



Matt Mead, Governor

# Department of Environmental Quality

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



Todd Parfitt, Director

November 25, 2013

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

**Re: Summary of 2013 Annual Inspection, Lost Creek ISR Project, Permit #788**

Dear Mr. Cash:

Enclosed is WDEQ/LQD's summary of the 2013 Annual Inspection conducted at the Lost Creek Project on November 6, 2013. The review is provided in the attached 26-page Inspection Memorandum (10 text pages and 13 photo pages) as well as a three-page addendum evaluating topsoil loss at the site. A total of five (5) new action items resulted from this inspection. Those are in addition to five (5) action items remaining from the September 19, 2013 site inspection. Listed below are all of the remaining action items (10 total) to be done at the site.

- Clean out culverts,
- Place backfill around down gradient side of culvert on west access road with erosion,
- Reclaim ground above main trunk line,
- Pick up loose trash downwind from the Plant Site,
- Build a toe ditch around the southern flank of the DDW-3 drill pad,
- Develop SOP for trash pick-up at site,
- Remove equipment stored in Plant Site drainage ditch,
- Complete construction of travel routes in MU1 – HH1 – 3,
- Document all short-term topsoil stockpiles, and
- Submit written plan to address site's topsoil loss problems (Deadline December 31, 2013).

All of the action items listed above are expected to be completed by the next site inspection which is scheduled for December 18, 2013, unless indicated otherwise. If you have any questions regarding this correspondence, please contact Melissa Bautz in the Lander Land Quality Division office at (307) 335-6943.

Sincerely,

Melissa L. Bautz, P.G.  
Natural Resources Analyst  
Land Quality Division - Lander

Enclosure      Inspection Memorandum for 2013 Annual Inspection - Permit 788 (26 pages w/encls)

cc: Mark Newman – BLM, P. O. Box 2407, Rawlins, WY 82301(w/encl)  
John Saxton – US Nuclear Regulatory Commission (w/encl)  
Tanya King - WDEQ-LQD, District II Supervisor→Pt. 788 Inspection File (w/encl)  
Miles Bennett – WDEQ-LQD Sheridan, Uranium Coordinator (w/encl)  
Ramona Christensen - Cheyenne LQD Records Specialist→ Pt. 788 Inspection File (w/encl)  
Chron (w/encl, minus photos)

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**Wyoming Department of Environmental Quality (WDEQ)- Land Quality Division (LQD)**  
**Inspection Memorandum**

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File: Lost Creek ISR, LLC – Permit 788

Date of Inspection: November 6, 2013

Date of Report: November 25, 2013 *MB*

Participants: Michael Gaither, Lost Cree ISR/Ur-Energy  
Eric Stonaker, Lost Creek ISR/Ur-Energy  
Melissa Bautz, WDEQ-Land Quality Division

Report Prepared by: Melissa Bautz – WDEQ-Land Quality Division

Subject: Annual Inspection

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***Introduction***

On November 6, 2013, the Annual Inspection of the Lost Creek ISR (LCI) site was conducted. The last bi-weekly site Inspection was conducted on September 19, 2013 (see Report dated September 26, 2013). On October 2, 2013 the first of monthly site inspections was conducted. The October 2, 2013 Inspection was conducted by WDEQ/LQD's Miles Bennett (Uranium Coordinator) and Brian Wood (Project Geologist). No report was written summarizing the October 2, 2013 Inspection. However, observations noted during that Inspection are provided below.

On Friday August 2, 2013 ISR mining commenced in MU1. ISR mining has continued since that start-up date, with LCI seeing good results and success.

***October 2, 2013 Inspection***

As indicated above, a monthly inspection was conducted at the site on October 2, 2013. During that inspection, LQD's Miles Bennett (who has been recently appointed as the Uranium Coordinator for LQD) hoped to gain an understanding of the site's layout and operations. LQD's Brian Wood (Project Geologist from WDEQ/LQD District 2) accompanied Mr. Bennett in the absence of the site's normal Inspector, Melissa Bautz. Mr. Bennett had six (6) comments based on the October 2, 2013 Inspection. Those comments, listed below, were addressed during the site's 2013 Annual Inspection. A review of each comment is presented in underlined type after the comment in the list below. (The original comment appears in italicized type.)

1. *The Storm Water Pollution Prevention Plan (SWPPP) did not appear to be available for viewing at the site. LCI staff indicated to LQD during the 2013 Annual Inspection that the SWPPP is, indeed, available in the site's office. This was documented by LQD's Ms. Bautz.*
  
2. *Better topsoil stripping is needed on drill pads. That is, the topsoil under overburden piles must be stripped. The removal of topsoil from the subsoil/overburden stockpiles associated with mud pit construction is a Permit requirement. Several drill pads were noted during the 2013 Annual Inspection and were found to have adequate topsoil*

stripping under the subsoil stockpiles. This Permit requirement is checked by LQD staff on a regular basis and LCI staff are reminded of this requirement to ensure all field staff are stripping topsoil properly at drill pads.

