Mendiola, Doris

From: Shannon Anderson [sanderson@powderriverbasin.org]
Sent: Wednesday, March 03, 2010 3:13 PM
To: NicholsRanchISRSEIS Resource
Subject: Nichols Ranch ISL comments - 1 of 2
Attachments: NicholsRanchSEISComments.pdf; UraniumGEIScomments_PRBRC.pdf; FINALStateLandCoreAreaSageGrouseStips7312008.pdf; ConsultantsFinalReport.5-09.pdf; Smith_Highland Mar08NOV.pdf

Attached please find our comments and attached documents on the Nichols Ranch ISL uranium project. Thank you,
Shannon Anderson

Shannon Anderson
Powder River Basin Resource Council
934 N. Main St., Sheridan, WY 82801
307-672-5809 cell: 307-763-1816
sanderson@powderriverbasin.org

12/11/2009
74FR65808
13

SUNSI Review Complete
Template = ADM-013

E-RIDS = ADM-03
Add = I. YU (IWY1)

Powder River Basin Resource Council
Wyoming Outdoor Council

March 3, 2010

Chief, Rulemaking and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop TWB-05-B01
Washington, DC 20555-0001
Submitted electronically to nicholsranchisrseis@nrc.gov

RE: Comments on the Environmental Impact Statement for the Nichols Ranch ISR Project in Campbell and Johnson Counties, Wyoming, NUREG-1910, Supplement 2

Dear Mr. Lesar,

Thank you for the opportunity to submit comments on the draft environmental impact statement (DEIS or DSEIS) for the Nichols Ranch in-situ leach (ISL or ISR) uranium facility in the Powder River Basin of Wyoming.

The Powder River Basin Resource Council is a grassroots Wyoming organization that promotes responsible extraction and use of our state's abundant mineral resources. Most of our approximately 1,000 members are rural landowners in Wyoming and many of them will be impacted by uranium exploration and production.

Since 1967 the Wyoming Outdoor Council has worked to protect Wyoming's environment and quality of life for future generations. We envision a Wyoming thriving with abundant wildlife, healthy landscapes, clean air and water, strong communities, and sustained by renewable energy.

These comments are submitted on behalf of our organizations and behalf of our members who live, work, and/or recreate in areas impacted by the Nichols Ranch project.

I. The purpose and need statement does not meet NEPA requirements and unreasonably limits the consideration of a reasonable range of alternatives.

According to NRC

> The purpose and need for the proposed action is to provide an option that allows for the applicant to use ISR technology to recover uranium and produce yellowcake...This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act or findings in the NEPA environmental analysis that would lead the NRC to reject a license application, the NRC has no role in a company's business decision to submit a license application to operate an ISR facility at a particular location.

DSEIS at 1-1. Similar to the GEIS, the purpose and need statement is too narrow and thus unreasonably restricts the range of alternatives that NRC is able to consider in this NEPA

document. The purpose statement basically limits the NRC to two options: 1) approve the project (i.e. allowing the applicant an option to use ISL to recover uranium) or 2) reject the project. Like the GEIS before it, the NRC fails to discuss the *public* purpose and need for the project, including whether the uranium produced is needed as a fuel source for domestic nuclear power plants.

By contending that it "has no role in a company's business decision," the NRC prevents consideration of reasonable alternatives. Alternatives consideration is "the heart of the environmental impact statement" and agencies must "[r]igorously explore and objectively evaluate all reasonable alternatives" in order to "sharply defin[e] the issues and provid[e] a clear basis for choice among options by the decisionmaker and the public." 40 C.F.R. § 1502.14.

By creating such a narrow purpose and need, NRC is unreasonably restricted from considering reasonable alternatives, such as a true phased development alternative (which would require restoration and reclamation achievements for each well field prior to proceeding to the next), changing project boundaries to reduce environmental or cultural impacts, or rejecting the placement of wells within ephemeral drainages. By failing to consider these, and potentially other, reasonable alternatives, the NRC has violated NEPA.

II. The EIS improperly tiers to the Generic Environmental Impact Statement.

According to NRC, the "SEIS supplements the GEIS, published as a final report in June 2009." DSEIS at 1-2. However, as this statement clarifies, the GEIS is merely a report. It was never issued as a final NEPA document with an official Record of Decision. In a meeting with NRC staff on June 30, 2009, NRC staff told participants (including our organization) that "the GEIS does not make a final binding decision." In fact, if it was a final decision, we note the NRC – according to its own regulations – should have issued a record of decision. *See* 10 C.F.R. § 51.102(a) ("A Commission decision on any action for which a final environmental impact statement has been prepared shall be accompanied by or include a concise public record of decision.")

The NRC downplays the extent to which it relies on the GEIS by saying that the GEIS merely "provides a starting point for NRC's NEPA analyses." DSEIS at 1-2. However, certain aspects of the GEIS appear to be binding upon the SEIS, including the scope of the document. *Id.* ("In defining the scope of the SEIS, the NRC staff considers the scope of the GEIS to be sufficient for this purpose"); *see also Id.* at 1-5 (issues and concerns determined to be outside the scope of the GEIS are also outside the scope of the SEIS).

Improperly limiting the scope of the document leads the NRC to fail to analyze a host of impact areas. In particular, the NRC fails to consider climate change impacts, which was determined to be outside the scope of the GEIS.[1] We hereby incorporate by reference our comments on the Draft GEIS relating to climate change and all other aspects of the GEIS. (A copy of our

[1] Although the NRC briefly touches on the issue of climate change on pages 5-12 to 5-13, the discussion is nowhere near complete. Also, the discussion mixes traditional air pollutants with greenhouse gases and does disservice to the impacts analysis of both. Climate change is a significant enough topic to deserve its own section and detailed discussion in the EIS.

comments on the Draft GEIS is attached for easy reference). These comments demonstrate why the GEIS is a legally deficient document and cannot be relied upon for impacts analysis of the Nichols Ranch project.

III. The NRC relies on "mitigation" that is not enforceable by the agency and in many cases has yet to be decided.

Routinely, the NRC makes statements about mitigation measures as if they are in place and enforceable. Here is a sampling of these statements:

- "[A]ccess roads would...follow BLM criteria for road building material." DSEIS at 2-7;
- "During construction, the roads would be wetted to reduce dust emissions." *Id.*;
- "Mitigation measures similar to those specified in the PA for the Pumpkin Buttes TCP may apply to construction activities in the Hank Unit because it lies within the 3.2 km (2 mi) radius of the TCP." *Id.* at xxi;
- "As required, the disposal well will be completed (e.g. screened) in an approved subsurface formation and will be operated according to permit requirements." *Id.* at 3-23;
- "[W]hile impacts from incidental spills of drilling fluids into local streams could occur, they would be expected to be temporary due to the use of mitigation measures." *Id.* at 4-16;
- "Uranerz would also use proper sedimentation and erosion control to minimize sedimentation into the channels...";
- "Mitigative measures, such as minimizing noise, vehicular traffic, and human proximity, would be taken near greater sage-grouse leks." *Id.* at 4-36; and
- "Operational practices to mitigate impacts and prevent erosion and water quality degradation on a regional basis would be an important component to the future of surface waters and wetlands." *Id.* at 5-10.

NRC fails to mention that it does not have the authority to enforce any of these requirements because, *if* they are required, they will be a part of other agency approvals of the project. None of these other agency approvals have been granted to the company and thus NRC cannot rely on them to reduce impacts of this project. The final EIS must fully disclose what mitigation measures NRC will incorporate into its license for the project and thus what measures the agency has the authority to enforce. All other measures are merely conjecture at this point.

In doing this analysis of mitigation measures, NRC must comply with NEPA, which requires a full discussion of the effectiveness of each measure. As federal courts have explained:

> An essential component of a reasonably complete mitigation discussion is an assessment of whether the proposed mitigation measures can be effective. *Compare Neighbors of Cuddy Mountain v. U.S. Forest Service*, 137 F.3d 1372, 1381 (9th Cir. 1998) (disapproving an EIS that lacked such an assessment) *with Okanogan Highlands Alliance v. Williams*, 236 F.3d 468, 477 (9th Cir. 2000) (upholding an EIS where "[e]ach mitigating process was evaluated separately and given an effectiveness rating"). The

> Supreme Court has required a mitigation discussion precisely for the purpose of evaluating whether anticipated environmental impacts can be avoided. *Methow Valley*, 490 U.S. at 351-52 (citing 42 U.S.C. § 4332(C)(ii)). A mitigation discussion without at least *some* evaluation of effectiveness is useless in making that determination.

South Fork Band Council, et al. v. Dept. Interior, et al., Decision No. 09-15230 (9th Cir. 2009). The NRC fails in this EIS to discuss the effectiveness of any of the proposed mitigation measures.

As discussed below, every ISL project to date in Wyoming has experienced a long series of mishaps – spills, excursions, well failures, evaporation pond leaks, etc. It is incumbent upon the NRC to address these issues and develop a strong range of mitigation measures that will *effectively prevent* (or at least minimize to the smallest possible degree) these problems at the Nichols Ranch site and other future ISL sites.

IV. The NRC fails in its duties under NEPA to disclose and analyze cumulative impacts.

Cumulative impacts analysis, especially in an area like the Powder River Basin, is an integral part of any NEPA document. As admitted by NRC, the agency failed to take a "hard look" at cumulative impacts in the GEIS. Short of conducting a true programmatic analysis of cumulative impacts for all proposed ISL projects, as called for in our comments on the GEIS, NRC must now do the analysis that was lacking in the GEIS.

In particular, the NRC must discuss potential cross-contamination from CBM, other oil and gas, or other uranium wellfields. Specifically, the EIS should discuss the following:

- Results of groundwater flow mapping, including information on groundwater flow direction, recharge rates, and vertical and horizontal migration of fluids.
- The location of wells from past, present, and reasonably foreseeable future operations and exploration. This would include uranium, CBM, oil and gas, and other wells present in the area. The EIS should detail whether casing and capping requirements are sufficient to prevent migration of fluids. Past exploration activities and improperly abandoned wells in the area could create significant impacts not contemplated or discussed in the EIS.
- The location of CBM water reservoirs and whether any reservoirs have leaked (as many do) into the groundwater (which could include the ore zone aquifers or surficial aquifers above them) or have storm water discharges into ephemeral drainages where the company plans to locate uranium wells.
- Recent publications regarding groundwater drawdown from CBM operations, including Wyoming Geological Survey's Report *1993 – 2006 Coalbed Natural Gas (CBNG) Regional Groundwater Monitoring Report: Powder River Basin, Wyoming*. This report is available at http://www.wsgs.uwyo.edu/docs/OFR-PRB.pdf. Among other things, the report details that there is communication between the coal seams and the Wasatch Formation that may create cumulative impacts related to water quality or quantity:

CBNG impacts such as drawdown in water levels have been measured in some of the overlying sandstone beds of the Wasatch Formation. These data indicate that there may be a greater degree of hydrologic interconnectedness between the upper Fort Union coal deposits and the overlying Wasatch sandstone beds than was modeled by the AHA and GEC (2002) groundwater model. Report at 5.

- Problems with DEQ permitting systems for discharged water. *See* Jan Hendrickx and Bruce Buchanan, *Expert Opinion on the Tier-2 Methodology*, Report to the Wyoming Environmental Quality Council, May 2009, at iii, and Report to the Wyoming Department of Environmental Quality, Sept. 2009, at ii (Tier 2 is "not [a] reasonable nor scientifically valid [method] for determining the EC water that can be discharged into an ephemeral drainage in Wyoming.").[2] Specifically, in relation to the Willow Creek drainage, EPA objected to permit modifications for the Willow Creek Watershed General Permit. Letter from Stephen Tuber, EPA Region 8, to John Corra, Wyoming DEQ, Nov. 13, 2009. EPA told DEQ that the modifications to this watershed permit "fail to ensure compliance with applicable requirements of CWA [Clean Water Act] regulations and fail to satisfy the requirements of 40 C.F.R. § 122.44(d)." Letter at 2.

Consideration of water quality impacts related to CBM is especially important given the proposed location of uranium wells *within* ephemeral drainages used for CBM discharged water.

The EIS dramatically underestimates the amount of CBM wells in the Powder River Basin. According to the EIS, only 4,500 CBM wells are in "various stages of development." DSEIS at 5-7. However, according to the Wyoming Oil & Gas Conservation Commission website, as of December 2009, there were 14,260 producing CBM wells and 12,390 shut-in CBM wells (wells that were producing but are on standby status, mostly because of economic conditions).[3] The 2003 Powder River Basin Oil and Gas EIS authorized 51,000 CBM wells. This error alone demonstrates that NRC's cumulative impacts analysis does not meet the "hard look" standard under NEPA. In addition to discussing the number of wells in the entire basin, NRC must also discuss the number and type of wells in the project area, which is especially important for cumulative impacts analysis.

Additionally, the NRC's methodology for analyzing cumulative impacts is flawed. The NRC states that since most of the site-specific impacts are "small" (according to the agency), "the activities at the proposed ISR site is not likely to contribute a perceptible increase in potential impacts to the resource beyond those resulting from past, present, and anticipated future actions." This means that NRC has determined, prior to any true analysis of cumulative impacts, that impacts are insignificant and not worth analyzing. NEPA requires more.

---

[2] Tier 2 is a permit methodology to implement DEQ's "agricultural protection policy," which is designed to implement the non-degradation requirements (i.e. protection of existing uses of the water) of the Clean Water Act. However, according to the consultants' report, Tier 2 will not protect existing agricultural uses of Wyoming's water. After the consultants' report DEQ has pulled the proposed rule relying upon this methodology, but is still implementing it through the existing policy. EPA wrote to the state on September 29, 2009 expressing concerns regarding the proposed rule and the use of the policy to issue permits. Letter from Karen Hamilton and Sandra Stavnes, EPA, to Dennis Boal, Environmental Quality Council, Sept. 29, 2009.

[3] http://wogcc.state.wy.us/coalbedchart.cfm

For instance, the discussion on land use impacts fails to include any analysis of well spacing, fencing, habitat loss, and other aspects of well field and infrastructure construction and operation. As discussed below, NRC notes that well spacing in an ISL field is just 50-150 feet. These are extreme impacts compared to traditional oil and gas and even CBM (which is typically developed at 80-acre spacing). Merely because other wells are present in the area does not translate to the uranium impacts being insignificant. NRC fails to analyze what the combined impacts are. As the CEQ regulations demonstrate, "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." 40 C.F.R. § 1508.7.

Moreover, the cumulative impacts section fails to discuss impacts to wildlife. Cumulative impacts to species like the greater sage-grouse are often significant because of the landscape-scale habitat needs of the bird. Additionally, species such as mule deer and pronghorn migrate over long distances and therefore this project must be considered in the scope of local and regional impacts to wildlife habitat and migration corridors.

NRC also appears to use the wrong scale for evaluating cumulative impacts. While some impacts – such as air quality – should be viewed at a regional scale, other impacts are specific to the license/permit area. For instance, the discussion regarding geology and soils blows things out of proportion. NRC states that

> The 41 ha (100 ac) of temporary disturbance anticipated for the proposed Nichols Ranch ISR Project amounts to less than 0.1 percent of the land area disturbed in the Powder River Basin in 2003. The ways in which soils are impacted for the proposed Nichols Ranch ISR Project are also far less damaging or adverse than the impacts which result from surface coal mining.

DSEIS at 5-9. Is the standard for determining significance the level of impacts associated with surface coal mining? Almost certainly, a large surface coal mine will disturb more land than an ISL uranium project. That does not mean, however, that impacts to geology and soils from an ISL project are insignificant, especially when combined with other impacts *in the project area.*

In short, NRC must substantially revise the cumulative impacts discussion in order for a final EIS to meet NEPA requirements.

V. Impacts to a wide variety of resource areas will be significant.

Like other NRC issued NEPA documents before it, the SEIS fails to properly disclose impacts to a wide variety of resources – impacts that will be significant. We look forward to a more robust discussion of impacts – and enforceable measures to mitigate those impacts – in the final EIS.

A. Land Use

Impacts to land use from the construction, operation, and reclamation of the project will be significant. As NRC notes, wells will be placed just 50-150 feet apart. DSEIS at 2-9. In addition to the well fields, the project will require a processing plant, sixteen header houses (for just the first production area alone), pipelines, fences, roads, and other infrastructure. These facilities will

require significant amounts of land and because of the well spacing will prevent the land from being used for other purposes. Please discuss in greater detail the amount of land that will be impacted either directly or indirectly and the time estimated for reclamation.

B. Water

NRC's conclusion that ground and surface water impacts will be "small" to "moderate" is premised on several flawed assumptions. First, NRC assumes that Uranerz and other ISL operators will implement practices (although the EIS fails to discuss what those practices are) to avoid or remediate spills, leaks, and excursions. The past history of ISL operations in Wyoming and elsewhere demonstrate otherwise. As the attached investigation report and Notice of Violation for the Smith Ranch-Highland ISL project and the attached permit history from the Irigaray-Christensen Ranch project shows, spills, leaks, and excursions are routine at ISL operations. Some of these spills and excursions have been extremely large. If the Nichols Ranch project is carried out in a "business as usual" fashion, it is very likely that these problems will be replicated during this project.

NRC briefly discusses this history in the EIS and concludes that "In all cases, none [of the spills, excursions, etc.] resulted in environmental impacts." DSEIS at 4-27. In neither the EIS nor the 2 page document from which this conclusion is based, does NRC discuss these past events at a level that can be used to determine impacts. How does the NRC make this determination? On what data is the determination based?

Second, NRC assumes that groundwater will be restored to "acceptable limits" but again fails to disclose what those limits may be. Past history of ISL sites demonstrates that it will be extremely difficult – if not impossible – to restore a well field to pre-mining water quality conditions. Our members are particularly concerned about mobilized heavy metals left in the aquifer after mining operations. As noted in the DSEIS, uranium is "present in the aquifer in a reduced insoluble form...Once uranium is oxidized, it easily complexes with bicarbonate anions in the groundwater and becomes mobile." DSEIS at 2-15. In addition to uranium, other heavy metals and hazardous elements are also mobilized from the ore and can contaminate the groundwater. These elements include the radioisotopes and progeny of uranium, thorium, radium, and radon, as well as the non-radioactive elements such as arsenic, vanadium, zinc, selenium, and molybdenum. NRC fails to discuss how these elements will be returned to pre-mining conditions – or if it is impossible to do, what alternative concentration limits may be allowed and therefore what water quality impacts may result from these operations.

NRC also fails to discuss how baseline water quality conditions have been developed and why averaging is allowed under NRC regulations. As noted in the EIS, some livestock and domestic wells are completed within the ore zone and that means water quality in local areas is of sufficient quality to be used for these purposes. Well field averaging could prevent those local aquifers from being returned to a sufficient quality to allow them to be used for their pre-mining uses.

NRC's flawed assumptions must be corrected in the final EIS and NRC needs to fully disclose the true risk of these projects.

Additionally, NRC's impacts analysis related to water must be substantially improved in several key areas.

First, NRC must accurately describe impacts related to locating wells *within* an ephemeral drainage. According to the EIS, "Ephemeral channels would be crossed at two locations on the Nichols Ranch Unit and at three locations on the Hank Unit due to the construction of these access roads," DSEIS at 2-7, and "Uranerz would place approximately 15 wells (5 production and 10 injection) in ephemeral channels during the dry season within the Nichols Ranch Unit and 22 wells in ephemeral channels on the Hank Unit (11 production and 11 injection)." *Id.* at 4-17. Locating wells *within* an ephemeral drainage presents unique challenges in regards to spills, leaks, and erosion. If spills of production or injection fluids enter waters of the state, DEQ enforcement authority is triggered. Once the spill enters the water, how would it be mitigated, i.e. cleaned up? Would all water in the stream have to be removed? Would topsoil of the streambed be removed? Locating wells *in* an ephemeral drainage presents serious risks to local water quality and soil ecology that are not appropriately discussed in the EIS. These impacts are of particular concern to our members, some of whom live downstream from this project.

Second, NRC does not fully disclose impacts to stock and domestic water wells within the project area (or outside in regards to excursions). According to the EIS, some water and stock wells are completed within the aquifer where Uranerz will conduct its mining operations and "wells that are completed in the ore-bearing zone will be abandoned per Wyoming regulations/guidance." *Id.* at 3-22. How many wells will need to abandoned? Will the owners of those wells be compensated? If the wells need to be re-drilled in a different formation, what is the water quality and quantity of that formation? What is the impact on artesian wells outside the ore zone? Will landowners be compensated if wells lose pressure? Will the aquifers be restored to water quality sufficient to allow them to be used for domestic and stock wells in the future? None of these questions are addressed in sufficient detail in the EIS.

Third, NRC fails to fully disclose what constituents will be injected into the aquifer. The EIS states that "chemicals *such as* oxygen or hydrogen peroxide would be added to the groundwater to produce a lixiviant. Sodium bicarbonate would also be added to complex the uranium in the solution." *Id.* at 2-14. Is there a plan established? If not, how can NRC analyze the impacts if it does not know what constituents will actually be injected? Elsewhere in the EIS, the NRC says that other chemicals may be added, included hazardous constituents such as hydrochloric acid. *Id.* at 2-15. Where is the analysis of impacts caused by adding these hazardous chemicals to the aquifer?

Finally, and perhaps most importantly, NRC fails to fully disclose the confining conditions (or lack thereof) at this project site. The EIS does not disclose data from the project site about permeabilities of the aquitards. Instead, NRC says that data necessary to determine confinement "would be submitted as part of the well field data packages and would be reviewed and approved by the NRC before each well field would begin operation." DSEIS at 3-18. As noted in the GEIS among other documents, ISL projects depend on confining conditions to minimize risk of vertical excursions and dewatering, among other impacts. NRC admits that the F Sand production zone at the Hank Unit "is an unconfined aquifer." *Id.* at 4-25. We believe that NRC

should not license a project at an unconfined location unless the agency fully demonstrates (through sufficient text in this NEPA document) that impacts to water resources can otherwise be prevented through *enforceable* and *effective* mitigation measures.

Please fully disclose impacts to water resources in the final EIS for this project.

C. Waste Disposal

The analysis of waste disposal impacts is particularly limited and must be bolstered in the final EIS for this project.

For instance, where will the waste from the facility go? NRC says that the 11e(2) byproduct waste disposal agreement is "under preparation" and "Uranerz has not selected a site." DSEIS at 1-9. Several options are available, but NRC has not analyzed the impacts of any of those options. Is there space available at the site? What are the impacts from transportation to the site? What are the local impacts of each of the disposal sites? All of these issues must be addressed because they are reasonably foreseeable impacts of disposing waste from this facility.

Additionally, Uranerz's plan for waste disposal goes against what past history tells us is necessary at an ISL facility. Significantly, Uranerz contends that all of the liquid effluent wastes from the project (upwards of 100 gallons per minute) can be disposed of in deep disposal wells. While we prefer this disposal method to other options on the table (e.g. evaporation ponds or land application), we are concerned that the wells might not be able to handle the amount of waste produced. What happens if the well fails? Where will the waste go? NEPA requires up-front consideration of impacts and it is important to fully disclose the potential impacts that may result from this project.

D. Wildlife

Our members are concerned about impacts to local and regional wildlife populations, especially the greater sage-grouse, which is under threat of being listed under the Endangered Species Act. As identified in the EIS, the "proposed project area includes habitat for a variety of big game animals, raptors, migratory birds, and small mammals that may be affected by the project." DSEIS at 1-12. NRC must discuss what these impacts entail and enforceable measures to mitigate those impacts.

After disclosing that "the property is part of a larger region of the state dedicated as a 'core breeding area' for the greater sage-grouse," DSEIS at 1-12, NRC then illogically proceeds to determine that impacts to ecological resources will be small. The core areas approach, adopted by the Buffalo Field Office of the BLM as a "focus areas approach," is the state's designated way to protect existing sage-grouse habitat. While our organizations have objected to the BLM's reliance on this approach as a way to abdicate its responsibilities to protect sage-grouse populations and habitat outside of the core areas,[4] in order for the approach to be even remotely

[4] *See, e.g.* appeal to the Interior Board of Land Appeals concerning BLM's approval of the Carr Draw III East Plan of Development.

successful in preventing a listing under the ESA, all remaining habitat in the core areas should be protected and impacts to sage-grouse populations must be minimized.

According to the EIS, "ten greater sage-grouse leks exist within a 3.2 km (2 mi) radius of the proposed Nichols Ranch ISR Project site." *Id.* at 3-30. Please discuss the number of birds (both male and female) that have visited these leks in recent years. A table listing the leks, the number of birds, and distance from the project site would be an important part of the final document. Leks within four miles should be included in this table as that would be consistent with BLM practices relating to CBM project authorizations and scientific literature that has determined that sage-grouse leks up to four miles away from a project suffer impacts. The EIS also needs to discuss habitat conditions, including the percent of breeding and nesting habitat and winter habitat within and adjacent to the project area.

In addition to providing better background information about environmental conditions, the EIS needs to disclose the wide variety of impacts to sage-grouse populations and their habitat that will result from the project. For instance, ISL projects will fail to reclaim sagebrush habitat because sagebrush is not a part of the seed mix used by ISL uranium projects and regardless, sagebrush ecosystems take decades to properly reclaim. The Northeast Wyoming Sage-grouse Working Group has identified that "[i]mpacts [from energy development] may be long-term (30 years or more), and rehabilitation of impacted habitats may take many years to complete." Northeast Wyoming Sage-grouse Working Group report at 23. The EIS is also lacking an analysis of how development will increase the spread of noxious or undesirable weeds and therefore limit the ability of sage-grouse habitat to be properly reclaimed. As a result of failed reclamation and invasion of noxious weeds, there will be permanent impacts to habitat. As the EIS notes, "For species with specialized habitat requirements, future population viability would be strongly influenced by the quality and composition of the remaining habitat." DSEIS at 5-11. However, the EIS fails to disclose the habitat impacts of this project – either at a site-specific level or cumulatively.

Additionally, the EIS fails to discuss impacts related to the use of overhead power or the use of diesel generators, which create significant levels of noise and thus impact local wildlife species.

We included with our comments on the draft GEIS several studies relating to sage-grouse impacts from CBM operations and we believe these studies must be considered in the context of uranium operations. The Wyoming Game & Fish Department has concluded that, absent uranium-specific scientific studies to the contrary, impacts of oil and gas operations can be applied to ISL uranium facilities.

E. Socio-economics

We appreciate the discussion of socio-economic conditions in section 3.11 of the EIS. We believe this is much better information than was included in the GEIS.

However, the EIS fails to disclose that uranium mining does not create *any* federal royalties under the 1872 Hardrock Mining Act and only produces modest state severance taxes (compared

to other mineral development in Wyoming). Please include a detailed discussion of taxes and royalties in the final EIS.

VI. NRC's analysis of many impact areas is premature because other agencies have not yet acted.

As discussed above, NRC is depending on other federal and state agencies to issue permits and project approvals with enforceable mitigation measures. This truncates NEPA's requirements of an up-front consideration of impacts and enforceable measures to mitigate those impacts. The SEIS artificially separates the NRC's consideration of impacts from the impacts that may actually result from the project after all of the project approvals are in place. Thus, this prevents a holistic evaluation of impacts.

NRC needs to do more to coordinate and consult with other agencies. While we appreciate that "the NRC staff has kept the BLM apprised of progress on the staff's environmental review analysis for the proposed Nichols Ranch ISR Project," *Id.* at 1-11, the BLM is not a cooperating agency on this EIS. That means BLM will have to do its own NEPA. NEPA analysis will thus be split and the impacts will not be looked at holistically.

Additionally, how can NRC determine the impacts of this action before the project has obtained the appropriate permits from state and federal agencies? NRC's analysis of impacts is speculation at best under this framework.

Thank you for your time and consideration of these comments and we look forward to a much-improved final EIS.

Sincerely,

Shannon Anderson, Powder River Basin Resource Council, 934 N. Main, Sheridan, WY 82801

Steve Jones, Wyoming Outdoor Council, 262 Lincoln Street, Lander, Wyoming 82520

Attachments: Powder River Basin Resource Council comments on the draft GEIS for ISL uranium facilities; Jan Hendrickx and Bruce Buchanan, *Expert Opinion on the Tier-2 Methodology*, Report to the Wyoming Environmental Quality Council, May 2009; Notice of Violation and associated report of investigation for the Smith Ranch-Highland ISL facility in Converse County, Wyoming; Permit History of the Christensen-Irigaray ISL facility in Campbell County; Wyoming Game and Fish recommendations regarding wildlife mitigation

EXPERT SCIENTIFIC OPINION ON THE TIER-2 METHODOLGY

Report to the Wyoming Environmental Quality Council

Jan M.H. Hendrickx
New Mexico Tech
Socorro, NM 87801

Bruce A. Buchanan
Buchanan Consultants, Ltd.
Farmington, NM 87499

May 2009

EXECUTIVE SUMMARY

All Wyoming surface waters are protected to some extent for agricultural uses. The primary agricultural uses are stock watering or irrigation. The uses are protected under the AGRICULTURAL USE PROTECTION POLICY (AUPP) which was finalized August 2006 in conjunction with the Triennial Review of the Chapter 1 Surface Water Standards. The policy is contained in Chapter 1, Section 20 of the AUPP. This policy is under consideration by the Wyoming Environmental Quality Council (WEQC) for adoption as an Appendix to the Chapter 1 rules. Until a final decision is rendered on the rulemaking, the provisions of the policy remain in effect for establishing effluent limits on discharges that may affect agricultural use.

The purpose of this report is to provide an expert, scientific opinion regarding the methods proposed for estimation of the EC (Electrical Conductivity) and SAR (Sodium Adsorption Ratio) of produced Coal Bed Methane (CBM) water. These produced waters are discharged into ephemeral drainages in Wyoming such that degradation of the receiving water will not affect crop production.

Chapter 2 lists the services to be provided by the contractors and specifically formulates two specific questions by the Council: *Question A.* Whether the Tier 2 methodology as set forth in Appendix H section c(vi)(B) is reasonable and scientifically valid for determining the EC and SAR of water that can be discharged into an ephemeral drainage in Wyoming so that degradation of the receiving water will not be of such an extent to cause a measurable decrease in crop production. *Question B.* Whether the method set forth in Appendix H section c(vi)(B) for determining EC and SAR for permitting the discharge of produced water is reasonable, sufficiently defined and scientifically defensible for the conditions in Wyoming, and provides a uniform testing procedure that is reasonably accurate and unbiased for the determination of soil EC from which you can reasonably infer the quality of the water EC and SAR that historically flowed within the drainage that will support the establishment of effluent limits for discharge permits in a given drainage that will not cause a measurable decrease in crop production.

