September 5, 2018

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 40-8943-MLA-2
CROW BUTTE RESOURCES, INC.	)	
	)	ASLBP No. 13-926-01-MLA-BD01
(Marsland Expansion Area)	)	

NRC STAFF'S REBUTTAL STATEMENT OF POSITION

The U.S. Nuclear Regulatory Commission (NRC) staff (Staff) responds to the Oglala Sioux Tribe's (OST's) Initial Position Statement on Contention 2. In Contention 2, the OST challenges the Final Environmental Assessment (EA) prepared by the NRC Staff for Crow Butte Resources, Inc.'s (CBR's) proposed Marsland Expansion Area (MEA) license amendment, as well as portions of the MEA application. For the reasons set forth below and in the Staff's Initial Statement of Position,[1] the Board should resolve Contention 2 in favor of the Staff and CBR because the MEA application and the Staff's environmental review complied with NRC regulations and applicable law.

I. Summary of Staff's Position on Contention 2

The Staff and CBR complied with the National Environmental Policy Act (NEPA), the Atomic Energy Act (AEA), and NRC regulations,[2] by providing hydrogeological information in

[1] NRC Staff's Initial Statement of Position (Aug. 17, 2018) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18229A317).

[2] The regulations that pertain to ISR facilities are found in 10 CFR Parts 20 and 40, including a subset of the criteria in Appendix A of Part 40. *See* Safety Evaluation Report for the Marsland Expansion Area of the Crow Butte Resources ISR Facility, Dawes County, Nebraska, Materials License No. SUA-1534 (January 2018) (Exhibit (Ex.) NRC008) at 9-10. The relevant regulatory provision pertaining to the Staff's review of geology and hydrology is 10 CFR 40.41(c). *Id.* at 27; Testimony of David Back, Thomas Lancaster, Elise Striz, and Jean Trefethen (Aug. 17, 2018) (Ex. NRC001) at A.6. The Staff explains in its initial testimony why Criteria 4(e) and 5G(2) of 10 CFR Part 40, Appendix A, are not applicable at the MEA. Ex. NRC001 at A.7.

the EA[3] and the application[4] that was sufficient for the Staff to find in its respective NEPA and safety reviews that *in situ* uranium recovery (ISR) production fluids from the MEA will not migrate offsite and contaminate surface water or groundwater resources.

First, the EA provides a thorough description of the affected environment with respect to the regional and local geologic setting and water resources, and this description of the affected environment allowed the Staff to adequately evaluate the potential effects of the MEA on surface water and groundwater quality. Second, the application contains the information on the specific parameters relating to the hydraulic properties of aquifers—effective porosity, hydraulic conductivity, hydraulic gradient, transmissivity, and storativity—alleged by the OST in its petition to be missing from the application.[5] Third, the EA and MEA application describe a hydrologic conceptual model for the MEA that is sufficient to demonstrate confinement of ISR production fluids. The complete hydrologic conceptual model for the MEA, which consists of both surface water and groundwater conceptual models, is supported by extensive and reliable site characterization data. These data, which were collected and analyzed using appropriate, widely used methods, include site-specific and regional cross-sections, isopach maps, and structure contour maps constructed from borehole data; physical and chemical properties of core samples; a regional aquifer pumping test; water quality data; and potentiometric surface contour maps. Finally, based on the information and supporting data provided in the MEA application, the Staff identified multiple lines of evidence supporting the conclusions that the Basal Chadron Sandstone aquifer (production zone aquifer) will be adequately confined at the MEA. The

[3] Final Environmental Assessment for the Marsland Expansion Area License Amendment Application (April 2018) (Ex. NRC006).

[4] The MEA application consists of CBR's Environmental Report (ER) and Technical Report (TR). The portions of the application relevant to the testimony of the parties are provided as Exhibits CBR005-R through CBR020.

[5] Petition to Intervene and Request for Hearing of the Oglala Sioux Tribe (January 29, 2013) (OST Petition) (Ex. OST009).

