UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY & LICENSING BOARD

In the Matter of	)	Docket No. 40-9091-MLA
	)	
STRATA ENERGY, INC.,	)	ASLBP No. 12-915-01-MLA
	)	
(Ross In Situ Recovery Uranium Project)	)	November 3, 2014

NATURAL RESOURCES DEFENSE COUNCIL'S & POWDER RIVER BASIN RESOURCE COUNCIL'S PROPOSED FINDINGS OF FACT & CONCLUSIONS OF LAW FOR ENVIRONMENTAL CONTENTIONS 1, 2 AND 3

Geoffrey H. Fettus, Senior Attorney
Natural Resources Defense Council, Inc.
1152 15th St., NW, Suite 300
Washington, D.C. 20005
Tel: (202) 289-6868/Fax: (202) 289-1060
Email: gfettus@nrdc.org

Shannon Anderson, Staff Attorney
Powder River Basin Resource Council
934 N. Main St.
Sheridan, WY 82801
Tel: (307) 672-5809/Fax: (307) 672-5800
Email: sanderson@powderriverbasin.org

Counsel for Powder River Basin Resource Council

Howard M. Crystal
Meyer Glitzenstein & Crystal
1601 Connecticut Ave., N.W., Suite 700
Washington, D.C. 20009
(202) 588-5206
hcrystal@meyerglitz.com

Counsel for NRDC

TABLE OF CONTENTS

PAGE

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I. INTRODUCTION

1. In accordance with 10 C.F.R. §§ 2.1204(b) and 2.1207 and this Atomic Safety and Licensing Board's ("ASLB" or "Board") Orders of July 25, 2014, August 7, 2014, and directions at the close of the evidentiary hearing held in Gillette, Wyoming on September 30, 2014 and October 1, 2014 ("Hearing"), Intervenors Natural Resources Defense Council and Powder River Basin Resource Council ("Joint Intervenors") hereby submit proposed findings of fact and conclusions of law on Environmental Contentions 1, 2 and 3 for the Ross In Situ Recovery Project in Crook County, Wyoming ("Ross Project"). For the reasons set forth, Joint Intervenors urge the Board to find the Supplemental Environmental Impact Statement ("SEIS") and associated environmental review for the Ross Project fails to comply with the National Environmental Policy Act ("NEPA"), 42 U.S.C. 4321, *et seq.*, and applicable regulations, and on that basis find in favor of Joint Intervenors on all three contentions, vacate the Ross Project Record of Decision ("ROD") and license, and remand the matter to the NRC Staff.

II. BACKGROUND

A. Project Background

1. The Ross Project

2. The United States (U.S.) Nuclear Regulatory Commission ("NRC") issued a Final Supplemental Environmental Impact Statement ("FSEIS") in response to an application by Strata Energy, Inc. ("Strata," "SEI" or "Applicant") submitted on January 4, 2011, to develop and operate the proposed Ross In Situ Uranium Recovery (ISR) Project (herein referred to as the "Ross Project"), located in Crook County, Wyoming, as the first "stage" in a three-stage series of "Lance Projects" to extract the entire "Lance District" uranium resource, with a planned mine life of at least 20 years. The Applicant is a wholly owned subsidiary of Peninsula Energy, Ltd., of Australia. SEI009A at 1-1(at .pdf p. 59) . The FSEIS is the subject of this challenge.

3. Pursuant to the "Proposed Action" described in the FSEIS, the NRC has issued SEI a source and byproduct materials license. SEI015 (License); NRC009 (Apr. 24, 2014 Record of Decision for the FSEIS).

4. SEI plans to use its license to construct and operate the Ross Project facility and wellfields as described in its license application. The Ross Project would occupy 696 ha [1,721 ac] in the north half of the approximately 90-km^2 Lance District. Figure 2.2 of the FSEIS shows Strata has identified four other uranium-bearing areas that would extend the area of uranium recovery in the Lance District itself to the north (the Ross Amendment Area 1) and to the south (the Kendrick, Richards, and Barber areas). SEI009A at 2-3(at .pdf p. 87) . However, the scope of the Proposed Action in the FSEIS excluded these

planned expansion areas: "These areas are not components of the Proposed Action in this Final SEIS." FSEIS at xviii. Nonetheless, "the Proposed Action includes the option of the Applicant operating the Ross Project facility beyond the life of the Project's wellfields...to process uranium-loaded resin from satellite areas within the Lance District operated by the Applicant." *Id*.

5. The Ross Project will utilize a uranium recovery process termed in-situ ("in place") leach ("ISL") or in-situ recovery ("ISR") uranium mining and milling. This process involves injecting an oxidizing solution – termed a "lixiviant" – into a groundwater aquifer containing naturally occurring uranium ore. The solution dissolves the uranium minerals and the 'pregnant' solution is pumped to the surface, where the uranium is subsequently processed and shipped offsite. SEI009A at xix (at .pdf p. 29).

6. The ISL process exploits the redox (oxidation-reduction) characteristics of uranium. In the ore body, uranium exists as U4+, the solid (UO2(s)), formed by natural conditions over geologic time frames. The injection of a lixiviant solution oxidizes the naturally occurring uraninite ore, creating the U6+ oxidation state, which is substantially more soluble. *See* JTI0022 at 1 (Curtis, *et al.*, "Simulation of reactive transport of uranium (VI) in groundwater with variable chemical conditions," Water Res. Rsch., Vol. 42 (2006)); *see also* SEI009A at 3-16 to 3-17(at .pdf pp. 160 to 161).

2. Groundwater Hydrology

7. An aquifer is a geological unit capable of storing and transmitting significant amounts of water. Aquifers are divided into two broad categories, unconfined and confined. An unconfined aquifer is a shallow aquifer that is 'open' to atmospheric conditions. That is,

it is not vertically constrained by an overlying confining unit. An unconfined aquifer's water-level is termed the water table, which represents the boundary between the saturated and unsaturated zone. A confined aquifer is overlain by an impervious confining geological unit, aquiclude or aquitard, which limits vertical transmission of water. JTI003-R (Larson Direct Test.) at 51, A.69; JTI047.

8. The potentiometric surface is the water-level surface for a confined aquifer that is due to both the elevation and pressure head. When the potentiometric surface exceeds the land elevation, an artesian well or spring will be observed. Internal solid matrix stress and expansion of groundwater in the pore spaces account for the pressure head. Groundwater flows from high-to-low head potential similar to surface water flowing from high to low elevation, due to friction losses within the geological units and reflected with relatively lower potentiometric surfaces. JTI003-R (Larson Direct Test.) at 5, A.7.

9. EPA approved an exemption for the ore zone aquifer in the Ross project area, based on the assumption that it is a confined aquifer. SEI034. In approving the exemption for the ore zone aquifer, EPA did not consider the quality of the groundwater. SEI034 at 2; *see also* September 30 and October 1, 2014 Hearing Transcript, as modified by Corrections Order of Oct. 28, 2014 (hereafter "Transcr.") at 622 (Testimony of Mr. Saxton: "Whether or not it meets an MCL [Maximum Contaminant Level] is not part of the criteria for [an aquifer exemption]"). Instead, EPA based its aquifer exemption decision on (1) whether the aquifer *currently serves* as a drinking water source, *i.e*. if there are drinking water wells present in the aquifer at the time of exemption, and (2)

whether there are minerals present in the aquifer that are expected to be commercially producible. SEI034 at 2; *see also* 40 CFR §146.4 (criteria for exempted aquifers).

B. Procedural History

1. Environmental Review Of The Ross Project

10. In early 2011 Strata submitted an application and supporting materials for a combined NRC source and 11e.(2) byproduct material license for the Ross Project. SEI014 (Technical Report); SEI016 (Environmental Report) ("ER"). On March 21, 2013, NRC Staff issued a Draft SEIS for the project, and the Final SEIS was issued on February 28, 2014. NRC006 (Draft SEIS); SEI 009 (Final SEIS). The Record of Decision ("ROD") was issued April 24, 2014 (NRC009), and final license was issued April 24, 2014. SEI015.

2. Joint Intervenors' Intervention

11. On October 27, 2011, Joint Intervenors submitted a Petition to Intervene and Request for a Hearing. The Petition raised five environmental contentions. On February 10, 2012, the Board admitted two of the contentions in whole, and the remaining three in part. LBP-12-3. The Board also found Petitioners have standing, a conclusion the Commission affirmed. CLI-12-12.

12. As originally admitted, Contention 1 claimed the ER failed to adequately characterize baseline (i.e. original or premining) groundwater quality; Contention 2 claimed the ER failed to analyze the environmental impacts that will occur if SEI cannot restore groundwater to primary or secondary limits; Contention 3 asserted the ER failed to include adequate hydrological information to demonstrate SEI's ability to contain

groundwater fluid migration; and Contention 4/5 claimed the ER failed to adequately assess the cumulative impacts of the planned Lance District expansion. LBP-12-3, Appendix A.

13. After issuance of the Draft SEIS, Joint Intervenors sought to amend or migrate their Contentions and submit a new Contention against the DSEIS. On July 26, 2013, the Board allowed the first three Contentions to migrate to the DSEIS, but denied the new Contention, —which asserted the scope of the DSEIS violated NEPA because it did not consider SEI's announced plan to mine and mill uranium throughout the wider "Lance District "—and also ruled Joint Intervenors failed to satisfy the regulatory requirements for restyling their admitted cumulative impacts Contention against the DSEIS. LBP 13-10; *see also* Mem. Order of Aug. 27, 2013 (denying reconsideration).

14. After issuance of the FSEIS, Joint Intervenors sought to once again amend or migrate their Contentions, and to submit two new FSEIS Contentions. On May 23, 2014, the Board migrated the admitted Contentions to the FSEIS, but denied admission of two additional contentions, the first alleging improper segmentation of the Proposed Action to exclude planned mining and milling activities, and the second citing a recent audit finding of the NRC Inspector General documenting a pattern and practice of noncompliance with NEPA's public scoping requirements as adopted in NRC's own 10 CFR Part 51 regulations. Mem. Order of May 23, 2014. Subsequently the Board also denied Joint Intervenors' motion for summary disposition on Contention 1. Order of Aug. 12, 2014.

3. The Evidentiary Hearing

15. On August 25, 2014 the parties submitted their Prefiled Direct Testimony in support of their Contentions. Joint Intervenors submitted the written direct testimonies of Drs. Richard Abitz and Lance Larson. JTI001-R (Abitz); JTI003-R (Larson).

16. Dr. Abitz is a geologist and geochemist with more than twenty-five years of domestic and international experience in conducting and managing environmental work associated with the restoration of groundwater and soil contaminated by uranium and other radionuclides. He has been retained by private, government, and nonprofit clients in a variety of areas to provide consultation and expert testimony associated with such environmental work. JTI002 (Dr. Abitz CV); JTI001-R at 1.

17. Dr. Larson earned a dual doctorate in environmental engineering and biogeochemistry from the Pennsylvania State University (2013). His graduate research focused on modeling acid mine drainage, arsenic and uranium fate and transport, and biogeochemical interactions between surface and groundwater. Dr. Larson has presented research at scientific conferences in the United States and internationally, and published multiple peer-reviewed research articles regarding interactions of redox-sensitive elements, such as iron, arsenic, and uranium. JTI004 (Dr. Larson CV); JTI003-R at A.2.

18. Staff submitted a single document containing the combined written direct testimonies of Johari Moore, NRC Environmental Program Manager; John Saxton, an NRC hydrologist; Dr. Anthony Burgess, a hydrogeolost; and Dr. Kathryn Johnson, a geochemist who served as principal editor for the FSEIS sections on hydrology. SEI045.

19. SEI submitted written direct testimonies for hydrologists Hal Demuth and Errol Lawrence (SEI026); geologist Ben Schiffer (SEI005); civil engineer Ray Moores (SEI042); Strata CEO Ralph Knode (SEI001); and Strata Vice-President Michael Griffin (SEI039).

20**.** On September 12, 2014, the parties submitted their prefiled Rebuttal Testimonies. Joint Intervenors submitted the rebuttal testimonies of Drs. Abitz and Larson. JTI051-R (Abitz); JTI052-R (Larson). Each of the Staff and SEI witnesses submitting written direct also submitted Rebuttal Testimonies. NRC044 (NRC Staff); SEI045 (Schiffer); SEI046 (Demuth and Lawrence); SEI047 (Knode); SEI048 (Moores); SEI049 (Griffin).

21. The Board conducted an evidentiary hearing on Contentions 1, 2 and 3 from September 30, 2014 through October 1, 2014. At the hearing the prefiled testimonies of the witnesses and supporting exhibits were admitted, and the witnesses were asked additional questions. *See generally* Transcr..

22. The Board admitted the following exhibits of Joint Intervenors: JTI001-R, JTI002; JTI003-R; JTI004; JTI005A-R2; JTI005B-R2; JTI006 through JTI024; JTI025R; JTI026 through JTI050; JTI051-R; JTI052-R; JTI053; JTI054; JTI055-R; and JTI056 through JTI062. *See* Transcr. at 409, 587, and 742, and 747.

III. <u>LEGAL STANDARDS</u>

A. Burden of Proof

22. "It is well established that the Applicant carries the burden of proof . . . ." *Duke Power Co.,* (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 17 N.R.C. 1041 (1983); 10 C.F.R. § 2.325 (2011). SEI and NRC Staff must demonstrate the environmental analysis took the required "hard look" at the environmental impacts associated with the issuance

of a materials license for the Ross Project ISL uranium recovery site. *Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 374 (1989). NRC has described the burden of proof in a NRC license proceeding as follows:

> [t]he ultimate burden of proof on the question of whether the permit or the license should be issued is . . . upon the applicant. But where . . . one of the other parties contends that, for a specific reason . . . the permit or license should be denied, that party has the burden of going forward with evidence to buttress that contention. Once he has introduced sufficient evidence to establish a prima facie case, the burden then shifts to the applicant who, as part of his overall burden of proof, must provide sufficient rebuttal to satisfy the Board that it should reject the contention as a basis for denial of the permit or license.

In re Amergen Energy Co., LLC (Oyster Creek Nuclear Generating Station), CLI-09-7, 69 N.R.C. 235, 269 (2009); *see also*, ASLB July 25, 2014 Order at 2-3 (describing SEI "as the party with the ultimate burden of proof").

23. Parties challenging a license must establish a prima facie case on their contentions. At that point, the burden of proof shifts back to the applicant to rebut the specific contentions. The applicant must demonstrate compliance with the applicable regulations by meeting a "reasonable assurance" standard, which is equated to a "preponderance of the evidence." *Amergen Energy Co.* 69 N.R.C.at 263. To establish a prima facie case for a NEPA contention, it is only necessary to show that the NRC has failed to take a "hard look" at the issues raised. *Marsh*, 490 U.S. at 374.

24. Particularly since the SEI license has already been issued, SEI and Staff may not defend the NEPA analysis by relying on new evidence, information, or analysis not considered by Staff in connection with the preparation of the FSEIS. *See, e.g., Fla. Power & Light v. Lorion*, 470 U.S. 729, 744 (1985); *Ctr. for Biological Diversity v. BLM*,

698 F.3d 1101, 1124 (9th Cir. 2012). The defense of the FSEIS must be confined to materials before the agency at the time the FSEIS was issued. *See, e.g., Grand Canyon Air Tour Coal. v. FAA*, 154 F.3d 455, 469 (D.C. Cir. 1998); *Izaak Walton League of Am. v. Marsh*, 655 F.2d 346, 369 (D.C. Cir. 1981) (emphasis added) (citing *Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 420, (1971)); *Envtl. Def. Fund, Inc. v. Costle*, 657 F.2d 275, 284 (D.C. Cir. 1981) ("[t]he focal point for judicial review should be the administrative record already in existence, *not some new record completed initially in the reviewing court*") (emphasis added).

B. The National Environmental Policy Act

25. The National Environmental Policy Act ("NEPA"). 42 U.S.C. § 4321, *et seq.*, is our "basic national charter for protection of the environment." 40 C.F.R. § 1500.1; *Dept. of Transp. v. Pub Citizen*, 541 U.S. 752, 756 (2004). NEPA requires an Environmental Impact Statement ("EIS"), or, where applicable a Supplemental EIS ("SEIS"), for any major federal action with significant environmental impacts. 42 U.S.C. § 4332; 40 C.F.R. §1502.9. NEPA's fundamental purpose is two-fold. First, it ensures the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts. Second, it guarantees the relevant information will be made available to the larger audience that may also play a role in both the decision-making process and the implementation of that decision. *Entergy Nuclear Generation Co. and Entergy Nuclear Operations, Inc.* (Pilgrim Nuclear Power

Station), LBP-06-23, 64 NRC 257, 277 (2006) ("LBP-06-23") (quoting *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 349 (1989)).[1]

26. The Council on Environmental Quality (CEQ) has issued regulations governing the preparation of an EIS which are binding on all agencies. 40 C.F.R. § 1500.3; *e.g., Brodsky v. NRC*, 704 F.3d 113, 120 n.3 (2d Cir. 2013) ("The weight of authority . . . holds CEQ regulations binding on federal agencies," including NRC) (citations omitted). The regulations require an EIS to describe, *inter alia*, (a) "the environment of the area(s) to be affected" by the project, 40 C.F.R. § 1502.15, (b) and "the environmental impacts of the alternatives including the proposed action." *Id.* § 1502.16.

27. NEPA regulations require agencies to "insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements." *Id.* § 1502.24. In doing so, "[T]hey shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement." *Id.* "If an agency requires an applicant to submit environmental information for possible use by the agency in preparing an environmental impact statement" (as applies in this case), then "the agency shall independently evaluate

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[1] *See also Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 349 (1989) (Explaining that NEPA requires federal agencies to examine the environmental consequences of their actions before taking those actions, in order to ensure "that important effects will not be overlooked or underestimated only to be discovered after resources have been committed or the die otherwise cast."); *Baltimore Gas & Elec. Co. v. Natural Res. Def. Council, Inc.*, 462 U.S. 87, 97 (1983) (explaining that NEPA "ensures that the agency will inform the public that it has indeed considered environmental concerns in its decision making process."); *Morongo Band of Mission Indians v. Federal Aviation Administration*, 161 F.3d 569, 575 (9th Cir. 1998) ("NEPA was created to ensure that agencies will base decisions on detailed information regarding significant environmental impacts and that information will be available to a wide variety of concerned public and private actors.").

the information submitted and shall be responsible for its accuracy." *Id.* § 506.5(a). The analysis of environmental impacts must be "of high quality." 40 C.F.R. § 1500.1(b) ("Accurate scientific analysis [is] essential").

