Nebraska case cited

BEFORE THE NEBRASKA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF THE REQUEST OF CROW BUTTE RESOURCES, INC. FOR AN AQUIFER EXEMPTION For portions of the Chadron Formation In Dawes County, Nebraska	))))))	AQUIFER EXEMPTION ORDER

The undersigned Director of the Nebraska Department of Environmental Quality (NDEQ) grants an aquifer exemption for portions of the Chadron Formation found in Dawes County, Nebraska, more particularly described as an area covering approximately 2,100 acres, including the Basal member of the Chadron Formation, ranging from a depth of approximately 350 feet in the northern and southern portions to 700 feet near the center, with horizontal boundaries legally described as follows:

T 32 N, R 52 W	Section 21	W ½ of the NW ¼, NE ¼, NW ¼ of the SE ¼, NE ¼ of the SE ¼, SE ¼ of the SE ¼
T 32 N, R 52 W	Section 22	NW ¼, SW ¼, SE ¼
T 32 N, R 52 W	Section 27	NW ¼, SW ¼, NW 1/4, of the NE ¼, SW ¼ of the NE ¼, NW ¼ of the SE ¼, SW ¼ of the SE ¼, NE ¼ of the NE ¼, SE ¼ of the SE ¼
T 32 N, R 52 W	Section 28	NE ¼ of the NE ¼, SE ¼ of the NE ¼, NE ¼ of the SE ¼, SE ¼ of the SE ¼
T 32 N, R 52 W	Section 33	NE ¼ of the NE ¼
T 32 N, R 52 W	Section 34	NW ¼, NE ¼, SW ¼

A map of the horizontal boundaries is attached to this Order as Attachment A.

FINDINGS

The Director has reviewed the administrative record compiled in this matter, indexed in Attachment B, and the Department's Response to Comments, a copy of which is attached to this Order as Attachment C. The Director, being fully advised, makes the following specific findings:

1. Crow Butte Resources, Inc. (CBR) submitted a petition for an aquifer exemption dated August 27, 2007, which was subsequently amended on August 20, 2008 and June 12, 2009.
2. The NDEQ has reviewed the petition, made substantive comments on the petition, and requested additional information as documented in the administrative record to this Order. The NDEQ determined that the information requirements set out in Title 122-Rules and Regulations for Underground Injection and Mineral Production Wells (Title 122), Chapter 11 have been satisfied and published a legal notice of its intent to approve the aquifer exemption, inviting the public to provide written comments during a public comment period of more than 30 days and attend a public hearing in the Crawford Public High School, Crawford, Nebraska on August 23, 2010, in accordance with law and Title 122.
3. Eight individuals testified at the August 23, 2010 public hearing and their remarks are transcribed in the written transcript. In addition, one individual submitted written materials at the public hearing for consideration.
4. The NDEQ has prepared a written Response to Comments received during the public comment period and the hearing, Attachment C, which are adopted in this Order and incorporated by this reference.

5. The NDEQ has jurisdiction of this matter pursuant to the Nebraska Environmental Protection Act, Neb. Rev. Stat. §81-1505(9) and Title 122. The United States Environmental Protection Agency (EPA) has delegated authority to the NDEQ to administer the Underground Injection Control program authorized pursuant to the Federal Safe Drinking Water Act, 42 U.S.C. §300f et seq.

6. The Petitioner, CBR, currently operates a commercial in-situ leach uranium mine at the Crow Butte Uranium Facility located near Crawford in Dawes County, Nebraska. The proposed aquifer exemption covers the area described above for which CBR has submitted an application on August 19, 2008 for a Class III underground injection permit for a satellite facility referred to as the North Trend Expansion Area (NTEA). The aquifer exemption area provides a buffer zone beyond the estimated mineralized ore deposit.

7. The Director's Order approving the above-described aquifer exemption is based on criteria established in Title 122, Chapter 5, Section 004. The criteria for exempting an aquifer are as follows:

> 004.01 It does not currently serve as a source of drinking water; and
>
> 004.02 It cannot now and will not in the future serve as a source of drinking water because:
>
> > 004.02A It is mineral, hydrocarbon or geothermal energy bearing with production capability;
> >
> > 004.02B It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical;
> >
> > 004.02C It is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or

004.02D It is located above a Class III well mining area subject to subsidence or catastrophic collapse.

8. The Director has determined that the specific criteria outlined above have been met for the aquifer exempted in this Order as set forth below:

A. The exempt portion of the aquifer does not currently serve as a source of drinking water. No one was identified as currently using water from this aquifer within the proposed exemption boundary for human consumption. CBR conducted a water user survey and provided information on all wells, including domestic, livestock or other types within the NTEA and within a 2.25 mile area of review beyond the proposed exemption boundary. CBR did not find any active water supply wells completed in the Basal Chadron Sandstone within the area. CBR identified 11 active permitted water supply wells completed within the shallow Brule Formation that are used for domestic as well as livestock watering or other agricultural purposes. The Brule Formation is hydraulically isolated from the underlying Basal Chadron Sandstone by up to 500 feet of low permeability claystones and siltstones. CBR identified twelve active water supply wells outside the NTEA and within the 2.25 mile area of review for the aquifer exemption area, only three of which are used for a domestic purpose.

No water supply wells completed in the exempted zone in the 2.25 mi AOR

only 3 well in AOR used as domestic wells.

B. The exempt portion of the aquifer cannot now, and will not in the future, serve as source of drinking water because the exempt aquifer contains minerals that, due to their quantity and location, are expected to be commercially mined. CBR has filed an application for a Class III underground injection permit for its NTEA, which is encompassed by the aquifer exemption area. CBR's petition demonstrates that the aquifer exemption area includes a mineral bearing zone based on water quality data showing significant levels of radionuclides, particularly radium and uranium, and is

commercially producible by in-situ leach method based on the results of pump tests conducted in the aquifer indicating favorable transmissivity and hyrdraulic conductivity. CBR estimates two million pounds of uranium ore deposits present at the NTEA.

C. The aquifer exemption area cannot now, and will not in the future, serve as source of drinking water because the aquifer portion is so contaminated that it would be economically or technically impractical to render that water fit for human consumption. The Basal Chadron aquifer within the NTEA qualifies as an "underground source of drinking water" as defined in Title 122, Chapter 1, based on the results of CBR's analysis of ground water samples taken from this formation that show Total Dissolved Solids values less than 10,000 milligrams per Liter (mg/L). Analysis of ground water samples taken by CBR from this aquifer have significantly exceeded maximum contaminant levels for radium and uranium. CBR in its petition demonstrates that treatment of ground water to remove radium and uranium is technologically possible, but prohibitively expensive, making it unlikely that this aquifer exemption area would ever serve as a source of drinking water. CBR demonstrated that treatment systems for individual's wells would be economically impractical because current treatment technologies are most economically viable on a community-wide system basis and individual domestic users cannot avail themselves of the economies of scale that might make treatment a viable option. CBR references EPA publications that evaluated the costs of removal technologies including point of use ion exchange and reverse osmosis in support of its analysis.

They used more criteria than necessary to approve the exemption

9. Based on the foregoing findings, the Director of the NDEQ determines that CBR has demonstrated to the satisfaction of the NDEQ that the criteria of Title 122, Chapter 5 have been met for aquifer exemption area identified in this Order.

10. IT IS THEREFORE DECIDED that:

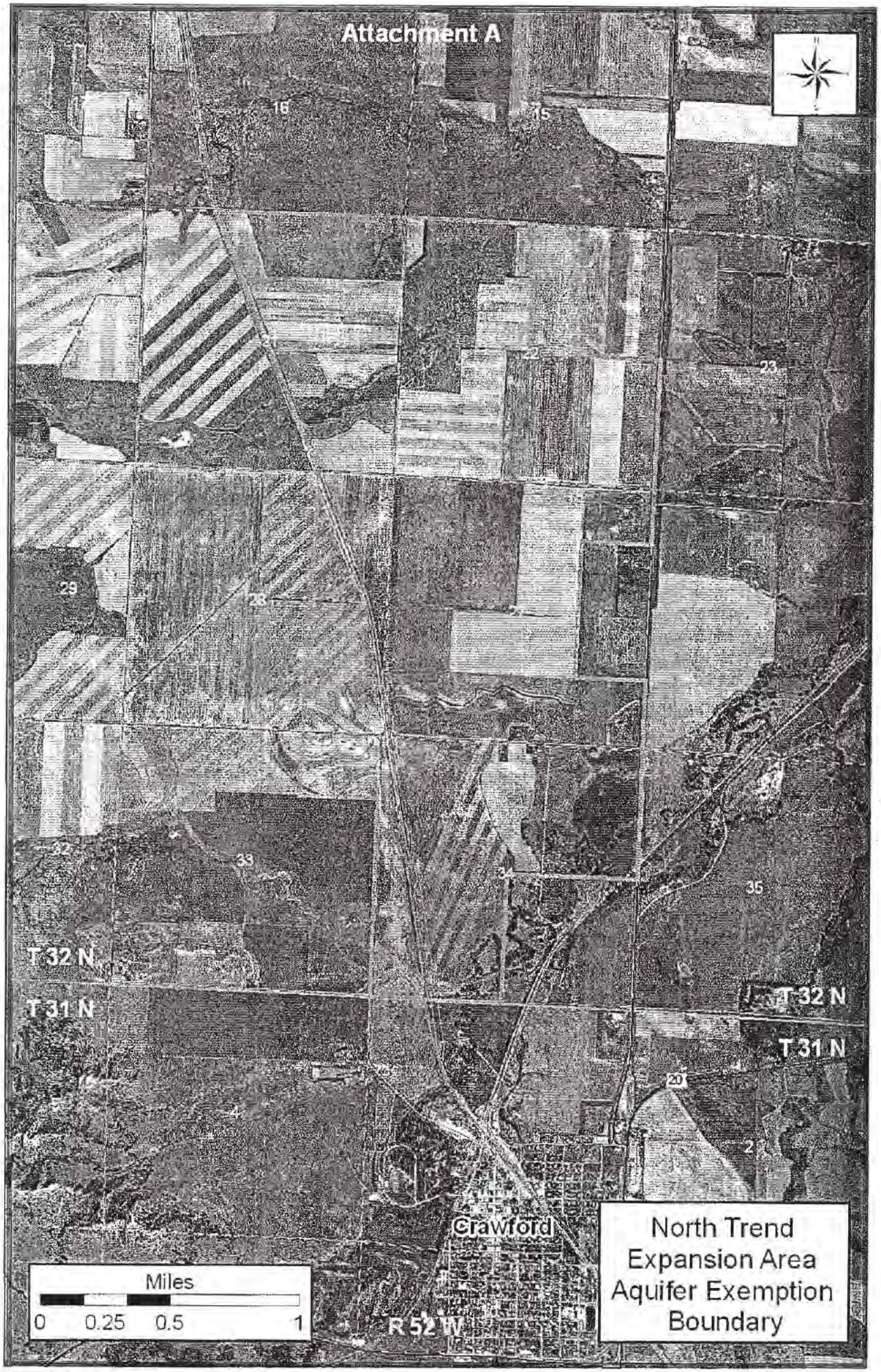
    A. The Petition for Aquifer Exemption submitted by CBR as described herein is granted.