Chapter 3 educates the reader on the causes of soil salinity focusing on the relation between soil salinity and the quality of irrigation water. Major causes for soil salinity are soil characteristics, ground water table depth, climate, presence of saline seepages, and irrigation management but not the quality of the irrigation water. No evidence has been found in the peer-reviewed literature in support of the assumption on which Tier 2 is based: "soil salinity in artificially and naturally irrigated lands in ephemeral drainages is *entirely* determined by pre-existing background water quality".

In Chapter 4 a succinct review of the testimony to the Council is discussed under three headings: Assumption for Tier 2 Methodology, Soil Testing Procedure for Unbiased Determination of Soil EC and SAR, and Managed and Unmanaged Irrigation with CBM Waters.

Finally, in Chapter 5 the expert scientific opinions are presented in answer to the two questions A and B by the Council. *Scientific Expert Opinion A*. The Tier 2 methodology as set forth in Appendix H section c(vi)(B) is not reasonable nor scientifically valid for determining the EC and SAR of water that can be discharged into an ephemeral drainage in Wyoming so that degradation of the receiving water will not be of such an extent to cause a measurable decrease in crop production. *Scientific Expert Opinion B*. The method set forth in Appendix H section c(vi)(B) for determining electrical conductivity (EC) and sodium adsorption ratio (SAR) for permitting the discharge of produced water is not reasonable nor sufficiently defined nor scientifically defensible for the conditions in Wyoming. It does not provide a uniform testing procedure that is reasonably accurate and unbiased for the determination of soil EC from which you can reasonably infer the quality of the water EC and SAR that historically flowed within the drainage that will support the establishment of effluent limits for discharge permits in a given drainage that will not cause a measurable decrease in crop production.

Scientific Expert Opinion on Way Forward. Since it is not scientifically defensible to use Tier 2, the question is how to move forward. The use of Tier 1 can be continued since it is conservative and has been accepted by the community. If the water quality

requirements of Tier 1 cannot be met, the Irrigation Waiver seems the preferred alternative since it requires an irrigation management plan that provides reasonable assurance that the lower quality water will be confined to the targeted lands. In this manner, the Irrigation Waiver will deal with the issue of water quantity. Given the large scale on which CBM water is produced it seems justifiable to implement an aggressive applied and basic research program to develop guidelines on how to use CBM water in a beneficial manner.

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	ii
TABLE OF CONTENTS	v
1. PURPOSE	1
2. SERVICES TO BE PROVIDED BY CONTRACTOR	2
3. WHAT CAUSES SOIL SALINITY?	4
4. REVIEW OF TESTIMONY AND SUBMITTALS TO THE COUNCIL	11
5. EXPERT SCIENTIFIC OPINIONS	21
6. REFERENCES	24

1. PURPOSE

All Wyoming surface waters are protected to some extent for agricultural uses. The primary agricultural uses are stock watering or irrigation. The uses are protected under the AGRICULTURAL USE PROTECTION POLICY (AUPP) which was finalized August 2006 in conjunction with the Triennial Review of the Chapter 1 Surface Water Standards. The policy is contained in Chapter 1, Section 20 of the AUPP. This policy is under consideration by the Wyoming Environmental Quality Council (WEQC) for adoption as an Appendix to the Chapter 1 rules. Until a final decision is rendered on the rulemaking, the provisions of the policy remain in effect for establishing effluent limits on discharges that may affect agricultural use.

The purpose of this AUPP report is to provide an expert, scientific opinion regarding the methods proposed for estimation of the EC (Electrical Conductivity) and SAR (Sodium Adsorption Ratio) of produced water. These produced waters are discharged into ephemeral drainages in Wyoming such that degradation of the receiving water will not affect crop production.

This report contains five chapters. Chapter 1 discusses the purpose of this report. Chapter 2 describes the services to be provided by the contractor and is followed by Chapter 3 that educates the reader on the causes of soil salinity focusing on the possible effects of EC and SAR of precipitation, irrigation, and flood waters. Chapter 4 presents highlights of the submittals and testimony presented to the Council while Chapter 5 presents the contractors' expert scientific opinions.

2. SERVICES TO BE PROVIDED BY CONTRACTOR

Drs. Buchanan and Hendrickx have been contracted to review the AGRICULTURAL USE PROTECTION POLICY and basically determine if making the policy a rule is reasonable and scientifically valid. Three specific services have been requested by the Wyoming Environmental Quality Council.

Service One:

Review the following:

A. Appendix H Section c(vi)(B) of the Rule as proposed by the DEQ on 11/20/2008 (see Appendix A).

B. Transcripts of the testimony received by the Council on October 24th and 28th, 2008.

C. Section 20 of the Rule as proposed by DEQ on November 11, 2008 (see Appendix A).

D. Written submittals, responses to comments, and other documents submitted to the Council under Docket No. 08-3101.

Service Two:

Based upon Contractor's training, education, and work experience provide, in written form, a report outlining Contractor's expert scientific opinion regarding:

A. Whether the Tier 2 methodology as set forth in Appendix H section c(vi)(B) is reasonable and scientifically valid for determining the EC and SAR of water that can be discharged into an ephemeral drainages in Wyoming so that degradation of the receiving water will not be of such an extent to cause a measurable decrease in crop production.

B. Whether the method set forth in Appendix H section c(vi)(B) for determining EC and SAR for permitting the discharge of produced water is reasonable, sufficiently defined and scientifically defensible for the conditions in Wyoming, and provides a uniform testing procedure that is reasonably accurate and unbiased for the determination of soil EC from which you can reasonably

infer the quality of the water EC and SAR that historically flowed within the drainage that will support the establishment of effluent limits for discharge permits in a given drainage that will not cause a measurable decrease in crop production.

Service Three:

Consult with DEQ to the degree necessary to achieve the goals of Section 2 of the Contract. Communicate any suggested improvements or procedures to EQC and DEQ.

Drs. Buchanan and Hendrickx have reviewed all documents listed under Service One and present a review summary in Chapter 4. They have made one consultation with DEQ in the form of eight questions on the subject of the permitting process. The clear response by Mr. John Wagner of DEQ to these questions was very helpful. Their expert scientific opinions are presented in Chapter 5.

The basic processes of soil salinization are reviewed in Chapter 3 since they are the scientific basis of the opinion. Moreover, these processes need to be understood –at least a conceptual level– in order to successfully implement the expert scientific opinion into a fair and balanced system for discharge permits of produced waters into ephemeral drainages in Wyoming.

3. WHAT CAUSES SOIL SALINITY?

Soil salinity is the amount of soluble salts in a soil (Soil Science Glossary Terms Committee, 2008)[1] but the term is often used in the sense that the salt content of the soil is too high for satisfactory crop production[2]: the soil is saline or salty. Important natural sources of salts in arid and semi-arid regions are atmospheric deposition (wet and dry) (Bresler et al., 1982; Scanlon, 1991), mineral weathering (Bresler et al., 1982; Rhoades et al., 1974), "fossil" salts (built up in poorly drained flood-plain or playa sediments) (Bresler et al., 1982; Carter and Robbins, 1978), seepage from uplands (Stephanie J. Moore, 2008), and upwelling from deep ground water brines (Hogan et al., 2007; Phillips et al., 2003; Stephanie J. Moore, 2008). Four common anthropogenic salt sources are: irrigation water (Rhoades et al., 1973; Rhoades et al., 1974), fertilizers (Darwish et al., 2005), discharge of treated sewage water (Gonçalves et al., 2007; Mills, 2003), and discharge of saline waters during coalbed methane (Ganjegunte et al., 2005) or oil and gas extraction (Hendrickx et al., 2005a). Most soil salinity is caused by mineral weathering and application of waters containing salt on irrigated lands. The importance of each source of salinity depends on soil type, climate and irrigation management (Bresler et al., 1982; Keren, 2000).

Salinity is common in arid and semi-arid areas where evapotranspiration exceeds annual precipitation as is the case in Wyoming. Evapotranspiration is defined as the evaporation of water from soil combined with the transpiration of water from plants. Since salts do not vaporize at atmospheric pressure, they are left behind during the processes of evapotranspiration and accumulate in the soil. Soil salinity will affect crop growth when the concentration of soluble salts in the root zone exceeds a critical threshold level (Hanson et al., 2006). For the purpose of this report three common scenarios of salt accumulation in the root zone of semi-arid lands will be described: soil water chloride profiles in semi-arid uplands with deep ground water tables where the only source of

[1] Scientific references are listed in Appendix xx.
[2] http://waterwiki.net/index.php/Soil_salinity on May 8, 2009.

water is precipitation, soil salinity in semi-arid riparian lands with shallow ground water tables, and soil salinity in irrigated fields.

Scenario I: Soil Salinity in Semi-arid Uplands with Deep Ground Water Tables. Figure 1 shows the chloride distribution with depth in two desert soil profiles in southern New Mexico. Although the chloride concentration of the incoming precipitation is the same for both profiles, the chloride content at depth is 1000 times larger in the profile that does not receive run-on water. Similar differences do occur due to changes in land use (Hendrickx and Walker, 1997; Stephens, 1995), soil and bedrock characteristics (Heilweil and Solomon, 2004), or geomorphic setting (Hendrickx and Walker, 1997; Johnston, 1987; Scanlon, 1991; Scanlon, 1992). For example, in Australia the chloride concentration in soil profiles beneath native *Eucalyptus* vegetation is about 4000 mg/l versus 1000 mg/l under fields cleared from native vegetation 12 years previously. The lower water use of the crops that replaced the native vegetation lead to an increased recharge and salt leaching (Walker et al., 1991). Thus, **in semi-arid uplands with deep ground water tables no unique relationship exists between salt concentration of precipitation and soil salinity.**

Scenario II: Soil Salinity in Semi-arid Riparian Lands with Shallow Ground Water Tables. In riparian areas soil salinity is often variable and can change over short distances (Amezketa and Lersundi, 2008; Hendrickx et al., 1994; Hendrickx et al., 1997; Sheets et al., 1994). For example, in the Horse Creek riparian area on the Rottman Ranch, Hawk Springs, Wyoming, soil samples indicated an "extremely high variability" of soil salinity depending on soil age and texture, topography, and depth to ground water[3]. Salinization in these areas is caused by discharge of groundwater to the atmosphere, a process that can result from three different mechanisms: (i) deep-rooted plants tap directly into the ground water to acquire water for transpiration, (ii) capillary rise from

[3] http://wsare.usu.edu/pro/fieldrep_00/pdf/refinal/aw96014.pdf on May 15, 2009.

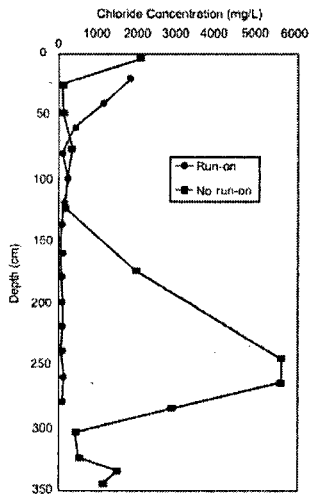


Figure 1. Soil water chloride profiles in two nearby loam soil profiles with a deep ground water table in southern New Mexico receiving precipitation with a chloride concentration of less than 5 mg/liter (Eppes and Harrison, 2003; Hogan et al., 2007). Despite the low chloride concentration of the precipitation the maximum chloride concentration in the "no run-on" profile exceeds 5000 mg/liter.

the ground water table to the soil surface where the water evaporates, or (iii) capillary rise to the bottom of the root zone where it becomes available for transpiration by vegetation. The dissolved salts in the evaporated and transpired water are left behind and accumulate in the soil. The rate of salt accumulation depends on the quantity or rate of ground water discharge as well as the quality or salt concentration of the ground water (Rose, 2004).

A dry sponge in contact with water will suck up the water and even make it flow upwards due to capillary forces. In the same way, water can flow from the ground water table to the soil surface or the bottom of the root zone. The resulting discharge rate depends on the depth of the ground water, the texture and sequence of different soil horizons, and the rooting depth (Hoffman and Durnford, 1999; Weeks et al., 1987). For example, during a seven year study near Buckeye, Arizona, the annual evapotranspiration of salt cedar varied from 2150 mm with ground water level at 1.5 m to less than 1000 mm with ground water level at 2.7 m (Van Hylckama, 1974). A computer simulation based on field observations during the 1999 growing season in the Bosque del Apache (Socorro, New Mexico) evaluated the effect of soil texture, ground water depth, and rooting depth on ground water discharge. The average discharge in a virtual homogeneous clay profile was 49 cm versus 19 cm in a virtual homogeneous sand profile; the average discharges from

ground water depth 100, 200, and 500 cm were 66, 31, and 5 cm; the average discharges with rooting depths 30 and 300 cm were 21 and 47 cm, respectively (Moayyad et al., 2003). Several authors have shown that discharge from ground water tables less than 5 m (15 feet) deep can be considerable (Hendrickx et al., 2003; Jolly et al., 1993; Moayyad et al., 2003) while it typically can be ignored when the ground water table falls below 10 m[4] but not always (Hoffman and Durnford, 1999).

During a soil reclamation project in a riparian area close to Albuquerque (Caplan et al., 2001), the authors of this report evaluated soil salinity dynamics in a non-flooded riparian area combining a detailed soil salinity survey using electromagnetic induction (Hendrickx and Kachanoski, 2002; Hendrickx et al., 1994; Sheets et al., 1994), extensive soil descriptions and laboratory analyses of representative riparian soils, ground water depth measurements, ground water quality measurements, and simulations with the forward model for prediction of electromagnetic induction responses (Borchers et al., 1997; Hendrickx and Kachanoski, 2002; Hendrickx et al., 2002) as well as simulations with the model HYDRUS1D for prediction of soil water contents and soil water salt concentrations (Šimůnek et al., 2008). Although all soils in this riparian area received their water from the river (salt concentration about 200-400 ppm) and precipitation, the soil salinity profiles are widely different (Hong, 2002). Figure 2 shows Profile 1 with almost no salt accumulation while Profile 6 has accumulated a considerable amount of salts since the construction of Cochiti reservoir around 1970 that prevented flooding of our riparian study area. The difference in soil salinity is caused by the interaction between soil texture, capillary rise, and ground water level fluctuations. Thus, this case study is strong evidence that no unique relationship exists between the historic salt concentrations in the Rio Grande and current soil salinity profiles in riparian areas with shallow ground water tables. Soil salinity depends on soil texture and ground water table depth rather than on historic water quality in the Rio Grande. Similar trends are observed in the River Murray region of Australia[5]. Thus, **in semi-arid riparian areas with**

[4] http://www.clw.csiro.au/research/rivers/flows/floodplain/timescales.html on May 15, 2009.
[5] http://www.clw.csiro.au/research/rivers/flows/floodplain/timescales.html on May 15, 2009.

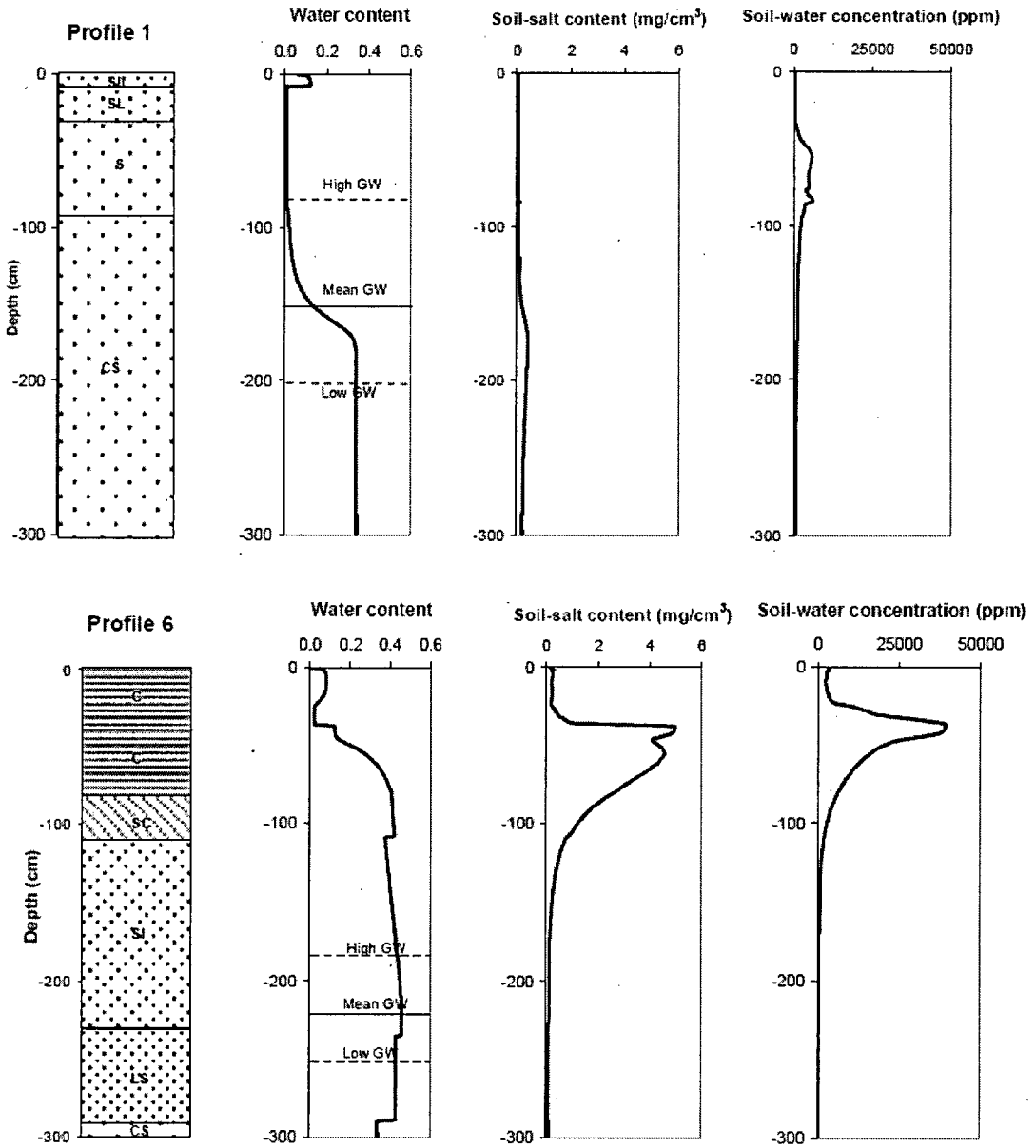


Figure 2. Soil stratigraphy and texture of representative profiles 1 and 6 with the simulated profiles of the water content, soil-salt content, and soil-water concentration. Initial ground water and time-independent bottom solute boundary conditions are 200 ppm. (SIL: silty loam, SL: sandy loam, S: sand, L: loam, LS: loamy sand, CS: coarse sand). The simulated salinity profiles have been confirmed in the field with electromagnetic induction measurements (Hong, 2002).

shallow ground water tables no unique relationship exists between historic salt concentration in the river and soil salinity.

Scenario III: Soil Salinity in Irrigated Fields. The purpose of irrigation is to provide sufficient water to agricultural lands in arid and semi-arid regions to meet crop water requirements during the growing season. Since even good-quality irrigation waters contain some salts, soil salinization will be certain unless sufficient water is supplied to leach the salts below the root zone. As a matter of fact 100 cm of good-quality irrigation water, i.e. a typical amount normally applied in a single irrigation season, contains about 5 tons of salt per hectare which is sufficient to salinate an initially salt-free soil (Hillel, 1998). Therefore, leaching of salt at the bottom of the root zone should be adequate to prevent salt accumulation in the root zone. Most irrigation projects need a drainage infrastructure to accomplish the leaching necessary to keep the root zone at salt levels that are tolerable for the crops (Hoffman and Durnford, 1999).

The soil salinity of irrigated fields depends mainly on the farmer's management. For a given irrigation water quality the farmer can regulate salinity conditions in the root zone by adjusting the leaching fraction which equals the volume of water drained from the field divided by the volume of water applied by irrigation. The larger the leaching fraction, the more water is drained, and the more salts are removed from the root zone (Hanson et al., 2006; Hillel, 1998; Hoffman and Durnford, 1999; Rose, 2004). For example, the senior author of this report used electromagnetic induction for the assessment of soil salinity in a 37 ha representative experimental drainage area located 35 km southwest of Faisalabad in the Punjab Province of Pakistan. Although the site received the same quality irrigation water on all fields, it had a wide range of salinity conditions from 269 dS/m on abandoned fields to 20 dS/m on pepper fields. Excluding the abandoned fields, the range of mean salinity values for different land uses went from 90 dS/m on fallow fields with irrigation inlet structures to 56 dS/m on fodder fields to 38 dS/m on rice fields and then to 20 dS/m on the pepper fields. These mean values are significantly different at the 5% level (Hendrickx et al., 1992) and demonstrate that irrigation management influences soil salinity to a much greater extent than irrigation

water quality. Thus, on irrigated lands **no unique relationship exists between the water quality in the rivers that supply the irrigation canals and soil salinity.**

Relevance for Tier 2. Tier 2 is based on the assumption that soil salinity in artificially and naturally irrigated lands in ephemeral drainages is entirely determined by pre-existing background water quality. However, the three typical scenarios for causing soil salinity in semi-arid lands described above do not support this assumption. On the contrary, pre-existing background water quality appears to be a minor factor or none at all. Major causes for soil salinity are soil characteristics, ground water table depth, climate, presence of saline seepages, and irrigation management (Hillel, 1998; Hoffman and Durnford, 1999; Hogan et al., 2007; Rose, 2004). No evidence has been found in the peer-reviewed literature in support of the assumption on which Tier 2 is based. We welcome to be informed of any scientific evidence in support of this assumption.

The Tier 2 assumption is scientifically flawed for several reasons: (i) effluent water quality that is better than the pre-existing background water quality could still cause severe soil salinity (Hillel, 1998), (ii) effluent water quality that is worse than the pre-existing background water quality may be used beneficially on artificially irrigated lands (Rhoades, 1999; Tanji, 1997), and (iii) soil salinity varies with time and can even change suddenly when riparian areas flood or when farmers irrigate fallow or abandoned lands. Therefore, a Tier 2 analysis will not result in a scientifically defensible assessment of water quality (EC and SAR) that can be released in an ephemeral drainage without irrigation management.

4. REVIEW OF TESTIMONY AND SUBMITTALS TO THE COUNCIL

The testimony and submittals to the Council have been an important source of information on the history of Section 20 of the AUPP as well as the issues faced by industry and landowners to deal with CBM water. In this section we will highlight and comment on relevant testimony for the formulation of our expert scientific opinion on the Tier 2 methodology as set forth in Appendix H section c(vi)(B). Our review and discussion is organized under three headings: Assumption for Tier 2 Methodology, Soil Testing Procedure for Unbiased Determination of Soil EC and SAR, and Managed and Unmanaged Irrigation with CBM Waters.

Assumption for Tier 2 Methodology. Tier 2 is based on the assumption that soil salinity in artificially and naturally irrigated lands in ephemeral drainages is entirely determined by pre-existing background water quality. Several testimonies consider this assumption flawed. Dr Paige testifies: "we cannot determine background water quality for measuring soil EC and SAR" and "my real problem is with trying to back out background water quality from soil EC and salinity within the soil". Later in the hearing Chairman Boal asks Dr. Munn "I think you're are telling me that it is not a good idea to use soil samples to come up with those [background water quality] numbers" and his answer is "That is my professional assessment".

On the other hand Mr. Harvey's testimony is in support of the Tier 2 methodology. He states "The relationships amongst salinity, sodicity, water, plants, and especially the soil are dynamic. They are very complex and dynamic systems, and we need flexibility in a rule ... to deal with this" and "the proposed rule, ... I believe is conservative and protective. I'm ... here to support it." He explains "There is no Tier 2 comparison between managed irrigation with coal-bed natural gas water and WYPDES discharge scenarios. ... Managed irrigation scenarios ... do not fall under the Tier 2 process ... It is a different environment. We're applying water in a managed manner evenly over a field using separate center pivot equipment or other such equipment. Discharge into channel,

it's just a different situation". He continues "The Tier 2 process ... is meant to derive conservative limits for unmanaged irrigation after discharge to the channel".

Since 2005 Mr. Harvey has been involved in "most of the Section 20 reports and analyses that are used to derive EC and SAR effluent limits". His method for deriving pre-existing background water quality from current soil salinity is based on the assumption "that the 1.5 concentration factor from water to soil EC is appropriate and conservative in the rule, and I am supporting DEQ's use of it". He adds "the 1.5 concentration factor was agreed to by all parties the first day of drafting this policy, that now is a proposed rule ... It's been the basis of all of the Tier 2-based WYPDES permits to date". Mr. Harvey's testimony did not provide scientific support for the number 1.5 to be used as the concentration factor for artificially and naturally irrigated lands in Wyoming's ephemeral drainages. However, Dr. Munn stated "the idea [of Tier 2] is ... we can use relationships from managed irrigation fields ... to back-calculate background water [quality] and the number chosen is 1.5" and "1.5 is an arbitrary number based on an assumption of an arbitrary leaching fraction ... in irrigated fields in southern California as a conversion between the applied water salinity and what you will see [i.e. soil salinity] in the root zone".

Experts' Opinion. In Chapter 3 scientific evidence has been presented that pre-existing water quality in a drainage cannot be derived from current soil salinity. The testimony to the Council has been mixed with Paige and Munn recognizing that no link exists between back-ground water quality in an ephemeral drainage and soil salinity while Harvey makes the case that such a relationship does exist and can be used for prediction of back-ground water quality. However, no scientific evidence was found to support the latter position.

In 1976, Ayers and Westcott published the first edition of a FAO (Food and Agriculture Organizations of the United Nations) Irrigation and Drainage Paper (Ayers and Westcot, 1994)[6] as a field guide for evaluating the suitability of water for irrigation. Two of their recommendations have

[6] http://www.fao.org/docrep/003/T0234E/T0234E00.HTM on May 16, 2009.

Leaching Fraction (LF)	Applied Water Needed (Percent of ET)	Concentration Factor [a] (X)
0.05	105.3	3.2
0.10	111.1	2.1
0.15	117.6	1.6
0.20	125.0	1.3
0.25	133.3	1.2
0.30	142.9	1.0
0.40	166.7	0.9
0.50	200.0	0.8
0.60	250.0	0.7
0.70	333.3	0.6
0.80	500.0	0.6

Table 1. Concentration factors for predicting root zone soil water salinity from irrigation water salinity and the leaching fraction from Ayers and Westcott (1994) (Ayers and Westcot, 1994).

been used for the development of Tier 2: (i) the concentration factors for predicting root zone soil salinity from irrigation water salinity and the leaching factor (Table 3 of Ayers and Westcott) and (ii) the relative rate of water infiltration as affected by salinity (EC) and sodium adsorption ratio (SAR) (Figure 21 of Ayers and Westcott (1994) as adapted from Rhoades (1977) (J.D., 1977) and Oster and Schroer (1979) (Oster and Schroer, 1979)). Table 1 presents Table 3 of Ayers and Westcott; it presents concentration factors as a function of leaching factors.

The concentration factors (X) have been developed by Ayers and Westcott to calculate average root zone soil salinity (EC_{soil}) from irrigation water salinity (EC_w):

$$EC_{soil} = EC_w \times X \qquad [1]$$

In Tier 2 Eq. [1] has been inversed as

$$EC_w = \frac{EC_{soil}}{X} \qquad [2]$$

Eq. [1] is based on several assumptions: (i) the crop water use pattern is such that 40 percent of the water is taken up from the upper quarter of the root zone, 30 percent from the next quarter, 20 percent from the next, and 10 percent from the lower quarter, (ii) actual crop evapotranspiration is known so that the water manager can determine the irrigation application for a desired leaching fraction, and (iii) no capillary rise from a

shallow ground water table. The crop water use pattern in the root zone and the absence of capillary rise are reasonable assumptions for managed irrigated lands in California but are uncertain assumptions in the artificially and naturally irrigated lands in ephemeral drainages in Wyoming. Not knowing past actual evapotranspiration rates and water applications from the ephemeral drainages to the irrigated lands makes it next to impossible to estimate a leaching fraction. An irrigator who knows the crop water use pattern and the actual evapotranspiration can use Table 1 and Eq. [1] to estimate the unknown leaching fraction necessary to maintain a favorable root zone soil water salinity. In other words, Eq. [1] is used to estimate one unknown variable, the leaching fraction. On the other hand, a regulator who only knows the root zone soil water salinity will face great difficulties using Eq. [2] to estimate the pre-existing back-ground water quality in the drainage. Instead of one unknown, the regulator must estimate three unknowns: crop water use pattern in the root zone of the heterogeneous artificially and naturally irrigated lands of an ephemeral drainage, the average amount of water delivered by the drainage to the irrigated land, and the average actual evapotranspiration of the crop during those deliveries. An error in any of these estimates will lead to an error in the concentration factor and, therefore, the pre-existing back-ground water quality. Even when capillary rise is ignored the regulator is faced with the problem of solving one equation with three unknowns. For all these reasons, the use of Eq. [2] in Tier 2 cannot be scientifically defended; it is incorrect.

Tier 2 also depends on Figure 21 of Ayers and Westcott (1994) as adapted from Rhoades (1977) (J.D., 1977) and Oster & Schroer (1979) (Oster and Schroer, 1979) that estimate how salinity (EC) and sodium adsorption ratio (SAR) affect the relative rate of water infiltration. This figure is known as the "Hanson" diagram to the Council. Use of this figure has resulted in protecting the infiltration capabilities of the soils in ephemeral drainages but its use has little impact on root zone soil water salinity. The latter factor depends on soil type, climate, ground water table depth, and irrigation management as discussed in the previous sections.

Dr. Vance has expressed concern about using Figure 21 of Ayers and Westcott (1994) to assess how the relative infiltration rate of soils with smectitic clays is affected. Since these clays have low infiltration rates under the best conditions, a relative decrease will have much more impact on soil salinization than a relative decrease in soils with higher infiltration rates. The validity of Figure 21 for soils containing smectitic clays should be further explored.

Soil Testing Procedure for Unbiased Determination of Soil EC and SAR

Different testimonies referred to different procedures of soil sampling in the ephemeral drainages. The experts did not agree on one most optimal method for salinity surveys in the drainages. None referred to the new salinity monitoring approach that is increasingly used all over the world: this approach is based on a continuous survey of the entire area using electromagnetic induction followed by soil coring at selected validation sites.

Experts' Opinion. In the previous section we explained that the prediction of pre-existing back-ground water quality in the drainage using soil salinity samples is scientifically not correct. Yet, for the management of CBM waters on artificially and naturally irrigated lands it will be necessary to conduct salinity surveys that result in reliable soil salinity maps.