3. A toe ditch is needed on the south flank of the pad for deep disposal well (DDW) 3. LCI staff have been aware of the need to construct a toe-ditch on the south flank of the DDW-3 drill pad since the September 19, 2013 Inspection. It is expected that the work will be done before the end of the year (2013).
4. The reclamation at DDW-1 is over three (3) years old and unsuccessful. It should be reseeded this year. The drill rows should be set at 45° to the previous orientation. In mid-October 2013, DDW-1 was reseeded as prescribed. This was noted in the 2013 Annual Inspection (see below).
5. LCI should consider using crimped straw mulch on the site's reclamation, given the high speed of the winds in the area. LCI and Ms. Bautz are in the process of determining ways to improve reclamation success at the site due to the pervasive high winds. Crimped straw mulch may be part of that solution. This topic will be further addressed in the discussion below.
6. It appears that mixing of subsoil with topsoil has occurred in some of the site's topsoil stockpiles. During the 2013 Annual Inspection, LQD and LCI personnel inspected all of the site's topsoil stockpiles. No evidence of subsoil/topsoil mixing was noted. However, it was noted that wind erosion appears to have removed the upper layer of fines in all of the site's topsoil stockpiles. This erosion has left behind the coarse fraction of the topsoil. Consequently, when observing a topsoil stockpile at the site, there is a highly visible layer of coarse materials. The coarse fraction of the site's topsoil tends to be feldspars which are lighter colored than the more organic-rich portions of the site's topsoil. It is believed that this color contrast is what contributed to Mr. Bennett's comment. An extensive evaluation of the effects of wind erosion on the site's topsoil stockpiles is provided in the 2013 Annual Report Review (below).

### **2013 Annual Inspection**

#### Pre-Inspection Meeting:

Prior to the field inspection, LCI's Mike Gaither and LQD's Melissa Bautz met in the site's conference room and discussed LQD's comments on the 2013 Annual Report. This was a fruitful discussion during which Mr. Gaither was able to clarify the information LQD is seeking in the Annual Report. Mr. Gaither obviously had a keen understanding of LQD's Annual Report related needs and expectations before this meeting; but that understanding was expanded upon during the meeting.

### Report Organization:

For the sake of clarity, this report will be divided into the following four (IV) main sections: I) Overall summary of Mine Operations since October 2012, II) Records Review, III) Field Inspection, and IV) Conclusion. Subsections will be also indicated within these main sections in italicized text. Bold faced text is used for either sub-categories within subsections or as a means to flag action items. The action items resulting from this report are listed in the Conclusion of the report.

The sections and subsections used in this report are derived from a suggested checklist for LQD staff to use when conducting annual inspections at ISR mines. All sections from the checklist are included in this report, even if some of them were not addressed during this Inspection. These sections were retained to help LCI staff understand what LQD looks for in a typical annual inspection.

It should be noted that many of the standard annual inspection topics were not addressed during this Inspection because LQD has been conducting weekly and biweekly inspections of the Lost Creek operation over the past year, since ground-breaking occurred in October of 2012. Many of the standard annual inspection topics were already addressed in a previous inspection conducted earlier this year.

### Annual Inspection Report/Review:

#### I. Overall summary of Mine Operations since October 2012

The LQD Permit for this operation was approved in October 2011. In early October 2012, the BLM approved the Record of Decision for the site. Groundbreaking began immediately thereafter. Road construction, plant site construction, infrastructure construction, and well field construction occurred steadily at the site through the winter of 2012/2013 and into the spring of 2013.

By the time mining commenced at the site on August 2, 2013 in Mine Unit 1, the site's access road had been built, the plant building was completed, the site's ponds were built, power lines were connected to the site's Plant Building, several hundred wells were installed, and exploration occurred in future mine units (2 and 3) west of Mine Unit 1.

LQD personnel inspected the site weekly from October 2012 through the earliest part of January 2013 and then switched to biweekly inspections through September 2013. Currently LQD plans to start inspecting the site on a monthly frequency. LCI and LQD personnel are unanimous in their conclusion that regular, frequent site inspections have been paramount to the relative success with which LCI has adhered to their Permit commitments during the construction phase of operations.

As is indicated in the sections below, many of the site features that are often delegated to annual inspections have been inspected with regularity over the past year. Therefore, some inspection items (indicated in some of the tables below) were not checked during this Annual Inspection.

II. Records Review

<u>Records Topic/Category</u>	<u>Checked?</u>	<u>Compliance/Explanation</u>
Mining and groundwater restoration schedule	Yes	Mining on schedule. No restoration yet.
Spills properly reported and recorded	Yes	All spills have been reported properly.
Well completion certifications	Yes	Reviewed as they are submitted.
Wells being sampled on approved schedule	Yes	Was verified in Sept 2013 inspec.
Excursions	Yes	There are no excursions
MITs	Yes	Reviewed as they are submitted.
Laboratory analyses	No	Not checked.
Copy of current mine plan on site	Yes	Current mine plan is on site.
Copy of latest annual report on site	Yes	2013 annual report is on site.
Spill mitigation plan for deep disposal wells	No	Not checked.

III. Field Inspection

*Signs*

The site's entrance sign is legible and includes all the necessary information. All of the site's topsoil stockpiles are adequately identified with a sign.

*Facilities*

The site's facilities have been routinely inspected over the past year and were found to be in good condition. This includes the pond, the plant building, the shop building and the laydown yard. During this Inspection the drainage ditch that diverts water around the east side of the ponds was inspected. There was some trash noted in this area that needs to be picked up. Wind-blown trash is an ongoing maintenance problem at this site. **By the December 18, 2013 Inspection, LQD personnel will be asking LCI personnel to explain the frequency of trash clean-up at the site. That discussion will need to be backed-up with some sort of checklist or sign-in sheet that tracks LCI employees' trash pick-up endeavors.**

The portion of the drainage ditch in the Plant Site that is north of the ponds was noted during this Inspection as having some equipment placed within the ditch's channel (see Photo Addendum). This is an unacceptable practice and must be addressed promptly. **By the next Inspection (December 18, 2013) the equipment stored in the diversion ditch in the Plant Site must be moved**, and the diversion ditch must be cordoned-off (with metal t-posts or adequate signage or both) to prevent that from happening in the future.

