IN THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

IN THE MATTER OF:

Safe Drinking Water Determination; Underground Injection Control Program, Determination of Indian Country Status for Purposes of Underground Injection Control Program Permitting

ON REMAND FROM:

UNITED STATES COURT OF APPEALS FOR THE TENTH CIRCUIT COURT

Case Nos: 97-9556, 97-9557

HRI, Inc.

Petitioner

v.

United States Environmental Protection Agency

Respondent

APPENDIX OF EXHIBITS TO WRITTEN COMMENTS OF HRI, INC. IN SUPPORT OF THE POSITION THAT THE SECTION 8 LAND IN QUESTION IS NOT INDIAN COUNTRY AS DEFINED IN 18 U.S.C. § 1151(B) AND *STATE OF ALASKA v. NATIVE VILLAGE OF VENETIE TRIBAL GOVERNMENT*, 522 U.S. 520 (1998)

HRI, Inc., by and through its counsel of record, hereby submit the following exhibits in support of the position that the Section 8 land in question is not Indian country as defined in 18 U.S.C. § 151(b) and ***State of Alaska v. Native Village of Venetie Tribal Government***, 522 U.S. 520 (1998):

APPENDIX IX

APPENDIX IX

LBP-99-30

August 20, 1999

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges:
Peter B. Bloch, Presiding Officer
Thomas D. Murphy, Special Assistant
Robin Brett, Special Assistant

In the matter of HYDRO RESOURCES, INC. (2929 Coors Road Suite 101 Albuquerque, New Mexico 87120)	Docket No. 40-8968-ML Re: Leach Mining and Milling License ASLBP No. 95-706-01-ML

Appearances

Attorneys representing Eastern Navajo Dine Against Uranium Mining and Southwest Research and Information Center: Lila Bird, Johanna Matanich, Douglas Meiklejohn, Douglas Wolf, Santa Fe, New Mexico 87505; Diane Curran, Washington, D.C. 20009.

Attorneys representing the Staff of the Nuclear Regulatory Commission: John T. Hull, Mitzi Young, Rockville, Maryland 20852.

Attorneys for Grace Sam and Marilyn Morris: Roderick Ventura, Samuel D. Gollis. Window Rock, Arizona 86515.

Attorneys for Hydro Resources, Inc.: Anthony J. Thompson, Frederick S. Phillips, David C. Lashway, Washington, D.C. 20037

PARTIAL INITIAL DECISION CONCLUDING PHASE I
(Groundwater, Cumulative Impacts, NEPA and Environmental Justice)

This is a proceeding in which Hydro Resources, Inc. (HRI) seeks to retain a license to mine for uranium in McKinley County, New Mexico. It proposes to mine by injecting water, fortified with dissolved oxygen and sodium bicarbonate, into the uranium ore-bearing portion of the aquifer to oxidize and dissolve uranium and bring it to the surface for extraction. This process is also known as *in situ* leach (ISL) mining because it uses fluid to extract uranium from the place (situ) in which it is found. HRI's license is opposed by a group of Intervenors who have a variety of concerns, including an allegation that this process will adversely affect the quality of water in the aquifer.

This partial initial decision, which concludes consideration of Phase I of this case, affirms the validity of the license granted to HRI to mine its Church Rock Section 8 property. This decision follows a series of partial initial decisions. It covers the following issues: groundwater, National Environmental Policy Act of 1968 (NEPA), cumulative impacts and environmental justice.

The groundwater portion of this decision examines the geological model presented by Intervenors and concludes that it is not appropriate for the geology of this region and that HRI's analyses demonstrate that the Church Rock Section 8 portion of the Crownpoint Uranium Project meets NRC regulatory criteria for licensing. Accordingly, after consideration of all the areas of concern presented to me in this phase of the litigation, I conclude that the ISL mining project on Church Rock Section 8, with the license conditions imposed on it by the

Staff of the Commission, does not pose a credible threat to the environment or to human health and safety. That key determination provides the foundation for the further conclusion that the Final Environmental Impact Statement, NUREG-1508, February 1997, "Summary and Conclusions" (FEIS) and the findings made in this proceeding, both in prior decisions and in this one, take the "hard look" required for NEPA determinations, for consideration of cumulative impacts, and for environmental justice.[1]

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[1]CLI-99-22 was issued by the Commission on July 23, 1999. Pursuant to that decision, the Commission retained jurisdiction over the adequacy of HRI's financial assurance plan. For purposes of my finding concerning the hard look taken under NEPA, I assume that the Commission is taking a hard look at the adequacy of the financial assurance plan.

1. Background: Description of the HRI Project[2]

HRI has applied for and received a materials license to conduct ISL mining on Sections 8 and 17 in Church Rock, New Mexico, and on two sites in Crownpoint, New Mexico, "Unit 1" and "Crownpoint."[3] HRI's application proposes processing the uranium extracted from each site at its Crownpoint central processing facility.[4]

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[2]This introduction gives an overview of the nature of HRI's proposed project. It is drawn from the FEIS at xix to xxi.

[3]HRI has been granted a license (SUA-1508, January 5, 1998) to conduct ISL mining. It submitted its initial application on April 13, 1988, and proposed to mine on Section 8 in Church Rock. Hearing Record Accession Number (ACN) 8805200339, Application for Materials License (April 13, 1988). HRI later amended the application to include processing in Crownpoint and mining at Section 17, Unit 1, and Crownpoint. Consolidated Operations Plan, Rev. 2.0 (COP), at 2 (Hearing Record ACN No. 9708210179, August 15, 1997).

[4]COP Rev. 2.0 at 2. See also Hearing Record ACN 8811040138 (HRI changes location of the proposed Central Processing Facility) (October 12, 1988).

This phase of the proceeding, completed by this decision, covers concerns that the portion of the project at Church Rock Section 8 should not be licensed. It also covers concerns that might demonstrate that the overall project should not be licensed. Memorandum and Order, Scheduling and Partial Grant of Motion for Bifurcation, September 22, 1998 (unpublished) at 3. Prior partial initial decisions in this phase of the proceeding include LBP-99-1, Waste Disposal Issues, 49 NRC 29 (1999); LBP-99-9, Issues Related to the National Historic Preservation Act (NHPA) and the Native American Graves Protection Act (NAGPRA) and Cultural Resources, 49 NRC 136 (1999); LBP-99-10, Performance-Based Licensing Issues, 49 NRC 145 (1999); LBP-99-13, Financial Assurance for Decommissioning Issues, 49 NRC 233 (1999); LBP-99-18, Technical and Financial Qualifications, 49 NRC 415 (May 11, 1999); LBP-99-19, Radioactive Air Emissions, 49 NRC 421 (May 13, 1999).

At the Church Rock site, HRI's mineral rights include 65 hectares (ha) (160 acres) of patented mining claims in Section 8, T16N R16W, and 80 ha (200 acres) of private minerals operating leases in Section 17, T16N R16W. The site involves 512 ha (1280 acres) of allotted lands requiring mineral operating leases issued and held in trust for the Navajo allotees by the Bureau of Indian Affairs (BIA). The Unit 1 site is located in Sections 15, 16, 21, 22, and 23, T17 R13W. The Crownpoint site, which involves 365 ha (912 acres) of private leases and claims areas, is located in Sections 19, 24, and 25, T17N R13W, and Section 29, T17N R12W. The Church Rock Section 17, Unit 1, and Crownpoint sites are scheduled to be considered in Phase II of this proceeding.

The proposed project would be designed to extract a total of 19 million kg (42 million lb) of uranium reserves, at a maximum rate of approximately 1.5 million kg/year (3 million lb/year). HRI anticipates that uranium recovery activities at the Church Rock site would last approximately 8 years.

HRI proposes to construct ISL well fields where it has claims or leases to economic ore reserves. Existing and new surface facilities at each site would be used as processing plants for extracting uranium from aqueous mining solutions. Groundwater in the aquifer known as the Westwater Canyon Member[5] of the Morrison Formation (Westwater) would be fortified with dissolved oxygen and sodium bicarbonate, then continuously recirculated by wells through the ore-bearing portion of the aquifer to oxidize and dissolve uranium minerals. In the Church Rock area, the top of the Westwater is found at depths ranging from 140 to 230 m (460 to 760 ft). The proposed mining process would use a pattern of injection and production wells drilled into the ore zone. Each production well would be pumped at about 95 L/min (Lpm) [25 gal/min (gpm)], and enough patterns would operate in each well field area to provide a maximum processing plant flow rate of 15,000 Lpm (4000 gpm). Before mining could occur

[5]In the literature, the Westwater Canyon Member is referred to also as Westwater Canyon, Westwater Canyon sandstone, Westwater Canyon aquifer, Westwater sandstone and Westwater aquifer. In this decision, I will call it simply "Westwater" unless the term is included in a direct quotation, in which case I will accept the author's terminology.

at either the Unit 1 or Crownpoint site, HRI would be required to conduct a groundwater restoration demonstration at the Church Rock site. The demonstration would be conducted at a large enough scale to determine the number of pore volumes that would be required to restore a production- scale well field.

Uranium would be recovered from the mining solution in each processing plant by circulating it through ion exchange columns. The ion exchange columns would be alternately taken off line and the uranium stripped, precipitated, and concentrated. All uranium slurry produced would be dried using a single dryer located in the central processing plant at Crownpoint. Uranium slurry would be transported by truck from the satellite Church Rock facility to Crownpoint for drying. The Crownpoint processing plant would use an existing building constructed for earlier uranium mining. A satellite processing plant would be constructed at Church Rock. Approximately 2.5 ha (6 acres) of land would be cleared to construct the satellite plant, including buildings, storage and parking areas, and retention ponds.

HRI proposes that groundwater restoration criteria be established on a parameter-by-parameter basis, and that the primary goal of restoration be to return all parameters to average pre-mining baseline conditions. In the event that water quality parameters cannot be returned to average pre-mining baseline levels, the secondary goal would be to return water quality to the maximum concentration limits as specified in United States Environmental Protection Agency (EPA) secondary and primary drinking water regulations (40 C.F.R. §§ 141 and 143.3). For barium and fluoride, the secondary restoration goal would be set to the State of New Mexico primary drinking water standard. For uranium, 300 pCi/L (0.44 mg/L) would be

used. This concentration was obtained from 10 C.F.R. Part 20 and is suitable for unrestricted release of natural uranium to water. HRI proposes to employ a two-stage treatment system for all liquid effluents. Treated water that meets groundwater standards would be recirculated in the aquifer during restoration and then either reinjected into the Westwater in a location isolated from mine units or applied to the land using ordinary irrigation equipment. Most solid wastes that would be generated by the mining process are defined as 11e(2) byproduct material in the Atomic Energy Act of 1954, as amended, and would require disposal at an off-site licensed disposal facility.

After HRI concludes the mining operation and demonstrates complete aquifer restoration, HRI proposes to plug and abandon the wells, decontaminate or decommission processing facilities, remove all contaminated material to a licensed waste disposal site, survey all disturbed areas, decontaminate to acceptable levels, recontour, revegetate and release the areas for unrestricted use.

2. Groundwater Concern

Intervenors allege that HRI has made serious misrepresentations with respect to the hydrogeology and aqueous geochemistry at the Church Rock site, that necessary water tests were not conducted in a proper manner, and that the geologic unit known as the Westwater is inappropriate for mining activity. They conclude that mining will result in degradation of the quality of the water supply. This allegedly will occur because of inadequate monitoring for excursions, improper criteria for determining excursions, and inadequate groundwater restoration standards, especially for uranium. HRI and Staff both deny these allegations.[6] I examine each of the arguments, using the order of presentation in the Intervenors' Groundwater Brief.[7]

1. HRI has misrepresented the Westwater as a homogeneous aquifer.

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[6]HRI's Response to Intervenors' Brief . . . With Respect to Groundwater Issues, February 19, 1999 (HRI Groundwater Response); NRC Staff's Response . . . on Groundwater Issues, March 12, 1999 (Staff Groundwater Response).

[7]Intervenors Amended Written Presentation in Opposition to Hydro Resources, Inc.'s Application for a Materials License with Respect to Groundwater Protection, January 18, 1999 (Intervenors' Groundwater Brief).

Intervenors argue that ore in the Westwater, in which Church Rock Section 8 is located, was deposited along ancient channelways. Intervenors suggest that the Westwater "consists of thin, stacked, and crisscrossing sand channels bounded by less permeable siltstones and shales." Intervenors' Groundwater Brief at 17, 18. They are concerned because they believe that these channels form a pathway for rapid water travel, carrying toxic elements released by mining over large distances in a relatively short time, thus poisoning the aquifer and adversely affecting its use for drinking water. Intervenors' Groundwater Brief at 19.

The considerable literature on the Westwater[8] demonstrates that it consists predominantly of sandstone which contains discontinuous clay horizons formed by fluvial deposition[9] (Turner-Peterson at 47-75[10]). On a local scale it is heterogeneous due to the very local occurrence of clay and conglomerate (e.g., Turner-Peterson and Fishman at 373). On a broad scale, that of the proposed mining operation, the Westwater may be approximated as homogeneous.

Seismic studies at Church Rock indicate that the bulk of the ore zone occurs entirely within a portion of the Westwater consisting of a block down-dropped by ancient faulting

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[8]The source most cited by the parties is *A Basin Analysis Case Study: The Morrison Formation Grants Uranium Region New Mexico*, edited by Christine E. Turner-Peterson et. al.,1986 (AAPG Studies in Geology #22). This is a collection of articles. In this partial initial decision, I have used scientific citations to articles within this collection, all of which I find relevant and admissible.

[9]A process by which a river lays down deposits. *The Random House College Dictionary* 1980.

[10]Citations in this format, using author names not defined in the text, are citations to *A Basin Analysis Case Study*, cited in footnote 8, above.

(Phelps *et. al.* at 145). Thickness of sand and sand content are greater within this block than in the remainder of the Westwater. Therefore, the seismic data strengthen the conclusion that the ore zone of the Westwater behaves in a homogeneous manner. Similar thickening occurs elsewhere in the Westwater where the Westwater contains large sandstone-to-mudstone ratios (Turner-Peterson and Fishman, *Id.* at 373).

The technical literature cited by Intervenors offers similar descriptions of the Westwater to that quoted from the Intervenors' Groundwater Brief above. The Intervenors stress the heterogeneity of the Westwater, whereas HRI and Staff stress the homogeneity.

Intervenors differ from the published literature in their belief that channels will rapidly transport water through the Westwater and that the ore has been deposited in a series of vertically stacked channelways. Such deposition along channelways contradicts conventional uranium deposit models. Uranium deposits at redox fronts, where the circulating fluids encounter a more reducing environment, are commonly caused by the presence of organic material, especially humates (e.g., Turner-Peterson and Fishman at 357-388). The published literature does not suggest in any way that these redox fronts are ancient channelways.

The Intervenors rely on references to channelways in AAPG Studies in Geology #22. In examining the literature, however, there are no references to channelways, although statements are made about "vertically stacked and laterally coalesced sandstone beds interbedded with thin, *laterally discontinuous* mudstone beds" (Kirk and Condon at 111). These are not synonymous with channelways and are typical of fluvial sandstone deposits such as the Westwater.

For the Intervenors' concerns about channelways to be relevant to this proceeding, there must be narrow channelways that transport water much faster than surrounding rock, possibly causing water to bypass monitoring wells and to create rapid excursions, much as if there were underground pipes that somehow manage to avoid all the monitoring wells. A channelway must also be long enough to speed up the travel of water for an appreciable fraction of the total distance to be traveled. The principal characteristics of rock that permits water to move within it are its porosity and permeability. For a channelway to flow faster than the surrounding rock, it must have higher porosity (a higher percentage of pore space -- which measures its ability to contain water within pores) and higher permeability (ability of water to flow from pore to pore). I conclude, based on a review of the entire record, that the Westwater does not contain channelways.

Intervenors' expert, Wallace (Response Affidavit, May 20, 1999 at 4-11)[11], presents a model that he has constructed based on a pump test and some assumptions. However, HRI's license conditions acknowledge that one pump test is by no means definitive either in determining the hydrological properties of the aquifer, including whether or not it is vertically contained. Accordingly, additional pump tests will be conducted. License conditions 10.23 to 10.26, 10.30 to 10.31 (SUA-1508 at 8-9). Furthermore, the conclusions that can be drawn from models depend on their assumptions, and Wallace's model assumes a channelway, which is contrary to the weight of the evidence before me. Wallace states, however, that the model

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[11] *See* Intervenors' Joint Response to HRI's and the NRC Staff's Responses to the Presding Officer's April 21, 1999 Memorandum and Order (Questions), May 25, 1999

is "nothing more than one of many plausible configurations based on a channel theme." (Wallace Response Affidavit, May 21, 1996 at 10.) Wallace (*Id.* at 15) states that

> the results represent two solutions among many solutions that could fit the data. While alternative solutions could show lower impacts on the down-gradient well, other alternative solutions could show even greater impacts at any earlier time.

Wallace's model uses postulated conductivities, including the totally unreasonable assumption that the velocity of water through postulated channelways is 10,000 times the velocity of water through surrounding rock.