28. Environmental impacts, also called "effects," include "ecological effects" "such as effects on natural resources and the components, structures, and functioning of affected ecosystems." *Id.* at § 1508.8(b); *see also id.* (effects include the "effects on air and water and other natural systems, including ecosystems"). Effects also include "any adverse environmental effects which cannot be avoided should the proposal be implemented." *Id.* at § 1502.16; *see also* 10 C.F.R. Pt. 51, Subpt. A, App. A, § 6.

29. The regulations also mandate where there is data "essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement." 40 C.F.R. § 1502.22(a); *see also id.* § 1500.1(b) ("NEPA procedures must insure that environmental information is available to public officials and citizens *before* decisions are made and before actions are taken") (emphasis added). "Environmental impact statements shall serve as the means of assessing the environmental impacts of proposed agency actions, rather than justifying decisions already made." *Id.* § 1502.2 (f).

30. The NRC's own implementing regulations for the environmental review process impose similar requirements. Those regulations provide the environmental review process begins with the applicant's Environmental Report ("ER"), which contains the applicant's effort to address the issues that must be covered in the NEPA process. 10 C.F.R. § 51.45. Staff subsequently prepares a Draft EIS, *id.* § 51.71 and then a Final

EIS. *Id.* § 51.90. The NRC regulations require an EIS to "describe the environment to be affected by the proposed action," 10 C.F.R. Pt. 51, Subpt. A, App. A, § 6, and, more specifically, delineate certain data collection efforts required by a project proponent. As relevant here, those regulations require an applicant to provide "complete baseline data on a milling site and its environs" prior to construction and operation of the facility. *Id.* Pt. 40, App. A, Criterion 7 (emphasis added). Moreover, Criterion 5 requires the establishment of background concentration limits for groundwater that may not be exceeded. *Id.*, Criterion 5B(5)(a).

IV. JOINT INTERVENORS' PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW

A. Contention 1

Environmental Contention 1: The FSEIS fails to adequately characterize baseline (i.e., original or pre-mining) groundwater quality.

CONTENTION: The FSEIS fails to comply with 10 C.F.R. §§ 51.90-94, 10 C.F.R. Part 40, Appendix A, and NEPA because it lacks an adequate description of the present baseline (i.e., original or pre-mining) groundwater quality and fails to demonstrate that groundwater samples were collected in a scientifically defensible manner, using proper sampling methodologies. The FSEIS's departure from NRC guidance serves as additional evidence of these regulatory violations. NRC, NUREG-1569, Standard Review Plan for In Situ Leach Uranium Extraction License Applications, §§ 2.7.1, 2.7.3, 2.7.4 (2003).

1. PROPOSED FINDINGS OF FACT FOR CONTENTION 1

a. What Baseline Water Quality Is

31. The word baseline typically describes water quality parameters at a site prior to the start of any activity that might disturb or contaminate the aquifer. JTI001-R at 6.

32. Baseline and background are interchangeable terms when describing water quality in an aquifer that has not been disturbed by human actions. EPA's Statistical Analysis of

Groundwater Monitoring Data at RCRA Facilities Unified Guidance (2009) states: "[t]he most important quality of background is that it reflects the historical conditions unaffected by the activities it is designed to be compared to." JTI006 at 5-1 (73 of the pdf); JTI001-R at 6.

33. EPA's Unified Guidance also states: "High quality background data is the single most important key to a successful statistical groundwater monitoring program, especially for detection monitoring." *Id.*; JTI001-R at 7.

b. NRC Requirements For Collecting Baseline Data

34. NRC's regulations for uranium milling operations and the disposal of waste and tailings from such operations require an applicant to provide "complete baseline data on a milling site and its environs" prior to construction and operation of the facility. 10 C.F.R. Pt. 40, App. A, Criterion 7.

35. 10 C.F.R. Pt. 40, App. A, Criterion 5, which "incorporate[s] the basic ground-water protection standards imposed by the Environmental Protection Agency in 40 C.F.R. Part 192," provides that "[a]t the point of compliance, the concentration of a hazardous constituent must not exceed . . . [t]he Commission approved *background concentration* of that constituent in the ground water."[2] 10 C.F.R. Pt. 40, App. A, Criterion 5B(5)(a) (emphasis added).

[2] The Commission may also set as concentration limits either "[the] respective value[s] given in the table in paragraph 5C" (that is, safe drinking water standards) or "[a]n alternate concentration limit established by the Commission," which must "present no significant hazard" and must be "as low as reasonably achievable." 10 C.F.R. Pt. 40, app. A, Criteria 5B(5)(b), 5B(5)(c), 5B(6), 5C.

36. 10 C.F.R. § 51.90 requires that a final EIS (or SEIS) be prepared "in accordance with" 10 C.F.R. § 51.71 (the DEIS requirements). 10 C.F.R. 51.71(d), in turn, requires, in pertinent part (emphasis added):

> *[t]he analysis for all draft environmental impact statements will, to the fullest extent practicable, quantify the various factors considered.* To the extent that there are important qualitative considerations or factors *that cannot be quantified*, these considerations or factors will be discussed in qualitative terms. Consideration will be given to compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection, including applicable zoning and land-use regulations and water pollution limitations or requirements issued or imposed under the Federal Water Pollution Control Act. The environmental impact of the proposed action will be considered in the analysis with respect to matters covered by environmental quality standards and requirements irrespective of whether a certification or license from the appropriate authority has been obtained.

Baseline water quality is an environmental factor that can – and should – be quantified given the numeric nature of the data. *See* Transcr. at 435 (Testimony of Dr. Abitz: "The only way you . . . [can establish baseline] . . . is by quantitative analysis.").

37. NRC Regulatory Guidance 4.14 notes that at least one well must be hydrologically upgradient to serve as a source for background samples. SEI008 at 3.

38. NUREG-1569, NRC's Standard Review Plan for In Situ Leach Uranium Extraction License Applications, states that in order to properly characterize the proposed site, NRC staff must "[e]valuate the Applicant's assessment of water quality of potentially affected ground-water resources." SEI007 at 60. This is critical information because it "provide[s] the basis for evaluating potential effects of *in situ* leach extraction on the quality of local ground-water resources." *Id.*; *see also id.* at 58 (the "[c]haracterization of the hydrology at in situ leach uranium extraction facilities must be sufficient to establish potential

effects of in situ leach operations on the adjacent surface-water and ground-water resources.”).

39. In conducting its analysis, the NRC must “verify that a sufficient number of baseline ground-water samples are collected to provide meaningful statistics, that samples are spaced in time sufficiently to capture temporal variations, and that the chemical constituents and water quality parameters evaluated are sufficient to establish pre-operational water quality, including classes of use.” *Id*.

40. Similarly, a site characterization is not acceptable if it does not include “[r]easonably comprehensive chemical and radiochemical analyses of water samples, obtained within and at locations away from the mineralized zone(s)” that “have been made to determine pre-operational baseline conditions.” *Id*. at 62.

41. All samples must be collected using “acceptable sampling procedures.” *Id*.

42. While 10 C.F.R. § 40.32(e) prohibits “commencement of construction” prior to a license, in NRC’s regulations, “construction,” *excludes* “[s]ite exploration, including necessary borings to determine foundation conditions or *other preconstruction monitoring to establish background information* related to the suitability of the site, the environmental impacts of construction or operation, or the protection of environmental values.” 10 C.F.R. § 40.4 (emphasis added).

43. When these regulations were imposed in 2011, the Commission’s regulatory preamble specifically explained that “construction” does not include any “monitoring wells that are only intended to be used to collect background data or perform background aquifer testing.” 76 Fed. Reg. 56,951, 56,956 (Sept. 15, 2011).

44. This reading of the regulations is consistent with this Board's interpretation of them in admitting Contention 1. LBP-12-3, 75 N.R.C. at 194; *see also id.* at 193-95 (interpreting the regulations to permit the data collection necessary to provide a "description of the existing water quality baseline."); Mem. Order of May 23, 2014 at 6 (rejecting SEI's argument that applicable regulations do not "permit the gathering of detailed wellfield and monitor well quality data prior to issuance of an (ISR facility) license," and explaining that "SEI's (and the staff's) arguments regarding the legal merits of the contention do not suggest a different result" than they did as to the DSEIS).

45. This reading of the regulations is also consistent with the interpretation of the Board in the Dewey-Burdock licensing proceeding. That Board explained, the "preconstruction monitoring" expressly permitted under 10 C.F.R. § 40.4, "*includes adequate assessments of baseline water quality*." *Dewey-Burdock*, LBP-10-16, 72 N.R.C. 361, 424 (2010) (emphasis added); *see also Dewey-Burdock*, LBP-13-09 (ruling on DSEIS contentions) at 20 (admitting contention against DSEIS on grounds it "fails to include a proper analysis of the required baselines with respect to groundwater quality"); *accord Dewey-Burdock*, LBP-14-5 (2014) (ruling on FSEIS contentions), App. A ("The FSEIS fails to include necessary information for adequate determination of baseline ground water quality").

c. NEPA Regulatory Requirements To Collect Baseline Data And Use Best Available Science

46. Regulations implementing NEPA require an EIS to describe "the environment of the area(s) to be affected" by the project. 40 C.F.R. § 1502.15.

47. The regulations also mandate where there is data "essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement." *Id.* § 1502.22(a).

48. NEPA regulations further require agencies to "insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements." *Id.* § 1502.24. In doing so, "[t]hey shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement." *Id.*

d. How Baseline Water Quality Was Collected And Is Described In The EIS

49. The NRC Staff process for establishing baseline water quality characteristics in this FSEIS was bifurcated into a "pre-license site characterization" assessment and a "post-license pre-operational" assessment, with almost all the data collection and the actual setting of baseline values for regulatory compliance to be established only post-license, after the regulatory decision is made. SEI009A at 3-101 (at .pdf p. 245); *see also* Transcr. at 380 (Testimony of Dr. Johnson speaking to the FSEIS's terminology of pre-license versus post-license pre-operational site characterization); Transcr. at 308, line 24 to 351, line 8 (discussing what data will be collected post-license to provide "an accurate representation of the water in the aquifer."). Transcr. at 326 (Testimony of Mr. Knode). In other words, "an accurate representation" of baseline water quality will only be established *post*-license and *post*- NEPA review.

50. As a result, according to Staff itself, the water quality data considered in the FSEIS is limited and not sufficient to properly assess baseline conditions in a quantitative manner. As the NRC Program Manager Johari Moore testified at the hearing:

> In the NEPA review what we're doing is trying to determine or predict potential impacts. That's different than when you're actually assessing actual environmental impacts after some impacts have taken place and after operations have occurred. It's that stage where you want to make sure that you have the specific data to compare the specific data that you have after operations. We are simply predicting potential impacts. There's a difference as far as the type of data that you need at that stage.

Transcr. at 466, lines 1-15.

51. The terminology of "baseline" versus "background," which the regulations "use interchangeably," evolved in their use by NRC Staff to present its defense of the FSEIS. Indeed, the following discussion at the hearing presents the evolution of the distinct use of these commonly interchangeable words solely for this proposed project:

> MR. SAXTON: Your Honor, I just want to make one comment on the background and baseline. *The regulations in Part 40 actually use those interchangeably*. When we consider background is just a sample that was acquired before operations begin. It could be baseline if you're using that in the future as a measure of any impacts. So that's how we interpret it.
>
> JUDGE WHITE: A number against which to compare another number?
>
> MR. SAXTON: Yes.
>
> DR. JOHNSON: If I may, Judge White, for the purposes of the environmental impact statement, we noticed early on that the two terms *which are often used interchangeably but may not be,* would cause some degree of confusion or just a mixup. And so that's why we made the decision that we wanted to be very clear in what data set we were referring to. So we adopted the terminology which we defined at some point in the SEIS what those terms meant. And that's why we went then to the pre-license site characterization and post-license pre-operational terminology to try to differentiate and distinguish what we were talking about.

> CHAIRMAN BOLLWERK: Can I just ask one? Is that terminology *now going to be adopted in all FSEISs going forward or is this only for Strata*?
>
> MS. MOORE: *Your Honor, not necessarily*. It was unique to the situation where we thought it was warranted to clarify those terms and there's no reason why necessarily future SEISs would need to do that. I'm hoping through this hearing we'll be able to establish what's meant by that so it's not confusing in the future.
>
> CHAIRMAN BOLLWERK: All right, well, maybe the confusion will continue and maybe it won't. We'll have to see. All right, go ahead.

Transcr. at 379-81 (emphasis added).

52. The NRC Staff's assessment of "pre-license site characterization" can be found in Section 3.5.3.3 of the FSEIS. SEI009A at 3-37 to 3-45 (at .pdf p. 181 to 189). The Staff's assessment is based on: "…groundwater-quality data [from] the Applicant's own ground-water monitoring network which it constructed in 2009 and 2012 and which consists of six monitoring-well clusters and four piezometers…" *Id*. at 182. It is also based on "historical data from the former Nubeth operations." *Id.*

53. The FSEIS relies on "[a]pplicant provided construction details of the wells and methods used for ground-water sampling in its ER." *Id*. According to the ER, "All baseline monitoring wells were constructed using conventional mud rotary drilling techniques." SEI 016A at 262. Further, "[f]ollowing filter pack placement, air-lift development was conducted until turbidity readings stabilized." *Id*.

54. Table 3.6 in Section 3.5.3.3 of the FSEIS provides maximum, average, and minimum values for the chemical constituents measured in the groundwater samples collected from 2009, 2010, and 2011. SEI009A 3-40 (at .pdf p. 184).

e. The Baseline Water Quality Data On Which the FSEIS Relies Is Scientifically Flawed

i. Inadequacies In The Number Of Wells Used And Their Placement

55. The sampling methods used by Strata do not establish scientifically valid baseline water quality conditions. The sampling program was too limited, relying on only six well clusters and some other existing data in the EIS. JTI001-R at 22-23. In other words, the minimal data collection creates a statistically invalid, biased set of non-representative groundwater samples. *Id*.

56. There is no statistical justification provided for the location or number of the six monitoring-well clusters across the proposed mining area in the FSEIS, or in the Strata 2011 Technical Report documents. *Id*. at 16 (stating the well "locations are not located and distributed in a manner designed to collect data representative of overall site conditions.").

57. There were not a sufficient number of wells and samples to conclude with a stated level of confidence that the groundwater quality exceeds the EPA drinking water MCLs for heavy metals and radionuclides. JTI001-R at 17.

58. Under established EPA Guidance, 8 to 10 samples per well are needed at a minimum to perform a meaningful statistical analysis, and the independent samples must be collected from a sufficient number of randomly located wells across the proposed mining area. JTI006 at 5-3 (75 of the pdf). This was not done at the Ross Site. JTI001-R at 21.

59. In assessing baseline conditions, staff did not consider data from an upgradient well. No upgradient well was identified in the FSEIS, and according to NRC Staff no such well

is necessary. NRC001 at 14-16 ("Upgradient water quality data are not necessary for Ross Project site characterization purposes . . . ."). However, under EPA Guidance, and under NRC's own guidance documents, upgradient wells are necessary to establish baseline conditions. JTI001-R at 7-8.

ii. Deficiencies In Well Drilling Methods

60. An adequate scientific justification for the data that was collected is also lacking, because the screen lengths for the existing monitor wells were inappropriate. JTI001-R at 21-22. The wells were screened only through the part of the ore zone (OZ) water horizon that is in contact with the ore zone, rather than the entire column of water in the OZ sand interval. Transcr. at 354 ("It is correct, as we discussed earlier today, that we do only screen the ore zone"). The screen lengths for the existing six monitor wells in the OZ zone are approximately ¼ to ½ the thickness of the OZ sand and centered on the ore zone. JTI001-R at 21-22 (citing Technical Report and Addenda). Proper procedures require screening through the entire column. JTI001-R at 22 ("fully screened intervals are more accurate in their representation of the water quality . . ."); *see also* Transcr. at 416-417.

61. The approach for collecting groundwater quality data disclosed in the FSEIS also improperly biased the groundwater samples to high values for uranium, radium-226 and other uranium progeny and associated ore metals (e.g., arsenic, molybdenum, vanadium, etc) due to the disturbance and oxidation of the ore during well construction and development. JTI001-R at 22.

62. NUREG-1569 recognizes this bias and states that fully screened intervals are more accurate in their representation of the water quality that a monitor of the water will encounter. SEI007 at 140 ("Fully screened monitor wells would assure that excursions will eventually be detected, have the advantage of more accurately representing the water quality that a ground-water user is likely to experience, and do not suffer from the uncertainty of predicting the completion intervals of injection and production wells that have not yet been drilled.").

iii. Deficiencies In Staff's Use Of Well Data

63. The FSEIS also improperly averages the data that was collected. JTI001-R at 22-23. Tables 3.6 and 3.7 of the FSEIS groups SEI's six cluster wells together to report average and ranges for each water horizon. SEI009A at 3-40 to 3-41 (at .pdf pp. 184-185).

64. This averaging is contradictory to proper statistical methods for evaluating individual wells prior to grouping them and calculating an average or range for the aquifer horizon. *See* JTI006 and references therein; *see also* JTI001-R at 23.

65. A simple averaging or reporting a range of the values from all wells does not establish baseline unless it can be shown with proper statistical methods both that (i) the samples from the individual wells follow a normal or log-normal distribution, and (ii) an analysis of the data variance of each well demonstrates that the wells can be combined into a single population for statistical calculations. JTI001-R at 23. The samples from the six cluster wells do not fall into a single population with respect to uranium and radium-226. *Id*.

66. According to NRC Staff itself, the agency did not require or perform "unbiased group sampling" as part of its evaluation of baseline water characteristics for the EIS. Transcr. at 465. Nor did they perform a "statistical evaluation" of groundwater quality. *Id*. at 469.

f. The Data In NRC's NEPA Analysis Of Baseline Groundwater Quality Data Is Biased, Because The Aquifer Was Contaminated By Oxygenating The Ore Zone In The Process Of Well Drilling

67. The professional standards for well design, installation and development, which are discussed in detail by the United States Geological Survey (USGS), state: "The primary consideration for selecting well-installation methods and materials is to minimize the effects on the chemical and physical properties of the ground-water sample." JT1011 at 18; *see also* JTI001-R at 17.

