CBR-074

September 28, 2015

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	Docket No. 40-8943
CROW BUTTE RESOURCES, INC.	)	
	)	ASLBP No. 08-867-02-OLA-BD01
(License Renewal)	)	

SUPPLEMENTAL REBUTTAL TESTIMONY OF CROW BUTTE RESOURCES

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EXPERT WITNESSES

A. Wade Beins

Q1. Please state your full name, your employer, and your position.

A1. Wade Beins (WB). I am employed as a Senior Geologist at Crow Butte. A statement of my professional qualifications and work experience were provided previously.

Q2. What is the purpose of your testimony?

A2. (WB) The purpose of my testimony is to respond to the issues and new exhibits raised at the recent oral evidentiary hearing and supplemental direct testimony.

Q3. What documents have you reviewed to prepare your testimony?

A3. (WB) I am fully familiar with the Crow Butte license renewal application ("LRA") and the NRC Staff review documents, including the Environmental Assessment ("EA") and the final Safety Evaluation Report ("SER"). I also have reviewed the testimony and exhibits in this proceeding.

B. Robert Lewis

Q4. Please state your full name, your employer, and your position.

A4. Robert Lewis (RL). I am the owner and Principal Hydrogeologist of AquiferTek LLC, providing specialized hydrogeologic and environmental consulting services. A statement of my professional qualifications and work experience were provided previously.

Q5. What is the purpose of your testimony?

A5. (RL) The purpose of my testimony is to respond to the issues and new exhibits raised at the recent oral evidentiary hearing and supplemental direct testimony.

Q6. What documents have you reviewed to prepare your testimony?

A6. (RL) I am fully familiar with the Crow Butte LRA and the NRC Staff review documents, including the Environmental Assessment EA and the final SER. I also have reviewed the testimony and exhibits in this proceeding.

C. Doug Pavlick

Q7. Please state your full name, your employer, and your position.

A7. Doug Pavlick (DP). I am employed by Cameco Resources as General Manager for U.S. Operations. A statement of my professional qualifications and work experience were provided previously.

Q8. What is the purpose of your testimony?

A8. (DP) The purpose of my testimony is to respond to the issues and new exhibits raised at the recent oral evidentiary hearing and supplemental direct testimony.

Q9. What documents have you reviewed to prepare your testimony?

A9. (DP) I am fully familiar with the Crow Butte LRA and the NRC Staff review documents, including the Environmental Assessment EA and the final SER. I also have reviewed the testimony and exhibits in this proceeding.

D. Matt Spurlin

Q10. Please state your full name.

A10. Matt Spurlin (MS). I am a Senior Hydrogeologist at ARCADIS. A statement of my professional qualifications and work experience were provided previously.

Q11. What is the purpose of your testimony?

A11. (MS) The purpose of my testimony is to respond to the issues and new exhibits raised at the recent oral evidentiary hearing and supplemental direct testimony.

Q12. What documents have you reviewed to prepare your testimony?

A12. (MS) I am fully familiar with the Crow Butte LRA and the NRC Staff review documents, including the Environmental Assessment EA and the final SER. I also have reviewed the testimony and exhibits in this proceeding.

E. Larry Teahon

Q13. Please state your full name, employer, and position.

A13. Larry Teahon (LT). I am employed by Crow Butte Resources as the Safety, Health, Environment, and Quality (SHEQ) Manager at the Crow Butte facility. A statement of my professional qualifications and work experience were provided previously.

Q14. What is the purpose of your testimony?

A14. (LT) The purpose of my testimony is to respond to the issues and new exhibits raised at the recent oral evidentiary hearing and supplemental direct testimony.

Q15. What documents have you reviewed to prepare your testimony?

A15. (LT) I am fully familiar with the Crow Butte LRA and the NRC Staff review documents, including the Environmental Assessment EA and the final SER. I also have reviewed the testimony and exhibits in this proceeding.

SUPPLEMENTAL REBUTTAL TESTIMONY

Q16. Can you briefly summarize your approach to the supplemental testimony?

