriate corrective actions are applied to prevent loss of fluids.

LQD (4/10) – This item is resolved– The intent of this comment was to highlight the role of the fault, the potential thinning of the aquitard (Sagebrush Shale), and the often incomplete abandonment of historic drill holes as sources of communication between all three horizons. The manner in which the assessment was portrayed in the text was that fault acted as a significant barrier to flow (other parts of the application suggested that it was a partial barrier and the data collected seem to support this analysis) and the historic drill holes had no influence on the communication observed. The comment-response is declared acceptable because LC has: 1) revised the text in Attachment MU1 2-1, Section 8.0 to indicate the fault acts as a partial barrier to ground water flow, 2) added the commitment concerning the plugging and abandonment of historic drill holes, and 3) added a Summary of Engineering Controls (Attachment OP-2). These revisions to Section 8 of Attachment MU1 2-1 illustrate that LC is aware of the conditions present and the need to develop specific Operational Controls to properly their fluids. LC should understand that this comment was declared acceptable because it related to summary statements in the section of the application specified above, however there are still issues regarding containment that need to be addressed and are discussed in Comment #24. **(BRW, MLB)**

33) LQD (2/10) - Attachment MU1 2-1, Section 8.0, Summary and Conclusions, Bullet 3: In the third bullet in the list in this section, it is concluded that despite the hydraulic connectivity revealed during the North and South Pump tests conducted in late 2008, that engineering practices have been used at other ISR operations with similar subsurface conditions to prevent lixiviant from entering overlying and underlying aquifers.

Merely stating that "engineering practices" will be employed to protect the overlying and underlying aquifer from lixiviant is not sufficient to demonstrate that the overlying and underlying zones will be protected. W.S. §35-11-406(m)(v) states that a permit shall not be denied except for…(one or more of)…the following reason(s):

If the proposed mining operation will cause pollution of any waters in violation of the laws of this state or of the federal government;

To achieve the end of demonstrating that the overlying and underlying aquifers at the Lost Creek project will be protected from pollution in the form of lixiviant during ISR mining operations, LC ISR must provide a detailed groundwater model showing exactly how lixiviant will be controlled by engineering practices. This discussion must be very specific and should include volumes anticipated to be lost to the upper and lower aquifers (based on the pump tests) and pumping rate calculations projected through the life of the operation including unexpected down time from pumping. That is, this discussion must include more than merely a commitment to maintain a "bleed" on the operation.[11,18] **(MLB)**

LC ISR, LLC (3/10) - Per the discussion during the February 25, 2010 meeting between WDEQ-LQD and LC ISR, LLC, Attachment OP-2 (Summary of Engineering Controls) has been added to the main permit document. The focus is to identify: the specific practices (e.g., water level measurements); the operational limits (e.g., whether the rate of change in a parameter is of concern or an upper or lower limit); and the responses.

LQD (4/10) - Response not acceptable. The addition of Attachment OP-2 (Summary of Engineering Controls) does not adequately addresses concerns regarding control of production fluids. Chapter 11, section 10(a)(iii) and 11(d) require that the applicant demonstrate that mining fluids can be controlled and that movement into unauthorized zones (excursions) will be prevented. Simply monitoring to detect excursions is not adequate to control or prevent the movement of fluids out of the ore zone. Lost Creek has the burden of showing how the operation will be conducted to **prevent** excursions. It appears that Lost Creek is relying on the monitoring wells outside of the production

zone as their primary source of operational data for managing the wellfield. Chapter 11 section 14.(a)(iii)(A) requires semi-monthly monitoring of the fluid levels in the production zone, yet there is no discussion of this in Attachment OP-2. Given the marginal ore zone confinement at this site, it is appropriate for LC to directly monitor the water levels in the production zone. There are 13 existing MP wells in the production zone that would serve this purpose. It is requested that these wells be included in the monitoring program.

Attachment OP-2, Summary of Engineering Controls, does not provide sufficient detail as to how the wellfield operations will be managed to prevent excursions. Figures OP-A2-1 and OP-A2-2 show examples of "mounding" conditions in a monitor ring well. An approximate 6 foot rise in water levels is shown in a time plot chart and in a monitor ring "rose" chart. Such examples are helpful but much more discussion is needed. There is no discussion of how and when such charts would be prepared and evaluated. The monitor wells are only sampled on a twice-monthly basis. There is no discussion of what would be considered significant water level changes (hopefully something less than 6 feet) that would trigger operational adjustments. There is no discussion of what operational measures would be taken as a result of these examples.

The "rose" charts would be more useful if the charts were presented on a somewhat larger scaled map of the wellfield rather than a circle as shown on Fig. OP-A2-2. This would also allow for data for the interior wells to be plotted, giving a more complete picture of the water level status in and around the wellfield.