*Roads*

The site's main access road is a very well-constructed road. There are no concerns with this road. Minor roads within the site are also stable and of little concern. During this Inspection,

LCI personnel had just commenced the construction of formal travel routes within MU1. This endeavor should continue and a network of graveled travel routes within the well field should be built in accordance with the Permit. **The progress of travel route construction within well field MU1 will be the topic of future Inspections.**

#### *Erosion or Drainage Control Structures*

Immediately prior to the last Inspection on October 2, 2013, a significant precipitation event occurred at the site. This was in addition to the two significant precipitation events that occurred at the site in mid to early September 2013 (see September 26, 2013 Inspection Report). The late September 2013 precipitation event resulted in the pooling of water at the south end of the Plant Site's parking area and the north edge of Topsoil Stockpile 6. The erosion associated with that pooling of water was noted by Mr. Miles Bennett when he visited the site on October 2, 2013.

Since the October 2, 2013 Inspection, LCI personnel have completely re-sloped the parking area south of the Plant Building such that it drains to the east, to a drainage that is partly newly-constructed (within the Plant Site) and partly preexisting (just south of the Plant Site). Additionally, LCI staff reestablished the toe-ditch around Topsoil Stockpile 6, which had been compromised from the pooling water. These repairs are documented in the attached Photo Addendum. These repairs were tested somewhat in a fourth precipitation event that occurred about one week after the October 2, 2013 Inspection. It appears the repairs functioned well in that fourth precipitation event.

During this Inspection (November 6, 2013) the diversion ditch that runs along the east edge of the site's ponds was inspected and found to be stable and in good condition with only minor rilling evident from the numerous precipitation events that have pummeled the site this past September and October.

#### *Spills*

No spills were evident at the site during this Inspection. Two spills that occurred in August 2013 were reported to the WDEQ spill hotline, were properly documented via a report within seven days of the spills' occurrence, were properly remedied, and were properly documented in the 2012/2013 Annual Report. A third spill occurred on November 12, 2013. It was also reported to the Spill Hotline and LCI submitted a report to LQD summarizing that spill within the Permit-prescribed seven day time frame. There are no concerns with the manner in which LCI handles spills or spill reporting.

#### *Topsoil/Subsoil*

No topsoil or subsoil was being salvaged during this Inspection. All of the site's 15 long term topsoil stockpiles were inspected. All were found to be stable and properly identified with a sign. The toe ditches around the following topsoil stockpiles were noted as needing some maintenance: 3, 5, 7, 9, and 12. No topsoil stockpiles are located in drainages.

The recent review of the 2012/2013 Annual Report indicated that long-term and short-term topsoil stockpiles will need to be indicated on the AR map(s). While the 2012/2013 Annual

Report depicts long term topsoil stockpiles, no short term topsoil stockpiles were indicated. However, several short-term topsoil stockpiles were noted in the MU1 well-field. **All of the site's short-term topsoil stockpiles must be documented in the Annual Report (including their locations, volumes, and intended destination).**

*Wellfield(s)*

<u>Wellfield Topic/Category</u>	<u>Checked?</u>	<u>Compliance/Explanation</u>
Wellhead protection	Yes	Adequate
Collection House(s) Examined (Header Houses)	No	Header Houses 1 - 3 were inspected recently when their respective wells were approved for start-up.
Monitoring Wells Intact	Yes	All wells were intact.
Wells on excursion	Yes	No wells are on excursion
Excursion control measures in place and adequate	n/a	No wells are on excursion
Maximum allowable injection pressures being monitored and maintained?	No	This was not checked during this Inspection but will be at the next inspection in December 2013.

*Active Well Construction*

No active well construction was observed during this Inspection. However, well construction has been documented and monitored sporadically at the site over the past year. During all of those Inspections it was noted that centralizers were being installed at the proper spacing (every 40 feet), wells were being cemented to the surface, annular spaces were the correct size, and cement weights were being measured and recorded. At one point during the year (in January 2013) it was noted during one of LQD's weekly inspections that the cement weights were a little lower than the minimum acceptable value of 13.5 pounds per gallon (ppg). This was remedied immediately by LCI by ensuring weekly calibration of the project's cement balances. Cement weights have not been lower than 13.5 ppg since then. There are no concerns with the well construction practices employed at the site.

Well construction has ceased for the winter season. LCI personnel do not anticipate resuming drilling and well construction activities until around March 2014.

*MIT's viewed*

No MIT's were viewed during this Inspection. However, all MIT paperwork for the four header houses in Mine Unit 1 that are mining have been reviewed and were found to be meeting Permit standards.

*Development/Delineation Drilling*

Some exploration and/or delineation drill sites in MU2 and MU3 were inspected and found to be in good condition. Topsoil was salvaged properly. Mud pits were fenced. There are no concerns with the drilling practices employed at the site.