The proposed procedure in Appendix H section c(vi)(B) for determining EC and SAR is ambiguous since samples are taken at semi-random sites meaning that within specific terrain zones soils will be randomly sampled. The term *terrain zone* is not defined in any way and could be interpreted to mean a number of different landscape characteristics. The examples given range from units identified by landscape characteristics (channel bottom, first terrace, etc) and land use characteristics (sub and non-sub irrigated reaches). Another issue is the proposed number of required soil sample sites (from 3 to 7 depending on acreage) that would make it very difficult to characterize the soil landscape or to evaluate the natural variation of soil properties. Use of the proposed procedure by different capable soil scientists would yield different salinity maps and cause a challenge for the regulatory agencies. Therefore, we recommend the use of a continuous high-

density survey method based on electromagnetic induction that will leave no ambiguity in the final soil salinity map and is transparent for all stakeholders.

Currently, three basic procedures are available for the measurement of soil salinity: (i) soil extraction for measurement of the soil salinity as grams of salt over grams of dry soil, (ii) soil water extraction for measurement of the soil water salinity as grams of salt over grams of water, and (iii) indirect measurement of the soil water salinity by measuring the apparent electrical conductivity of the soil. Since soil extraction and soil water extraction methods are time consuming and expensive, faster indirect methods for measurement of soil salinity have been developed. These methods measure the apparent soil electrical conductivity and need a calibration function for determination of the salinity of soil water (Hendrickx and Kachanoski, 2002).

Electrical conductivity methods have been used for several decades (Rhoades and Halvorson, 1977; Rhoades and Oster, 1986; Rhoades et al., 1976) but advances in equipment, computers, and Global Positioning Systems have all come together now into a system that allows the measurement of soil apparent electrical conductivity at a reasonable cost (Hendrickx and Kachanoski, 2002). Of special interest is the electromagnetic induction method since it doesn't require contact with the soil (McNeill, 1980) and allows for quick and reliable measurements either on foot in difficult terrain (Hendrickx et al., 1997; Hendrickx et al., 1992; Sheets and Hendrickx, 1995) or on a vehicle in flat agricultural lands (Corwin and Lesch, 2003) (Figure 3). The method has been successfully used for the detection of produced oil-and-gas waters in the arid vadose zones of New Mexico (Hendrickx, 2003; Hendrickx et al., 1994; Hendrickx et al., 2005b). Often the electromagnetic induction (EMI) measurements alone are sufficient to prepare maps of soil salinity. Taking measurements at different heights above the soil surface and using inverse methods, it is even possible to determine the depth profile of apparent soil electrical conductivity (Borchers et al., 1997; Hendrickx et al., 2002). However, for regulatory purposes or for the management of lands irrigated with challenging water qualities it is necessary to relate the EMI measurements to EC and/or SAR. Therefore, the U.S. Salinity Laboratory in Riverside CA has developed a software

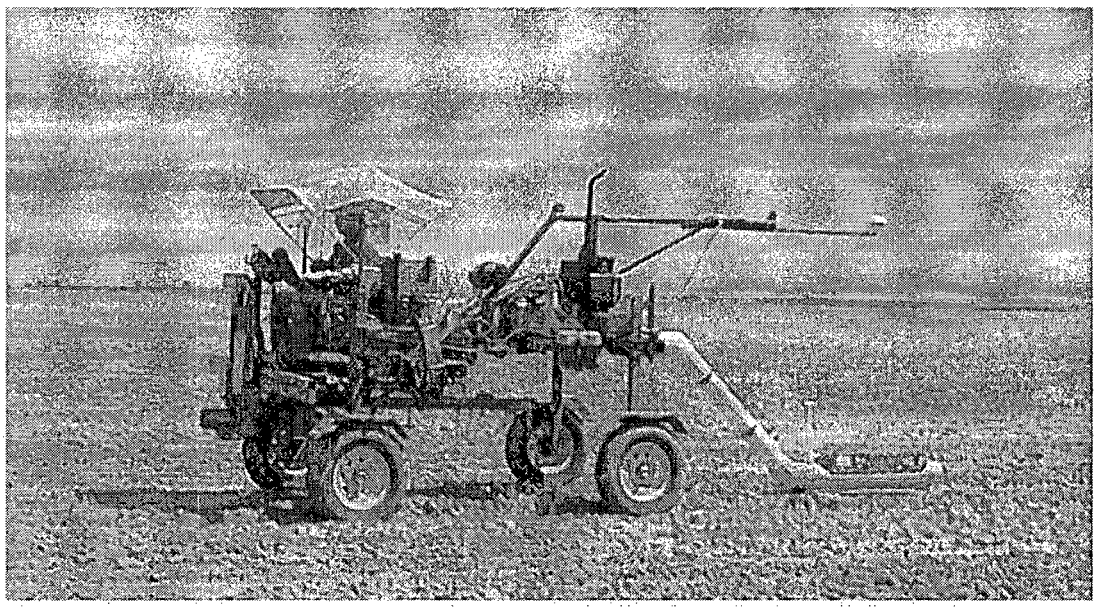


Figure 3. Mobile dual-dipole electromagnetic induction equipment for the continuous measurement of apparent soil electrical conductivity (Corwin and Lesch, 2003).

package, ESAP-95, to select optimal sites for calibration of the relationship between the apparent soil electrical conductivity measured with EMI and the EC of the soil water at different depths measured in the laboratory (Lesch et al., 2000). The soil samples can be easily taken with a soil coring device in the back of a 1-ton pickup with a 2-inch diameter device that can go down 4 to 6 feet or deeper if soil conditions permit. The theoretical background of ESAP-95 is presented by Lesch and his colleagues (Lesch et al., 1995a; Lesch et al., 1995b). Several applications of this software have been reported in the scientific literature (Amezketa, 2007; Amezketa and Lersundi, 2008; Corwin and Lesch, 2003; Corwin et al., 2006) as well as by consulting companies[7].

Managed and Unmanaged Irrigation with CBM Waters

In several testimonies reference was made to unmanaged and managed irrigation. Mr. Harvey summarizes best the management aspect of Tier 2: "The Tier 2 process ... is meant to derive conservative limits for unmanaged irrigation after discharge to the channel" while Chairman Boal expresses succinctly the idea on which Tier 2 is based:

[7] Soil and Water West, Inc. personal communication March 2009.

"Tier 2 is the option that if we know the water quality, the background water quality, then the discharge can be no worse than the known".

The testimony of landowners typically refers to water quantity rather than water quality. Ms. West states: "We have as much water as we want, and way more water than we want. ... We have had a great deal of flooding. We have lost 80 acres of prime hay meadow. ... Please do not implement this Tier 2". Ms. Barlow states: "In 2003 a large reservoir above my property contained CBM water, upper flowed and flooded the bottomland of my property for three months. ... The carpet of native grass was replaced for the first three years by bare soils, and now there is a few unpalatable weeds". Mr. Swartz quantifies: "June 2008 they dumped water at 102 to 136 cubic feet per second. ... DEQ likes to say ... We are not concerned with quantity. We're only concerned with quality. State engineer says we aren't concerned with quality, we're only concerned with quantity. And I'm getting the runaround and I don't like it". These statements confirm Dr. Munn's observation "In many cases, you're are going from ephemeral to a perennial flowing system".

Landowners who don't have to deal with damage by flooding are quite positive. Mr. Brug states: "I'd like to see the regulations surely not get any stiffer, because if it was, some of these instances I wouldn't be able to use more water". Mr. Litton observes: "We've got eight miles of bottomlands, which we hayed at one time. We don't anymore. But it has some methane water running the length of it, and spreads out for some places a quarter of a mile wide. And yet over this past seven years that we've been letting water on there, we still see no signs of salt showing up. Just a point of the quality of water that we have". Ms. Faye Mackey testifies: "I'm here to speak not only for my ranch, but the 581,250 acres, landowners represented here on the map in blue. ... These ranches use our water beneficially for our livestock, wildlife habitat, irrigation, and even some domestic water. ... There is no waste of water here. ... This water, and my ability to direct its use on my ranch, is essential to my current agriculture operation. ... There's no one-size-fits-all solution. We, as ranchers, know our soil types. We look at whether we can irrigate on a mister or pivot system, and industry has been very helpful in this, testing the soils and ...

taking water samples at different intervals ... There have been studies by industry in these areas of irrigation that the native grass is approximately five times thicker with CBM produced water than without the application of this water. Mr. Eitel's opinion: "If you set up real stringent rules, that one-size-fits-all, it just doesn't work in our area". Mr. Shepperson states: "I am in favor, as a landowner, of your Tier 2 regs. ... There's so much variability in the sites, ...So the variabilities of sites, you've got to have the flexibility to deal with these things site by site. And keep that in the regs, please. ... keep the negotiations between the landowner and industry open. Allow for that. Let us negotiate with industry on our ranches, but, boy, keep your oversight, too, on your rules".

Experts' Opinion. Several landowners clearly have suffered flood damage by unmanaged releases of CBM water and not recognizing the duration and volume of CBM waters to be received. Although these issues are serious, they can be resolved by proper engineering of CBM water release infrastructure and by developing management plans for the use of CBM water on artificially and naturally irrigated lands. As a matter of fact, the landowners who are enthusiastic about receiving CBM waters express a common concern against stiffer regulations that would prevent them to manage their CBM water in a flexible manner adapting to the natural variability of their ranches.

The amount of CBM water in Wyoming and other states is very large. For example, the Bureau of Land Management forecasts 51,000 wells in the Powder River Basin operating and producing gas and water by 2010. These 51,000 wells are expected to produce nearly 700 million gallons of CBM water per day[8]. These water supplies are sufficient to irrigate about 75,000 acres. However, to realize the potential benefits of CBM water it is necessary to manage both water quality and water quantity on the artificially and naturally irrigated lands receiving this water. There is general agreement that beneficial use of marginal waters for irrigation is possible if principles and strategies of salinity management are considered at on-farm and project-levels (Ayers and Westcot, 1994; Rhoades, 1999; Tanji, 1997). Mr. Harvey has presented some nice examples how marginal water can be made productive in Wyoming on managed irrigated lands.

[8] Petition 05-3102 before Wyoming Environmental Quality Council by the Wyoming Outdoor Council.

The most beneficial use of CBM waters can only be realized by managed irrigation taking into account both the quality and quantity of the produced waters. Managed irrigation needs to balance the supply from the CBM wells with the crop water requirements during the year taking into account quality and quantity of the produced waters. This will be a great challenge for engineers in the petroleum industry, landowners, soil and water resource consultants, researchers at the University of Wyoming, and regulators at DEQ. However, the hearings have shown that a large pool of dedicated professionals is ready to face this challenge. Given the broad range of experiences with existing use of produced waters in Wyoming, progress with irrigation management plans and regulations shouldn't take too long.

5. EXPERT SCIENTIFIC OPINIONS

In Chapter 2 expert scientific opinions are requested on two questions A and B. In this chapter we will respond to these questions and formulate a short opinion on the way forward that we consider relevant for the policy contained in Chapter 1, Section 20 of the AUPP.

Question A. Whether the Tier 2 methodology as set forth in Appendix H section c(vi)(B) is reasonable and scientifically valid for determining the EC and SAR of water that can be discharged into an ephemeral drainage in Wyoming so that degradation of the receiving water will not be of such an extent to cause a measurable decrease in crop production.

Scientific Expert Opinion A. The Tier 2 methodology as set forth in Appendix H section c(vi)(B) is not reasonable nor scientifically valid for determining the EC and SAR of water that can be discharged into an ephemeral drainage in Wyoming so that degradation of the receiving water will not be of such an extent to cause a measurable decrease in crop production.

Clarification A. Tier 2 is based on the option that if the background water quality in an ephemeral drainage is known, the quality of the discharge of CBM produced water can be no worse. Tier 2 is based on the erroneous belief that a measurable decrease in crop production only will occur if the quality of the discharge of CBM produced water is worse than the background water quality. In Chapter 3, we have explained that root zone soil salinity does not depend directly on the quality of the irrigation water; it depends on soil characteristics, climate, depth of ground water table, and more importantly irrigation management. The scientific literature provides examples where marginal irrigation water is successfully used for crop production.

Question B. Whether the method set forth in Appendix H section c(vi)(B) for determining EC and SAR for permitting the discharge of produced water is reasonable, sufficiently defined and scientifically defensible for the conditions in

Wyoming, and provides a uniform testing procedure that is reasonably accurate and unbiased for the determination of soil EC from which you can reasonably infer the quality of the water EC and SAR that historically flowed within the drainage that will support the establishment of effluent limits for discharge permits in a given drainage that will not cause a measurable decrease in crop production.

Scientific Expert Opinion B. The method set forth in Appendix H section c(vi)(B) for determining EC and SAR for permitting the discharge of produced water is not reasonable nor sufficiently defined nor scientifically defensible for the conditions in Wyoming. It does not provide a uniform testing procedure that is reasonably accurate and unbiased for the determination of soil EC from which you can reasonably infer the quality of the water EC and SAR that historically flowed within the drainage that will support the establishment of effluent limits for discharge permits in a given drainage that will not cause a measurable decrease in crop production.

Clarification B. See first Clarification A. As explained in Chapter 4 the proposed soil testing procedure would result in ambiguous soil maps. We refer to the recent science literature how an accurate soil salinity map can be made without spending too much.

Scientific Expert Opinion on Way Forward. Since it is not scientifically defensible to use Tier 2, the question is how to move forward. The use of Tier 1 can be continued since it is conservative and has been accepted by the community. Of course, as explained in Chapter 3 using Tier 1 CBM water can still result in increased soil salinity and reduced crop yields if not managed well. The latter aspect is of special importance when the quantity of available water is substantial. Current research in Wyoming and surrounding states may result in a relaxation of the crop threshold values that are currently based on California conditions. Mr. Harvey's testimony suggests that these threshold values may be too strict for Wyoming conditions.

If the water quality requirements of Tier 1 cannot be met, the Irrigation Waiver seems the preferred alternative since it requires an irrigation management plan that provides reasonable assurance that the lower quality water will be confined to the targeted lands. In this manner, the Irrigation Waiver will deal with the issue of water quantity. Given the large scale on which CBM water is produced it seems justifiable to implement an aggressive applied and basic research program to develop guidelines on how to use CBM water in a beneficial manner.

6. REFERENCES

Amezketa, E. 2007. Soil salinity assessment using directed soil sampling from a geophysical survey with electromagnetic technology: a case study Spanish Journal of Agricultural Research 5:91-101.

Amezketa, E., and J.D.V.d. Lersundi. 2008. Soil classification and salinity mapping for determining restoration potential of cropped riparian areas. Land Degradation & Development 19:153 - 164.

Ayers, R.S., and D.W. Westcot. 1994. Water quality for agriculture, Rome, Italy.

Borchers, B., T. Uram, and J.M.H. Hendrickx. 1997. Tikhonov regularization for determination of depth profiles of electrical conductivity using non-invasive lectromagnetic induction measurements. Soil Science Society of America Journal 61:1004-1009.

Bresler, E., B.L. McNeal, and D.L. Carter. 1982. Saline and sodic soils. Principles-dynamics-modeling. Springer-Verlag, New York.

Caplan, T.R., B.D. Musslewhite, B.A. Buchanan, and J.M.H. Hendrickx. 2001. Reclaiming sodic soils following saltcedar removal on the Pueblo of Santa Ana, New Mexico. Land Reclamation - A Different Approach. American Society for Surface Mining and Reclamation, Albuquerque, New Mexico.

Carter, D.L., and C.W. Robbins. 1978. Salt Outflows from New and Old Irrigated Lands. Soil Sci Soc Am J 42:627-632.

Corwin, D.L., and S.M. Lesch. 2003. Application of soil electrical conductivity to precision agriculture: theory, principles, and guidelines. Agron. J. 95:455-471.

Corwin, D.L., S.M. Lesch, J.D. Oster, and S.R. Kaffka. 2006. Monitoring management-induced spatio-temporal changes in soil quality through soil sampling directed by apparent electrical conductivity. Geoderma 131:369-387.

Darwish, T., T. Atallah, M.E. Moujabber, and N. Khatib. 2005. Salinity evolution and crop response to secondary soil salinity in two agro-climatic zones in Lebanon. Agric. Water Managem. 78:152-164.

Eppes, M.C., and J.B.J. Harrison. 2003. Water flow through a basalt flow in southern New Mexico, p. 174-177, *In* I. Simmers, ed. Understanding water in a dry environment. Hydrological processes in arid and semi-arid zones, Vol. 23. A.A. Balkema Publishers, Lisse, The Netherlands.

Ganjegunte, G.K., G.F. Vance, and L.A. King. 2005. Soil chemical changes resulting from irrigation with water co-produced with coalbed natural gas J. Environ. Qual. 34:2217-2227.

Gonçalves, R.A.B., M.V. Folegatti, T.V. Gloaguen, P.L. Libardi, C.R. Montes, Y. Lucas, C.T.S. Dias, and A.J. Melfi. 2007. Hydraulic conductivity of a soil irrigated with treated sewage effluent. Geoderma 139:241-248.

Hanson, B., S.R. Grattan, and A. Fulton. 2006. Agricultural salinity and drainage Cooperative Extension, Department of Land, Air and Water Resources, University of California, Davis, Davis, CA.

Heilweil, V.M., and D.K. Solomon. 2004. Millimeter- to kilometer scale variations in vadose-zone bedrock solutes: implications for estimating recharge in arid settings,

p. 49-68, *In* J. F. Hogan, et al., eds. Groundwater recharge in a desert environment. The Southwestern United States, Vol. Water Science and Application 9. American Geophysical Union, Washington, DC.

Hendrickx, J.M.H. 2003. Electromagnetic induction for delineation of brine affected soil volumes. Rice Operating Company, Hobbs, New Mexico.

Hendrickx, J.M.H., and G. Walker. 1997. Chapter 2 Recharge from precipitation, p. 19-114, *In* I. Simmers, ed. Recharge of phreatic aquifers in (semi)-arid areas. Balkema, Rotterdam, The Netherlands.

Hendrickx, J.M.H., and R.G. Kachanoski. 2002. Nonintrusive electromagnetic induction, p. 1301-1310, *In* J. Dane and C. Topp, eds. Methods of soil analysis. Part 1. Soil Science Society of America Madison, Wisconsin.

Hendrickx, J.M.H., F.M. Phillips, and J.B.J. Harrison. 2003. Chapter 5. Water flow processes in arid and semi-arid vadose zones, p. 151-210, *In* I. Simmers, ed. Understanding water in a dry environment. Hydrological processes in arid and semi-arid zones, Vol. 23. A.A. Balkema Publishers, Lisse, The Netherlands.

Hendrickx, J.M.H., C.D. Grande, B.A. Buchanan, and R.E. Bretz. 1994. Electromagnetic induction for restoration of saline environments in New Mexico. Chapter 13. , p. 247-265, *In* R. K. Bhada, et al., eds. Waste-management: From Risk to Remediation, Vol. 1. ECM Press, Albuquerque, New Mexico.

Hendrickx, J.M.H., J. Beekman, R. Koch, and G. Rodriguez-Marin. 1997. Salinity survey for revegetation potential along the Rio Grande in the Paso Del Norte region. El Paso Field Division of U.S. Bureau of Reclamation, El Paso.

Hendrickx, J.M.H., G. Rodríguez-Marín, R.T. Hicks, and J. Simunek. 2005a. Modeling study of produced water release scenarios. API Publication Number 4734. American Petroleum Institute Publishing Services, Washington D.C.

Hendrickx, J.M.H., B. Baerends, Z.I. Raza, M. Sadiq, and M.A. Chaudhry. 1992. Soil salinity assessment by electromagnetic induction on irrigated land. Soil Sci. Soc. Am. J. 56:1933-1941.

Hendrickx, J.M.H., B. Borchers, D.L. Corwin, S.M. Lesch, A.C. Hilgendorf, and J. Schlue. 2002. Inversion of soil conductivity profiles from electromagnetic induction measurements: theory and experimental verification. Soil Science Society of America Journal 66:673-685.

Hendrickx, J.M.H., B. Borchers, S.-h. Hong, J.B.J. Harrison, L.M. Hall, R.S. Bowman, and R.L. Van Dam. 2005b. Electromagnetic induction for environmental restoration and hydrological characterization. Fast Times 10:35.

Hillel, D. 1998. Environmental soil physics Academic Press, San Diego, CA.

Hoffman, G.J., and D.S. Durnford. 1999. Drainage design for salinity control., p. 579-614, *In* R. W. Skaggs and J. V. Schilfgaarde, eds. Agronomy Series 38. Agricultural Drainage.

Hogan, J.F., F.M. Phillips, S.K. Mills, J.M.H. Hendrickx, J. Ruiz, J.T. Chesley, and Y. Asmerom. 2007. Geologic origins of salinization in a semi-arid river: the role of sedimentary basin brines. Geology 35:1063-1066 doi: 10.1130/G23976A.1.

Hong, S. 2002. Soil salinity in arid non-flooded riparian areas. M.S. Thesis, New Mexico Tech, Socorro NM.

J.D., R. 1977. Potential for using saline agricultural drainage waters for irrigation. , pp. 85-116 Water Management for Irrigation and Drainage. ASCE, Reno, Nevada.

Johnston, C.D. 1987. Preferred water flow and localised recharge in a variable regolith. . J. Hydrol. Engrg. 94:129-142.

Jolly, I.D., G.R. Walker, and P.J. Thorburn. 1993. Salt accumulation in semi-arid floodplain soils with implications for forest health. Journal of Hydrol. 150:589-614.

Keren, R. 2000. Salinity, p. G3-G25, *In* M. E. Sumner, ed. Handbook of soil science. CRC Press, Boca Raton.

Lesch, S.M., D.J. Strauss, and J.D. Rhoades. 1995a. Spatial prediction of soil salinity using electromagnetic induction techniques: 1. Statistical prediction models: A comparison of multiple linear regression and cokriging. WATER RESOURCES RESEARCH 31:373-386.

Lesch, S.M., D.J. Strauss, and J.D. Rhoades. 1995b. Spatial prediction of soil salinity using electromagnetic induction techniques: 2. An efficient spatial sampling algorithm suitable for multiple linear regression model identification and estimation. WATER RESOURCES RESEARCH 31:3387-398.

Lesch, S.M., J.D. Rhoades, and D.L. Corwin. 2000. The ESAP-95 version 2.01R user manual and tutorial guide. Research Report No. 146. , . USDA-ARS, George E. Brown, Jr., Salinity Laboratory, Riverside, California.

McNeill, J.D. 1980. Electromagnetic terrain conductivity measurement at low induction numbers. Tech. Note TN-6 Geonics Ltd., Ontario, Canada.

Mills, S. 2003. Quantifying salinization of the Rio Grande using environmental tracers, New Mexico Tech, Socorro, NM.

Moayyad, B., S.A. Bawazir, J.P. King, S. Hong, and J.M.H. Hendrickx. 2003. Groundwater depth and arid zone riparian evapotranspiration, p. 188-195, *In* I. Simmers, ed. Understanding water in a dry environment. Hydrological processes in arid and semi-arid zones, Vol. 23. A.A. Balkema Publishers, Lisse, The Netherlands.

Oster, J.D., and F.W. Schroer. 1979. Infiltration as influenced by irrigation water quality. Soil Sci. Soc. Amer. J. 43:444-447.

Phillips, F.M., J. Hogan, S. Mills, and J.M.M. Hendrickx. 2003. Environmental tracers applied to quantifying causes of salinity in arid-region rivers: Preliminary results from the Rio Grande, southwestern USA, p. 327-334, *In* A. S. Alsharhan and W. W. Wood, eds. Water Resource Perspectives: Evaluation, Management, and Policy. Elsevier Science, Amsterdam.

Rhoades, J.D. 1999. Use of saline drainage water for irrigation, p. 615-657, *In* R. W. Skaggs and J. V. Schilfgaarde, eds. Agronomy Series 38. Agricultural Drainage.

Rhoades, J.D., and A.D. Halvorson. 1977. Electrical conductivity methods for detecting and delineating saline seeps and measuring salinity in Northern Great Plains soils. ARS W-42. USDA-ARS Western Region, Berkeley, CA.

Rhoades, J.D., and J.D. Oster. 1986. Solute content. , p. 985-1006, *In* A. Klute, ed. Methods of soil analysis. Part 1. 2nd ed. SSSA and ASA, Madison, WI.

Rhoades, J.D., P.A.C. Raats, and R.J. Prather. 1976. Effects of liquid-phase electrical conductivity, water content and surface conductivity on bulk soil electrical conductivity. Soil Sci. Soc. Am. J. 40:651-655.

Rhoades, J.D., R.D. Ingvalson, J.M. Tucker, and M. Clark. 1973. Salts in Irrigation Drainage Waters: I. Effects of Irrigation Water Composition, Leaching Fraction,

and Time of Year on the Salt Compositions of Irrigation Drainage Waters. Soil Sci Soc Am J 37:770-774.

Rhoades, J.D., J.D. Oster, R.D. Ingvalson, J.M. Tucker, and M. Clark. 1974. Minimizing the Salt Burdens of Irrigation Drainage Waters. J Environ Qual 3:311-316.

Rose, C. 2004. An introduction to the environmental physics of soil, water and watersheds Cambridge University Press, Cambridge, U.K.

Scanlon, B.R. 1991. Evaluation of moisture flux from chloride data in desert soils. J. of Hydrology 128:137-156.

Scanlon, B.R. 1992. Moisture and solute flux along preferred pathways characterized by fissured sediments in desert soils. J. Contam. Hydrol. 10:19-46.

Sheets, K.R., and J.M.H. Hendrickx. 1995. Non-invasive soil water content measurement using electromagnetic induction. WATER RESOURCES RESEARCH 31:2401-2409.

Sheets, K.R., J.P. Taylor, and J.M.H. Hendrickx. 1994. Rapid salinity mapping by electromagnetic induction for determining riparian restoration potential. Restoration Ecology 2:242-246.

Šimůnek, J., M. Šejna, H. Saito, M. Sakai, and M.T.v. Genuchten. 2008. The HYDRUS-1D Software Package for Simulating the Movement of Water, Heat, and Multiple Solutes in Variably Saturated Media, Version 4.0, HYDRUS Software Series 3 Department of Environmental Sciences, University of California Riverside Riverside, California, USA.

Soil Science Glossary Terms Committee. 2008. Glossary of soil science terms 2008 Soil Science Society of America, Madison, WI.

Stephanie J. Moore, R.L.B.B.L.C.P.W.D.D. 2008. Geochemical Tracers to Evaluate Hydrogeologic Controls on River Salinization. Ground Water 46:489-501.

Stephens, D.B. 1995. Vadose zone hydrology CRC Press, Boca Raton, FL.

Tanji, K.K. 1997. Irrigation with Marginal Quality Waters: Issues. Journal of Irrigation and Drainage Engineering 123:165-169.

Van Hylckama, T.E. 1974. Water use by Salt Cedar as measured by the water budget method., Washington DC.

Walker, G.R., I.D. Jolly, and P.G. Cook. 1991. A new chloride leaching approach to the estimation of diffuse recharge following a change in land use. J. of Hydrology 128:49-67.

Weeks, E.P., H.L. Weaver, G.S. Campbell, and B.D. Tanner. 1987. Water use by Salt Cedar and by replacement vegetation in Pecos River floodplain between Acme and Artesia, New Mexico. USGS Paper 491-G:G1-33.

ENCOURAGING RESPONSIBLE DEVELOPMENT TODAY ~ FOR TOMORROW

934 N. MAIN ST. SHERIDAN, WY 82801 (307) 672-5809 FAX (307) 672-5800
INFO@POWDERRIVERBASIN.ORG WWW.POWDERRIVERBASIN.ORG

POWDER RIVER BASIN
Resource Council

November 4, 2008

Michael Lesar
Chief, Rulemaking, Directives and Editing Branch
U.S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, DC 20555-0001
NRCREP.Resource@nrc.gov

RE: Draft Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities, NUREG-1910

Dear Mr. Lesar,

Thank you for the opportunity to submit comments on the draft Generic Environmental Impact Statement (GEIS) for In-Situ Leach (ISL) Uranium Milling Facilities. We appreciate the opportunity to participate in this process. These comments are submitted on behalf of our organization and behalf of our members who live, work, and/or recreate in areas impacted by current and proposed uranium mining.

The Powder River Basin Resource Council is a grassroots Wyoming organization that promotes responsible extraction and use of our state's abundant mineral resources. Most of our approximately 1,000 members are rural landowners in Wyoming and many of them will be impacted by uranium exploration and production. We have participated in the GEIS since the beginning and plan to participate in future licensing activities, including NEPA reviews, for ISL projects in Wyoming.

In the pages below, we present comments on a number of different impact areas. Although we believe NRC must consider these topics in this over-arching "generic" document, to the extent that NRC determines that the issues brought up in this letter are better addressed at the site-specific level, please consider these comments scoping comments for future NEPA documents for Wyoming projects. We have been disappointed by past NRC NEPA documents for ISL projects, and we hope the level of analysis will be improved in the future.

In short, based on the reasons presented below we believe this Draft GEIS needs to be substantially improved and re-circulated for public comment.[1]

[1] In addition to our comments, it appears from the NRC's docket that numerous organizations, including the National Mining Association, Department of Energy, Department of the Interior, and state governments have also

1. **<u>The GEIS does not have a purpose and scope compliant with NEPA.</u>**

During the public meetings for the draft GEIS, the NRC claimed that the GEIS is not really a "generic" document, but is really a "programmatic" document. We disagree – the GEIS is in fact "generic" and in no way meets the requirements for programmatic analysis. In general, programmatic NEPA documents present a reasonably foreseeable development scenario (RFD scenario). A RFD scenario is a long-term projection of exploratory activities, development, production, and reclamation activity in a defined area for a specified period of time. This scenario allows agencies to properly analyze and plan for projected environmental and socio-economic impacts at site-specific and programmatic levels. Instead of identifying a scope of analysis similar to a RFD scenario, NRC chose to analyze impacts of ISL projects in the abstract. NRC has not provided information to the public in the GEIS specifying a projected number of projects, well fields, evaporation ponds, access roads, processing centers, exploration wells – the list goes on. In other words, the public, or in fact the agency itself, has no idea of the true extent of impacts that will actually occur from this programmatic action.[2] Responding to such an abstract statement through the public comment process is, to say the very least, difficult. As a recent editorial in the *Buffalo Bulletin* pointed out, "It's tough to comment on uranium mining as a general practice and supply any useful feedback."