68. The standards further state that, "[t]he goal for water quality studies is to have the well design compatible with requirements to obtain samples that accurately represent the chemical constituents of concern in groundwater." JTI011 at 20. Additionally, well design must consider "requirements inherent in the chemical constituents targeted for sampling, their anticipated concentrations, and the accuracy needed to meet study objectives." JTI011 at 45; JTI001-R at 18.

69. It is inconsistent with these standards to use a well construction method that introduces oxygen into the ore zone because of the need to properly measure uranium concentrations in groundwater in contact with a uranium ore body. JTI001-R at 27, 28. Oxygen levels are extremely low in uranium ore deposits, including the ore deposit at SEI's proposed site location. *See*, e.g. SEI009A at 3-16 (at .pdf p. 160) (discussing the presence of pyrite); JTI012 at 153. Therefore, wells intended to be relied upon to

generate monitoring data must be drilled using well-construction methods that ensure no oxygen is introduced to the ore zone via drilling fluids and compressed atmospheric air. *Id*.

70. The levels of oxygen in groundwater contacting pyrite and uranium ore (uraninite) can be calculated using commercial software, such as the Geochemist's Workbench (http://www.gwb.com/). JTI001-R at 18, 19. The stability field for pyrite can also be calculated using the Geochemist's Workbench with corresponding approximate highest groundwater concentrations for iron (0.57 milligrams/liter), carbonate (610 milligrams/liter) and sulfate (920 milligrams/liter), as reported for the ore zone (Appendix C of FSEIS). *Id*. The thermodynamic calculations indicate that pyrite is stable over the pH range of 6 to 10 only when oxygen levels are below $1x10^{-65}$moles/liter. *Id*.

71. The uranium concentration in groundwater can be calculated by constraining the uraninite stability field to oxygen levels less than about $1x10^{-65}$moles/liter. Using the same water quality data noted in Appendix C of FSEIS, when the uraninite stability field is below oxygen levels of $1x10^{-65}$moles/liter, uranium concentrations in groundwater are less than $1x10^{-10}$ moles/liter (2.38E-08 grams/liter or 2.38E-14 micrograms liter, which is over 13 orders of magnitude lower than the EPA uranium MCL of 30 micrograms/liter). *Id*. This data, and the calculations done at JTI001-R at 19, 20, reveals that the true uranium concentration in the groundwater at the Ross Site contacting uraninite and pyrite is so low that it cannot be detected with present laboratory methods and these analytical results demonstrate SEI oxidized the uranium ore prior to collection of the groundwater samples. *Id*.

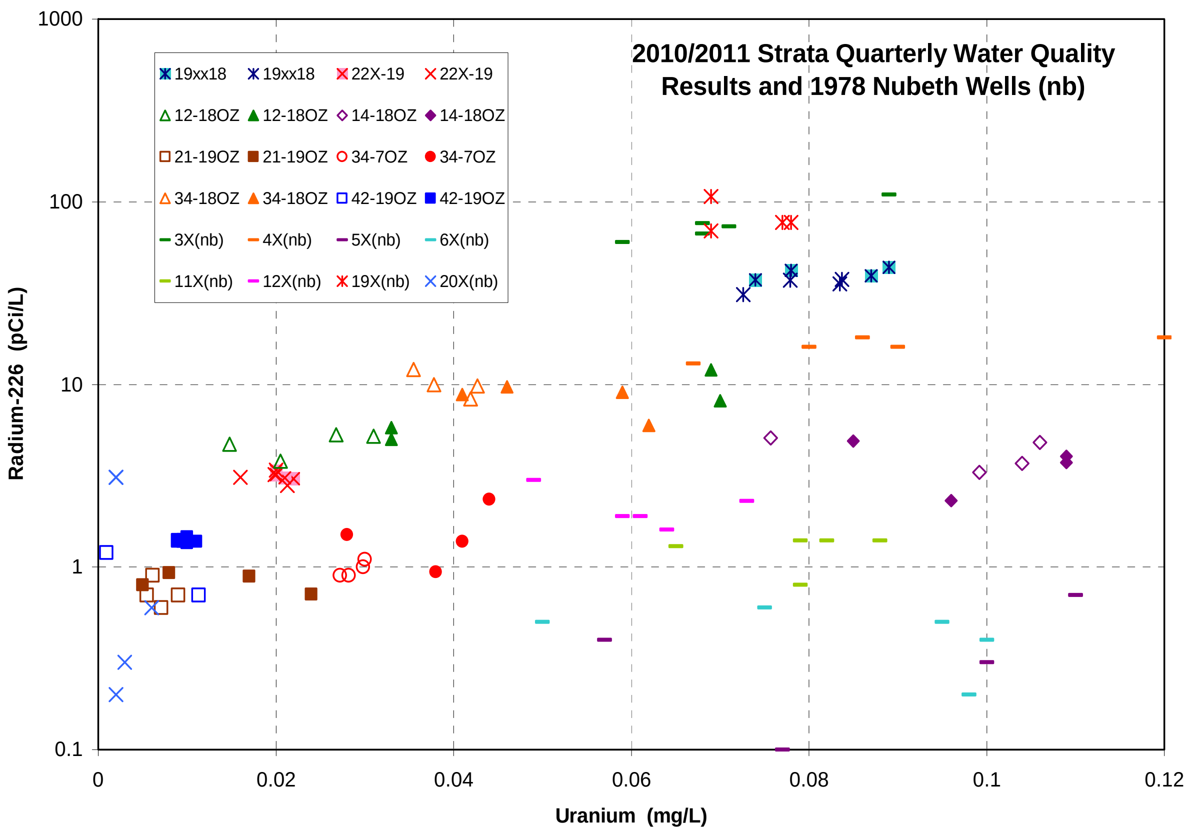
72. Once the ore body is oxidized during well installation, the radium-226 released from the uranium ore will not drop out of solution because it is insensitive to redox changes. Therefore, allowing improper well installation methods results in contamination of the groundwater prior to any mining activity taking place and, having relied on such methods for the "baseline" water quality data collected here, the 'baseline' values in the FSEIS are invalid for uranium, radium-226 and other contaminants associated with the ore (e.g., arsenic, molybdenum, selenium). JTI001-R at 27.

73. The analytical results of uranium concentrations in the groundwater, described in the FSEIS and the ER, demonstrate SEI improperly oxidized the uranium ore prior to collection of the groundwater samples. *Id*. at 20.

74. As evidence of this, uranium data from 2011 show lower levels relative to 2010 and 2009. *Id*. at 23. This is consistent with reducing conditions returning to the ore zone in the aquifer after anthropogenic oxidation during monitoring well installation and development. *Id*. at 17.

75. The FSEIS asserts that the 2011 data were consistent with the 2010 and 2009 data. SEI009A at 3-38 (at .pdf p. 182) ("The data from 2011 are generally consistent with the 2009 and 2010 data; this consistency indicates a representative characterization of ground-water quality."). However, the 2011 results were *not* actually consistent with the 2009 and 2010 data. The 2011 ore-zone data for SEI's six regional wells (open symbols in the figure below, prepared by Dr. Abitz) show uranium has decreased in 4 of the 6 wells (12-18, 21-19, 34-07, 34-18) and radium-226 is essentially unchanged, relative to the 2010 data (filled symbols). Uranium decreases over this time interval as the aquifer

begins to return to reducing conditions following the initial disturbance and oxidation of the uranium ore when the wells were installed and developed. Further, Radium-226 remains at the 2010 levels as radium, and is insensitive to redox changes once it is released from the uranium bearing ore. The initial magnitude of disturbance and oxidation of the uranium ore varies from location to location, as it is dependent on the time spent in developing the well with air lift and jetting techniques. For well 14-18, the similar results for 2010 and 2011 indicate the ore zone may have been disturbed for a longer period of time during well development. Importantly, the trends for uranium and radium-226 show that the ore zone is disturbed and oxidized by well installation and development activities. JTI001-R at 24-26.



Id. at 26.

76. This trend of decreasing oxidation is not a coincidental event and would be captured at any ISL site where sampling were carried out for two to three years prior to initiation of ISL operations. JTI001-R at 26. This same striking decrease in uranium, but not radium-226, occurred in two pre-license sampling events from production wells placed into the uranium ore at Goliad, Texas. JTI015 (UEC 2008 Table 5.2); JTI016 (2009 updates).

77. Groundwater data collected by UEC for the Goliad site were invalid for establishing baseline values because the uranium ore zone had been oxidized by improper well installation and development techniques and the water samples were collected only from the narrow ore zone horizon (10 to 15 feet) of the aquifer, rather than the entire thickness of sand (50 to 75 feet). Using proper statistical protocols to evaluate the data, the median groundwater values for uranium and radium-226 at the Goliad site met the EPA drinking water MCLs. JTI001-R at 13. Results presented by UEC concluded that uranium and radium-226 exceeded the EPA drinking water MCLs because they used a simple average calculation (parametric statistic), but this type of calculation is invalid because the data do not follow a normal distribution. *Id*.

78. Therefore, at the Goliad site, extremely high uranium and radium-226 values for several of the groundwater samples biased the estimate of the population mean (UEC's simple average calculation) to high values. It is because of these very high values that the data do not follow a normal distribution. JTI001-R at 13. The improper statistical calculation performed by UEC was incongruous with the fundamental statistical principle

to test the data distribution prior to estimating population parameters. *Id*. at 13-14. In this case, non-parametric estimates were required and the median uranium and radium-226 values met the EPA MCLs for a drinking water aquifer. *Id*. at 14.

79. This finding is consistent with EPA's unified guidance (EPA 2009) on performance standards for the statistical treatment of groundwater samples:

> Any statistical method chosen under §264.97(h) [or §258.53(g)] for specification in the unit permit shall comply with the following performance standards, as appropriate: 1. The statistical method used to evaluate ground-water monitoring data shall be appropriate for the distribution of chemical parameters or hazardous constituents. If the distribution of the chemical parameters or hazardous constituents is shown by the owner or operator to be inappropriate for a normal theory test, then the data should be transformed or a distribution-free test should be used. If the distributions for the constituents differ, more than one statistical method may be needed.

JTI006 at 2-7 (27 of the pdf).

80. Neither SEI nor NRC Staff considered an alternative method that would use air-rotary drilling with recirculated nitrogen gas instead of air and a foam surfactant that contains organic constituents to eliminate oxygen. *See, e.g.* Transcr. at 366 (witness for SEI stating that he was not aware of any ISL site that had used nitrogen in drilling); *see also* JTI011 at 57; JTI001-R at 18 (describing these methods).

g. Oxidation Bias Will Increase As Wellfield Development Progresses

81. The oxidation effect caused by SEI's well drilling methods also undermines the scientific integrity of the FSEIS approach whereby actual baseline groundwater quality will be established with data collected post-license. A true baseline cannot be developed after hundreds to thousands of wells are drilled in the well fields (*i.e.*, SEI's proposed post-licensing, pre-operational 'baseline'). JTI001-R at 25-26.

82. As evidence of this, the statistically invalid values reported in the mining permits for the Kingsville Dome ISR operations in Texas (JTI017, TWC 1988; JTI018, TWC 1990)[3] show that this flawed methodology will have the effect of creating a cascading deterioration in nominal 'baseline' water quality measurements from wellfield to wellfield. JTI001-R at 29.

83. For the Kingsville Dome site, the initial PAA1 "baseline" was established after the installation of production wells in the ore zone in August 1983. *See* JTI019 at Table 2.7-

84. After additional well fields were built out, the Texas Water Commission[4] (TWC) allowed the operator to revise the "baseline" for PAA1 in November 1987. JTI017 at 10. In doing so, TWC allowed the operator to increase the "baseline" for both uranium and radium-226 by using maximum values that were approximately ten times higher relative to the initial 'baseline' established in 1983. JTI001-R at 29-32.

85. In February 1990, after mining at PAA1 for approximately 6.5 years, the agency allowed the operator to establish "baseline" values at the adjacent PAA2, which is located downgradient from the ISL operations in PAA1. JTI018 at 9. This action, allowed the operator to elevate the uranium 'baseline' value using a maximum value (3.8 mg/L) that is <u>100 times</u> higher than the maximum uranium value (0.071 mg/L) used to calculate the initial PAA1 'baseline'. JTI001-R at 30.

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3 Baseline for Kingsville Dome Production Area Authorization (PAA) 1 and PAA 2 were established two years apart and much higher values were measured for PAA2 (invalid average values - PAA1: uranium = 0.164 mg/L; radium-226 = 22 pCi/L. PAA2: uranium = 1.89 mg/L; radium-226 = 92 pCi/L).

4 The Texas Water Commission is now the Texas Commission on Environmental Quality (TCEQ). JTI001-R at 30, l. 7.

86. TWC then allowed the operator to establish 'baseline' for PAA3 in June of 1998, nearly fifteen years after mining began in PAA1. JTI020 at 12. Collectively, this data presents a record at Kingsville Dome that shows the deterioration of the nominal invalid "baseline" values over time when the operator is allowed to develop the 'baseline' for each unit as the well fields are built out. JTI001-R at 30-32.

87. A direct consequence of this, according to the evidence, is that this methodology for establishing baseline allows much higher levels of uranium to pass through the monitor well ring without being reported as an excursion. At Kingsville Dome, this is evident in the significant increase in uranium at the Garcia wells (just outside and downgradient from the monitoring well ring) over the fourteen years of mining. JTI001-R at 31. The old Garcia well was sampled in 1988 and the initial water quality met the EPA drinking water MCLs for radium-226 (1.1 pCi/L) and uranium (0.011 mg/L) (Garcia Wells Data Sheets JTI021 at page 2 of the pdf). By 1998, the uranium had increased in the old well by over an order of magnitude (0.17 mg/L) and radium-226 was essentially unchanged (0.9 pCi/L). JTI021 at page 3. This observation is in line with the high mobility of uranium, but not radium-226, in the carbonate lixiviant injected into the ore zone. Due to the impact of uranium on the old well, a new well was installed in 1998. However, the new Garcia well had uranium levels similar to the old well (0.15 mg/L) and the uranium levels continued to increase; reaching a level of 0.98 mg/L in 2007. JTI021 at page 6 of the pdf.

88. There is no indication that a similar biasing in the course of building-out the Ross Project, and pursuing adjacent Lance District Development, will not occur. JTI001-R at 29.

h. NRC's FSEIS Also Improperly Relies On Biased Data From The Nubeth Test Project

89. In 1976, Nubeth initiated a single-well, push-pull study (i.e., the injection and extraction of lixiviant from a single well). SEI009A at 3-38 (at .pdf p. 182).

90. The FSEIS relies partly on "historical data from the former Nubeth operation" to characterize groundwater quality in the proposed Ross Project area. *Id*.

91. The use of this data is problematic because the 1976 project occurred nearly two years ***before*** the first baseline samples were collected in April 1978. NRC017. The use of the 1978 well data is not accurate in establishing baseline values because the impacts of the Nubeth project had already occurred. This impact is evident by the data presented in Table 3.7 of the FSEIS. SEI009A at 3-41 (at .pdf p. 185). Nubeth wells 3x, 4x and 19x captured water samples from the aquifer where the lixiviant injection oxidized the ore zone, as they all had high radium-226 values in excess of 10 mg/L. Wells 5x, 6x, 11x and 12x had radium-226 values less than 3 pCi/L, but uranium values as high as wells in the oxidized ore zone.

92. Therefore, because the ore was injected with lixiviant *before* baseline water-quality samples were collected, the Nubeth wells used to collect water-quality samples were contaminated by the injection of the lixiviant prior to sample collection. In other words, pre-project baseline does not exist for the Nubeth pilot-scale study and the post-project

well data cannot accurately be described as "baseline" data for the Ross Project area. JTI001-R at 33-34.[5]

i. Groundwater Quality Baseline Data Can Be More Accurately Quantified Than The Data Presented In The FSEIS

93. In contrast to the information presented in the FSEIS, described above, standard statistical practices for the environmental industry are routinely and easily carried out using statistical software.[6] JTI001-R at 23. These practices include random grid sampling, using a statistically significant number of sampling locations, and using proper statistical tests, none of which were used in the FSEIS. *Id*.

94. EPA's Unified Guidance is persuasive on this topic because of its recommendations on how to properly establish baseline water quality in a scientifically defensible quantitative manner. The Guidance explains basic fundamental scientific and statistical principles that apply regardless of site type. *See* Transcr. at 428 (Testimony of Dr. Abitz: "It's the same fundamental principles, scientific and statistically [that] apply."); Transcr. at 431 (Testimony of Dr. Abitz: "A baseline or background is just that. It's the same regardless of what type of regulatory environment you're in.").

95. Similarly, the Department of Energy's Characterization of Background Water Quality for Streams and Groundwater presents instructive statistical procedures for

[5] Moreover, groundwater quality data from 1978 is not data from the "environment that existed just prior to Strata submitting its license application" which, as NRC Staff witnesses identified, is the most relevant to establishing baseline conditions at the Ross Project site. Transcr. at 452.

[6] e.g., JTI013, Visual Sampling Plan, http://vsp.pnnl.gov; and Pro UCL, http://www.epa.gov/osp/hstl/tsc/ProUCL_v4.00.02_user.pdf) available free from Pacific Northwest National Laboratory and the EPA).

quantitatively determining baseline water quality. JTI014 at 923-995 (Appendix F on Statistical Procedures, Equations, and Results).

96. EPA's Unified Guidance recommends a minimum of 8 to 10 independent samples be collected before running statistical tests. JTI006 at 5-3 (75 of the pdf). Independent samples are defined as representative samples drawn from randomly located wells in the study area that have been properly installed and developed; and the submission of the samples to a certified and licensed laboratory for analysis of water quality parameters. After receipt and validation of the analytical results, proper scientific and statistical methods are used to establish valid baseline values. JTI001-R at 7, 35-39.

97. As described above, for the oxygen-depleted conditions associated with uranium ore deposits, baseline water quality data should be collected using wells that have not been installed and developed with oxygen-rich fluids and air-purging techniques. This is in accordance with professional standards for well installation recommended by the USGS. JTI011; JTI001-R at 16.