    B. In accordance with Title 122, Chapter 5, Section 005, the NDEQ will require CBR and any other person or entity to apply for and obtain "an individual permit for injection into the exempted aquifer in order to protect underground sources of drinking water outside the exempted aquifer which may become subject to pollution caused by the injection."

    C. This aquifer exemption does not authorize any activity not otherwise in compliance with law.

Decided this 7th day of April, 2011.

/s/ Michael J. Linder
Michael J. Linder
Director


Attachment A
16
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Crawford
R 52 W
Miles
0 0.25 0.5 1
North Trend
Expansion Area
Aquifer Exemption
Boundary

ATTACHMENT B
ADMINISTRATIVE RECORD INDEX

Transcript of public hearing held August 23, 2010.

Exhibit 1 – Order appointing a hearing officer for the public hearing on August 23, 2010.

Exhibit 2 – Affidavit of proof of publication in the Lincoln Journal Star on July 7, 2010 of the public notice of the comment period and public hearing for the proposed aquifer exemption.

Exhibit 3 -- Affidavit of proof of publication in the Crawford Clipper/Harrison on July 7, 2010 of the public notice of the comment period and public hearing for the proposed aquifer exemption.

Exhibit 4 -- Affidavit of proof of publication in the Alliance Times-Herald on July 7, 2010 of the public notice of the comment period and public hearing for the proposed aquifer exemption.

Exhibit 5 -- Affidavit of proof of publication in the Scottsbluff Star-Herald on July 8, 2010 of the public notice of the comment period and public hearing for the proposed aquifer exemption.

Exhibit 6 – Copy of the public notice of aquifer exemption.

Exhibit 7 – Fact Sheet describing the proposed aquifer exemption.

Exhibit 8 – Petition for Aquifer Exemption submitted by Crow Butte Resources, Inc. (CBR) submitted to the NDEQ on or about August 20, 2007.

Exhibit 9 – Memorandum from Dr. Steven Fischbein, NDEQ, to David Miesbach, NDEQ, dated September 21, 2007 regarding preliminary review of the petition for aquifer exemption for the North Trend Expansion Area submitted by CBR.

Exhibit 10 – Letter with attachment from Dr. Steven Fischbein, NDEQ to Stephen P. Collings, CBR, dated November 8, 2007 regarding detailed technical review of the aquifer exemption petition.

Exhibit 11 – Email from Rhonda Grantham to David Miesbach, NDEQ, dated February 21, 2008.

Exhibit 12 – Petition for Aquifer Exemption for the North Trend Expansion Area, submitted by CBR on or about August 20, 2008.

Exhibit 13 – Letter from Jennifer Abrahamson, NDEQ, to Pat Costello, U.S. Environmental Protection Agency (EPA), Region 7, dated August 21, 2008 forwarding a copy of the aquifer exemption petition.

Exhibit 14 – Letter from Jennifer Abrahamson, NDEQ, to Steve Cohen, U.S. Nuclear Regulatory Commission, dated September 5, 2008 transmitting a copy of the aquifer exemption petition.

Exhibit 15 – Letter from Jennifer Abrahamson, NDEQ, to Dr. Harmon Maher, University of Nebraska at Omaha (UNO), dated January 13, 2009 transmitting a copy of the aquifer exemption petition and requesting review and an independent opinion regarding the structural geology interpretations presented in the aquifer exemption petition.

Exhibit 16 – Email from Jennifer Abrahamson, NDEQ, to Dr. Harmon Maher, UNO, dated approximately January 15, 2009.

Exhibit 17 – Email from Dr. Harmon Maher, UNO, to Jennifer Abrahamson, NDEQ, dated January 25, 2009 transmitting his review of the structural geology of the aquifer exemption petition.

Exhibit 18 – Email from Jennifer Abrahamson, NDEQ, to Dr. Nancy Lindsley-Griffin, University of Nebraska – Lincoln (UNL) dated January 27, 2009 requesting an independent review of the aquifer exemption petition.

Exhibit 19 – Email from Jennifer Abrahmason, NDEQ, to Dr. Steven Fischbein, UNL, dated February 17, 2009 requesting review of the aquifer exemption petition.

Exhibit 20 – Letter with attachment from Jennifer Abrahamson, NDEQ, to Steve Collings, CBR, dated February 26, 2009 requesting additional information.

Exhibit 21 – Letter from Steve Collings, CBR, to Jennifer Abrahamson, NDEQ, dated June 11, 2009 responding to NDEQ request for information.

Exhibit 22 – Letter from Jennifer Abrahamson, NDEQ, to Pat Costello, EPA Region 7, dated June 15, 2009.

Exhibit 23 – Email from Pat Costello, EPA Region 7, to Jennifer Abrahamson, NDEQ, dated August 7, 2009 regarding comments on the revised aquifer exemption petition.

Exhibit 24 – Letter from Jennifer Abrahamson, NDEQ, to Steve Collings, CBR, dated August 7, 2009 requesting additional information.

Exhibit 25 – Email from Pat Costello, CBR, to Jennifer Abrahamson, NDEQ, dated August 1, 2009 regarding the revised aquifer exemption petition.

Exhibit 26 – Letter from Jennifer Abrahamson, NDEQ, to Steve Collings, CBR, dated August 13, 2009 requesting addition information.

Exhibit 27 – Letter from Steve Collings, CBR, to Jennifer Abrahamson, NDEQ, dated August 27, 2009 in response to NDEQ request for additional information.

Exhibit 28 – Email from Jennifer Abrahamson, NDEQ, to Lee Snowhite, Cameco Resources, dated September 21, 2009 regarding the aquifer exemption boundary.

Exhibit 29 – Letter from Steve Collings, CBR, to Jennifer Abrahamson, NDEQ, dated September, 24, 2009 responding to NDEQ August 7, 2009 request for additional information.

Exhibit 30 – CBR Responses to NDEQ request for additional information on petition for aquifer exemption for North Trend Expansion Area received by NDEQ on June 12, 2009.

Exhibit 31 – NDEQ powerpoint dated August 20, 2010.

Exhibit 32 – Written submission of public comments with attachments to NDEQ from David C. Frankel dated August 23, 2010.

Attachment C

RESPONSES TO STATEMENTS FROM CROW BUTTE RESOURCES, INC., HEARING

AUGUST 23, 2010

During the August 23, 2010 public hearing regarding the Department's preliminary decision to exempt a portion of the Chadron Formation, several comments and questions were raised. Some of these comments were in regard to Crow Butte Resources, Inc.'s (CBR) proposed North Trend Expansion Area Aquifer Exemption. Others related to proposed uranium mining activities associated with in-situ mineral production at the North Trend Expansion Area satellite facility. The Department understands there are environmental concerns related to the aquifer exemption and the in-situ activities; however, in many instances the comments related to the North Trend in-situ uranium mining activities did not have bearing on the proposed aquifer exemption. All questions and comments received have been responded to, including those not associated with the preliminary decision to exempt a portion of the Chadron Formation.