We believe that a true programmatic EIS is required in this case. NRC's individual licensing activities for ISL projects in the four identified geographic areas should not be viewed in isolation. The combined and cumulative impacts of licensing 20-30 new ISL projects will be significant and must be disclosed in a programmatic document. CEQ regulations require "cumulative" actions to be considered in a single EIS, particularly when actions "have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography."40 C.F.R. § 1508.25. Federal Courts have affirmed this requirement: "In many ways, a programmatic EIS is superior to a limited, [project]-specific EIS because it examines an entire policy initiative rather than performing a piecemeal analysis within the structure of a single agency action." *Northcoast Envtl. Ctr. v. Glickman,* 136 F.3d 660, 668 (9th Cir. 1998), quoting *Ass'n of Pub. Agency Customers v. Bonneville Power Administration,* 126 F.3d 1158, 1184 (9th Cir. 1997).[3] Many of the individual licensing actions will occur within a short time period and will be in close geographic proximity to each other. Therefore, the actions will create cumulative impacts that should be considered in a programmatic document. This is essential so that NRC can consider management alternatives commensurate with the context and intensity of impacts and, accordingly, consider and, if necessary, adopt management alternatives that would reduce such impacts to acceptable levels. All of this proper NEPA analysis must be done *prior to* "any irreversible and irretrievable commitments of resources

---

submitted detailed comments. Considering all of these comments – and the extensive revision to the DGEIS that they call for – we believe NRC must revise and re-circulate the DGEIS for public comment.

[2] Based on NRC documents and statements, the "programmatic" action in Wyoming could be anywhere from 12-30 new ISL projects of varying size, and that is just in the next few years. As discussed below, the NRC neither analyzes the impacts of this programmatic action nor analyzes cumulative impacts of this programmatic action linked with other development in Wyoming.

[3] *See also Kleppe v. Sierra Club*, 427 U.S. 390, 410 (U.S. 1976) (where several proposals that "will have cumulative or synergistic environmental impact upon a region are pending concurrently before an agency, their environmental consequences must be considered together").

which would be involved in the proposed action should it be implemented." 42 U.S.C. § 4332(2)(C)(v).

During a public comment period at the Newcastle meeting, our organization asked the NRC to change the GEIS to four separate programmatic EISs that will allow for greater analysis of information specific to the four geographic regions NRC has chosen to focus on. This approach would also allow greater public involvement from individuals, organizations, and other stakeholders interested in uranium mining in their region. We hope the NRC seriously considers this approach as a way to both meet the efficiency needs of the agency and the requirements of NEPA. Even a single programmatic EIS covering all four geographic regions would be preferred to an abstract document like the GEIS.

On the other hand, if this document remains "generic," its usefulness in future NEPA analysis will be significantly curtailed. Although NEPA does allow "generic" environmental impact statements,[4] these statements are *only* appropriate for analyzing impacts that will be *identical* or, as the NRC has identified, "common." As discussed in detail below, it is extremely difficult, if not impossible, for the public to determine what the "common" elements are that can be appropriately incorporated by reference into site-specific analyses. It would be better, and perhaps more efficient in the long run, to explicitly limit this "generic" document to the "common" elements so the agency, the public, and other stakeholders will know what can and cannot be tiered to future NEPA documents.

Additionally, the "generic" approach of this document appears to preclude NRC from discussing the purpose and need for the federal action analyzed by this NEPA document. NRC chose not to analyze or disclose the purpose or need for new uranium mines in the western U.S. and said that this need would instead be addressed at the site-specific level.[5] If this document is meant to be a "programmatic" document, it must disclose the need for a programmatic action (which, again if this document was a programmatic document, would presumably be a large expansion of uranium mining and milling in the four geographic areas identified in the GEIS). The NRC needs to give an overview of expected new nuclear power facilities in the United States and globally and discuss current stockpiles of uranium and reserves at existing mines to determine whether new mines are needed. The NRC needs to discuss export and import requirements for uranium and whether or not uranium mined from these new ISL projects will be used for domestic supply. In other words, the NRC needs to disclose what the need for this federal action really is.

Another concern with this "generic" approach is there is no clear way of determining when a supplemental environmental impact statement (SEIS) will be needed. A SEIS is required if "[t]here are substantial changes in the proposed action that are relevant to environmental concerns." 10 C.F.R. § 51.72. How will the public, the agency, or other stakeholders know if substantial changes have been made because the "proposed action" is undefined?

Furthermore, what will happen if new ISL projects are outside the geographic boxes of analysis? Can these projects be appropriately tiered to the GEIS? John Hall of the NRC said at the public

---

[4] *See* 40 C.F.R. § 1502.4(c)(2); this regulation is discussed on page 1-24 of the GEIS.

[5] Numerous scoping comments called for this analysis, but the NRC determined that this analysis was not relevant to the GEIS. *See* NRC response to scoping comments.

meeting in Casper that the "boundaries [for the four areas] were arbitrarily drawn" and "if [the project] is close, [it] will be considered in that region." The first question that comes from that statement is why the NRC chose to act arbitrarily. The more complex question is why there is not more disclosure in the GEIS of the true scope of the document and how new ISL projects will fit into (or not fit into) the analysis. [6] Perhaps the NRC needs to put a sunset provision on this document, which would require a future review to determine if it is being used in a manner compliant with NEPA. At the very least, NRC needs to clearly state how site-specific NEPA analysis will or will not be tiered to the GEIS. This is important not only for the public, but for the agency itself and other federal and state agencies that may rely on the GEIS for analysis of environmental and public health impacts of ISL uranium mining.

2. **The NRC does not disclose the significance of impacts in a manner compliant with NEPA.**

Throughout the GEIS, the NRC characterizes impacts as "small" "moderate" and "large." The GEIS must disclose what impacts are significant, which is the legal trigger for an environmental impact statement under NEPA. For instance, will "moderate" impacts be deemed to be significant? What impacts will require the preparation of a site-specific EIS? After quoting the appropriate CEQ regulation on significance on pg. 1-6, NRC then chooses to avoid the analysis this regulation calls for; how will NRC determine what impacts are significant (either at this larger programmatic level or the site-specific level) in a manner compliant with NEPA? NRC needs to fully disclose the methodology it has used to determine the *significance* of impacts.

Additionally, NRC parses off impacts by the stage of the project and is thus not analyzing impacts in a way that will consider the overall impacts of an entire ISL project. The question NRC must answer is whether impacts of licensing the project, e.g. the federal action taken, will be significant. Impacts at various stages of the project can combine to be significant. It is ok to look at impacts at the various stages of a project to facilitate incorporation by reference in site-specific documents, but NRC must look at the whole process to determine significance of impacts. This is particularly important given the NRC's statement that "well fields are developed in sequence, and at any one time, different well fields are likely to be in different stages of construction, operation, aquifer restoration, and decommissioning/reclamation." GEIS at 2-10.

3. **The GEIS does not address the true risk of ISL Facilities & NRC's inability to mitigate, monitor, and enforce.**

The uranium companies claim the ISL process is "benign" and yet the track record of these operations is not comforting to the public. In July, the Wyoming Department of Environmental Quality and Power Resources (dba Cameco) entered into a $1.4 million settlement agreement stemming from a notice of violation issued for a "number of major long-standing environmental concerns," including delayed water restoration, insufficient bonding, and spills and underground excursions of fluids used in the mining process.[7] Even after Cameco was issued this substantial

[6] The GEIS says that "the applicability of the Draft GEIS would depend on the similarities of the proposed site and regional conditions with those described in the Draft GEIS." GEIS at 3.1-6

[7] *See* Wyoming Department of Environmental Quality Land Quality Division Settlement Agreement and related Investigation Report, *available at* http://deq.state.wy.us/out/LQenforcementactions.htm.

fine by the state, the company still experiences frequent environmental problems, including spills and excursions. (See correspondence attached to these comments documenting spills and excursions since July 2008). As evidence of the level of problems at the Smith Ranch-Highland facilities, Cameco has a "Spill Committee" which meets monthly to discuss regularly occurring spills and preventative measures that should be taken. For an operation that is over twenty years old, it seems odd that regular problems still occur. Clearly, in-situ uranium mining is not an exact science and rarely happens as planned.

As a result of this questionable activity, many members of the public have reasonably concluded they cannot trust characterizations from an industry that stands to financially benefit from these projects. At the very least, the public needs to be assured that regulatory bodies, such as the NRC, can handle the boom and appropriately monitor and enforce these operations. However, from its outset, the GEIS has been billed as a way to streamline the permitting process because the NRC is short-staffed and unable to do a full EIS for each project. This is very concerning to members of our organization. The NRC needs to find the qualified staff to oversee these projects – both for permitting and enforcement. Otherwise, the public will be at risk from these projects.

Additionally, the NRC needs to closely monitor qualifications of workers at licensed ISL sites. Companies often wash their hands of problems caused by consultants and independent contractors. Since qualified workers are hard to find in Wyoming (partly because of already extensive mineral development) companies will most likely hire workers that do not have the background and experience necessary to conduct these operations. Former contractors for the Smith Ranch-Highland facilities have told our organization that because of inadequate oversight wells have broken, resulting in groundwater contamination. NRC regulations require the licensee to be "qualified by reason of training and experience to use the source material for the purpose requested in such manner as to protect health and minimize danger to life and property" and "proposed equipment, facilities, and procedures" to be "adequate to protect health and minimize danger to life or property." 10 CFR § 40.32. How will NRC ensure these requirements will be met for new ISL projects? A greater discussion is needed in the GEIS of qualifications and oversight of independent contractors.

NRC only conducts inspection visits at sites once a year. NRC inspection staff now visit the Smith Ranch-Highland operation twice a year, but that is completely inadequate given the ongoing violations and environmental problems at the site. We call on NRC to open an enforcement office in Wyoming and to conduct quarterly inspections, if not more frequent. As demonstrated by the continuous and unchecked problems at Smith Ranch-Highland, merely looking at the reports is not enough. After the Smith Ranch-Highland DEQ investigation report came out, NRC did nothing – why? Wyoming is not an agreement state and if there were licensing violations or related problems, NRC cannot rely on the state DEQ to enforce. NRC has an independent obligation to carryout enforcement actions. In short, what is NRC willing and able to do to ensure proper oversight of these operations? Please discuss these issues, including an enforcement plan for future ISL sites, in the GEIS.

The GEIS needs to discuss staffing levels and needs at the NRC and analyze environmental impacts that could occur as a result of insufficient oversight.

4. The GEIS can be used in a way to violate NEPA provisions on public involvement.

Involving the public in the NEPA process is one of the law's most important aspects. Section 1500.1 of the CEQ regulations states that "public scrutiny [is] essential to implementing NEPA." Section 1503 of the regulations discuss commenting and specifically require agencies to "[r]equest comments from the public, affirmatively soliciting comments from those persons or organizations who may be interested or affected" after the issuance of a draft EIS. Additionally, Section 1506.6 requires agencies to "[m]ake diligent efforts to involve the public in preparing and implementing their NEPA procedures," which includes providing public notice, sponsoring public hearings, and soliciting appropriate information from the public.

Public involvement in the NEPA process is not only a legal requirement – it is the right agency choice. Public participation improves agency decision-making by bringing in additional stakeholders that have information and resources. A recent report from the National Research Council found that increased public participation generally improves the quality of agency decisions and "increases the legitimacy of decisions in the eyes of those affected by them, which makes it more likely that the decisions will be implemented effectively."[8]

For these reasons and others, NRC should be increasing opportunities for the public to become involved not decreasing them. Unfortunately, the GEIS may be used in a way to limit public involvement, particularly for site-specific NEPA review.

The NRC needs to answer definitively whether site-specific draft environmental assessments (EA) will be available for public notice and comment. The GEIS says they will be, GEIS at 1-27, but then contradicts this with the NEPA flow-chart on p. 1-18. The NRC needs to make a binding commitment to public scoping and comment processes for site-specific environmental EAs. Until a commitment to public comment is made through regulation, NRC does not have the obligation to involve the public in the EA process. NRC has not made EAs available for public comment in draft form prior to the GEIS and it is possible this trend will continue after the GEIS – in spite of public statements to the contrary.

If NRC issues regulations, we suggest that the NRC creates the requirement for at least one public hearing in the impacted community and a 60 day public comment period given the complex nature of these operations and the lengthy applications the public must review to provide substantive comments.

The NRC website is a potential tool to help the public be involved, and we appreciate the creation of the NRC NEPA reviews page.[9] Please keep this updated as a way for the public to stay informed on the status of NEPA reviews. Perhaps you could also link to this page on the NRC website for documents out for public comment so the viewers of the documents out for comment site would know NEPA documents are also available for public comment.

---

[8] Thomas Dietz and Paul C. Stern, *Eds. Public Participation in Environmental Assessment and Decision Making*, Panel on Public Participation in Environmental Assessment and Decision Making, National Research Council 2008, *available at* http://www.nap.edu/catalog.php?record_id=12434.

[9] *See* http://www.nrc.gov/materials/active-nepa-reviews.html

In addition to website notice, NRC should consider requiring local press releases and other ways to inform the public in impacted areas. Not everyone in rural areas has Internet access and many that do only have dial-up Internet that does not allow them to download long documents.

Finally, the NRC license hearing process should not be viewed as a surrogate for NEPA public participation. The hearing process is an extremely burdensome trial-like situation and standing requirements are very stringent. In contrast, NEPA public processes are designed to be open and accessible to any interested parties.

In many ways, the NRC needs to re-think the way it involves the public. Holding a public meeting on a Friday evening of Labor Day weekend is just one example of a larger problem. NRC needs to view public participation as a vital component of the NEPA process. Instead, NRC staff is sending a different message to the public. For instance, John Hall at the Casper public meeting said the word "draft" should not be taken too seriously and the GEIS "is complete in every sense."[10] So, what role does the public really play? Our members are concerned that NRC automatically discounted the weight and breadth of comments that came out against the GEIS in scoping, and will only do the same after the draft. Even making a commitment to having public notice and comment will not solve the problem if the agency does not view public participation as an important, in fact essential, part of the NEPA process.

5. The GEIS may prevent adequate site-specific analysis compliant with NEPA.

Not surprising, a large number of scoping comments expressed concern that the GEIS will prevent adequate site-specific analysis. The draft document did little to assuage those concerns.

First, the GEIS often describes potential impacts as a range, e.g. "small" to "large." NRC staff at the public meeting in Newcastle acknowledged that there will be "quite a range" of impacts for projects. What impacts will be determined as significant? Will the NRC tier to the GEIS even if the impacts were not defined or a significance determination was not made, e.g. the impacts were considered as a range?

Second, NRC staff members have said that cumulative impacts will be deferred to site-specific analysis. How will NRC determine whether these impacts are significant and thus require an EIS? Most of Wyoming is already heavily impacted by mineral development and thus cumulative impacts analysis is of particular importance to our members.

Third, what information will NRC consider "common" in the GEIS? NRC staff at the Casper public meeting said there is "some commonality of impacts."[11] "Some" is not sufficient to substitute analysis in one document for another. At the same meeting, NRC staff said the agency "will focus its attention on unique aspects of each site." Whatever is not "common" must be "unique" and should be discussed in detail in a site-specific document. In particular, hydrologic characteristics for a particular site will be unique. Aquifer formations, confining layers, and uranium deposits particular to a given site will greatly affect the potential environmental impacts associated with a site. NRC acknowledges this: "Given the nature of the ISL uranium recovery

[10] Casper Hearing transcript at 24.
[11] Casper Hearing transcript at 31.

process, hydrologic characterization of the site is a critical component of the applicant's pre-construction activities." GEIS at 2-6. Aquifer characteristics, solution constituents, and impact on water supplies must all be considered at the site-specific level because of the site-specific nature of this information.

The NRC needs to disclose what is "common" in the GEIS so the public, and the agency itself, will have a better idea of what can be used in place of site-specific analysis.

Our members are concerned that NRC will not prepare a site-specific EIS even if "unique" site-specific impacts are significant. For instance, in a letter to the U.S. Fish and Wildlife Service regarding the proposed Nichols Ranch project, NRC staff said:

> "As established in Title 10 *Code of Federal Regulations* Part 51 (10 CFR 51), the NRC regulation that implements the National Environmental Policy Act of 1969, as amended, the agency is preparing an environmental assessment (EA) for the proposed action that will tier off a Generic Environmental Impact Statement currently under development."[12]

It appears that NRC concluded that an EA is appropriate even before the final GEIS is released. In fact, this letter was written prior to the release of the draft and prior to a completed technical review of the project. NRC could have easily told FWS they are preparing NEPA analysis, leaving out whether this analysis will be an EA or EIS. Instead, NRC has once again affirmed its intent to disregard potentially significant impacts in the interest of streamlining the permitting process. This is not acceptable to the public and is certainly not compliant with the letter and the spirit of one of our most important and fundamental environmental laws.

6. **The GEIS does not consider adequacy of existing NRC regulations and whether additional rulemaking is needed. The GEIS also fails to discuss ongoing ISL rulemaking efforts and how those efforts will relate to future ISL licensing activity.**

The GEIS mentions, almost in passing, that "NRC is currently engaged in a rulemaking that would clarify the requirements for groundwater protection at ISL facilities." GEIS at 2-26. This rulemaking may considerably alter impacts to water quality at future ISL facilities. The GEIS needs to discuss this proposed rulemaking and specifically disclose whether projects that will be tiered to the GEIS will be required to meet the new standards. We understand that the rulemaking is still pre-decisional, but it will likely impact (for better or worse) groundwater restoration at ISL facilities in a significant manner. Will a SEIS be issued once the rulemaking is complete? One would think that the new rulemaking would meet the criteria for a supplement to this document.

In addition to the groundwater rules, NRC needs to take a hard look at the adequacy of all of its existing regulations. ISL facilities have been licensed for over twenty years in what often appears as an ad-hoc manner. It is now time, before the boom, to determine whether new regulations are needed given past history and environmental impacts. Much of Appendix A to 10 CFR Part 40 is

[12] Letter from NRC to Fish and Wildlife Service, *Request for Information Regarding Endangered or Threatened Species and Critical Habitat for the Proposed License Application for Uranerz Energy Corporation's Nichols Ranch Uranium Recovery Project*, July 3, 2008, ADAMS Accession No. ML081820857.

couched in non-mandatory terms – merely goals, objectives, or criterions. NRC needs to consider new enforceable regulations that will prevent or mitigate environmental impacts. For instance, NRC should consider the following:

Frequent mechanical integrity tests: Given that "poor well integrity" is a cause of excursions, GEIS at 2-18, NRC should consider requiring frequent mechanical integrity tests. It appears that these tests are only required every five years. Perhaps a test should be required every 1 or 2 years at the most? Wells at current ISL sites have failed integrity tests [e.g. Smith Ranch-Highland well CI-125] and it is important to catch that failure as soon as possible.

Additional sampling: GEIS says that "monitoring wells are typically sampled every 2 weeks during operation." GEIS at 2-19. Should samples be required weekly? Or should more frequent samples be required for sites where excursions have occurred (such as Smith Ranch-Highland)?

Split-sampling: NRC should consider split-sampling. This would allow independent verification and analysis. NRC could also require independent lab technicians (as opposed to company employees) to take samples.

Other mitigation measures suggested below

7. **The GEIS needs to consider a wide-range of alternatives to the proposed federal action.**

NEPA requires agencies to consider, evaluate and disclose to the public "alternatives" to the proposed action. 42 U.S.C. §§ 4332(2)(C)(iii) & (E). CEQ regulations require an agency to "rigorously explore and objectively evaluate all reasonable alternatives" to the proposed action. 40 C.F.R. §1502.14 (This CEQ section is attached to these comments). Additionally, the evaluation of alternatives must constitute a "substantial treatment," presenting the impacts of the alternatives in comparative form "sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and public." *Id.*

The duty to consider a range of alternatives is accompanied by a duty to "study ... significant alternatives suggested by other agencies or the public during the comment period." *DuBois v. U.S. Dept. of Agriculture*, 102 F.3d 1273, 1286 (1st Cir. 1996).

Alternatives are important because:

> Ultimately, of course, it is not better documents but better decisions that count. *NEPA's purpose is not to generate paperwork – even excellent paperwork – but to foster excellent action.* The NEPA process is intended to help public officials make decisions that are based on [an] understanding of environmental consequences, and take actions that protect, restore, and enhance the environment.

40 C.F.R. § 1500.1(c) (emphasis added); *see also* 40 C.F.R. § 1500.2(e).

Unfortunately, the NRC does not present alternatives to its proposed action, and therefore NRC is not complying with NEPA's requirements. The alternatives cannot be limited to (1) no action (2) permit as planned and (3) mining options that are not economically or technically feasible and not even analyzed in detail. The NRC also rejected all alternatives that were proposed during the scoping process. We suggest the following alternatives and hope the NRC will consider them and others as alternatives in this NEPA document. It is important that NRC discusses the relative environmental advantages and disadvantages of various aspects of ISL projects in this "generic" document prior to any commitment of agency resources. [13] With that analysis, project proponents and the agency can suggest, or perhaps even require, mining and milling methods that will best protect public health and the environment.

Alternatives regarding water restoration methods:
There are various methods available for groundwater restoration, including groundwater transfer, groundwater sweep, reverse osmosis, groundwater recirculation, and stabilization monitoring. GEIS at 2-26. NRC needs to analyze methods and determine the relative environmental impacts of each, particularly analyzing the length of time needed for groundwater restoration, effectiveness of the method, and how much water will be consumed during restoration activities. NRC could then recommend an alternative for restoration that will be most beneficial. For instance, a document from the NRC regarding the Oshoto test project stated that "the method of restoration utilized (groundwater sweep-fresh water injection) is not considered to be the state-of-the-art method" and that even after restoration there was "some water quality degradation."[14] If groundwater sweep was not "state-of-the-art" back in 1983, how can it be a primary restoration method today? Are other methods preferable? The NRC needs to analyze the differences between water restoration methods in the GEIS.[15]

Alternatives regarding waste disposal methods:
According to the GEIS three options for water/solution waste disposal are used by ISL operations: land application, deep disposal wells, and evaporation ponds. Although, like water restoration methods, it appears that some projects use a combination of all three methods, NRC should analyze each method as an alternative in this GEIS to determine which method is preferred. All disposal methods have very different environmental impacts. For instance, land application can create significant impacts to soil and surface water quality because of selenium, arsenic, and other trace metals that are found in the ISL project waste. Evaporation ponds may create other impacts, such as a breeding ground for mosquitoes carrying West Nile Virus or an area that could be harmful for wildlife or livestock.

---

[13] To "foster excellent action," NEPA's implementing regulations provide that "[a]gencies shall not commit resources prejudicing selection of alternatives before making a final decision ([40 C.F.R. §] 1506.1)." *Id.*; 40 C.F.R. § 1502.2(f). The regulations further provide that the NEPA analysis "shall serve as the means of assessing the environmental impact of proposed agency actions, rather than justifying decisions already made." 40 C.F.R. § 1502.2(g).

[14] Memorandum from Ted L. Johnson, Project Manager, Licensing Branch I, Uranium Recovery Field Office, Region IV, Regarding ND Resources review of Groundwater Restoration Activities, Jun. 9, 1983, NRC Docket File 40-8663.

[15] This analysis would also facilitate proper incorporation by reference for sites that have proposed using one or more restoration methods.

NRC has characterized impacts from "waste management" as "small." Is this characterization true for all disposal alternatives? Wouldn't impacts be significant if some of the methods were used as the preferred or sole disposal method? Analysis of the differing types of waste disposal will help the NRC incorporate that analysis into various site-specific documents for sites using different disposal techniques.

Alternatives regarding injection fluid and drilling constituents:
According to the GEIS, there appears to be several options for the uranium mobilizing agent in ISL projects – sodium bicarbonate, carbon dioxide, ammonia-based solutions, and acid leaching. However, NRC does not analyze the relative impacts and identify whether one or the other is better for public health and the environment. NRC does, however, note that "The leaching agent chosen for the ISL operation may affect the type of potential contamination and vulnerability of aquifers during and after ISL operations." GEIS at 2-16.[16] We ask NRC to look at injection fluids as alternatives, and we specifically ask NRC to prevent the use of acid and ammonia-based solutions at ISL facilities given their extreme environmental impacts.

Alternatives regarding enforceable mitigation:
NRC also needs to consider enforceable mitigation options as alternatives to the planned action. In the next section, we describe several options that NRC should pursue to mitigate environmental impacts from ISL projects.

Alternative of phased construction/operations:
Phased construction/operation is needed to minimize cumulative impacts for ISL projects, and particularly for projects that will co-exist with CBM and other industrial development. NRC should consider phased development as an alterative in this "programmatic" document. This could mean that NRC limits the number of licenses (and projects) in a particular geographic area and ensures water restoration and land reclamation for existing projects before new projects can occur.

8. The GEIS needs to consider a wide-range of *enforceable* mitigation measures.

John Hall, NRC staff, at the meeting in Casper said that there are potentially "large" impacts with ISL mining, and that the "key here is mitigation" to decrease the significance of these impacts. We agree, but unfortunately NRC does not take its own advice in the GEIS. As opposed to incorporating enforceable mitigation measures, the NRC merely lists voluntary "best management practices." Voluntary practices are not substitutes for enforceable license requirements.

NRC needs to require dust suppressant on unpaved roads and construction areas. Wyoming has frequent high winds, especially in the winter, and controls are needed to mitigate impacts from fugitive dust. Another option could be limiting the number of trucks per day on unpaved access roads.

[16] Additionally, "[T]he system requires much larger amounts of groundwater be removed and processed during aquifer restoration" if ammonia-based solutions are used. GEIS at 2-15.

NRC also needs to require mitigation measures to minimize erosion. For instance, no-surface-occupancy buffers around stream banks are important and the NRC should prevent drilling in ephemeral drainages.[17] NRC should also prohibit surface activity on certain inclines or other areas that are particularly prone to erosion.

Mitigation measures should also promote saving topsoil. Saving the topsoil layer helps speed reclamation and is extremely beneficial for future land uses, such as farming or ranching. Topsoil should be segregated and stockpiled in short-term (4-6 months maximum) and shallow (less than 3 feet) piles. Shallow piles help to minimize heat impacts to micro-organisms and organic matter. If topsoil is not properly segregated, it will be contaminated by deeper, poorer quality soils.

These mitigation measures, and others, should be required and should be fully enforceable under the license.

9. **The GEIS needs to discuss how it will be used in conjunction with other federal agency NEPA analysis, including the BLM and U.S. Forest Service**

It is unclear from the draft how other federal agencies that must complete NEPA analysis prior to operations, such as the BLM, will use the GEIS. Will BLM or other agencies tier to this document?[18]

The analysis of public lands impacts in the GEIS is largely insufficient, and the NRC did not complete consultation with public lands agencies prior to the draft. (See Freedom of Information Act response from BLM attached to these comments). In the past, public land agencies like BLM have conducted their own NEPA analysis because the NRC did not properly analyze and disclose impacts.[19] We contend that given the inadequate analysis of public land issues,[20] the GEIS cannot be used in place of comprehensive analysis by public lands agencies.

10. **The GEIS needs to fully consider impacts to traditional cultural property. Nation-to-Nation tribal consultation is required for the GEIS.**

The Pumpkin Buttes area in Wyoming is considered a traditional cultural property, and BLM requires tribal consultation for development within two miles. NRC should adapt similar requirements and also conduct tribal consultation for the GEIS. The results of this tribal consultation should be disclosed in the final GEIS.

11. **The GEIS needs to fully explain how it will be used for expansion or re-start of existing ISL sites.**

As discussed above, the GEIS must disclose what sites will be "tiered" to it. In particular, some sites in Wyoming are scheduled for "expansion" or re-start. These sites are moving at a quicker

[17] According to some project documents and the NRC EA, it appears that drilling in an ephemeral drainage is planned for the Reynolds Ranch project.
[18] We understand that there is a meeting scheduled for December 11th between NRC and BLM on this topic.
[19] For instance, the BLM is currently doing its own NEPA analysis for the proposed Reynolds Ranch project.
[20] Including situations where the federal government may own the minerals underneath private surface land.

pace than some of the new sites and NEPA analysis is currently occurring before the GEIS has been finalized. If these sites are not included in the scope of the GEIS, will their impacts be considered in the cumulative impacts section? Many of these sites are located in close proximity to proposed sites and cumulative impacts to groundwater and other resources will be significant.

Additionally, these sites may present additional or unique impacts, and therefore it is important to note in the GEIS whether the document will be used for site-specific analysis of re-starts or "expansions." For instance, the Wyoming DEQ has noted that Cameco develops new well fields before restoration is completed at prior well fields:

> "It is readily apparent that groundwater restoration is not a high priority for PRI. It appears in reality that both production and restoration timeframes have doubled or tripled and yet additional wellfields are being brought into production."[21]

12. <u>The GEIS needs to fully and adequately consider cumulative impacts in the GEIS.</u>

NRC has told the public during the GEIS meetings that cumulative impacts will be addressed at the site-specific level. In fact, the GEIS itself discloses that the document "does not make conclusions regarding cumulative impacts for specific sites." GEIS at 1-12. This statement is not comforting to the public. The state of Wyoming is already heavily impacted by federal energy programs, including coalbed methane development, other oil and gas development, and coal mining. Cumulative impacts of increased activity are often the most significant impact for people who live in the area.

In particular, the GEIS at a programmatic level and site-specific NEPA documents at the site-specific level should discuss potential cross-contamination from CBM or other oil and gas wellfields. NEPA documents need to disclose results of groundwater flow mapping and discuss how wells from current operations, uranium or otherwise, may impact water quality. Our members in the Pavillion area of Fremont County are suffering from water contamination as a result of natural gas operations. How will uranium projects in Southwest Wyoming contribute to these impacts?

The GEIS at a programmatic level must also address groundwater drawdown cumulative with other industrial activities. CBM has substantially contributed to groundwater drawdown in the Powder River Basin and the GEIS should discuss how uranium will contribute (or not contribute) to those impacts. The GEIS needs to discuss the recharge rate for aquifers versus the amount of water required for uranium and other industrial activity in the area. Cumulative impacts of groundwater withdrawal are important to analyze because as the National Research Council has noted:

> [G]roundwater withdrawal at a single mine has the potential to create a deep cone of depression in the local aquifer. As this cone expands over time, it may join those created by

[21] DEQ investigation report of Smith Ranch-Highland operations, *supra* note 5.

neighboring mines and lower the regional water table, which in turn may decrease or terminate flow in streams and springs some distance from the mines.[22]

Some of our members rely on artesian wells that they may lose as a result of uranium and other industrial activity. This will result in significant expense on the part of our members to replace these wells, which may require bringing a power source to that replacement well.

Moreover, roads, power lines and power needs, and other infrastructure are particularly important for cumulative impacts analysis. Additionally, as discussed below, cumulative analysis of socio-economic impacts are very important. Wyoming is a very rural state and a large influx of projects and workers could dramatically impact socio-economic conditions.