The use of observation wells and permanent piezometers has been mentioned but no specific plans are provided for their use in mine unit #1. Much more specificity is required to demonstrate how Lost Creek will control their wellfields, aside from maintaining a bleed. **(MM, MLB)**

34) LQD (2/10) - Attachment MU1 2-1, Figure 2-5 Structure Map, HJ Horizon. Please indicate on the map that this represents the top of the HJ horizon. **(AB)**

LC ISR, LLC (3/10) - The typographic error has been corrected.

LQD (4/10) The Figure is now titled 'Structure Map – Top of the HJ Horizon'. **This item is resolved. (AB)**

35) LQD (2/10) - Attachment MU1 2-1, Figures 6-17 and 6-18: These figures depict observed drawdown in the HJ horizon during the North and South Pump Test, respectively. The contour lines of the drawdown are truncated at the fault due to the significantly smaller drawdowns observed on the opposite side of the fault during the tests. This graphic is misleading because there was some drawdown observed across the fault during both pump tests. The contour interval chosen for Figures 6-17 and 6-18 (five feet) precludes the depiction of any influence across the fault. Additional figures should be provided for each pump test with a contour interval of one half a foot (0.5') which was done on Figures 6-19 through 6-22. Additionally, there appears to be an error on Figure 6-17. Monitoring well M-114 indicates a drawdown of 2.8 feet but it appears between the 5 and 10 foot contour lines.[9,11] **(MLB, AB)**

LC ISR, LLC (3/10) - During both the North and South Tests, there was a large range of drawdown on the side of the Fault where the pumping well was located. Therefore, a one-half foot drawdown contour interval would result in a very high density of contours on the side of the Fault where the pumping well was located, making the contour maps unreadable. All drawdown data for the HJ Horizon at the end of the tests are posted on the maps. As discussed during the February 25. 2010, the following statement has been placed on Figure 6-17:

"Maximum Drawdown South of the Lost Creek Fault In The HJ Horizon At The End of The Hydrologic Test Was Less Than 3 Feet".

For Figure 6-18, the statement reads:

"Maximum Drawdown North of the Lost Creek Fault In The HJ Horizon At The End of The Hydrologic Test Was Less Than 3 Feet".

The contour on Figure 6-17 has been corrected to properly address the drawdown at Well M-114.

LQD (4/10) – **This item is resolved.** The changes made to Figures 6-17 and 6-18 clarify the status of drawdown on the opposite sides of the fault during the pump tests. **(MLB and AB)**

36) LQD (2/10) - Attachment MU1 2-1, Section 6.5. Although MIT testing is required on all Class III wells, Section OP 3.4 indicates that MIT testing would be conducted on monitoring wells as well. Was an MIT conducted on MU-108 or was the North pump test the first indication that there was something wrong with this well? The drill notes indicated that the reaming bit was not fully retracted when retrieved. Did this information indicate immediately that there was an integrity problem with this well? Please provide further explanation regarding when the integrity of this well was first questioned, and future procedures to prevent a problem like this during production. [19] **(AB)**

LC ISR, LLC (3/10) - Well MU-108 (HJMU-102) was piloted on July 25, 2007 to 600'. On July 27, 2007 the hole was reamed with a 7-7/8" bit to 495', cased and pressure cemented to 495'. On August 21, 2007, the excess cement was drilled out of the casing with a 4-¼" rock bit, then under-reamed from 495'-525', and then screened over the same interval with the J-collar set at 482'. The well was not mechanical integrity tested prior to the regional pump test in 2007. (The monitor wells had not been mechanical integrity tested as of the pump test because the MIT unit was still under construction.) In November 2008, some of the well clusters installed in 2007 were included in the MU1 pump test to monitor the overlying and underlying sands. The test on the north side of the fault revealed that well MU-108 had communication between the underlying horizon and the HJ horizon. Well MU-108 was then abandoned with a pressure cementer from the bottom up. The MU1 pump test on the south side of the fault was completed after the well had been abandoned. In early 2009, all the wells that were used in the MU1 pump test were mechanical integrity tested. In July 2009, a short term pump test was completed around MU-108 to demonstrate that abandonment was successful.

LC ISR, LLC has since taken steps to eliminate the possibility of using wells that have not passed an MIT. Every well that is installed on site is required to pass an MIT before that well can be used for testing, monitoring or operations. All wells that fail mechanical integrity testing will be abandoned unless they can be repaired and successfully MIT tested.