Staff's related conclusions that ISR production fluids will not migrate outside the license area, and will not lead to significant environmental impacts on surface water or groundwater quality, are based on the same information and supporting data, along with the Staff's independent evaluation of relevant literature and requirements imposed by license condition.

Because the Staff and CBR have complied with NRC regulations and applicable law, the Board should resolve Contention 2 in favor of the Staff.

II. The Staff's Expert Witnesses

The Staff submitted initial testimony from four witnesses: Mr. David Back, Mr. Thomas Lancaster, Dr. Elise Striz, and Ms. Jean Trefethen.[6] In its initial testimony, the Staff explained why the EA and the application satisfy the requirements of NEPA and the AEA and why the OST's petition and supporting documents, including the opinion of Dr. Hannan LaGarry filed with the OST's original petition in 2013,[7] do not support the OST's claims in Contention 2. On rebuttal, three of the Staff's witnesses,[8] Mr. Back, Mr. Lancaster, and Dr. Striz, provide additional testimony on Contention 2 in response to the opinions of OST witnesses Dr. David Kreamer and Mr. Michael Wireman.[9] The qualifications for each of the Staff's rebuttal witnesses are described in the Staff's Initial Statement of Position and Initial Testimony and are detailed in the Staff's Exhibits NRC002 through NRC004.

III. OST's Position on Contention 2

In its Initial Position Statement, the OST asserts that the MEA application and EA "fail to provide sufficient information regarding the geologic setting of the area to meet the requirements of 10 C.F.R. Part 40, Appendix A, Criteria 4(e) and 5G(2); [NEPA]; and NUREG-

[6] Ex. NRC001.

[7] LaGarry Opinion (Ex. OST010).

[8] The Staff's rebuttal testimony addresses issues related to hydrogeology that are outside the expertise of the Staff's other witness, Ms. Trefethen. Therefore, she is not providing rebuttal testimony.

[9] Testimony of David Back, Thomas Lancaster, and Elise Striz (Sept. 5, 2018) (Ex. NRC014).

1569 section 2.6," and likewise "fail to provide sufficient information to establish potential effects of the project on the adjacent surface and ground-water resources, as required by NUREG-1569 section 2.7, and [NEPA]."[10] The OST reiterates the four deficits identified by the Board: (1) "the descriptions of the affected environment for establishing the potential effects of the proposed MEA operation on the adjacent surface water and groundwater are inadequate"; (2) the application does not contain "an adequate description of effective porosity, hydraulic porosity, hydraulic conductivity, and hydraulic gradient of site hydrogeology, along with other information relative to the control and prevention of excursions"; (3) CBR "has developed a scientifically flawed conceptual model of site hydrology" for purposes of demonstrating confinement; and (4) the EA "contains unsubstantiated assumptions as to the isolation of the aquifers in the ore-bearing zones."[11] Finally, the OST states that the opinions of Dr. Kreamer, Mr. Wireman, and Dr. LaGarry support its position.[12]

IV. The Staff's Response to OST's Initial Statement of Position and Testimony

The application and the EA present sufficient information to support the Staff's conclusions in its EA and Safety Evaluation Report (SER) that ISR production fluids will not migrate offsite and contaminate surface or groundwater resources. An application or EA is adequate if it "comes to grip with all important considerations."[13] It is not the Board's role to

[10] Oglala Sioux Tribe's Initial Position Statement at 39 (Aug. 17, 2018) (ADAMS Accession No. ML18230A840) ("OST Initial Position Statement").

[11] *Id.* at 39-41. The OST's initial testimony, provided in the opinions of Mr. Wireman and Dr. Kreamer, does not address the second issue (the asserted omission of descriptions of particular aquifer parameters) or the fourth issue (asserted "unsubstantiated assumptions" about isolation of aquifers in ore-bearing zones).

[12] *Id.* at 4-6, 41.