Cumulative impacts analysis of air quality is also very important. For instance, particulate matter emissions levels in the Powder River Basin are often high and dangerous to public health. Although the Powder River Basin is reportedly in attainment, there are frequent violations of particulate matter levels that should be discussed in the cumulative impacts section.[23] Additionally, Southwestern Wyoming is experiencing major ozone problems as a result of natural gas and other industrial development. The state's air quality is becoming increasingly degraded because of energy development. How will uranium contribute to this problem? Will it tip Wyoming airsheds over the edge from being in attainment for various emissions levels? What monitoring and mitigation will be used to ensure that Wyoming's air is kept clean?

Cumulative impacts analysis of wildlife impacts is also essential at the programmatic level. Noise, roads, and other surface impacts will most likely be cumulatively significant. In particular, the GEIS should discuss cumulative impacts to sage-grouse populations. The greater sage-grouse is listed as a state sensitive species by the Wyoming BLM and populations are under significant threat because of mineral development activities in the state. We have attached some studies detailing impacts to sage-grouse populations from oil and gas activities. The GEIS should discuss the best available science, including guidance from the Western Association of Fish and Wildlife Agencies that interpreted peer-reviewed sage-grouse research published between 2003 and 2008.[24]

13. <u>The GEIS does not fully and adequately analyze impacts to water resources.</u>

Water has intrinsic value, especially in an arid state like Wyoming. Most of Wyoming is technically classified as a desert because of limited rainfall and dry, windy conditions. Thus, most of our members rely on groundwater for their homes and livelihoods and they are especially concerned about impacts to groundwater resources. (See attached article).

---

[22] National Research Council, Hardrock Mining on Federal Lands, National Academy Press, 1999, at 151, *available at* http://books.nap.edu/html/hardrock_fed_lands.

[23] According to BLM, there were 11 exceedances of the 24-hour PM10 standard at six coal mines in the Powder River Basin in 2007. Draft Environmental Impact Statement for the South Gillette Area Coal Lease Applications at K-16, available on BLM Wyoming's website.

[24] Memorandum from Tom Christiansen and Joe Bohne, Wyoming Game and Fish Department, to Terry Cleveland and John Emmerich (Jan. 29, 2008), with attached report *Using the Best Available Science to Coordinate Conservation Actions that Benefit Greater Sage-Grouse Across States Affected by Oil & Gas Development in Management Zones I-II (Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming).*

Water Quality

According to a study by the National Research Council, "The primary risk associated with *in situ* uranium mining is the potential for contamination of adjacent groundwater." The study identified that

> If the system of injection and production wells is not properly designed and constructed, the pregnant lixiviant may escape into the sandstone aquifer, carrying with it dissolved uranium and radium. Small amounts of several trace metals are also present in the lixiviant, including lead, selenium, molybdenum, and arsenic.[25]

To date, all ISL projects have had "excursions" and "spills" and other events that could threaten waters resources during operations. The track record of the Smith Ranch-Highland site may be a good indication of what can happen during an ISL project:

> Over the years there have been an inordinate number of spills, leaks and other releases at this operation. Some 80 spills have been reported, in addition to numerous pond leaks, well casing failures and excursions. Unfortunately, it appears that such occurrences have become routine. (DEQ) currently has two large three-ring binders full of spill reports from the Smith Ranch-Highland operations.[26]

Because of the frequency of spills and excursions, significant impacts have occurred: "Some of the spills may have little impact individually, but cumulatively they might have a significant effect on soils and/or groundwater."[27]

Additionally, ISL projects leave water resources threatened after operations. To date, no ISL project has returned groundwater quality to baseline conditions. In fact, it is doubtful that some wellfields may ever be returned to restored conditions. For instance, the Wyoming DEQ noted that one wellfield at the Smith Ranch-Highland site has not made restoration progress even after ten years: "Wellfield C has now been in restoration for ten years. The 2007 Annual Report states that the ground water quality is similar to '*end of mining*' wellfield conditions."[28]

Elevated levels of arsenic, molybdenum, selenium, vanadium, and uranium are often present at higher levels than baseline even after groundwater restoration. Additionally because of the mining solution, elevated levels of sodium, carbonate, or sulfate are present. Mining may also increase total dissolved solids and change pH levels. What is the probability of a ISL facility properly restoring water – especially given new drinking water standards for various constituents:

> The USEPA decreased the uranium drinking water standard from 5.00 mg/L to 0.03 mg/L. Some state agencies have pushed for even lower limits; the New Mexico

[25] National Research Council, *supra* note 19 at 146.
[26] Wyoming DEQ investigation report, *supra* note 5.
[27] *Id.*
[28] *Id.* (emphasis in original)

Environment Department proposed 0.007 mg/L based on a higher incidence of kidney ailments observed in communities located near uranium deposits. Likewise, the primary drinking water arsenic standard was lowered by USEPA from 0.05 mg/L to 0.01 mg/L. These standards, or alternative concentration limits if permitted, would directly effect remediation of uranium sites because NRC, or agreement states, must adopt the USEPA standard in regulating the industry.[29]

The NRC needs to consult with a toxicologist or other public health expert to disclose health impacts of trace constituents leftover from mining. The NRC needs to disclose impacts to water quality from past mines and projected impacts from future mines in the GEIS. How likely is contamination of areas outside the mining zone before it can be cleaned-up? Are confining layers really confining? What has their success been in previous projects? On some level, NRC and the companies should accept the uncertainty of geologic conditions and acknowledge the high probability of unanticipated problems.

Does NRC independently verify that the mining zone (and nearby aquifer) is not used as a source of drinking water or water used for stock or irrigation purposes? Or does it rely on information submitted by the company? Shouldn't NRC wait to license projects until the aquifer exemption is obtained?

One issue that needs to be analyzed for each project – and cumulatively at the programmatic level – is how new ISL operations will interact with past uranium mining – underground mines, open-pit mines, and abandoned or not properly plugged exploratory wells.[30] Similar to CBM or other oil and gas wells, past uranium activities may dramatically impact the success rate of groundwater restoration efforts and could lead to contamination during operations. Documentation in the Smith Ranch-Highland file shows that a well field on top of an underground mine had significant difficulties during restoration. In the GEIS, NRC must identify and discuss historic mining that may impact restoration in all three Wyoming regions.

Water Quantity

The Powder River Basin and other areas of Wyoming have experienced prolonged periods of drought, which will most likely only increase because of climate change impacts. New water sources may be needed and unfortunately may not be available if water has been depleted or contaminated from these operations. A greater discussion of aquifer drawdown and recharge is needed to detail the significance of these impacts.

ISL facilities consume tremendous amounts of water. According to a NRC EA, Cameco estimates to consume 50 gallons per minute of groundwater during its Reynolds Ranch operations. NRC EA on Reynolds Ranch at 20. NRC's EA stated that "The amount of water used in the [ion-exchange] columns or discharged to an authorized deep disposal well under these assumptions equates to approximately 1200 acrefeet of water over the course of a 15-year

---

[29] William L. Dam, *New Plans for Uranium Production in America: Can Significant Adverse Impacts be Mitigated*, ENVIRONMENTAL PRACTICE at 235, Dec. 2007.

[30] Excursions at the Irigary and Christensen Ranch ISL facilities "were believed to be due to improperly abandoned wells from earlier exploratory programs prior to regulation by a UIC program." GEIS at 2-47.

period." *Id.* at 25. One acre-foot is approximately equivalent to 325,851 gallons so 1200 acre-feet would be the equivalent of 391,021,200 gallons of water over the lifetime of the mine. NRC must determine the significance of these impacts – both at the site-specific and larger programmatic levels.

14. <u>The GEIS does not fully and adequately analyze socio-economic impacts.</u>

Local hiring is becoming increasingly difficult as Wyoming continues to experience a workforce shortage. According to an article in the *Casper Star-Tribune*, "A strong Wyoming economy combined with a shortage of skilled workers resulted in work force shortages in many industries, particularly the energy industry..."[31]

Industry recruits workers from neighboring states and nationally as they cannot find the workers here in Wyoming.[32] To attract workers, extractive industries typically pay more than other economic sectors, with frequent overtime because of the labor shortage, and this has contributed to a large wage gap in communities like Gillette and Casper. For instance, the median income in Campbell County is now $71,800 up from $53,200 ten years ago before the CBM boom really took off. However, the majority of people in the county and across Wyoming still earn much less than that. Wyoming is fast becoming a state of the haves (those who work in the energy industries) and the have-nots (everyone else). Current economic information shows that although Wyoming's per capita income has grown as a result of the energy boom, most Wyoming residents are not benefiting. A recent report from the Equality State Policy Center, *The State of Working Wyoming*, explains that "Those who do not work in the energy industries or who do not own shares of production see little of the additional income generated by the boom."[33] Income inequality in the state continues to grow,[34] and many families have difficulty covering the basic costs of life. Costs for food, health care, transportation, rent, and other essential costs are all going up. According to state economist Justin Ballard, "'While rising energy-related commodities have increased the state's treasury and led to low unemployment rates, they have also hurt citizens at the fuel pumps and cash registers.'"[35] While most parts of the country are facing severe economic declines, Wyoming's inflation rate is the highest it has been since 1980.[36] This leads to an overall decrease in the quality of life of many families. Additionally, small businesses are suffering as hotels and other local businesses are finding it increasingly

---

[31] *See* Jeff Gearino, *Searching for Workers*, CASPER STAR TRIBUNE, January 3, 2007.

[32] *See, e.g.* Bob Moen, *Power Shortage: Uranium and wind industries lack workers*, CASPER STAR TRIBUNE, Sept. 5, 2008:

> Chuck Foldenauer of Cameco Resources, which operates the only active uranium mine in Wyoming near Glenrock, said uranium mining companies are in need of workers for jobs ranging from construction to chemists...Cameco...is currently looking to fill 30 additional positions....In trying to fill the jobs, Cameco is recruiting in Wyoming and nationwide, working with colleges and improving wages and benefits.

[33] Equality State Policy Center, *The State of Working Wyoming*, February 2008, available at http://www.equalitystate.org/PDFs/State_of_Working_Wyoming.pdf.

[34] *See* Equality State Policy Center, *Pulling Apart – Economic Equality Declines, available at* http://www.equalitystate.org/PDFs/Pulling%20apart_Economic%20equality%20declines.pdf; Jared Miller, *Income gap widens in Wyo.*, CASPER STAR TRIBUNE, April 9, 2008, A1, A6.

[35] *Wyoming Inflation: Report: Rate high as 8.1 percent*, SHERIDAN PRESS, March 31, 2008, *citing* Wyoming Economic Analysis Division report.

[36] See attached articled from the CASPER STAR TRIBUNE.

difficult to find workers as low-level employees seek higher-paying jobs with mines and oil and gas companies.

The combination of out of state workers and high wages produces a number of related impacts in communities with energy booms. Communities in Wyoming have faced everything from increased housing costs to a paucity of teachers, doctors, and police officers to increased drugs, drunk driving, and prostitution.[37] The energy boom has created a number of growth inducing effects and ISL projects will only exacerbate those impacts or create new impacts in communities that have not yet seen recent large booms (such as the Gas Hills and the Black Hills areas of Wyoming). Analysis of these impacts is needed on both the site-specific level but also the larger programmatic or cumulative level. Where is the analysis in the GEIS of the impacts from 20-30 new ISL sites in the state? This analysis needs to happen during the NEPA process before a license is issued for any new project.

In particular, the GEIS needs to discuss impacts to housing stock availability and affordability. Communities like Wamsutter, Casper, Gillette, and others are already heavily impacted by energy booms and housing affordability has degraded fast. Gillette currently has a .1 percent apartment vacancy rate[38] and other Powder River Basin communities are just as impacted. The lack of available housing stock has led to a significant increase in housing prices. For instance, "the cost of renting a two- to three-bedroom house in Natrona County increased more than 22 percent" only last year.[39] Other communities near proposed ISL projects have experienced similar housing cost increases. According to the State of Wyoming's Economic Analysis Division's 2007 Economic Summary:

> With booming natural resource explorations... communities are facing severe housing shortages, despite speedy home construction. This shortage has caused as much as a 20 percent increase annually on rent and house prices, making the affordability degrade fast, particularly for workers in low paying industries. Home prices have more than doubled in some of these communities in the last 5 years.[40]

Wyoming has in many ways become a single-sector economy. Unfortunately, this economy is not sustainable because extractive industry jobs are limited by the nature of what they are producing – a non-renewable resource. The GEIS needs to discuss recoverable uranium reserves in Wyoming. How long will this industry last at current or projected uranium prices? And how will communities be impacted when the bust comes? Communities like Jeffrey City, Wyoming have seen their socio-economic stability shattered from mining busts. The GEIS should discuss these impacts and weigh them against any short-term economic benefits to determine the overall significance of socio-economic impacts.

Moreover, ISL projects require a substantial amount of land, as evidenced by currently operating and proposed facilities, and therefore impacts to existing land uses, including agriculture,

---

[37] *See In a Red State Rolling in Green: A Relaxed Attitude*, attached to this letter.
[38] Meland, Christa, *Housing Permits at Record Numbers*, GILLETTE NEWS RECORD, January 3, 2008.
[39] *Cost of renting a home in Natrona County sees a big surge, study says*, GILLETTE NEWS RECORD, March 31, 2008.
[40] State of Wyoming, Economic Analysis Division, 2007 Economic Summary, *available at* http://www.ccedc.net/images/data/Economic_Summary0707.pdf.

recreation, and hunting will be significant. This will create socio-economic consequences. NRC needs to fully analyze these impacts in the GEIS.

For instance, many of our organization's members have ranches or farms in areas that will be impacted by proposed uranium mining. Depending on the size of a well field, it could mean that large portions of surface land will not be available for grazing or farming. Additionally, frequent vehicle travel on rural roads impacts loose livestock. Construction of new roads or modifications/improvements of existing roads impact livestock grazing or farming activities. Analysis of these impacts for both private surface and public surface land is critical. For instance, if grazing permits on public lands are impacted, will producers compensate permitees?

The GEIS also needs to fully analyze impacts to hunting and other recreational activities on public and private surface lands. A recent federal government survey found that in 2006 "762 thousand Wyoming residents and nonresidents 16 years old and older fished, hunted, or wildlife watched in Wyoming...state residents and nonresidents spent $1.1 billion on wildlife recreation in Wyoming."[41] Clearly, lands in Wyoming have economic value beyond mineral production.

The Campbell County land use plan echoes these sentiments: "it is important that residents continue to have access to state and federal land for activities such as agriculture, recreation, and hunting. These and other historic uses play an important role in Campbell County's social stability." Thus, impacts to existing land uses – agriculture, hunting, and recreation – will adversely affect the socio-economic structure of rural areas.

In addition to considering impacts to existing economic uses of the land, the GEIS should also consider impacts of lost economic opportunities. Natural beauty is part of the local economic base that attracts people to an area. Many landowners in Wyoming enjoy living in our state because of its rural nature. Industrial uses, like uranium mining, inherently change the character of an area and may discourage individuals from moving into a community and starting a business or retiring on a piece of rural property. In other words, uranium projects may discourage other investment that would be more economically sustainable for the area.

Furthermore, new ISL projects could impact community resources, like road and highways and cause related socio-economic consequences. The state estimates that Highway 59 (between Gillette and Douglas) needs to be expanded to handle the additional traffic from coal mines and CBM. (See attached article). Uranium projects will only add to the problem. Will counties and the state need to bear the burden of impacts to community resources caused by the uranium boom? Again, what are the cumulative impacts of new projects in a close geographic area?

Unlike coal and oil and gas resources, uranium is not a big income generator for local, state, and federal governments. Under the 1872 Hardrock Mining Act, there are no federal royalties for uranium produced from federal government lands. State severance taxes are often less than other minerals – for instance, in Wyoming, the state severance tax rate for coal is 7% while it is only 4% for uranium. Additionally, state lease rates are often very low. According to the Wyoming

[41] U.S. Department of Interior, Fish and Wildlife Service, and U.S. Department of Commerce, *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Wyoming* at 6, *available at* http://www.census.gov/prod/2008pubs/fhw06-wy.pdf.

Office of State Land and Investments, state land is leased for uranium mining for $1/acre per year for 10 years with a state royalty of only 5%. The GEIS needs to fully disclose information regarding royalties and tax revenue from expected uranium mining.

Finally, as discussed throughout our comments, there are possible significant environmental legacy costs to ISL projects, including long-term groundwater contamination. Any short-term benefit of local tax revenue or other economic pluses should be weighed against the true long-term costs of these projects.

15. The GEIS does not fully and adequately analyze impacts to soils and land quality.

Project impacts should not be downplayed by labels such as "short-term" or "temporary." Some oil and gas projects last for about the same time as uranium ISL projects, and impacts have been shown to be significant. Regardless, NEPA mandates consideration of the relevant environmental factors and environmental review of "[b]oth short- and long-term effects" in order to determine the significance of the project's impacts. 40 C.F.R. § 1508.27(a) (emphasis added), *see also State ex rel. Guste v. Lee*, 635 F.Supp. 1107, 1121(E.D.La. 1986) ("environmental impacts...are not reduced below the significance threshold merely because of the fact that the effects are temporary") (emphasis added).

ISL operations impact land quality in a variety of ways and NRC needs to analyze these impacts – both at the site-specific level and the programmatic cumulative level – in the GEIS. For instance, if liners fail for projects that use evaporation ponds or water is discharged from evaporation ponds as has occurred during the Oshoto test project and other sites,[42] soils, grasses, and surface water could be impacted. In particular, barium sulfate and selenium levels could adversely impact land quality.

As discussed above in the alternatives section, if projects use land application for waste disposal, this could negatively impact soils and vegetation.

Topsoil protection is of special importance and appropriate mitigation measures should be implemented (see discussion above). ISL facilities have not adequately protected topsoil:

> PRI's typical wellfield installation procedures result in the near total disturbance of the native vegetation and soils. This is not consistent with the regulation that allows for 'minor disturbance' without topsoil stripping.[43]

Additionally, mitigation measures should be implemented to prevent the spreading of noxious weeds and protecting habitat for livestock and wildlife. Reclamation standards for ISL facilities need to be discussed in the GEIS.

16. The GEIS does not fully and adequately address impacts to surface lands because of split-estate situations.

---

[42] Letter from Doyl M. Fritz, Western Water Consultants to John Wagner, Wyoming DEQ, Regarding ND Resources Oshoto Project Discharge Permit, Jan. 13, 1984, NRC Docket No. 40-8663.
[43] Wyoming DEQ investigation report, *supra* note 5.

Split estate lands present a problem of particular significance to our members. Many of our members are agricultural producers who only own the surface estate of their land. The GEIS needs to discuss impacts to agricultural and other land uses that could occur because of split estate situations – either federal government or private development of minerals. What is required in a surface use agreement? Surface owner consent is needed to minimize impacts to existing ranching and other land uses.

17. **The GEIS does not address foreign ownership and concerns for financial assurance.**

Cameco has in the past significantly underestimated financial assurance requirements, which has left the public at risk: "Rough calculations based primarily on PRI's figures reveal an alarming scenario...clearly the public is not protected."[44] We urge NRC and other public agencies to scrutinize financial assurance estimates, especially in light of realistic expectations for groundwater restoration and surface reclamation.

Foreign ownership presents special circumstances for financial assurance and oversight. Most uranium companies are subsidiaries of foreign companies. In some instances, there is very little difference between the parent and the subsidiary. For instance, a Cameco sign now hangs outside the Smith Ranch processing center. NRC regulations prevent the agency from giving a license if the corporation "is owned, controlled, or dominated by an alien, a foreign corporation, or foreign government" 10 CFR § 40.38. How do these rules apply to companies like Cameco? What financial documents are considered for financial assurance? In order to protect the public, financial assurance must only be satisfied by cash-equivalents held in FDIC insured U.S. banks.

Additionally, the NRC needs to speak to the financial condition of the uranium mining sector in the GEIS. (See attached articles). Do junior mining companies (and even some of the senior companies) have the financial resources to complete a license application, post an appropriate bond, and carryout the project and restoration? Bonds are particularly important if the price of uranium drops (which it has been doing) and companies pull out of projects. The economic situation in the U.S. and around the world is very tenuous these days and many junior uranium companies are without sufficient capital.[45]

The GEIS states that "NRC is currently engaged in a rulemaking that may change the list of NRC-approved surety instruments and conditions for other approved forms of financial assurance." GEIS at 2-41. Please explain this and describe how these new rules may or may not be applicable to sites that will tier to the GEIS.

18. **The GEIS needs to address climate change impacts.**

"Consideration of human induced climate change" was deemed to be outside the scope of the GEIS. GEIS at 1-13. Why was this topic rejected from the scope of the GEIS? Numerous scoping comments suggested to NRC that these impacts be analyzed and disclosed. In fact, NRC

---

[44] Wyoming DEQ investigation report, *supra* note 5.

[45] *See* Uraniumletter International, Overviews per Aug. 31, 2008, *available at* http://www.goldletterint.com/documents/pdf/URANIUM_Overviews_29Aug08.pdf.

must address climate change impacts as "reasonably foreseeable" consequences of increased uranium mining. 40 C.F.R. §§ 1508.7, 1508.8. Greenhouse gas emissions are clearly within the direct, indirect and cumulative effects that NEPA documents must analyze.[46] Completing a thorough analysis of global warming impacts will also help NRC fulfill its legal obligation under NEPA to "recognize the worldwide and long-range character of environmental problems" and support international efforts to prevent "declines in the world environment." 42 U.S.C. § 4332 (F).

Climate change will greatly impact the people of Wyoming and the western United States

Human-induced climate change is of concern to our members because of its ability to impact Wyoming and the west. Numerous studies have documented that climate change will dramatically impact states like Wyoming. For instance, the National Wildlife Federation estimates that "Global warming is likely to alter essential habitat in the Greater Yellowstone Ecosystem" and impact plant and animal species across the state.[47] Global warming could also impact industries that depend on snow and water resources, such as skiing, tourism, and agriculture. In a report released in May 2008, even the U.S. Department of Agriculture found "climate change is already affecting U.S. water resources, agriculture, land resources, and biodiversity, and will continue to do so." Some findings of the report include:

> Grain and oilseed crops will mature more rapidly, but increasing temperatures will increase the risk of crop failures, particularly if precipitation decreases or becomes more variable.
>
> Higher temperatures will negatively affect livestock. Warmer winters will reduce mortality but this will be more than offset by greater mortality in hotter summers. Hotter temperatures will also result in reduced productivity of livestock and dairy animals.
>
> Weeds grow more rapidly under elevated atmospheric CO2. Under projections reported in the assessment, weeds migrate northward and are less sensitive to herbicide applications.
>
> Invasion by exotic grass species into arid lands will result from climate change, causing an increased fire frequency. Rivers and riparian systems in arid lands will be negatively impacted.[48]

State Climatologist, Steve Gray, has warned that global warming could dramatically impact Wyoming, especially water supplies in the state. (See attached article). Communities in

---

[46] *See Mid States Coalition for Progress v. Surface Transp. Bd.*, 345 F.3d 520 (8th Cir. 2003) (holding increased coal consumption and global warming emissions was reasonably foreseeable effect of railroad expansion to transport coal).

[47] National Wildlife Federation, *Global Warming and Wyoming, available at* http://www.nwf.org/GlobalWarming/pdfs/Wyoming.pdf.

[48] USDA, *US Climate Change Science Program Releases Report on the Effects of Climate Change on Agriculture, Land and Water Resources, and Biodiversity*, Press Release, May 27, 2008. The report is available at http://www.climatescience.gov/Library/sap/sap4-3/default.php.

Wyoming, including the City of Gillette, are already facing water shortages and climate change impacts caused by increased uranium mining could intensify those impacts.

New nuclear power will not mitigate catastrophic climate change

Although nuclear power has been billed a solution to the climate crisis, unfortunately given permitting and construction timelines, new power plants will not mitigate the most severe impacts projected from global climate change.

We need solutions to global warming now – not in 20 or 25 years when new power plants may be in operation. Preeminent climate scientist Jim Hansen of NASA has been warning about dangerous levels of carbon dioxide for a number of years and has noted that carbon dioxide levels must remain constant or decrease from current levels in order to avoid the most catastrophic impacts of climate change:

> Hansen concludes that even if the human race could maintain today's level of atmospheric CO_2, which stands at 385 ppm - not even halfway to the atmospheric doubling we are headed for - sea level would rise several meters thanks to the disintegration of continental ice sheets.... If today's CO_2 levels would lead to several meters of sea-level rise - putting many coastal areas, housing hundreds of millions of people, completely underwater - then letting CO_2 rise to 560 ppm could lead to a disaster of unimaginable proportions. Even a rise to 450 ppm could be catastrophic, according to Hansen's team's analysis.[49]

In other words, proponents of nuclear power are wrong in concluding that new plants down the line could solve the world's climate crisis. A *New York Times* journalist recently reported that:

> [M]any energy experts have run the numbers on just how many nuclear power plants would have to be constructed between now and 2050 just to avert even a tenth or so of the projected increase in emissions of carbon dioxide coming from expanding use of coal in that span.
>
> According to analysis by Professors Stephen Pacala and Robert Socolow of Princeton University, the world, in the end, would need to build about 880 nuclear plants — twice the number operating worldwide today — by 2050 just to avoid that small fraction of projected emissions.
>
> So nuclear power, even in a best case, is only likely to be a small fraction of the long-term effort to curb emissions of carbon dioxide.[50]

The full cycle of nuclear power, including uranium mining and milling contributes to global climate change

[49] Michael D. Lemonick, *Global Warming: Beyond the Tipping Point*, Scientific American , Oct. 6, 2008, *available at* http://www.sciam.com/article.cfm?id=global-warming-beyond-the-co2&print=true.
[50] Andrew Revkin, *Debating the Facts on Oil, Nukes, and Climate*, NEW YORK TIMES, *quoting* other New York Times blog reports, October 8, 2008, *available at* http://dotearth.blogs.nytimes.com/.

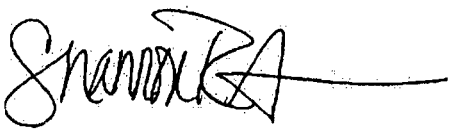
While the end product of nuclear power may not substantially contribute to global emissions of greenhouse gases, the full cycle of nuclear power, including ISL operations, will. For instance, ISL operations are power intensive, as demonstrated by the power needs of the Smith Ranch-Highland projects in Wyoming. (See attached photos). Almost all electricity in Wyoming is from coal-fired power plants. Coal-fired power plants are a leading emitter of greenhouse gases, such as carbon dioxide, and are thus a leading cause of climate change. Even if ISL sites will not use electricity from the grid, they will most likely use diesel generators, which also are strong contributors to climate change.

Additionally, ISL operations are transportation intensive. ISL operations require the use of heavy and light trucks throughout the process. Additionally, the yellowcake from these facilities must be transported all of the way to Illinois. Then the fuel is sent to a power plant. In most cases, this involves significant transportation efforts – whether it is trucks, trains, or boats in the case of exporting to plants abroad.

The environmental report that Uranerz submitted with its license application said the Hank and Nichols Ranch projects are estimated to emit 353.70 tons/year of carbon dioxide. The source of these emissions was not specified in the report, but the GEIS does state that some carbon dioxide used in the lixiviant is released during operations. GEIS at 4.2-35. Once again, NRC needs to analyze the cumulative and full life-cycle environmental impacts of this programmatic action.

Thank you for the opportunity to submit these comments. We hope they are useful in revising the Draft GEIS. Please keep our organization informed of developments related to the GEIS and future NEPA actions for ISL sites in Wyoming.

Sincerely,



Shannon Anderson, Esq.
Organizer, Powder River Basin Resource Council

List of Appendices

Appendix A: Specific Comments on GEIS
Appendix B: CEQ regulation regarding alternatives analysis
Appendix C: Documentation of spills at Smith Ranch-Highland ISL facility
Appendices D-G: Articles discussing socio-economic impacts of energy development in WY
Appendices H-I: Articles discussing current uranium market conditions
Appendices J-K: Articles discussing climate change impacts
Appendix L: Article discussing nuclear power and climate change
Appendix M: Article quoting PRBRC member Jim Jones and concerns regarding water resources

List of Attachments

Pictures of Smith Ranch-Highland facility
Response from BLM to PRBRC Freedom of Information Act request regarding GEIS
An Environmental Critique of In-Situ Leach Mining from Friends of the Earth
Documentation of problems at Smith Ranch-Highland facility
Effects of URI's Kingsville Dome Mine on Groundwater Quality from George Rice
WY DEQ settlement agreements with Power Resources Inc.
Letter from NRC to FWS regarding consultation for Nichols Ranch project
November 2008 Notice of Violation issued to Strathmore Resources
Consideration of Geochemical Issues in Groundwater Restoration at Uranium In-Situ Leach Mining Facilities, prepared by US Geological Survey on behalf of NRC, January 2007
March 2008 Notice of Violation issued to PRI with Report of Investigation
Uranium Mining and Water, prepared by Coloradoans Against Resource Destruction
Report on In-Situ Leach and Open Pit Mining, Larimer County Environmental Advisory Board
Socio-Economic Information from Wyoming Economic Analysis Division

Appendix A

Specific Comments on the GEIS

Section 1.1
Please explain the statement that "NRC's research indicates that the technology used for ISL uranium recovery is relatively standardized throughout the industry." What specifically has been standardized?

Section 1.2
Please give more information about the proposed federal action. Is the GEIS itself the proposed federal action? The GEIS states that "The proposed federal action is to prepare a GEIS…" If the GEIS itself is the proposed federal action how can the GEIS analyze environmental impacts of the federal action, which is really itself? The analysis seems to run in a circle. What specifically is the federal action proposed?

If there is in fact no federal action proposed by the GEIS, this could mean that there is still a future federal action with significant impacts (e.g. the licensing action taken at the site-specific level) that will require preparation of an EIS.

Section 1.3
Similar to the comments above, please give more information on the purpose and need for this proposed action. If the proposed action is truly licensing ISL projects, then the GEIS needs to detail the purpose and need of those licenses.

Section 1.4
Please explain whether the GEIS will be used to tier to site-specific analysis for projects located outside the geographic areas of analysis.

Section 1.4.1
Please state whether sites from agreement states, such as Texas, are included in the scope of "historical operations information from ISL facilities NRC licenses and regulates." It seems appropriate to include historical information from ISL facilities in agreement states to get a better picture of the true range of impacts of ISL facilities. If Texas facilities have been excluded from the analysis, please give a reason for this exclusion.

Section 1.4.3
Please explain how NRC is complying with 40 C.F.R. § 1508.27 to determine significance of impacts.