A16. (All) Yes. In an Order, dated September 4, 2015, the Board directed that the parties limit their supplemental testimony to the following topics:

- Topic 1: Whether the water levels in the Brule aquifer have lowered due to mining activities;
- Topic 2: What is the available head in the Basal Chadron/Chamberlain Pass formation and the maximum anticipated drawdown during Crow Butte's operation and restoration of its mining facility;
- Topic 3: Whether the results from the four pump tests demonstrate a hydraulic connection between the Brule and Basal Chadron/Chamberlain Pass formations;
- Topic 4: Whether the Basal Chadron/Chamberlain Pass formation exists beneath the Pine Ridge reservation and its connection (if any) to the Basal Chadron/Chamberlain Pass formation beneath the license renewal area;
- Topic 5: To what degree (if any) do the additional exhibits affect the conclusions regarding the structure of the White River feature and the NRC Staff's maximum likelihood modeling; and
- Topic 6: To what degree (if any) do the additional exhibits illustrate the groundwater flow directions in the Arikaree and Brule aquifers underlying the Pine Ridge reservation and the license renewal area.

We addressed each of these topics in our supplemental direct testimony. In the paragraphs that follow, we address the NRC Staff's and intervenors' supplemental testimony and exhibits for each topic.

A. Brule Water Levels

Q17. In his testimony, Mr. Wireman states that "ground water levels in the Brule have not been adequately monitored" and that there are "far too few Brule monitoring wells to assess long term trends." Do you agree?

A17. (WB, LT, MS, BL) No, not at all. As we indicated during the evidentiary hearing, Crow Butte currently maintains in excess of 200 shallow monitoring wells in the Brule formation (approximately one well every four acres). Water level data is collected every two weeks for each of these wells for the entire time that the mine unit containing the monitoring well is in operation. As a result, there is a lengthy history of water level data for each of these wells and therefore for the entire mining area for the time that the mine has been in operation. *See, e.g.*, Exhs. CBR-063 to CBR-065 (water level data) and CBR-066 (locations of shallow monitoring well water level data). There is no indication that water levels in the Brule aquifer have been lowered due to mining activities in the Basal Chadron Sandstone or inadequate confinement. There is no sustained downward trend in water levels or correlation to mine activities within the underlying Basal Chadron Sandstone that would suggest mining is having an effect on Brule water levels.

Q18. Mr. Wireman notes in two places on page 4 of his testimony that there is a downward vertical gradient that would, for example, "facilitate flow from the Brule downward." Do you have any comments on his observation?

A18. (WB, LT, MS, BL) Yes. As we have noted throughout this proceeding (*e.g.*, Exh. CBR-001 at ¶¶40, 93), mining activities in the Basal Chadron Sandstone have lowered the potentiometric surface of the mined aquifer such that the vertical hydraulic gradient in the permit area is strongly downward. This is a positive attribute — not a negative one as Mr. Wireman implies — because it eliminates the potential for groundwater to flow upward from the production aquifer and into

the shallow aquifer during mining and restoration. Regardless, as noted above, there is no indication that mining activities in the Basal Chadron have caused a decline in Brule water levels.

Q19. Mr. Kreamer states (at page 11) that "no data" was presented for the pre-1999 period during the evidentiary hearing. Can you explain?

A19. (WB, LT, MS, BL) Yes. The two exhibits that Crow Butte provided during the hearing (CBR-063 and CBR-064) showed long-term water level trends (1999-present) because those were the dates that those two monitoring wells were in use. As Crow Butte did not start operating until 1991, there is no additional data for the period from 1983 until then. In Exh. CBR-065, Crow Butte presented data from SM1-2 and SM4-9 starting in 1994. The hydrographs for SM1-2 start in 1994 as that is the limit of Crow Butte's electronic data, and earlier dates require retrieval of archived reports and then data entry into electronic format (>300 individual water level measurements would need to be individually retrieved and tabulated just for SM1-2). Data for other monitoring wells is provided for the entirety of the time that those well were in use.

In addition, with respect to Dr. Kreamer's claim that Crow Butte has selectively ignored water level changes that may have occurred during early mine operations, we note that the first mine unit, MU-1, was the smallest of the mine units. As subsequent, larger units were commissioned (with more pumping wells), there would be a change in the drawdown in the Basal Chadron Sandstone within that mine unit (*i.e.*, perturbation towards a "new" steady-state). If there were a hydraulic connection with the Brule, you would expect to see changes in Brule

water levels for shallow monitoring wells located within that new mine unit once that mine unit began operations. As Exh. CBR-065 shows, there are no long-term declines in water levels in shallow monitoring wells for newly-commissioned mine units that would suggest an impact on Brule water levels as a result of Crow Butte's mining operations in the Basal Chadron Sandstone. Instead, the relatively narrow band of water levels (+/- several feet) are consistent with seasonal and annual climactic patterns in the area.