2. PROPOSED CONCLUSIONS OF LAW FOR CONTENTION 1

98. As provided for in NRC and NEPA regulations described above, adequately characterizing baseline groundwater quality, in an accurate and quantitative way, is crucial to a sound, meaningful NEPA analysis for a proposed ISL facility. Understanding and characterizing baseline conditions, including water quality conditions, is vital to informing the agency and the public about the environmental impacts of the project. *See N. Plains Res. Council, Inc. v. Surface Transp. Bd.*, 668 F.3d 1067, 1083-85 (9th Cir. 2011) (rejecting EIS for failing to collect baseline data, for "without this data, an agency

cannot carefully consider information about significant environmental impact [and] fails to consider an important aspect of the problem, resulting in an arbitrary and capricious decision.") (internal quotations omitted); *N.C. Wildlife Fed. v. N.C. Dep't of Transp.*, 677 F.3d 596, 603 (4th Cir. 2012) (finding NEPA decision must be based on accurate baseline data).

99. Based on the Board's factual findings discussed above concerning (a) the inadequate number and placement of pre-licensing monitoring wells and requisite samples; (b) the deficient drilling methods used; and (c) the improper interpretation of the monitoring data, including improper averaging and use of the Nubeth data, the Board concludes the FSEIS violates NEPA. The Staff has not adequately characterized baseline groundwater quality in a statistically meaningful and defensible quantitative manner and disclosed the results of this characterization effort in the FSEIS. 10 C.F.R. § 51.71(d*); Id.* § 1502.15; *see also Friends of Back Bay v. U.S. Army Corps of Engineers*, 681 F.3d 581, 588 (4th Cir. 2012) (holding that "A material misapprehension of the baseline conditions existing in advance of an agency action can lay the groundwork for an arbitrary and capricious decision.")

100. NEPA documents must be based on data of "high quality," 40 C.F.R. § 1500.1(b), collected with methods that reflect "[a]ccurate scientific analysis," *id.*, and "scientific integrity." *Id.* at § 1502.24. NRC violated these mandates by relying on deficient pre-licensing monitoring data – data the agency itself recognizes is not adequate to characterize baseline water quality (and thus the agency requires SEI to collect additional data *post*-license). *See* Transcr. at 465 and 469 (NRC Staff explaining the agency did not

require or perform "unbiased group sampling" as part of its evaluation of baseline water characteristics for the EIS, or perform a "statistical evaluation" of groundwater quality).

101. NRC and SEI's arguments that additional data could not be collected pre-license because of the alleged prohibition on pre-license "construction" activities is not persuasive. The "construction" prohibited pre-license does not include "preconstruction monitoring to establish background information related to the suitability of the site." 10 C.F.R. § 40.4. Accordingly, NRC regulations prohibiting pre-license "construction," *id.* § 40.32(e), in no manner restrict the drilling of necessary monitoring wells prior to license issuance – which means the monitoring wells necessary to sufficiently characterize water quality baseline can lawfully be created and used to collect background data prior to license issuance.

102. Accordingly, to comply with NEPA this data must be collected and analyzed as part of the NEPA decision-making process. *See* 40 C.F.R. § 1502.22(a) (requiring that where data "essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement"); *Ocean Mammal Inst. v. Cohen*, No. 98-CV-160, 1998 WL 2017631, at *5 (D. Haw. Mar. 9, 1998) ("an agency is required to engage in reasonable research *to supply missing information*" in preparing an EIS to fulfill its "affirmative duty under NEPA and its implementing regulations to undertake research in order to prepare a comprehensive EIS federal government officials can use to make a reasoned decision"); *Idaho Pub. Util. Comm'n v. ICC*, 35 F.3d 585, 596 (D.C. Cir. 1994); *Or. Envtl Council v. Kunzman*, 817 F.2d 484, 495 (9th Cir. 1987) (NEPA "imposes a

duty on federal agencies to gather information and do independent research when missing information is important, significant, or essential to a reasoned choice among alternatives.") (citations omitted); *Greenpeace Found. v. Mineta*, 122 F. Supp. 2d 1123, 1135 n.16 (D. Haw. 2000) (same).

103. While the license requires additional *post-license* baseline water quality characterization, considering this data *after* the license deprives the public and the decision-maker of any meaningful evaluation of the project's likely environmental impacts in the EIS. The NRC cannot rely upon this yet-to-be-determined data to meet its obligations under NEPA. The fact that existing NRC licensing procedures for ISL facilities require further "post-licensing" characterization of baseline water quality is no defense to the failure to undertake a scientifically valid characterization of baseline water quality as part of the obligatory NEPA review that by law must *inform* the licensing decision. *See* 40 CFR § 1500.2 ("Federal agencies shall *to the fullest extent possible*: (a) Interpret and administer the policies, regulations and public laws of the United States in accordance with the policies set forth in the Act and in these regulations"; "(b) Implement procedures to make the NEPA process more useful to decisionmakers and the public"; and "(c) Integrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice *so that all such procedures run concurrently rather than consecutively*")(emphasis added). The NRC Staff's approach of deferring a complete and thorough characterization of baseline water quality to the "post-licensing, pre-operational" stage for the Ross project, rather than performing it "concurrently" with it NEPA analysis of the proposed license, expressly

violates this regulatory injunction. *See also* 40 C.F.R. § 1500.6 ("The phrase 'to the fullest extent possible' in section 102 [of the Act] means that each agency of the Federal Government shall comply with that section unless existing law applicable to the agency's operations *expressly prohibits or makes compliance impossible."*)(emphasis added). Since neither the AEA nor NRC's implementing regulations "expressly prohibit" the performance of the timely and scientifically adequate baseline water quality assessment at issue in this proceeding, these regulatory requirements dictate that Staff may not defer a thorough baseline assessment until the post-licensing stage. *See also, e.g.,* 40 C.F.R. § 1502.2 (f) (data may not be utilized simply to justify[ ] decisions already made."); *Metcalf v. Daley*, 214 F.3d 1135 (9th Cir. 2000) (vacating NEPA document issued *after* the agency's underlying decision for which the NEPA document was prepared had been made); *see also* 40 C.F.R. § 1500.1(b) ("NEPA procedures must insure that environmental information is available to public officials and citizens *before* decisions are made and before actions are taken") (emphasis added).[7]While the license requires additional *post-license* baseline water quality characterization, considering this data *after* the license deprives the public and the decision-maker of any meaningful evaluation of the project's likely environmental impacts in the EIS. The NRC cannot rely upon this yet-to-be-determined data to meet its obligations under NEPA. *See e.g.* 40 C.F.R. § 1502.2 (f) (data may not be utilized simply to justify[ ] decisions already made."); *Metcalf v.*

[7] Even were the post-licensing data required by the license collected as part of the NEPA process, it would not satisfy NEPA standards due to oxidation bias. Such data would not comply with the NEPA mandate for information of "high quality," 40 C.F.R. § 1500.1(b), and for "[a]ccurate scientific analysis . . . ." *Id.* at § 1502.24. Rather, legally sufficient monitoring data can and must be collected in a manner that does not bias results through oxidation.

Daley, 214 F.3d 1135 (9th Cir. 2000) (vacating NEPA document issued *after* the agency's underlying decision for which the NEPA document was prepared had been made); *see also* 40 C.F.R. § 1500.1(b) ("NEPA procedures must insure that environmental information is available to public officials and citizens *before* decisions are made and before actions are taken") (emphasis added).[8]

104. Rather, to comply with NEPA, NRC Staff must collect and rely on additional data, collected from additional monitoring wells, and analyzed as part of the NEPA process and *before* the NEPA decision is made. 40 C.F.R. § 1502.22(a); *see also* NUREG-1569 ("[c]haracterization of the hydrology at in situ leach uranium extraction facilities must be sufficient to establish potential effects of in situ leach operations on the adjacent surface-water and ground-water resources" and "a sufficient number of baseline ground-water samples [must be] collected to provide meaningful statistics").

B. Contention 2

Environmental Contention 2: The FSEIS fails to analyze the environmental impacts that will occur if the applicant cannot restore groundwater to primary or secondary limits.

CONTENTION: The FSEIS fails to meet the requirements of 10 C.F.R. §§ 51.90-94 and NEPA because it fails to evaluate the virtual certainty that the applicant will be unable to restore groundwater to primary or secondary limits in that the FSEIS does not provide and evaluate information regarding the reasonable range of hazardous constituent concentration values that are likely to be applicable if the applicant is required to implement an Alternative Concentration Limit (ACL) in accordance with 10 C.F.R. Part 40, App. A, Criterion 5B(5)(c).

[8] Even were the post-licensing data required by the license collected as part of the NEPA process, it would not satisfy NEPA standards due to oxidation bias. Such data would not comply with the NEPA mandate for information of "high quality," 40 C.F.R. § 1500.1(b), and for "[a]ccurate scientific analysis . . . ." *Id.* at § 1502.24. Rather, legally sufficient monitoring data can and must be collected in a manner that does not bias results through oxidation.

1. PROPOSED FINDINGS OF FACT FOR CONTENTION 2

104. Contention 2 asserts that after operations SEI will be unable to restore the groundwater either to baseline quality (primary) or to drinking water quality (secondary) standards. Because no previous ISL mining operation has been able to restore groundwater to baseline standards, contention 2 asserts NRC Staff must evaluate the "virtual certainty" that SEI will be unable to do so, necessitating SEI to request that the Commission set an Alternative Concentration limit ("ACL") for contaminants (see 10 C.F.R. Part 40, App. A, Criterion 5B(5)(c)). Because restoring groundwater to a quality that is no lower than the ACL would necessarily result in a degradation of groundwater quality from pre-mining baseline conditions, contention two avers that the FSEIS must outline the environmental impacts of such an ACL – *i.e.*, disclose a reasonable range of what the resulting contamination is likely to be. *See* Order of May 23, 2014, Appendix A; *see also* Transcr. at 500-01 (setting forth contention 2).

a. NRC Requirements For Restoration And Relevant Board Rulings

105. 10 C.F.R. Part 40, Appendix A, Criterion 5B(5) provides groundwater restoration standards for ISL mining operations.

106. Under these rules, an ISL mining operator must, during decommissioning, first seek to achieve primary groundwater restoration standards, or restoration to baseline quality levels. *Id.* In other words, "the concentration of a hazardous constituent must not exceed . . . [t]he Commission approved background concentration of that constituent in the ground water." 10 C.F.R. Pt. 40, App. A, Criterion 5B(5)(a).

107. If this standard is not feasible, the ISL operator must then seek to achieve secondary groundwater restoration standards, or standards that reflect "the drinking water limits" for hazardous effluents provided in the table published at Criterion 5C. *Id.* at Criteria 5B(5)(b), 5C.

108. Finally, if neither of these standards is "practically achievable at a specific site . . . [t]he Commission will establish a site specific *alternate concentration limit* for a hazardous constituent," provided that the alternative standard is "as low as reasonably achievable, after considering practicable corrective actions, and that the constituent will not pose a substantial present or potential hazard to human health or the environment." *Id.* at Criteria 5B(6), 5B(5)(c) (emphasis added) (hereinafter "ACL").

109. Although Criteria 5B(5) and (6) contemplate that the Commission may set alternate concentration limits for water quality restoration, these rules do not relax NRC's implementing regulations for NEPA, which require that an applicant's ER "discuss . . . the impact of the proposed action on the environment . . . [a]ny adverse environmental effects which cannot be avoided should the proposal be implemented … [and] [a]ny irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." 10 C.F.R. § 51.45(b)(1), (2), (5).

110. 10 C.F.R. Pt. 51.71(d) states in pertinent part (emphasis added):

> The analysis for all draft environmental impact statements will, to the fullest extent practicable, quantify the various factors considered. To the extent that there are important qualitative considerations or factors *that cannot be quantified*, these considerations or factors will be discussed in qualitative terms. Consideration will be given to compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection, including applicable zoning and land-use

> regulations and water pollution limitations or requirements issued or imposed under the Federal Water Pollution Control Act. The environmental impact of the proposed action will be considered in the analysis with respect to matters covered by environmental quality standards and requirements irrespective of whether a certification or license from the appropriate authority has been obtained.

111. The Board, in addressing an assertion from Staff and SEI that given the differences that exist among well fields it cannot be known exactly what alternative concentration limits will be deemed necessary to protect human health and the environment under the factors of Appendix A, Criterion 5B(6), explained the utility of a "bounding analysis, something that is not unheard of in the context of NEPA analyses and does not seem untoward in this instance, given the importance of NEPA as a mechanism for providing information regarding the parameters of 'irreversible and irretrievable' resource commitments." LBP-12-3, at 34-35.

112. The Board also addressed SEI's challenge to Contention 2 that SEI will be required to submit a license amendment request for an ACL and thus Joint Intervenors could petition for a new hearing regarding the sufficiency of the request at some later date many years hence. The Board rejected the assertion, and found "the ability of any interested person to obtain an AEA hearing at that point would not provide the relief Joint Petitioners should be able to obtain now, consistent with NEPA, i.e., a public explanation of the impacts of being unable to restore the mined aquifer to primary or secondary baseline and, instead, having to use an ACL, as that alternate limitation might be implemented per a reasonable bounding analysis" before the project is approved in the first instance. *Id*.

b. NRC's Inadequate Presentation And Analysis Of Aquifer Restorations For The Ross Project FSEIS

113**.** The FSEIS sets forth that the groundwater restoration at the site will progress as follows:

1) Groundwater sweep
2) Reverse osmosis (RO) permeate injection
3) Recirculation
4) Chemical treatment
5) Stability monitoring

Groundwater sweep (1) involves collective recovery pumping in the wellfield to capture elevated constituents in ISL impacted water. Following groundwater sweep, RO permeate injection (2) occurs as a 'pump-and-treat' method where recovered groundwater is treated using RO and the permeate is re-injected into the wellfield. After RO permeate injection, 'hot spots' (where uranium concentrations remain elevated) are focused using recirculation (3), which aims to homogenize elevated groundwater concentrations through dilution. Recirculation is similar RO permeate injection, except the recovered groundwater is not treated with RO. In certain instances, chemical injection treatment (4), typically hydrogen sulfide gas or NaS, is injected in an attempt to reduce groundwater concentrations further. Upon completion of the restoration phase, 12 months of stability monitoring (5) is required to confirm that wellfield water quality concentrations are stable and water quality parameters of concern are not migrating beyond the permit boundary. SEI009A at 2-35 (at .pdf p. 119).

114. The FSEIS states "[t]he Applicant has proposed a ground-water restoration schedule that is benchmarked to production schedules and waste-water disposal capacity, and it

estimates that aquifer restoration for each wellfield would take approximately eight months (Strata, 2011b).” SEI009A at 2-35 (at .pdf p. 119).

115. The FSEIS will use synonymous water recirculation treatment volumes consistent with other ISR operations: “[t]he NRC staff found that the Applicant’s estimate of 9.5 pore volumes was acceptable because the estimate is within the range currently used by the uranium-recovery industry, and the Applicant commits to minimizing inefficiencies and adjusting the decommissioning estimate based upon its future experience (NRC, 2014a).” SEI009A at B-46 (at .pdf p. 584).

116. The costs of groundwater restoration at ISL sites are significant, typically 40% of the entire project budget. JTI029; p 55 in pdf, p. 48 in document.

117. The Ross Project Site has an aquifer exemption granted by the EPA. SEI034. However, in determining whether to grant the exemption, EPA only considered whether the aquifer is currently used for drinking water purposes – not whether the water is of sufficient quality to be used for future drinking water purposes. *Id*.

118. The FSEIS defines “large” environmental impacts as “clearly noticeable and sufficient to destabilize important attributes of the resource considered.” SEI009A at xxi (at pdf. p. 31).

119. The FSEIS defines “small environmental impacts as “ environmental impacts are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource considered.” SEI009A at xx (at .pdf p. 30).

120. Staff asserts potential groundwater impacts from the Ross Project would be SMALL and temporary, notwithstanding the potential future need for an ACL at the site. SEI009 at 4-26 (at .pdf p. 300); *see also*, NRC Staff Initial Position Statement at 33.

121. NRC Staff asserts that "the Staff's conclusion in the FSEIS regarding potential impacts to groundwater from the Ross Project assumes that a Commission-approved ACL *of any amount* would have only a SMALL impact on groundwater at the site." *Id*. at 32-33 (emphasis in original).

122. The following exchange occurred at the evidentiary hearing, which demonstrates Staff's lack of analysis and a meaningful standard to gauge the environmental impacts of ISL recovery in the exempted aquifer within the ore zone:

> CHAIRMAN BOLLWERK: All right. Let's go back on the record, please. We have returned from a break for Board consideration of a question that was posed relative to Contention 2, to the staff panel, and we are going to ask the following question, and this is for, at least, initially for Dr. Johnson. You testified that, in evaluating the size and level of the environmental impacts on groundwater, the focus is on the nonexempt aquifer, and that, therefore, the impacts to the exempted aquifer, itself, are immaterial. Does this mean that if the NRC were to approve an ACL thousands of times above EPA Safe Drinking Water Act Standards for uranium, the impacts could still be small?
>
> DR. JOHNSON: Judge Bollwerk, the -- I certainly did not imply that the concentrations of any constituent – let's use uranium as an example -- inside the exempted aquifer is immaterial. The concentrations that are within the exempt aquifer at the -- at the time, let's say, a restoration is approved, first of all, there are for two reasons, I would say. One is because the way that the approved restorations were done that are discussed in the SEIS were average concentrations over all the wells within the -- the production area. So, that average, of course, would be -- would be higher if there were some wells that were, you know, very, very high concentrations. So, the overall average has to be to, you know, some level that would -- would be approved. And so, of course, those levels are important in any given well in terms of making sure that your average meets the -- the ACL that is ultimately approved. Now, the ACL can't just

> be any number. It has to be a number that – a value, a concentration, that, upon evaluation shows that, once you reach the boundary of the exempted aquifer, you are at drinking water standards for constituents, including uranium.
>
> So, if the ACL were, you know, let's say, you know, at a ridiculously large number then, in all likelihood, it would not -- you could not demonstrate that it would be protective of the human health and the environment at that boundary of the exempted aquifer. So, the -- you know, the ACL can't just be any number. It has to be a number that meets that, you know, very important criteria that is protective of -- at the -- at the boundary of the exempted aquifer.
>
> CHAIRMAN BOLLWERK: All right. Judge White, do you have any –
>
> JUDGE WHITE: So, you are -- am I correct that you are saying that -- that the that the aquifer outside the exempt aquifer, at that boundary of the exempt aquifer, is still the standard for deciding whether the impact is small, medium or large and that -- and that you are saying that this -- this example, this hypothetical here with some extremely high value would be reflected in the water quality outside the exempt aquifer, and that is what -- that is still what is -- is what is important? It isn't really what concentration in the exempt aquifer is, it is how the concentration in the exempt aquifer will affect water just outside the boundaries, is that correct, that you are saying that?
>
> DR. JOHNSON: Yes. That is correct.