Section 1.5.3
The GEIS states that "Because the environmental impacts of national transportation of yellowcake uranium have been previously analyzed, they will not be studied in detail within this Draft GEIS." The NRC cites two studies to support this, one from 1977 and one from 1980. Please disclose whether these studies are still relevant given their age.

Section 1.6.1.1, 1.7.1
Please discuss staffing levels and needs at the NRC, both at your office in Maryland and in your regional office in Texas. How many staff members are allocated to enforcement for the four geographic regions identified in the GEIS? Will additional staff be hired to carryout permitting and enforcement activities?

Sections 1.6.1.2, 1.7.2, and 1.7.5.1
Please disclose whether ISL facilities in the past have received NPDES permits for the discharge of produced waters. If so, please disclose what environmental impacts this may cause. Given the hazardous pollutants present in this waste, NRC should prevent discharges of uranium waste water to waters of the state or waters of the United States.

Please describe in what situations a facility may require a stormwater discharge permit, e.g. only if the facility has an evaporation pond? Again, given the hazardous pollutants present in this waste water, it would be best for NRC to regulate pond levels to prevent storm water discharges into streams or other surface water sources.

Figure 1.7-1
Please add on your chart a requirement that the Draft EA will be made available for public comment.

Section 1.7.2.2, 1.7.5.1
The GEIS states that "Before any construction of or major modification to an ISL facility begins, a New Source Review permit scrutinizes the site-specific air quality impacts." Is this accurate? Please explain the thresholds for when an air quality permit will be required. Our understanding of clean air rules is a PSD permit is only required for major stationary sources (specific sources emitting 100 tons per year or more of any criteria pollutant or other sources emitting 250 tons per year or more). Fugitive emissions are generally excluded from this threshold. Even coal mines in the Powder River Basin generally do not need to obtain PSD permits. Other new source review permits may be required, such as a pre-construction permit. Facilities could be subject to either state-level BACT limits of New Source Performance Standards. Please discuss in detail what requirements ISL facilities must meet, including modeling, inventory of air emission sources (point and fugitive sources), emissions monitoring, and BACT measures.

If ISL facilities are not required to obtain air quality permits, why is this section in the GEIS? As whether an air quality permit is required is one indication of the significance of air quality impacts, shouldn't the GEIS disclose whether ISL facilities will need to obtain these permits? Also, if an air permit is not required, NRC should discuss air impacts in more detail as a separate public permit process will not be available to focus on these impacts.

Section 1.7.3
Please discuss the role of the Forest Service if projects are in National Forests, National Grasslands, or other land administered by the Forest Service.

Section 1.7.5.1

Please also describe the State Engineer's role in permitting groundwater rights for use in ISL operations.

Section 1.8
As discussed in Section 1-1 above, please explain what is "relatively standard" and thus can be incorporated by reference in site-specific NEPA analyses.

Section 1.8.4
Please specify the length of the public comment period for draft EAs. Will this be a 30, 45, or 60 day comment period? Given the complexity of the information in an ISL application, a longer comment period may be appropriate. Please also disclose that making the draft EA available for public comment is merely a proposal and is not a legally enforceable requirement embodied in regulation.

Section 2.1.1 and sidebar on pg. 2-1
If the four characteristics identified by Holen and Hatchell are not present, will NRC still license a project? Are there site-specific deviations to this formula that would allow ISL facilities even without the presence or perhaps with a limitation of one of the factors?

Section 2.1.2
Is there a difference between roll-front deposits and tabular deposits that would alter environmental impacts of ISL operations? Is one type of deposit preferable to another? The regional differences in uranium deposition and ore grade, if these differences alter potential environmental impacts, may necessitate further analysis in the GEIS or regional/site-specific documents.

Section 2.1.3
The GEIS says the surface extent of a full-scale ISL facility encompasses 2,500 to 16,000 acres. Obviously, this range presents substantial differences in environmental impacts. For currently licensed sites and sites proposed for licensing, what is their surface footprint? How typical is it for a site to be closer to the 2,500 acres as opposed to the 16,000 acres? For instance, do most sites have evaporation ponds and processing facilities? Will licensees share infrastructure for projects to reduce surface impacts?

Is analysis in the GEIS tied to sites that are 16,000 acres or 2,500 acres? If analysis of land impacts is based on smaller projects, will additional site-specific analysis be conducted for larger sites?

Section 2-2
The GEIS says that NRC could license a facility prior to requiring "a comprehensive discussion of all aspects of the site and of planned operations." If this is the case, how will NRC determine and analyze environmental impacts of a proposed project prior to taking a federal action?

Table 2.1.-1
This table lists constituents that are to be sampled to determine baseline water quality. However, the GEIS states that "an applicant can propose a list of constituents that is tailored to a particular

location." Please explain in what situations a tailored list will be appropriate. Please also discuss long-term monitoring required by the NRC or other agencies.

Section 2.3.1.1
Please disclose the typical well spacing for an ISL well field. How many wells does an average well field have? How many well fields are necessary for a typical ISL licensed site? Page 2-9 of the GEIS gives a range of wells (190-900) for each of 10 well fields at the Crow Buttes site – is this typical of other sites? Similar to the surface use range above, is it more or less typical for a site to be close to the 190 wells? Is it typical for a site to have 10 well fields – more? Less? What well spacing is used as the basis of analysis in the GEIS?

Do all ISL sites have deep disposal wells?

Please discuss how often a licensee must conduct a mechanical integrity test (p. 2-13). The typical time is every 5 years – are there situations when NRC requires more frequent testing?

Section 2.4.1.1
If an applicant proposes using an acid or ammonia-based lixiviant, will NRC conduct additional NEPA analysis given the statement that "For the purposes of the analyses presented in this draft GEIS, it is assumed that alkaline lixiviants will be used in uranium recovery operations"? GEIS at 2-15. The GEIS acknowledges that "The leaching agent chosen for the ISL operation may affect the type of potential contamination and vulnerability of aquifers during and after ISL operations."

Section 2.4.1.3
Please detail past history of ISL operations and the frequency and cause of excursions at these sites. Please discuss the likelihood of excursions and whether the factors listed in this section, e.g. "discontinuity within the confining layers" or "improperly abandoned exploration drill holes," are present for proposed ISL sites.

Section 2.4.1.4
Please explain why an excursion is defined to occur when "two or more excursion indicators in a monitoring well exceed their UCLs"? Why is an exceedance of one UCL not an excursion? Please also discuss NRC policy guidance with respect to criteria for determining the mining zone, especially when there are no confining areas between the ore zone and another zone. Determination of the mining zone may impact what is characterized as an excursion.

Please also add Section 2.4.1.5 on corrective measures required after excursions occur. This is particularly important for vertical excursions as identified in Section 2.4.1.4.

Section 2.4.3
Is one waste disposal method preferred over others? What is typically used at ISL facilities?

Section 2.5
What is the most effective method of groundwater restoration? Please discuss the environmental advantages and disadvantages of various restoration methods.

Section 2.5.3
The GEIS states that "Reverse osmosis and permeate injection are used after groundwater sweep operations." Are these restoration methods effective on their own?

Section 2.6, 2.7.3
Please expand this discussion. How are solid wastes disposed of – for instance, building materials, pipeline infrastructure, contaminated soils, used vehicles, etc.? Where is the nearest 11e.(2) licensed disposal facility to proposed ISL operations in Wyoming? The GEIS needs to discuss impacts from waste disposal. If solid waste is disposed of on-site, please discuss the solid waste permitting requirements, both state and federal.

Please explain reclamation standards for ISL facilities. Must operators reclaim the land back to its original contour and vegetative condition? Please correct line 29 on pg. 2-31 to read "returned to PRE-production" land use. The GEIS states that "After reclamation is complete, lands are normally capable of supporting wildlife and land uses such as livestock grazing." Please explain in what situations an ISL site would not return the land to a condition compatible with livestock and wildlife uses, particularly if those uses were pre-production uses of the land.

Section 2.11
Please also discuss historical experiences at ISL facilities in agreement states, such as Texas.

Section 2.11.4
Why are spills and excursions so frequent? Are there mitigation measures that would prevent them (or greatly reduce their occurrence)?

Why can wells be on excursion status for months and even years? Shouldn't these wells be shut down to correct the problem? What mitigation measures can be implemented to correct the situation in a timely manner?

Section 2.11.5
Why does aquifer restoration take so long? The GEIS notes that a recent study "generally concluded that for the sites and data they examined, aquifer restoration took longer and required more pore volumes than originally planned." Why is it so difficult for companies to accurately estimate how long it will take them to properly restore the aquifer?

Please explain the results of the US Geological Survey study released in January 2007 (NUREG/CR-6870) and its implications for groundwater restoration. A copy of the study is attached to these comments for your reference.

Section 2.11.6
Please disclose the amount of severance taxes and mineral royalties ISL operations have paid. Please compare this to other forms of mineral development, such as coal or oil and gas.

Section 2.12

Please explain why NRC did not analyze alternatives to the proposed action. Please explain how NRC is meeting the requirements of NEPA with only one alternative – the no action alternative.

Please explain the statement "The information in this section does not constitute NRC's final consideration of reasonable alternatives for the site-specific environmental reviews of ISL license applications." What alternatives are possible considerations at the site-specific level? And why are those alternatives not appropriate for consideration in the GEIS? It is common to have greater alternatives analysis in an EIS than in an EA, not the other way around.

Section 3.2.10
Please update your socio-economic information. Information more current than the 2000 Census is available, particularly from state agencies, and should be used in your analyses. Wyoming's demographics have changed since 2000, particularly in areas impacted by energy development.

Section 3.3.1
Although the GEIS is correct in stating that "land ownership in [the Wyoming East] region is predominately private," please discuss split estate situations. Although surface land may be privately owned, the ultimate decision of whether to have a uranium project may come from the mineral owner, which in some cases could be the federal government. Please discuss staking and requirements for claiming minerals under the 1872 Hardrock Mining Act.

Section 3.3.6.2
Please discuss air quality violations at coal mines and other air quality concerns in the Powder River Basin. See information available at http://deq.state.wy.us/aqd/NEAP.asp and other information in EISs from the BLM on air quality issues in the Powder River Basin. Most coal mines are just East or North of proposed uranium mining near Pumpkin Buttes. Please also discuss emissions levels from natural gas compressor stations and CBM natural gas fields.

Section 3.3.8.4
Please discuss the cultural significance of the Pumpkin Buttes area.

Section 3.3.10
Please update your socio-economic information. Information more current than the 2000 Census is available, particularly from state agencies, and should be used in your analyses.

Please explain why socio-economic information on Ft. Collins, CO and Billings, MT is included in the GEIS? Will workers from uranium mines live in these communities? If so, please address additional impacts that this will cause on roads and infrastructure because of the long commuting distances.

Section 3.4.4.3.2
Please explain how unplugged or abandoned exploration or previous production wells will impact the level of confinement of aquifers in this area.

As groundwater from the aquifers is currently being used for agricultural and domestic uses, how will these uses be protected?

Section 3.4.8.4.2
Please create a new section 3.4.8.4.3: Places of cultural significance in Wyoming and move the discussion about Devil's Tower and the Black Hills to that section.

Section 3.4.6.1
For all three Wyoming descriptions, in the meteorology and climatology section, please provide information on average wind speeds, with a wind rose graphic. Wind speed impacts the potential for air emissions to spread to nearby residences or communities.

Section 3.4.6.2
Air quality would not necessarily be similar to the Wyoming West region. Please provide analysis specific to this region. The Wyoming West region has natural gas fields and other impacts that this region does not have. Alternatively, this region has air impacts that the Wyoming West region does not have, e.g. larger population centers in Spearfish and Rapid City. Clearly, there was a reason for NRC to treat these as two different regions, so it is important to analyze them as separate.

Section 3.4.8.3
Please disclose whether tribal consultation will occur for Wyoming, particularly for ISL sites near Devil's Tower. As mentioned in our comments, we believe tribal consultation is necessary for this larger programmatic action in addition to the site-specific level.

Section 3.4.10.1
Please provide updated information for demographics. Information more current than 2000 is available, particularly from state agencies.

Section 3.4.10.3
Please explain whether hotels/motels are available during high tourism seasons. This region is dependent on tourism given national parks and monuments in the area and recreational uses in the Black Hills. Particularly during the summer, hotels, motels, trailer camps, and campgrounds may not be readily available for ISL workers, and in fact need to be available to support the tourism industry.

Section 3.4.10.4.1
Please explain why Casper was the chosen community analyzed in the Wyoming-South Dakota-Nebraska region.

Section 3.4.10.7
Please discuss the current needs of volunteer fire departments and emergency services. Many rural counties in Wyoming rely on volunteers to fulfill emergency service needs.

Section 4.2.1
Please confirm whether well fields will in fact be fenced or put another way, whether livestock and wildlife can safely graze amongst the wells in a well field.

Section 4.2.1.1
Explain why you would consider a project that spans three construction seasons temporary (Lines 10-12). We feel the NRC may have a different definition of "temporary" than ranchers in Wyoming. Please also explain the speed of reclamation. Are the "temporary" impacts both construction activities and reclamation to suitable rangeland? Please describe the mitigation measures that may be implemented by "responsible federal or state agencies such as BLM, USFS, or private entities." Please also describe cumulative impacts of the entire programmatic action, e.g. numerous ISL facilities in the region.

Please discuss well field spacing and whether livestock and wildlife can graze in a well field given the short distances between wells. Also, please confirm whether or not well fields will be open to hunting or recreational use during construction or operations. Again, please confirm whether or not well fields will be fenced as this greatly affects the level of impacts.

Please describe the requirements for surface owner consent. It seems that some of the areas of negotiation available in other mineral development (for instance relocating wells or access roads in oil and gas fields) may not be available for ISL given the amount of wells necessary to extract the mineral. Please describe what sort of accommodations have been made by industry in the past and thus how effective the surface owner consent process is.

Section 4.2.1.2
Impacts to land use during operation may actually be greater than impacts during construction given the length of operations.

Will "sequentially moving active operations from one well field to the next" be required as a mitigation measure? If so, please include this in the mitigation section.

Please also propose prohibition of land application of treated process water as either an alternative or mitigation measure. Impacts from land application may be significant given heavy metals and other hazardous materials present in the waste. As mentioned in our comments, topsoil is of particular importance to agricultural producers and land application may contaminate these soils beyond repair.

Section 4.2.1.4
Please describe the length of restoration/decommissioning and whether these impacts will in fact be "temporary."

Section 4.2.2
Please describe cumulative impacts projected from the programmatic action (e.g. at least several ISL projects in a close geographic area).

Most of this section does not make conclusions about the impacts. Please explain how information will be considered "common" and appropriate to incorporate by reference into site-specific NEPA documents. We agree that transportation impacts will vary considerably based on the exact location of a facility.

Section 4.2.2.2
Please explain why "most of the roads assessed for average annual daily traffic counts in the Wyoming West Uranium Milling Region have sufficiently high [traffic] counts." What roads are considered in that analysis? Presumably, rural access roads would not have high traffic. Even some of the other "major" roads in the area do not have high amounts of traffic.

Section 4.2.3.1
Again, please describe the expected length of time for construction activities to verify that they will in fact be "temporary." Even if temporary, please disclose whether these impacts will be *significant*. Please also discuss how voluntary best management practices satisfy as mitigation in NEPA analysis. If projects do not adopt these measures, will additional NEPA analysis be completed? This section says that impacts "are commonly mitigated." The conclusion from that statement is they are not always mitigated and again, it is voluntary on the part of the specific company. Please confirm that practices will be required as an enforceable condition of the federal license or state permit to mitigate impacts from top soil stripping, erosion, and other soils impacts. We disagree that impacts will be "small" – particularly if mitigation measures are not taken.

Section 4.2.3.2
Lines 18-20: please explain how the depth would decrease subsidence risks. Is this because of the "confining" layer?

Lines 27-28: have ISL projects occurred in the Wyoming West region? I think you may mean: "Based on historical ISL operations, reactivation of faults [is not anticipated] in the Wyoming West Uranium Milling Region."

Lines 30-44: Given the likelihood of spills based on past ISL operations, wouldn't likely impacts to soils from these spills be significant? What happens if an "immediate spill response" does not occur? Are the spill responses effective? Additionally, are there mitigation measures that the NRC could implement that would avoid or minimize, not just rectify impacts?

Lines 31-40: Again, given the past history of liner failure in evaporation ponds at ISL operations, wouldn't potential impacts be significant? Can the NRC implement additional mitigation measures to prevent or reduce the likelihood of such impacts?

Lines 42-50,1-9: Please refer to Wyoming Department of Agriculture comments on the use of land application as a waste disposal method. Given the presence of selenium and other heavy metals and radioactive materials in the waste, won't impacts of applying this to the land be significant? If soil concentration limits are exceeded, how is the soil disposed of during decommissioning? As noted in our comments, top soil is of particular importance to agricultural uses in Wyoming.

Section 4.2.3.3
See discussion regarding mitigation measures to prevent spills in the section above.

Lines 10-27: What is the length of the monitoring program? If land application is used, long-term post site-closure monitoring is necessary.

Section 4.2.4.1.1
Site-specific impacts of construction activities will vary substantially depending on local surface water resources and construction activities. Please explain how NRC will incorporate this general section into site-specific review.

Section 4.2.4.1.2
Lines 40-50: See comment above

Line 9-10: Why is a storm water WYPDES permit without numeric standards considered an appropriate mitigation measure?

Lines 31-32: The GEIS states that "because most, if not all ISL operations would be expected to occur where the ore-bearing aquifers are confined..." In what circumstances will an ISL facility be permitted if aquifers are not confined? If they are not confined, will additional NEPA analysis be completed?

Section 4.2.4.13
Impacts to surface water varies greatly based on the surface water present in the area, the method of waste disposal, frequency of storm water events, and artesian flow dynamics. As all of these factors vary greatly site-to-site, how will this section be incorporated into site-specific analysis?

Section 4.2.4.2.1
How much groundwater is consumed during the construction period? Will best management practices be license requirements?

Section 4.2.4.2.2
Please clarify what impacts are significant. Please also clarify how information in this section will be applied to site-specific analyses given the significance of site-specific hydrogeology.

Please also discuss recharge rates to determine the true significance of groundwater consumption or will this be considered at the site-specific level?

Lines 4-15 (page 4.2-21): Please explain why impacts of consumptive use would only be "moderate" if local water users use the production aquifer or if the production aquifer is not well-isolated from other aquifers that are used locally. Why are impacts of *water consumption* dependent on other water users? Although other impacts, such as depleting drinking water or livestock water sources, would be greater if local users are present, consumption impacts would be the same regardless. As stated in our comments, water is an incredibly valuable resource in an arid state like Wyoming. Even if local water is not used currently, it could be needed in the future, and impacts should be analyzed regardless.

Line 36: We disagree with the conclusion that water quality impacts during operations would be "small and temporary." First off, please explain what you consider to be temporary – sites last

for approximately a decade or sometimes longer. Second, if you are analyzing impacts DURING operations, why is restoration that occurs after operations considered? The first sentence in this section is very appropriate: "Groundwater quality in the production aquifer is degraded as part of the ISL facility's operations." How then, can impacts during operations be "small"? Even if restoration is valid to consider, it has been shown that ISL facilities do not return groundwater to baseline conditions even after restoration so by its very nature, groundwater resources will be degraded during and after ISL operations.

Lines 40-50: The GEIS estimates that impacts from excursions will be "moderate to large." These impacts must be analyzed before licensing. Which is it – moderate or large? And are either of these significant? Given the probability (and in fact occurrence at previous ISL sites) of excursions of large volumes of injection and production fluids, how can the NRC determine that these impacts will be anything but significant?

Line 11-12 (page 4.2-23): The GEIS states "These specifications typically are made conditions in the NRC license." Please state definitively whether these requirements are in fact license conditions and therefore can be considered mitigation measures. Please also describe the effectiveness of these mitigation measures given the past history of excursions at ISL facilities.

Section 4.2.4.2.3
Please explain how this section will be used in site-specific analysis given the statement on page 4.2-26 that "The potential environmental impacts of groundwater consumption during restoration could be small to moderate depending on site-specific conditions." Please also define significance for groundwater consumption.

Are water quality impacts significant? Lines 30-39 describe restoration standards, but then do not determine whether impacts to water quality after restoration are significant.

Section 4.2.4.2.4
Once again, please explain whether best management practices are considered enforceable mitigation measures.

Section 5.2.5.1
Lines 11-12 (page 4.2-28): please disclose whether licensees would control noxious weeds or would merely "be expected" to control them. Are these measures federal license requirements or state mine permit requirements (or preferably both)? The spread of noxious weeds from industrial activities in Wyoming is a major problem for landowners.

Wildlife: how will this section be incorporated into site-specific analysis? Will additional site-specific analysis be conducted to disclose impacts to wildlife populations? In this section, there is no analysis of wildlife surveys or other bases from which to determine the significance of impacts.

Lines 33-35 (page 4.2-32): will Wyoming Game & Fish guidelines be required? Are they mentioned merely for reference or will they be used as mitigation measures?

Section 4.2.6
How will this section be incorporated into site-specific analysis? The GEIS acknowledges that the section is merely a "general discussion" and "conditions reflect the fact that determining the significance of ISL mining facilities impacts on air quality depends on the emission levels of the proposed action and the existing air quality in the defined region of influence." We would also add site-specific conditions such as wind speed and direction and cumulative sources of pollution.

Lines 20-21 (page 4.2-34): why are diesel emissions limited to construction activities? Will ISL operations require diesel generators?

Line 28: Why is information from New Mexico being used to determine the significance of impacts for sites in Wyoming?

Lines 48-2: What emissions limits are used for diesel generators? Are these not unregulated sources in Wyoming?

Please also expand the discussion on fugitive dust during construction activities (creating or expanding roads, etc.)

Line 42-43 (page 4.2-35): Just because ISL operations do not require a Title V permit, does this automatically mean emissions will be "small"? There are other criteria for determining the significance of air impacts. Also, merely because NAAQS limits are not exceeded does not mean that air impacts do not occur. Wyoming has, in general, good air quality but it has been degraded because of industrial sources. NAAQS is an upper limit of healthy air; citizens of Wyoming want to keep our air much below that level.

Lines 34-36: Please confirm that ISL operations do not produce diesel emissions. What if diesel generators are the source of power for ISL operations?

Please expand the analysis to describe specific levels of potential fugitive dust emissions and the significance of those emissions.

Section 4.2.10
As explained in our written comments, please greatly expand the discussion on socio-economic impacts using updated information on housing availability and affordability, school enrollment information, hospitals, etc. Please also discuss impacts such as increased drug rates, drunk driving, and traffic.

Section 4.2.11
Please add discussion of groundwater contamination to this section.

Section 4.3.1
Please see comments and questions above regarding land use impacts.

This section must analyze impacts as a result of split-estate situations.

Section 4.3.3
Please see comments and questions above regarding geology and soils impacts.

Section 4.3.4.1
Please see comments and questions above regarding surface water resources impacts.

Line 27, 37, 48 (page 4.3-9): Although there are few perennial streams in the region, there are a number of ephemeral drainages that are important tributaries to perennial streams, such as the Powder and Platte Rivers. These are regulated water bodies in the state of Wyoming.

Section 4.3.4.2
Please see comments and questions above regarding groundwater impacts.

Section 4.3.5
Please see comments and questions above regarding ecological resources impacts.

Lines 10-11 (page 4.3-19): Is this statement accurate? Please explain any differences in vegetation between the Wyoming West and Wyoming East regions.

Lines 26-34: Please explain whether the Wyoming Game and Fish Guidelines will be enforceable mitigation measures.

Section 4.3.6
Please see comments and questions above regarding air quality impacts.

Line 48 (page 4.3-21): what "applicable regulatory limits and restrictions" apply to ISL facilities?

Section 4.3.10
Please see written comments on socio-economic impacts and comments and questions on the Wyoming West section above. A comprehensive analysis of housing availability and impacts to housing stock and affordability is needed. The same is true for local motels or other housing arrangements that could be used.

Section 4.3.10.4
Please discuss potential socio-economic destabilization related to mining busts.

Section 4.3.11
Please also discuss groundwater contamination in this section.

Section 4.4.1
Please see comments and questions regarding Land Use Impacts in the Wyoming West section above.

Section 4.4.3
Please see comments and questions regarding Geology and Soils Impacts in the Wyoming West section above.

Section 4.4.4
Please see comments and questions regarding Water Resources Impacts in the Wyoming West section above.

Section 4.4.5.1
We question whether vegetation in this region is similar to the Wyoming West region. In particular, this region contains National Forest lands.

We also question whether impacts to aquatic resources would be similar given the number of water bodies in this region.

Section 4.4.6
Please see comments and questions regarding Air Quality Impacts in the Wyoming West section above.

Lines 10-11 (Page 4.4-22): While we acknowledge that Wind Cave National Park is located within the region and we encourage NRC to analyze air impacts to that Class I area, please confirm whether "more stringent Class I allowable increments would apply." As noted above, if ISL facilities do not need to obtain air quality permits, no requirements would apply.

Section 4.4.10
Please see comments and questions regarding socio-economic impacts above. Please fully describe the context and intensity of these impacts.

Section 5 – The section on cumulative effects must be substantially revised. Lists do not count as analysis. The GEIS acknowledges that "cumulative effects assessment is an important part of the licensing process for ISL projects" GEIS at 5-1 but then does not do this assessment.

Section 5.2.1
Please also assess past exploratory activities and whether there are unplugged and/or abandoned exploration wells present in the area.

Please also assess non-NRC licensed uranium recovery sites, such as underground or open-pit mines.

Please explain how these past and current activities could contribute to cumulative impacts from proposed activities.

Section 5.2.2
While we agree that EISs could be some indication of the level of development in an area, the mere listing of these documents is no where sufficient to determine the significance of cumulative effects. The number of permits issued by federal and state agencies may be a better

indication, but again, the site-specific and regional information is critical. The NRC needs to analyze these impacts, not just assume that they were analyzed in previous documents. None of these previous documents considered 20-30 new ISL projects in the region.

Additionally, a number of BLM and Forest Service field offices in regions covered by the GEIS are revising resource management plans. Please explain how the GEIS will contribute to or complement those efforts.

Specific comments:

- The Dry Fork Station is moving forward and is currently in construction. It was only the EIS process that was withdrawn.
- The Casper BLM office just released a new EIS on four new coal lease tracts in the PRB.
- The BLM will have most likely finalized the West Antelope Coal Lease Application by the time the final GEIS is released so please update that information.
- Some PEISs, such as the Powder River Oil and Gas EIS (covering CBM development), were issued before 2005 and are still applicable to new projects in the area.

Table 5.3-1
Please add wind projects and transmission lines to the table.
Please add new coal plants in Campbell County and related transmission lines to the list.

Please analyze the extent of all of this development and the cumulative effects of new ISL projects.

Table 5.3-2: Please verify this information with the Casper Field Office of the BLM and/or Wyoming DEQ Land Quality Division. Please extend this information through 2008 and projected through the lifetime of the ISL facilities.

Please combine tables 5.3-1 and 5.3-3 as they are repetitive. Either that or separate out the information for each region.

Section 7 – Please disclose which of these practices qualify as mitigation measures for NEPA analysis. As discussed throughout our comments, voluntary best management practices should not be considered enforceable measures that will appropriately mitigate environmental impacts.

Appendix B

Sec. 1502.14 Alternatives including the proposed action.

This section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Affected Environment (Sec. 1502.15) and the Environmental Consequences (Sec. 1502.16), it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public. In this section agencies shall:

(a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.

(c) Include reasonable alternatives not within the jurisdiction of the lead agency.

(d) Include the alternative of no action.

(e) Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.

(f) Include appropriate mitigation measures not already included in the proposed action or alternatives.

Appendix C

ADAMS Accession Number ML082390093

From: John McCarthy [John_McCarthy@cameco.com]
Sent: Monday, August 18, 2008 5:50 PM
To: 'Rothwell, Pam'
Cc: 'Steve Ingle'; Douglas Mandeville; Krista_Wenzel@cameco.com; 'Chuck Foldenauer'; Scott_Bakken@cameco.com
Subject: Spill Notification

Pam,
A spill of injection fluid was identified via computer monitoring system by a wellfield operator at 1:00 am on August 17, 2008. The spill occurred due to a failed line fusion at the injection trunk line to Header House K-6. The operator immediately shut down the trunk line then a vacuum truck recovered 450 gallons of solution. The fluid was transferred to the Smith Ranch evaporation pond for ultimate disposal through the deep disposal well. A sample of the spilled solution has been collected and will be forwarded to Energy Labs for analysis of uranium, radium 226, selenium and arsenic. The preliminary uranium concentration of the solution was 1.4 ppm. In addition soil samples and gamma surveys will be obtained from the impacted and background areas. A map of the spilled area and sample locations will be supplied with the official report.

The spill did not threaten waters of the state and was contained within a topographical bowl. The spill committee will investigate and make recommendations for preventative actions. As a standard practice, Mr. Joe Hunter of WDEQ/WQD was notified by phone.

Regards,
John McCarthy
Manager, Safety, Health and Environment, RSO
Cameco Resources
Smith Ranch-Highland
P.O. Box 1210
Glenrock, WY 82637
Phone: (307) 358-6541, ext. 46

ADAMS Accession Number ML082670520

From: John McCarthy [John_McCarthy@cameco.com]
Sent: Wednesday, September 17, 2008 6:43 PM
To: 'Rothwell, Pam'
Cc: 'Steve Ingle'; Douglas Mandeville; Krista_Wenzel@cameco.com; Thomas_Cannon@cameco.com; Scott_Bakken@cameco.com
Subject: Spill Notification

Pam,

A spill of injection fluid was identified by a wellfield operator at 1:30 am on September 17, 2008. The spill occurred due to a motor overheating a 12-inch poly line at booster house K field injection line. The operator immediately shut down the line then a vacuum truck recovered 12,842 gallons of solution. The fluid was transferred to the Smith Ranch evaporation pond for

ultimate disposal through the deep disposal well. A sample of the spilled solution has been collected and will be forwarded to Energy Labs for analysis of uranium, radium 226, selenium and arsenic. In addition soil samples and gamma surveys will be obtained from the impacted and background areas. A map of the spilled area and sample locations will be supplied with the official report.

The spill did not threaten waters of the state. The spill committee will investigate and make recommendations for preventative actions. As a standard practice, Mr. Joe Hunter of WDEQ/WQD was notified by phone.