The model also concludes that restoration will be unsuccessful and that pollution at the nearest private well after 274 years will be about one fifth the value of maximum contaminant content in the mine area. (*Id.*, Exhibit 2-G.) Finally, the model assumes no precipitation of toxic elements along the flow path. However, it is well documented that the Westwater is rich in humates. (Turner-Peterson, Fisher at 357-388). Humates are organic compounds that serve as reducing agents, taking oxygen from groundwater, thus precipitating elements, such as uranium, that depend on the oxygen to remain in solution.

Wallace finds that modeled concentrations of uranium after about 200 years are about 0.17 mg/L. *Id.*, Exhibit 2G. Assuming Wallace's scenario is correct, then this value is still substantially less than the NRC's primary goal of a restoration value of a uranium concentration of 0.44 mg/L. *See, e.g.,* FEIS at 4-60. Accordingly, even if I accept the validity

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(Intervenors' May 25, 1999 Response) at Exhibit 2 (Wallace Response Affidavit).

of Wallace's model, I would still find that water quality remained acceptable. Thus, I conclude that Wallace's model, which makes unsupportable assumptions (see the preceding paragraph, above), has not cast serious doubt on HRI's demonstration that it can adequately restore the mining area.

Intervenors' experts, Abitz[12] and Wallace, are unclear about the three dimensional structure of the Westwater. The most recent Intervenor position, responding to the informative paper by Cowan (SEPM Concepts in Sedimentology and Paleontology, 3, at 80-93, 1991 (Cowan article)), is the position taken by Lucas. Intervenors' expert, Lucas[13] (Lucas Response Affidavit at 4 to 7), gives an excellent summary of Cowan's work with respect to the internal structure of the Westwater. He points out that the Westwater is lithologically heterogeneous, but on the large scale each "channel belt" can be "superficially characterized as sandstone, because the majority of the deposit is sandstone." I agree. If one looks at Cowan's

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[12] Abitz's qualifications are cited in Intervenors' Groundwater Brief at Exhibit 1, written Testimony of Dr. Richard J. Abitz at 1-3, and Exhibit A. I accept Abitz as an expert.

[13] Intervenors' May 25, 1966 Response at Exhibit 3 (Lucas Response Affidavit). Lucas's qualifications appear in Lucas Response Affidavit at 1-2 and Exhibits A, B. I accept Lucas as an expert.

photographs and drawings, the Westwater is clearly a fairly pure sandstone, albeit cross-bedded and scoured, and may thus, as noted above, be regarded as generally homogeneous.

Lucas (Id., ¶ 14 at 6) reports that

> Cowan's article can be used to conclude that there must be at least two levels of permeability/porosity in the Westwater Canyon Member: (1) the small scale (averaging 30 meters [100 feet]) of complex conduits; and (2) large scale conduits that correspond to the channel belts.

For reasons stated by Lucas, who is an Intervenor witness, I agree. However, this conclusion does not support Intervenor's position.

Cowan (Cowan Article at 89) states that sheet sandstones act as fluid conduits, but he points out that "in general, it is not possible to trace the base of a sandstone sheet across to adjacent cliff exposures separated by valleys." In addition, the "channelways" are quite discontinuous, and in no sense can be regarded as channelways in a regional sense. Indeed, Cowan points out that these individual sheet sandstone bodies are at least 1 km wide and they "possibly exceed several km." Based on these characteristics, there seems little chance that monitor wells spaced 400 feet apart would miss an excursion in this environment. I find, contrary to Lucas, that the sheets are 5-10 m. thick, not 30 m.

The single sheets are discontinuous, possibly because they are overlain and scoured by other sheets. As Lucas points out (Lucas Response Affidavit, ¶ 13 at 6), "the Westwater Canyon is a three dimensionally very complex amalgamation of many coalesced channel, bar, and overbank deposits."

It is important to place the Westwater in context when considering whether it is homogenous or heterogenous. If you consider a small area of the Westwater, then it might be

heterogenous even though considering a larger area, as if from a distance, it might be homogenous.

On a small scale, groundwater flow in the Westwater is complicated, just as water flow through a filter is complicated on a very small scale. But on a larger scale the Westwater may be treated as homogenous, especially because the coalesced channels are kilometers wide. By homogenous (isometric medium), what is meant here is that groundwater will flow down gradient at about the same velocity in different parts of the Church Rock area.

I agree with HRI expert Bartels that if lengthy channelways exist at Church Rock, they should occur in other ISL uranium sites which have a very similar fluvial environment. (Bartels Affidavit at 10-14.)[14] Channelways have not been reported elsewhere, so far as I am aware, nor do the Intervenors provide evidence of them.

In light of all the above, I conclude that the ore zone in the Church Rock area is homogenous (isotropic) with respect to fluid flow, and that the ore zone does not contain significant channelways. Staff (Ford May 24, 1999 Affidavit at 1 to 3)[15] also persuasively refutes the Channelways hypothesis, as do Bartels (Bartels Affidavit, Feb. 19, 1999 at 12-30,

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[14] Bartel's February 19, 1999 Affidavit is an unnumbered attachment to HRI Groundwater Response (Bartels Affidavit). Bartels qualifications are summarized at HRI Groundwater Response, unnumbered exhibit to Bartels Affidavit, Feburary 19, 1999 at ¶ 2. I accept Bartels as an expert.

[15]Exhibit 1 to NRC Staff's Response to HRI's Answer to Presiding Officer's Questions, May 25, 1999 (Ford May 24, 1999 Affidavit). Ford's qualifications are found at Exhibit 9, ¶ 2 to NRC Staff's Response to Motion for Stay, Request for Prior Hearing and Request for Temporary Stay, February 20, 1998 (Ford February 20, 1998 Affidavit). I determine that Ford is an expert.

and Wasiolek and Spinks (Affidavit, Feb. 16, 1999[16] at 4-5). The statement (Intervenors' Groundwater Brief at 19) that the sand channels in the Westwater function as "pipelines" is without basis. I see no misrepresentation on the part of HRI. Intervenors have an incorrect understanding of the origin of this type uranium deposit.

2. Alleged Misrepresentation

1. HRI misrepresents groundwater pathways and divides as features that provided a lixiviant barrier.

The Intervenors (Intervenors' Groundwater Brief at 19-22) make this allegation by citing the Wallace Jan. 8, 1999 Testimony (Attached as Exhibit 3 at 30-37). The Intervenors accuse HRI of misrepresentation on this issue. All arguments are presented for Crownpoint and are therefore not directly relevant for this phase of the hearing, which is limited to Church Rock. However, the method employed by HRI is a commonly used method for evaluating *in situ* mines (HRI Groundwater Response at 8) and do not misrepresent the groundwater pathways.

[16]Affidavit of Mary Ann Wasiolek and Michael P. Spinks, P.E., February 16, 1999, unnumbered attachment to HRI Groundwater Response (Wasiolek/Spinks Affidavit).

2. HRI misrepresents its groundwater travel times as conservative.

None of the arguments (Intervenors' Groundwater Brief at 22-23) presented involve Church Rock. Further, in discussing Unit 1 and Crownpoint, Intervenors' witness, Wallace (Jan. 8, 1999 Testimony at 42), appears to question the assumption of homogeneity of the Westwater, rather than the method of calculation of flow rates if homogeneity is assumed. As discussed above, homogeneity appears to be the most reasonable characterization. Accordingly, there is no misrepresentation by HRI.

3. HRI Misrepresented that it evaluated whether faulting exists that connects the Westwater with other aquifers.

1. Alleged Connection to Aquifers Below Westwater

The Intervenors state, in their Groundwater Brief at 23-26, that the Recapture Shale (thought to exist under the Westwater, separating it from the underlying Cow Springs aquifer) probably does not exist at Section 8, so it cannot act as a barrier to the Cow Springs aquifer. They state that HRI uses data from a single borehole, although they possess data from 200 such holes. They state that a 5 foot clay layer is the sole barrier between the two aquifers. Intervenors claim that the Cow Springs aquifer "comes into nearly direct contact with the Westwater." (Wallace Jan. 8, 1999 Testimony, at 62-63; see also Intervenors' Staub Testimony at 27-28, attached as Exhibit 2 to Intervenors' Groundwater Brief. (Staub January 9, 1999 Testimony)[17]) Intervenors' Wallace cites Hilpert (Staub Testimony, Exhibit N), whose cross-sections indicate that the Recapture is thin or missing in the area of Church Rock. Staff (FEIS 3-18) and HRI (HRI's Groundwater Response at 9 and 10) adequately rebut this allegation, as is discussed below.

The Intervenors further claim (Intervenors' Groundwater Brief at 25-26) that the Recapture Shale may be an aquifer in its own right and may be contaminated by vertical

[17]Staub's qualifications appear at 1-3 and Exhibit A. I accept Staub as an expert.

excursions (Intervenors' Groundwater Brief at 25-26; Wallace Jan. 8, 1999 Testimony at 14 to 17). Many drill holes penetrated the Recapture Shale to varying degrees, and in every case its characteristics are those of an aquatard. The Recapture appears to be present throughout Section 8, as reported by Staff in the FEIS and HRI (HRI Groundwater Response at 10).

HRI's expert, Lichnovsky (Lichnovsky Affidavit, attached to HRI Groundwater Response at 19)[18] states that at the Church Rock area the Recapture Shale is shale (at 19) and offers evidence (at 21) that the Cow Springs sandstone does not intertongue with the Recapture Shale at the site. In addition, HRI will conduct tests to determine whether the Cow Springs aquifer is hydrologically confined from the Westwater. Cow Springs will be monitored if confinement does not exist (HRI Groundwater Response at 17-18). I find no misrepresentation by HRI.

Lucas (Lucas Response Affidavit at 3) points out "that the Recapture Shale is not a confining layer in this region because the Recapture is a fluvial deposit in the southern part of the San Juan Basin." Condon and Peterson, at 21, agree with this, but point out that it contains sandstone, claystone, mudstone and siltstone, in agreement with HRI and Staff. I therefore find that it is an aquatard, separating the Westwater from the Cow Springs aquifer so that there is little reason to believe that there is an appreciable flow of water between them.

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[18]Lichnovsky's qualifications are cited in his affidavit at 1, 2. I accept him as an expert.

Lucas (Lucas Response Affidavit at ¶ 6) then states, in disagreement with Intervenors' affidavits, Staff, HRI, and the literature cited by them, that "the rock section immediately below the Westwater is not shale -- it is a mixture of sandstone, siltstone, and thin gypsum beds that overlie the gypsum beds of the upper Todilto Formation." He does not state if this mixture is the Recapture Shale, nor does he give any reference to support this statement. In stating this, he did not account for either the considerable thickness of the Cow Springs sandstone, which is a known aquifer in the region, or for the Beclabito Member, both of which overlie the gypsum-bearing Todilto Limestone, which is quite thin in this area (e.g., Condon and Peterson at Fig. 4a, p.11). I reject this uncorroborated statement. Instead, I accept the findings of Condon and Peterson that over 500 feet of Recapture, Cow Springs, and Beclabito lie between the Westwater and the Todilto.

Lucas then states that the gypsum beds to which he refers are easily deformed and dissolved, which "produces numerous fractures at the subsurface and at the surface." (Lucas Response Affidavit at ¶ 6 at 3.) This is entirely to be expected for gypsum, and if present could provoke vertical excursions if one accepts Lucas' stratigraphy. However, there is no evidence concerning fractures at the surface in the mine area, which one should see if Lucas' scenario were correct. For the reasons stated, I therefore conclude that Lucas' scenario is incorrect and that there is no fracturing caused by gypsum beds, as Lucas alleges.

2. Alleged Connection to Aquifers Above Westwater

Intervenors' Staub (Staub January 9, 1999 Testimony at 26) makes claims about overlying strata. He contends that the Westwater and overlying Dakota aquifer may be in contact at Church Rock because the Brushy Basin member has been scoured away. Staff (FEIS, 3-18) quotes HRI and Hilpert (1969)[19] on the varying thickness of the Brushy Basin at the Church Rock site. Based on the information provided by the Staff, I am persuaded that the minimum thickness of the Brushy Basin Member is 45 feet, and at no place is the sandstone unit in the Brushy Basin separated from the Westwater and Dakota Members by less than 16 feet of mudstone, which is known to be an efficient aquatard (FEIS 3-35).

Bartels (Bartels Affidavit at 9, attached to HRI 2/19/99 Response) discusses the Church Rock Environmental Report (Hearing Record ACN 9304130415 at 110), which points out that the Dakota Sandstone and Poison Canyon units have a positive differential pressure with respect to the underlying Westwater. Bartels correctly concludes that there cannot be appreciable leakage between these units because the leakage would equalize the pressures.

[19]Wallace Testimony, Jan. 8, 1999 at 8.

HRI Expert Orr (Orr Affidavit at ¶ 3, attached to HRI 2/19/99 Response)[20] concludes that because of the lower pressure of the Westwater with respect to the Dakota, "any vertical excursion into the Dakota could be reversed simply by stopping the operation." This would cause the net flow to be into the lower-pressure, underlying Westwater.

Bartels (Bartels May 11, 1999 Affidavit at 5, attached to HRI May 11, 1999 Response) quotes a memo by J. Holonich, NRC to P. B. Bloch (dated April 20, 1998):

> Historically almost all vertical excursions at ISL mining operations [anywhere] have been caused by faulty well completions or unsealed exploration boreholes. The staff is aware of only one ISL site where vertical excursions may have been caused by stratigraphic interconnections.

Based on this memorandum, I conclude that the Brushy Basin Member shows characteristics of an efficient aquatard in the mine area. Thus, HRI has not misrepresented this issue. I also conclude that there are unlikely to be any serious problems from vertical excursions in the course of mining Church Rock Section 8.

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[20]The Orr February 19, 1999 affidavit is an unnumbered attachment to the HRI Groundwater Response. Irr's qualifications are cited in his affidavit at ¶ 1. I accept Orr as an expert.

4. HRI misrepresented that it evaluated whether faulting exists that connects the Westwater with other aquifers.

Intervenors claim (Intervenors' Groundwater Brief at 26-27, 30) that structural cross-sections were not reviewed, so that HRI did not determine whether faults could provide vertical pathways for fluid by bringing one aquifer in contact with another. They point out that vertical faulting is common in the San Juan Basin and that fractures and shear zones could create pathways for vertical excursions (Wallace Jan. 8, 1999 Testimony at 2-24, Exhibit 3).

There is no evidence for any faulting later than Late Jurassic Period at Church Rock and that faulting appears to have occurred at the time the Westwater was deposited, explaining the greater thickness and sand content in the trough formed by the faulting (Phelps et. al. at 145, 1986). HRI conducted a seismic survey at the Church Rock site and saw no faulting later than the Triassic period (HRI Groundwater Response at 10 and 11). Pump testing saw no evidence of vertical excursion indicative of faulting, fracturing, or shearing or of drill holes capable of transporting fluid. HRI will do further hydrologic testing for vertical excursion prior to mining (FEIS 4-18).

Wallace's (Wallace May 20, 1999 Response Affidavit at 18) view of the scientific literature about Church Rock is that the extent to which the seismic cross-section reproduced by Kirk and Condon (*Id.* at 105 to 144) "goes through the mining zone cannot be discerned from the relevant figures or text." However, I have examined the text and figures and find that this is wrong. In addition, Phelps et. al.at 145 to 160, which Wallace cites in the same footnote, clearly shows the position of faults, ore-bodies and seismic lines.

Wallace states (Wallace Response Affidavit at 19) that if most vertical excursions occur due to artificial pathways, then the 174 or more old bore-holes in Section 8 may serve as conduits, and that Staff has not assessed this risk. Also Wallace on the same page points out that HRI has data on all these (now "hundreds") of boreholes and has used them to construct stratigraphic cross-sections. However, I find that the Staff has assessed the risk that the boreholes might be conduits and has found it to be small. (FEIS at 4-55.) I concur.

Wallace (Wallace Response Affidavit at 17-22) complains about lack of structural cross-sections fence diagrams and structure contour maps. I find that these techniques are useful but not totally reliable when there are changes in the depth of strata not associated with faults. Seismic reflection methods are more direct. They work by passing shock waves through underlying rock and observing the deflection of those waves. This kind of measurement is intrinsically more reliable than by obtaining data on bed depth and thickness from the boreholes and trying to infer how to characterize the strata in the area between the boreholes. To further reduce this element of uncertainty, pump tests have been conducted and more will be performed. License conditions 10.23 to 10.26, 10.30 to 10.31 (SUA-1508 at 8-9).

Moreover, Staff (Ford May 11, 1999 Affidavit at 15 - 20, exhibit 1 to NRC Staff Response to Questions in April 21, 1999 Order) deals adequately with the question of vertical excursion through faults, fractures, shears, joints, etc., and I find that the danger of lasting damage is very small.

5. HRI misrepresents baseline water quality in the Westwater.

Intervenors (Intervenors' Groundwater Brief at 28 and 29) allege that HRI lumped chemical data from poor quality water in the ore zone with data from high quality water outside the ore zone, thus degrading the baseline for the high quality water. Intervenors are concerned that may also be done when setting restoration goals. Furthermore, they claim that there is no role for the NRC in establishing baselines.