Q20. Mr. Wireman states (at 2) that there has been a 40-foot decline in Brule water levels from 1982. Do you agree?

A20. (WB, LT, MS, RL) No. As we explained at the evidentiary hearing (Tr. at 1983-1895), the elevation at Well #11 in Figure 2.7-3a (3883.7 ft-amsl) is a clearly a transcription error. *See* Exh. BRD-008A. Based on the information in Table 2.7-5 of the LRA (Exh. CBR-011 at 2-194), water levels for Well #11 throughout 1982 were in the low 3830s, not the 3880s.

Q21. Mr. Wireman states (at 3) that the increase in Brule water levels in SM7-22 and SM7-17 (CBR-063 and CBR-064) could indicate that pumping in the Basal Chadron Sandstone affects water levels in the Brule. Do you agree?

A21. (WB, LT, MS, RL) No. The hydrographs for SM7-17 and SM7-22 show variation in response to precipitation (or the lack thereof), and are not related to mine activities in the Basal Chadron Sandstone.

Q22. Mr. Wireman states (at 4) that the pre-mining Basal Chadron potentiometric surface was above or within a few feet of the surface over most of the permit area. Is that true?

A22. (WB, LT, MS, RL) No. That statement would be accurate only if limited to the northern quarter of the mine area (not "most" of the permit area). Otherwise, both the pre-mining and present operational water levels result in downward hydraulic gradients.

B. <u>Available Head and Drawdown</u>

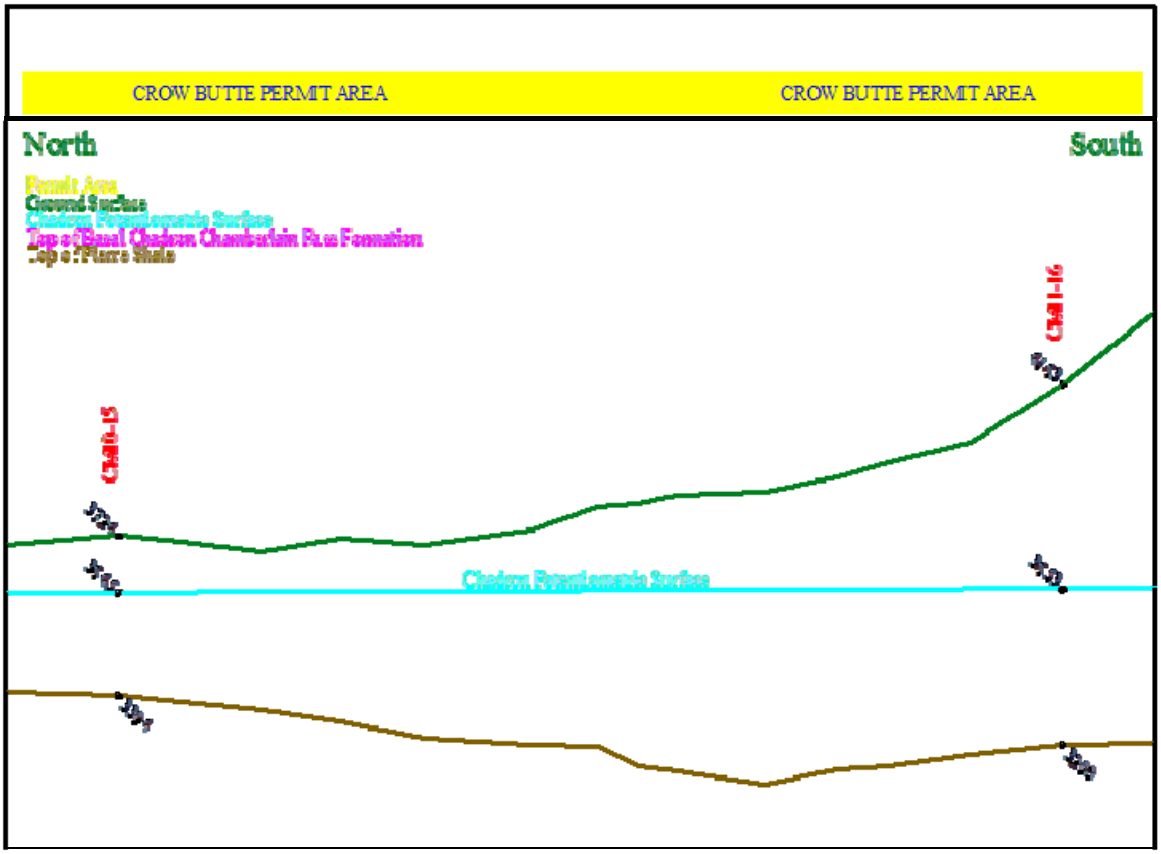
Q23. In their supplemental testimony (Exh. NRC-095 at 7-8), the NRC Staff states that consumptive use rates would have to increase to approximately 495 gallons per minute to decrease the potentiometric surface of the mined aquifer an additional 147 feet and concludes that this rate is not realistic. Do you agree?