## *Reclamation*

### **DDW-1**

The recently reclaimed area around DDW-1 was inspected. The reclamation was in the form of reseeded the drill pad which had been seeded previously in 2009. The 2009 seeding efforts resulted in poor vegetation. It was noted that the fall 2013 seeding was done at a 45° angle to the previous seeding furrows. This was done at the recommendation of LQD staff during the October 2, 2013 Inspection. LCI personnel had installed metal t-posts to delineate the travel route to be used to access DDW-1. See attached Photo Addendum. These reclamation efforts are applauded. There are still two culverts that must be removed from the former access road to DDW-1. The culverts are on the road that is south of DDW-1.

### **On Site Seeder**

LCI field staff anticipated seeding several tens of acres this fall (2013). Several acres within the Plant Site were noted as having been reclaimed in the September 2013 Inspection report. However, Mr. Stonaker indicated that the site's seeder broke about ¼ of the way through the planned reclamation activities this fall. This ill-timed failure was a big disappointment for the reclamation staff at LCI. Mr. Stonaker has been working on getting the equipment repaired. The DDW-1 drill pad was the last area to be reclaimed (reseeded) at the site (as of this Inspection). All areas in need of seeding that were not seeded this fall can be seeded in the spring of 2014.

### **Reclamation Mapping**

During the pre-inspection meeting between LCI's Mr. Gaither and LQD's Ms. Bautz it was noted that LCI staff need to be recording reclamation polygons (via GPS mapping) throughout the year so that the information can be adequately presented in the annual report. This was somewhat lacking in the 2012/2013 Annual Report (AR) but is being addressed as part of LCI's responses to LQD's AR comments.

### **Future Reclamation (MU1)**

Over the next year, it will imperative that LCI reclaim the portions of MU1 that are no longer under construction. The utter obliteration of vegetation in most of MU1 is problematic. The Permit requires that 50% of the vegetation in the well field be remaining after construction. This did not occur with MU1 and is, technically speaking, a violation of Permit commitment.

### **Proactive measures**

Currently, LQD is closely monitoring how LCI 1) handles reclamation of MU1 and 2) is proactive in preventing damage to vegetation in MU2. For example, it will be imperative that LCI personnel establish travel routes within MU2 before well construction commences. Additionally, LCI personnel will be expected to establish areas of no disturbance within the well field wherever possible. These areas will need to be cordoned off with metal t-posts.

### **Topsoil Loss Evaluation**

The destruction of vegetation and degradation of topsoil in the well fields is a significant concern at this site. As revealed in the attached Topsoil Evaluation (addendum), the extreme high winds



that characterize the Great Divide Basin have already caused significant loss of topsoil. LQD will be asking LCI to seriously consider the benefits of summarily stripping the well field of topsoil prior to well construction activities as a means to best preserve topsoil at the site. Based on the attached Topsoil Evaluation, it is estimated that a four-fold increase in topsoil savings can be realized at this site by simply stripping the well field.

During this Annual Inspection a veritable “sand-storm” had developed across the MU1 well field in response to the 25 mph sustained winds and 35 mph gusts that were occurring that day. No photos were taken of that phenomenon on November 6, 2013 because it was too difficult to photograph. However, the field inspection participants duly noted the intensity of the wind during the Inspection as well as the large amounts of topsoil blowing off the MU1 well field. Another windy day during the summer at the site was captured in the photo below.



**Figure 1: This depicts a high-wind day in the MU1 well field at the Lost Creek site. The date stamp on the photo above is accurate, indicating it was taken on June 19, 2013. This type of topsoil loss due to the degradation of the vegetation (see roots of sagebrush in photo) is truly incalculable.**

The photo above (in Figure 1) characterizes the wind- and ground-conditions that were observed on the November 6, 2013 Annual Inspection of the site. Interestingly, however, no topsoil was blowing off any of the site's 15 long-term topsoil stockpiles on this day (Figure 2, below).



**Figure 2:** This photo was taken on November 6, 2013 on a very windy day. Absolutely no topsoil was seen blowing off any of the site's topsoil stockpiles during this Inspection. Whereas the MU1 well field, on this day, looked like it did in the above photo from June 2013.

**LCI is expected to formally respond to the topsoil loss problem associated with the excessive degradation of vegetation in the MU1 well field. That formal response should include a written action plan to be submitted no later than December 31, 2013. In the absence of a plan, LQD will have no choice but to pursue enforcement action for the failure to meet Permit commitments with regard to the degradation of the vegetation in well field MU1.**

#### *Offsite impacts*

No offsite impacts were noted during this Inspection.

### *Compliance Assessment*

As indicated above in the section entitled “*Reclamation*”, the most significant compliance issue at the site is the degradation (loss) of topsoil from the MU1 well field. However, LCI should also be aware of the need to keep up with the removal of trash blowing off the site and the need to cordon-off areas around the site that should not be used for equipment storage (e.g. the north side of the ponds). See Conclusion.

### *Topics from the last Inspection Report*

The following topics were indicated as “action items” at the end of the last Inspection report dated September 26, 2013.

1. Clean out culverts and conduct necessary maintenance on down gradient sides of the culverts indicated in the Photo Addendum.
2. Place backfill around down gradient side of culvert on west access road with erosion,
3. ~~The tracks in the drainage west of MU1 need to be repaired/reclaimed,~~
4. Reclaim ground above main trunk line,
5. ~~Reclaim area south and east of the Fire Suppression Water Storage Tank,~~
6. Pick up loose trash downwind from the Plant Site,
7. Begin to delineate travel routes in MU2 in anticipation of winter conditions,
8. ~~Dig out the toe ditch around TS-6 and any other topsoil stockpiles that may need it, and~~
9. Build a toe ditch around the southern flank of the DDW-3 drill pad.