Transcr., 559-561.

123. In discussing whether impacts of an ACL could ever be large, NRC Staff testified at the Hearing that:

> A large impact means that the environmental impacts are clearly noticeable and are sufficient to destabilize important attributes of the resource considered. We have not found that an ACL, which would have no -- pose no current or potential hazard to human health would also destabilize important attributes of the resource considered.

Transcr. at 548. In other words, according to Staff, impacts of an ACL within the mined and exempted aquifer could never be considered "large."

124. In making this conclusion, NRC Staff relied on the fact that the aquifer is not currently used as a drinking water source and received an aquifer exemption from EPA. *Id*. at 549 (Testimony of Ms. Moore: "if the groundwater is exempted as a source of drinking water, then that is something that goes into our determination of what would destabilize that resource.").

125. Further, this disregard for the environmental effects of ISL recovery on the exempted and mined aquifer evolved over the course of the proceeding as Joint Intervenors demonstrated the environmental degradation inflicted. In the DSEIS, Staff stated that aquifer restoration will "return the ground-water quality *in the production zone* (i.e. the exempted ore zone) to ground-water protection standards specified at 10 CFR Part 40, Appendix A." NRC006B at 4-39 (emphasis added). It further stated that the "purpose of aquifer restoration is to restore the respective aquifer to its baseline conditions, as defined by post-licensing, pre-operational constituent concentrations, so as to ensure public health and safety." In particular the DSEIS explained that specific groundwater restoration techniques will "return total dissolved solids (TDS) (a water quality parameter), trace-metal concentrations, and aquifer pH to the preoperational baseline values that would have been determined during the Applicant's post-licensing, pre-operational sampling and analysis program; these concentrations would be required by the NRC license (NRC, 2009)." *Id.* at 2-32 to 2-34.

126. The FSEIS, by contrast, states:

> The purpose of aquifer restoration is to restore the ground-water quality in the wellfield to the ground-water-protection standards specified at 10 CFR

> Part 40, Appendix A, Criterion 5B(5) (see SEIS Section 2.1.1.2), so as to ensure no hazard to human health or the environment (NRC, 2014b). Water quality is measured at the *point of compliance that coincides with the established boundary of the exempted aquifer*. During uranium-recovery operation, the point-of-compliance wells would be those in the perimeter ring as well as those in the overlying-and underlying-aquifers, as required by the ground-water monitoring program (see SEIS Section 6). During aquifer restoration, however, *the group of point-of-compliance wells would be expanded to include the representative wells in the exempted aquifer*.

SEI009A at 2-34 (at .pdf p. 118) (emphasis added).

127. The FSEIS further states:

> [S]hould Strata submit a request for application of an Alternate Concentration Limit (ACL) at a designated wellfield, the NRC staff will review the aquifer restoration activities to ensure that an appropriate level of effort has been performed. Based upon the NRC staff's review of the Applicant's commitments in the license application coupled with Condition No. 10.6 in the Draft Source and Byproduct Materials License pertaining to ground-water restoration, the NRC staff is reasonably assured that the Applicant would restore ground water to the ground-water-protection standards of 10 CFR Part 40, Appendix A, Criterion 5B(5) and would provide the information for the NRC's determination required per 10 CFR Part 40, Appendix A, Criterion 5D (NRC, 2014a; NRC, 2014b).

SEI009A at 2-35 (at .pdf p. 119).

c. The FSEIS's Inadequate Analysis of Restoration At Other ISL Sites

128. The FSEIS presents information from NRC approved restorations at three sites – a) Crow Butte mine unit 1, b) Smith Highland Ranch ISL mine unit A, and c) the Irigaray ISL site (mine units 1-9). SEI009A at 4-45 to 4-48 (at .pdf pp. 319 to 322).

129. The FSEIS also purports to disclose what happened with the Nubeth Project, a 1970s ISL project conducted in the same proposed permit area as the Ross site. *Id*. at 2-11; 5-27 to 5-29.

130. Staff asserts "the Commission approved restoration of uranium to values ranging from 4 to 71 times post-licensing, pre-operational background values. Specifically, the average concentration of uranium in the wellfield(s) for which the Commission issued restoration approval were as follows: (1) Crow Butte Wellfield 1: 1.73 mg/L, or 18 times background levels; (2) Smith Ranch- Highland A-Wellfield: 3.53 mg/L, or 71 times background levels; and (3) Irigaray Mine Units 1-9: 1.83 mg/L, or 4 times background levels . NRC001 at 33.

131. Staff's further clarified this subsequent to the FSEIS that based upon the available historical record of uranium concentrations at the close of active restoration, if an ACL is requested by Strata for the Ross Project, it is likely to range between 1.7 mg/L and 3.5 mg/L, or 4 to 71 times the post-licensing, preoperational background values for uranium that ranged from 0.05 to 0.52 mg/L." NRC001 at 33.

132. Staff's discussion of each of these four sites is inadequate and fails to present an accurate or meaningful understanding of what is certain to occur as a result of the Ross Project: irretrievable and irreversible environmental degradation of groundwater quality where the environmental impacts are clearly noticeable and are sufficient to destabilize important attributes of the resource considered, which the FSEIS does not acknowledge or discuss. JTI003-R and JTI005(A)-R2 and JTI005(B)-R2.

133. In neither the FSEIS or in Staff's August testimony is there a risk or dose calculation to support the contention that the elevated radium-226 and uranium concentrations pose no threat to human health and the environment. JTI003-R at 11.

i. Crow Butte

134. While the FSEIS (SEI009A at 4-46 (at .pdf p. 320)) briefly describes the Crow Butte history and states that restoration levels were approved, citing a 2001 Crowe Butte restoration report, such a treatment leaves out important details.

135. Referenced in the FSEIS as "stability monitoring," on March 29, 2002, the NRC Staff *rejected* the Crow Butte restoration report, discussed in the FSEIS, as not being protective of human health and the environment. JTI053 at 99 of the pdf. In particular, Staff explained:

> *the data in your Restoration Report, submitted by letter dated January 14, 2000, and the additional information submitted by letter dated August 24, 2001, <u>do not demonstrate that the restoration activities in Unit 1, have resulted in constituent levels that will remain below levels protective of human health and the environment, in accordance with 10 CFR 40.31(h) and Criterion 5F, 10 CFR Part 40, Appendix A.</u>*"

Id. (emphasis added).

136. Although the concentrations did not diminish in subsequent sampling, NRC Staff subsequently *approved* the restoration. Additional groundwater samples were collected between June and September 2002. Those samples reflected uranium concentrations of similar magnitudes to the levels on which NRC's rejection earlier was premised (1.6 – 1.8 mg/L) (*see* JTI053 at 125 – 126), thus, precisely the same as the levels NRC Staff had previously decided was too high to be protective of human health and the environment.

137. Thus, while there was no decrease in the uranium, after this second round of stability sampling NRC approved the restoration, on the grounds that the concentrations did not approach an arbitrarily set secondary standard of 5 mg/L. In other words, despite persistent elevated uranium concentrations, roughly equivalent to those observed

previously that were deemed not adequately protective, the NRC reversed itself and ultimately approved the Crow Butte restoration as adequately protective, an environmentally degrading outcome not disclosed in the FSEIS. JTI052-R at 5-6.

138. Staff's approval of the Crow Butte mine unit 1 concentration levels – 1.73 mg/L, or 18 times background levels – as "protective of human health and the environmental" was an arbitrary standard chosen out of expedience for that site and has little meaning for assessing a future ACL at the Ross project. Thus, while NRC Staff seeks to rely on Crow Butte results to suggest a similar ACL might be authorized for Ross, in fact the outcome in Crow Butte merely suggests that at the Ross site Staff is likely to approve an ACL reflecting whatever contamination remains after SEI has worked on restoration efforts for a period that Staff deems sufficient to try to restore the site, even if those levels are much higher than at Crow Butte or other sites. The ACL selected lacks a scientific or empirical basis for assessing restoration performance. JTI0052-R at 5.

ii. Smith Ranch

139. For the Smith Ranch Site analysis in the FSEIS, Staff acknowledges the averaging of uranium concentrations at 71 times the background as a purported high end of what could happen at Ross. However, Staff failed to perform an analysis on the entire distribution of data available from the Staff's own data at Smith Ranch, an analysis necessary before Staff could seek to justify why the cited concentration is relevant to the likely outcome at the Ross site, rather than some potentially higher value based on the complete set of data. JTI052-R at 5.

iii. Irigaray

140. Pre-mining activities which were not restored in Irigaray mine unit 1 had a profound impact on the 'average baseline' concentrations. *See* table at JTI003-R at 15. This extremely high value, which was an artifact of injection of lixiviant prior to collection of 'baseline' samples, was used in order to skew the baseline dataset for mine units 2-9 to the substantially higher value ~0.52 mg/L. Thus, the upper bound baseline concentration for NRC Staff's purported bounding analysis was unjustified. *Id*. at 14-15; JTI052-R at 10-12.

141. Staff's determination that the range of uranium concentrations at Irigaray mine units 1-9 showed only an increase of 4 times baseline is unfounded. While the Staff acknowledges that Irigaray mine unit 1 data was skewed from research and development activities (NRC001 at 22), they assert that the results of mine units 2-9, data (see JTI003-R at 15 for contrary discussion), would "fall below the high end of the range for uranium established by the three facilities presented in the FSEIS – that is 3.5 mg/L, or approximately 71 times the background value for uranium." In fact, while the average stability concentrations of Irigaray mine units 2-9 ranged from approximately 1.46 – 3.8 mg/L; the actual range of increase from average baseline was between 16x and 125x background (See table in JTI003; p.15), exceeding both the upper and lower bounding limits proposed by Staff (4x – 71x). *Id*. at JTI052-R at 12.

142. Staff's use of Irigaray demonstrates how baseline and restoration efforts are mischaracterized and the failure of the FSEIS to accurately portray restoration results. First, as noted above, "baseline" values from Irigaray (Mine Unit 1) were significantly

elevated from research and development mining activities prior to 1976 (NRC020 at p. A-6, 4th paragraph and subsequent pages). Baseline uranium groundwater concentrations for Irigaray mine unit 1 were collected between 11/9/1976 – 2/24/1977 (JTI034 at B-4) (at .pdf p. 256).

143. Therefore, baseline uranium groundwater samples were biased towards high concentrations. These 'baseline' data from Irigaray were presented as the minimum, maximum, and averaged for all wellfields (wellfields 1-9). NRC032; p. 3.

144. The entire Irigaray restoration results for all wellfields were presented as a single combined wellfield. NRC030 at 4-3 (at .pdf p. 71); *see also*, JTI003-R at 16.

145. All wellfields (1-9) were combined for a composite average 'baseline' and compared to restoration composite concentrations, as determined by COGEMA and WDEQ. However, 8 of the 9 wellfields (Wellfields 2 through 9) have significantly lower average 'baseline' uranium concentrations (range 0.023 – 0.13 mg/L) relative to the composite average 'baseline' value of 0.52 mg/L.

146. Dr. Larson prepared a table (JTI003-R at 15) demonstrating that the elevated 'baseline' samples collected after research and development activities at Wellfield 1 skewed the composite wellfield average uranium concentration to a higher average value of 0.52 mg/L.

147. The table is as follows:

Irigaray Mine Unit	Average Baseline	Average Stability Rounds 1-4	% Change Average Stability 1-4

Mine Unit 1	3.042	0.988	32%
Mine Unit 2	0.130	3.782	2908%
Mine Unit 3	0.023	2.878	12515%
Mine Unit 4	0.046	2.420	5292%
Mine Unit 5	0.020	1.493	7467%
Mine Unit 6	0.112	1.854	1663%
Mine Unit 7	0.119	1.456	1226.8%
Mine Unit 8	0.041	1.591	3923%
Mine Unit 9	0.066	1.825	2751%

Uranium Concentrations (mg/L)

Id.

148. Consequently, it is an illusion that the overall post-restoration average uranium concentrations increased from only 0.52 to 1.83 mg/L (~3.52x increase). When compared to the initial average 'baseline' uranium concentrations for each wellfield, the average post-restoration uranium increases for Wellfields 1 through 9 are substantially higher. This post-operations and post-restoration manipulation of data essentially masks the reality of the groundwater impacts of the mining operations. *Id*. at 17.

149. WDEQ approved this restoration and concluded further attenuation monitoring was not required and wells within the wellfield could be abandoned. NRC035; p. 4.

150. The NRC Staff agreed with WDEQ's assessment of the restoration on September 20, 2006. NRC034 at 1.

151. Rather than providing a bounding estimate, the Irigaray example cited by Staff demonstrates previous mining activities and operations bias 'baseline' values to high

concentrations, and pre-industrial baseline may not exist at these ISL mining sites.

JTI003-R at 17.

152. Staff challenged the assertion that what transpired at the Irigaray Mine Unit 1 site skewed the resulting baseline and restoration data. They further asserted the issue has no relevance for the Ross operation. NRC001 at 23, 24.

153. The Board rejects Staff's argument. What transpired at Irigaray directly parallels the two failed groundwater restorations from Nubeth's research (explained below) and development activities within the Ross project boundaries. In other words, localized previous mining activities at Nubeth would result in high 'background' or 'baseline' values, masking the actual impacts to the groundwater, and diminishing perceived responsibilities for groundwater restoration. This is true regardless of the type of lixiviant used (in contrast to Staff's assertion that ammonium based lixiviant mattered, see NRC001 at 24). ISL sites using sodium carbonate lixiviants like Irigary have likewise failed to restore baseline values at all such operations in the U.S. after ending ammonia-based lixiviants in the early 1980s. JTI052-R at 13.

iv. Nubeth

154. The Nubeth project had two separate ISL recovery operations which were conducted within the current Ross permit boundary. Project A was a single push-pull (the injection and recovery processes were used with one well) which was located "*1000 ft north of Oshoto Reservoir*" and occurred in 1976. Project B was a research and development project located "*3,000 feet south of Oshoto Reservoir*" which occurred began in 1978. SEI009A at 3-39 (at .pdf p. 183) (emphasis added); *see also* JTI003-R at 8, 9.

155. The table found at page at 9 of Dr. Larson's testimony (JTI003-R) displays the complete results from project B of the Nubeth restoration. Samples for individual wells associated with the Nubeth ore zone operation (3x, 4x, 5x, 6x, 11x, 12x, 19x, and 20x) are shown for 'baseline' (derived from data in NRC017 at .pdf p.66) and Restoration/Post-Restoration.

156. The Table is as follows:

	Baseline - (Nuclear Dynamics 1978 - ML12135A358) Nubeth Well - Uranium Concentration (mg/L)									Restoration and Post-Restoration Nubeth Well - Uranium Concentration (mg/L)							
Date	3x	4x	5x	6x	11x	12x	19x	20x		3x*	4x*	5x ^	6x ^	11x ^	12x ^	19x*	20x*
	0.071	0.08	0.1	0.075	0.079	0.073	0.3	0.006		0.12	0.21	0.1	0.09	0.1	0.09	8	0.094
	0.059	0.067	0.077	0.08	0.065	0.049	0.069	0.002		0.18	0.12	0.09	0.1	0.1	0.09	1.1	0.081
6/1978	0.068	0.086	0.068	0.1	0.079	0.064	0.069	0.003		0.64	0.16	0.09	0.1	0.1	0.09	1.4	0.088
	0.089	0.12	0.057	0.098	0.088	0.059	0.077	0.002		0.51	0.16		0.1	0.1	0.09	0.84	0.065
	0.068	0.09	0.11	0.095	0.082	0.067	0.078	0.002		0.24	0.22	0.08	0.1	0.08	0.11	0.48	0.068
Average =	0.071	0.089	0.082	0.090	0.079	0.062	0.119	0.003	Average =	0.338	0.174	0.090	0.098	0.096	0.094	2.36	0.079
Max =	0.089	0.12	0.11	0.1	0.088	0.073	0.3	0.006	Max =	0.64	0.22	0.1	0.1	0.1	0.11	8	0.094
									Percent Change (Averages) =	**476**	**196**	**109**	**109**	**122**	**151**	**1993**	**2640**

Highlighted values presented by the NRC staff in Table 5-4, p. 5-28, FEIS
^ - May - September 1979 (Nuclear Dynamics 1980 - ML13274A287)
* - March - October 1981 (ND Resources 1982 - ML13274A178)

Id. at 9.

157. The NRC Staff presented the highlighted data in the above table in their own Table 5.4 of the FSEIS, but Staff omitted four other 1981 samples taken post-restoration (NRC018; p 47-53 in pdf and JTI031; p. 8-11 pdf). When the average restoration/post-restoration values are compared to the average "baseline," for the complete data set, the percent increase for post-restoration, average uranium values (range from 109 – 2640 %) are greater than the values the NRC Staff provided in Table 5.4. JTI003-R at 9.

158. Wells 4x, 6x, and 12x were near or below uranium concentrations reported by the NRC Staff, yet all post-restoration sample averages exceeded average 'baseline' uranium concentrations. These data are critical to assessing the potential environmental impacts to water quality from previous ISL restorations near the applicant's proposed mining activities, yet the FSEIS did not provide a complete analysis with the available data. *Id.*

159. Further, the FSEIS contains no data or discussion regarding the groundwater restorations from Nubeth project A, which was located within the proposed permit boundary, except for Table 3.7 (SEI009A at 3-41 (at .pdf p. 185)) which displays a pre-test sample that does not aid in understanding what happened with the restoration of the aquifer after leaching occurred. However, groundwater restorations at the Nubeth project A were unsuccessful as well (JTI032 at 14-15 and 87). JTI003-R at 10.

160. The lesson and finding to be drawn from the Nubeth example is that failure to restore the groundwater after a short six-month pilot-scale single well leaching project should have clearly communicated to the NRC Staff that it will not be possible to restore a full-scale commercial ISL operations in 8 months as the FSEIS claims (see SEI009A at 2-35 (at .pdf p. 119)). The FSEIS seriously underestimates the time necessary to restore groundwater after full-scale ISL operations, such as the Ross Project. JTI003-R at 10, 11.