As pointed out by HRI (Pelizza Affidavit February 19 at 20 and 21, Exhibit to HRI February 19, 1999 Response)(hereinafter "Pelizza Affidavit"),[21] baselines have not been set but will be set according to the protocol in COP Rev. 2.0 § 8.6. There is no basis in the record for finding that this protocol is unacceptable. Accordingly, I accept this protocol as adequate, and there has been no misrepresentation. Staff approved the protocol and there is no reason to believe that the protocol is inadequate.

[21]Mr. Pelizza's qualifications are cited in his Affidavit at 2-6. Based on his qualifications and my review of his testimony, I find that he is an expert.

3. HRI's Aquifer Testing is Inappropriate for Evaluating Whether a Hydraulic Connection Exists.

1. HRI has not submitted structural cross-sections, fence diagrams or structure contour maps.

I have already addressed all of these concerns. See II.B.4., page 21.

2. HRI used an inappropriate model to analyze pump test data.

Intervenors claim (Intervenors' Groundwater Brief at 30-31) that the Theis method used by URI to model drawdown data from pump tests is inappropriate because it assumes that the aquifer being tested is fully confined vertically. Wallace, for the Intervenors, used the Modified Hantush method. Although Intervenors' witness Wallace states that the Modified Hantush Test agrees with the Theis Test at Church Rock, namely that no upward excursion occurred there during the pump tests, he alleges that the Modified Hantush Method indicates that the Westwater and Cow Springs aquifers are in hydrologic communication.(Wallace Jan. 8, 1999 Testimony at 48-49.) As the FEIS indicates at 4-18, license conditions require that more pump tests and monitoring be done before mining commences. The hypothesis that there is hydrologic communication will be further tested during the additional pump tests required by the license. License conditions 10.23 to 10.26, 10.30 to 10.31 (SUA-1508 at 8-9). While I find HRI's model to be correct, I take further comfort because additional testing will add to the assurance provided by the model.

3. HRI did not conduct pump tests on an appropriate scale.

Wallace for the Intervenors (Intervenors' Groundwater Brief at 32-33; Wallace Jan. 8, 1999 Testimony at 43 to 47) points out that pump tests were performed involving pumping 60 gpm for several days, and that HRI plans to pump several thousand gpm for years. He concludes that the stress on the rocks involved are many orders of magnitude more than those imposed by these pump tests. He alleges that such additional pressures may cause excursions.

However, Staff requires additional pump tests before mining (License Condition 10.23). HRI plans well-field pressures considerably below anticipated conservative fracture pressures for the aquifer (FEIS at 4-24). It would be unrealistic to conclude that fracture definitely will not occur, because rock may be heterogeneous in its reaction to stress. By keeping well pressures considerably below anticipated fracture pressures,[22] however, the probability of fracture is low. If a vertical excursion occurs, it can be detected and dealt with without threat to the quality of drinking water drawn from the aquifer. (FEIS at 4-55.)

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[22]The anticipated fracture pressure is the pressure at which a fracture is expected to occur.

4. NRC Staff relies on improper data to detect vertical movement between aquifers.

Wallace (Intervenors' Groundwater Brief at 33; Wallace January 8, 1999 Testimony at 57-58) claims that historic water levels should have been used to complement pump test results. He analyzed the pump tests for Unit 1 and Crownpoint and found that they were in error. He then analyzed historic water levels, which confirm his results. As a result, he alleges a vertical connection. He suggests that Crownpoint results "are relevant to the hydrologic conditions at the Church Rock site" (*Id.* at 60). However, Wallace did not have any reason to differ with the pump tests at Church Rock and could not consult historic water levels from wells at Church Rock because there are no wells in the vicinity. I find no reason to believe that the Unit 1 and Crownpoint well tests are relevant to Church Rock, especially when Wallace's interpretation of pump test results at Church Rock agreed with that of HRI and suggests no vertical connection. See § II.C.2., pp. 24 ff, above.

5. HRI did not model the amount of groundwater it will "bleed" to control lixiviant and prevent horizontal excursions.

The Intervenors claim (Intervenors' Groundwater Brief at 34) that reintroduction into the Westwater of 97.5% of the bleed water that has been removed gives a true bleed rate of 0.025%, not the 1% that is claimed. (Staub Jan. 9, 1999 Testimony at 28-29). This is potentially significant because the bleed is intended to create a cone of depression that will cause injected water to move toward the production well rather than spreading outward in a horizontal excursion. FEIS at 2-7.

Intervenors allege that this reintroduction of bleed water will reduce the negative pressure that is needed to avoid excursions. HRI (Pelizza Affidavit at 53) agrees with Staub that reinjection should not be done upgrade of the mining operation and they state that it will be done outside the influence of production patterns. HRI, or its parent company, has had experience in reinjection and there is no reason to doubt the statement. Since the reintroduction is outside the production pattern, it will not reduce the negative pressure. Consequently, I conclude that HRI has accurately represented its bleed rate.

4. Licensing of the Crownpoint Project is inimical to health and safety because HRI's groundwater monitoring plan is inadequate.

1. The proposed spacing of groundwater monitoring wells is inadequate to provide timely detection of horizontal excursions.

License Condition 10.17 requires monitoring wells in the Westwater to be placed 400 ft. apart and at a maximum distance of 400 ft. from production/injection wells. Intervenors claim (Intervenors' Groundwater Brief at 37-40) that these parameters are inadequate because the bulk of fluid passes along narrow sand channels (see p. 8 *et seq.*, above). Intervenors claim that sand channels at Church Rock average 158 ft. wide (Brief at 37) so that monitors should be placed 300 ft. apart, and that a greater concentration be placed down gradient in the mine zone.

This complaint about pump placement is part of Intervenors claim that sand channels may dominate flow direction and that municipal water pumps at Crownpoint will influence flow. I have concluded that there is a lack of evidence for sand channels, *supra* II.A. at page 15. Moreover, given the slow speed at which groundwater travels and the distance of Church Rock from Crownpoint, Crownpoint municipal pumping would have no effect on groundwater flow at Church Rock.

Staff (Ford March 12, 1999 Affidavit at ¶ 25; see also Ford Feb 20, 1999 Affidavit at ¶ 14) also argues that two rows of monitoring wells -- as suggested by Intervenors -- have never been required by NRC at any ISL site. Intervenors (Abitz Testimony at 25 and 26) point out that no other mines occur in areas with such high water quality. This argument is

irrelevant. Given the homogenous nature of the rock structures in this area, I conclude that one tier of monitors will be adequate for Church Rock Section 8. (See p. 8 *et seq.*, which discusses the hydrogeology of this area.) With high water quality, even a minor excursion would be detected because the Upper Control Limits (UCLs) would be lower. (See p. 31, below.)

2. HRI's groundwater monitoring plan is inadequate to detect vertical excursions in overlying and underlying aquifers.

Intervenors claim (Intervenors' Groundwater Brief at 41-42) that monitoring is inadequate to detect excursions into the Cow Springs, Brushy Basin (B Sand Layer), and Dakota aquifers. *See* FEIS 3-19 (describing three layers known as the Brush Basin)..

1. The HRI license and application improperly failed to provide for monitoring of the Cow Springs aquifer.

Intervenors complain (Intervenors' Groundwater Brief at 41-42) that HRI has no plans to monitor the Cow Springs aquifer. However, HRI will conduct tests to determine if the aquifer is hydrologically confined from the Westwater. The Cow Springs member will be monitored if confinement does not exist. (See HRI Groundwater Response at 17 and 18.)

2. The frequency of monitor wells in the overlying Dakota and Brushy Basin B aquifers is inadequate.

Monitoring of the Dakota aquifer is required at a minimum of one well per eight acres, and the Brushy Basin at a minimum of one well per four acres. (FEIS at 4-56.) Intervenors complain (Intervenors' Groundwater Brief at 42-43) that Staff has not adequately explained or quantified this assessment in terms of the risks involved. However, well densities here are consistent with NRC-approved densities at other ISL operations. The FEIS states (at 4-55)

> the risk of a vertical excursion occurring outside the area of former mining activities should be low given the thick aquatards over and under the production zone, the planned well integrity testing program, and the potential for old boreholes to squeeze shut. HRI proposes to monitor water levels and water quality in the overlying aquifer to detect leaks. Further, in the event of a vertical excursion, HRI proposes to proceed immediately to determine the cause of the leakage and reverse the trend. The potential for an upper aquifer excursion to go undetected should be small, as discussed for the Unit 1 Site in Section 4.3, 1.2.

Intervenors claim (Intervenors' Groundwater Brief at 43) that spacing should be closer at Church Rock because the other sites were "in aquifers where groundwater does not meet drinking water standards." However, HRI reports (HRI Groundwater Response 2/19/99 at 19) that a number of these sites are in aquifers whose water is extensively used for drinking.

The purer the water is, the easier it should be to detect an excursion, especially in sandstone sheets that are at least 1 km (3250 ft.) wide and cannot therefore be considered as narrow channelways (see p. 13, ff, above). The Upper Control Limits would be lower in zones

of pure water, thus making the detection of excursions easier. Accordingly, Intervenors' assertion that the frequency of monitor wells is inadequate is without merit.

5. Licensing of the Crownpoint Project is adverse to public health and safety because HRI has failed to provide adequate protection against excursions.

Intervenors claim (Intervenors' Groundwater Brief at 43, 44) that critical excursion indicators are not listed in the license, so that HRI may create scientifically unsound control limits for monitoring excursions.

1. HRI's license excludes the use of necessary excursion parameters.

License Condition 10.21 establishes bicarbonate, chloride, and conductivity as the parameters for determining whether or not an excursion has occurred. These parameters are expected to increase in an excursion because they are characteristics of the injected lixiviant and are expected to serve as lead indicators that uranium also may be spread in an excursion. FEIS at 4-19 to 4-20. Intervenors state (Intervenors' Groundwater Brief at 44-45) that uranium content should be an additional parameter and that groundwater elevation control limits should also be used. HRI (Pelizza Affidavit at 44) is willing to monitor uranium despite the fact that it and Staff have not found it to be a useful indicator because it comes out of solution outside the oxidizing zone, so that levels may not reach critical limits during an excursion. I am therefore satisfied that there is no need to measure uranium levels and I will

not impose a license condition requiring such measurement. Regardless, HRI will monitor water levels. This is an adequate response to Intervenors' objections.

2. HRI proposes to use scientifically unsound UCLs (Upper Control Limits).

Intervenors state (Intervenors' Groundwater Brief at 45) that an excursion will be considered to have occurred when the readings from a monitor well show that any *one* excursion parameter (bicarbonate, chloride, and conductivity) exceeds its UCL by 20% or that *two* excursion parameters exceed their UCL. (LC 10.12; FEIS at 4-21.) UCLs are to be determined from baseline mean concentration then adding five standard deviations from the mean to this value (FEIS, 4-20). It is clear from inspecting Church Rock Site Water Quality Data (FEIS, Table 3.19 at 3-36) that UCL plus 20% for all elements listed with EPA standards are purer than EPA standards except for the two elements that do not meet EPA standards in the Church Rock water: uranium and radium. The quality of water impure enough to signal an excursion is usually not harmful unless the original water is harmful. The same conclusions can be made for other water qualities listed in the FEIS.

Intervenors claim (Intervenors' Groundwater Brief at 45, 46) that allowing five standard deviations ". . . allow[s] concentrations of excursion parameters to be two to three times greater than under the Groundwater Monitoring [plan] . . . before an excursion can be declared" (Intervenors' Groundwater Brief at 45). This, they claim imposes danger to the aquifer. Abitz (Abitz Testimony at 38-42) claims that by the time chloride reaches its UCL,

uranium would be highly concentrated, and that laboratory analyses take two weeks to a month to perform. This, Abitz claims, would result in pollution beyond the monitoring area. Uranium is discussed at subsection 1. above. Although monitoring is not necessary, it will be monitored.

HRI rebuts by pointing out (Pelizza Affidavit at 45-48) that five standard deviations are widely required by NRC of licensees in Wyoming and that such limits would markedly decrease the number of false positives. Numerous false positives could encourage disregard of a true excursion. Pelizza also states that analyses will be done on site within 24 to 48 hours after samples are received.

Pelizza makes a convincing argument on the danger of setting limits that are too close to baseline. One could successfully argue for fewer standard deviations if baselines were constructed for each individual monitoring well. However the bulk mean is used for a field because baseline values are variable over time and from well to well. Leach water ranges from a factor of 4 to 17 over UCLs in the example given (*Id.* at 47); using three standard deviations, the factors range from 5 to 26. It seems clear that both the 3 standard deviation UCL and the 5 standard deviation UCL would detect excursions and that the latter would do so with fewer false alarms, as discussed below.

The UCL for chlorine is particularly conservative. FEIS (4-20) states that

> in areas of good water quality, NRC has found the mean plus 5 standard deviations to be acceptable. However, in aquifers with good water quality, chloride populations have been found to have such a narrow statistical distribution that the mean plus 5 standard deviations plus a defined concentration has been used.

Intervenors point out that away from the ore zone the Westwater contains good drinking water. FEIS at 3-35. Therefore NRC's mean plus 5 standard deviations for determining UCLs would

apply. However an increment is not being added to the chlorine mean plus 5 standard deviations (FEIS at 4-20 to 4-21), thus making this UCL more conservative than those at some other sites. I therefore conclude that the 5 standard deviation excursion parameters to be applied are reasonable.

6. Licensing of the Crownpoint Project is inimical to health and safety because HRI has failed to demonstrate that groundwater restoration can be achieved.

HRI's License Condition 10.21A requires the operator to restore groundwater to baseline as a primary goal, with a secondary goal of Federal primary and secondary drinking water standards except that the secondary standards for barium (Ba) and fluorine (F) should be the New Mexico primary standard for drinking water and that for uranium (U) shall be 0.44 mg/L.

Intervenors allege that the HRI method of determining baseline will "inflate the concentration of contaminants in baseline averages" and that secondary standards for barium, fluoride, and uranium do not allow for safe drinking water (Intervenors' Groundwater Brief at 47). Further, "the track record of the ISL industry demonstrates that restoration to the good water quality of the Westwater is not technologically feasible."

1. HRI's methods to determine baseline will inflate the concentration of contaminants in baseline averages.

Abitz states (Intervenors' Groundwater Brief at 47; Abitz Testimony at 43) that averages of water analyses in the mineralized zone, which are higher in harmful elements than those outside the mineralized zone are lumped together, thus producing an inflated baseline for water quality in the mineralized zone.

It is quite clear that the figures given by HRI do not constitute baseline. HRI (HRI Groundwater Response at 22) states:

> As described in C.O.P. Rev. 2.0 § 8.6.3, baseline will be determined after the mine units have been installed for groundwater in the ore zone and non-ore zone separately. HRI agrees that baseline should be determined in both the production area and the mine area separately.

As water in the production area would be expected to be naturally higher in radionuclide concentrations, baseline levels may be elevated and they must be measured and accounted for in establishing restoration goals. Conversely, the monitor wells would be expected to have lower concentrations of radionuclides and these levels should be measured and accounted for so that an excursion could be verified and/or corrected properly. Any assertion that Abitz's Table 1 (Abitz Testimony at 12) represents baseline for compliance purposes is therefore incorrect. HRI has taken the statistically sound approach that it will not derive baseline from a small sample but will augment the sample by using actual well field data. HRI Groundwater Brief at 22. I accept the need for more data and adopt this point of view as my conclusion.

2. The secondary standards for barium and fluorine are not protective of health and safety.

Intervenors claim (Intervenors' Groundwater Brief at 48) that the New Mexico standards for barium and fluoride are groundwater quality standards, but not drinking water standards. Also, these standards are irrelevant because the project lies within the jurisdiction of the Navajo Nation. Therefore, Navajo Nation standards for drinking water, which are the same as Federal standards, should serve as the secondary restoration goal.

The Presiding Officer rejects this argument. The New Mexico standard for barium is 1.0 mg/L, the EPA and Navajo Nation Environmental Protection Agency standard (EPA/NNEPA) is 2.0 mg/L. For fluoride, the New Mexico standard is 1.6 mg/L, the EPA/NNEPA standard is 4.0 (FEIS, Table 4.7 at 4-30). Since the New Mexico standard is more rigorous than either the Federal or Navajo Standard for drinking water, this concern is without merit.

3. The secondary standard for uranium is not protective of health and safety.

Intervenors claim (Intervenors' Groundwater Brief at 49-51) that the secondary standard for uranium (U) at 0.44 mg/L "is not protective of public health, and is contrary to other relevant pollution controls." The EPA standard is 30 pCi/L (0.044 mg/L) as the groundwater restoration standard at inactive uranium processing sites, and the National Research Council proposes a drinking water standard of 0.035 mg/L (Id. at 49).

At the Church Rock site, uranium in the groundwater varies from 10.9 to 0.002 with a mean of 1.8 mg/L (FEIS Table 3.19 at 3-36). For Crownpoint, the figures are a range of 0.021 to 0.0 (sic) with a mean of 0.005 mg/L (FEIS Tables 3.13 and 4.5). (It seems clear that EPA standards should be attainable for Crownpoint, but that topic is not part of this phase of the case.)