Items 3, 5, and 8 (indicated with a strike-out font) from the above list were noted during this Inspection as having been addressed (see attached Photo Addendum). **By the next Inspection, all remaining action items but Item 7 should be addressed; i.e. action items 1, 2, 4, 6, and 9 in the above list must be addressed by the next Inspection.** Item 7 will be necessary to complete prior to the commencement of drilling and well field construction in early 2014 in the MU2 and MU3 well fields.

### Conclusion:

In addition to the action items indicated in the list above, LCI is expected to:

- 1) Provide documentation to LQD of a Standard Operating Procedure documenting regular trash pick-up efforts at the site (Deadline is December 18, 2013),
- 2) Remove all of the equipment that was noted in this Inspection as being stored in the diversion ditch in the Plant Site and cordon-off the diversion ditch to prevent future misuse (Deadline is December 18, 2013),
- 3) Complete all necessary travel routes within the MU1 well field, Header Houses 1 – 3 (Deadline is December 18, 2013),
- 4) All of the site’s short-term topsoil stockpiles must be documented in the Annual Report including their source, location, volume, and intended destination (Deadline is LCI’s submittal of responses to AR comments), and
- 5) Submit a written response addressing the topsoil loss topics indicated in this report. The written response must include plans for the protection of topsoil in future mine units at the site. (Deadline is December 31, 2013).

The next site Inspection is planned to occur on December 18, 2013, Wednesday, at 10am. If LCI staff feel that accomplishing the above-listed action items is not possible by the next site Inspection, please contact WDEQ/LQD's Melissa Bautz at (307) 335-6943.

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

W/Photo Addendum (Pages 11 – 26) and Topsoil Evaluation (separate attachment)

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788**



**Photo Number 1:** This depicts the travel route established leading to the DDW-1 well head. Areas outside this travel route were recently reseeded in the fall of 2013. This method of travel route establishment is applauded and should be implemented at other locations across the site, where vehicular travel is intended to be restricted.



**Photo Number 2:** This is a panoramic view of a portion of the DDW-1 well pad and associated travel route delineated by t-posts. The structure in this view is the well head housing. The shadow on the left side of the photo is from the pump-house for DDW-1. The view is looking west by northwest. Recent (fall 2013) reclamation (in the form of reseeded) is evident beyond the t-posts.

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 3: This depicts the toe ditch at the south end of topsoil stockpile #6. It is in constant need of maintenance due to its proximity to the road leading to the Plant Site.**

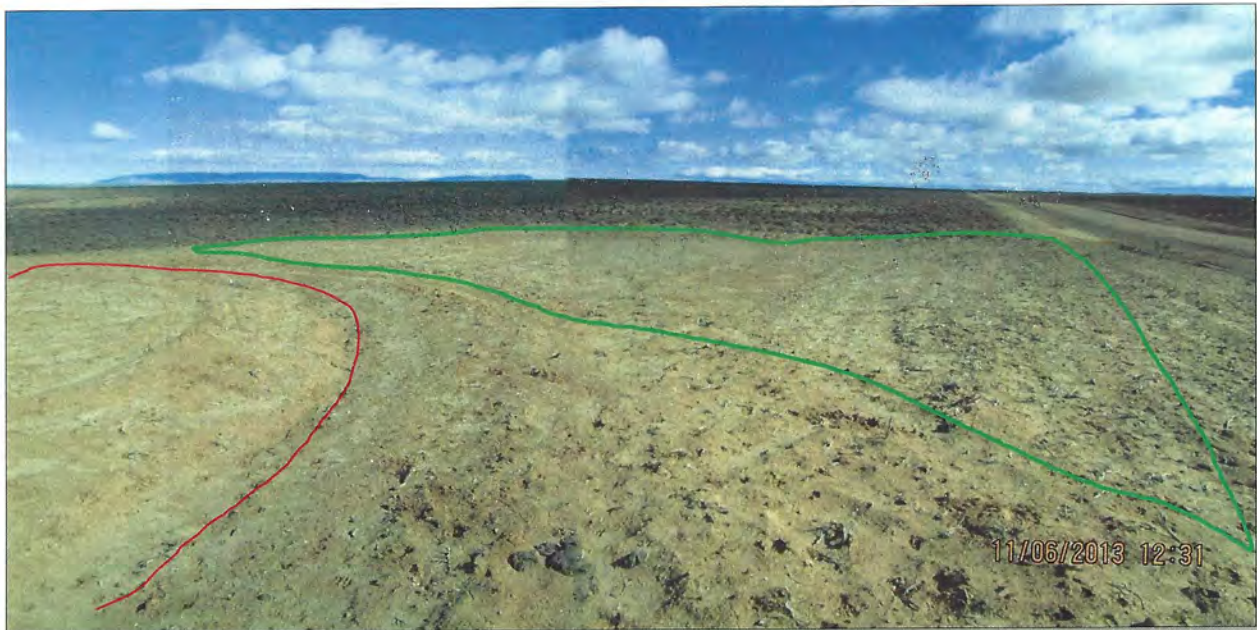


**Photo Number 4: This depicts the toe ditch in the south end of the topsoil stockpile at DDW-4.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 5: This depicts the toe ditch on the south face of topsoil stockpile #2. This view is looking west. The LCI project's access road is on the left side of this photo. This ditch is in good condition.**