161. Additionally, the Nubeth Project used only a single injection well, whereas commercial operations of ISL, like the Ross Project, use hundreds of wells, which means that groundwater restoration at the commercial scale will be even more difficult. *Id*.

d. These Other Sites Demonstrate There Will Be Substantial Degradation Of The Mined Aquifer At The Ross Project Site

162. As demonstrated below, the record of this proceeding presents uncontroverted factual comparisons of baseline and post-restoration uranium concentrations in the affected groundwater that demonstrate substantial degradation of that groundwater, clearly noticeable and sufficient to destabilize important attributes of the resource considered.

163. No ISL mine has ever returned groundwater concentrations to primary or secondary standards. JTI003-R at 68. As confirmed at the Hearing:

> CHAIRMAN BOLLWERK: All right. So, it sounds like, in terms of license amendments, all roads lead to ACL's?
>
> MR. SAXTON: That is correct.
>
> CHAIRMAN BOLLWERK: All right. And so, I guess -- well, the question would be relative to number one and number two, have any applicant -- I am sorry. Have any licensees ever come and requested approval under one or two?
>
> MR. SAXTON: No, Your Honor.

Transcr. at 552-553.

164. Groundwater data from other representative ISL sites, such as Christensen Ranch Mine Units 2 – 6 and Smith-Highland Ranch Mine Units A and B, is relevant because those operators used restoration methods and circulation volumes similar to those proposed for the Ross project. SEI009A at 2-35 (at .pdf p. 119) ("The aquifer-restoration activities proposed for the Ross Project are the same as those methods described in GEIS Section 2.5: 1) ground-water transfer, 2) ground-water sweep, 3) RO treatment with permeate injection, 4) ground-water recirculation, and 5) stabilization monitoring."). These sites show that after those restoration methods were employed, uranium concentrations in the groundwater within the ore zone have still increased substantially, and in some cases, by several magnitudes or more. JTI003-R at 22-48; JTI052-R at 3-7.[9] The actual results from the NRC's own database follow in findings ¶¶s 165-182.

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[9] This data (JTI005A-R2) was presented as screenshots from a dynamic interactive web based application in order to visualized, interpret, and assimilate the data, rather than presenting the data in a static spreadsheet or figure. Screen capture images were created from the application (JTI005B-R2) which were presented and explained progressively

i. Christensen Ranch Analysis

165. Christensen Ranch mine unit 2, well 2AI30-1 baseline uranium concentrations were measured on 8/28/1992, 9/9/1992, 9/18/1992, and 10/8/1992. JTI005A-R2 at 2-7. The respective uranium concentrations in groundwater at this well prior to mining were 0.026, 0.037, 0.022, and 0.004 mg/L, for respective sampling dates. The average uranium concentration was 0.022 mg/L. JTI005B-R2 at 6; *see also*, discussion at JTI003-R at 36-38.

166. Next, at the same well, Christensen Ranch mine unit 2, well 2AI30-1, post-restoration stability uranium concentrations were measured on 4/8/2004, 7/15/2004, 10/12/2004, and 1/4/2005. JTI005A-R2 at10-15. The respective uranium concentrations in groundwater at this well were 0.207, 0.113, 0.263, and 0.25 mg/L, for respective sampling dates. Thus, compared to the average baseline concentrations at this well, these values observed increases of 9.4x, 5.1x, 11.9x, and 11.4x, respectively. These values exceed EPA's safe drinking water standard for uranium (*see* U.S. ENVTL. PROT. AGENCY, NATIONAL PRIMARY DRINKING WATER REGULATIONS, EPA 816-F-09-004 (2009), available at http://water.epa.gov/drink/contaminants/upload/mcl-2.pdf., 0.03 mg/L) by 6.9 times (or "x"), 3.8x, 8.8x, and 8.3x, respectively. JTI005B-R2 at 8.

167. Christensen Ranch mine unit 5, well 5BL76-1 baseline uranium concentrations were measured on 9/1/1994, 9/15/1994, 9/28/1994, and 10/12/1994. JTI005A-R2 at 90-102. The respective uranium concentrations in groundwater at this well prior to mining were

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throughout JTI003-R. The well(s) shown in each screen capture (JTI005B-R2 1-36) can be sourced to the original spreadsheet data page location, along with other information, such as the date of sampling. *See* JTI005A-R2, 1-356 (NRC ISL Database Spreadsheets).

0.027, 0.031, 0.021, and 0.024 mg/L, for respective sampling dates. The average uranium concentration was 0.026 mg/L. JTI005B-R2 at 9; *see* also JTI003-R at 39-40.

168. At the same well, Christensen Ranch mine unit 5, well 5BL76-1 post-restoration stability uranium concentrations were measured on 11/12/2003, 2/11/2004, 5/11/2004, and 8/12/2004. JTI005A-R2 at 112-118. The respective uranium concentrations in groundwater at this well were 18, 20.7, 21.7, and 14.8 mg/L, for respective sampling dates. Again, compared to the average baseline concentrations at this well, these values observed increases of 692x, 796x, 835x, and 569x, respectively. These values exceed EPA's safe drinking water standard for uranium (0.03 mg/L) by 600x, 690x, 723x, and 493x respectively. JTI005B-R2 at 10.

169. Next, Christensen Ranch mine unit 5, well 5BN162-2 baseline uranium concentrations were measured on 10/26/1994, 11/8/1994, 11/22/1994, and 12/5/1994. JTI005A-R2 at 90-102. The respective uranium concentrations in groundwater at this well prior to mining were 0.047, 0.034, 0.035, and 0.025 mg/L, for respective sampling dates. The average uranium concentration was 0.035 mg/L. JTI005B-R2 at 11.

170. And at the same well, Christensen Ranch mine unit 5, well 5BN162-2 post-restoration stability uranium concentrations were measured on 11/12/2003, 2/10/2004, 5/11/2004, and 8/12/2004. JTI005A-R2 at 112-118. The respective uranium concentrations in groundwater at this well were 0.359, 0.44, 1.01, and 2.08 mg/L, for respective sampling dates. Compared to the average baseline concentrations at this well, these values observed increases of 10.3x, 12.6x, 28.9x, and 59.4x, respectively. These

values exceeded EPA's safe drinking water standard for uranium (0.03 mg/L) by 11.9x, 14.7x, 33.7x, and 69.3x. JTI005B-R2 at 12.

171. At Christensen Ranch mine unit 4, well 4T114-1, baseline uranium concentrations were measured on 1/19/1994, 2/2/1994, 2/16/1994, and 3/7/1994. JTI005A-R2 at 66-72. The respective uranium concentrations in groundwater at this well prior to mining were 0.009, 0.008, 0.005, and 0.009 mg/L, for respective sampling dates. The average uranium concentration was 0.008 mg/L. JTI005B-R2 at 13.

172. At the same well, Christensen Ranch mine unit 4, well 4T114-1, post-restoration stability uranium concentrations were measured on 4/1/2004, 6/29/2004, 9/28/2004, and 1/3/2005. JTI005A-R2 at 78-82. The respective uranium concentrations in groundwater at this well were 17.1, 12, 15.6, and 16 mg/L, for respective sampling dates. Compared to the average baseline concentrations at this well, these values observed increases of 2138x, 1500x, 1950x, and 2000x, respectively. These values exceeded EPA's safe drinking water standard for uranium (0.03 mg/L) by 570x, 400x, 520x, and 533x. JTI005B-R2 at 14.

173. Christensen Ranch mine unit 5, well MW-07 baseline uranium concentrations were measured on 8/30/1994, 9/13/1994, 9/27/1994, and 10/11/1994. JTI005A-R2 at 91-104. The respective uranium concentrations in groundwater at this well prior to mining were 0.028, 0.008, 0.012, and 0.09 mg/L, for respective sampling dates. The average uranium concentration was 0.035 mg/L. JTI005B-R2 at 17.

174. Christensen Ranch mine unit 5, well MW-07 post-restoration stability uranium concentrations were measured on 11/11/2003, 2/9/2004, 5/10/2004, and 8/11/2004.

JTI005A-R2 at 113-119. The respective uranium concentrations in groundwater at this well were 1.17, 2.85, 3.90, and 3.83 mg/L, for respective sampling dates. Compared to the average baseline concentrations at this well, these values observed increases of 33x, 81x, 111x, and 109x, respectively. These values exceed EPA's safe drinking water standard for uranium (0.03 mg/L) by 39x, 95x, 130x, and 128x. JTI005B-R2 at 18.

ii. Smith Highland Ranch Analysis

175. Smith-Highland Ranch mine unit A, well MP5 baseline uranium concentrations were measured on 8/18/1987, 8/19/1987, 8/26/1987, 8/28/1987, and 9/9/1987. JTI005A-R2 at 223-225. The respective uranium concentrations in groundwater at this well prior to mining were 0.0282, 0.0564, 0.0185, 0.0399, and 0.042 mg/L, for respective sampling dates. The average uranium concentration was 0.037 mg/L. JTI005B-R2 at 26.

176. Smith-Highland Ranch mine unit A, well MP5 post-restoration stability uranium concentrations were measured on 2/5/1999, 2/23/1999, 4/1/1999, 5/27/1999, 7/21/1999, 8/18/1999, 9/17/1999, 10/20/1999, 11/11/1999. JTI005A-R2 at 228-232. The respective uranium concentrations in groundwater at this well were 5.9, 8.35, 7.9, 6.6, 6.7, 9.17, 10.1, 9.3, and 11 mg/L, for respective sampling dates. Compared to the average baseline concentrations at this well, these values observed increases of 159x, 226x, 214x, 178x, 181x, 248x, 273x, 251x, and 297x, respectively. These values exceed EPA's safe drinking water standard for uranium (0.03 mg/L) by 197x, 278x, 263x, 220x, 223x, 306x, 337x, 310x, and 367x. JTI005B-R2 at 27.

177. Smith-Highland Ranch mine unit A, well MP4 baseline uranium concentrations were measured on 8/24/1987, 8/25/1987, 8/28/1987, 8/31/1987, and 9/9/1987. JTI005A-

R2 at 223-225. The respective uranium concentrations in groundwater at this well prior to mining were 0.0307, 0.0447, 0.034, 0.039, and 0.026 mg/L, for respective sampling dates. The average uranium concentration was 0.028 mg/L. JTI005B-R2 at 28.

178. Smith-Highland Ranch mine unit A, well MP4 post-restoration stability uranium concentrations were measured on 2/5/1999, 2/23/1999, 4/1/1999, 5/27/1999, 7/21/1999, 8/18/1999, 9/17/1999, 10/20/1999, 11/11/1999. JTI005A-R2 at 227-232. The respective uranium concentrations in groundwater at this well were 5.5, 8.2, 10.8, 11.5, 10.8, 8.75, 10.4, 9.9, and 10.6 mg/L, for respective sampling dates. . Compared to the average baseline concentrations at this well, these values observed increases of 196x, 293x, 386x, 411x, 386x, 313x, 371x, 354x, and 379x, respectively. These values exceed EPA's safe drinking water standard for uranium (0.03 mg/L) by 183x, 273x, 360x, 383x, 360x, 292x, 347x, 330x, and 353x. JTI005B-R2 at 29.

179. This well (MP4) was sampled again in 2012. The uranium concentration was observed as 17.3 mg/L. NRC029 at 53.

180. Smith-Highland Ranch mine unit B, well MP30 baseline uranium concentrations were measured on 8/12/1988, 8/13/1988, and 8/14/1988. JTI005A-R2 at 236-240. The respective uranium concentrations in groundwater at this well prior to mining were 0.0263, 0.0282, and 0.0194 mg/L, for respective sampling dates. The average uranium concentration was 0.024 mg/L. JTI005B-R2 at 30.

181. Smith-Highland Ranch mine unit B, well MP30 post-restoration stability uranium concentrations were measured on 8/30/2004, 9/27/2004, 10/25/2004, 12/28/2004, 1/26/2007. JTI005A-R2 at 246-254. The respective uranium concentrations in

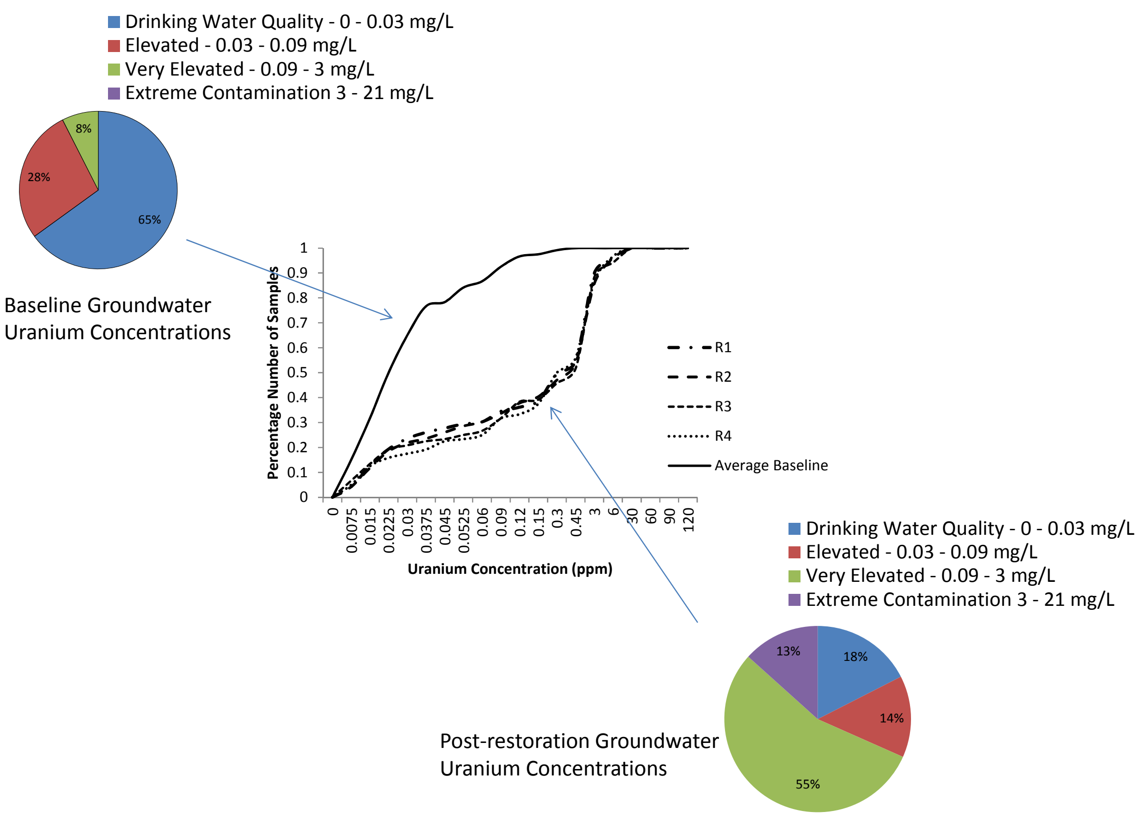
groundwater at this well were 4.36, 3.06, 3.13, 5.02, and 5.68 mg/L, for respective sampling dates. Compared to the average baseline concentrations at this well, these values observed increases of 182x, 128x, 130x, 209x, and 237x, respectively. These values exceed EPA's safe drinking water standard for uranium (0.03 mg/L) by 145x, 102x, 104x, 167x, and 189x. JTI005B-R2 at 31.

182. Finally, samples at well MP-4 observed extremely elevated uranium concentrations (5.5 – 11.5 mg/L) compared to average baseline (0.03 mg/L), exceeding the average baseline uranium concentration by ~183x - 383x, with no evidence that natural attenuation was decreasing elevated uranium concentrations. JTI052-R at 6. Well MP-5 observed a similar trend, where uranium concentrations range from 5.9 – 11.00 mg/L, where 11.00 mg/L was the last sample available suggesting an progressively increasing trend. The average baseline was 0.04 mg/L, indicating concentrations had increased between 148x – 275x baseline concentrations, well above the 71x proposed by Staff. *Id*. Further, according to the NRC Staff's spreadsheets, these samples were all collected between February 1999 and November 1999, implying they should be relevant to the bounding analysis. *Id*. None of these complexities and none of this granular data or analysis are presented by Staff in the FSEIS or in their testimony. *Id*.

iii. Cumulative Aquifer Restoration Data Analysis For Christensen Ranch MU2-6

183. Next, using the entire wellfield data set from Christensen Ranch MU2-6, a histogram for average baseline and each post restoration phase sampling round concentrations (denoted as "R1, R2, R3, R4") presents that entire data set. The figure presents a visual display of the cumulative distribution of the NRC's own data at

JTI005A-R2 at 1-188 (at .pdf pp. 2-187). The y-axis shows the percent number of samples which observe uranium concentrations at various magnitudes. To interpret the figure, choose a concentration of uranium (for example: 0.03 mg/L), and read the corresponding value on the y-axis. For pre-mining baseline conditions, the histogram demonstrates the percentage of samples with concentrations of 0.03 mg/L or less is approximately 65%, while post-restoration samples show the percentage of samples at or below 0.03 mg/L was approximately 18%. The distributions for average baseline conditions (top left) and post-restoration conditions (bottom right) are included in the histogram. JTI003-R at 40.

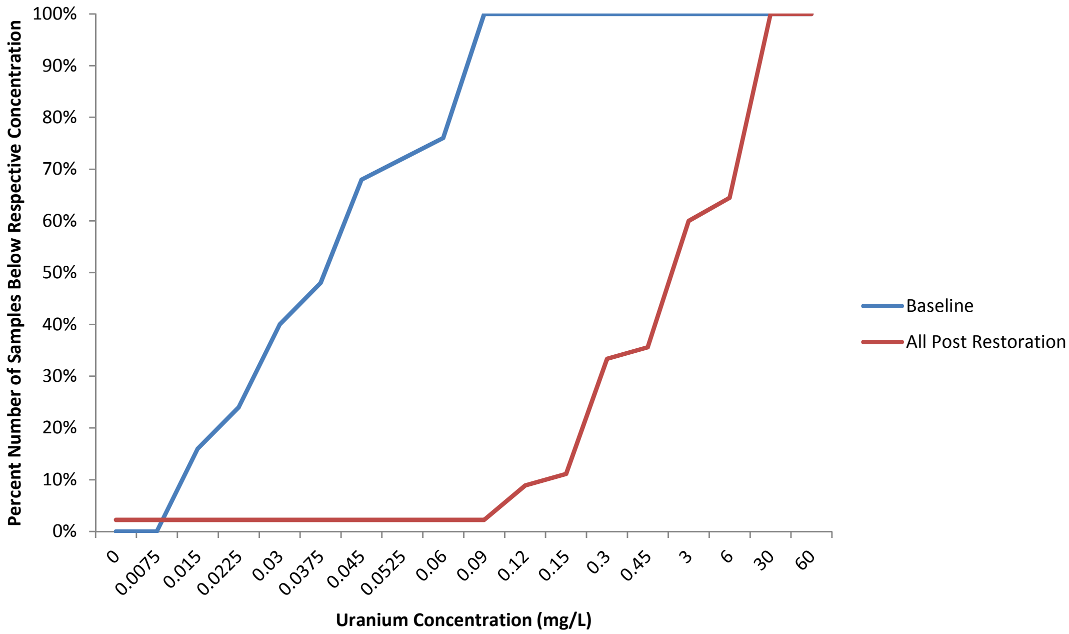


184. The histogram shows that elevated uranium concentrations (0.03-0.09 mg/L) were observed in 28% of the baseline samples and very elevated (0.09 – 3.0 mg/L) in 8% of the baseline samples, however the majority of the average baseline groundwater samples were below the MCL for uranium of 0.03 mg/L (~65%, n = 120). *Id*.