[13] *Exelon Generation Co., LLC (Early Site Permit for Clinton ESP Site)*, CLI-05-29, 62 NRC 801, 811 (2005) (quoting *Systems Energy Resources. Inc.* (Early Site Permit for Grand Gulf ESP Site), CLI-05-4, 61 NRC 10, 13 (2005) (footnote omitted)).

"'flyspeck' environmental documents or to add details or nuances."[14] The arguments and concerns raised by the OST in its Initial Position Statement and initial testimony[15] do not identify material omissions or inadequacies in the application or EA, or raise a material challenge to the EA's findings and conclusions.[16]

In its initial statement of position and initial testimony, the Staff explained that the EA provides an extensive description of the geologic setting, surface water hydrology, and groundwater hydrology at the MEA—the three areas that comprise the information needed to establish potential effects on surface water or groundwater quality.[17] The Staff also described the comprehensive array of site characterization information and supporting data on geology and hydrology that CBR provided in the MEA application to support the hydrologic conceptual model.[18] And finally, the Staff explained that its conclusions (and CBR's) about confinement of the production zone aquifer rest on multiple lines of evidence derived from CBR's site characterization.[19]

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[14] *Id.* NRC hearings are not intended to fine-tune and parse Staff NEPA documents, or to edit them to meet an intervenor's preferred language or emphasis. *Grand Gulf*, CLI-05-4, 61 NRC at 13.

[15] The OST submitted the following testimony in support of their positions on Contention 2: "Dr. Kreamer Opinion August 16, 2018 Opinion" (Ex. OST003) and "Mike Wireman August 16, 2018 Opinion" (Ex. OST004). In addition, the OST submitted as exhibits Dr. Kreamer's testimony from a supplemental hearing that was held in the Crow Butte license renewal proceeding in 2015 (Ex. OST005), and an opinion from Dr. Hannan LaGarry that was submitted as support for the OST Petition in 2013 (Ex. OST010). Because the Staff addressed all of Dr. LaGarry's relevant claims at length in the Staff's initial statement of position and initial testimony, this rebuttal statement of position and rebuttal testimony focuses on the OST's new or expanded arguments and the testimony of Dr. Kreamer and Mr. Wireman.

[16] *See Clinton*, CLI-05-29, 62 NRC at 811 ("There may, of course, be mistakes in the DEIS, but in an NRC adjudication, it is Intervenors' burden to show their significance and materiality."). Claimed deficiencies must be "significant enough to defeat the goals of informed decision making and informed public comment." *Fuel Safe Washington v. FERC*, 389 F.3d 1313, 1323 (10th Cir. 2004).

[17] Ex. NRC001 at A.6, A.9, A.11, A.12, A.17, A.18, A.19.

[18] This information includes regional and site-specific cross sections, isopach maps and structure contour maps created from borehole data; analyses of cores from the production zone, confining units, and overlying aquifers; aquifer properties and demonstration of confinement from an aquifer pumping test; potentiometric surface maps illustrating groundwater flow, water quality data, and flood and erosion studies. *See id.*at A.9, A.12, and A.19.

[19] *Id.* at A.21, A.26.

The OST's initial statement of position, and the testimony of Mr. Wireman and Dr. Kreamer, fail to acknowledge or address the vast majority of the information in the EA and MEA application referred to above.[20] Both Mr. Wireman and Dr. Kreamer make several assertions about purportedly missing information in the EA or MEA application that is, in fact, provided in those documents. The remainder of Mr. Wireman's testimony consists of largely conclusory assertions about deficiencies in the descriptions of geology and hydrology in the EA and the MEA application, along with general assertions about other topics[21] that are not material to the ultimate question presented in Contention 2: whether there is sufficient hydrogeological information in the application and EA to demonstrate that ISR production fluids will not migrate offsite and contaminate surface water or groundwater.[22]

Dr. Kreamer's testimony focuses exclusively on the aquifer pumping test, which is only a single component of CBR's entire site characterization effort. Importantly, aside from the aquifer pumping test, the OST witnesses fail to address any of the other bases described by the Staff and CBR that demonstrate the confinement of the Basal Chadron Sandstone aquifer at the MEA.[23]

As discussed more fully in the following sections, the set of narrow concerns raised by the OST witnesses are ultimately either peripheral or immaterial to Contention 2, and they fail, either individually or collectively, to call into question the Staff's and CBR's compliance with NEPA, the AEA, and NRC regulations. The Staff's rebuttal testimony, outlined below, responds

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[20] As previously noted, the OST initial testimony does not address two of the four specific "deficits" identified by the Board. *See supra* note 11.