**Photo Number 6: This depicts the east edge of topsoil stockpile #1. The view is looking east. In addition to depicting the stockpile's toe ditch (indicated with a red line), this panoramic also depicts a triangular-shaped area of reclamation (indicated with a green outline). This reclamation was necessary due to the route that scrapers took when approaching this stockpile during its construction.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 7: This depicts the sign identifying topsoil stockpile 3. The view is looking east.**



**Photo Number 8: This depicts the toe-ditch around topsoil stockpile 3. It is in good condition here but is in need of some extra definition in some locations.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 9: This depicts the toe ditch at the northwest corner of topsoil stockpile #4.**



**Photo Number 10: This depicts the east end of the toe ditch around topsoil stockpile #5. This area needs to be redefined. View is looking northeast.**



**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 11: This depicts the toe-ditch around topsoil stockpile #8. It is an exemplary ditch around the entire perimeter of the stockpile. This view is looking toward the northwest. Note the accumulation of coarse grained sands on the surface. This is due to the winnowing of finer materials from the topsoil due to wind erosion.**



**Photo Number 12: This depicts the southwest corner of topsoil stockpile #10. It depicts a reclaimed area (where the scrapers drove during the stockpile's construction). The coarse sands (light colored materials) cap the surface here because of winnowing of finer portions of the topsoil due to wind erosion.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 13:** This depicts the west edge of topsoil stockpile #7. This stockpile is immediately adjacent to the road that leads to MU1 from the Plant Site. This view is looking north. The road ditch indicated with a red line in this photo also (currently) functions as the stockpile's toe-ditch. This is an unacceptable geometry and must be remedied immediately. The topsoil stockpile must have a unique and wholly separate toe ditch from the road's ditch.



**Photo Number 14:** This depicts the northwest corner of topsoil stockpile #7. The portion of the stockpile's toe ditch that runs along the north edge of the stockpile is indicated here with a red line. The red arrow (bottom of the photo) indicates where that toe ditch empties (via rills) into the road's borrow ditch. As indicated in the caption for Photo Number 13, above, this is unacceptable and must be redesigned. Topsoil will be lost to the road's ditch if this is left as-is.

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 15: Short term topsoil stockpile in Mine Unit 1. The site's short term topsoil stockpiles must be inventoried and reported in the Annual Report.**

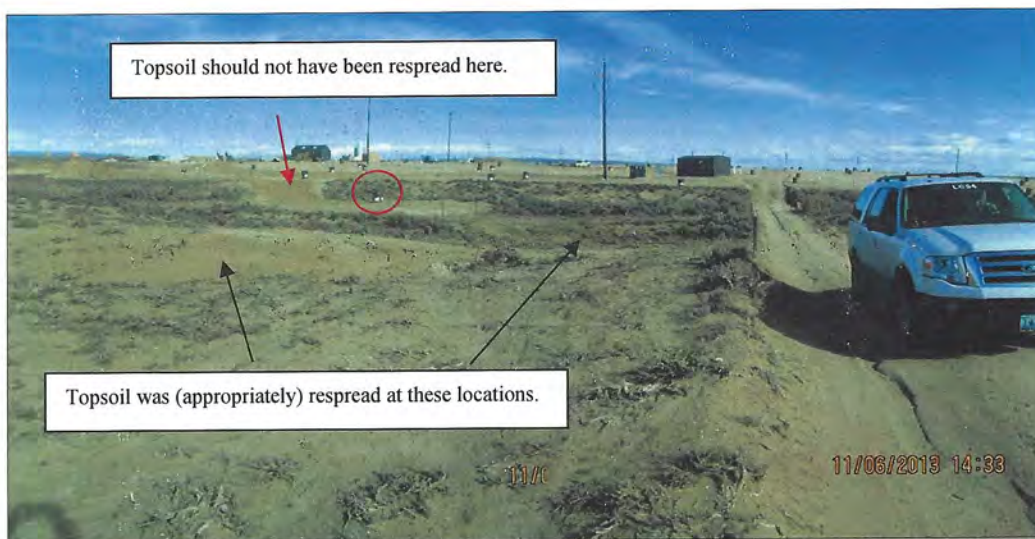


**Photo Number 16: This depicts an area at the northwest corner of MU1 where some topsoil has been respread adjacent to a proposed travel route. Care must be taken in these scenarios to ensure topsoil is not trampled once it is reapplied.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 17: The black arrows depict the repair (reclamation) of an unauthorized travel route coming from the west edge of MU1 across the drainage and heading westward. Well heads in the west end of MU1 are visible in the background in this photo.**



**Photo Number 18: This depicts an area just north of the east-west road that runs west out of the MU1 well field. This view is looking east. The areas indicated with arrows were respread with topsoil since the September 2013 site inspection. The respreading of topsoil on the areas indicated with the black arrows was necessary due to unauthorized vehicular travel on native ground. However, the area indicated with the red arrow should not have been respread with topsoil, as it was the only travel route to the well head indicated with a red circle. The topsoil spread at this location will have to be stripped and a formal travel route will need to be established to the indicated well head.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 19: This depicts a recently-established travel route (covered with gravel) within MU1. It is expected that this travel route will somehow be cordoned-off from the areas adjacent to it.**