185. This histogram shows that upon conclusion of mining and restoration activities, the groundwater quality sample distribution shows significant changes to these observed percentages. For example, "extreme contamination" (>3.0 mg/L, or >100x safe drinking water standards) samples represent roughly 13% of all observed post-restoration groundwater wells. Further, "very elevated" uranium concentrations increased from 8% (Baseline) to 59% (Post-restoration). Finally the drinking water quality samples decreased from approximately 2/3 of all samples, to roughly 18% of the observed samples. This uncontroverted analysis demonstrates, quantitatively, the severe water quality degradation which occurs as a result of ISL licensed activities, which is not disclosed or discussed in the FSEIS.

iv. Cumulative Aquifer Restoration Data Analysis For Smith Ranch Well MP-4

186. Joint Intervenors prepared a cumulative histogram from the NRC's own data for Smith Ranch wellfield A (MP1 – MP5) that demonstrates that extreme contamination levels (defined as >3 mg/L or 100x safe drinking water standards) were approximately 40% of the post restoration samples. All baseline samples were used (n=25) and all post-restoration samples were used (n = 45) in creation of the cumulative histogram. *Id*.



Id. at 7.

187. Staff's assertion that the "post-licensing, pre-operational background values for uranium that ranged from 0.05 to 0.52 mg/L", is flawed and without merit. *Id*. at 11. By presenting the actual cumulative distribution for baseline data from a representative site, such as Willow Creek - Christensen Ranch, the value of 0.05 mg/L would be higher than roughly 85% of the baseline samples measured. *Id*.; *see* Figure at JTI003 at 41. For the Smith Highland Samples, 0.05 mg/L baseline would have exceeded approximately 705% of the observed baseline samples. *Id*.; *see* histogram figure above. Staff had no basis to assume a concentration at such a high baseline concentration (0.05 mg/L), when that value is unrepresentative of the actual concentrations observed in the groundwater representative of baseline groundwater at ISL sites. *Id*.

2. PROPOSED CONCLUSIONS OF LAW FOR CONTENTION 2

188. NEPA requires an agency to analyze the environmental impact of a project on, *inter alia*, "air and water and other natural systems, including ecosystems," 40 C.F.R. § 1508.8(b), including by disclosing "any adverse environmental effects which cannot be avoided should the proposal be implemented." *Id.* at § 1502.16; *see also* 10 C.F.R. Pt. 51, Subpt. A, App. A, § 6. The impacts on these resources must be disclosed irrespective of immediate human consumption of the affected groundwater. *See* 40 C.F.R. § 1508.14 (defining the "environment" covered by NEPA to include "the natural and physical environment . . . .").

189. The regulations also mandate that where there is data "essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement." 40 C.F.R. § 1502.22(a); *Ocean Mammal Inst. v. Cohen*, No. 98-CV-160, 1998 WL 2017631, at *5 (D. Haw. Mar. 9, 1998) ("an agency is required to engage in reasonable research *to supply missing information*" in preparing an EIS to fulfill its "affirmative duty under NEPA and its implementing regulations to undertake research in order to prepare a comprehensive EIS federal government officials can use to make a reasoned decision"); *Idaho Pub. Util. Comm'n v. ICC*, 35 F.3d 585, 596 (D.C. Cir. 1994); *Or. Envtl Council v. Kunzman*, 817 F.2d 484, 495 (9th Cir. 1987) (NEPA "imposes a duty on federal agencies to gather information and do independent research when missing information is important, significant, or essential to a reasoned choice among alternatives.") (citations

omitted); *Greenpeace Found. v. Mineta*, 122 F. Supp. 2d 1123, 1135 n.16 (D. Haw. 2000) (same).

190. When an agency relies on various *mitigation* techniques as an approach to ameliorate adverse impacts on the environment, it must demonstrate that such techniques will be effective. *See, e.g. Southfork Band Council v. Interior*, 588 F.3d 718, 727 (9th Cir. 2009) ("An essential component of a reasonably complete mitigation discussion is an assessment of whether the proposed mitigation measures can be *effective*") (emphasis added); *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 352 (1989) ("omission of a reasonably complete discussion of possible mitigation measures would undermine the 'action-forcing' function of NEPA"). Thus, an agency may not rely on "conclusory or unsupported suppositions," *McDonnell Douglas Corp. v. U.S. Dep't of the Air Force*, 375 F.3d 1182, 1186-87 (D.C. Cir. 2004), regarding mitigation.

191. Neither Strata nor NRC Staff analyzed the environmental impacts to groundwater that are likely to exist post-restoration, including what will occur if the applicant cannot restore groundwater to primary of secondary limits, either in the ER, the DSEIS or the FSEIS. Specifically, the FSEIS fails to present a clear picture of the extent of groundwater impacts at previous ISL sites, as what the FSEIS calls a "bounding analysis" fails to accurately present the data and further, fails to accurately and precisely display the irreversible degradation of the natural resource. As documented extensively in this proceeding, the likelihood of meeting either the original baseline or the EPA Maximum Contamination Limit for uranium, is non-existent and the environmental impacts are large and long-term. Thus, in addressing the obligation to analyze and present the likely

restoration results from the Ross project, Staff has not complied with these mandates in several respects.

192. As a result, the conclusion that the long term risk of adverse environmental impacts from excursions is "SMALL," SEI009 at 4-38 (at .pdf p. 312), is not supported by the Record. *E.g. Greater Yellowstone Coal. v. Kempthorne*, 577 F. Supp. 2d 183, 201 (D.D.C. 2008) (agency must cogently explain basis for terminology such as "small" impact); *Sierra Club. v. Mainella*, 459 F. Supp. 2d 76, 100-01 (D.D.C. 2006) (same); *Motor Vehicle Manufacturers Ass'n v. State Farm Mutual Automobile Ins. Co.*, 463 U.S. 29, 43 (1983). (agency decision arbitrary and capricious where it "runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise").

193. First, NRC Staff maintain that "potential groundwater impacts from the Ross Project would be SMALL and temporary."SEI009A at 4-37 (at .pdf p. 311). NRC Staff acknowledges that "the Staff's conclusion in the FSEIS regarding potential impacts to groundwater from the Ross Project assumes that a Commission-approved ACL *of any amount* would have only a SMALL impact on groundwater at the site." NRC Staff Initial Position Statement (Aug. 25, 2014) at 32-33 (emphasis in original). In other words, NRC Staff contend that *no matter what the future ACL is*, impacts will be SMALL. This conclusion is flawed as a legal matter, since it means that there is no impact threshold that NRC would consider to be LARGE. *See State Farm, supra*, 463 U.S.at 43

194. Second, the record in this proceeding shows that the ACL criteria established by Criterion 5(B) – relied upon the NRC Staff and SEI to allege that any impacts of an ACL

will be SMALL[10] – is inherently flexible and allows for a great variety of restoration values, some many times greater than pre-mining or baseline groundwater quality levels. *See* JTI052-R at 3-7.

195. Third, Staff's "bounding analysis" of the historical environmental consequences of employing ACLs at a few sites in its FSEIS is both an inaccurate representation of the historical record and insufficient to demonstrate the reasonably foreseeable environmental impacts of ISL uranium recovery *in the particular environs of the Ross Project*, which is, after all, the intended purpose of the analysis From the well-established "hard look" NEPA perspective, Staff's bounding analysis fails to accurately portray the environmental benefits and risks in a manner that would fully inform federal-agency policy and project decisions with the irreversible and plain environmental impacts of this ISL licensing.

196. Fourth, Staff seeks refuge in the limitations inherent in NEPA, which does not require complete certainty, but rather an appropriate "*estimate* of anticipated (not unduly speculative) impacts." Staff Initial Statement at 31(emphasis in original). However, the record in this proceeding demonstrates that *Staff's* FSEIS conclusions about the likely post-restoration values at the Ross site are entirely too speculative to satisfy NEPA, which requires information "of high quality." 40 C.F.R. § 1500.1(b) ("Accurate scientific analysis [is] essential"); *id.* at 1502.24 ("Agencies shall insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements"). And as for the argument that predicating a NEPA analysis on a

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10 See SEI Initial Position Statement at 44-45; NRC Staff Initial Position Statement at 29, 33.

resort to environmentally degrading ACL's at the Ross Project would be unduly "speculative, " the Board elicited uncontroverted testimony from NRC Staff during the hearing that, based on the environmental performance of previous ISL aquifer restoration efforts, *resort to such ACL's is a virtual certainty. See* ¶163*, infra*.

197. For all these reasons the Staff has violated NEPA and implementing regulations by failing to analyze the environmental impacts that will occur if the applicant cannot restore groundwater to primary or secondary limits.

C. Contention 3

Environmental Contention 3: The FSEIS fails to include adequate hydrological information to demonstrate SEI's ability to contain groundwater fluid migration.

CONTENTION: The FSEIS fails to assess [adequately] the likelihood and impacts of fluid migration to the adjacent groundwater, as required by 10 C.F.R. §§ 51.90-94 and NEPA, and as discussed in NUREG-1569 § 2.7, in that:

1. The FSEIS fails to analyze sufficiently the potential for and impacts associated with fluid migration associated with unplugged exploratory boreholes, including the adequacy of applicant's plans to mitigate possible borehole-related migration impacts by monitoring wellfields surrounding the boreholes and/or plugging the boreholes.

2. There was insufficient information for the NRC staff to make an informed fluid migration impact assessment given that the applicant's six monitor-well clusters and the 24-hour pump tests at four of these clusters provided insufficient hydrological information to demonstrate satisfactory groundwater control during planned high-yield industrial well operations.

1. PROPOSED FINDINGS OF FACT FOR CONTENTION 3

a. The Unplugged Exploratory Boreholes In The Ross Project Area Pose Concrete Risks Of Excursions

198. Aquifer confinement is key to understanding fluid migration and the necessity to analyze sufficiently the potential for, and impacts associated with, unplugged exploratory boreholes discussed in the FSEIS. Aquifer confinement occurs when an aquifer is

bounded by an overlying and underlying geologic unit of relatively lower permeability. If an aquifer used for ISL mining is confined, then the lixiviant solution and associated contaminants of concern are prevented from moving vertically. JTI003-R at 52.

199. NRC has purported to find aquifer confinement for previous ISL sites, where subsequent excursions have demonstrated that finding to be erroneous. There are several examples of vertical excursions in aquifers used for ISL mining, where the NRC staff had determined the aquifer was confined and therefore would not allow for vertical fluid excursions.

200. For example, the NRC stated in 1988, in the Environmental Assessment (EA) for Malapai Resources, Christensen Ranch In Situ Leach Satellite operation:

> This data [aquifer testing characterizations] would theoretically indicate that ground-water flow would be contained by the aquitards and concentrated within the production zone. Further evidence of the confining characteristics associated with the units bounding the production zone has been evidence by the successful operation of the Christensen Ranch Research and Development operation.

JTI044 at 26; discussion at JTI003-R at 52-54.

201. However, analysis of the Christensen Ranch Restoration Technical Evaluation Report (TER), in 2008, shows that, contrary to Staff's confinement finding, vertical excursions were an issue. To quote (JTI035 at 11), "*First, excursions in the <u>shallow aquifer</u> in the vicinity of the southern area of MU-2 and the northern area of MU-3 indicate an impact greater than a single well.*" At this same site, NRC Staff included a comment about how the groundwater monitoring parameter values, called upper control limits (UCLs), in an overlying aquifer were set extremely high, not allowing them to detect a fluid migration:

> The staff evaluated the setting and found spatial nexus between the wells that were, or have been reported, on excursion. The relations are: (1) well 2MW-89 is located between MU-2 South and MU-3, (2) three (2MW-68S, 3MW-46S, and 3MW-48S) of five wells in the shallow aquifer overlying the southernmost portion of MU-2 South and northernmost of MU-3 have been on excursion either during operations (3MW-48S and 3MW-46S), or during or subsequent to restoration (2MW-68S and 3MW-48S); and (3), established UCLs for two other wells in the shallow aquifer in that area (2MW-70S and 2MW-72S) are <u>extremely high, limiting their potential to detect an excursion</u>."

JTI035 at 22 (emphasis added).

202. The precise source of the vertical excursions was unclear. The NRC confirmed this uncertainty with the following statement:

> Furthermore, the staff notes that the documentation by the licensee on the source of the excursions for wells in the overlying aquifer is <u>inconclusive</u>. For example, for the 1991 excursion at well 3MW-48S, the licensee noted that the excursion in the overlying aquifer could be through well completions, exploration boreholes or hydraulic communication between aquifers.

JTI035 at 23 (emphasis added).

203. Staff has elsewhere acknowledged that "[a]quifer testing procedures have had more limited success in determining the potential for vertical excursions." NRC020 at 32; last paragraph (at .pdf p. 50).

204. Staub further supported this statement with an analysis of vertical excursions at Irigaray in the late 1970s:

> WMC investigated possible reasons for the excursions in wells SM-1, SM-6, and SM-7 beginning in April, 1979. Geologic and hydrologic data were studied, including geophysical logs, core data, geologic cross sections, and pump test data. WMC (1980) [original document] <u>could find no evidence of natural hydraulic connection</u> between the Upper Irigaray Sandstone and the Coal Unit (Staub et al. 1986, p.A-28, 2nd paragraph)." As a result of these diagnostic tests, WMC (1980) concluded that the most likely

> pathways for lixiviant migration to the Coal Unit in Production Units 4 and 5 during 1980 were unplugged exploration boreholes.

NRC020 at 29, 4th paragraph (emphasis added).

205. Thus, standard methods for proving aquifer confinement can neither predict nor explain vertical excursions. JTI003-R at 54.

206. Unidentified, unsealed abandoned boreholes affect aquifer confinement by permitting fluid migration between aquifers. Vertical excursions are directly related to the number of abandoned, unidentified exploration drillholes, or failed well casings. *Id.*; *see also* NRC020 at 29, last paragraph; *id.* at 30, 2nd paragraph. In other words, as Staub *et al.* concluded, "*vertical excursions are directly related to the intensity of drilling activity*." (NRC020 at 30, 1st paragraph) (at .pdf p. 48) (emphasis added).

207. In sum, even where an aquifer was naturally confined, a drillhole or abandoned well creates preferential vertical flow paths. And many such drillholes create many pathways for those contaminants.

208. In the 1970s Nubeth Joint Venture ("Nubeth"), a joint venture between Nuclear Dynamics and Bethlehem Steel, obtained a license for exploratory uranium mining in the site of the Ross Project. FSEIS at 2-11 (SEI 009). The project operated from August 1978 through April 1979. *Id.* SEI anticipates that there are approximately 1,682 boreholes remaining from the Nubeth Project. *Id.* at 2-48.[11]

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[11] Although the FSEIS states there are 1,682 boreholes, *id.*, SEI's witness testified this number reflects wells outside the Ross Project permit area, and stated there are 1,483 wells within the permit area. Transcr. at 679.

209. As of the issuance of the Final SEIS, SEI had plugged only 55 of these boreholes. *Id.* at 2-48. According to SEI's witness, an additional 53 boreholes were filled as of August 1, 2014. SEI001 at A.25; *see also* Transcr. at 679, l.23.

210. The FSEIS acknowledges the risks associated with fluid migration from unplugged boreholes. SEI009A at 3-37 (at .pdf p. 181) (finding communication between OZ and DM aquifers due to unplugged boreholes); *id.* at 4-42 (finding "improperly plugged drillholes from previous exploration programs that have not yet been properly abandoned."). Staff recognizes even where an aquifer would otherwise be confined, unplugged boreholes are more likely to destroy that confinement and cause vertical excursions, which have proven even more difficult to control than horizontal excursions. *Id.* at 4-37 ("Vertical excursions tend to be more difficult to recover than horizontal excursions, and in a few cases, remained on excursion status for as long as eight years. The vertical excursions were traced to thinning of the confining geologic unit below the ore zone and *improperly abandoned drillholes from earlier exploration activities*") (emphasis added); *see also* NRC020 at 29 (Staub *et al.* 1986); *see also* JTI003-R (Larson Direct Test.) at 54, A.72.

211. The FSEIS concludes that the potential environmental impacts associated with fluid migration will be SMALL, however. FSEIS at 4-43. Critical to that conclusion is the assumption that the remaining approximately 1,500 Nubeth boreholes will be both located and properly filled. FSEIS at 4-23 ("SEI will "attempt to locate and abandon all historic drill [holes] located within the ring of perimeter monitoring wells around each wellfield").

212. Although the Staff assumes these holes will be located and filled, old exploratory wells can be difficult to locate, or to properly plug and abandon, because their precise locations may not be available and uncased holes tend to collapse and fill in, making them difficult to find. JTI001R (Abitz Written Direct) at 46, ll. 10-19).

213. SEI also does not intend to even try to fill boreholes beyond the monitoring ring. Transcr. at 674-75. That ring may be as close to the production wells as SEI chooses, but may not be more than 400 feet away. *Id.* at 675-76. This means that contamination moving beyond those areas is even more likely to be unconfined as it may reach unplugged boreholes SEI does not intend to fill.

214. Because the license condition only requires SEI to "attempt" to fill the boreholes, SEI may not comply. Transcr. at 764-65. As Staff's witness testified, an enforcement action can only occur if the violation is willful. *Id.* And as SEI's witness testified, "we may not be able to find every" abandoned borehole. *Id.* at 766.