LQD (4/10) **Response not acceptable.** Please add additional text to Section 6.5 explaining that well MU-108 was utilized in the pump test prior to being tested for mechanical integrity. However, that all future wells are required to be tested prior to startup or the initiation of any future pump tests. **(AB)**

37) LQD (2/10) - Attachment MU1 2-1, Appendix A, Well Completion Reports. . Currently some of the wells are only in Attachment D6-3, some are only in MU1 Appendix A, and some appear in both locations. Please add a Table to this Appendix that indicates the wells that make up the first Mine Unit package and whether the completion log is located in Attachment D6-3 or MU1 Appendix A. **(AB)**

LC ISR, LLC (3/10) - The requested table has been included in Appendix A of Attachment MU1 2-1. Also, the table in Attachment D6-3 of Appendix D6 has been revised to indicate which wells have been recompleted and which wells have been renamed.

LQD (4/10) - The revised Tables help to clarify the earlier confusion regarding the various well designations and locations. **This item is resolved, (AB)**

38) LQD (2/10) - Attachment MU1 2-1, Appendix A, Well Completion Reports There are eight wells with two designations. Well UKMU-101 and UKMU-102 in Appendix D6-3 do not include MO-114, and MO-115 in their designation on their well completion report. Please correct these. **(AB)**

LC ISR, LLC (3/10) - The completion logs for UKMU-101 and UKMU-102 submitted in Attachment D6-3 were revised as requested. See also the Response to Comment MU1 #39 below for additional discussion regarding the completion logs and their organization.

LQD (4/10) - The completion logs were revised. **This item is resolved. (AB)**

39) LQD (2/10) - Attachment MU1 2-1, Appendix A, Well Completion Reports The completion on the following eight wells was changed following the submittal of Attachment D6-3 and need to be revised to indicate the revised screen interval, back plug elevations or well deepening elevation and the date that the work was conducted and why. [UKMU-101, UKMU-102, HJMP-102, HJMP-103, HJMP-106, HJMP-107, HJMP-111, HJMP-112, HJMP-114] The well completion reports should be consistent at either location. **(AB)**

LC ISR, LLC (3/10) - Recompletion logs for each of the following wells UKMU-101, UKMU-102, HJMP-102, HJMP-103, HJMP-106, HJMP-107, HJMP-111, HJMP-112, HJMP-114 were submitted in Appendix A of Attachment MU1 2-1 of the MU1 Application. These completion logs have been revised to include the date of recompletion and why.

During the February 25, 2010 meeting between LQD and LC ISR, LLC staff, LC ISR, LLC stated that the original completion logs submitted in Appendix D6-3 of the main permit document would be removed rather than be revised to match the completion logs submitted in Appendix A of Attachment MU1 2-1 of the MU1 Application. However, LC ISR, LLC decided not to remove the original completion logs for the following reason. The original completion logs of the wells in question (UKMU-101, UKMU-102, HJMP-102, HJMP-103, HJMP-106, HJMP-107, HJMP-111, HJMP-112, HJMP-114) were submitted in Appendix D6-3 since they had been used to collect groundwater level data during the regional pump tests conducted in July and November of 2007. These wells were completed to monitor specific horizons at that time. These wells were then recompleted to monitor groundwater levels in specific horizons for the MU1 pump tests conducted in November and December of 2008. As an example, UKMU-101 was originally completed to monitor the KM Horizon during the regional pump tests. UKMU-101 was later recompleted to monitor the LFG Horizon for the MU1 pump tests and was re-designated as MO-114. If the completion log for well UKMU-101 submitted in Appendix D6-3 were revised to match the completion log for well MO-114 submitted in Appendix A of Attachment MU1 2-1, then the data reported in the regional pump test reports will not make sense. Therefore, the original completion logs presented in Appendix D6-3 have not been revised since these wells were used during the collection of data that is submitted with the main permit document. The table at the beginning of Appendix D6-3 titled "List of Well Completion Logs in Appendix D6-3" was revised to indicate which wells were recompleted. Also, the table at the beginning of Appendix A of Attachment MU1 2-1 titled "List of Completion Logs for Wells Monitored during the MU1 Pump Tests" was revised to indicate which wells were recompleted.

LQD (4/10) - Thank you for the explanation, and the revised Tables for Appendix A of Attachment MU1 2-1, and Appendix D6-3. **This item is resolved. (AB)**

40) LQD (2/10) - Attachment MU1 2-1, Appendix A, Well Completion Reports. Well M-120A was installed to replace well M-120. Please indicate in a footnote on the Completion Report for Well M-120 why it needed to be replaced, and when it was abandoned. Please revise Table 3-1 in Attachment MU1 2-1 by replacing well M-120 with Well M-120A. **(AB)**

LC ISR, LLC (3/10) - The Completion Report for Well M-120 has been revised as requested. Table 3-1 in Attachment MU1 2-1 was not revised since M-120 was the well used during the Mine Unit 1 pump tests to monitor the water level data. Well M-102A was included in the Mine Unit 1 report since it replaced Well M-120 after the pump tests and was used to collect baseline groundwater quality samples, therefore a Completion Report for Well M-120A has been included in Appendix A of Attachment MU1 2-1. A description of the activities associated with Well M-120 and Well M-120A is provided in Section 4.1.1 of the Mine Unit 1 Application.