The uranium content at Church Rock is much higher than at Crownpoint. This suggests that the EPA standard would be difficult or impossible to meet, and even the required secondary standard of 0.44 mg/L might be difficult to meet.

However, as pointed out in the FEIS (FEIS at 4.57, 4.58), dewatering activities caused by the underground mining at Church Rock in Section 17 have created oxidizing conditions in the mine zone. Once the workings filled with water, the oxidized uranium dissolved, causing elevated uranium values down-grade. In addition, as Ford (Ford May 11, 1999 Affidavit at 7) points out, the mining activities may have influenced the natural reducing capacity of the aquifer. This effect is local to the mine area, as is evidenced by the fact that the

concentration of uranium in water near the town of Church Rock is a factor of 9 lower than at the proposed mine site. Further, restoration will ameliorate the high uranium content of the mine site, because water high in toxic elements will be removed and replaced with cleaner water.

There is an abandoned surface mine on Church Rock 17. Although this area has been beneath the water table for many years and no remediation has occurred, uranium in the water in the vicinity of the Church Rock mine is only a factor of 5 above the EPA standard. Because of the well known property of uranium ions to precipitate under reducing conditions and because humates are common in the Westwater, uranium values can be expected to decrease rapidly with distance from the mine area (FEIS at 4-57, 4-58; Ford May 11, 1999 Affidavit at 7-8).

4. HRI may be permitted to modify restoration goals to a level that degrades water quality.

Intervenors state that the HRI's License Condition 10.21A allows it (HRI) to make a case to the NRC to relax the standards for a given parameter beneath the primary and secondary standards — if these standards cannot be met and if such restoration neither degrades water quality nor threatens public health. Intervenors claim that this "gives HRI the latitude to set different restoration goals and creates an impetus to move away from the baseline to contaminant levels that exceed drinking water standards." (Intervenors' Groundwater Brief at. 51-53).

I disagree with Intervenors' assumptions. The intent of the license is to require compliance with the primary and secondary standards. However, the license recognizes that practical experience might dictate relaxing those goals because they may not be achieved. Intervenors have not established that relaxing the goals would create serious problems. Given the distance of Church Rock Section 8 from the nearest water well, it is very unlikely that relaxation of these standards would affect the quality of drinking water taken from the aquifer. In addition, I expect both the Staff and the Environmental Protection Agency to be ardent protectors of the quality of the water supply in the event these standards are exceeded.

5. The track record of the ISL industry demonstrates that restoration to the good water quality of Westwater is not technologically feasible.

Intervenors claim that HRI "has not provided a reasonable level of assurance that it will be able to restore the Westwater ..., to a level that meets either baseline conditions or drinking water standards ...." (Intervenors' Groundwater Brief at 53). They allege that "no ISL operation to date has been attempted in an aquifer that meets all EPA primary and secondary drinking water standards, as most of the Westwater does" (Abitz Affidavit at 25). Abitz speculates that this is presumably because the technology does not exist to restore such high quality aquifers to their original condition. *Id.* at 26.

The Intervenors' Groundwater Brief at 54 concludes the section by stating that

> Since restoration to the water quality present in the Westwater has never been achieved, and indeed well fields in Wyoming and Texas, with poor water quality, have failed to achieve restoration, it is easy to deduce that HRI will not be able to achieve either the

> primary or secondary restoration goals. These goals are technologically beyond the reach of this company.

Pelizza (Pelizza Affidavit at 34 - 36), rebuts the statement that ISL licenses are not given for mines in aquifers with potable drinking water by giving several examples. One is that the City of Kingville (Pop. 25,000) obtains its water from the Goliad aquifer four miles from an ISL mine in the same aquifer.

It should be noted that Church Rock Section 8 is not required to be an area where subsurface water must be potable by EPA standards; it is exempt. (*Id.* at Attachment 22.) The subsurface water in this part of the Westwater is not potable today; it does not meet EPA standards. It also should be recognized that the Westwater is huge, so that it can tolerate relatively small toxic areas like the Section 17's old mine workings and still provide high quality drinking water. The water near the old mine workings is undrinkable yet the aquifer as a whole has not suffered because toxic elements that migrate out of this area are affected by both precipitation and dilution. These natural mechanisms help to protect the quality of water in the aquifer as a whole from the toxicity contained in small areas. FEIS at 4-57 to 4-58; Ford May 11, 1999 Affidavit at 7-8.

With respect to plans to restore sites after the completion of ISL mining, Pelizza states that:

> HRI will conduct a small isolated pattern demonstration at each site at the beginning of mining activities to verify that general leach solution chemistry and restoration responds as expected. After production begins at any mine site of the CUP

> (Crownpoint Uranium Project), HRI will immediately begin work on a field restoration demonstration outside of the actual production, yet inside the monitor well ring, and within the target ore zone.

(Pelizza Affidavit at 78). Key elements of the restoration demonstration are:

> An isolated restoration demonstration pattern, completed in the ore zone, constructed to the same basic configuration as the proposed production wellfield pattern and operated under the same conditions as the proposed mining procedures.
>
> Leaching of the pattern will be run for at least three months under commercial activity conditions using leaching agent concentrations equal to, or greater than is expected to be required for production.
>
> After the leaching phase, a complete chemical description of the produced fluid will be obtained, and a demonstration of a restoration will be initiated.
>
> Sample analysis of key parameters, and fluids will be completed at least every week during the restoration demonstration.
>
> Restoration will continue until the groundwater is restored to levels consistent with baseline.
>
> With each progress report, HRI will calculate and submit the volume of groundwater affected, expressed in pore volumes. Factors to be considered include: areal extent, formation, thickness, and porosity. Upon the completion of the restoration demonstration, the data, analysis, and conclusions will be compiled into a final report.

I am persuaded that these demonstration elements are appropriate measures to assure adequate restoration.

Ford (Ford May 11, 1999 Affidavit at 2 - 15) further persuades me of the likelihood of successful restoration and discusses the problems associated with restoration at the Church Rock site. In the interest of full disclosure, he reveals that "it is extremely likely that after ISL mining is completed, the groundwater quality will be restored to acceptable levels so that the

water use of the aquifer is maintained." "[I]t is unlikely that groundwater activities at the Church Rock site will achieve baseline concentrations for all groundwater parameters. . . . However, it is likely that most, if not all, of the groundwater parameters will achieve the secondary groundwater restoration goals stated in HRI License Condition 10.21."

The "if not all" statement by Ford above likely is not satisfactory to the Intervenors, but I find that it is adequate. Ford points out that 26%, a total of 6, of the parameters in the Mobil demonstration in the same or similar horizon of the Westwater as the planned Church Rock operation did not meet secondary groundwater restoration goals after 9 - 10 pore volumes of restoration effort. However, of the six parameters, three (calcium, sodium, and molybdenum) do not have primary or secondary standards because they are not considered hazardous to humans.

Pelizza (Pelizza Affidavit at 26) points out that the Mobil pilot ore is much higher in certain trace elements, especially molybdenum, than the Church Rock ore, so that similar restoration problems would not be anticipated at Church Rock. Total dissolved solids (TDS) at the Mobil restoration after 9.7 pore volumes were close to the EPA standard of 500 ppm. Id. at 77.

Ford suggests (Ford May 11, 1999 Affidavit at 3) that the TDS secondary goal would be achieved at Church Rock, although calcium and sodium may not meet their baseline concentrations. High calcium is one of the reasons people drink milk. The sodium content of water after the Mobil pilot restoration was 141 ppm (FEIS Table 4.13 at 4-38), and sodium in water in the Westwater aquifer under Church Rock Section 8 is 130 ppm (FEIS Table 3.19 at

3-36) and at some distance from the mine site is 125 ppm (FEIS Table 4.5 at 4-16). There are, as I have said, no primary or secondary standards restricting the amount of these elements in drinking water.

The other three elements in the Mobil pilot restoration that did not achieve baseline after restoration are radium, arsenic, and uranium. Arsenic at 0.079 mg/L came very close to the primary standard at 0.05 mg/L (Ford May 11, 1999 Affidavit at 4). Pelizza (Pelizza Affidavit at 26) states that like molybdenum, arsenic is much more concentrated at the Mobil site than at the Church Rock site. Arsenic removal therefore should not present a problem at Church Rock. Arsenic, molybdenum, radium, and uranium are readily precipitated by redox reactions or adsorption on mineral grains while traveling through the rock so most of these elements will remain close to the mine site and not to create problems at a distance (see Ford May 11, 1999 Affidavit at ¶¶ 12 - 14, ¶ 24).

So far as I am aware, there are no reports of water with elevated uranium levels in wells away from the Church Rock site, despite the fact that the mean values of water sampled in the vicinity of the site show values for this element well above any drinking water standards (see FEIS Table 3.19 at 3-36). This is persuasive evidence that uranium does not travel readily through the aquifer, even over time scales of thousands of years.

On the other hand, the existing concentration of radium-226 is double the EPA drinking water standard in wells in the vicinity of Church Rock (FEIS Table 4.5 at 4-16). This occurs because uranium is more easily reduced than radium in its travel through the rock. Abitz

(Abitz Affidavit at 3)[23] cautions that there is too much reliance on "natural attenuation through chemical reduction." Abitz states that this is likely to fail. However, the Intervenors make a point of emphasizing the outstanding purity of water outside the mine area at Church Rock. Because the old mine workings contain highly toxic water, precipitation must occur, so that even if the water "courses" along channels through the aquifer, uranium would not reach the wells from which pure water currently is being obtained.

I have concluded, for reasons stated above at p. 8 *et seq.* and in the text immediately above, that the water in the channels does not course, that there are no channels, and that the drill holes at Church Rock which sampled the water did not intersect channels. I also conclude that the rock does act as a significant precipitating agent for uranium and other elements.

I also find, based on the behavior of radon at the Crownpoint site, that radium contamination does not move rapidly in the Westwater. Radium is about six times more concentrated at the Crownpoint site than at Church Rock (FEIS Table 3.13 at 3-27; Table 3.19 at 3-36). This cannot be ascribed to mining operations in the vicinity. Radium occurs in high concentrations in water in the vicinity of uranium deposits. In contrast to the Crownpoint mine site, the Crownpoint town water, from wells in the Westwater, contains radium at about one-

[23]Intervenors' May 25, 1999 Response, Exhibit 1; Affidavit of Dr. Richard J. Abitz in Response to the Presiding Offer's Questions in the Memorandum and Order of April 21, 1999 (Abitz Affidavit).

tenth of EPA drinking water standard (FEIS Table 3.12 at 3-26), indicating that radium is both diluted and removed from the water by the time it reaches the town wells. As was the case with uranium, water in the vicinity of a uranium deposit may be well above safe standards for radium in the vicinity of the mining area, as at Church Rock, but the water from the same aquifer will be safe to drink away from the mine area because the toxic elements are diluted and precipitated.

Ford states that the results of the Mobil pilot restoration represent the closest parallel to a restoration at Church Rock (Ford May 11, 1999 Affidavit at ¶ 17). I note that the simulated restoration using drill core at Church Rock does not closely simulate conditions underground at the Church Rock site. Nevertheless, I will discuss the results (FEIS Tables 4.8, 4.9 at 4-32, 4-33).

The drill core results are affected because conditions of porosity and permeability of the crushed drill core are not the same as those underground; however, the geochemistry of the ore is that of the underground ore. Core leach tests were both slow and fast leaches; the latter clearly represents unrealistic conditions for a restoration. The slow leach test showed that radium, uranium, iron, and manganese do not reach acceptable drinking water standards even after 20 pore volumes have passed through. As discussed above, uranium precipitates in a reducing environment, so it poses no threat to present or reasonably foreseeable water supplies, especially considering the distance to the nearest well.

The radium result is in error. It is improbable that rock containing pregnant lixiviant containing 1010 pCi/L radium in its pores, would be flushed with 20 pore volumes of clean

water, and finish up with a radium content of the final fluid of 1000 pCi/L. The result is quite unlike any other restoration test reported in the FEIS. Another indication that the test is flawed is that the iron is 500 times more abundant in the restored fluid than in the leach water, and 1000 times higher than in the pregnant lixiviant. No other restoration tests show such results, which must be ascribed either to analytical error or the presence of particulates in the dissolved fluid. The Church Rock test does not warrant further discussion.

In addition to the Mobil restoration and the core leach study, the FEIS at 4-31 discussed the Teton test. The results are impressive (FEIS Table 4.9 at 4-33; Table 4-12 at 4-36) considering that only one pore volume was used, but for this and other reasons the FEIS does not place much confidence in this test. Of the three tests, I find that the Mobil test is most applicable, with the limitations discussed above.

Intervenors (e.g., Abitz Affidavit at ¶ 18) believe that successful restoration will require more than 9 pore volumes of fluid. If this is correct, HRI will be required to continue to restore; the requirement does not end at 9 pore volumes. FEIS 4-62. In addition, HRI must demonstrate successful restoration at the Church Rock 8 site or it will not be permitted to conduct injection mining elsewhere. Id.

In light of the above, I agree with Ford (Ford May 11, 1999 Affidavit at 15) that it is very likely that after ISL mining is completed, the water quality will be restored to acceptable levels.

7. Licensing of the Crownpoint Project is inimical to public health and safety because the Westwater is not suitable for ISL mining.

Intervenors allege that "because of the documented problems of site characterization, the high quality of the Westwater, and its use as a drinking water source, the Westwater is not an appropriate location for continued experimentation with ISL mining." Intervenors' Groundwater Brief at 55.

Intervenors claim that excursions are so common-place in ISL mining that operators do not have an adequate control of ISL well fields. (Id.) However, excursions do not constitute a spill like an oil spill or a spill of toxic waste. They represent a warning system within the exempt mine zone that alerts the operator that unless something is done, a spill outside the exempt zone may occur. Excursions fill a similar role in ISL mining to an oil pressure light in a car -- if something is not done promptly, damage will be done. (*See* HRI's May 11, 1999 Bartels Affidavit at 8 to 13.)

Intervenors report that "restoration efforts at other ISL mines have taken longer than anticipated."[24] (Intervenors' Groundwater Brief at 55.) What they have not shown, however, is that long restoration time results in harm to the aquifer.

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[24]Intervenors exaggerate the length of the restoration time taken by a mining company because regulatory approval time is included in the time for restoration. Pelizza (Pelizza

Affidavit at 73) points out that the time taken for regulatory agencies to approve restoration is of the same order as the time taken for actual restoration.

Intervenors claim that "few mines have been restored to baseline and none have been restored to baseline water quality equivalent to that of the Westwater or drinking water standards." This is true because: (a) the water quality did not match that of the Westwater to begin with, as the Intervenors have acknowledged, and (b) in the mine areas the original water in the vicinity of the uranium deposits probably never met drinking water standards, just like the water quality in the vicinity of the Church Rock, Crownpoint and Unit 1 deposits at present.

Most ISL mining has been done in fluvial aquifers like the Westwater, and no public or environmental harm has occurred (HRI's Bartels May 11, 1999 Affidavit at 8 to 13; Lichnovsky Feb. 19, 1999 Affidavit at 25 and 27). The Intervenors cite no instances of permanent environmental harm. Consequently, I do not draw any adverse inferences from the history of ISL mining that would affect my conclusions about the adequacy of the portion of the Crownpoint Uranium Project that is planned for Church Rock Section 8.

8. Licensing of the Crownpoint Project is inimical to public health and safety because conditions are inadequate to remedy defects in the project.

Intervenors re-introduce (Intervenors' Groundwater Brief at 57) a number of perceived problems again in this complaint: "unsuitability of the confining units to prevent vertical . . . movement of lixiviant out of the ore zone," "undetected high permeability," "geologic faults," and "hydrofracturing of the ore zone of an underlying and overlying strata." All of these alleged problems are a repetition of complaints that are discussed above, *passim*.

9. HRI's planned use of Church Rock Section 8 as a restoration demonstration is hydrogeologically unsound.

Intervenors claim that "because of the hydrogeologic connection between Section 8 and Section 17, Section 17 must be mined first to avoid additional complications with restoration." (Intervenors' Groundwater Brief at 58.)

Intervenors contend that

> Section 17 with its old mine workings is up-gradient from Section 8. Therefore, if Section 17 were mined last, an excursion in a Section 17 well-field would flow down gradient and contaminate a previously restored well-field, or a well-field undergoing restoration in Section 8.

(Intervenors' Groundwater Brief at 59.) They therefore claim that it would be more sensible to mine Section 17 before Section 8. Pelizza (Pelizza Affidavit at 52-53) discusses the consequences of mining Section 8 before Section 17 and he argues that there will not be a problem of competing bleeds because of the distance apart of the restoration wells in Section 8 and production wells in Section 17.

However, I need not decide this issue now. In Phase II of this proceeding, Intervenors may argue that it is improper to mine Section 17 because Section 8 will have been mined first.

10. Licensing of the Crownpoint Project is inimical to public health and safety because HRI's operation poses an undue threat to the quality and safety of the public water supply.