[21] These topics include groundwater quantity impacts (i.e., consumptive use), adequacy of meteorological data, baseline restoration wells, and groundwater restoration standards. *See* Ex. OST004 at 2, 3, 5.

[22] *See* Ex. NRC001 at A.3.

[23] Furthermore, the aquifer pumping test demonstrates confinement in several ways that are not disputed by the OST witnesses: (1) the lack of observed drawdown in overlying Brule aquifer observations wells; (2) the observed pressure responses at significant distances with relatively low pumping rates; and (3) the low storativity values. Ex. NRC014 at A.18.

the OST witnesses' specific claims. Because the Staff and CBR have shown that they have complied with NEPA, the AEA, and NRC regulations, the Board should resolve Contention 2 in favor of the Staff and CBR.

A. Response to Mr. Wireman's Testimony

Mr. Wireman's testimony contains several incorrect claims that information is missing from the EA or the MEA application. First, he asserts that the technical report (TR) does not discuss sources of recharge to the Basal Chadron Sandstone aquifer or identify where it discharges.[24] The information on sources of recharge to the Basal Chadron Sandstone aquifer that Mr. Wireman asserts is missing from TR is, in fact, described in Section 2.7.2.3 of the TR.[25] The TR, as well as the EA, discuss recharge and discharge areas for the Basal Chadron Sandstone aquifer. The EA states that groundwater within the Basal Chadron Sandstone aquifer flows from recharge areas south of Dawes County northward through the MEA, and that the aquifer discharges north of Crawford where it is exposed at the land surface.[26] Because the TR and EA contain this information, the "hydrogeologic mapping" suggested by Mr. Wireman is not necessary.[27]

Mr. Wireman also asserts that the EA and TR contain "no data on surface water hydrology" and suggests that sampling and investigation of ephemeral surface water features should be done.[28] But as the Staff explains, Sections 3.3.1, 3.11.3, and 4.2.2 of the EA provide an extensive description of surface water hydrology, based on information in Sections 2.2.3 and 2.7.1 of the TR.[29] Furthermore, the EA describes the ephemeral surface water features at the

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[24] Ex. OST004 at 2.

[25] Ex. NRC014 at A.3.

[26] *Id.*

[27] *Id.*

[28] Ex. OST004 at 3.

[29] Ex. NRC014 at A.7.

MEA, including Dooley Spring, and explains that lack of water has prevented surface water sampling.[30] Both the TR and EA explain that CBR has committed to perform such sampling if there is sufficient water flow.[31]

Mr. Wireman also inaccurately claims that the TR does not include information on the geologic formations to be used for deep disposal wells (DDWs).[32] Both the EA and the MEA application (TR and ER) identify the relevant formations. The TR provides relevant information on water quality, and the ER explains that the proposed DDW formations are located below the lowest underground source of drinking water and are not considered sources of drinking water due to their total dissolved solids (TDS) content.[33] In addition, the EA, TR, and ER all describe the confining unit between the Basal Chadron Sandstone aquifer and the proposed DDW formations, which consists of several thousand feet of low-permeability units.[34]

Finally, with respect to Mr. Wireman's claim that there is no discussion of the potential effects of the reported Pine Ridge and Niobrara River faults on groundwater flow in the Arikaree and White River groups,[35] the TR in fact contains a detailed discussion of CBR's interpretations and conclusions related to those structures.[36] The EA and SER document the Staff's independent evaluation of the evidence of those reported faults and CBR's interpretations of subsurface data related to those faults, including site-specific and regional cross-sections and

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[30] *Id.*

[31] *Id.*

[32] Ex. OST004 at 6.