LQD (4/10) - **This item is resolved. (AB)**

41) LQD (2/10) - Attachment MU1 2-1, Appendix A, Well Completion Reports. Well MP -109 states that the well is screened from 422-438 feet, yet the diagram shows the screen extended to 450 feet. Similarly, Well MP 110 is reportedly screened from 419 – 438 Feet, yet the diagram shows the screen extended to 445 feet. Please correct the Well Completion reports for these wells. **(AB)**

LC ISR, LLC (3/10) - The completion logs for Well MP -109 and Well MP-110 submitted in Appendix A of Attachment MU1 2-1 were revised as requested.

LQD (4/10) - The well completion reports were corrected. **This item is resolved. (AB)**

42) LQD (2/10) - Attachment MU1 2-1, Appendix A, Well Completion reports. LQD ISL Regulation, Chapter 11, Section 6(c)(i) states that the wells should be constructed with a "*drill hole of sufficient diameter for adequate sealing and, at any given depth, at least three inches greater in nominal diameter than the diameter of the outer casing at that depth*". The Outer diameter of the SDR17 pipe used is 5 inches and the drill hole diameter is 7 7/8 Inches – giving a 2 7/8 inch gap, yet with the joints that gap would be smaller. There is a possibility that the State Engineer may propose that the spacing be 4 inches.[7] **(AB)**

LC ISR, LLC (3/10) - LC ISR, LLC is aware of the current SEO proposal of 4 inches, which was also under consideration in the mid-2000s. The difference between the outer casing and joint diameters was part of the discussion of the Chapter 11 rule changes in the mid-2000s. It is LC ISR, LLC's intent to ensure that the purpose of the sealing is met, i.e., each well is adequately sealed and tested to prevent movement of fluids into areas which should not be impacted. LC ISR, LLC will stay informed about well construction requirements and adjust construction techniques if the requirements change.

LQD (4/10) - LC acknowledges the issue related to drill hole diameter. **This item is resolved. (AB)**

43) LQD (2/10) - Attachment MU1 4-2 Groundwater Quality Laboratory Results. The CD provided contains scanned *.pdf copies of the Energy Laboratory reports. An electronic spreadsheet of the data was provided via email. Please also provide a CD of the monitoring data in the required spreadsheet

format provided on the following DEQ website link: http://deq.state.wy.us/lqd/Uranium_Data.htm. **(AB)**

LC ISR, LLC (3/10) - An electronic copy of the groundwater quality lab results is being submitted under separate cover to the WDEQ-LQD Lander Office in the requested format. This copy has been updated with sample results collected subsequent to the initial submittal with the Mine Unit 1 Application.

LQD (4/10) - Response not acceptable. Please provide an Index Sheet indicating where the CD, submitted April 1, 2010 is to be located, and if needed update the Table of Contents. Also why was no water level reading available for MP-109 on 12/1/09 and 12/16/09, and for KPW-2 on 6/4/09, yet samples were collected on these dates. An explanation should be added to the MU1 submittal, or footnoted on the CD. **(AB)**

NEW INFORMATION

The water quality data for Wells MO-111, MO-114, M-120A, and MP-109, which was not available at the time of the original MU1 submittal, has been incorporated into Attachment MU1 4-1. The associated tables and UCL calculations have also been updated.

LQD (4/10) - The new pages and replacement pages submitted for insertion into Attachment MU1 4-1 are acceptable. Additionally, the new versions of the outlier and UCL calculation tables (Tables 4-6 through 4-12) are acceptable. **(MLB)**

New comment:

1. Figure OP-A2-3, Schematic of Header House Instrumentation, does not show any control valves on any of the individual wells. The only control valve that is shown is on the injection header. Is this correct? Section OP 3.6.1 in the main permit says that individual well flows will be monitored and adjusted. Please clarify the schematic. **(MM)**

Summary:

Please respond to the above comments, where appropriate. Should you have any questions concerning this memorandum, please contact the individual reviewer(s) at the WDEQ-LQD District 2 Office in Lander (307-332-3047).

**********END OF MEMORANDUM**********

Enclosure Map of Lost Creek Site comparing 2006 and 2009 NAIP imagery

Cc: Chron (Amy Boyle)
Chron (Mark Moxley)
Chron (Brian Wood)

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

**"Lost Creek ISR, LLC uranium exploration site (WDEQ/LQD drilling Notification 334DN)
A comparison of 2006 with 2009 NAIP Imagery, northeast Sweetwater County, Red Desert, Wyoming**

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