A23. (WB, LT, MS, BL, DP) We agree that the 495 gpm is not realistic given site conditions, licensed flow rates, and disposal capacity. As importantly, there are no new mine units to be commissioned at the current license area and pumping rates are presently at or near their projected maximum. As production ends in the current mine units and restoration is completed, pumping rates will decline. This provides further support for the NRC Staff's conclusion that a consumptive use rate of 495 gpm is not reasonably foreseeable.

Q24. In his supplemental testimony (at 4), Mr. Wireman posits that the differences in available head across the site could be a concern. Can you explain?

A24. (WB, LT, MS, BL) Mr. Wireman's assumptions regarding the cause of the decreased amounts of available head on the north end of the mine are inaccurate. The lesser head has to do with both geologic structure and surface topography, as a comparison of monitoring wells from the south and north end of the mine demonstrates. From the south to the north end of the mine, the surface

topography drops 543 feet in elevation. At the same time, the Pierre Shale surface rises from south to north an additional 104 feet. The Basal Chadron potentiometric surface drops from south to north a total of 8 feet with lower drawdowns observed in between. These features are shown in the simplified figure below:



C. Aquifer Pump Test Results

Q25. In his testimony (at 1-2), Dr. Kreamer states that Crow butte has performed ten aquifer tests, but does not explain where those tests were performed or their purpose. Can you please elaborate?

A25. (WB, LT, MS, BL) Yes. The Nebraska Department of Environmental Quality ("NDEQ") authorized Crow Butte to operate in Underground Injection Control

("UIC") Permit Number NE 0122611 (Exh. CBR-017) at the current license area. The permit required aquifer pumping tests to demonstrate the integrity of the confining layer above the mining zone prior to mine development. Crow Butte performed four groundwater pumping tests between 1982 and 2002 in order to comply with the requirements of the UIC permit. Crow Butte has performed additional aquifer tests within the region, but no additional tests have been conducted at the license renewal area. The other aquifer tests referenced by Dr. Kreamer and discussed to some extent during the evidentiary hearing (Tr. at 1260-1262) were part of the investigations for the North Trend Expansion Area, which is the subject of a separate licensing action and outside the scope of this proceeding. Regardless, nothing in those North Trend tests undermines any of the evidence presented or conclusions made in this license renewal proceeding.

Q26. On page 2 of his supplemental testimony, Dr. Kreamer states that the barometric response of Basal Chadron Sandstone wells during Aquifer Test #1 indicates vertical groundwater communication. He makes similar statements on page 6 for Aquifer Test #2. Do you agree with his assessment?

A26. (WB, LT, MS, BL) No. The small changes in water level observed in the Brule aquifer and the Basal Chadron Sandstone aquifer in response to barometric fluctuations are expected and are completely consistent with the response of a fully confined aquifer (Basal Chadron) and a shallow unconfined aquifer (Brule Aquifer). There is no correlation or conclusion that can be drawn between the observed barometric pressure fluctuations, small water level fluctuations, and potential leakage between aquifers.

In addition, if small changes in shallow water levels due to barometric pressure changes caused similar water level changes in the Basal Chadron, as Dr. Kreamer implies, significant drawdown in shallow water levels would have been observed as a result of lowering water levels in the Basal Chadron during aquifer testing. Drawdown in shallow Brule monitoring wells has never been observed during aquifer tests in the license renewal area.

Q27. On page 3-6 of his supplemental testimony, Dr. Kreamer addresses Aquifer Test #1. Do you have any comments regarding his analysis?