**Photo Number 20: This depicts another recently-built travel route within MU1.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 21: This view looking east depicts the area south of the ponds in the Plant Site (i.e. in the southeast corner of the Plant Site) where tire tracks are evident on recent reclamation. This area was reclaimed as part of the recent reconstruction of the Plant's parking lot (i.e. the resloping of the parking lot to ensure that it drains to the east). However, soon after this area was reclaimed, the large trucks that come onto the site to refill the HCl acid storage tanks (immediately behind the viewer in this vantage point) were forced to pull into this area. This oversight was noticed during this Inspection, and LCI staff are aware of the problem. It is anticipated that topsoil will be stripped from this area, and that metal t-posts will be relocated to enable the large trucks to have the space needed to fill the HCl tanks.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 22: This a view looking down gradient (south) where the diversion ditch that goes around the east side of the site's ponds enters native ground. This area was recently reclaimed (seeded) earlier this fall (2013) and was tested by the numerous precipitation events that occurred in September and October. While evidence of the run off associated with those precipitation events is evident in this picture, the reclamation held-up extremely well. Once vegetation is established here, this area will most likely be well-equipped to absorb any/all storm events that may occur.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 23: This is a view looking up gradient from the same vantage point that is in the previous photo (Photo Number 22). Considering this is brand new reclamation with zero vegetation that experienced four large precipitation events in a three-week period of time, this reclamation looks really good.**



**Photo Number 24: This is a view looking north along the diversion ditch that runs along the east side of the ponds. There are no concerns with the ditch's construction. Some trash is evident in the middle of the photo.**



**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**

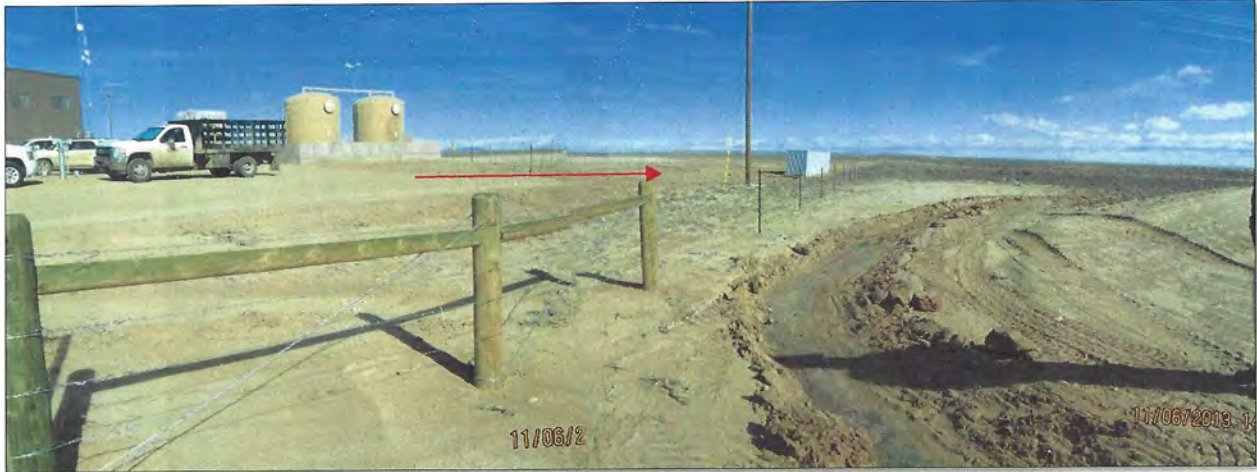


**Photo Number 25: This depicts some rilling on the newly reclaimed area east of the pond diversion ditch. These rills will need to be repaired.**



**Photo Number 26: This depicts the pond diversion ditch just north of the ponds. The ditch runs east-west here. This view is looking east and it depicts equipment being stored in the ditch's channel (red line). This is unacceptable and the equipment must be removed immediately. LCI staff will need to cordon-off the ditch's path at this location to prevent unwanted equipment storage at this location in the future. Topsoil stockpile #15 is on the left side of this photo. Materials had recently been removed from topsoil stockpile #15, which explains the recent scar indicated by the black arrow in this photo. A more well-defined toe-ditch will need to be created along the flank of topsoil stockpile #15.**

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 27:** This depicts the south edge of the Plant Site's parking area (left side of photo) and the north edge of topsoil stockpile #6 (right side of photo). This area had water accumulating during the late September 2013 precipitation event. Since then, LCI staff have resloped the parking area to drain toward the east (see red arrow) and the toe ditch around topsoil stockpile #6 has been reestablished.



**Photo Number 28:** This depicts the southwest corner of topsoil stockpile #6. The recent scar (indicated by the black arrow) is due to the recent reclamation of the temporary office complex to the west of here.

**Photo Addendum to accompany the 2013 Annual Inspection of Lost Creek ISR's Permit 788 cont'd...**



**Photo Number 29: This is a view looking north along the west flank of topsoil stockpile #6. The toe ditch here was also recently reestablished.**



**Photo Number 30: This is looking west at the intersection between the fire access road to the Plant Site with the main access route to the Plant Site. A culvert will need to be installed under the fire access route at this location due to the accumulation of materials indicated by the red oval.**

## Evaluation of topsoil loss due to wind erosion at the Lost Creek ISR Site (LOD Permit 788)

Written by Melissa Bautz, P.G. - WDEQ/LQD November 8, 2013

**Introduction:** The pervasive winds in the Red Desert are highly erosive to ground surface soils especially in areas denuded of vegetation. This wind erosion inevitably results in the loss of topsoil to the wind. The Mine Units (well fields) at ISR mine facilities become denuded of vegetation (due to trampling) during well field construction activities (E.g. Lost Creek's Mine Unit 1). Therefore, ISR well fields are highly susceptible to wind erosion and topsoil loss during and after their construction.