[33] Ex. NRC014 at A.14.

[34] *Id.* These units include the Pierre Shale, a regional aquitard with extremely low hydraulic conductivity. *Id*.

[35] Ex. OST004 at 3.

[36] Ex. NRC014 at A.9. Mr. Wireman also asserts that the structural setting at the MEA is "more complex than what CBR describes." Ex. OST004 at 3. However, the EA and TR describe significant structural features and provide a map showing their locations, and Mr. Wireman's general, unsupported assertion does not indicate any error in these discussions of structural geology. Ex. NRC014 at A.9.

structure contour maps.[37] Based on this data, there is no evidence of vertical offsets indicative of faults at the MEA, and the multiple lines of evidence that demonstrate confinement at the MEA, discussed in detail in the EA and the Staff's initial testimony,[38] refute any implication that faults—known or unknown—are a preferential pathway for ISR production fluids to migrate outside the MEA license area.[39]

Mr. Wireman asserts that additional monitoring wells are needed upgradient and downgradient to fully evaluate downgradient impacts.[40] In response, the Staff explains that additional wells outside the MEA are not necessary for safe operation or the evaluation of potential environmental impacts.[41] As required by license condition, perimeter monitoring wells will be installed in the Basal Chadron Sandstone aquifer for each wellfield.[42] These wells will be sufficient to monitor for excursions and to assess the inward hydraulic gradient during operation.[43]

According to Mr. Wireman, the Staff incorrectly states that the Pine Ridge Escarpment will not affect groundwater flow in the Basal Chadron Sandstone aquifer, because the escarpment was uplifted prior to the deposition of the Basal Chadron Sandstone.[44] But CBR's regional cross-sections show that the Basal Chadron Sandstone is continuous and essentially

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[37] Ex. NRC014 at A.9. In its initial testimony, the Staff explains why CBR's regional and site-specific data from subsurface exploration at and near the MEA site is more relevant and persuasive than previous interpretations of reported structural features in the literature. Ex. NRC014 at A.9 (citing Ex. NRC001 at A.25).

[38] Ex. NRC006 at 3-32 to 3-34; Ex. NRC001 at A.21.

[39] Ex. NRC014 at A.9; Ex. NRC001 at A.25.

[40] Ex. OST004 at 2-3.

[41] Ex. NRC014 at A.6.

[42] *Id.*

[43] *Id.*

[44] Ex. OST004 at 3.

flat from the MEA, beneath the Pine Ridge Escarpment, to the existing Crow Butte license area.[45] Overlying units (Chadron, Brule, and Arikaree) are also continuous and relatively flat from north of the Pine Ridge Escarpment to the southern boundary of the MEA.[46] These observations indicate that the formations were deposited without any interruption by the escarpment.[47] In addition, groundwater flow in the Basal Chadron Sandstone aquifer is northwest from the MEA toward the existing Crow Butte license area, which would be unlikely if there was a groundwater flow divide associated with the Pine Ridge Escarpment.[48]

Mr. Wireman also asserts that the Arikaree aquifer is heterogeneous at the MEA site and suggests that aquifer testing and monitoring should account for the heterogeneity.[49] In response, the Staff explains that the heterogeneity of the Arikaree (the surficial aquifer) is not germane to the demonstration of confinement.[50] Furthermore, there is no need to perform an aquifer pumping test on the surficial aquifer at the MEA,[51] and monitoring wells for vertical excursions are placed in the first overlying aquifer, which is the Brule.[52]

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[45] Ex. NRC014 at A.4.

[46] *Id.*

[47] *Id.*

[48] *Id*.

[49] Ex. OST004 at 4.

[50] Ex. NRC014 at A.10. None of the multiple bases for confinement relate to the Arikaree aquifer or its properties. *See* Ex. NRC001 at A.21.

[51] At ISR facilities, aquifer pumping tests are used to assess vertical confinement of the production zone aquifer and to determine its hydraulic properties, which are important for selecting injection and extraction rates and maintaining an inward hydraulic gradient. Ex. NRC014 at A.15.