Intervenors claim (Intervenors' Groundwater Brief at 59, 60) that underground injection violates the Safe Drinking Water Act (SDWA). Contrary to this assertion, the Environmental Protection Agency has granted an aquifer exemption for the Church Rock Section 8 site. (Pelizza Affidavit at Exhibit 22.) This exemption means that EPA has determined, pursuant to its authority, that there is no drinking water to be protected at this site. Thus, the allegation is groundless. (See also the discussion in the next section of the Decision, § K.)

11. The SDWA applies to protect the Westwater at Church Rock and Crownpoint.

Intervenors (Intervenors' Groundwater Brief at 61), state that the Crownpoint Uranium Project (CUP) will violate EPA's program to protect drinking water, as set forth in 40 C.F.R. § 144.12, which prohibits injection activity "that allows the movement of fluid containing any contaminant into underground sources of drinking water." The Intervenors paint a ghastly scenario of pregnant lixiviant escaping undetected along a channel, oxidizing more and more radium and uranium in its path until the contaminants have invaded NTUA Well No. 1. In these channels, the water "courses" through the aquifer, perhaps reminiscent of a mountain stream during the spring melt off.

This argument is a dramatic repetition of the earlier argument that there will be undetected excursions. I reject that argument. *See* pp. 8. First, the concept of channelways contradicts both the published literature on the Westwater (some cited earlier, and in Intervenors, Staff, and HRI Exhibits) and the literature on all similar sandstone aquifers containing uranium deposits (e.g., Lichnovsky Affidavit, Bartels' February 19, 1999 Affidavit). For these reasons, I agree with the arguments against the channel theory made in the Bartels February 19, 1999 Affidavit and the Wasiolek and Spinks' Affidavit.)

Second, although the lixiviant oxidizes only a limited amount of the toxic elements listed because it contains only a limited amount of oxygen, humates in the rock will cause reduction, thus further depleting the lixiviant and ultimately causing precipitation of some toxic elements from solution. *See* p. 12, above. Finally, the closest well down-grade to the mining operation is 14,200 ft. from the north east corner of Section 8. At reasonable flow velocities not involving water coursing along channelways, it would take 1,632 years at 8.7 ft./year and would be diluted and much of the toxic elements re-precipitated before it reached the site (see HRI May 11, 1999 Reply).

In general, as discussed above, the underground geology of this area and the monitoring program that HRI will implement, carefully attend to the protection of drinking water. There is no reason to believe that the Church Rock Section 8 project will contaminate sources of drinking water.

For these reasons, I conclude that HRI's project does not violate the SDWA at Church Rock Section 8, nor has there been a showing that the license should be invalidated because of a serious problem under the SDWA at Crownpoint.

In reaching this conclusion, I note again that *the portion of the aquifer* in which the Church Rock ore is found has been exempted. It is not necessary that the whole aquifer qualify for an exemption. It is enough that the ore-bearing portion of the aquifer qualify. 40 C.F.R. § 146.4. EPA has granted an exemption for this section. Intervenors' Groundwater Brief at 14; Pelizza Affidavit at Exhibit 22.

12. <u>The FEIS fails to adequately describe impacts of the Crownpoint Uranium Project on groundwater.</u>

Intervenors' claim (Intervenors' Groundwater Brief at 65) that the FEIS failed to adequately consider the environmental impacts of the Crownpoint project. This is a recapitulation of themes already stated by Intervenors and addressed by me. They do not state separate grounds for this argument. Accordingly, my discussion of Intervenors' arguments, above, is an adequate response to Intervenors' overall assertion. I find that there is no reason to question the Staff's conclusions in the FEIS with respect to groundwater. The FEIS is therefore adequate because it is both thorough and correct.

13. Groundwater Conclusions

In sum, I conclude that the risks of ISL mining at Church Rock are minimal and that they do not call the validity of the HRI license into question. I also conclude that Inter-venors' allegations that HRI and its experts are guilty of misrepresentation are without merit.

3. Conclusions Concerning Safety and the Effect on the Environment

In this proceeding, I have issued partial initial decisions considering Intervenors' arguments concerning the environmental, safety and cultural impacts of liquid wastes, air emissions, effects on cultural resources, performance-based regulation, groundwater, and financial assurance for decommissioning. In the course of these decisions, I have considered each of Intervenors' significant arguments. Nevertheless, I have been convinced by HRI and the Staff, by a preponderance of the evidence, that the Church Rock Section 8 portion of the Crownpoint Uranium Project -- conducted pursuant to the license granted by the Staff -- will have no substantial inimical impact. Reasonable conditions have been imposed to assure that

any risks have been minimized so that they do not constitute a public health and safety concern.[25]

4. Alleged Failure to Comply With NEPA, to Consider Cumulative Effects and to Consider Environmental Justice Issues

1. Failure to Comply With NEPA

1. The Law

As the Nuclear Regulatory Commission said in *In the Matter of Louisiana Energy Services, L.P.*, (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 87-88 (1998):

> NEPA establishes a "broad national commitment to protecting and promoting environmental quality." *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 348 (1989), citing 42 U.S.C. § 4331. To ensure that this commitment is "infused into" the actions of the federal government, NEPA mandates particular "action-forcing" procedures. *Id.*, quoting 115 Cong.Rec. 40,416 (1970) (remarks of Sen. Jackson). Chief among these procedures is the environmental impact statement (EIS), which NEPA requires federal agencies to prepare for all proposals that would "significantly affect . . . the quality of the human environment." 42 U.S.C. § 4332(2)(C). The EIS must

[25]CLI-99-22 was issued by the Commission on July 23, 1999. Pursuant to that decision, the Commission retained jurisdiction over the adequacy of HRI's financial assurance plan. For the purpose of making my finding concerning compliance with NEPA, I assume that the Commission will take a hard look at the issue concerning the financial assurance plan and that they will modify the license, if necessary, to assure that risks are minimal based on its consideration of the evidence and the law.

describe the potential environmental impact of a proposed action and discuss any reasonable alternatives. See 42 U.S.C. § 4332.

The principal goals of an FEIS are twofold: to force agencies to take a "hard look" at the environmental consequences of a proposed project, and, by making relevant analyses openly available, to permit the public a role in the agency's decision-making process. See *Robertson*, 490 U.S. at 349-50; *Hughes River Watershed Conservancy v. Glickman*, 81 F.3d 437, 443 (4th Cir.1996). This latter information disclosure function of the EIS "gives the public the assurance that the agency has indeed considered environmental concerns ... and perhaps more significantly, provides a springboard for public comment." *Robertson*, 490 U.S. at 349 (citation omitted). The EIS, then, should provide "sufficient discussion of the relevant issues and opposing viewpoints to enable the decisionmaker to take a 'hard look' at environmental factors and to make a reasoned decision." *Tongass Conservation Society v. Cheney*, 924 F.2d 1137, 1140 (D.C.Cir.1991) (quoting *Natural Resources Defense Council, Inc. v. Hodel*, 865 F.2d 288, 294 (D.C.Cir.1988)). It is intended to "foster both informed decision-making and informed public participation," [FN2] and thus ensure that the agency does not act upon "incomplete information, only to regret its decision after it is too late to correct." *Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 371 (1989).

As the Licensing Board emphasized repeatedly in LBP-96-25, NEPA does not require agencies to select the most environmentally benign option. See, e.g., 44 NRC at 341-42. "If the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh the environmental costs." *Robertson*, 490 U.S. at 350.

Although the statute itself does not mandate a cost-benefit analysis, NEPA is generally regarded as calling for some sort of a weighing of the environmental costs against the economic, technical, or other public benefits of a proposal. See, e.g., *Idaho By and Through Idaho Public Utilities Commission v. ICC*, 35 F.3d 585, 595 (D.C.Cir.1994); *Calvert Cliffs' Coordinating Committee, Inc. v. AEC*, 449 F.2d 1109 (D.C.Cir.1971). The EIS need not, however, always contain a formal or mathematical cost-benefit analysis. See, e.g., *Sierra Club v. Lynn*, 502 F.2d 43, 61 (5th Cir.1974) ("NEPA does not demand that every federal decision be verified by reduction to mathematical absolutes for insertion into a precise formula"), cert. denied, 422 U.S. 1049 (1975). See also Council on Environmental Quality (CEQ) Regulations, 40 C.F.R. § 1502.23. NRC regulations direct the Staff to consider and weigh the environmental, technical, and other costs and benefits of a proposed action and alternatives, and, "to the fullest extent practicable, quantify the various factors considered." 10 C.F.R. s 51.71(d). If important factors cannot be quantified, they may be discussed qualitatively. *Id.*

The core of the Commission's principled statement about NEPA is that the EIS should provide "sufficient discussion of the relevant issues and opposing viewpoints to enable the decisionmaker to take a 'hard look' at environmental factors and to make a reasoned decision." The test is one of judgment that requires an analysis of the particular decision that is being examined. Look hard. Look reasonably.

2. Is an FEIS Required?

HRI has argued, without reference to specific regulations, that an EIS is not required by law. HRI NEPA Response at 6-7.[26] It cites a mining engineering text for the proposition that the risks from *in situ* uranium mining are minimal. *Id.*, at 6-7 and Exhibit 1. However, HRI also acknowledges that the Bureau of Indian Affairs requires an EIS in connection with any lease of Navajo territory. *Id.* at 7.

For its part, the Staff of the Nuclear Regulatory Commission found that the EIS "is based on the requirements" of law. Moreover, in preparing the EIS, the Staff found that the proposal had potential significant impacts that "can be mitigated" through conditions the Staff chose to apply.[27] *Final Environmental Impact Statement: to construct and operate the*

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[26]HRI's Response to ENDAUM and SRIC'S Brief With Respect to NEPA Issues Concerning Project Purpose and Need, Cost/Benefit Analysis, Action Alternaqtives, No Action Alternative, Necessity to Supplement EIS, Mitigation and Cumuolative Impacts, March 25, 1999 (HRI NEPA Response).

[27]For example, the FEIS that was prepared concluded, among other things, that before doing lixiviant injection at the Crownpoint site, HRI should relocate the town's drinking wells. FEIS at 4-59.

Crownpoint Uranium Solution Mining Project, NUREG-1508 (February 1997)(FEIS) at xxi, §§ 1.3, 1.4 (page 1-3). The Staff's decision to prepare an EIS was consistent with its responsibility under 10 C.F.R. § 51.20.

3. Intervenors' Arguments

Intervenors have made a variety of arguments concerning the inadequacy of the NEPA analysis.[28]

1. Inadequate Statement of Purpose and Need

SRIC and ENDAUM allege that the FEIS provides an inaccurate and simplistic statement of purpose and need which unreasonably distorts the entire FEIS. Intervenors' NEPA Brief at 20-23. They cite the FEIS at 1-3 as saying:

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[28]ENDAUM'S AND SRIC'S, "NEPA Issues Concerning Project Purpose and Need, Cost/Benefit Analysis, Action Alternatives, No Action Alternative, Failure to Supplement EIS, and Lack of Mitigation," February 19, 1999 (Intervenors' NEPA Brief); Grace Sam and Marilyn Morris, "Final Written Presentation," February 19, 1999. Staff "Response to Intervenor Presentations on NEPA Issues, April 1, 1999; HRI "Response to ENDAUM and SRIC'S Brief With Respect to NEPA Issues," March 25, 1999 (SAM Final Presentation).

The purpose of the proposed action is to license and regulate HRI's proposal to construct and operate facilities for ISL uranium mining and processing. The NRC's need for action is to fulfill its statutory responsibility to protect public health and safety and the environment in matters related to source nuclear material (Atomic Energy Act of 1954 as amended). The BLM and BIA's need for action is to fulfill their statutory responsibilities to regulate mining activities on Federal and Indian lands (Mining Law of 1872, Allotted Lands Mineral Leasing Act of 1921, National Historic Preservation Act of 1966, Endangered Species Act of 1973, Federal Land Policy and Management Act of 1976).

2. The FEIS Fails to Perform an Adequate Cost/Benefit Analysis

The principal argument advanced by Intervenors is that the FEIS overstates economic advantages to local communities because it assumes a uranium price of $15.70 per pound[29], which is far above the current market price of under $11 per pound and because it overstates the need for domestic uranium. Intervenors' NEPA Brief at 32-46. Given Intervenors' assumptions, they are correct. Present market conditions do not indicate support for additional uranium supplies. HRI states that its fixed cost to bring the Church Rock Section 8 property into production is approximately $14.50 per pound, as discussed in FEIS Chapter 5.[30] HRI also states that its break-even production cost is $15.70 per pound; and Intervenors do not challenge

[29]FEIS Table 5.4 at 5-5.

[30]HRI Reply to April 21, 1999 Questions, May 11, 1999 at 19. I note that Intervenors object that HRI's brief represents attorney testimony and should not be admitted. However, this objection is not well taken. Each statement made in HRI's brief is properly documented by reference to a part of the record. Most of the Brief is merely explaining what the FEIS has said.

this statement.[31] I therefore conclude that the FEIS was correct in using a $15.70 price per pound for uranium. It is highly unlikely that the project will proceed unless the price reaches that level. Furthermore, an increase in price to that level would indicate an improvement in the demand/supply ratio, validating the Staff's assumption of demand for uranium production.

[31]See Intervenors' Joint Response to HRI and Staff Responses, May 25, 1999 at 26-29, challenging whether the breakeven point will be reached but not challenging the validity of the breakeven point.

It does not concern me that at present market prices this project will not go forward. That is the very result Intervenors' seek. It is the no action alternative. If that happens, there will be none of the adverse effects discussed in the FEIS. It is only when the market price crosses HRI's breakeven point, that the validity of the FEIS is in question. And, assuming that the market price has climbed to that level, it is clear that there would be an active market for uranium and that the additional supply would be useful. Intervenors' have not succeeded in casting any doubt on the assumptions made in the FEIS *at the price level of $15.70 per pound* for uranium.[32] FEIS at 4-97, 5-2 to 5-3.

There may be small differences in the local benefits if the actual price of uranium is slightly different from $15.70. In the overall scheme of things, these differences are not important. The risks to the environment have been thoroughly analyzed and license conditions imposed to mitigate the risks.

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[32]Although Intervenors argue that production costs may be higher than anticipated by HRI or that the price of uranium may fall subsequent to startup, making HRI's operation uneconomical, they do not address why the surety bond required of HRI would not provide adequate protection to permit effective cleanup if further production was uneconomical.

I thus find no basis for disturbing the Staff's FEIS conclusion that it is desirable to initiate a project that creates minimum risks[33] to public health and safety and to the environment and that increases local economic activity.

3. Groundwater

In the portion of this opinion concerning groundwater, I have determined that Intervenors' arguments on groundwater are invalid. See page 7 *et seq.* Accordingly, I find that failure to address these erroneous arguments (Intervenors' NEPA Brief at 46-50) in the FEIS was not an error.

4. Relocating Individuals

Intervenors argue that proposed mitigation for relocating residents is inadequate. Intervenors' NEPA Brief at 50-51. People who graze livestock on HRI's Unit 1 property are either mineral lease holders or are beneficiaries of leases held by others. Some of these people may be displaced because HRI is exercising mineral rights to which it has valid title. Under applicable law, these people do not have the right to continue to graze their livestock upon land

[33]Risks to the public are, of course, a public concern. Costs borne by HRI are internal to HRI, affecting its costs and its business decision about whether to commence this project. See FEIS at 5-1.

on which they do not have continuing grazing rights. Nevertheless, the FEIS considers this impact to be an environmental justice impact and grazing rights permittees and others who would be required to relocate will be compensated. FEIS at 4-118, § 4.12.6. I conclude that the FEIS has given adequate consideration to the relocation of individuals. The loss of the small plot of land in Church Rock Section 8, set as it is in the midst of a vast desert, will not materially affect the ability of people to graze their cattle.

5. Environmental Costs of Air Emissions

Intervenors argue that radiological emissions will exceed NRC standards. Intervenors' NEPA Brief at 51. The FEIS discusses the effect of Alternative 3 (the NRC Staff-recommended action) on radioactive air emissions. It concludes that there would be only minor impacts on air quality. These issues have been considered in detail in LBP-99-19, Radioactive Air Emissions, 49 NRC 421 (May 13, 1999), and I am satisfied that the FEIS has given adequate consideration to possible radioactive air emissions. The conditions imposed by the Staff, FEIS 4-5, § 4.1.3 (SUA-1508, § 10.9 at 5 and § 10.30 at 9) provide additional protection against air emissions. These conditions, in my opinion, represent an abundance of caution.

6. Environmental Costs of Liquid Waste Disposal and Cultural Impacts

Intervenors complain that there is inadequate treatment in the FEIS of liquid waste disposal and cultural resources. Intervenors' NEPA Brief at 51-52. The FEIS discusses the

effect of Alternative 3 (the NRC Staff-recommended action) on waste disposal issues. In my prior decision on this issue, I concluded that the FEIS was adequate. *Hydro Resources, Inc.*, LBP 99-1, 49 NRC 29 (1999). For reasons stated in that opinion, I consider the FEIS to be more than adequate with respect to waste disposal issues; and I also find that HRI's methods of waste disposal provide adequate protection for the environment. Intervenors had failed to provide any reason to believe that the waste disposal methods will have substantial adverse environmental impacts. For reasons stated in the Partial Initial Decision on cultural resource impacts, I also find no reason to believe that there will be substantial adverse impacts on cultural resources. LBP-99-19, 49 NRC 421 (1999).