During the Annual Inspection of the Lost Creek ISR site by WDEQ/LQD, the wind was blowing very strongly (gusts >35 mph and sustained winds >25mph). Topsoil was blowing off of the MU1 well field, creating a wall of windblown sand that was readily visible downwind from the well field. However, at all of the site's 15 topsoil stockpiles (which were individually inspected that day) no topsoil was observed blowing off the stockpiles.

It was also noted during the Lost Creek ISR 2013 Annual Inspection, that patches and pockets of coarse sand covered the low-lying surfaces on the topsoil stockpiles (i.e. in the furrows created during seeding/discing). Further scrutiny of these coarse sand pockets revealed that they were pervasive at the surface as a result of the loss of finer soil particles (to previous wind erosion). Additionally, it was noted that a soil crust had formed on all of the topsoil stockpiles (subsequent to the loss of the finer soils to wind erosion). The crust and pockets of coarse sands appeared to be preventing further topsoil loss in the strong winds (via a sort of "armoring" effect).

The contrast between the absence of wind borne topsoil downwind from the topsoil stockpiles and the pervasive, visible presence of wind borne topsoil downwind from the Mine Unit 1 well field was dramatic during the 2013 Annual Inspection of the Lost Creek ISR site. The contrast appears to indicate that the stripping and stockpiling of topsoil from a well field will prevent ongoing topsoil loss to the wind.

**Thesis:** Based on the above-described observations made during the 2013 Annual Inspection at the Lost Creek ISR site, it is estimated that a nearly four-fold decrease in topsoil loss can be achieved by stripping and stockpiling topsoil from well fields during well field construction.

**Case Study: Lost Creek ISR's Topsoil Stockpile #1 (TS #1)**

TS #1 contains topsoil that was stripped from approximately 2.5 acres of the western access road leading to the Lost Creek ISR site. The average topsoil stripping depth for the road was ~12". The stripping of 12" from 2.5 acres resulted in approximately 4000 cubic yards (cy) of topsoil. 4000 cy is the estimated volume of topsoil stored in TS #1. TS #1, just like all the other topsoil stockpiles at the Lost Creek ISR site, has a soil crust on the entire stockpile and is riddled with pockets of coarse sand in the stockpile's furrows. A comparison of the surface areas of TS #1 with the area from which that topsoil was stripped is presented below.

	<u>TS #1</u>	<u>Ground Surface from which topsoil was stripped</u>
<u>Surface Area</u>	<u>Acres</u> 0.65	<u>Acres</u> 2.5
	<u>Square ft</u> 28,314	<u>Square feet</u> 108,900

\*The surface area of TS #1 used the formula for the Surface Area of a triangular prism to approximate the topsoil stockpile.

The percent increase in surface area between TS#1 and the ground from which the topsoil was stripped is: 385 %

**Estimate of topsoil volume loss in MU1:**

The actual depth of topsoil that has been lost from the Lost Creek ISR site's denuded areas (in MU1) and its topsoil stockpiles is currently unknown. However, a conservative estimate of 1 inch, based upon the observations made during the 2013 Annual Inspection of the site's topsoil stockpiles, is suggested. Using the estimate of 1 inch of topsoil soil loss in the year since the construction of the site's topsoil stockpiles and since the denuding of the MU1 well field, the following calculations apply.

<u>MU1 Well Field (unstripped, denuded due to trampling)</u>			
<u>Acreeage</u>	<u>Topsoil Volume (pre-erosion), ft<sup>3</sup></u>	<u>Topsoil Volume Lost (to wind erosion) ft<sup>3</sup></u>	<u>Topsoil Volume Lost (to wind erosion) ft<sup>3</sup></u>
38	1,655,280	137,940	137,940
<u>137,940 / 35,393 = 3.9</u>			

<u>*Topsoil Stockpiles from stripping MU1 Well Field</u>			
<u>*Acreeage</u>	<u>Topsoil Volume (pre-erosion) ft<sup>3</sup></u>	<u>Topsoil Volume Lost (to wind erosion) ft<sup>3</sup></u>	<u>Topsoil Volume Lost (to wind erosion) ft<sup>3</sup></u>
9.75	1,655,280	35,393	35,393

\*This assumes that a topsoil stockpile would be necessary for every 2.5 acres of well field, which translates to ~15 topsoil stockpiles. The average topsoil stockpile for every 2.5 acres of disturbance will contain about 4000 cy of topsoil and will have a surface area of 0.65 acres.

**Summary:** In the above example, nearly four (4) times as much topsoil will be lost via wind erosion if the well field is not stripped than the volume of topsoil that would be lost to wind erosion if that same topsoil were placed into stockpiles.

**Conclusion:** The stripping of topsoil from well fields is recommended because it will result in a 4-fold savings in topsoil loss due to wind erosion.

**Recommendation:** ISR facilities in windy areas should strip topsoil across the entire well field prior to well field construction.



This photo depicts the furrows in and around TS#10 at the Lost Creek Site. The light colored materials are coarse-sized grains of sand. These coarse sand grains appear to be the remnants of the upper one-inch of topsoil that is left behind after winnowing (removal) of the finer particle sizes in the topsoil due to heavy winds. The coarse sand grains, along with the soil crust that has formed in this stockpile over the year it has been in existence, appear to provide a wind-resistant armor. The armor prevented any wind erosion from occurring at this location during the 2013 Annual Inspection of the Lost Creek ISR site on November 6, 2013. The winds during the Inspection were estimated to be between 25 - 35 mph.