1) ***The aquifer is currently being used for drinking, domestic and ranching purposes and is connected through faults and fractures to other aquifers including the Arikaree and Brule formations that are being used for drinking water and other domestic and ranching purposes.***

   The Chadron Formation aquifer within the proposed North Trend Expansion Area (NTEA) exemption boundary is not being used as a source of drinking water. Two hundred and one (201) wells were identified in a Water Users Survey for Water Supply Wells within a 2 ¼ mile radius from the proposed exemption boundary. Of those wells, 178 of them were screened in the Brule Formation and 23 were screened in the Chadron Formation. Of the 201 wells, 14 Brule wells and two Basal Chadron wells were identified within the proposed exemption area. All other identified wells are not within the area proposed for exemption, but are within the area of review. Of the 14 Brule wells, eight wells are active and used for agricultural purposes, four wells are inactive agricultural wells, and three wells are active domestic wells. Of the two Basal Chadron wells, one was an abandoned agricultural well and one is a monitoring well not being used. None of the wells screened in the Basal Chadron Formation and identified within the boundary are used as a source of drinking water. - no active domestic wells in exempted zone

During the public hearing, one individual, Dr. Francis "Doc" Anders, was identified as a user of the Basal Chadron Formation aquifer for drinking, domestic, and ranching purposes. Dr. Anders has two wells within the area of review screened in the Basal Chadron Formation, one of which has been abandoned. The NDEQ has identified these wells as being outside the proposed NTEA boundary for aquifer exemption, but within the area of review. Both wells were identified by Crow Butte Resources, Inc. in the Water Users Survey.

I human water source within the same aquifer but outside the exempted zone

The Arikaree Group is absent within the proposed NTEA aquifer exemption boundary. This group overlies the White River Group in Nebraska south and west of the proposed site location, and in South Dakota to the north and east of the proposed site location. Drilling activities at the Crow Butte project site identified a structural feature referred to as the White River Fault, located between the current facility and the proposed NTEA boundary. The White River Fault generally follows the drainage of the White River north of Crawford. Evidence of the fault was identified during the exploration drilling phase of the Crow Butte Project in 1984. The fault is manifested as a significant northeast-trending, subsurface fold.

In order to decipher whether geologic units are disrupted by the White River Fault, one would expect to see at least one of the following, regardless of how the fault moved:

- less stratigraphic section than expected (i.e. structural thinning);
- repeated stratigraphic sections (i.e. structural thickening);
- missing stratigraphic sections; or
- linear features associated with a fault rupture.

Three-dimensional modeling of geophysical logs indicates that none of the above conditions were observed that could not be associated with other geological processes (e.g. erosional denudation or paleotopographic highs associated with fold development). Instead, all of the stratigraphic units within the NTEA are well-correlated southward across the structure with no apparent offsets or truncated units on the north limb of the fold structure, with the exception of the Upper/Middle Chadron (correlated to the lower portion of the Big Cottonwood Creek Member as described by Terry & LaGarry, 1998).

There are 300-500 vertical feet of structural relief existing across the fold structure, depending on the location. Given all of this information, the observed thinning of individual members[1] of the Chadron Formation is likely related to either a localized reduction in sediment accommodation along the north limb of the fold structure as part of the developing basin (folding at the same time as deposition), localized thinning within the fold limb[2] as a result of flexural bending (post-depositional folding) associated with fault-propagation folding above a blind reverse fault, or highly distributed normal faulting with no apparent fault offsets.

Drilling data within the NTEA suggest that, while a fault may cut the Pierre Formation at depth along with stratigraphically lower units, there is no evidence that a fault offsets the geologic contact with the Pierre Formation and overlying White River Group, nor individual members of the White River Group (i.e., Brule and Chadron formations).

2) ***Many new filtering technologies demonstrated in the field (especially concerning recovery of high TDS water in connection with oil and gas operations) have shown that it is not technologically impractical to filter the water in the "Basal Chadron" formation which is properly known scientifically as the "Chamberlain Pass Formation."***

The history of stratigraphic nomenclature for the White River Group of Nebraska and South Dakota has had various interpretations as described by Clark et al. (1967), Harksen and Macdonald (1969), and Singler and Picard (1980). More recently, the stratigraphic nomenclature of the White River Group has been revised by Terry and LaGarry (1998), Terry (1998), LaGarry (1998), and Hoganson et al. (1998). The NDEQ recognizes these recent interpretations of the stratigraphic nomenclature for the White River Group; however, to be consistent with historical permitting and to prevent confusion as to where mining is occurring, the Department is allowing the continued use of the term "Basal Chadron Formation" to describe the mining formation.

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[1] Geologic members are defined as a division of a [geologic] formation differentiated by separate or distinct lithology or complex of lithologies. (Dictionary of Geologic Terms, Revised Edition. Anchor Press, 1976.)

[2] A fold limb is defined as one of the two parts of a [fold] on either side of the axis. (Dictionary of Geologic Terms, Revised Edition. Anchor Press, 1976.)

The groundwater in the area proposed for exemption exhibits a total dissolved solids (TDS) concentration that makes it a potential underground source of drinking water. The U.S. Environmental Protection Agency (EPA) defines an underground source of drinking water as waters having a TDS of less than 10,000 mg/L (40 CFR 144.3). Groundwater samples were collected in 1996, 1997, 2005, and 2008 to determine the water quality of the Basal Chadron Formation and the Brule Formation within the proposed aquifer exemption boundary. The TDS for the Basal Chadron Formation ranged from 1,200 to 2,550 mg/L. The TDS for the Brule Formation ranged from 423 to 479 mg/L. The Basal Chadron Formation water, while it meets the criteria for an underground source of drinking water based on TDS (<10,000 mg/L), exceeds drinking water standards for radium-226 and uranium. The EPA and NDEQ drinking water standard (i.e. maximum contaminant level, or MCL) for radium-226 is 5 pCi/L. The EPA and NDEQ drinking water standard for uranium is 0.030 mg/L. Concentrations of radium-226 within the proposed aquifer exemption boundary ranged from non-detect to 44.6 pCi/L for the Basal Chadron Formation. Radium-226 in the Brule Formation ranged from non-detect to 0.5 pCi/L. Measureable uranium in the Basal Chadron Formation within the proposed aquifer exemption area ranged from non-detect to 0.031 mg/L. Measurable uranium was also present in all four groundwater samples from the Brule Formation, and ranged in concentration from non-detect to 0.016 mg/L. Uranium concentrations were non-detect at all sampling locations outside of the proposed exemption boundary.

Although expensive, it is technologically possible to remove both radium and uranium from groundwater. Removal of these constituents has been required of municipal water supplies since December 2003. In 1998, the U.S. EPA identified Point of Entry (POE) or Point of Use (POU) removal technologies that would be amenable to individuals using well water, including POU ion exchange and POU reverse osmosis. The EPA also evaluated the cost of implementing treatment technologies and determined that the threshold above which treatment becomes economically impractical is about 2.5 percent of the median household income. The median 2008 household income in Dawes County was $37,318 (Website: http://www.city-data.com/county/Dawes_County-NE.html; accessed 10/12/2010). Given this information, the maximum cost an individual might be expected to incur if they desired to treat well water to MCLs would be $933/year. If individuals elect to perform wellhead treatment at the household level, the cost would include maintenance and application costs, in addition to the initial cost of the system.

Proven approaches to uranium and radium treatment are not readily adaptable to small domestic sized systems. Periodic well use (i.e. periods of no flow) of individual domestic wells would either require regular system modifications or periodic treatment that directs treated water to a tank or cistern. Additionally, the size, cost, and operational requirements that are necessary to reduce uranium and radium to below MCLs are not easily transferred to individual domestic use. Current technologies are most economically viable as community-wide treatment systems for a central water supply. Costs for radium and uranium treatment systems are approximately $50,000 each, as the treatment methods operate separately and independently of one another. Media exchange, an on-going maintenance aspect of these systems, costs approximately $25,000 per system per exchange. Frequency of media exchange depends upon concentrations of uranium and radium and utilization of the system. Disposal of effluent and materials from such treatment would also be problematic and would add to the expense of the owner. Therefore, while technologies exist to treat groundwater for the removal of radium and uranium, to do so might be considered cost prohibitive on an individual scale.

The State of Wyoming has determined the individual household treatment for radium has the potential to negatively impact human health by concentrating the radioactive source within a household and creating a regulated radioactive source (Wyoming DEQ, 2001). Treating a groundwater source, which contains radium at background concentrations commonly found in in-situ uranium production zones, could produce a filtrate or wastewater that would be prohibited for unrestricted disposal. Treatment for radium and uranium at the individual household level will not be considered, due to concerns with the safe disposal of any water treatment by-products.

CBR can treat the water using reverse osmosis (RO) for $3.12 per 1000 gallons. The pumping costs to get it from the aquifer to the RO unit are not considered in the above estimate, and amount to approximately $1200-$1500 per year. The biggest cost is disposal of the reject water after treatment. The state would require an appropriate method of managing the reject water (e.g. disposal down a non-hazardous Class I well, licensed evaporation ponds, disposal at a licensed commercial facility, or other approved method).

3) ***Lack of confinement between aquifers due to faults, fractures, artesian pressures and existing well pressures make it impossible to delineate a "portion" of an aquifer to be exempted without affecting other aquifers such as the Brule and Arikaree formations, which are widely used as sources of drinking water.***

Opinions among geologists as to the presence of faults serving as conduits of contamination within the Crow Butte project area have differed since the inception of the project in 1984. What is not addressed by those who question the geologic interpretation is whether the projects can be operated in an environmentally safe manner and in accordance with the proposed Underground Injection Control (UIC) permits and NRC license. The UIC permit for Crow Butte is designed to establish operating parameters which will control the possibility of environmental pollution. The permit also requires stringent monitoring to detect any environmental pollution which may occur and requirements for immediate response and clean-up of any pollution caused by the project. In a letter to the Department, dated May 17, 1989, State Senator Sandra Scofield suggested that the data be reviewed by independent experts who specialize in faulting, and the Department has requested the assistance of independent experts for all its reviews of Petitions for Aquifer Exemptions and Class III Injection Well Applications.