7. Environmental Costs of Health Impacts

In this argument, Intervenors again reiterate their groundwater allegations. Intervenors NEPA Brief at 52-53. There is no reason to find that these arguments are any more valid in this context than they have been found to be in the discussion in Section II, beginning at page 7 above. To the extent that Intervenors' challenge the validity of the NRC standard of 0.44 mg/l for the concentration of uranium, they are impermissibly challenging the validity of an NRC regulation. Since EPA also will have to be satisfied with the effect of this project on the quality of drinking water, this attempt to challenge the NRC regulation overlooks an important additional safeguard for water quality. To the extent that Intervenors raise questions of cumulative impacts, those questions are addressed below at page 67.

8. The Costs Listed in Section 5 of the FEIS are Unreasonably Undervalued

The FEIS at 5-6 and 7, § 5.2, lists a variety of costs of the proposed project. The earlier Partial Initial Decisions and the discussion of groundwater in Section II, above, beginning at p. 7, appear to be the "hard look" at costs required by NEPA. Intervenors' NEPA Brief at 53-54. Intervenors do not present evidence to challenge the adequacy of this list.

9. The FEIS Does Not Perform an Ultimate Cost-Benefit Analysis Among Alternatives and does not Adequately Evaluate the Action Alternatives and the No-Action Alternatives

Intervenors argue that the FEIS does not provide a suitable summary of the costs and benefits of alternative courses of action. To the contrary, I find that the FEIS, as explained by the cost/benefit determination filed by Mr. Robert Carlson of the NRC Staff as an attachment to NRC Staff Response to Questions Posed in April 21 Order, May 11, 1999 (Carlson May 11, 1999 Affidavit)[34], takes a suitable, hard look at the costs and benefits of this project and is adequate to fulfill the requirements of NEPA.

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[34]A relevant excerpt of Carlson's May 11, 1999 Affidavit is provided as Attachment A to this decision. I find that Carlson's explanation of information already contained in the FEIS clarifies the Staff's analysis of the costs and benefits of this project. I include it as a way of notifying the public of this explanation.

j. HRI's Environmental Reports do not Calculate the Costs and Benefits of the Project

Intervenors argue that the Environmental Reports do not contain a cost benefit analysis. Intervenors' NEPA Brief at 55-56. 10 C.F.R. § 51.45(b) states that the "environmental report shall contain a description of the proposed action, a statement of its purposes, a description of the environment affected . . . . " However, it is clear that this requirement is designed to facilitate the Staff's preparation of the FEIS, which is the focus of any NEPA concerns. Providing that the Staff prepares an adequate FEIS, the purpose of NEPA is fully met. Therefore, I find that Intervenors' criticism of the ER is without merit.

11. The NRC Staff Violated NEPA by Failing to Supplement the DEIS and FEIS and Re-circulate Them for Public Comment

Intervenors argue that the use of "performance based licensing" by the Staff required supplementation of the FEIS.[35] Intervenors' NEPA Brief at 60-72. I disagree. This license, which contains many conditions, is not a dramatic departure from previous licensing practices. See LBP-99-10, 49 NRC 145 (1999). Moreover, Intervenors have provided no reason to believe that performance based licensing, as applied to this license, will result in any increased risks to public safety or to the environment.

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[35]The argument about performance based monitoring also is reiterated in Intervenors' NEPA Brief at 74.

Next, Intervenors argue that the FEIS developed and evaluated two new alternatives. These did not, however, involve any substantial change in the description of the project. What the Staff did was to pursue further analysis of the proposed project, including the evaluation of some fresh alternatives and the evaluation of some license conditions that helped to improve safety and reduce risk to the environment. Consistent with 10 C.F.R. § 51.72(a), I conclude this further Staff analysis did not require a further circulation of the FEIS for comment. Nor was it necessary to develop further alternatives for evaluation.

Finally, Intervenors argue that the Staff permitted a substantial change in the sequence of mining, thus requiring EIS supplementation. (Intervenors' NEPA Brief at 69-70.)

This portion of the case is restricted to an examination of Church Rock Section 8 and of issues that are so important that they call in question the validity of the entire license. Intervenors have, however, challenged whether the change in the order of mining Section 8 and Section 17 requires supplementation of the FEIS. Whether or not to require a supplement requires consideration of whether or not it will be appropriate subsequently to permit the mining of Section 17 after Section 8 has been mined. That question need not be answered in this phase of the case. If it is inappropriate to mine Section 17 after Section 8 or if subsequent mining of Section 17 raises important questions requiring supplementation may be reserved for a subsequent portion of this case. In that portion of the case, Intervenors will need to raise some question concerning how the change in the order of mining will *affect drinking water.*

Accordingly, I do reserve the question concerning the impact of the change in the order of mining.[36]

l. Impact of Mitigative Measures

Intervenors argue that the FEIS fails to explore the impact of measures to mitigate or reduce environmental effects, such as the requirement that Crownpoint drinking water wells should be moved. (Intervenors' NEPA Brief at 73-75). In their brief, Intervenors distort the purpose and effect of requiring that the Crownpoint Water Supply be moved. (id. at 73.) The purpose of having the wells moved is to avoid having the wells cause a cone of depression that would cause an excursion of lixiviant. Hence, once the wells are moved, there is no reason to believe that an excursion would occur that would affect the quality of the water in the area of the closed wells. With the wells closed, there will be nothing to draw lixiviant in that direction.

Furthermore, the required moving of the wells will occur only if the Crownpoint water authority agrees to close down the affected wells and to open new ones. At that point, the Staff would examine the new plan to assure that it would protect water quality. The EPA likewise

[36]The phased consideration of this case does not create an improper segmentation for NEPA purposes. Intervenors have not provided any evidence that a project-by-project NEPA balance is improper because of an alleged additive effect when the projects are considered together. Hence, there are no NEPA issues being neglected because of phased consideration.

would examine that question. So it will take the concurrence of HRI, the municipal water authority, the NRC and the EPA before this plan is effectuated. If there is no appropriate way to move the wells, then they will not be moved and the no action alternative for Crownpoint will be implemented.

There is no reason to determine now whether this plan is adequate. There is nothing in Intervenors' Groundwater Brief that persuades me to rule that the entire license is invalid because of this license condition. Accordingly, the question of whether Crownpoint's municipal water supply is adequately protected is reserved for a subsequent phase of this case.

m. Livestock and Displacement

Intervenors object that it is impermissible for HRI to displace individuals from this area, even if it compensates them. They also object that the loss of grazing rights will prevent Larry J. King and Mitchell Capitan from being "complete or 'free'." (*Id.* at 75.) However, I have been to the site of these projects and I am at a loss to understand the harm of which Intervenors complain. There are no people living on Church Rock Section 8 so there will be no displacement. Furthermore, the land being removed from grazing is very small in comparison to the size of the vast desert in which it is located. I do not understand how anyone could possibly be prevented from raising livestock because ISL mining will take place on Section 8. Furthermore, there is no indication in the record that *any* family will be required to relocate. Accordingly, I find Intervenors allegations about relocation and about grazing rights to be without merit.

n. Inadequate Discussion of Secondary Effects

Grace Sam and Marilyn Morris (the Sams) argue that the FEIS gave inadequate attention to "socioeconomic or 'secondary' benefits." Sams Final Written Presentation at 24 *et seq.* They argue that the benefits are too speculative. However, the gist of the argument is that the specific benefits to be derived from the project may be somewhat different than the FEIS estimates, particularly in the area of benefits from employment, royalty income and benefits from tax revenues. In some of these arguments, the Sams appear to be at least partially correct. For example, legal disputes may cause the Navajo Nation to lose the right to a Business Activity Tax and it may also cause some of the benefit for local communities to be wasted in litigation expenses. There is also a mention of the possibility that revenue might be derived by a hotel or motel from visitors to the project or to its employees. As the Sams state, no dollar figure is put on this speculative item. Likewise, the FEIS anticipates that workers at the project would spend some of their earnings locally, generating secondary benefits to the local economy. The Sams are concerned that there is no more detailed analysis than this. The FEIS also says that only about 10 to 15 employees would likely come from outside these communities. The Sams criticize this discussion on the ground that Navajo law requires equal treatment of all Navajos, so that benefits might flow to Navajo's who do not live locally. Likewise, the FEIS discusses a possible tax benefit to McKinley County but does not analyze the extent to which the County would keep these funds local or would benefit local residents outside the area.

The Sams are correct that the calculation of secondary benefits is approximate. However, I find the FEIS to be adequate in this respect. None of the items suggested by the Sams would have a significant impact relative to the overall cost/benefit discussion. Basically, this project represents local economic activity in an area affected by poverty. The increase in economic activity associated with the CUP will produce direct and indirect economic benefits, thus having a small favorable impact on local poverty. Since there are no serious risks attendant to this project, as I have found in this decision and in prior partial initial decisions, there is a net benefit to the local community if the project goes forward. There is, of course, some uncertainty about the extent to which these benefits will remain strictly local or will benefit others in the County, the State and the Navajo Nation.

B. Cumulative Effects and Segmentation Issues

This portion of the Final Initial Decision denies relief requested by Intervenors ENDAUM and SRIC concerning "Cumulative Impacts and Segmentation of Consideration of Impacts, (Intervenors' Segmentation Brief).[37] In addressing these issues, it is important to note that the issuance of a license to HRI does not condone past practices by other companies with respect to mining or mill tailings. When there are substantial impacts imposed by the HRI

[37]HRI responded with a Brief With Respect to NEPA Issues Concerning Project Purpose and Need, Cost/Benefit Analysis, Action Alternative, No Action Alternative, necessity to Supplement EIS, Mitigation and Cumulative Impacts, March 25, 1998 (HRI NEPA Brief) and the Staff responded with a Presentation on Cumulative Impact and Segmentation Issues, April 1, 1999 (Staff Segmentation Brief).

project, then Intervenors are correct in pointing out that those impacts must be considered cumulatively with existing impacts in order to assess their importance. However, when the impacts imposed by this project are very small, as they uniformly appear to be for this project, the harm does not flow from this project but from the already existing problems and the small incremental increases caused by HRI are acceptable, absent some showing that they are the "straw that breaks the camel's back."

4. Intervenors' Arguments

Intervenors argue that Council on Environmental Quality regulations require that an EIS consider cumulative effects of proposed federal actions. Intervenors' Segmentation Brief at 8-11. 40 C.F.R. §§ 1508.7, 1508.8, 1508.25. They cite *Baltimore Gas and Electric Company v. Natural Resources Defense Council*, 462 U.S. 87, 106-107 (1983) for the proposition that "NEPA requires an EIS to disclose the *significant* health, socioeconomic and cumulative consequences of the environmental impact of a proposed action." Intervenors' Cumulative Impact Brief at 9. [Emphasis added.]

Intervenors further provide a catalog of alleged specific deficiencies regarding cumulative effects including radiological and health effects (*Id.* at 15-25); groundwater effects (*Id.* at 25-30); effects on cultural resources (*Id.* at 30-33); cumulative impacts from disposal of liquid waste (*Id.* at 33-34); and socioeconomic and infrastructure cumulative impacts (*Id.* at 35-36). In addition, Intervenors argue that the cumulative impacts of health and environmental

effect, along with environmental justice impacts on the communities of Crownpoint and Church Rock, cause psychological stress ("stressors") that is not evaluated. (*Id.* at 36-43)

HRI responds that the Staff adequately analyzed all of the cumulative impacts Intervenors claim as deficient in Section 4.13 of the FEIS. HRI NEPA Brief at 30-35. The Staff responds that the FEIS adequately addresses the cumulative impact concerns argued by Intervenor. Staff Segmentation Brief at 4-7.

5. Analysis and Conclusion

In LBP-98-9, 47 NRC 261, 283 (1998), I ruled that concerns regarding *existing* radiological conditions in and around HRI's Church Rock site are not germane to this proceeding. The Intervenors argue that the FEIS inaccurately represents existing and continuing sources of radioactivity in the Church Rock area. My reading of the FEIS at 4-72, 4-73 and 4-124 confirms that the FEIS acknowledges the existence of elevated levels of radioactivity from previous mining and milling activities near Church Rock. In addition, there is a thorough discussion of the background radiological characteristics of the Church Rock, including levels from a previous mining and milling activities site, in the DEIS at Section 3.7. This information was inadvertently omitted from the FEIS but had been made available in the DEIS and was available so that the public might have information about radiation. McKenney April 7, 1999 Affidavit at 9 [attached to Staff's April 7, 1999 response to LBP-99-15, March 18, 1999 Order].

The FEIS, NUREG-1508 (February 1997) reviews cumulative impacts at pp. 4-120 to 4-127. The key section on health physics effects states:

> The total annual population dose was estimated for the period in time of greatest releases from all three project sites. Two population dose estimates were calculated: one for the Crownpoint/Unit 1 sites and one for the Church Rock site. As the area of impact is similar for both calculations, the results were combined with a total population dose less than 0.01 man-Sv/year (1 man-rem/year). The population within the 80 km (50 mi) radius of the entire project is approximately 76,500 persons. Population dose commitments resulting from facility operations represent less than 1 percent of the dose from natural background sources. The population dose from natural background would be approximately 170 man Sv/year (17,000 man-rem/year). FEIS at 4-124.

Additionally, the FEIS at 4-124-125 adequately discusses the negligible impact on the population in the 50 mile radius from the expected releases from *in situ* leach mining activities HRI proposes.

As I pointed out in LBP-99-15, March 18, 1999 (Questions Concerning Radioactive Air Emissions), the expected impact of radiation from the HRI project will be a small fraction of 1 millirem to an individual in the area. There is no reason to anticipate health effects from such a minimal dose. Accordingly, the FEIS and DEIS have adequately addressed issues concerning radioactive air emissions and no more detailed discussion is required. Likewise, the FEIS Section 4.6 at 4-80-4-88 adequately treats liquid waste issues. In my Partial Initial Decision (Waste Disposal Issues), 40 NRC 29, I analyzed the Intervenors waste disposal concerns and ruled that the Staff has adequately conditioned the license to handle waste disposal issues. 49 NRC 29, 32-35.

With respect to groundwater cumulative impacts, claims that groundwater will not be restored properly are addressed above. (Section II.E. at p. 33.) The FEIS satisfactorily

evaluates potential excursions at 4-54 and 4-55. Finally, in my Memorandum and Order (Scheduling and Partial Grant of Motion for Bifurcation) dated September 22, 1998, I narrowed the scope of this phase of the proceeding to the Church Rock area. Accordingly, Intervenors argument at this time raising concerns about relocation of wells in Crownpoint is not ripe for this phase of the proceeding, which is focused on Church Rock Section 8. Intervenor Segmentation Brief at 25-26.

FEIS Section 13.3 analyzes cultural resources and states that no significant effects are likely to occur. In my Partial Initial Decision (Issues related to the National Historic Preservation Act (NHPA) and the Native American Graves Protection and Repatriation Act (NAGPRA), and Cultural Resources (49 NRC 137) I found that Intervenors failed to make a case that the Staff did not comply with NHPA, that NAGPRA was not applicable and that the Staff adequately conditioned the license to handle cultural resource concerns. 49 NRC 137, 143.

The FEIS Section 4.13.9 adequately considers socioeconomic and infrastructure impacts. In fact, it considers many of the impacts such as long-term employment, wages and tax revenues to be a positive impact. I find the treatment in the FEIS adequate.

I have analyzed below Intervenors' health and environmental stress and environmental justice concerns. Intervenors have made no additional arguments with respect to the cumulative impacts of these issues that have not been addressed below. Intervenors segmentation concerns are addressed in my analysis of their NEPA concerns.

After a careful review of the FEIS and Intervenor arguments concerning cumulative impacts and segmentation issues, I conclude that Intervenors have not provided any analysis or testimony that leads me to conclude that the Staff has not adequately analyzed and weighted the past and future cumulative impacts and segmentation issues associated with licensing HRI to conduct ISL operations at Section 8.

C. Environmental Justice Concerns

1. Legal Background

Executive Order 12898 (EO), "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," 3 C.F.R. § 859 (1995), provides that "each Federal agency[38] shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." EO 12898, 59 Fed. Reg. 7629 (Feb. 16, 1994), codified at 3 C.F.R. § 859 (1995). The President's memorandum accompanying the EO states that "each Federal agency shall analyze the environmental effects, including human health, economic, and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by the National Environmental Policy Act of 1969 ("NEPA"), 42 U.S.C. section 321 *et seq.*" Memorandum for the Heads of All Departments and Agencies, (accompanying EO) (Feb. 11, 1994), 30 Weekly Comp. Pres. Doc. 279 (Feb. 14, 1994). The EO goes on to state that:

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[38] For the purposes of the EO, "Federal agency" is defined as any agency on the Working

Group, and such other agencies as are designated by the President of the United States, that conducts any Federal program or activity that substantially affects human health or the environment. Independent agencies, like NRC, are requested to comply with the order pursuant to the EO. See EO at 6-604.