Regards,
John McCarthy
Manager, Safety, Health and Environment, RSO
Cameco Resources
Smith Ranch-Highland
P.O. Box 1210
Glenrock, WY 82637
Phone: (307) 358-6541, ext. 46
pri_jmccarthy@vcn.com

Appendix D

http://www.nytimes.com/2008/10/05/us/politics/05wyoming.html?_r=1&scp=1&sq=rock%20springs%20wyoming&st=cse&oref=slogin

Road to November

In a Red State Rolling in Green, a Relaxed Attitude

By JENNIFER STEINHAUER

ROCK SPRINGS, Wyo. — There are any number of ways to gauge an economic boom, and here lap dances may be a pretty good measure.

"I make over $100,000 a year," bragged Eric Palmer, who works as a gas field operator in a town that has enriched many of them. Mr. Palmer was surrounded by a bevy of strippers at the Astro Lounge, all of them eager to take advantage of his generosity. "I spend $3,000 a weekend here," he said. "I just love the company of beautiful women."

The women in Rock Springs, off Interstate 80 in southern Wyoming, seem to like Mr. Palmer and his ilk, which is why they travel from cities across America — often places where the economy has tanked — to make thousands of dollars a week at places like the Astro Lounge. Most of their customers are men who work in natural gas exploration and production and who have few other ways or places to spend money on their rare days off.

The gas industry has almost single-handedly set Wyoming in stark contrast to the rest of the nation, where industries have fallen on hard times, homes are in foreclosures and many Americans have lost their jobs. While other states are laying off workers and cutting programs, Wyoming has enjoyed billions of dollars in surpluses in recent years.

There is a sort of relaxed composure here that other towns in America are not enjoying as the race for president enters its final chapter. Many voters here seem to agree: whoever wins is not likely to stand in the way of Wyoming and its natural gas fortunes.

"We have the opposite economy of the rest of the United States," said Steve Aaron, who was eating dinner at the Coyote Creek steak house across the street from the Astro Lounge. Mr. Aaron works in the court system and is a part-time minister. "But we still wonder and worry about what's going on around the rest of the country," he said, "even though people in the oil fields are making more money than they ever have in their lives."

The fortunes here stem from the state's enormous supply of natural gas — its reserves are second only to Texas — and its role in supplying not only a demanding domestic market but other nations as well. Wyoming, the home state of Vice President Dick Cheney, has benefited from the Bush administration's energy policies, which opened up land for natural gas drilling.

Men making $15 an hour five years ago now take in as much as $26, and it all makes for very deep pockets for the workforce, much of it drawn from out of state. There is not very much to do in this town but work, and that is enough for most people.

"I was drawn here for economic reasons," said Colt Felmlee, 24, who was interviewed at the steak house. Mr. Felmlee, a foreman for an oil fields service company, moved here from Montana, where the wages are not as high. "I don't find it hard to relate to the rest of the country's problems because I've been there," he said....

All the industries that serve oil workers — steak houses, title brokers and bars — have done well in the boom.

"I find it odd that we are so for finding alternative sources of energy when this is where the money is," said Meesa, a stripper in the club who came from Idaho and asked to be identified by only her stage name. She makes about $500 a night. "The guys here are paid hand over fist for extremely hard labor," she said, "and there is no where to spend it here but on us."

Appendix E

Small town, big changes

Want more domestic energy? Take a look at how big oil and gas companies are transforming lives in a small cow-town.

By Steve Hargreaves, CNNMoney.com staff writer
Last Updated: October 20, 2008: 5:21 AM ET

PINEDALE, Wyo. (CNNMoney.com) -- The United States is in the midst of one of the biggest domestic oil drilling booms in recent history. High prices and better technology mean that previously inaccessible energy reserves across the nation are ripe for exploitation.

Places like North Dakota, New York, Tennessee and Kentucky, not generally associated with the oil and gas industry, are getting a taste of what it's like to have major oil and gas development in their back yard - the benefits and the headaches.

As states across the country grapple with this new drilling, Wyoming - which has been drilling for oil and gas for over 100 years and is currently in the midst of a huge boom itself - can offer a window into the lives of people impacted by this necessary but controversial industry.

While money from this boom is literally overflowing Wyoming's government coffers - there's no state income tax, nearly every college bound student is getting scholarships and communities pay cash to build schools and recreation centers - many residents wish that the rate of progress could just slow down.

Traffic clogs once quiet streets. Rents have skyrocketed. Contaminated drinking water and mysterious illnesses - which some say result from lightly regulated drilling practices in the state - have made people in Wyoming nervous. It's not that people want the drilling to stop, they just want it to slow down - and they want it done right.

"I like to have heat and fuel just like everyone else," said Jeff Locker, a 54-year old barley farmer living near Pavilion, a town of 165 people in the Western part of the state. "But they need to strengthen the regulations and oversight. No one checks what these people are doing out here."

Tainted water

Locker says he's now paying the price for that lax oversight. He and several of his neighbors say the drilling has contaminated their water.

These aren't tree-hugging Wyoming transplants. These are people like Louis Meeks, a disabled Vietnam veteran from Riverton, Wyo., who bought a house near Locker 30 years ago.

"We were planning on staying here [to retire], now I'd like to get out," said Meeks.

But as he filled a tub with water from his well, a rainbow sheen like an oil slick appeared on the surface. The water smelled like gasoline. It was clear that Meeks - who now gets his drinking water trucked in - is going to have a hard time selling his house.

"These guys are going to leave with their bag of money, and leave us high and dry," he said. 'It ain't right."

John Fenton, a 36-year old hay farmer living up the road from Meeks is also angry with the drilling.

Fenton farms 200 acres that have been in his family for generations. But like many landowners in the West, he doesn't own the mineral rights beneath his property. So now at least a dozen natural gas wells have sprouted up in what is essentially his front yard.

His wife periodically loses her sense of taste and smell, while his 11-year old son suffers epileptic seizures. Fenton says the energy companies don't properly capture the fumes that come from the wells.

Meeks and Locker also say family members have come down with debilitating aches and pains, and blame it on the gas wells - although they freely admit establishing a concrete link between the industry and their illnesses is very difficult.

Even establishing the source of Meeks' water contamination is difficult.

A spokesman for EnCana, the Canadian energy outfit that owns the well near Meeks' house, said it's bacteria, not the oil company, that's responsible for the contamination. Hydrocarbons like oil or diesel fuel, they say, have not been found in the well.

Each side has independent tests supporting their claim, and the state's Department of Environmental Quality is still trying to get to the bottom of it.

Air and land pollution

The environmental issues go beyond the water. Further west from Pavilion lies the considerably larger town of Pinedale - population 1,412.

Pinedale is rustic old cow town lying just west of the chiseled Wind River mountain range. The town has one main drag, a handful of bars and restaurants, no stop lights, and a booming natural gas industry.

Along the plateau east and south of town lies some of the country's most prolific natural gas production, accounting for 3% of what is produced in the U.S.

Most of it is sent to California - a state fighting to reduce its greenhouse gas emissions - for electricity production, cooking, or heating homes. Because it is cleaner than coal, and abundant domestically, natural gas has become one of the most important fuel sources for this country.

But while there are ecological benefits to burning natural gas for the U.S. as a whole, Pinedale is paying a price.

For five days last year, Pinedale had air quality that rivaled the city of Los Angeles. The trucks, drill rigs, and gas-gathering equipment in the oil fields themselves are spewing tons of pollution into the otherwise clean Wyoming air.

"When the ozone alerts came, the DEQ advised us to no go outside and recreate," said Linda Baker, a coordinator at the environmental group Upper Green River Valley Coalition. "And we're in one of the outdoor recreation capitals of the world."

The agency that governs oil and gas leasing on federal land in Wyoming, the Bureau of Land Management, says air quality is one area where regulators dropped the ball. And Chuck Otto, the BLM's field manager in Pinedale, says the agency certainly could use more staff.

But overall, he thinks regulators and the industry are doing a good job balancing the need to develop this domestic energy resource and protecting the environment.

"Would I rather see rolling sage brush with elk and deer, yes," says Otto, a career BLM man who got his start wrangling horses. "But the companies are trying to do a very good job updating their equipment, and we have to accept the realities that we need the energy here."

EnCana, which has big natural gas leases on land near Pinedale along with BP, Shell and a handful of other companies, is putting their drill rigs on giant wooden pallets in an effort to protect the sage brush. The company says it is also running its drill rigs on the cleaner burning natural gas, and working on a central gas gathering system that will reduce air pollution.

The company recognizes its impact on the environment and the difficulty it has in balancing our energy needs with its ecological responsibility.

"People want it all, they want it in abundance, and they want it at a reasonable price," says Randy Teeuwen, a spokesman for EnCana. "But they assume it comes from a plug in the wall. They don't want to know the details of how it gets there."

Because the drilling has fragmented the habitat for mule deer and sage grouse, wildlife officials have noted a decline in their population.

Locals say slowdown

In addition to the environmental issues, the influx of people drawn to work in the natural gas fields - many from Texas and Louisiana - has created a bevy of social problems in towns across Wyoming.

Statewide, drunk driving arrests jumped nearly 10% in 2007, and several reports have noted a rise in the use of crystal meth, a stimulant which some have tied to the 12-hour shifts common in the oil and gas fields.

In Pinedale, a one-bedroom apartment can go for $1000 a month, a stretch for anyone not making $60,000 a year in the gas fields. Local business are struggling to find workers.

"It's hard to get people to stay because the oil industry pays so much," says Pat Schwab, 50, pouring drinks on a Monday night at the Cowboy Bar, a main street watering hole often filled with gas field workers.

This night was slow - maybe a half dozen people in the bar. But Schwab also works Fridays when the bar is packed with young working men looking for a good time. On Fridays she also flies solo - no bouncer, no dishwasher, no one to back her up in case there's trouble.

"You can't find help in this town, so when you're slammed, you go it alone," she says.

Shane Thomson, owner of the Half Moon Motel just off the main drag, also says it's hard to find help. He pays his housekeepers $10 an hour, plus provides them a free place to stay. But for Thompson life would be easier in Pinedale if the energy development was more measured.

'It would be nice if they could slow it down a bit," he said, echoing the feelings of many others in town. "It seems to me like they're trying to push it through all at once."

For other states facing or soon to face the oil industry, the main advice people in Wyoming have is to be proactive. Set up a natural resource tax that can fund schools, roads and health clinics, and get some state money to do it before the workers pile into town. Make sure the environmental rules are up to snuff, and the state has the manpower to enforce them.

And most of all, make sure the industry's plans, the the town's preparations, are all known to the public.

"A lot of these things happen without the involvement of the common person who goes to work eight hours a day," said lifelong area resident Sara Domek, 23, having a drink in the town's eco-minded coffee shop. "And then there's a new drilling rig right behind their house, and they're wondering why." ■

Appendix F

Wyo. inflation rate highest since 1980s

Published: Thursday, October 2, 2008 4:36 AM CDT

CHEYENNE, Wyo. (AP) — New figures from the state show that Wyoming's annual inflation rate in the second quarter was 7.9 percent — highest since the 1980s.

The national annual inflation rate in June was 5 percent.

Transportation costs in Wyoming increased 15 percent compared to the same quarter last year. Food prices rose 7.4 percent.

The Wyoming Division of Economic Analysis says housing also fueled Wyoming's high inflation. Inflation for housing was 7.2 percent in the second quarter.

Housing costs are down elsewhere. State economist Justin Ballard says housing is up in Wyoming because of people moving into areas with booming energy development.

Appendix G

Bill would allocate severance tax money for state highways

From staff and wire reports

Published: Sunday, August 3, 2008 12:54 AM MDT

CHEYENNE □□" State lawmakers are talking about using some of the state's severance tax revenue to pay for widening and expanding some of Wyoming's more congested highways.

Severance taxes are levied on resources extracted in the state. The Legislature's Joint Transportation, Highways and Military Affairs Committee has decided to sponsor a bill next legislative session that could allocate $10 million to $15 million a year in severance tax revenue for highway construction.

"We think these improvements are important enough that there should be money set aside to do them," said Sen. Michael Von Flatern, R-Gillette.

Del McOmie, chief engineer for the Wyoming Department of Transportation, said traffic on parts of some state highways has reached full capacity. He said other highways are nearing about as much traffic as they can handle.

Highways eyed for widening include Wyoming Highway 59 between Wright and Gillette, U.S. Highway 191 between Rock Springs and Pinedale, and Wyoming Highway 220 south of Casper.

"What we see on these routes is they typically have a higher accident record," McOmie said. "That's one of the reasons for trying to move these projects forward."

In the committee's May meeting in Gillette, McOmie said that Highway 59 was already at full capacity with more than 5,000 vehicles traversing the road a day in a 2004 study. The addition of temporary passing lanes in recent years has eased some congestion, but that the only way to improve the full capacity of the road is to add more lanes.

If approved, the bill would divert a portion of the severance tax revenue that currently flows into the Legislature's reserve fund to WyDOT for highways. A portion of that amount would go into an existing multilane highway account that was created by the Legislature several years ago but never funded.

A goal of allocating a steady stream of annual funding would be to speed up completion of projects that have been through the planning process and are ready for bidding.

The Legislature has appropriated millions in additional highway funds in recent years: $11 million in 2005, $75 million in 2006, $95 million in 2007, and $190 million in 2008. Even with the increases, WyDOT officials have said they need an additional $250 million a year to catch up on overdue highway work and to maintain the state highway system.

They say that increased traffic, heavier vehicles, less federal funding and large increases in construction costs are driving the need for more state highway funding.

Appendix H

http://www.mineweb.com/mineweb/view/mineweb/en/page38?oid=63616&sn=Detail

Uranium prices fall again as credit crunch bites

Author: Barry Sergeant
Posted: Wednesday , 01 Oct 2008

JOHANNESBURG -

Scores of investors in dozens of listed uranium stocks around the world were once again disappointed in the past few days as uranium oxide prices moved down again, this time, to two year lows. Specialist trade entities Ux Consulting reported spot prices falling this week to USD 53/lb, down by USD 5/lb, while TradeTech reported USD 55/lb, also down USD 5/lb.

Ux Consulting, which also reported that the term
(contract) market price fell USD 5/lb to USD 75/lb, after remaining at around USD 90/lb for much of the past 12 months, told its clients that the continued credit crisis gripping the US and its impact on the world economy was also impacting the uranium market. The uranium market, states UX Consulting "has experienced a great amount of activity as sellers (including hedge funds) have adopted a more aggressive posture to the market".

Ux Consulting believes the credit crisis does not bode well for the future of nuclear power as economic growth will likely be much slower in the future "resulting in a reduced need for new electricity generating capacity". Furthermore, "nuclear power plants are highly capital intensive and require a great deal of financing, which will now be more expensive and difficult to obtain".

The rate of uranium mine production expansion is expected to be cut back due to a recent falls in price, coupled with continued high production costs: "some projects may now be unprofitable and go undeveloped".

The spot uranium oxide price has crashed since peaking around USD 138/lb in June 2007. In the past few years, as uranium spot prices rushed upwards to the 2007 peak blow off from starting lows of around USD 10/lb, an investor mania spurred enormous growth in numbers of would-be uranium diggers. The demand side was seen as an irresistible story, with global energy requirements pushing utilities to seek alternatives to conventional power plants, and switching heavily into nuclear choices.

Corporate activity in the global uranium sector has been relatively muted. Rio Tinto, the diversified major mining stock, recently acquired a stake of 11% in Kalahari Minerals, which holds 39% of Australia-listed Extract Resources, in which Rio Tinto recently acquired a 13% stake.
Extract Resources has been in the news recently, on materially positive drill analysis results announced by it out of Namibia, from the Rössing South discovery.

On 5 September, Kalahari Minerals and Extract agreed to a friendly merger, by way of a scheme of arrangement, where Kalahari Minerals would bid 1.6 of its shares for each Extract Resources share, creating a "Mergeco" with some 341m shares in issue. Rio Tinto currently stands as No 2 uranium producer in the world, after Canada-based Cameco. Rio Tinto holds a majority stake in ERA, and also owns 69% of the Rössing mine, known to uranium specialists as the "grand old lady" of the Namibian uranium industry.

Uranium-related activity and development in Namibia gained a relatively high profile in August 2007, when Areva, world No 3 uranium miner, paid USD 2.5bn for Uramin, formed just two years previously to acquire and develop mineral properties, predominantly uranium, in Namibia, the Central African Republic and South Africa.

Extract Resources ranks as one of the better performing of dozens of listed uranium stocks, currently trading "just" 26% off its high price, compared to industry bellwether Cameco (down 54%), and favoured growth story Paladin (down 57%). Paladin recently announced a new resource estimate for the Langer Heinrich project in Namibia, where it has been mining since late 2006.

Further names present in Namibia include Bannerman (down 84%), Deep Yellow (down 58%), Xemplar (down 97%), and Forsys, down a "very"
modest 20%. The relative outperformance of Forsys among uranium names is based at least in part on the recent grant of a mining license for its Valencia uranium project, 25km east of the Rössing Mine.

Appendix I

http://www.financialpost.com/story.html?id=862391

Between a rock and a hard place

With the junior mining sector in disarray, the mood at the Toronto Resource Investment Conference over the weekend was grim and downcast.

The annual gathering of junior miners, letter writers and retail investors is normally an upbeat affair full of outrageously bullish predictions for the sector.

But at this year's show, there was a realization that many of the companies on display will not even be around next year in their current form.

"We had maybe about 2,000 juniors at the peak. I think we'll see at least a quarter to a third of them in the next six months stop being an active company," said Peter Grandich, publisher of the Grandich Letter.

The credit squeeze has made it impossible for many junior mining companies to raise money. As a result, the ones that are running low on cash have simply stopped doing anything, and the ones that have cash are being very prudent with it.

Meanwhile, commodity prices are cooling off, hedge funds are forced to liquidate positions and costs on mining projects are soaring. The result is that share prices are plummeting as investors have no confidence that the juniors will ever be able to develop their projects.

It made it difficult for the companies at the conference to put a positive spin on things.

"No one wants to finance anything in this market. If you need financing, God help you, it's pretty brutal," said Mark Kolebaba, chief executive of Diamonds North Resources Ltd.

Diamonds North made a potentially huge diamond discovery early this year, but it still plummeted back to penny-stock territory in the past few months like nearly all its junior counterparts.

"Last year, you couldn't get the people or the drills you wanted. This year, it's a complete turnaround. You can get the people and the drills, but you won't be able to raise money," Mr. Kolebaba said.

At the conference, there was little optimism that things will get better in the near future as the credit crunch gets worse and a global economic slowdown looms.

A popular theme at the show was the so-called "disconnect" in which commodity prices remain relatively strong, but many junior companies trade at a discount to their cash.

John Kaiser, publisher of the Kaiser Bottom Fish Online report, told an audience that a healthy "washout" is coming in the junior sector, in which the companies that survive are the ones with strong management teams and "pounds in the ground" that can be mined. This is a great buying opportunity for those companies, he said.

"All of this fear and angst that we're seeing now is pushing the supply pipeline farther into the future. And [therefore] we might see a period with metals taking off again and spiking to crazy levels," he added.

When the junior sector does recover from its current state, the consensus from the industry insiders is that it will look a lot different than it does now. While bank financing will eventually pick up again, the banks will be much more selective of which juniors they give money to than at any other point in the past five years. Company executives said more emphasis will be put on raising money from senior mining companies, strategic Asian buyers and even private equity.

"The senior companies with good cash flow should be like kids in a candy store looking for good prices and looking to consolidate," said Brian Gavin, chief executive of Franconia Minerals Corp.

Mr. Gavin added that most juniors are preparing to hunker down for anywhere from six months to two years as they conserve whatever cash they have on hand. He is confident bank financing will come back, but also said the junior mining sector will not be the first place banks turn to when they're eager to lend again.

"We're the first ones turned away from the banquet and the last ones given a knife and fork to come back," he said.

Appendix J

U.S. CLIMATE CHANGE SCIENCE PROGRAM RELEASES REPORT ON THE EFFECTS OF CLIMATE CHANGE ON AGRICULTURE, LAND AND WATER RESOURCES AND BIODIVERSITY

WASHINGTON, May 27, 2008 -- The U.S. Climate Change Science Program (CCSP) today released "Synthesis and Assessment Product 4.3 (SAP 4.3): The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States." The CCSP integrates the federal research efforts of 13 agencies on climate and global change. Today's report is one of the most extensive examinations of climate impacts on U.S. ecosystems. USDA is the lead agency for this report and coordinated its production as part of its commitment to CCSP.

"The report issued today provides practical information that will help land owners and resource managers make better decisions to address the risks of climate change," said Agriculture Chief Economist Joe Glauber.

The report was written by 38 authors from the universities, national laboratories, non-governmental organizations, and federal service. The report underwent expert peer review by 14 scientists through a Federal Advisory Committee formed by the USDA. The National Center for Atmospheric Research also coordinated in the production of the report. It is posted on the CCSP Web site at:

http://www.climatescience.gov/Library/sap/sap4-3/default.php .

The report finds that climate change is already affecting U.S. water resources, agriculture, land resources, and biodiversity, and will continue to do so. Specific findings include:

- Grain and oilseed crops will mature more rapidly, but increasing temperatures will increase the risk of crop failures, particularly if precipitation decreases or becomes more variable.
- Higher temperatures will negatively affect livestock. Warmer winters will reduce mortality but this will be more than offset by greater mortality in hotter summers. Hotter temperatures will also result in reduced productivity of livestock and dairy animals.
- Forests in the interior West, the Southwest, and Alaska are already being affected by climate change with increases in the size and frequency of forest fires, insect outbreaks and tree mortality. These changes are expected to continue.
- Much of the United States has experienced higher precipitation and streamflow, with decreased drought severity and duration, over the 20th century. The West and Southwest, however, are notable exceptions, and increased drought conditions have occurred in these regions.
- Weeds grow more rapidly under elevated atmospheric CO2. Under projections reported in the assessment, weeds migrate northward and are less sensitive to herbicide applications.
- There is a trend toward reduced mountain snowpack and earlier spring

snowmelt runoff in the Western United States.

- Horticultural crops (such as tomato, onion, and fruit) are more sensitive to climate change than grains and oilseed crops.
- Young forests on fertile soils will achieve higher productivity from elevated atmospheric CO2 concentrations. Nitrogen deposition and warmer temperatures will increase productivity in other types of forests where water is available.
- Invasion by exotic grass species into arid lands will result from climate change, causing an increased fire frequency. Rivers and riparian systems in arid lands will be negatively impacted.
- A continuation of the trend toward increased water use efficiency could help mitigate the impacts of climate change on water resources.
- The growing season has increased by 10 to 14 days over the last 19 years across the temperate latitudes. Species' distributions have also shifted.
- The rapid rates of warming in the Arctic observed in recent decades, and projected for at least the next century, are dramatically reducing the snow and ice covers that provide denning and foraging habitat for polar bears.

USDA agencies are responding to the risks of climate change. For example, the Forest Service is incorporating climate change risks into National Forest Management Plans and is providing guidance to forest managers on how to respond and adapt to climate change. The Natural Resources Conservation Service and Farm Services Agency are encouraging actions to reduce greenhouse gas emissions and increase carbon sequestration through conservation programs. USDA's Risk Management Agency has prepared tools to manage drought risks and is conducting an assessment of the risks of climate change on the crop insurance program.

For more information, please visit:

- http://www.usda.gov/oce/global_change/
- http://www.climatescience.gov/Library/sap/sap4-3/default.php

http://www.sap43.ucar.edu/ .

#

Appendix K

TUESDAY SEPTEMBER 23, 2008 :: Last modified: Tuesday, September 23, 2008 6:51 AM MDT

Scientists: Global warming seriously affects Wyoming

By PHIL WHITE
Star-Tribune correspondent

LARAMIE -- Citizens of Wyoming and the West wrongly believe global warming is something that will only seriously affect people on the coasts or other areas, state climatologist Steve Gray said.

Gray spoke at the Stroock Forum on Wyoming Lands and People at the University of Wyoming on Monday.

A recent poll, he said, found that 57 percent of Wyoming residents and 51 percent of Westerners think global warming is a bigger threat to others. Gray said Wyoming is instead "extremely vulnerable to climate change, no matter the cause." He added that it represents "a real and serious threat to Wyoming's water."

Seemingly small average temperature increases can generate serious consequences for Wyoming's water resources and economy, Gray said.

Even if precipitation levels in Wyoming do not decline as temperatures increase, he said, higher average temperatures of only 1 to 2 degrees Celsius could reduce the amount of water available in the latter part of the growing season. This scenario would create earlier and faster runoff of water stored as snow in the high mountains and cause more of the state's precipitation to fall as rain instead of snow.

Gray said Wyoming is the fifth-driest state in the nation. Most of its water comes from snowpack stored on 7 percent of the state's land -- the high mountains. Thus, "we have all our eggs in one basket," he said.

Wyoming sits at the top of major watersheds such as the Colorado River Basin, which means, Gray said, a drought has greater impact on the state because shortages here cannot be buffered by excess precipitation elsewhere in the watershed.

Brad Udall, director of the Colorado University-National Oceanic and Atmospheric Agency's Western Water Assessment, told about 40 people attending the 11th annual forum that the "vast majority" of the world's scientists agree that human activity has played a significant role in global warming.

Udall said current carbon emissions into the atmosphere are turning out to be greater "than the worst-case scenario" used in one major study.

Both Udall and Gray said today's management systems are based on the assumption that climate changes will not vary significantly from historical patterns. Udall said it would be a mistake to continue to assume climate "stationarity," because "we know those records from the past are less and less true."

Udall showed photos of Lake Mead that indicated storage has dropped by a half in recent years. He said the mean annual temperature in the Lower Colorado River states has risen 2 degrees Fahrenheit since 1970, and he predicted that the heat will cause Arizonans to move to Colorado and Wyoming in the near future.

Udall and Gray also agreed that climate change is playing a role in the pine bark beetle epidemic. Gray presented maps showing large areas of tree kill in British Columbia and northern Colorado and said it was moving into Wyoming. Higher temperatures allow more beetles to survive the winter, then have a second life cycle in the summer, Udall said.

The tree kill and warmer temperatures create more fires, and the loss of the forests leads to faster runoff with more sediment, Gray said.

Larry MacDonnell of Boulder, Colo., a visiting professor in the UW College of Law this semester, noted that the legal system for regulating water use is based on "first in time, first in right," without giving major significance to the question of how the water is being used.

He said the North Platte River is fully appropriated already and is being impacted by decreasing runoff and increasing demand.

"The best thing we can do in water management is reduce new demands for water," he said.

One way to help address the water shortage problem is to store water underground -- to avoid evaporation loss -- in wet years, then reserve that water for drought years, he said.

Another event in the Stroock Forum will occur in Pinedale later this fall.

Appendix L

http://scitizen.com/stories/Future-Energies/2008/07/Nuclear-power-False-climate-change-prophet/

Nuclear power: False climate change prophet?

21 Jul, 2008 09:31 am

A new study reveals that nuclear power is not as clean as the industry claims.

These days, the nuclear power industry often portrays it as an important part of any solution aimed at fighting climate change and reducing greenhouse gas emissions. The Nuclear Energy Institute reports that nuclear power is a "carbon-free electricity source." The World Nuclear Association claims that "nuclear energy today represents nothing less than an indispensable asset" if our world is to meet challenges of climate change. Opponents of nuclear power have responded in kind. In their calculation, Australian researchers at the ISA have estimated that wind turbines have one-third the carbon equivalent emissions of nuclear power over their lifecycle and hydroelectric one-fourth the equivalent emissions. The Oxford Research Group projects that if percentage of world nuclear capacity remains what it is today, by 2050 nuclear power would generate as much carbon dioxide per kilowatt-hour (kWh) as comparable gas-fired power stations.

Which side is right?

One new study published in the August 2008 issue of the peer-reviewed journal *Energy Policy* attempts to answer this question. It screened 103 lifecycle studies of greenhouse gas equivalent emissions for nuclear power plants to identify a subset of the most current, original, and methodologically rigorous studies. The study found that while the range of emissions for nuclear energy over the lifetime of a plant reported was from 1.4 grams of carbon dioxide equivalent per kWh (gCO2e/kWh) to 288 gCO2e/kWh, the mean value was 66 gCO2e/kWh.

The frontend component of the nuclear fuel cycle (uranium mining, milling, and enrichment) is responsible for 38 percent of equivalent emissions. Decommissioning and plant operation, including the use of fossil-fueled generators to backup nuclear plants when they offline for servicing, account for 35 percent. The backend of the fuel cycle, which includes storing spent fuel and fuel conditioning, account for 15 percent of the emissions, and plant construction is responsible for 12 percent.

This average—66 grams of carbon dioxide for every kWh—is shockingly high compared to what the nuclear industry has reported. It also shows, conclusively, that nuclear energy is in no way "carbon free" or "emissions free," and that nuclear power is worse than the equivalent carbon emissions over the lifecycle of renewable and small scale distributed generators (although it is an improvement over oil-, coal-, and natural gas-fired generators).

To provide just a rough estimate of how much equivalent carbon dioxide nuclear plants emit over the course of their lifecycle, a 1,000 MW reactor operating at a 90 percent capacity factor will emit the equivalent of 1,427 tons of carbon dioxide every day, or 522,323 metric tons of carbon dioxide every year. Nuclear facilities were responsible for emitting the equivalent of some 183 million metric tons of carbon dioxide in 2005. Assuming a carbon tax of $24 per ton—nothing too extreme—and that 1,000 MW nuclear plant would have to pay almost $12.6 million per year for its carbon-equivalent emissions. For the global nuclear power industry, this equates to approximately $4.4 billion in carbon taxes per year.

Researchers in the United Kingdom conducted lifecycle analyses for 15 separate distributed generation and renewable energy technologies found that all but one, solar photovoltaics (PV), emitted much less gCO2e/kWh than

the mean reported for nuclear plants. In an analysis using updated data on solar PV, researchers in the United States found that current estimates on the greenhouse gas emissions for typical solar PV systems range from 29 to 35 gCO2/kWh.

This has two very important insights for the current debate about nuclear power and climate change.

First, nuclear power plants would not benefit directly from a global carbon tax or a carbon cap-and-trade system. While the nuclear industry would be penalized less than fossil-fueled generators, the carbon equivalent emissions from uranium mining operations, enrichment facilities, plant construction, decommissioning, and spent fuel storage are significant. *Any* type of extra cost for carbon-equivalent would increase, absolutely, the price of these elements of the nuclear fuel cycle, and would thus make nuclear power more expensive.

Second, while it may be unfair to compare baseload sources such as nuclear to intermittent or non-dispatchable sources such as wind and solar PV, if these numbers are correct, then offshore wind power has less than one-seventh the carbon equivalent emissions of nuclear plants; large-scale hydropower, onshore wind, and biogas, about one-sixth the emissions; small-scale hydroelectric and solar thermal one-fifth. This makes these renewable energy technologies seven-, six-, and five-times more effective on a per kWh basis at fighting climate change.