The Department enlisted the help of independent experts for the review of geologic data presented in applications for aquifer exemptions and Class III UIC permits. During review of the Aquifer Exemption Petition for the proposed North Trend Expansion Area, geologists at the University of Nebraska – Conservation and Survey Division (CSD) reviewed the geologic interpretations presented in the document. A geologist from the University of Nebraska – Omaha also reviewed CBR's interpretations of the local and regional structural geology. In their reviews, these geologists agreed that the structural interpretations presented by CBR were plausible.

Drill-hole data indicate there is no evidence of faults or contaminant pathways between the mining aquifer and the upper drinking water aquifer. This is further evidenced by the flowing artesian conditions observed in the proposed North Trend Expansion Area, and the results of the pumping test performed by Crow Butte Resources, Inc. in 2006. Crow Butte Resources, Inc. performed the pumping test in association with preparation for a

Class III UIC permit application. The pumping test was used to evaluate the hydrogeologic conditions in the vicinity of the proposed North Trend Expansion Area (NTEA). Specifically, the test was designed to assess: 1) the degree of hydrologic communication between the Basal Chadron Formation at the pumping well and the surrounding Basal Chadron monitoring wells; 2) the presence or absence of hydrologic boundaries within the Basal Chadron Formation over the test area; 3) the hydrologic characteristics of the Basal Chadron Formation within the test area; and 4) the degree of hydrologic isolation between the Basal Chadron Formation and the overlying aquifers (i.e. the Brule Formation. NOTE: the Arikaree Group is absent within the proposed NTEA).

During the 2006 pumping test, 13 wells were monitored using automated equipment. The test was conducted by pumping one well at 16.4 gallons per minute for 357 hours (14.9 days). More than 110 feet of drawdown was achieved at the pumping well, and all Basal Chadron Formation wells showed at least 1.3 feet of drawdown, which confirms hydrologic communication within the Basal Chadron Formation. No significant water level changes were observed in wells installed in the Middle Chadron Formation or the Brule Formation, indicating no significant connection between the Brule Formation and the Basal Chadron Formation or the Middle Chadron Formation and the Basal Chadron Formation.

The test results demonstrate that: 1) the Basal Chadron Formation monitoring well network is in hydraulic communication throughout the proposed NTEA; 2) the hydrogeologic conditions of the Basal Chadron Formation have been adequately characterized within the test area; 3) there is adequate confinement between the Basal Chadron Formation and the overlying Upper/Middle Chadron and Brule formations throughout the NTEA; and 4) transmissivity of the Basal Chadron Formation in the NTEA is relatively consistent, but the thickness and hydraulic conductivity vary with direction and location.

The data from the pumping test was evaluated for apparent boundary conditions that would indicate structural folding of the Basal Chadron Formation. A groundwater model was used to simulate a no-flow boundary at a distance that correlates to the midpoint of the fold limb south of the NTEA, and near one of the monitoring wells used in the

pumping test. The simulations predict that more drawdown should have been observed at that monitoring well if there was a no-flow boundary at that location than what was actually observed. The simulated boundary was then moved to a distance of 7,500 feet (the extent of the radius of influence for the test). This simulation also predicted increased drawdown at the monitoring well nearest the fold structure. Since this predicted increased drawdown was not observed during the actual pumping test, likely a hydraulic boundary does not exist within the fold structure.

All available data indicate an upward hydraulic gradient between the Basal Chadron Formation and the Brule Formation, which results in artesian pressures within the Basal Chadron Formation. The magnitude of the hydraulic head difference between the Basal Chadron and the Brule formations, coupled with no observed drawdown in the Brule Formation related to pumping in the Basal Chadron Formation during the 2006 pumping test, further indicates adequate hydraulic confinement and therefore hydraulic isolation between the two water-bearing units.

Different heads indicate isolation

Moreover, the Brule Formation and Arikaree Group are not proposed for exemption, and the Brule Formation could continue to be used as a source of drinking water within the proposed NTEA. (NOTE: The Arikaree Group is absent within the proposed North Trend Expansion Area.)

4) ***On July 30, 2007 [sic], the NDEQ issued its press release notifying the public of this hearing on August 23, 2010, to be held in compliance with Ch. 5, Title 115.***

Public notice of the public hearing on the petition for an aquifer exemption filed by CBR scheduled to be held on August 23, 2010 in Crawford, Nebraska was published in the following newspapers on the dates indicated:

Lincoln Journal Star on July 7, 2010
Crawford Clipper/Harrison Sun on July 7, 2010
Alliance Times-Herald on July 7, 2010
Scottsbluff Star-Herald on July 8, 2010
Chadron Record on July 14, 2010

This public notice provided information about the reasons for the aquifer exemption and where interested persons could obtain additional information about the aquifer exemption petition. In accordance with Title 122 – Rules and Regulations for Underground Injection and Mineral Production Wells, more than 30 days were provided for the public to comment on the proposed aquifer exemption and notice of the hearing was provided more than 30 days in advance of the scheduled hearing. The press release referred to in the comment was issued on July 30, 2010 as a reminder of the upcoming hearing and was cumulative to the newspaper notices and not obligatory.

5) ***Crow Butte's proposed expansion of mining operations will use and contaminate water resources, resulting in harm to public health and safety, through mixing of contaminated groundwater in the mined aquifer with water in surrounding aquifers and drainage of contaminated water into the White River.***

The Department recognizes this is an environmental concern in the scope of In-Situ Leach (ISL) uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

Groundwater consumption for the entire North Trend Expansion Area (NTEA) operation is expected to be on the order of 50 to 100 gpm. Within the wellfield, more water is pumped out than is injected to create an overall hydraulic cone of depression in the production zone and to protect groundwater resources outside of the mining area. Under this pressure gradient, the natural groundwater movement from the surrounding area is toward the wellfield, providing additional control of the mining solution movement. The current facility operates on a 0.5-1.5% "bleed", which means that they withdraw 0.5-1.5% more water than they inject. A similar "bleed" has been proposed for the North Trend Expansion Area (NTEA) mining operation. Beyond the boundaries of the NTEA, however, the magnitude of regional groundwater flow will not be meaningfully affected, and will resume to regional flow conditions within a few hundred feet outside the proposed boundary.

Water quality sampling will be conducted bi-weekly at all monitoring well locations, if a mining permit is issued, which would indicate an excursion (i.e. the presence of mining fluids). Water level measurements in the Basal Chadron Formation and the overlying

water-bearing zones will also be monitored bi-weekly. Sudden changes in water levels within the production zone may indicate that the wellfield flow system is out of balance. Pumping and injection rates are adjusted to correct this situation, and often injection wells are shut off and production is increased to draw fluids toward the mining area. If mining solutions were to be detected in the overlying drinking water aquifer, rigorous groundwater remediation would be required of CBR. Remediation measures would include, but not be limited to, excavation of contaminated soils and recovery and treatment of contaminated groundwater.

Wellfields at the currently operating facility are installed with berms or dikes to prevent spilled solutions from entering surface water features. Process buildings are constructed with secondary containment, and a regular program of inspections and preventative maintenance is in place. Similar methods for surface water protection will be required at the NTEA.

6) ***Crow Butte has not established the Brule Formation as a confining layer in that Crow Butte acknowledges that the Brule conducts water at 25 ft/day, that there may be more saturated areas; and that fracturing may be present (e.g., by the observed tectonic movements or earthquakes).***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

Approximately 130 geophysical well logs were reviewed for interpretation and correlation in the NTEA. The local stratigraphy present within the NTEA consists of the following units, in descending order using historical nomenclature: alluvial sediments, Brule Formation, Upper Chadron Formation, Upper/Middle Chadron Formation, Middle Chadron Formation, Basal Chadron Formation, and the Pierre Formation. The Brule Formation is a locally significant aquifer. The Basal Chadron Formation is the mineral-bearing zone within the NTEA. The Middle Chadron Formation is considered the upper confining unit for the mineral-bearing zone, and the Pierre Formation is considered the lower confining unit.

The Brule Formation represents the youngest unit within the White River Group identified in the NTEA. The Brule Formation has been subdivided into three members (LaGarry, 1998), from youngest to oldest: the "brown siltstone" member, the Whitney Member, and the underlying Orella Member. The "brown siltstone" member consists of pale brown and brown nodular, cross bedded volcaniclastic siltstones and sandy siltstones. The Whitney Member consists of pale brown, massive, and typically nodular siltstones with occasional thin interbeds of brown and bluish-green sandstone and volcanic ash. The Orella Member consists of pale brown, brown, and brownish-orange volcaniclastic overbank clayey siltstones and silty claystones, brown and bluish-green overbank sheet sandstones, and volcanic ash. Occasional thick fine- to medium-grained channelized sandstones occur throughout the Orella Member. These sandstones appear to have limited lateral extent. The majority of the Brule Formation present at the NTEA consists of the Orella Member; the entire "brown siltstone" member and most of the Whitney Member have been eroded. Locally, the Brule Formation serves as an aquifer. A reasonable estimation of hydraulic conductivity for the Brule Formation, which is predominantly siltstones and claystones, may be 10^{-7} m/s or 0.028 ft/d (Freeze & Cherry, 1979).