> Each Federal agency shall conduct its programs, policies, and activities that substantially affect the human health or the environment, in a manner that ensures that such programs, policies and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discriminate under, such programs, policies, and activities, because of their race, color, or national origin.

EO at 2-2 (emphasis added).

In interpreting and applying the EO and CEQ guidance, NRC has determined that the executive order "by its own terms, establishe[s] no new rights or remedies." Louisiana Energy Services, L.P. (Claiborne Enrichment Center), CLI-98-5, 47 NRC 113, fn. 2 (1998) (hereinafter "LES"); citing EO 6-609; LES at 102. "Its purpose was merely to "underscore certain provision[s] of existing law that can help ensure that all communities and persons across this nation live in a safe and healthful environment." *Id.*, citing LES at 102.

The NRC has decided that it will not examine a company's motive in order to assess whether or not it has been responsible for racial or economic discrimination. This view is fortified by the position taken by the agency with the greatest expertise in interpreting NEPA, the Council on Environmental Quality (CEQ). In recently issued draft "Guidance for Considering Environmental Justice under NEPA," CEQ calls for a close NEPA examination of a proposed project's impacts on minority and disadvantaged communities, but neither states nor implies that if adverse impacts are found, an investigation into possible racial bias is the appropriate next step.

Instead of focusing on racial bias, the Commission chose in the LES case to focus on measures that might mitigate adverse effects on minority communities. It said:

> The Board directed the NRC Staff to consider whether actions can be taken to mitigate the impacts of relocating Parish Road 39. See 45 NRC at 406. We concur in that direction, and also direct the NRC Staff to consider whether actions can be taken to mitigate the impacts on property values. Dr. Bullard ***110** describes roads in Forest Grove and Center Springs as generally "either unpaved or poorly maintained." See Bullard Prefiled Testimony, dated Feb. 24, 1995, at 18. There may well be simple and relatively inexpensive measures that could be taken to improve existing driving and walking conditions (e.g., improving current roads and footpaths). This in turn could mitigate property devaluation in these communities by improving overall living conditions.

2. The Facts

In this case, Intervenors have attempted to show that serious environmental costs will be imposed on the communities of Church Rock and Crownpoint, where the alleged environmental justice population lives. These communities are more than four miles from HRI's Church Rock Section 8 project.[39] FEIS at 3-79, 3-55. In previous partial initial decisions and my discussion of groundwater, I have already determined that Intervenors' principal arguments concerning environmental effects are without merit. Accordingly, I have no basis for finding that injection mining at the Church Rock Section 8 site will have any serious impact on an environmental justice population.

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[39]ENDAUM and SRIC filed a Brief in Opposition to the HRI Application, With Respect to: Environmental Justice Issues, February 19, 1999 (Intervenors' Environmental Justice Brief); Grace Sam and Marilyn Morris filed a Final Written Presentation, February 19, 1999 (Sam Final Presentation); HRI Filed a Response to Intervenors' Brief Regarding Environmental Justice, March 25, 1999; and the Staff filed a Response to Intervenors' Presentations on Environmental Justice, April 1, 1999.

Indeed, my visit to this site permitted me to observe the vastness of the desert and raises serious questions about how this project at Church Rock Section 8 could possibly have any serious adverse impact on the people of the area. The project is industrial in nature, but it creates no serious risk of pollution. Since I have found the project at Church Rock Section 8 to be safe, there is no serious adverse impact on an environmental justice population and, unlike the LES situation, there is no basis for taking measures to mitigate or reduce that effect. Nor is there any reason to consider, in the context of a new project, the highly regrettable negative impacts of prior projects that involved uranium milling and mining. See Intervenors' Environmental Justice Brief at 21.

The only "adverse" impacts are those that any new economic activity would have, like road traffic; and, as the entirely adequate discussion of transportation risks in the FEIS makes clear, there is no reason to mitigate that kind of effect. See FEIS at 4-116.[40]

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[40]Although Grace Sam and Marilyn Morris are correct in mentioning that there also is a risk to pedestrians walking along the roads and to cattle grazing near to roads (Sams

I find that the consideration of Environmental Justice in the FEIS is wholly adequate with respect to Church Rock Section 8. FEIS at 3-78 to 4-5 and 4-112 to 4-120. The Staff has taken a hard look at a project that does not raise serious risks for the surrounding community.

V. Overall Conclusions

All areas of concern with respect to Church Rock Section 8 have been considered. See pages 4 and 52, above. None of the Intervenors' concerns have been found to require relief. Accordingly, the HRI license for Section 8 stands as issued.

Final Presentation at 8), there is no evidence that any roads will be closed or that the risk to pedestrians or livestock will be of such importance that the failure to analyze this risk means that the FEIS took an inadequate look at the costs and benefits of this project. In particular, during my site visit I did not see any livestock roaming free and I have not seen any evidence concerning the frequency of this alleged problem.

The argument that roadways might also be used at night is not significant (FEIS at 4-69 to 4-70 and 4-116). In particular, the Sams have not shown an increase in the probability of release of materials from a night-time accident. Furthermore, HRI will not be transporting licensed material to or from its sites at night. HRI's Response to the Final Written Presentation of Grace Same and Marilyn Morris, at 2.

VI. ORDER

For all the foregoing reasons and upon consideration of the entire record in this matter, it is this 20rd day of August, 1999, ORDERED, that:

1. The relief requested by Eastern Navajo Diné Against Uranium Mining (ENDAUM) and the Southwest Research and Information Center (SRIC) and Grace Sam and Marilyn Morris relative to the revocation or revision Hydro Resources Inc.'s license (SUA-1508, January 5, 1998) to conduct *in situ* leach mining in Church Rock Section 8 is *denied.*

2. There is no reason either for further Phase I filings or for oral argument before the Presiding Officer.

3. Pursuant to the Commission's order of May 3, within 14 days after the Presiding Officer issues this decision, each party may file a single petition for review by the Commission, not to exceed 30 pages, addressing all remaining challenges to decisions rendered by the Presiding Officer. Responses to such petitions for review shall be filed within 14 days after the petition is filed, and shall not exceed 30 pages.

4. Hydro Resources, Inc., may file a brief before the Presiding Officer concerning the schedule and procedures for the remainder of this case. Its brief must be received by the Service List on or before September 14, 1999. Intervenors (ENDAUM, SRIC, Grace Sam and Marilyn Morris) may file a brief concerning the schedule and procedures for the remainder of the case.
The Intervenors' brief must be received by the Service List on or before September 28, 1999. The Staff of the Nuclear Regulatory Commission may file a responsive brief concerning the schedule and procedures for the remainder of the case. Their brief must be received by the Service List on or before October 5, 1999.

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Peter B. Bloch, Administrative Judge
Presiding Officer

Rockville, Maryland

ATTACHMENT A
Carlson Affidavit
(See footnote 34 at page 62, *supra.*)

> 3. [Question] 4. What are the adjusted benefits of the CUP, as stated in the FEIS, for one or two prices of yellowcake that are at or above the minimum price at which HRI would commence work on this project? (This is important because the price of uranium fluctuates and a reasonable cost/benefit picture requires an assessment of benefits at more than one arbitrary price.)

The Staff does not know the minimum price that HRI would commence work on Section 8 or the rest of the mining project. The FEIS cost/benefit analysis assumes a price of $15.70 per pound of U_3O_8 (FEIS Section 5.1). The "adjusted benefits" of the proposed project, using a similar cost/benefit analysis using two realistic U_3O_8 prices (*e.g.*, minimum prices) based on the current spot market value of uranium can be examined as follows.

4. The first step in the analysis is to determine the "minimum" prices. The FEIS, at page 5-3, states:

> The important point relevant to assessing the project's potential benefits to the local community is that the benefits depend on HRI's costs being lower than the future price of U_3O_8, which has been quite volatile. If the price of U_3O_8 is less than the costs of operation, then operations may be discontinued. If this happens, there would be no economic benefits to the local community.

FEIS Table 5.1 (reprinted here as Table 1) indicates that HRI's production costs would vary from $9.38 to $11.83 per pound, depending on where the U_3O_8 is mined, processed, and dried. Thus, a conservative estimate of benefits would be to assume prices of $9 and $12 per pound. These prices are conservative because they "bound" HRI's production costs as well as the current spot market price ($10.85 per pound) as of May 3, 1999. **www.uxc.com/review/ux_prices.shtml** (Ux Consulting Company LLC website).

5. The second step is to examine the project's benefits using these two alternative U_3O_8 prices. As discussed in the FEIS, both the employment generated by the project and the taxes paid by HRI would depend on the production of U_3O_8. In turn,

the amount of U_3O_8 produced would depend on the market price and the cost of production. Table 1 (FEIS Table 5.1), below, shows HRI's projected costs of producing U_3O_8 for the alternative operations.

Table 1. Average production costs per pound of U_3O_8 under alternative project designs

Alternative configurations	Church Rock	Unit 1	Crownpoint
Haul loaded resin to other site for processing and drying	$11.36	$10.46	$9.46
Ship yellowcake slurry to dryer at other site for drying	$11.32	$10.48	$9.40
Ship yellowcake slurry to Texas for drying	$11.83	$11.05	$9.87
Stand alone—all processing done at each site	$11.30	$10.51	$9.38

Source: HRI, *Response to Request for Additional Information, Issue 92: Cost/Benefit Analysis*

6. The most important local benefit would be opportunities for employment and earnings. The FEIS assumes that the project would create about 100 long-term jobs with an average annual salary of around $24,000. FEIS at 5-3, Section 5.1.2. The number of jobs and average salary might be lower with U_3O_8 prices of $9 and $12 per pound (as compared to $15.70 per pound), if HRI decides to hire less workers and pay less salary. The Staff has no information from HRI to make revised assumptions regarding these matters.

7. There could be between $630,000 (see Table 2, below, which is a modified version of FEIS Table 5.4) and $840,000 (see Table 3, below, which is a modified version of FEIS Table 5.4) in annual royalty income going to holders of leases, depending on production from Unit 1. (There would be no individual lease holders receiving royalties from production of the Church Rock site. However, HRI would have to pay royalties to private companies holding lease rights at the Church Rock site, *e.g.*, United Nuclear Corporation.) As indicated in the FEIS, at page 5-4, Section 5.1.2, this income would be concentrated (in the hands of about 9 lease holders), and would probably not have a widespread effect.

Table 2. Annual project benefits (assuming U_3O_8 at $9 per pound)

	Navajo Nation	Local Navajo communities	McKinley County/ Non Navajo
Employment	NA	Of 100 long-term jobs that would not require highly specialized skills, local	Total estimated long-term jobs less those

		communities could get up to 100 depending on how well HRI executes its intention to hire local Navajo.	going to Navajo (about 40 if Navajo get 100).
Earnings	NA	Average annual earnings for local employees would be about $24,000.	Average annual earnings for management/technical positions would be about $36,000.
Royalties	None	$630,000 annually (assuming 1 million pounds of yellowcake produced annually from allotment leases at $9/lb.). This would be distributed among 9 lessors of Unit 1 properties.	None.
Taxes	$540,000 annually for Business Activities Tax (assuming 2 million pounds of yellowcake at $9/lb. and contingent on legal jurisdiction to tax).	Cannot tax.	$270,000 annually for real property tax (assuming 2 million pounds of yellowcake at $9/lb.).
	$15,000 for construction tax (assuming $500,000 in drill rig contracts).	Cannot tax.	$55,000 for personal property (based on value of assets at Unit 1 and Crownpoint).
Other benefits	NA	Several jobs related to income expenditure in local community or incidental services required by project.	Several jobs related to expenditures in the local community or incidental services required by project.

Table 3. Annual project benefits (assuming U_3O_8 at $12 per pound)

	Navajo Nation	Local Navajo communities	McKinley County/

			Non Navajo
Employment	NA	Of 100 long-term jobs that would not require highly specialized skills, local communities could get up to 100 depending on how well HRI executes its intention to hire local Navajo.	Total estimated long-term jobs less those going to Navajo (about 40 if Navajo get 100).
Earnings	NA	Average annual earnings for local employees would be about $24,000.	Average annual earnings for management/technical positions would be about $36,000.
Royalties	None	$840,000 annually (assuming 1 million pounds of yellowcake produced annually from allotment leases at $12/lb.). This would be distributed among 9 lessors of Unit 1 properties.	None.
Taxes	$720,000 annually for Business Activities Tax (assuming 2 million pounds of yellowcake at $12/lb. and contingent on legal jurisdiction to tax).	Cannot tax.	$360,000 annually for real property tax (assuming 2 million pounds of yellowcake at $12/lb.).
	$15,000 for construction tax (assuming $500,000 in drill rig contracts).	Cannot tax.	$55,000 for personal property (based on value of assets at Unit 1 and Crownpoint).
Other benefits	NA	Several jobs related to income expenditure in local community or incidental services required by project.	Several jobs related to expenditures in the local community or incidental services required by project.

8. As discussed in FEIS Section 5.1.3 and indicated in Tables 2 and 3 above, significant tax revenues would be collected by McKinley County and possibly the Navajo Nation regardless of the price of U_3O_8.

9. The potential costs of the proposed project to the local communities would not change from those discussed in the FEIS (Section 5.2), regardless of the price of U_3O_8. 10. [Question] 5. Because of financial and market uncertainties, it is foreseeable that Church Rock Section 8 will be the only section developed. What are the governmental needs that arise because of the CUP? Would local governments need to make any capital expenditures that might not be recouped if the CUP suspended or terminated mining operations without going beyond Section 8? In light of the financial situation of local governments, would environmental justice considerations require indemnification or assurances to local governments for possible losses [footnote: *See Louisiana Energy Services, L.P.* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 100 (1998).]

The demand for public infrastructure and services (*i.e.*, "governmental needs") associated with the proposed project would decrease if Church Rock Section 8 were the only section of the project developed. Typically, increases in the demand for public infrastructure and services are related to increases in population.

11. As discussed in FEIS Section 4.9.2, HRI's proposed project may cause increases in population of about 25-40 people (less than 0.1 percent of the 1990 McKinley County population of 60,686) and such increases would not be significant. FEIS at 4-99. Therefore, the FEIS concludes that no significant or detrimental effects on housing, schools, utilities, or other public services would occur as a result of project-related population growth in Crownpoint or other communities in the project vicinity. This conclusion, which also relates to environmental justice considerations, would remain valid if Church Rock Section 8 were the only section developed by HRI since mining there is only projected to last six years, *see* FEIS at 4-97 to 4-98, and the resulting population increase would be less than that mentioned above.

12. With respect to HRI's proposed project, the most significant risk in terms of "governmental needs" would be the need to replace the town of Crownpoint's water supply wells *See* FEIS Section 4.3.1.1. If the entire project were developed, HRI would be required to pay for water supply well replacement and to reimburse the town of Crownpoint for operating costs that would occur because of the drawdown of the water table. *See* FEIS Section 4.3.3; Source Material License SUA-1508, License Conditions (LCs) 10.16 and 10.27. The FEIS concludes that little or no adverse effect would occur to the community because these required mitigation measures would provide a process to assure that replacement wells are acceptable. The need to replace

the wells would *only* stem from project development at the Crownpoint site, and *not* from development at Church Rock Section 8. Therefore, the conclusion that the need to replace Crownpoint water supply well is the most significant governmental needs risk remains valid if Church Rock Section 8 were the only section of the project developed.

13. Because project-related population increases would be less than predicted in the FEIS if Church Rock Section 8 were the only section of the project developed or due to lower uranium prices, there would be only slight changes in demand for emergency, fire, and police services. FEIS Section 4.9.4, at page 4-100, notes that "although the probability of accidents related to the project's operation is very low," responding to radiological hazards associated with the processed material "would result in the need for additional standby emergency services that currently are not required or available in the Church Rock area." As discussed in FEIS, HRI has made several commitments to address these issues which include providing "the local hospital with the proper equipment, on-going training for hospital staff, and a separate room equipped for decontamination (Pelizza 1996a)." FEIS at 4-100. HRI's proposed mitigation measures have been found adequate for the entire project, and therefore would suffice if Church Rock Section 8 were the only section of the project developed.

14. Traffic on New Mexico Highway 566 would increase as project employees commute to Church Rock Section 8 during the work week. Because existing traffic on this road is very light, *see* FEIS at 4-100, the additional traffic associated with the project would not cause congestion or traffic problems. Average Annual Daily Traffic on Highway 566 (which extends north from I-40 through the town of Church Rock, then bypasses the Church Rock mining site and continues north into the Navajo Indian Reservation property) from 1990 to 1994 was 3,490 vehicles. FEIS at 4-101. This volume of traffic is consistent with the Transportation Research Board's "peak hour Level of Service (LOS) rating of 'C,' which is characterized by stable traffic flows." *See* FEIS at 4-101. "Using the methodology in *Highway Capacity Manual* (Transportation Research Board 1985) for evaluating traffic flow on rural two-lane highways, at peak project [*i.e.,* the entire Crownpoint project] employment (assuming the addition of up to 100 vehicles at rush hour) the additional traffic would not degrade the existing LOS." FEIS at 4-101. Therefore, there would be even less traffic impacts associated with mining at Church Rock Section 8 only based on the reduced number of people/employees discussed in paragraph 11, above.