A27. (WB, LT, MS, BL) Yes. Dr. Kreamer incorrectly uses early-time drawdown data to draw conclusions regarding potential leakage observed during the test. The reliance upon early time drawdown data is flawed and inconsistent with long-established aquifer testing guidance which concludes that the use of late-time drawdown data is superior for analytical curve-matching purposes. Early-time drawdown data are negatively influenced by a number of factors not related to the aquifer response to pumping, which greatly limits the use of early-time data for estimating aquifer behavior. As stated by Kruseman and de Ridder at page 64 (Exh. CBR-081):

> In applying the Theis curve-fitting method, and consequently all curve-fitting methods, one should, in general, give less weight to the early data because they may not closely represent the theoretical drawdown equation on which the type curve is based. Among other things, the theoretical equations are based on the assumption that the well discharge remains constant and that the release of water from the aquifer is immediate and directly proportional to the rate of decline of the pressure head.

Another factor that negatively influences early-time drawdown data, and not accounted for in Dr. Kreamer's analysis, is wellbore storage in both pumping and

observation wells. In wells of large diameter or deep wells with large water column height, the amount of water stored within the wellbore (casing and gravel pack) can be substantial. This water must be removed from the wellbore before the aquifer can respond properly to the induced drawdown. As a result of wellbore storage in both pumping and observation wells, measured drawdown in early time is less than what would should theoretically be observed using analytical type-curve matching techniques. *This can give the false impression of aquifer leakage*. In the case of the production aquifer at Crow Butte, production wells are unusually deep and have an unusually large water column height, which in turn results in a relatively large wellbore storage volume. In the case of Aquifer Test #1, the volume of water in wellbore storage is greater than 500 gallons. At a pumping rate of 23.8 gpm, it would take more than 21 minutes to purge a single casing volume from the pumped well. An example of the effect of wellbore storage, among other factors, on early-time drawdown at observation wells is shown on Figure 2-15 of Kruseman and deRidder (Exh. CBR-081 at 52). The deviation of the early time drawdown data on Figure 2-15 shows close resemblance to early time data used by Dr. Kreamer in his "Exhibit 3" to supposedly illustrate confining unit "leakage" in observation well COW-3 during Aquifer Test #2. This further supports the conclusion that Dr. Kreamer's reliance on early-drawdown data is flawed.

Q28. Can you please respond to Dr. Kreamer's comments (on page 5) regarding leakage and aquifer thickness?

A28. (WB, LT, MS, BL) Yes. Dr. Kreamer states the calculations used by the aquifer report authors to estimate the rate of leakage are inappropriate, but he does not provide an independent estimate for the rate of leakage, despite having all the necessary information to do so. As stated in the supplemental testimony (Exh. CBR-067 at ¶26), the rates of leakage are clearly so low as to be considered negligible and within the range expected for a fully confined aquifer.

Dr. Kreamer correctly points out that there was considerable variation in aquifer thickness across the Aquifer Test #1 area. Such variations in aquifer thickness can cause significant deviation from the theoretical type-curve used to determine aquifer parameters. This is why the authors also selected to use a two-stage Theis type-curve analysis, as stated on page 2.7A(8) of the Aquifer Test #1 report. As directly related to Aquifer Test #1 analyses, variation in aquifer thickness can give the false impression of leakage or recharge on the type-curve (*e.g.*, flattening of time-drawdown curve as a result of a local increase in thickness or transmissivity). The authors of the Aquifer Test #1 Report note a 30-50% variation in aquifer thickness over the test area that "cannot be ignored". An important result of the two stage Theis analysis is an observed 53% increase in aquifer transmissivity using late time data compared to early time data (see page 2.7A(13) of the Aquifer Test #1 Report). The increasing transmissivity in late time would be reflected as a "flattening" of the time-drawdown curve relative to early time, giving the false impression of aquifer leakage or recharge boundary.

Q29. On page 7-9 of his supplemental testimony, Dr. Kreamer addresses Aquifer Test #2. Do you have any comments regarding his analysis?

A29. (WB, LT, MS, BL) Yes. Dr. Kreamer states that "the clearest demonstration of a recharge boundary" for Aquifer Test 2 is shown in Figure 2.7-14 on page 2.7 (40) on a semi-logarithmic Cooper Jacob plot of the time drawdown of the piezometric surface of COW-3 during the second pumping test. According to Dr. Kreamer, "[t]he figure has been miss-drawn to consider only the late time data." For the reasons discussed above and in Kruseman and de Ridder, Dr. Kreamer's use of the early-time drawdown data is inappropriate. There is no evidence of aquifer leakage or recharge boundaries in time-drawdown data or type-curve matches in the Aquifer Test #2 report.