The Chadron Formation consists of the Upper Chadron, Upper/Middle Chadron, Middle Chadron, and Basal Chadron formations. The Upper Chadron and Upper/Middle Chadron formations are primarily composed of volcaniclastic overbank silty claystones interbedded with tabular and lenticular channel sandstones, limestones, calcretes, marls, volcanic ashes, and gypsum (Terry & LaGarry, 1998). The upper part of the Upper Chadron Formation is light green-gray bentonitic clay grading downward to green and frequently red clay, though interbedded sandstones also occur. These interbedded sandstones are not water-bearing. The Upper/Middle Chadron Formation is typically very fine- to fine-grained, well-sorted, poorly cemented sandstone. This sandstone, also, is not water-bearing. The Middle Chadron Formation is described as a clay-rich interval that grades from brick red to gray in color with interbedded bentonitic clay and sands. A light green-gray "sticky" clay in this unit serves as an excellent marker bed. The Middle Chadron Formation is composed of bluish-green, smectite-rich mudstone and claystone. The Middle Chadron Formation is the thickest member of the White River group, and ranges from about 200-300 feet thick within the NTEA. This formation is the primary confining layer to the Basal Chadron Formation.

The Basal Chadron Formation is the oldest unit in the White River Group. The lower portion is a coarse-grained, arkosic sandstone with frequent interbedded thin silt and clay lenses of varying thickness and continuity that lies on a marked regional unconformity with the Pierre Formation. Occasionally, the Basal Chadron Formation grades upward to fine-grained sandstone containing varying amounts of interstitial clay material and persistent clay interbeds. The greenish-white channel sandstones of the Basal Chadron Formation are the focus of CBR's ISL uranium mining activities.

CBR performed a pumping test in 2006 to determine if there was adequate isolation between the Brule Formation and the Basal Chadron Formation (i.e. no fractures exist that could transmit a significant amount of water between the two aquifers). Please see responses to Comment (3) regarding the results of the 2006 pumping test.

Although the region is tectonically active (as evidenced by the continued Black Hills Uplift), all stratigraphic units within the NTEA are well-correlated southward across the White River fault/fold structure with no apparent offsets or truncated units on the north limb of the fold structure, with the exception of the Upper/Middle Chadron (correlated to the lower portion of the Big Cottonwood Creek Member as described by Terry & LaGarry, 1998). Please see responses to Comment (1) regarding structural interpretations of the area, and fracturing/faulting of the White River Group.

7) ***Crow Butte has not established the continuity of the Pierre as a lower confining unit.***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

The Pierre Formation is part of the Montana Group, and is extensively exposed throughout the Northern Great Plains (Martin et al., 2007). It is a thick, homogeneous black marine shale with low permeability and represents the most laterally extensive formations of Northwest Nebraska. Local logging data indicate that the Pierre Formation ranges in thickness from 1,327 to 1,565 feet in the NTEA.

Prior to 1980, seven deep oil and gas wells were drilled in the vicinity of the NTEA: Johnson, Ostermeyer, Pinney 1, Leeling 1, True-State, Soester-Wulfoil, and Heckman No. 1. The entire Pierre Formation in the vicinity of the NTEA can be observed in geophysical logs from three of the seven nearby abandoned oil and gas wells (Heckman No. 1, Soester-Wulfoil, and Leeling 1), as these wells were completed through the entire thickness of the unit. These wells do not identify any faulting within the Pierre Formation.

Please refer to the last paragraph of Item (1) regarding potential faulting of the Pierre Formation.

8) ***Crow Butte has not shown that the White River fault, tectonic movements and/or nearby drilling of other wells will not cause increased movement of water between the aquifers. Crow Butte has not shown that the White River fault will not cause communication between the mined aquifer and the overlying aquifer and the White River.***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

No matter how the formations may be moved by seismic events, CBR must maintain hydraulic control over the site in accordance with its UIC permits. If hydraulic control is not maintained, injection associated with mining must cease, and restoration/remediation activities must begin.

9) ***Crow Butte's [NRC] License Amendment Application does not accurately describe the environment affected by its proposed mining operations or the extent of its impact on the environment as a result of its use and potential contamination of water resources, through mixing of contaminated groundwater in the mined aquifer with water in surrounding aquifers and drainage of contaminated water into the White River.***

The Department has not provided comments on the License Amendment Application submitted to the federal Nuclear Regulatory Commission. For the Department's response regarding CBR's use and potential contamination of surface and groundwater, see response to Comment (5).

10) ***The application does not take into consideration current and future use of water from the Basal Chadron in the area surrounding the NTEA.***

Please see Comments (1) and (2). The Petition for Aquifer Exemption submitted by CBR discusses the use of the aquifer as an underground source of drinking water. Within the area proposed for exemption, there are 11 active wells. All of these wells are completed within the Brule Formation and are used for domestic or agricultural (i.e. livestock watering) purposes. The Brule Formation is hydraulically isolated from the underlying Basal Chadron Sandstone by up to 500 feet of low-permeability claystones and siltstones. There are no active water supply wells completed in the Basal Chadron Sandstone within the area proposed for exemption.

In regard to future potential use of the Basal Chadron, please see Comment (2).

11) ***CBR refuses to use the correct scientific name for the Basal Chadron which is the "Chamberlain Pass Formation."***

Please see the first paragraph in response to Comment (2) in regard to stratigraphic nomenclature.

12) ***CBR has failed to include recent research which shows that incorrect overestimations of geology mapping of between 40-60% using the "layer cake" concept applied by pre-1990s workers.***

The differences in geologic mapping of units between pre-1990s workers and post-1990s workers has been accounted for by correlating historical nomenclature with the more modern terms applied to stratigraphic sections in this region. Please see Comment (1), (2), and (3) regarding geologic interpretations.

13) ***Crow Butte's spill contingency plan does not adequately addresses non-radiological contaminants.***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

At their current facility, CBR installs protective berms and dams around Squaw Creek and English Creek to minimize the potential for a spill of mining, process, or restoration solutions from impacting the creeks. These berms and dams are routinely maintained and inspected to ensure their integrity and protect the surface water in the permit area. The current permit for in-situ recovery (Permit Number NE0122611) requires corrective action for any lixiviant movement that may impact waters of the State (surface water and groundwater).

The Nebraska State Fire Marshal regulates both above ground storage tanks and underground storage tanks for fuel (Title 158 and Title 159 respectively). The Office of Emergency Management of the U.S. Environmental Protection Agency (EPA) requires Spill Prevention, Containment, and Countermeasures, along with a Facility Response Plan.

14) ***Crow Butte's characterization that the impact of surface waters from an accident is "minimal since there are no nearby surface water features," does not accurately address the potential for environmental harm to the White River.***

The Department recognizes this is an environmental concern in the scope ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

The NTEA is drained by the White River, which flows northeast along the southern boundary of the area proposed for exemption. Spring Creek flows west to east through the northern portion of the NTEA. Little Cottonwood and Sand Creeks flow from west to east to the north of NTEA, where they join the White River. Squaw, English, and White Clay Creeks flow into the White River south of the NTEA. Deadman's, Cherry, and

Bozle Creeks are all located outside the NTEA and flow northward toward the White River. If mining activity is permitted, these surface water bodies will be protected from an accidental spill of mining, process, or restoration solutions through the use of berms and dams, similar to what is used at their currently operating facility. Please see response to Comments (13) regarding current operations, and Comment (29) regarding water quality of the White River.

15) ***The Basal Chadron aquifer, where mining occurs, and the aquifer which provides drinking water to the Pine Ridge Indian Reservation, communicate with each other, resulting in the possibility of contamination of the potable water.***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

Please see the response to Comment (3) regarding the communication between the upper drinking water aquifer (Brule Formation) and the lower production zone aquifer (Basal Chadron Formation). The Arikaree Group is not present within the proposed boundary.

16) ***The Basal Chadron (proposed to be exempted) is currently used as a source for drinking water.***

Please see response to Comment (1) regarding the current use of the Basal Chadron Formation water within the NTEA.

17) ***It is premature to rule on the aquifer exemption because the Crow Butte Intervenors in the NRC proceedings are litigating these issues now.***

The proceeding before the United States Nuclear Regulatory Commission (NRC), Atomic Safety and Licensing Board Panel, Docket No. 40-8943, ASLBP No. 07-859-03-MLA-BD01, involves an application by CBR to amend its current NRC license to operate an ISL uranium recovery facility in Crawford, Nebraska to allow the development of a satellite ISL uranium recovery facility, the NTEA. The NRC proceeding is being

conducted pursuant to the Federal Atomic Energy Act of 1954, 42 U.S.C. §2011 et seq. This aquifer exemption proceeding before the Department is being conducted pursuant to the Federal and State Safe Drinking Water Acts, 42 U.S.C. §300f et seq. and Neb. Rev. Stat. §71-5301 et seq. respectively, and the Underground Injection Control Program administered by the Department pursuant to a delegation of authority from the EPA. The NRC and the Department proceedings are separate both jurisdictionally and substantively, even though both cover the same temporal NTEA. While the approval of both agencies is required before ISL uranium mining can occur in the area, the decision of each agency is completely independent of the other. The decision to exempt an aquifer rests squarely with the Department.

18) ***Any decision on an aquifer exemption should be after an adjudication of the issues before the ASLBP in the Expansion Proceeding and the Renewal Proceeding.***

The decision to exempt an aquifer must satisfy the criteria in Title 122, Chapter 5. The Department has made a preliminary determination that the basal and middle members of the Chadron Formation proposed for exemption do not currently serve as a source of drinking water and cannot now and will not in the future serve as a source of drinking water because it is mineral-bearing with production capability and it would be economically or technically impractical to render that water fit for human consumption. This decision to exempt an aquifer can be made independently and regardless of whether a license is issued to allow ISL uranium recovery to occur in the future. If the aquifer exemption were not granted, however, the expansion of ISL uranium mining could not occur. Please refer to Comment (17) for additional information.