[52] *Id.* at A.10; Ex. NRC001 at A.28. Mr. Wireman also claims that because the Brule and the Arikaree comprise a single aquifer system, contaminated groundwater migrating into the Brule could enter Arikaree water wells. Ex. OST004 at 4. Although the Staff and CBR agree that the two aquifers function as a single hydrogeological unit, Mr. Wireman's concern is unfounded. As the Staff explains, there are multiple bases for concluding that there is a high degree of confinement between the Basal Chadron Sandstone aquifer and overlying aquifers that will prevent such migration. Ex. NRC014 at A.11. In particular, the strong downward gradient between the Brule and Basal Chadron Sandstone aquifers at the MEA would preclude such upward migration of ISR production fluids. *Id.*

Finally, Mr. Wireman raises several immaterial claims concerning groundwater quantity impacts (e.g., relationship between recharge and consumptive use, drawdown due to pumping from MEA operations), meteorological data, baseline restoration wells, and groundwater restoration standards.[53] None of these topics is relevant to the issue raised in Contention 2, which is the adequacy of the description of geologic setting and site hydrology as it relates to CBR's ability to demonstrate confinement of the production zone aquifer and contain fluid migration at the MEA.[54]

B. Response to Dr. Kreamer's Testimony

Dr. Kreamer's testimony focuses exclusively on a single aspect of CBR's comprehensive site characterization efforts: the aquifer pumping test conducted at the MEA in 2011. Dr. Kreamer asserts various omissions and deficiencies in the design of the test and, primarily, in the analysis of the drawdown data for the Basal Chadron observation wells.

The Staff explains that several observations from the test—the lack of water level changes in the Brule observation wells, the observed pressure effects from pumping at long distances, and the low calculated storativity values—indicate confinement.[55] Furthermore, the aquifer pumping test is only one of the multiple lines of evidence supporting the conclusion that there is a high degree of confinement between the Basal Chadron Sandstone aquifer and the overlying Brule aquifer at the MEA.[56]

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[53] Ex. OST004 at 2, 3, 5.

[54] Ex. NRC014 at A.5, A.8, A.12, and A.13. This contention relates to groundwater quality, not groundwater quantity. *Id.* at A.5. The Board rejected OST's contentions on groundwater quantity impacts submitted in the original OST Petition and again when the final EA was issued. *See Crow Butte Resources, Inc.* (Marsland Expansion Area), LBP-13-6, 77 NRC 253, 305 (2013); *Crow Butte Resources, Inc.* (Marsland Expansion Area), LBP-18-3, 88 NRC __ (Jul. 20, 2018) (slip op. at 30-31). With regard to meteorological data, higher than normal rainfall in one particular month has no bearing on the demonstration of confinement. Ex. NRC014 at A.8. Nor do baseline restoration wells, which are used to establish background water quality for restoration (and cannot be installed until after wellfields have been constructed), or the applicable standards for groundwater restoration. Ex. NRC014 at A.12, A.13.

[55] Ex. NRC014 at A.15, A.18.

[56] *Id.* at A.15.

Dr. Kreamer incorrectly asserts that the MEA aquifer pumping test report contains several omissions.[57] First, he asserts that CBR did not perform the Cooper-Jacob analysis as stated in the report; however, a Cooper-Jacob distance-drawdown analysis is provided in Figure 18 of the report.[58] He also asserts, incorrectly, that data from two wells (Monitor-2 and Monitor-8) were not analyzed, when in fact they were.[59] Finally, Dr. Kreamer asserts that the report did not state whether actual or average thickness was used "to calculate transmissivity."[60] As the Staff explains, transmissivity is calculated directly from aquifer pumping test data; however, for purposes of calculating hydraulic conductivity, the report clearly states that "an average net sand thickness of 40 feet" was used.[61]

Dr. Kreamer also asserts that CBR did not analyze all of the aquifer pumping test data, claiming that data from the first, failed test was not included, and that data from the second test was selectively and arbitrarily analyzed.[62] As the Staff explains, the first test would not have provided materially different useful information.[63] CBR reported that the test was discontinued after 19 hours because of a poor hydraulic connection between the pumping well and the

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[57] Ex. OST003 at 2.