In addition, the Cooper-Jacob straight-line method is an approximation of the more rigorous Theis curve-matching method. As such, it is not the preferred method to rely upon in drawing any conclusions concerning aquifer properties or boundary conditions. In particular, the Cooper-Jacob method is considered invalid during early time and at moderate distances from the pumping well, or where $u < 0.01$, where $u = r^2S/4Tt$ and:

- r is radial distance from pumping well to observation well [L]
- S is storativity [dimensionless]
- t is elapsed time since start of pumping [T]
- T is transmissivity [L^2/T]

Observation wells of interest are located 61-101 feet from the pumped well in Aquifer Test #2. At these distances, $u < 0.01$ is only satisfied at times greater than about 37 minutes using average values for S and T from the Aquifer Test #2 report. In other words, early time data less than 37 minutes should be considered

discarded in the Cooper-Jacob analysis (as correctly applied by the authors of the Aquifer Test #2 report). Because Dr. Kreamer states there is "a distinct breakpoint at about 30 minutes" representing a "recharge boundary", and because he uses the early time data less than 37 minutes to "redraw" the Cooper-Jacob curve fit, his analysis and conclusions regarding potential aquifer leakage during Aquifer Test #2 are invalid.

Q30. On page 9-10 of his supplemental testimony, Dr. Kreamer addresses Aquifer Test #3. Do you have any comments regarding his analysis?

A30. (WB, LT, MS, BL) Dr. Kreamer's analysis of Test #3 hinges on his invalid assessment of Test #1 and Test #2 reports. Because, contrary to Dr. Kreamer's testimony, those tests did not indicate leakage consistent with vertical communication of groundwater through strata at the license renewal area, his concerns with Test #3 rest on a flawed premise.

Q31. Overall, do the results from the four pump tests demonstrate a hydraulic connection between the Brule and Basal Chadron/Chamberlain Pass formations?

A31. (WB, LT, MS, BL) No. All four pump tests conclude that that there is no hydraulic connection between the Brule and the Basal Chadron Sandstone/Chamberlain Pass Formation. Overall, there is strong evidence for hydraulic isolation and a competent upper confining unit at the site, indicating that groundwater flow pathways between the production zone and overlying aquifers are not present.

D. Basal Chadron at Pine Ridge Reservation

Q32. Dr. LaGarry states that "continued incorrect usage" demonstrates a clear "lack of due diligence" by Crow Butte and the NRC Staff. Do you agree?

A32. (WB, MS, BL, LT) No. As we have explained repeatedly in this proceeding (*e.g.*, Exh. CBR-001 at ¶¶63-64), the history of stratigraphic nomenclature for the White River Group of Nebraska and South Dakota has had various interpretations. For example, 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). Crow Butte, as well as NDEQ and others, recognize 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 (for both the public and regulators), Crow Butte is continuing to use the term "Basal Chadron Sandstone" to describe the mined formation. So, rather than it being a matter of due diligence, the decision to continue using historical nomenclature reflected a conscious decision to maintain consistency among licensing documents.

Q33. Does Crow Butte correlate the nomenclature among various sources?

A33. (WB, MS, RL, BS) Yes. A table provided with the Marsland Expansion Area application correlates the nomenclature for the various units. *See* MEA Technical Report, Table 2.6-2, *Representative Stratigraphic Section* (Exh. CBR-015).[1] The description of the regional geology in the Marsland Technical Report also

[1] Correlation with more recent nomenclature was also provided in the NTEA and Three Crow Expansion Area documents. *See, e.g.*, NTEA Aquifer Exemption Petition (Exh. CBR-013) at Table 3.

correlates the nomenclature used by Crow Butte, NDEQ, and NRC to more recent interpretations. *See* MEA Technical Report, Section 2.6, *Geology and Seismology* (Exh. CBR-016). For example, the Brule Formation was originally subdivided by Swinehart, et al. (1985) and later revised by LaGarry (1998) into three members, from youngest to oldest: the "brown siltstone" member, the Whitney Member, and underlying Orella Member. Additionally, the Basal Chadron Sandstone is referred to as the Chamberlain Pass Formation in the revised nomenclature. So, far from ignoring the changes, Crow Butte and others have incorporated the new interpretations into licensing documents while still maintaining consistency with past usage.