15. For the reasons discussed above and in FEIS Section 4.9, it is not likely that local governments would need to make any capital expenditures that might not be recouped if HRI suspended or terminated mining operations without going beyond Church Rock Section 8. Any "losses" to local governments could be addressed as part of socioeconomic mitigation measures required by the license. FEIS Section 4.9.6

discusses the mitigation of socioeconomic impacts provided for in the Staff-recommended action (Alternative 3). Such measures are addressed in LC 9.13 (HRI required to have applicable Memoranda of Agreements with local authorities, the fire department, medical facilities, and other emergency services), LC 9.14 (HRI required to obtain necessary permits and licenses from the appropriate regulatory authorities), LC 10.16 (HRI required to reimburse operators of the Crownpoint water supply wells for any increased costs caused by the project), and LC 10.27 (HRI required to replace the town of Crownpoint's water supply wells).

16. [Question] 6. What are the financial effects of uncertainties about the application of a tax on the CUP by the Navajo Nation? In light of these uncertainties and the possibility of litigation about this tax, are the parties willing to offer to begin negotiation with relevant governments? Have negotiations begun? Are negotiations producing results?
As stated in FEIS Section 4.9.5.2:
Potential tax collections by the Navajo Nation would be through the Navajo Business Activities Tax (BAT) and the BAT Construction Tax. . . .

> [These taxes] apply to activities on the Navajo Reservation and in areas outside the reservation if such areas meet the definition of "Indian country." The proposed project would not be located on the Navajo Reservation. However, the BAT could apply to the project's gross receipts if it is determined that the project would be within Indian country. The definition of Indian country may be viewed by some as vague and may ultimately be determined through litigation.

The above excerpt from Section 4.9.5.2 of the FEIS reflects that HRI is litigating such issues in the U.S. Court of Appeals for the 10th Circuit. While the Staff is of the opinion that the financial effects of uncertainties related to these taxes is unclear, the FEIS already recognizes that, for the Navajo Nation, if taxes are not applied to the project, there would be the loss of the potential tax revenues as reported in FEIS Table 4.29 on page 4-102.

17. The NRC Staff has no information as to whether the parties are willing to begin negotiations with relevant governments, whether negotiations have begun, or whether the negotiations are producing results.

18. [Question] 7. For Church Rock [sic] Section 8 . . . What is your comparative analysis of the NRC Staff-Recommended Action to: (1) the non-action alternative, and (2) Alternative 2 (modified action) -- including a concise, descriptive summary of the advantages and disadvantages of the options? *See* CEQ "Memorandum

to Agencies; Answers to 40 Most Asked Questions on NEPA Regulations," 46 Fed. Reg. 18,026; *see also* 40 C.F.R. § 1502.14 (Council on Environmental Quality, guidance). *Louisiana Energy Services, L.P.* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 98 (and 97-99) (1998). In your answers to this question, please consider the answers to the questions set forth above in your overall discussion. [footnote omitted]

Tables 4 through 15 (attached) provide the NRC Staff's comparative analysis for Church Rock Section 8 of the "NRC Staff-Recommended Action" alternative (Alternative 3) with the "No Action" alternative (Alternative 4) and the Modified Action alternative (Alternative 2). These tables summarize information in FEIS Sections 4.1 through 4.12.

19. In general, the NRC Staff-Recommended Action would have the advantage of allowing HRI to develop Section 8, while providing more environmental protection than the Modified Action (because of the additional mitigation measures recommended by Staff). The NRC Staff-Recommended Action would have the disadvantages of being more expensive for HRI than the Modified Action alternative and of creating impacts that would not exist under the No Action alternative.

20. The Modified Action alternative would have the advantage of allowing HRI to develop Section 8 at a lower cost than under the NRC Staff-Recommended Action, but would have the disadvantages of providing less environmental protection than the NRC Staff-Recommended Action (because there would be no additional mitigation measures recommended by staff) and of creating impacts that would not exist under the No Action alternative.

21. The No Action alternative would have the advantage of maintaining the status quo and avoiding the minimal impacts (to air quality and noise, geology and soils, groundwater, surface water, transportation risks, health physics and radiological risks, ecology, land use, socioeconomics, aesthetics, cultural resources and environmental justice) associated with development of Section 8. The disadvantages of the No Action alternative would be not allowing any uranium production from Section 8 and any of the beneficial socioeconomic impacts discussed in the FEIS. *See* FEIS Sections 4.9.1, 4.9.5, 5.1.2 and 5.1.3.

TABLE 4. AIR QUALITY AND NOISE (CHURCH ROCK -SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS

ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Air quality and noise impacts in Church Rock Section 8 will be relatively insignificant under both Alternatives 2 and 3.
ALTERNATIVE 3 (STAFF-RECOM-MENDED AC-TION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): - Utilize dust suppression techniques to reduce fugitive dust from unpaved roads	Under Alternative 3, the NRC Staff's recommendation to utilize dust suppression techniques to reduce fugitive dust from unpaved roads was primarily for the Crownpoint and Unit 1 sites (i.e., Church Rock Section 8 has only a short stretch of unpaved roadway). However, construction and maintenance activities at the Church Rock well fields, and traffic on the facility grounds could result in creation of some fugitive dust, thereby necessitating use of some form of dust suppression technique.
ALTERNATIVE 4 (NO ACTION)	No impacts to air quality; no noise impacts.	

TABLE 5. GEOLOGY AND SOILS (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Geological and soils impacts at Church Rock Section 8 are expected to be minimal under both Alternatives 2 and 3. Under Alternatives 2 or 3, HRI has not determined which of its proposed groundwater restoration approaches or methods of waste water disposal it will utilize.
ALTERNATIVE 3 (STAFF-RECOMMENDED ACTION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): 1. No construction of above grade wastewater retention ponds prior to NRC approval of embankment engineering system. 2. Maintain sufficient reserve capacity in retention pond system to enable transfer of contents among ponds. 3. Submit detailed site reclamation plan for NRC approval 12 months prior to shutdown. 4. Maintain adequate financial surety to cover reclamation costs.	Under Alternative 3, the NRC Staff imposes additional license requirements to ensure licensee compliance with regulatory requirements. - Reduces risk of surface water and soils being contaminated from structural failure of the retention ponds. - Reduces risk of surface water and soils being contaminated from over-topping of the retention ponds. - Ensures adequate safety evaluation review is conducted of licensee's reclamation plan. - Establishes adequate funding to ensure all groundwater restoration and surface reclamation costs are covered.
ALTERNATIVE 4 (NO ACTION)	No impacts to geology or soils.	

TABLE 6. GROUNDWATER (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Alternative 2 has a higher risk than Alternative 3 that groundwater could potentially be contaminated by vertical excursions and that the groundwater may not be properly restored
ALTERNATIVE 3 (STAFF-RECOM-MENDED AC-TION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): 1. Perform well integrity tests on each injection and production well before use. 2. Dispose of all liquid effluents from process buildings and other process waste streams in NRC-approved manner. 3. Do not exceed maximum flow rate of 15,000 Lpm (4000 gpm) at ion exchange plant. 4. Establish NRC-approved effluent and environmental monitoring program.	- Reduces risk of aquifer contamination from vertical excursions. - Ensures licensee requirement to obtain NRC review and approval of any future liquid waste effluent disposal option. - Ensures potential risk scenarios are within the scope of the EIS/SER review. - Ensures licensee's environmental monitoring program meets NRC regulatory requirements.

TABLE 6. GROUNDWATER (CHURCH ROCK - SECTION 8) (Cont'd)

ALTERNATIVE 3 (STAFF-RECOMMENDED ACTION)	5. Establish baseline water quality data at NRC-specified locations in well field.	- Improves baseline characterization and reduces risk of inadequate restoration.
	6. Collect sufficient water quality data and conduct sufficient hydrologic confinement tests to characterize the Cow Springs aquifer.	- Reduces risk of Cow Springs aquifer contamination from vertical excursions.
	7. Conduct acceptable groundwater restoration demonstration; determine number of pore volumes required for restoration; determine amount of surety based on demonstration.	- Reduces risk of inadequate groundwater restoration by setting an adequate level of surety.
	8.Conduct Westwater Canyon aquifer step-rate injection test.	- Reduces risk of contaminating overlying aquifers from vertical excursions caused by high injection pressures.
	9. In the event of vertical excursion, explore significant aquifers above Dakota sandstone aquifer for vertical excursions.	- Ensures that all aquifers contaminated by vertical excursions are identified and cleaned up.
	10. Develop NRC-approved groundwater restoration plan.	- Reduces risk that groundwater will not be adequately restored.
	11. [illegible]	[illegible]
ALTERNATIVE 4 (NO ACTION)	No impacts to groundwater.	

TABLE 7. SURFACE WATER (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Surface water impacts in Church Rock Section 8 are expected to be minimal under both Alternatives 2 and 3. Under Alternative 2 no design details have been provided to NRC by HRI.
ALTERNATIVE 3 (STAFF-RECOM-MENDED ACTION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): - No construction of wastewater retention ponds prior to NRC approval of embankment engineering system.	Under Alternative 3, the licensee will be required to provide design details to the NRC Staff for approval of its waste water retention ponds prior to operation. The NRC Staff has provided additional guidance to HRI for design of surface water impoundments and erosion protection measures, which will further minimize any potentially adverse impacts from construction of the facility.
ALTERNATIVE 4 (NO ACTION)	No impacts to surface water.	

TABLE 8. TRANSPORTATION RISK (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Although the number of shipments of U_3O_8 and other materials would be the same under both Alternatives 2 and 3, transportation risk would be reduced under Alternative 3 because of additional NRC-required safety measures.
ALTERNATIVE 3 (STAFF-RECOMMENDED ACTION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): 1. All delivery trucks must carry appropriate certifications of safety inspections. 2. All delivery trucks must hold appropriate licenses.	
ALTERNATIVE 4 (NO ACTION)	No increased transportation risk.	

TABLE 9. HEALTH PHYSICS AND RADIOLOGICAL IMPACTS (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Radiological impacts in Church Rock Section 8 are expected to be minimal under both Alternatives 2 and 3. HRI will restrict access to operating and restoring wellfields, which will reduce potential exposures to the public.
ALTERNATIVE 3 (STAFF-RECOMMENDED ACTION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): 1. All U_3O_8 must be stored inside restricted area; liquid oxygen tanks must be located in well fields; other chemical storage tanks must be located on concrete pad near waste retention pond. 2. Maintain an area within restricted area boundary for storing contaminated materials prior to disposal; all contaminated waste must be disposed of at NRC- or Agreement State-licensed radioactive waste disposal site.	Under Alternative 3, HRI would be required to clean-up the wellfields (or any other part of the restricted area) after use before allowing unrestricted access. This will allow NRC staff to verify compliance with regulatory clean-up standards for those affected areas related to the mining process.
ALTERNATIVE 4 (NO ACTION)	No health physics or radiological impacts.	

TABLE 10. ECOLOGY (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Ecological impacts in Church Rock Section 8 are expected to be minimal under both Alternatives 2 and 3. The amount of land disturbed in Section 8 would be the same (between 140 and 150 acres) under Alternatives 2 and 3.
ALTERNATIVE 3 (STAFF-RECOMMENDED ACTION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): 1. Revegetate disturbed areas with NRC-recommended seed mixture. 2. Follow NRC guidelines listed in FEIS for revegetating disturbed areas. 3. Implement methods for discouraging waterfowl use of project retention and evaporation ponds.	Under Alternative 3, impacts would be further reduced because revegetation guidelines recommended by the NRC Staff (which were adopted from the Navajo Nation EPA guidelines) were specifically designed for the terrestrial and meteorological environment in which the project would be located. Additionally, Alternative 3 includes measures to discourage waterfowl use of project ponds, which should reduce potential impacts to waterfowl in the area.
ALTERNATIVE 4 (NO ACTION)	No impacts to ecological resources.	

TABLE 11. LAND USE (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts same as under Alternative 3 (no grazing permits affected; no allottee lands affected).	Land use impacts in Church Rock Section 8 are expected to be minimal under both Alternatives 2 and 3. Surface rights to Section 8 of the project are owned by HRI, and therefore no grazing permits or allottee lands will be affected.
ALTERNATIVE 3 (STAFF-RECOMMENDED ACTION)	Impacts same as under Alternative 2 (no grazing permits affected; no allottee lands affected).	
ALTERNATIVE 4 (NO ACTION)	No land-use impacts.	

TABLE 12. SOCIOECONOMICS (CHURCH ROCK -SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Adverse socioeconomic impacts from mining on Church Rock Section 8 are expected to be minor under both Alternatives 2 and 3. The number of jobs created (approximately 60), the amount of income generated (between $1-1.7 million annually), and the amount of tax revenues generated (at least $250,000) would be the same under both Alternatives 2 and 3.
ALTERNATIVE 3 (STAFF-RECOM-MENDED ACTION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): 1. Document intention to hire local Navajo in written project hiring plan. 2. Provide annual report concerning employment of local Navajo. 3. Develop memorandum of understanding with local governments to outline responsibilities for emergency medical response and training.	Under Alternative 3, beneficial effects would be increased because the Navajo hiring practices recommended by NRC Staff would help ensure that local residents benefit from the project. Alternative 3 also includes the additional measure of developing an MOU to ensure that local governments do not have to pay for increased fire and emergency medical services.
ALTERNATIVE 4 (NO ACTION)	No socioeconomic impacts.	Alternative 4 would mean the potential loss of jobs, royalties,

		increased salaries, and tax revenues to the local populace.

TABLE 13. AESTHETICS (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Impacts on aesthetics at Church Rock Section 8 are expected to be minimal under both Alternatives 2 and 3.
ALTERNATIVE 3 (STAFF-RECOM-MENDED ACTION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): - Develop and implement NRC-approved site reclamation plan.	Under Alternative 3, the long-term impacts (e.g., permanently disturbed land areas) would be minimized because of the development and implementation of an NRC-approved reclamation plan by the licensee -- which would include the revegetation guidelines discussed under ecological resources.
ALTERNATIVE 4 (NO ACTION)	No impacts to aesthetic resources.	

TABLE 14. CULTURAL RESOURCES (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Cultural resource impacts are expected to be minimal at Church Rock Section 8 for both Alternatives 2 and 3.
ALTERNATIVE 3 (STAFF-RECOM-MENDED ACTION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI):	Under Alternative 3, cultural resource protection would be enhanced because of the development and implementation of an NRC-

	- Develop and implement NRC-approved cultural resources management plan.	approved cultural resources management plan. The plan would include additional NRC Staff recommended measures in the event that HRI's policy of "total avoidance' is not practicable.
ALTERNATIVE 4 (NO ACTION)	No impacts to cultural resources.	

TABLE 15. ENVIRONMENTAL JUSTICE (CHURCH ROCK - SECTION 8)

ALTERNATIVES	IMPACTS	COMMENTS
ALTERNATIVE 2 (MODIFIED ACTION)	Impacts more significant than under Alternative 3 (no mitigation measures except those proposed by HRI).	Adverse environmental justice impacts are potentially significantly higher under Alternative 2 than under Alternative 3.

ALTERNATIVE 3 (STAFF-RECOM-MENDED ACTION)	Impacts less significant than under Alternative 2 (staff-recommended mitigation measures plus those proposed by HRI): 1. In the event of lixiviant excursion, notify Navajo Nation, BIA, and BLM by telephone within 24 hours and by letter within 7 days. Provide written report within 60 days. 2. In the event of retention pond leak, notify Navajo Nation, BIA, and BLM by telephone within 48 hours and provide written report within 30 days. 3. In the event of solution spill or embankment failure, notify Navajo Nation, BIA, and BLM by telephone within 48 hours and provide written report within 7 days. 4. Work with U.S. EPA and State of New Mexico to involve Navajo Nation in UIC permitting. 5. Facilitate negotiations between	Under Alternative 3, potentially significant environmental justice impacts would be avoided because HRI would implement the NRC Staff recommended measures for all resource areas. Additionally, the NRC Staff has included the Navajo Nation regulatory authorities in oversight and decision making regarding HRI's mining project in order to provide the Navajo Nation a more active role in regulating the project.
ALTERNATIVE 4 (NO ACTION)	No environmental justice impacts.	

22. Based on the Staff's comparative analysis in the FEIS and summarized in Tables 4-15, above, Alternative 3 (Staff Recommended Action) was superior to Alternative 2 (Modified Action) with respect to mitigating environmental impacts from

the project. Similarly, Alternative 3 (Staff Recommended Action) was considered favorable to Alternative 4 (No Action) because the environmental impacts are acceptable (*i.e.*, insignificant and/or mitigable) and has socioeconomic benefits that flow from conducting mining operations at Section 8. These socioeconomic outweigh the benefits of the No Action alternative.