19) ***The Basal Chadron aquifer will in the future serve as a source of drinking water, especially as potable drinking water becomes more scarce and more valuable due to insufficient recharge rates in aquifers, climate change, and increased usage of water resources by the public, and as water filtration technologies continue to improve and make processing of brackish water cost-effective.***

Please see response to Comment (2) regarding the economic and technologic practicality of treating Basal Chadron Formation water for use at individual homes.

20) ***The Basal Chadron is not so contaminated that it would be economically or technologically impractical to render that water fit for human consumption.***

Please see response to Comment (2) regarding the economic and technologic practicality of treating Basal Chadron Formation water for use at individual homes.

21) ***Crow Butte Resources, Inc., as a wholly-owned subsidiary of a Canadian company, Cameco, Inc., is a foreign controlled entity. This foreign corporation owns real property despite the fact that Nebraska law prohibits a foreign corporation from owning real property.***

According to records filed with the Nebraska Secretary of State, CBR is a domestic corporation authorized to do business and in good standing with the State of Nebraska. The company's principal office is located in Cheyenne, Wyoming and it maintains a registered agent in Crawford, Nebraska. As a domestic corporation, CBR meets the definition in Title 122 of a person who may apply for an Underground Injection Control permit and petition for an aquifer exemption. The Secretary of State's good standing presumes propriety on this point. The fact that CBR is a wholly owned subsidiary of Cameco, Inc. is not relevant to this aquifer exemption proceeding. Neb. Rev. Stat. §76-402 restricts aliens and foreign corporations acquiring or holding interest in real property in Nebraska. The commenter provided no evidence to support its assertion that Cameco, Inc. owns any property in Nebraska.

22) ***The Nebraska Attorney General investigated and ruled that CBR was in violation of the alien ownership prohibition.***

The Department is aware of only one investigation of alien ownership in relation to the Crow Butte mine having been conducted by the Nebraska Attorney General. In September 1989, the Attorney General determined that Ferret Exploration Company of Nebraska, Inc. was in violation of the Nebraska Alien Ownership of Land Act. After Ferret restructured its board of directors and ownership of shares, the Attorney General concluded that the company had come into compliance with the Nebraska Alien Ownership of Land Act.

Current listing by the Secretary of State for the petitioner, CBR, indicates the corporation is in good standing.

23) ***The NE Attorney General: (1) caused the Dawes County Attorney to commence forfeiture proceedings where the mineral leases were located pursuant to Neb. Rev. Stat. Section 76-048; (2) caused the NE Secretary of State to commence an action to forfeit CBR's corporate charter and dissolve Applicant and its subsidiary; and (3) caused the Nebraska Department of Environmental Control (NDEC) to cease any processing of CBR's permits related to the then-proposed ISL mine in Crawford, NE.***

The Nebraska Attorney General issued a press release dated September 18, 1989 which provided information regarding a review by that office of allegations made by Western Nebraska Resource Council including violation of alien property ownership laws. The press release reported the Attorney General had found that a majority of both the stockholders and board of directors of the Ferret Exploration Company of Nebraska, Inc. (FEN) appeared to be aliens under the state law. The press release also indicated that the Attorney General's office would be contacting the County Attorney to ask forfeiture proceedings to begin in counties in which FEN held mineral leases, contacting the Secretary of State to begin an action to forfeit the corporate charter for FEN and its wholly owned subsidiary Crow Butte Land Company, and requesting that the Department of Environmental Control delay issuing any permits for the mine.

In a subsequent press release dated January 29, 1990, however, the Attorney General's office reported that FEN and Crow Butte Land Company, Inc. were no longer in violation of the alien ownership laws because of recent changes in the board of directors and stockholders of the corporations such that a majority were American citizens. In addition and as a consequence, the Attorney General no longer believed that forfeiture proceedings, dissolution of the corporation or delay in the permitting process were necessary and would be informing the Dawes County Attorney, Secretary of State, and Department of Environmental Control of this decision.

24) ***CBR and its shareholders changed the share ownership structure to satisfy the expressed concerns of the NE Attorney General.***

As previously mentioned in Comments (22) and (23), the press release issued by the Nebraska Attorney General on January 29, 1990 reported that recent changes in the board of directors and stockholders of both FEN and Crow Butte Land Company, Inc. resulted in compliance with Nebraska law. Those events related to FEN and Crow Butte Land Company, Inc. are too remote to bear on this aquifer exemption. As noted, current listing by the Secretary of State for the petitioner, CBR, indicates the corporation is in good standing.

25) ***A foreign corporation appoints all the directors of Crow Butte in violation of the Nebraska Alien Ownership Act.***

Neb. Rev. Stat. §76-406 only prohibits the election of aliens as members of a corporation's board of directors or board of trustees in numbers sufficient to constitute a majority of such board or election of aliens as executive officers or managers. As noted previously, current listing by the Secretary of State for the petitioner, CBR, indicates the corporation is in good standing. This presumption of corporate propriety is reinforced by the lack of evidence that aliens comprise a majority of the Board of Directors for CBR.

26) ***Every time it rains, contaminants that enter into the river alluvium of the White River get pushed down toward the Pine Ridge Indian Reservation, which is 30 miles away from the proposed exemption site.***

The Department recognizes this is an environmental concern in the scope ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

No contamination from CBR activities within the NTEA is anticipated to enter into the White River. CBR's Class III permit (NE0122611) prohibits any discharge of mining, process, or restoration fluids, or any other liquid waste stream to surface water. Liquid waste must be disposed of either in the Class I deep disposal well or the evaporation pond.

27) ***There are many technological methods available to treat water for high TDS and make it a potential source of drinking water. Just because it is outside of current drinking water standards doesn't mean that a cost effective solution doesn't exist to use that water.***

Please see response to Comment (2) regarding the economic and technologic practicality of treating Basal Chadron Formation water at individual homes.

28) ***The Arikaree Formation was not present on the map shown by NDEQ. The baseline hydrological map from 1982 shows in this project area there are a dozen wells into the Arikaree Formation.***

In the original Class III Application for the commercial phase of the currently operating ISL uranium mine, four (4) wells completed in Arikaree formations were identified within the area of review. However, none of these wells were within the permit boundary. The Arikaree Group is absent within the NTEA. The Arikaree Group would overlie the Brule Formation, which is composed, from youngest to oldest, of the "brown siltstone" member, the Whitney Member, and the Orella Member. Within the NTEA, all of the "brown siltstone" member and most of the Whitney Member have been eroded. Please see responses to Comment (6) regarding stratigraphy within the NTEA.

29) ***In the time period CBR has been in operation, the White River has changed from white to a dark green color and the fish in it have boils and bubbles on their skin.***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

The Department has had an ambient surface water monitoring network in place since the early 1970s to monitor the water quality of surface water bodies across the state. The primary objective of the ambient stream network is to provide long-term information on the status and trends of water quality in rivers and streams within Nebraska.

The Department collects water samples of the White River at three locations: one in the Crawford City Park (Lat. 42.68663, Long. -103.41772); one upstream of Fort Robinson approximately 2 miles (Lat. 42.6277, Long. -103.51752) ; and one northeast of Chadron, approximately 2 miles from the South Dakota border (Lat. 42.94828, Long. -102.90054). The water samples are collected once a month. Temperature, oxygen, pH, conductivity, turbidity, and flow are measured in the field. The samples are sent for laboratory analysis for: total suspended solids (TSS), chloride, ammonia, nitrate-nitrite, Kjeldahl nitrogen, and total phosphorus. Water samples collected April through September are analyzed for pesticides (Atrazine, Acetochlor, and Metolachlor) in addition to the abovementioned parameters. Each quarter (four times a year) the surface water samples are analyzed for metals including: total selenium, total mercury, sodium, magnesium, calcium, arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc.

On a six-year rotation, rivers, streams, and lakes from two or three river basins each year are more intensively monitored. This "basin rotation network" monitoring provides the quality and quantity of data necessary to effectively characterize and evaluate surface water quality across Nebraska. Data from this network also adds to the database for watershed assessments including the status and trends of water quality in rivers, streams and lakes. In 2008, the White-Hat-Niobrara basin was monitored under the basin rotation program. In 2011, the White-Hat basin will again be monitored under this program.

The Department also has a fish tissue monitoring program and a stream biological monitoring program. The objective of the fish tissue monitoring program is to assess toxic pollutant trends, identify potential problem areas, and assess the suitability of fish for human consumption and issue fish consumption advisories. The stream biological monitoring program is in place to evaluate the health of aquatic life populations and make beneficial use support statements using a unique randomized sample design that allows for water quality status and trend assessments to be determined with a known level of confidence.

None of the data gathered by the Department through these rigorous surface water sampling programs substantiates the commenter's claim of color change and fish distress in the White River.

30) ***By the 1903 Winters Doctrine, Supreme Court law, the Native Americans of the Pine Ridge Indian Reservation own the water underneath and adjacent to the reservation.***

The Winters Doctrine is an expression of the right of inhabitants of a federally created Indian Reservation to have water sufficient to support the activities occurring on the reservation. The doctrine relates to both quantity and quality of water. The commenter's concern in this instance is groundwater quality. For reasons expressed in the process description in Comments (5) and (39), we conclude that contents of the exemption area will not reach the reservation, and consequently will not interfere with uses protected under the Winters Doctrine.