Put simply, investments in nuclear power are much worse at fighting climate change than pursuing wind, solar, and other small-scale power generators. Policymakers would be wise to embrace these more environmentally friendly technologies if they are serious about producing electricity *and* mitigating climate change.

For further reading:

Barnaby, Frank and James Kemp. 2007. *Secure Energy? Civil Nuclear Power, Security, and Global Warming* (Oxford: Oxford Research Group, March, 2007).

Fthenakis, V.M., Kim, H.C., and Alsema, M. 2008. "Emissions from Photovoltaic Life Cycles." *Environmental Science and Technology* 42, 2168-2174.

Pehnt, Marin. 2006. "Dynamic Lifecycle Assessment of Renewable Energy Technologies." *Renewable Energy* 31 (2006), pp. 55-71.

Sovacool, Benjamin K. 2008. "Valuing the Greenhouse Gas Emissions from Nuclear Power: A Critical Survey," *Energy Policy* 36 (8) (August), pp. 2940-2953.

Sovacool, Benjamin K. 2008. "Nuclear Power is a False Solution to Climate Change," *The Jakarta Post* (July 15), p. 6.

Appendix M

Will uranium mining hurt water resources?

By ALEXANDRA SUKHOMLINOVA, News-Record Writer
asukhomlinova@gillettenewsrecord.net
Published: Tuesday, September 30, 2008 12:55 PM MDT

Wyoming ranchers and landowners are worried about the future of ranching, because uranium mining puts at stake a vital resource: water.

Smith Ranch-Highlands in Converse County, one of the in-situ leaching facilities now operating in Wyoming, pumped 40 million gallons of water per year during the milling process and more than 100 million gallons of water during restoration of the land, Jim Jones of Hulett told representatives of the U.S. Nuclear Regulatory Commission at a meeting Tuesday in Gillette.

"So far they've only made promises," said Jones, a mechanical engineer and a former gold and silver miner. "What they (the commission) haven't told us is that millions of gallons of water will be removed from the aquifers, will be polluted and removed during the restoration and mining. This water will not be returned to the aquifers. Wyoming just doesn't have that much water to waste."

He also added that the restoration on the Smith Ranch-Highlands did not bring the underground water to the acceptable levels and that the process is past the deadline by a year.

In-situ leach milling offers some environmental benefits because it doesn't disturb the surface, involves no open pit mining, no grinding and crushing. But it does involve concentration of uranium in the underground water. The water is infused with oxygen with sodium carbonate and injected through wells into the uranium ore body and then pumped back to the surface, where it is treated with ion exchange to extract uranium.

Because of that interaction between water and uranium, residents at the meeting wanted to ensure that the water is protected.

Mike O'Brien, chairman of Crook County Land-use Planning and Zoning Commission, took issue with the number of inspectors working for the Nuclear Regulatory Commission in the area. It has only two inspectors assigned to the 18 sites in Wyoming, which might not be sufficient to save scarce Wyoming water from radioactive contamination, residents said.

O'Brien said there has to be a third party who is monitoring the groundwater even though the commission representatives assured residents that their inspectors will monitor the safety on the mine sites.

"With what's going on in Wall Street, companies with large dollars cannot necessarily be trusted," O'Brien said. "We request that you require third-party monitoring of the groundwater. The fact that you are only looking at those every six months or a year is scary. If there is a

problem, that's a lot of time before it can be discovered."

He said that a federal investigation will not fix the contaminated water.

"Our current comprehensive plan supports the practical use of our resources in Crook County. We would like to see the mining happen, but we need to make sure it happens in a very responsible manner," O'Brien added.

Campbell County Commissioner Roy Edwards said worries about the safety of Wyoming water once the uranium mining begins may be overstated.

Edwards referred to the Christensen ranch in Johnson County, where another in situ leaching facility operates. The landowner, his cousin, has "no problems whatsoever," he said.

The interest in mining uranium has boomed again as its price skyrocketed in the past few years and since scarce fossil fuels spawned interest in alternative fuel sources. There are two sites with in-situ leaching milling facilities: Christensen Ranch and Smith Ranch-Highlands. The U.S. Nuclear Regulatory Commission expects to have 18 applications for in situ sites by 2011 in Wyoming.

Campbell County falls into Wyoming's east region, which also includes Converse County, the southeastern portion of Johnson County, the eastern part of Natrona County and the northeastern corner of Carbon County.

In addition to the need to have a third party involved in managing the water, the audience also proposed an extension of the comment period.

"I think our ability to comment should be extended by another 180 days or six months. Two weeks after today just doesn't give us enough time to comment," said Terry Everard, Crook County landowner.

The commission representatives will meet with Casper residents at 9 a.m. Thursday to discuss issues related to the Moore Ranch Uranium Project.

The meetings are part of the assessment process on a draft Generic Environmental Impact Statement regarding in-situ uranium mining in Wyoming, Nebraska, South Dakota and New Mexico. That process requires public input before the commission issues the final version of the environmental statement.

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

March 10, 2008

CERTIFIED MAIL, RETURN RECEIPT REQUESTED #7005 1820 0005 1478 8828

Mr. John McCarthy
Power Resources, Inc.
P.O. Box 1210
Glenrock WY 82637

RE: Insitu Uranium Permits 603 and 633, Notice of Violation, Docket No. 4231-08

Dear Mr. McCarthy:

Enclosed you will find a Notice of Violation issued under the provisions of W.S.§ 35-11-415(a) and (b)(ii). The Notice of Violation is based on the investigation conducted Mr. Mark Moxley during the fall of 2007. The investigation found that PRI failed to conduct concurrent reclamation which is a violation of Chapter 3, Section 2(k)(i)(D), and that PRI failed to follow the approved permits.

The Wyoming Department of Environmental Quality/Land Quality Division (LQD) is attempting to resolve this issue without further enforcement action, and requires that you contact Mr. Donald R. McKenzie, LQD Administrator at 307-777-7046 **within fifteen (15) days of receipt of this letter** to schedule a meeting to resolve this enforcement action. Should resolution of this enforcement action be reached as a result of this meeting, a Settlement Agreement including a penalty assessment will be signed by both parties.

Respectfully,

John V. Corra
Director
Department of Environmental Quality

Donald R. McKenzie
Administrator
Land Quality Division

Enclosures: Notice of Violation
Investigation Report

cc: Lowell Spackman, District I w/attachments
Mark Moxley, District II w/attachments
Docket # 4231-08 w/attachments
Doug Mandeville, NRC w/attachments

DEPARTMENT OF ENVIRONMENTAL QUALITY
STATE OF WYOMING

NOTICE OF VIOLATION

IN THE MATTER OF THE NOTICE OF VIOLATION ISSUED TO
POWER RESOURCES, INC.
P.O. BOX 1219
GLENROCK, WY 82637
Re: Insitu Uranium Operation, Permit #603
Re: Insitu Uranium Operation, Permit #633

DOCKET NO. 4231-08

NOTICE

NOTICE IS HEREBY GIVEN THAT:

1. Notice of Violation is being sent to you pursuant to W.S. §35-11-701(c) which requires that a written notice shall be issued in the case of failure to correct or remedy an alleged violation specifying the provision of the act, rule, regulation, standard, permit, license, or variance alleged to be violated.

2. As a result of Land Quality Division (LQD) concerns over the slow pace of groundwater restoration of wellfields at Power Resources, Inc. Permits 603 and 633 Insitu Uranium Mine, an investigation was conducted of the mine and reclamation plans in the approved permits, plus information provided in annual reports. This investigation was conducted by LQD staff during October and November of 2007. In addition to the violations cited below, LQD identified serious deficiencies with both permits. The plans contained in the permit documents are dated and incomplete in numerous ways: spill detection, reporting, and follow-up protocols are not defined in the permit; groundwater restoration procedures, necessary facilities, and time schedules for restoration must be thoroughly described; waste disposal facilities and processes must be described for all waste streams; all critical process installations need thorough construction details and specifications; and topsoil protection procedures are not adequately defined. As a consequence of the inadequacies of the permits, both operations are seriously under-bonded.

3. The investigation found that PRI failed to conduct concurrent reclamation which is a violation of Chapter 3, Section 2(k)(i)(D) requiring concurrent reclamation; and that PRI failed to follow the approved permits, which is a violation of W.S. §35-11-415(a). The following lists the specific violations:

   Permit 603

   a. Wellfield C was in production for approximately ten years. The approved Mine Plan states, *"Once a wellfield is installed it takes approximately one to three years to recover the leachable uranium from a production area."* Extending the production time period has become a routine practice and is not in compliance with the approved permit or the requirement for concurrent reclamation.

   b. In addition to the production phase, Wellfield C has now been in restoration for ten years. The 2007 Annual Report states that the ground water quality is similar to *"end of mining"* wellfield conditions. The permit states that restoration and stability are estimated to take approximately five years. This restoration delay is not in compliance with the approved permit or the requirement for concurrent reclamation.

   c. Wellfield E has removed 100% of the leachable reserves, and in recent years wellfield production has slowed to maintenance levels. This rate of production delays completion of mining and restoration of this wellfield

unit. This is not in compliance with the approved permit, and is a violation of Chapter 2, Section 2(b)(ii) which requires coordination of the Mine and Reclamation Plans to facilitate orderly development and reclamation.

d. The timetable listing the schedule of mining-related activities in the permit (Figure A, page OP-3A) and the timetable provided in the 2007 annual report both indicate that PRI is not in compliance with their restoration schedules for Wellfields C, D, and E. The schedule shows that Wellfield C should be decommissioning instead of in restoration, and that Wellfields D and E should be in restoration instead of production.

Permit 633

a. The permit indicates that "An updated schedule will be supplied with the annual report if the mining or restoration schedule varies from Table 3-1." The timetable commitments in the permit are not consistent with wellfield status. Therefore, the table in the annual report is the schedule that PRI is committed to for wellfield status. Based on this table, PRI is not in compliance with their restoration schedules for Wellfields 2, 3, and 4/4A. The annual report text indicates that Wellfield 2 will continue to be in production, while the annual report schedule referred to in the permit shows that it will be in restoration in 2008. Wellfields 3 and 4/4a should be in restoration instead of production.

b. The permit states that it generally takes "three years for uranium production, and three years for aquifer restoration." Actual times for wellfield production and restoration are, thus far, 2-3 times longer than permit commitments.

4. Wyoming Statute §35-11-901(a) provides that any person who violates any provision of the Environmental Quality Act or any rule, standard, permit, license or variance adopted hereunder is liable to a penalty of ten thousand dollars ($10,000.00) for each day of violation, which penalty may be recovered in a civil action brought by the Attorney General in the name of the People of the State of Wyoming.

NOTHING IN THIS NOTICE shall be interpreted to in any way, limit or contravene any other remedy available under the Environmental Quality Act, nor shall this Order be interpreted as being a condition precedent to any other enforcement action.

SIGNED this 7th day of March, 2008

John V. Corra
Director
Department of Environmental Quality

Donald R. McKenzie
Administrator
Land Quality Division

Please direct all inquiries regarding this Notice of Violation to Mr. Donald R. McKenzie, Administrator, Land Quality Division, Wyoming Department of Environmental Quality, 122 West 25th Street, Cheyenne, WY 82002. Telephone No. (307) 777-7046.

ec: Lowell Spackman, District I
Mark Moxley, District II
Docket # 4231-08
Doug Mandeville, NRC

Report of Investigation

Operator : **Power Resources, Inc.**

Facility : **Smith Ranch - Highland Uranium Project**
Mine Permit #603 (Highland) and #633 (Smith Ranch)

Prepared By : **Mark Moxley, LQD District 2 Supervisor**

Date : **November 21, 2007**

Background:

This investigation was conducted at the request of Rick Chancellor, LQD Administrator, in response to concerns over recent spills and the slow pace of groundwater restoration at the Smith Ranch-Highland ISL operation. PRI's operation is located in Converse county in LQD District 1. An investigator was brought in from LQD District 2 with the intention of having a fresh pair of eyes look at the operation. The investigation was intended to identify and focus on "big picture" issues, not specific details. The investigation proceeded as follows:

- Review of permit documents and annual reports
- Interviews with LQD District 1 staff
- Site tour and interviews with PRI staff
- Interviews with LQD District 3 staff
- Follow-up reviews and discussions

PRI began producing in 1988 and is currently the only significant producer of uranium in Wyoming. They are currently producing at capacity levels (2 million pounds of yellow-cake in 2006 and they are expecting similar production in 2007). PRI has applied for a mine permit amendment to add the Reynolds Ranch property and they are also planning to consolidate the Smith Ranch and Highland permits. This will result in a combined mine permit area some 41,000 acres in size. PRI is planning to increase their throughput capacity next year and add approximately 30 people to their current staff of 100. They are also considering adding facilities to provide toll milling services to process feedstock from other operators.

Given that PRI's operation has for many years been the major uranium producer in Wyoming, there is an expectation that the operation might serve as a model for excellence in ISL mining. Unfortunately, this is not the case. There are a number of major long-standing environmental concerns at this operation that demand immediate attention. Recommendations are made as to how to address these concerns.

Currently the uranium industry is experiencing a major boom. Drilling and pre-permitting investigations are proceeding on many different properties around the state, including several owned by PRI. The LQD is expecting numerous new ISL mine permit applications within the coming 12-18 months. This increase in workload will be a major challenge for the LQD staff. Achieving regulatory effectiveness and efficiency will be a high priority for LQD and it will require the cooperation of the industry.

Major Regulatory Issues and Concerns with Permits 603 & 633:

1. Mine Permit:

The mine permit document is the primary regulatory mechanism governing the operation. The mine and reclamation plan should describe in detail how the operation will be conducted so as to comply with all of the major regulatory requirements. The mine and reclamation plans should be updated and maintained so as to be a definitive reference for the operator, the regulatory agencies, and also the public. Having a definitive mine and reclamation plan is particularly important for new staff. In the case of the Smith Ranch - Highlands operation (mine permits #603 and #633), the plans contained in the permit document are out of date and incomplete in several important areas. The following major deficiencies were noted:

A. The approved mining and reclamation schedules are not being followed and are not current. PRI is not conducting contemporaneous restoration as required by their permit and WDEQ-LQD regulations. See discussion under item 2, below.

B. Spill detection, reporting, delineation, remediation, follow-up and tracking protocols are not defined in the permit and should be. PRI experiences spills on a routine basis. See discussion under item 3 below.

C. Groundwater restoration processes, facilities and procedures (incorporating and defining BPT), flow rates and time schedules should be thoroughly described in the permit so that expectations are clear. This has implications for bonding also.

D. Waste disposal facilities and processes should be clearly defined for all waste streams. One example of inaccurate information in permit #603 (on pages OP-15 and 19) states that byproduct solid waste materials will be disposed at the ANC Gas Hills facility (which closed in 1994). This waste actually goes to the Pathfinder Shirley Basin facility.

E. Construction details and specifications should be thoroughly described for critical process installations, including wells, pipelines, header houses, ponds, etc. One example of inaccurate information in permit #603(on page OP-24)states that well casing joints are fastened with screws. This practice is not consistent with the regulations and was discontinued years ago.

F. Topsoil protection procedures are not adequately defined to assure that disturbance is minimized and that the soil resource is protected. PRI's typical wellfield installation procedures result in the near total disturbance of the native vegetation and soils. This is not consistent with the regulation that allows for "minor disturbance" without topsoil stripping. More definitive procedures should be implemented to restrict and consolidate disturbance from roadways and pipelines and to insure careful topsoil salvage from well sites, mud pits, pipelines, roadways, etc.

With the permit updates required by Chapter 11 and the proposed consolidation of the Highland and Smith Ranch permits, now is an opportune time to correct permit deficiencies and construct a permit that is informative and useful to all parties.

2. Contemporaneous Reclamation:

One of the fundamental requirements for any mining operation is that reclamation be conducted concurrently with mining. Not only is this the most efficient operational strategy but it also insures that the reclamation liability is kept at a reasonable and manageable level. This approach ensures that the public is protected in the event of a forfeiture.

The schedule in permit #603, Highland, dates from 2005. An identical schedule was provided in the July, 2007 annual report. That schedule shows that restoration of the C wellfield should have been completed in 2006 and decommissioning should now be in progress. In actuality the restoration of the C wellfield has been on-going for ten years and the RO treatment phase has only just recently begun. According to the schedule, restoration of the D wellfield should have commenced in 2006 and restoration of the E wellfield should have commenced in early 2007. The annual report states that both the D and E wellfields are still in production. According to the schedule there should now be five wellfields in production (D-ext, F, H, I & J), two in restoration (D & E) and three restored (A, B & C). In fact there are currently 7 wellfields in production, one in restoration (C), and only 2 restored (A & B) at Highland.

The schedule contained in permit #633, Smith Ranch, dates from 1998. A more current schedule was provided in the July, 2007 annual report, yet even this recent schedule is not being followed. According to that schedule, wellfields 1, 3 and 4/4A should now be in restoration. Production from these wellfields was started in 1997, 1998 and 1999 respectively. Restoration of wellfield 1 is to be complete by mid 2008 and restoration in wellfield 2 is to commence in early 2008. However, as reported in the annual report only wellfield 1 is in restoration (no completion date stated) and no mention is made of any other planned restoration. In addition, a new wellfield (K) went into production this year and it does not even appear on the schedule. According to the schedule there should now be three wellfields in production (2, 15 & 15A)and three in restoration (1,3 & 4/4A). In fact there are currently five wellfields in production and only one in restoration. No wellfields have been restored at Smith Ranch.

It is readily apparent that groundwater restoration is not a high priority for PRI. Reclamation is not contemporaneous with mining. A total of 12 wellfields are now in production and restoration is proceeding (slowly) in only 2 wellfields. Only 2 wellfields (A and B) have been restored in 20 years of operation. The permits project that production will typically last for 3-5 years per wellfield and restoration will take 3-5 years per wellfield. It appears in reality that both production and restoration timeframes have doubled or tripled and yet additional wellfields are being brought into production.

It is recommended that a notice of violation be issued to PRI for failure to conduct concurrent reclamation and failure to follow the approved schedules. A rigorous compliance schedule should be implemented to accelerate restoration. A thorough re-evaluation of the operation schedules is warranted. As pointed out below, new deep disposal wells (DDW's) and RO units will be required to support restoration operations. LQD approval of the Reynolds Ranch amendment as well as any new wellfields should be contingent on installation of appropriate DDW's and RO units and completion of restoration in existing wellfields.

3. Spills, Leaks and Excursions:

Over the years there have been an inordinate number of spills, leaks and other releases at this operation. Some 80 spills have been reported, in addition to numerous pond leaks, well casing failures and excursions. Unfortunately, it appears that such occurrences have become routine. The LQD currently has two large three- ring binders full of spill reports from the Smith Ranch - Highland operations.

Protocols for spill detection, reporting, control, delineation, remediation and tracking should be defined in the mine plan to cover all potential fluid types (injection fluids, production fluids, waste fluids, chemicals and petroleum products) and all potential sources (buried pipelines, surface pipelines, wellhead fittings, headerhouses, ponds, well casing failures, etc.). Protocols should include mapping and delineation of the extent of soil and/or groundwater contamination associated with each occurrence. A GIS system should be developed to facilitate long term tracking of all spills and releases. An updated cumulative spill map showing all historic spills and releases should be presented in each annual report along with documentation of follow-up actions. Excursion protocols are addressed in some detail in the permit, but excursions should be tracked on a cumulative basis in the annual report.

Cumulative tracking of spills and releases is important to insure appropriate follow-up on every incident. Some of the spills may have little impact individually, but cumulatively they might have a significant effect on soils and/or groundwater. A cumulative record will also assist in pinpointing potential problem areas and developing appropriate preventative measures. PRI should develop and implement an inspection and maintenance program designed to prevent future spills. Spills should not and need not be an accepted consequence of ISL mining.

4. Reclamation Cost/Bonding:

The reclamation cost estimates contained in PRI's annual reports assume completion of all groundwater and surface reclamation in 4 years with a staff of 26 people (1/4 of current staff), using the existing facilities with the addition of only 2 new 400gpm RO units. This scenario is totally infeasible and unsupported by any critical path timeline or water balance. Rough calculations based primarily on PRI's figures reveal an alarming scenario.

- Adding the pore volumes for all of the existing wellfields gives a total pore volume (PV) for the project (excluding restored wellfields A&B) of 5,133 Ac.Ft.

- PRI's bond calculation includes only one PV of groundwater sweep, vs three PV's specified in the permit. [Removal of this volume of water from the aquifer would be problematic and warrants further evaluation.] PRI's four existing deep disposal wells (DDW's) have a combined capacity of approximately 600gpm (@100% availability). Disposal of one PV would take more than 5 years! This is not an acceptable schedule. A more reasonable scenario would require at least doubling the disposal capacity (1,200gpm), which would require 4 or 5 new DDW's. These would also be needed for disposal of RO brine and should be included in the bond.

- PRI's bond calculation includes only 3 pore volumes of RO treatment. The approved reclamation plan specifies circulation of a total of 6 PV's (3 groundwater sweep and 3 RO). It is likely that at least 5 PV's of RO treatment would be required if only one PV of groundwater sweep was completed. Using the five existing RO units on the site, plus two new 400 gpm units included in the bond calculation, producing a combined total of 1,360gpm of permeate (@80/20 permeate to brine ratio @100% availability), it would take 854 days (2.3 years) to treat one PV! It would take at least 11.5 years to treat 5 pore volumes. This is a not an acceptable schedule. A more realistic reclamation scenario would require increasing the RO capacity by 2-3 times (3,000 - 4,000 gpm permeate production). The additional RO units, as well as the additional building space, ancillary treatment facilities and piping, should be included in the bond.

- Using the existing RO units (plus the two bonded RO units) and existing DDW's, reclamation would take 20+ years, assuming groundwater restoration was achieved without any problems. (5 years for one PV of GW sweep + 11.5 years for 5 PV's of RO treatment + 1 year stability monitoring + 1 year decommissioning + 1 year of surface reclamation). Clearly this is not an acceptable schedule, but it does point out the need for reevaluation of the reclamation plan, restoration schedule and the bond calculation.

- PRI's bond calculation includes minimal funds for new infrastructure, maintenance, replacement and repair. Only two new 400 gpm RO units are included in the bond estimate. The need for new wells, including DDW's, water storage and treatment ponds, additional RO units, membranes, pumps, piping and general wellfield renovation should be anticipated and included in the bond calculation.

- PRI's bond calculation assumes a staff of only 26 people, with 22 of them on a salary of only $34,000 per year! If their current operations require a staff of 100 people then it will take at least 1/2 to 2/3 of that staff to conduct restoration. The restoration operations will look very similar to production operations. Operation of RO units, in particular, is very high maintenance and labor intensive. Retaining competent staff will require that wages and benefits be at least $50,000 per year.

- Considering that reclamation will take several times longer, require at least twice the staff with higher wages and require much greater investments in infrastructure than PRI has estimated, a realistic reclamation cost estimate for this site would likely be on the order of $150 million, as compared to PRI's current calculation of $38,772,800. PRI is presently bonded for a total of only $38,416,500. No bond adjustments have been made since 2002. Clearly the public is not protected. It is recommended that PRI's bond be immediately raised to a level of $80 million until a thorough evaluation, including critical path analysis, can be completed and an appropriate bonding level established. No permit amendments should be approved or new wellfields authorized until the bonding situation is corrected.

5. Regulatory compliance:

Achieving environmental compliance at an operation of the size and complexity of PRI's Smith Ranch - Highland Mine requires a high level of commitment from both the company and the regulatory agency. PRI's environmental efforts have suffered from inadequate staffing, high turnover, lack of institutional memory and a low level of corporate commitment. There has been a lack of continuity and follow-through on many issues. At this point in time, overall environmental compliance at this operation is poor. PRI should retain a full-time environmental staff of 4-5 qualified people, including a groundwater hydrologist to manage the groundwater restoration. It is recommended that LQD immediately assign a staff person full-time to manage this project as their #1 priority, and that monthly inspections be conducted to get a handle on the issues identified in this investigation.

End of Report

7/31/08

Stipulations for Development in Core Sage Grouse Population Areas.

Goal for stipulations is to maintain existing habitat function by permitting development activities that will not cause declines in sage grouse populations.

A. Oil and Gas Lease Stipulations:

1. One well pad per 640 acres. No more than 11 well pads within 1.9 miles of the perimeter of occupied sage grouse leks with densities not to exceed 1 pad per 640 acres (Holloran 2005). Clustering of well pads may be considered and approved on a case-by-case basis.
2. Surface disturbance will be limited to < 5% of sagebrush habitat per 640 acres. Distribution of disturbance may be considered and approved on a case-by-case basis.
3. No Surface Occupancy within 0.6 mi of the perimeter of occupied sage grouse leks (Carr 1967, Wallestad and Schladweiler 1974, Rothenmaier 1979, Emmons 1980, Schoenberg 1982 as analyzed by Colorado Greater Sage Grouse Conservation Plan Steering Committee 2008).
4. Locate main haul trunk roads used to transport production and/or waste products to a centralized facility or market point ≥ 1.9 miles from the perimeter of occupied sage grouse leks (Lyon and Anderson 2003). Locate other roads used to provide facility site access and maintenance ≥ 0.6 miles from the perimeter of occupied sage grouse leks. Construct roads to minimum design standards needed for production activities while minimizing surface disturbance and traffic.
5. Locate electrical supply lines at least 750 m (0.5 miles) from the perimeter of occupied sage grouse leks. Design electrical lines to be raptor- proof by installing anti-perching devices, or burying them when possible.
6. Exploration and development activity will be allowed from July 1 to March 14. In Core Population Areas that also contain sage grouse winter concentration areas,

exploration and development activity will be allowed only from July 1 to December 1 in the winter concentration areas.

7. Limit noise sources to 10 dBA above natural, ambient noise (~39 dBA) measured at the perimeter of a lek from March 1 to May 15 (Inglefinger 2001, Nicholoff 2003).

B. Wind Energy

There is no published research on specific impacts of wind energy on sage grouse. Wind energy facilities should be designed to reduce habitat fragmentation and mortality to sage grouse. Tubular tower designs to reduce raptor perches and noise reduction to minimize disturbance to nesting birds are encouraged. Design criteria for these projects should include minimizing the facility footprint (including the road network required to service the generators) in sage-grouse habitat. Leasing in Core Population Areas should only be approved through a review process as described below. Wind farm permitting should include a requirement to acquire data on sage grouse response to development and operation.

C. In-situ Uranium

There is no published research on specific impacts on sage grouse. Since development scenarios (well density, roads, activity) are similar to oil and gas, assume impacts are similar to oil and gas development. Use same stipulations used for oil and gas. In-situ uranium permitting should include a requirement to acquire data on sage grouse response to development and operation.

D. Sagebrush treatment

Sagebrush eradication projects should not be authorized. Treatments to enhance sagebrush/grassland may be considered through the review process described below.

E. Reclamation

Reclamation should re-establish native grasses, forbs and shrubs during interim and final reclamation to achieve cover, species composition, and life form diversity commensurate with the surrounding plant community or desired condition. Landowners should be consulted on desired plant mix on private lands

F. Transmission Line Rights of Way

To the extent possible, new rights of way should be authorized parallel and adjacent to existing rights of way. Above ground towers should be designed to minimize raptor perching. Any new rights of way not sited parallel and adjacent to existing rights of way should be routed at least 750 m (0.5 miles) from the perimeter of occupied sage grouse leks.

G. Other Activities

Applications to conduct any other surface activity not described previously will be evaluated on a case by case basis and forwarded, as necessary, to the Wyoming Game and Fish Department Habitat Protection Program Supervisor for consideration of stipulations needed to prevent declines in sage grouse populations in core sage grouse population areas. All surface activities should be designed to reduce habitat fragmentation and mortality to sage grouse. Design criteria for all activities should include minimizing the footprint of the activity in sage-grouse habitat.

Review Process

Development proposals incorporating less restrictive stipulations may be considered depending on site-specific circumstances. The company proposing to

develop within Core Population Areas and requesting exceptions to the standard stipulations bears the responsibility to demonstrate that the alternative development proposal will not cause declines in sage grouse populations occupying the proposed area of development.

Proposals to deviate from standard stipulations will be considered by a team including the Wyoming Game and Fish Department and appropriate land management agencies, with input from the U.S. Fish and Wildlife Service. Project proponents need to demonstrate that the project area meets at least one of the following conditions:

1) No suitable habitat is present in one contiguous block of land that includes at least a 0.6-mile buffer between the project area and suitable habitat;

2) No sage grouse use occurs in one contiguous block of land that includes at least a 0.6 mile buffer between the project area and adjacent occupied habitat, as documented by total absence of sage grouse droppings and an absence of sage grouse activity for the previous ten years;

3) Provision of a development/mitigation plan that has been implemented and demonstrated not to cause declines in sage grouse populations through credible monitoring data compiled and analyzed during the implementation period.

References and Literature Cited

Carr, H. D. 1967. Effects of sagebrush control on abundance, distribution, and movements of sage grouse. Job Completion Report. W-37-R-20.Job 8a. Colorado Game, Fish and Parks Department, Colorado, USA.

Colorado Greater Sage-Grouse Conservation Plan Steering Committee. 2008. The Colorado Greater Sage-Grouse Conservation Plan. Colorado Division of Wildlife. Denver, CO. Unpublished Report.

Emmons, S. R. 1980. Lek attendance of male sage grouse in North Park, Colorado. Thesis, Colorado State University, Fort Collins, Colorado, USA.

Holloran, M. J. 2005. Greater sage-grouse (*Centrocercus urophasianus*) population response to natural gas field development in western Wyoming. Dissertation. University of Wyoming, Laramie, USA.

Inglefinger, F. M. 2001. The effects of natural gas development on sagebrush steppe passerines in Sublette County, Wyoming. M.S. Thesis, Univ. of Wyoming, Laramie. 110pp.

Lyon, A. G. and S. H. Anderson. 2003. Potential gas development impacts on sage grouse nest initiation and movement. Wildlife Society Bulletin 31:486-491.

Nicholoff, S. H., compiler. 2003. Wyoming Bird Conservation Plan, Version 2.0 Wyoming Partners In Flight. Wyoming Game and Fish Department, Lander, Wy.

Rothenmaier, D. 1979. Sage grouse reproductive ecology: breeding season movements, strutting ground attendance and nesting. Thesis, Univ. of Wyoming, Laramie, Wyoming, USA.

Schoenberg, T. J. 1982. Sage grouse movements and habitat selection in North Park, Colorado. Thesis, Colorado State University, Fort Collins, Colorado, USA.

Wallestad, R. O., and P. Schladweiler. 1974. Breeding season movements and habitat selection of male sage grouse. Journal of Wildlife Management 38:634-637.