215. The difficulty in locating and filling such holes is exemplified by the Notice of Violation issued to Uranium Energy Corporation in March, 2007, for failure to comply with a license condition designed to insure boreholes are able to be readily located. JTI001R (Abitz Written Direct), at 47, ll. 8-17; JTI026 (Notice of Violation).

216. Nonetheless, nowhere in the Final SEIS or elsewhere in the Record did SEI or Staff provide a time table for filling the more than 1,500 holes which remain, or otherwise define the scope and extent of the "attempt, " FSEIS at 4-23, at finding these holes required by SEI.

217. This approach leaves an alarming potential for uranium bearing lixiviant to migrate to overlying or underlying aquifers. JTI003-R (Larson Direct Test.) at 54, A.73.

b. The Pump Tests On Which The FSEIS Relied Are Insufficient To Demonstrate Aquifer Confinement

218. Staff acknowledges in order to even attempt to characterize the ground water hydrology, it is necessary to collect empirical data. Thus, SEI utilized six monitoring well clusters in the OZ aquifer in 2010 to measure water levels. FSEIS at 3-35. Staff based its conclusions of the area hydrology on these samples. *Id.* at Sec. 3.5.3.2.

219. Neither the number of wells nor the short duration of the pump tests are sufficient to provide adequate hydrological information for the Ross site. JT001 (Abitz Direct Testimony) at 49, ll. 6-14. While stratigraphic units are often projected as continuous layers, that assumption is not necessarily accurate in light of the complex stratigraphy of alluvial sediments. NRC020 at 24; JTI001-R (Abitz Direct Test.) at 52; *see also* Oct. 1, 2014 Tscpt. at 750, ll. 11-25.

220. This is a particular concern for ISL mining, given that excursions have been documented at many ISL operations, traced to thinning of the confining layer in the complex fluvial stratigraphy as well as improperly abandoned boreholes. JTI001 at 49, ll.14-17.

221. The 24-hour pump test data from well 12-18OZ and the water quality results for sodium and sulfate demonstrate groundwater communication between the SM and OZ horizons. JTI001(Abitz Direct Test.) at 49, ll. 20-22. Although groundwater from the ore horizon (OZ) generally has higher sodium and sulfate relative to overlying

groundwater (SM), the test results show a linear trace of the sodium and sulfate trend. JTI001(Abitz Direct Test.) at 50, ll. 1-4.

222. In order to properly understand the hydrology of the Ross site, many more test wells, and much longer pump test intervals, must be utilized. JTI001-R (Abitz Direct Test.) at 51, ll. 15-21.

c. The FSEIS Does Not Demonstrate That Excursions Will Be Adequately Detected

223. NRC guidance defines an excursion as occurring when two or more excursion indicators or parameters in a monitoring well exceed their upper control limits ("UCLs") or if one excursion parameter exceeds its UCLs by 20 percent. The FSEIS referred to GEIS Section 2.4.1.4, describing how ISL operations can potentially affect the ground-water quality near an ISL facility when, during an excursion, lixiviant escapes the zone where uranium-recovery is underway and is not recovered by the intended recovery wells. This would result in either a vertical or horizontal excursion. SEI009A at 2-30 (at .pdf p. 114); *see also* JTI003-R at 30.

224. Excursions can be caused by an improper water balance between injection and recovery wells, undetected high-permeability geological strata or faults, improperly plugged or abandoned drillholes, discontinuity within the confining layers, poor well integrity, or unintended fracturing in the uranium-recovery zone or surrounding geological strata. SEI009A at 2-30 (at .pdf p. 114).

225. Excursions of mining fluids impacts water in aquifers outside of the EPA exempted aquifer, either vertically or horizontally adjacent aquifers. The record of this proceeding includes dozens of examples of vertical excursions where there were observed

concentrations for uranium and selenium in exceedance of drinking water standards that occurred in shallow aquifers, not the mined ore zone subject to an aquifer exemption. *See, e.g.*, JTI005B-R2 at 61-62; discussed in the following paragraphs, the data from the Smith Highland ISL site shows extensive elevated groundwater concentrations of uranium and selenium in the shallow (~<200 ft depth), non-uranium ore bearing aquifers. These elevated concentrations of uranium and selenium were reportedly the result of dozens of failed ISL injection well casings in mine units C, E, and F. JTI036 at .pdf p. 8. Examples follow.

226. Well C4-3 is located within the spatial boundary of mine unit C at the Smith Highland ISL site. Samples were taken on 7/24/2012 and observed uranium and selenium concentrations of 0.428 mg/L and 0.415 mg/L, which was 14x and 8x respective drinking water standards (U - 0.03 mg/L and Se – 0.05 mg/L) (JTI036 at .pdf p. 60). The depth of this well is 65 feet deep, which was located above the exempted aquifer depth and vertical excursion monitoring wells. JTI036 at .pdf p. 51.

227. Well E6-2 is located within the spatial boundary of mine unit E at the Smith Highland ISL site. Samples were taken on 7/17/2012 and observed uranium and selenium concentrations of 1.16 mg/L and 3.24 mg/L, which was 39x and 65x respective drinking water standards (U - 0.03 mg/L and Se – 0.05 mg/L) (JTI036 at .pdf p. 70). The depth of this well was 140 feet deep, which is located above the exempted aquifer depth and vertical excursion monitoring wells. JTI036 at .pdf p. 53.

228. Well F16-1 is located within the spatial boundary of mine unit F at the Smith Highland ISL site. Samples were taken on 8/24/2012 and observed uranium and

selenium concentrations of 1.4 mg/L and 0.138 mg/L, which was 47x and 3x respective drinking water standards (U - 0.03 mg/L and Se – 0.05 mg/L) (JTI036 at .pdf p. 81). The depth of this well is 60 feet deep, which was located above the exempted aquifer depth and vertical excursion monitoring wells. JTI036 at .pdf p. 55.

229. At Kingsville Dome, excursions outside of the exempted aquifer were evident in the significant increase in uranium at the Garcia wells (just outside and downgradient from the monitoring well ring) over the fourteen years of mining. The old Garcia well was sampled in 1988 and the initial water quality met the EPA drinking water MCLs for radium-226 (1.1 pCi/L) and uranium (0.011 mg/L). JTI021 at 2.

230. By 1998, uranium had increased in the old well by over an order of magnitude (0.17 mg/L) and radium-226 was essentially unchanged (0.9 pCi/L). JTI021 at 3. This observation is in line with the high mobility of uranium, but not radium-226, in the carbonate lixiviant injected into the ore zone. Due to the impact of uranium on the old well, a new well was installed in 1998. However, the new Garcia well had uranium levels similar to the old well (0.15 mg/L) and the uranium levels continued to increase; reaching a level of 0.98 mg/L in 2007. JTI021 at .pdf p. 6.

231. The FSEIS concludes in the long terms the impacts from excursions will be "SMALL" because Staff assumes excursions will be detected and remediated. FSEIS at 4-43. As explained below, these assumptions are unsupported by the Record.

232. SEI's license provides that the company will monitor for excursions by establishing upper control limits ("UCLs") for certain excursion control parameters. SEI015 (License at Sec. 11.4 and 11.5). The license provides that a well goes on excursion status after a

two step process. In the first step, either two of the excursion parameters must exceed their respective UCL during one semi-monthly sampling, or one parameter must exceed its UCL by 20 percent. In the second step, which occurs after step one is triggered, a second, and if that one is negative, a third sample are taken within 48 hours . If the second or third samples confirm the first results the well goes on excursion status. *Id.*

233. For the wells in the ore zone and overlying aquifer the parameters are chloride, conductivity and total alkalinity, and for wells in the underlying aquifer they are sulfate, conductivity and total alkalinity. *Id.* at 11.4. Uranium itself is not an excursion parameter, *id.*, based on the assumption that these constituents will move through the aquifer faster. SEI009A at 4-41 (at .pdf p. 315).

234. This approach may result in undetected uranium excursions, because contrary to Staff's assumption uranium may travel faster than the existing excursion parameters. Without carbonate anions, soluble uranium (i.e. uranium in the plus-six oxidation state, or U(VI)), as the uranyl ion (UO2+2) is readily absorbed to the surfaces of various iron oxides and clay. However, with the introduction of oxidizing, carbonate-rich lixiviant, used to enhance U(VI) solubility and mobility, uranium absorption to iron oxide surfaces decreases. The result is that the aqueous uranium-carbonate species formed from the lixiviant injections will be highly mobile in the groundwater. JTI 001 (Abitz Direct Test.) at 41, ll.19-22 to 42, ll.1-10; *see also* Curtis *et al* 2006 (JTI022) at 41. The likelihood of uranium excursions is further evidenced by the fact that many publications have shown uranium migrating beyond the monitoring well ring at ISL sites. NRC020 (Staub et al., 1986 at 123); NRC040 (Uranium One, 2010 at 4); NRC 039 (WDEQ, 2011

at p. 4); *see also* JTI003-R (Larson Direct Test.) at 51-53, A.70-71 (documenting excursions); JTI052-R (Larson Rebuttal Test.) at 16-23, A. 9-13 (explaining that updated geochemical models demonstrate uranium migration at much greater rates than previously assumed).

235. The introduction of the lixiviant is also likely to cause significantly elevated uranium concentrations long after operations have been completed. JTI003-R (Larson Direct Test.) at 50 (A.68). Over the thousands of millions of years that these ore deposits formed, the fluvial deposits accumulated uranium where reducing conditions were favorable. The introduction of lixiviant is intended to destroy that natural balance by substantially altering the reducing capacity, but doing so will cause ongoing uranium contamination. *Id.* This may occur because lixiviant is stored in confining units, providing a continual source of oxidizing capacity, or because the continual re-introduction of dissolved oxygen in the RO permeate injection process further degrades the aquifer's reducing capacity. *Id.; see also* JTI003-R (Larson Rebuttal Test.) at 23, A.13.

236. The EPA Report on which Staff's expert Dr. Johnson relied at the hearing further supports this conclusion, explaining:

> Once uranium has been precipitated or adsorbed, the sustainability of the geochemical driving force (e.g., phosphate/silicate, redox, pH, and/or available surface sites) is critical to whether natural attenuation will be a viable cleanup option. Thus, it is recommended that post-attenuation changes in water chemistry be carefully considered to ensure that re-mobilization of attenuated uranium does not occur. Of particular concern are situations in which uranium is attenuated under reducing conditions that are induced by characteristics of the contaminant plume, specifically if the natural conditions within the aquifer are more oxidizing.

NRC052 at 61; *see also* Transcr. at 489 (relying on this Report).

237. Multiple excursions have occurred at other ISL sites, and nothing in the Record demonstrates that this project will be undertaken in a manner reasonably likely to have differing results. JTI003-R (Larson Direct Test.) at 57-64, A.77-85 (providing other site examples).

238. The Record also does not support Staff's assumption that, once excursions are detected, they can be remediated. FSEIS at 4-43. This conclusion cannot be reached with any reasonable scientific certainty without a detailed analysis of the hydrological properties in the exempted aquifer, redox conditions in the aquifer, the availability of various complexing anions, microbial community structure, and structural heterogeneity of the fluvial deposits. JTI001-R (Abitz Direct Test.) at 45.

239. In addition, uranium contamination that has moved beyond the monitor-well ring when an excursion is reported is not remediated by groundwater pumping, and thus the authorized approach will permit contamination outside the exempted zone. JTI051-R (Abitz Rebuttal Test.) at 17, ll.6-14.

2. PROPOSED CONCLUSIONS OF LAW FOR CONTENTION 3

240. NEPA's implementing regulatory scheme requires an agency analyze the environmental impact of a project on, *inter alia*, "air and water and other natural systems, including ecosystems," 40 C.F.R. § 1508.8(b), including by disclosing "any adverse environmental effects which cannot be avoided should the proposal be implemented." *Id.* at § 1502.16; *see also* 10 C.F.R. Pt. 51, Subpt. A, App. A, § 6. The regulations also mandate where there is data "essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in

the environmental impact statement." 40 C.F.R. § 1502.22(a); *Ocean Mammal Inst. v. Cohen*, No. 98-CV-160, 1998 WL 2017631, at *5 (D. Haw. Mar. 9, 1998) ("an agency is required to engage in reasonable research *to supply missing information*" in preparing an EIS to fulfill its "affirmative duty under NEPA and its implementing regulations to undertake research in order to prepare a comprehensive EIS federal government officials can use to make a reasoned decision"); *Idaho Pub. Util. Comm'n v. ICC*, 35 F.3d 585, 596 (D.C. Cir. 1994); *Or. Envtl Council v. Kunzman*, 817 F.2d 484, 495 (9th Cir. 1987) (NEPA "imposes a duty on federal agencies to gather information and do independent research when missing information is important, significant, or essential to a reasoned choice among alternatives.") (citations omitted); *Greenpeace Found. v. Mineta*, 122 F. Supp. 2d 1123, 1135 n.16 (D. Haw. 2000) (same).

241. When an agency relies on various *mitigation* techniques as an approach to ameliorate adverse impacts on the environment, it must demonstrate that such techniques will be effective. *See, e.g. Southfork Band Council v. Interior*, 588 F.3d 718, 727 (9th Cir. 2009) ("An essential component of a reasonably complete mitigation discussion is an assessment of whether the proposed mitigation measures can be *effective*") (emphasis added); *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 352 (1989) ("omission of a reasonably complete discussion of possible mitigation measures would undermine the 'action-forcing' function of NEPA"). Thus, an agency may not rely on "conclusory or unsupported suppositions," *McDonnell Douglas Corp. v. U.S. Dep't of the Air Force*, 375 F.3d 1182, 1186-87 (D.C. Cir. 2004), regarding mitigation. *See also Southfork Band Council v. Interior*, 588 F.3d 718, 727 (9th Cir. 2009) ("An essential

component of a reasonably complete mitigation discussion is an assessment of whether the proposed mitigation measures can be effective").

242. In addressing the risks of excursions from the Ross project, Staff has not complied with these mandates in several respects. In summary, in the FSEIS the Staff fails to present any meaningful analysis of the potential for, and impacts associated, with vertical fluid migration. The FSEIS fails to adequately address the likely impacts caused by unidentified or unsealed drillholes between aquifer units, including the adequacy of applicant's plans to mitigate possible borehole-related migration impacts by monitoring wellfields surrounding the boreholes and/or plugging the boreholes. The FSEIS also fails to disclose that the early detection systems will be inadequate to capture potential for fluid migration, and there is a failure to understand the aquifer geochemistry.

243. As a result, the conclusion that the long term risk of adverse environmental impacts from excursions is "SMALL" is not supported by the Record. *E.g. Greater Yellowstone Coal. v. Kempthorne*, 577 F. Supp. 2d 183, 201 (D.D.C. 2008) (agency must cogently explain basis for terminology such as "small" impact); *Sierra Club. v. Mainella*, 459 F. Supp. 2d 76, 100-01 (D.D.C. 2006) (same).

244. First, neither Staff nor the applicant has undertaken sufficient analyses to characterize the complex stratigraphy of the area. Many more test wells, and much longer pump test intervals, must be utilized for a meaningful characterization.

245. Second, Staff's assumption that the approximately 1,500 remaining unplugged boreholes will not become a vehicle for excursions is not supported by the record. Joint Intervenors have demonstrated these wells can be difficult to locate, or to properly plug

and abandon, and the Record contains neither a time table for filling these holes, or any definition of the scope and extent of the "attempt, " FSEIS at 4-23, at finding these holes required by SEI.

246. Third, the assumption that excursions will be detected and remediated is not supported by the Record. While uranium will not be utilized as an excursion parameter, it may migrate faster than the control parameters that *will* be utilized.

247. Fourth, the Record does not support Staff's assumption that, once an excursion is detected, it can be remediated. Such a conclusion cannot be reached with any reasonable scientific certainty without a detailed analysis of the hydrological properties in the exempted aquifer, redox conditions in the aquifer, the availability of various complexing anions, microbial community structure, and structural heterogeneity of the fluvial deposits. In addition, groundwater pumping will not remediate uranium contamination that has already moved beyond the monitor-well ring. Finally, uranium may continue to be present in elevated concentrations in groundwater long after operations are completed.

248. For all these reasons the Staff has violated NEPA and implementing regulations by failing to consider adequate hydrological information to demonstrate SEI's ability to contain groundwater fluid migration.

V. <u>PROPOSED ORDER</u>

249. In light of the foregoing, the Board hereby DECLARES that the NRC violated NEPA and implementing regulations and requirements in the Ross Project environmental review; VACATES the April 24, 2014 Record of Decision for the Ross Project (NRC009), and the April 24, 2014 NRC Materials License for the Ross Project (SEI015);

and REMANDS to the NRC Staff to proceed in a manner consistent with the Board's factual findings and legal conclusions.

250. In accordance with 10 C.F.R. § 2.341(b)(1), any party to this proceeding may file a petition for review of this Initial Decision with the Commission within twenty-five (25) days after service. In accordance with 10 C.F.R. § 2.340(g) and § 2.1210, this Initial Decision shall constitute the final decision of the Commission forty (40) days after its issuance, unless there is a petition for Commission review filed, or the Commission decides to review this Initial Decision under 10 C.F.R. §2.1210(a)(2) or (3).

Respectfully submitted,

/s/ Geoffrey H. Fettus
Geoffrey H. Fettus, Senior Attorney
Natural Resources Defense Council, Inc.
1152 15th St., NW, Suite 300
Washington, D.C. 20005
Tel: (202) 289-6868/Fax: (202) 289-1060
Email: gfettus@nrdc.org

/s/ Shannon Anderson
Shannon Anderson, Staff Attorney
Powder River Basin Resource Council
934 N. Main St.
Sheridan, WY 82801
Tel: (307) 672-5809/Fax: (307) 672-5800
Email: sanderson@powderriverbasin.org

Counsel for Powder River Basin Resource Council

s/ (electronically signed)
Howard M. Crystal
Meyer Glitzenstein & Crystal
1601 Connecticut Ave., N.W., Suite 700
Washington, D.C. 20009
(202) 588-5206
hcrystal@meyerglitz.com

Counsel for NRDC

Date: November 3, 2014

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing *Proposed Findings of Fact & Conclusions of Law* in the captioned proceeding were served via the Electronic Information Exchange ("EIE") to the Board and all other parties on the 3rd day of November 2014, which to the best of my knowledge resulted in transmittal of same.

Geoffrey H. Fettus (electronic signature)

Date: November 3, 2014