31) ***In the Arikaree Aquifer, CBR had some accidents. There was a crack in a PVC pipe coupling that admitted 1 gallon per minute of lixiviant for two years into the Arikaree formation. The lixiviant will do the same thing in the Arikaree as it does in the Basal Chadron. It's going to contaminate the Arikaree with heavy metals and circulate that water down-gradient.***

The event described in this comment involved a leak in injection well I-196 that was identified on March 29, 1996. During this event, lixiviant (mining fluid) went into the Brule Formation through a leak in the well casing if I-196 (an injection well), which constituted a violation of CBR's Class III UIC permit NE0122611. The facility calculated that approximately 300,000 gallons of fluid would have flowed down that well between the time the well was last tested for mechanical integrity and the time the leak was discovered, based on operation records. Not all of the calculated 300,000 gallons would have escaped the well through the leak and impacted the Brule Formation. Most of the fluid would have taken the most conductive path, which is down the well and into the intended injection zone.

On April 23, 1996, CBR sent a letter to the Department providing information about the leak, and describing the remediation efforts undertaken by CBR. The Department set up a delineation drilling and recovery process to determine where the fluids had moved. As part of the CBR-initiated remedial response effort, 16 wells were drilled radially from the

well: four in each cardinal direction, spaced 50 feet apart. These wells were sampled to determine if lixiviant had impacted the Brule Formation. Based on water quality samples, the lateral extent of the affected area was less than a 100 ft from the well. On May 28, 1996, CBR submitted an update to the Department on the drilling and recovery process. During the recovery process, the 16 wells were repeatedly evacuated to dryness, recovering 100,000 gallons over the course of the three-year drilling and recovery program.

The assistance of the University of Nebraska – Lincoln Conservation & Survey Division (CSD) was enlisted to determine whether the remedial response to the situation was appropriate and consistent with the general hydrogeologic nature of the Brule Formation. In their review, CSD looked at all of the technical documents submitted to the Department between the April 23, 1996 and October 24, 1996 concerning the contaminated area of the Brule Formation associated with the leak from I-196. They concluded, based on water quality data and geologic information, that the response was appropriate. The Brule Formation, which consists primarily of siltstone, is an aquitard with relatively low hydraulic conductivity in most area. Although the Brule Formation can have localized zones of higher hydraulic conductivity (channel sands and fracture zones), none of the data from the contaminated area suggests that higher conductivity type material is present at this site. The CSD performed research on the Brule Formation at other sites, where they noted that vertical hydraulic conductivity can be much less than horizontal hydraulic conductivity. As a consequence, migration of fluid through the Brule Formation is even slower in the vertical direction. On August 19, 1999, the Department determined the area was returned to baseline conditions, and the remediation activities associated with this leak were ceased.

The Arikaree Group is not present in the proposed NTEA. ISL uranium mining leaves the majority of other contaminants (e.g. heavy metals) where they naturally occur instead of moving them to waste dumps and tailings ponds where their presence is of more environmental concern. Furthermore, operating on a bleed (i.e. pumping out more fluid than what is injected) maintains hydraulic control over the wellfields, keeping the mining fluids from migrating horizontally. Therefore, the fluids will not be able to affect areas outside the permitted area.

32) ***A 30-foot well 100 feet from the White River that has been in use since the '80s was recently tested for uranium and the result was 45.9 ppm. The drinking water standard for uranium is 15 ppm. What affect does this have?***

It does not appear that this well is within the area of review associated with the Petition for Aquifer Exemption.

In 1976, the EPA promulgated the National Interim Primary Drinking Water Regulations for radium-226 and -228, gross alpha particle radioactivity and beta particle and photon radioactivity. In 2000, EPA established the National Primary Drinking Water Regulations and maximum contaminant levels (MCLs) for radionuclides, including uranium. The MCL for uranium was set at 30 ppb (0.03 ppm, or mg/l), a level that maximizes health risk reduction benefits at a cost that is justified by the benefits.

This level was determined to correspond to a "drinking water equivalent level" with respect to kidney toxicity for a lifetime exposure. The EPA determined a MCL of 30 ppb was sufficient to protect the public from kidney toxicity and carcinogenicity (risk of developing cancer) due to uranium.

In regard to the potential for mining activities affecting drinking water or the White River, please refer to Comments (3), (6), (7), and (29).

33) ***How can it be that the City of Crawford is between the currently operating CBR uranium mining facility and the proposed North Trend Expansion Area (NTEA) mining facility, and it is not exempt?***

Uranium is one of the most abundant elements found in Earth's crust, and it can be found almost anywhere – from soils and rocks to rivers and oceans. It is slightly more abundant than tin and 40 times more abundant than silver. The uranium that is found in Nebraska was once a part of volcanic ash in the Rocky Mountains, Wyoming, southern South Dakota, and western Nebraska. The ash was eroded by water and altered to clays. During this process, the uranium was released from the ash and incorporated into the groundwater. Over the course of thousands of years, the uranium traveled in groundwater through aquifers to a low oxygen zone. When the oxygen was depleted

from the groundwater, the uranium attached to the sand grains, creating what is called a roll-front deposit of uranium.

The roll-front deposit identified north of Crawford as the NTEA is the part of the same deposit southeast of Crawford and currently mined by CBR. This uranium deposit is not laterally extensive, and water quality outside the orebody may be suitable for use as drinking water. There may be uranium in the Basal Chadron Formation underneath the City of Crawford. The City of Crawford gets its drinking water from areas outside the identified orebody. The majority comes from an infiltration gallery near Fort Robinson State Park and the supply is supplemented with a wellfield approximately 1.5 miles south of the City. The infiltration gallery collects water from surficial alluvium overlying the Brule, and the wellfield draws water from the Brule.

An Aquifer Exemption would only be granted for the portion of the aquifer under the City of Crawford upon request by Petition, and if it met the criteria listed in Title 122 Ch. 5. No such request has been made.

34) ***The pumping test performed by CBR for the NTEA, performed at a pumping rate of 49 gpm for 7 days, was not sufficient to determine whether the water supply of Crawford will be affected. In their application, the mine says it will use 4,000 gpm, up to 9,000 gpm.***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

According to the NTEA Class III UIC application, injection of solutions for mining will be at a rate of 4,500 gallons per minute (gpm) with a 0.5 to 1.5 percent "bleed" stream. This means that the process will pump 0.5 to 1.5 percent more water than it injects. The amount of water used is significantly different from the amount of water consumed in the process, since most of the water pumped out of the aquifer is returned via injection. The 0.5 to 1.5 percent of the production flow that is not re-introduced to the aquifer is the amount of water that is consumed by the process of ISL uranium solution mining. Using an average consumption of 1% of the 4,500 gpm injected, the total amount of water

consumed in the process is 45 gpm. Therefore, performing the pumping test at 49 gpm is an appropriate approximation of the total amount of water consumed in the process of ISL uranium solution mining.

35) ***There is the potential for mixing of groundwater between where they mined or want to mine and the Pine Ridge Reservation.***

Please see responses to Comments (1), (3), (5), and (39) regarding the potential for groundwater mixing.

36) ***Cameco cherry-picked geological information favorable to what they wanted to do at NTEA, and did not use all the available information regarding recent geologic interpretations. There has not been a thorough analysis of all existing information.***

Geologic interpretations from several sources were used to determine the stratigraphy of the NTEA. Please see the response to Comments (1) and (3) regarding the review of geologic data and interpretations presented in the petition for aquifer exemption and the Class III UIC application for the NTEA.

37) ***Not all the concerns about uranium have been resolved. Crow Butte has not been in compliance for the entirety of its operation. Cameco has had to pay $100,000 to the State of Nebraska because of license violations. There have been at least 30 leaks and spills at Crow Butte, one of them for three years. What happened to that 300,000-gallon spill? It was previously documented that only 100,000 gallons of it could be recovered.***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

In 2008, the State of Nebraska settled an enforcement case against CBR for technical violations of CBR's UIC permit relating to management of well development water at the individual wellheads. The well development water had been allowed to infiltrate on the

ground surface adjacent to the well and no pollution resulted from the practice. The Court assessed a $50,000 civil penalty and CBR paid $50,000 to the Attorney General's Environmental Protection Fund to be used for environmental safety, training, public awareness, and related uses.

Please see response to Comment (31) regarding the specific events surrounding the leak of well I-196.

38) ***Cameco also has had to pay Wyoming for environmental degradation, and who's to say they won't degrade the environment here in Nebraska?***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

The Department has not researched potential Cameco violations in other jurisdictions. CBR's UIC permit number NE0122611 requires corrective action for any release of mining, process, or restoration fluid into an unauthorized area. Furthermore, well construction, mechanical integrity testing, and monitoring requirements provide protection against any environmental degradation. Similar requirements would be in place for any activities associated with uranium mining at the proposed NTEA.

39) ***CBR has to show us their radioactive water isn't going to Pine Ridge.***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

The ISL process of uranium recovery consists of an oxidation step and a dissolution step. Oxygen or hydrogen peroxide is used to oxidize the uranium, and a carbonate species (essentially baking soda) is used for dissolution. The uranium bearing solution resulting from this recovery is pumped from the wellfield and the uranium is extracted in the process plant. A slightly larger quantity of fluid is pumped out of the aquifer than what is injected. This is called a production "bleed". Removing more fluids than what is

injected creates a cone of depression around the mining area and keeps the fluids from migrating horizontally out of the permitted area.
Aquifer testing performed by CBR indicates the aquifer is not hydraulically connected to overlying aquifers. Please see the response to Comment (3).