Q34. Dr. LaGarry, on page 3 of this testimony states that, based on Figure 1 alone, one would expect all three formations (Chamberlain Pass, Chadron, and Brule Formations) to be ubiquitous on the Pine Ridge Reservation and in western Nebraska. Do you have any comments?

A34. (WB, MS, BS) As both Crow Butte and NRC have stated in the hearings and, as shown by Exhs. NRC-023 and INT-059, the particular sandstone unit of the Chamberlain Pass Formation mined in the license renewal area is not present a few miles east of the mine site. In fact, the entire White River sequence, including the Chamberlain Pass, has been completely eroded away from those areas shown on Exh. NRC-097 where the Pierre Shale or older strata are shown. While deposits representing the Chamberlain Pass, Chadron, and Brule Formations are likely present beneath the Pine Ridge Reservation, this does not mean that the specific depositional packages of interest (*i.e.*, the basal sandstone

unit of the Chamberlain Pass mined in the license renewal area) are present, or that there is any hydrologic connectivity between these formations on the reservation and the license renewal area.

Q35. Can you address Dr. LaGarry's reference to Terry (1998) at the bottom of page 4?

A35. (WB, MS, BS) At the bottom of page 4 of Dr. LaGarry's testimony, he discusses photographs and measured sections of Chamberlain Pass and Chadron Formations shown in Terry (1998) (Exh. BRD-005). However, the only location mentioned as being on the reservation is the location near Red Shirt village, which is around 75 miles from the Crow Butte site. The other location he mentions is location 1 on Figure 3B, Terry (1998). Dr. LaGarry identifies location 1 as White Clay, Nebraska. However, a review of Terry (1998) shows location 1 to be Orella Bridge, which located 18 miles northwest of Crawford — nowhere near the southern border of the reservation. It may be that Dr. LaGarry is referring to location 9 on Figure 3B, which is along the southern boundary of the Pine Ridge Reservation near White Clay. Close examination of the measured section at this location shows that, while the Chamberlain Pass Formation is interpreted to be present, it is only the shale and volcanic ash members of the formation and not the channel sandstones (*i.e.*, the Basal Chadron Sandstone) found in the Crow Butte license area.

Q36. Any comments on the photos in Figure 2?

A36. Of the pictures included by Dr. LaGarry in Figure 2, those pictures showing actual locations on the Pine Ridge Reservation are C, D, and E. None of the

photographs and the accompanying illustrations showing the Chamberlain Pass Formation show evidence of the channel sandstone portion of the Chamberlain Pass.

E. <u>White River Structural Feature</u>

Q37. In his testimony (at 12), Dr. Kreamer makes several "observations" regarding the NRC Staff's models of the White River Structural Feature. Do you have any comments?

A37. (WB, MS, RL) First, Crow Butte has not relied on the NRC Staff's modeling results for its conclusions in the license renewal application regarding the White River Structural Feature. The NRC Staff's independent assessment simply confirms what Crow Butte had already demonstrated through its close-spaced drilling program and three-dimensional models, as well as through other lines of evidence. Beyond that, Dr. Kreamer's concerns are general — "model is somewhat rudimentary", "no rigorous analysis is presented justifying the mathematical uniqueness of the solutions", or "numerical stability is not adequately addressed" — and fail to acknowledge the limited purpose of the model. Further refinements and additional modeling runs can also always be made, but there is no reason to believe that the NRC Staff's modeling efforts were unreasonable given the model's objectives.

F. <u>Groundwater Flow Directions</u>

Q38. To what degree (if any) does the additional testimony address the groundwater flow directions in the Arikaree and Brule aquifers underlying the Pine Ridge reservation and the license renewal area?

A38. (WB, LT, MS, RL) The intervenors' supplemental testimony does not address whether the new exhibits, such as the Arikaree flow directions in BRD-006, accurately represent flow directions underlying the Pine Ridge reservation. As noted in our supplemental direct testimony, there is no hydraulic connection between the Basal Chadron Sandstone and the Arikaree or Brule aquifers at the mine site. The possibility that mining fluids would travel the many 10s of miles from Crow Butte's mine to the Pine Ridge Reservation is remote and speculative. There is no need to address such events in an Environmental Assessment, which is focused on reasonably foreseeable impacts.