40) ***There hasn't been an ISL uranium mine cleaned up anywhere in the world.***

The Department recognizes this is an environmental concern in the scope of ISL uranium mining; however, the mining operation is a separate issue from the decision to exempt a portion of an aquifer.

Several ISL sites have been restored in Texas and released back to landowners. In 2009, the USGS published an open-file report (Hall, 2009) addressing widespread assertions that "groundwater has never been returned to baseline at any [ISL] mine". This report compared the average value, post-restoration value, and baseline ranges of chemical constituents for 22 wellfields that have post-restoration analyses in 36 ISL uranium mines Texas. Ninety-five percent of Texas wellfields exhibited baseline values for uranium above the EPA MCL of 0.03 mg/l. Eighty-six percent of these wellfields show a final restoration value for above the EPA MCL, and 32% of these wellfields were below the established pre-mining baseline value for uranium.

The EPA drinking water MCL for radium is 5 pCi/L. All of the 22 Texas wellfields examined in the 2009 USGS open-file report had baseline and post-restoration radium concentrations above this MCL. After mining and restoration, 96% of the wellfields were below the established baseline radium concentrations.

Overall, in Texas, ISL mines are characterized by high baseline arsenic, cadmium, lead, selenium, radium, and uranium. After mining and restoration, for those wellfields that reported final values to the Texas Commission on Environmental Quality, more than half of the wellfields had lowered levels of many elements, including some that dropped below MCLs.

41) ***How will the citizens become aware of all this information?***

The petition for an aquifer exemption regarding the NTEA, the associated Class III underground injection control application, correspondence regarding these documents, a transcript of the public hearing, and the responses to comments received are available upon request from the Department. In addition, an electronic copy of the transcript and responses to comments received regarding the Department's preliminary decision to exempt a portion of the Chadron Formation will be available on the NDEQ website. The Department will notify all commenters of the final decision on the aquifer exemption and provide a copy of this response to comments.

42) ***Nebraska should not grant an aquifer exemption because the discussion of groundwater mixing in the area proposed for exemption has not been resolved.***

Please see response to Comments (1), (3), (5), and (39) regarding the potential for comingling of Brule and Chadron formation waters in the area proposed for exemption.

43) ***Crow Butte Resources, Inc. was not aware of all the wells in the area of review.***

CBR has performed a thorough water well inventory as part of their Petition for Aquifer Exemption for the proposed NTEA. CBR contacted well owners to confirm the status of those wells. A comprehensive list of active, inactive, and abandoned water wells in the NTEA area of review can be found in the NTEA petition for aquifer exemption.

44) ***It does not make sense to remove from any possible use water that could be needed in the future, given the growing scarcity of water.***

As a point of clarification, an exempted status for an aquifer means that the aquifer is no longer protected under the Safe Drinking Water Act, and its use for drinking water is not advised. Water can be used post-mining, but the water will not be protected to the drinking water standards of the Safe Drinking Water Act. The Upper Niobrara-White Natural Resources District also retains the right to impose restrictions on use based on their groundwater management plan. Currently, the Basal and Middle Chadron formations are exempted in the current mining area, which comprises approximately 2745 acres, or 4.3 mi^2.

45) ***Is there any data and information available from Crow Butte that we can see in the interest of transparency, totally open public information being provided, not what the company wants us to hear?***

All documents submitted to the Department are available to the public in accordance with the Public Records Act, Neb. Rev. Stat. §84-712 et seq., unless those documents are entitled to confidential protection as described in the Act.

46) ***What is the economic benefit to Crow Butte? What is the economic benefit to Dawes County, to Crawford? Is that benefit worth placing any water out of potential use?***

The Department recognizes this is an economic concern in the scope of ISL uranium mining and community sustainability; however, the mining operation and economic concerns are separate issues from the decision to exempt a portion of an aquifer and have no bearing in the decision to exempt a portion of the aquifer.

Please refer to Comments (2) and (44) in regard to taking water out of potential use.

47) ***What can be done about contamination of aquifers that are next to the one proposed for exemption? How can it be reclaimed? How can it be rectified? Once it's contaminated it is contaminated. If this company has to come before a board and a group of people to get this exemption and if there is contamination, the people are just out of luck. There is no rectification for it.***

If any of the drinking water aquifers (the Brule and portions of the Basal Chadron not included in the proposed aquifer exemption) become contaminated, CBR will be required to immediately begin remediation efforts to clean up the aquifers. If the portions of the Basal Chadron aquifer adjacent to the proposed exemption boundary become contaminated, that means that CBR has not maintained hydraulic control over the site. If hydraulic control is not maintained, injection associated with mining must cease, and restoration/remediation activities must begin.

Under the Class III permit currently held by CBR, Permit NE0122611, Part II, A. 2., CBR is required to have no more than five mine units in the mining stage at any given time, no more than five mine units in restoration (excluding those in stabilization) at any given time, and no more than three mine units constructed in advance of the active mining. These limitations ensure that CBR initiates restoration before adding mine units to the active mining phase.

At its currently operating facility, CBR has provided a financial assurance document to cover the costs of: the proper closing, plugging, and abandonment of wells; the proper disassembly, decontamination, and restoration of the aquifer site; any post-operational monitoring as may be required by the Environmental Protection Act, and Title 122 – Rules and Regulations for Underground Injection and Mineral Production Wells, and its permit; and additional estimated costs to the State which may arise from applicable oversight requirements. This financial assurance document is updated annually to account for future planned activities of the facility and the cost of inflation. The current amount of financial assurance held for the facility is $35,248,294.00. A financial assurance instrument will be required for the proposed NTEA mining operations. If CBR would be unable to complete restoration, plugging and abandonment, and reclamation of the site, the State of Nebraska would draw on the financial assurance instrument to perform the appropriate site clean-up activities.

48) ***Research has shown that there is a network of faults and fractures in Western Nebraska, and this network is visible from outer space. Radar images that include the area proposed for exemption show faults and fractures in the earth's crust visible from space, including large ones that travel down the White River, which follows a fault, and the same fault and network of faults that are interconnected could potentially transmit liquids in them directly to Chadron, the Pine Ridge, and to anywhere these faults form a connected network. These faults extend downward for hundreds of feet and extend laterally for miles.***

Please see response to Comments (1) and (3) regarding the confinement of the proposed injection zone.

49) ***Very inexpensive work could be done that would answer for once and for all if such contaminants were getting into the environment, and if they were, where they were going. There are several technologies that would make it easy to mitigate contamination.***

The Department recognizes this as an environmental concern in the scope of the ISL uranium mining; however, mining operations are a separate issue from the proposed aquifer exemption.

The current mining operation southeast of Crawford is permitted under Permit Number NE0122611. CBR employs a rigorous monitoring program (Permit NE0122611, Part II.B.; Part III.) to detect the unintended movement of mining fluid within the permitted boundary. Monitoring wells within the permitted boundary are sampled every two weeks. These samples are analyzed for chloride, conductivity, and alkalinity concentrations to identify any unintended movement of mining fluids. These parameters were chosen as the monitoring parameters for excursions because they move through the subsurface faster than other constituents (Potter et al., 1979). The Department feels that chloride concentrations, specifically, provide an adequate indicator of how fluids move in the subsurface because chloride ions are conservative. Chloride has been used as a conservative tracer in environmental studies for decades because it is not removed or supplied significantly by reaction with rocks or sediment, and it is not precipitated as salt until very high salinities are reached. Some sources of chloride in the subsurface are anthropogenic (i.e. road deicer), and must be accounted for when considering the use of chloride as a conservative tracer in shallow environments.

A similar monitoring program has been proposed for the NTEA satellite mining facility.

50) ***None of the geologic work done by LaGarry has been used in discussions about whether or not there were contaminants leaking out of the mining operation.***

Although Dr. LaGarry's maps were not expressly used, other methods were employed to determine if there was any hydraulic connection between the Brule and the Basal Chadron formations. Please see the response to Comments (3), (6), and (7) regarding

the 2006 pumping test performed by CBR and the confinement of the proposed injection zone.

51) ***Will the transcript be available to everybody?***

The transcript is available on the Department webpage in its entirety.

52) ***Is the PowerPoint presentation by NDEQ available?***

The PowerPoint presentation made by the Department at the Aquifer Exemption public hearing on August 23, 2010 is available on the Department webpage in its entirety.

53) ***All of the diagrams in the information session are dated 2008. Has anything happened since 2008? Do any of the maps or graphs or the well drillings et cetera represent a current situation?***

The maps and diagrams at the information session were dated 2008 because that was when the application was submitted. No additional drilling has occurred in the proposed NTEA to date.

54) ***Why was the announcement of the hearings not dated by NDEQ? There was a press release but that was even later, and the time for comments was extended from August 10th to August 23rd. It would be more helpful if somehow the information of these hearings and the time for responses is made more widely available.***

Please see the response to Comment (4) for more information regarding the public notice and the press release associated with the Department's preliminary decision to exempt a portion of the Chadron aquifer.

55) ***Regarding potential contamination pathways, have the concerns been addressed by CBR? What were the responses? How can the public learn of the responses to the eight suggestions specifically made by Dr. LaGarry?***

The eight suggestions made by Dr. LaGarry were made during a Nuclear Regulatory Commission (NRC) hearing. This information was not submitted to the Department.

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