[58] Ex. NRC014 at A.19; Ex. CBR016 at PDF 49 (Figure 18). There are two types of Cooper-Jacob analyses: distance-drawdown and time-drawdown. The report clearly states that CBR used "Theis (1935) drawdown and recovery methods and the Cooper-Jacob Straight-Line Distance-Drawdown method (Cooper and Jacob 1946)" to analyze the aquifer pumping test data. Ex. CBR016 at 11. As the Staff explains, the Cooper-Jacob time-drawdown method is an approximation to the Theis curve analysis that would not provide any additional information not already available from a Theis analysis. Ex. NRC014 at A.18.

[59] The Theis drawdown analyses for these wells are presented in Figures C2 and C8 of the report, and the Theis recovery analyses for these wells are presented in Figures C11 and C 17. Ex. NRC014 at A.19; Ex. CBR016 at PDF 80, 86, 89, 95.

[60] Ex. OST003 at 2.

[61] Ex. NRC014 at A.19; Ex. CBR016 at 1, 13, 14, PDF 30 (Table 8).

[62] Ex. OST003 at 2.

[63] Ex. NRC014 at A.16.

aquifer.[64] CBR subsequently rectified the issue (constructing a new pumping well close to the original one) and conducted the complete 103-hour test discussed in the report.[65] The changes made for the second test would not have materially affected the overall results and data interpretation; for all practical purposes, the drawdown response curves for both tests would have been the same for the first 19 hours.[66] And because the pumping well in the first test was not hydraulically connected to the aquifer, the data would not have been suitable for a meaningful quantitative analysis.[67]

With regard to Dr. Kreamer's claim that CBR only analyzed portions of the data and excluded others,[68] no data was excluded. Appendix C of the MEA aquifer pumping test report presents drawdown and recovery response curves showing all data points for all of the observation wells used in the test.[69] And contrary to Dr. Kreamer's assertion that CBR "arbitrarily" analyzed selected portions of the data, the report clearly explains the rationale for matching type-curve data to late- or middle-time data.[70]

Dr. Kreamer also claims that analysis of excluded data could demonstrate lack of confinement.[71] Specifically, he asserts that the Theis curves for all of the MEA observation wells show deviations consistent with leakage (i.e. a recharge boundary), and he appears to suggest that if this is so, water must be flowing from the overlying aquifer into the Basal

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[64] *Id*.

[65] *Id*.

[66] *Id*.

[67] *Id*.

[68] Ex. OST003 at 2, 7.

[69] Ex. NRC014 at A.17.

[70] *Id.* The Staff also notes that the report authors appropriately chose not to use early time data. *Id.* (citing Ex. CBR029 at PDF 16).

[71] Ex. OST003 at 2, 6. It is not clear what data were "excluded," because, as discussed previously, all data from all of the observation wells was presented in the report. Ex. NRC014 at A.17, A.18.

Chadron Sandstone aquifer.[72] This is an implausible explanation given the multiple lines of evidence demonstrating a high degree of confinement, which would preclude such downward flow.[73] As the Staff explains, there are several other plausible explanations for the deviations, which are apparent only in wells located close to the pumping well.[74] These include an increase in transmissivity (CBR's explanation), release of water from storage, and wellbore storage or near-wellbore effects.[75] The Staff also explains that a Cooper-Jacob time-drawdown evaluation (which Dr. Kreamer suggests would show a recharge boundary) is not necessary and would not provide any additional information not already available from a Theis analysis.[76]

Dr. Kreamer and Mr. Wireman both assert that a single aquifer pumping test for the entire site was inadequate.[77] However, based on the reported radius of influence (ROI) of the test, it covered approximately 3 miles of the 7.5 mile length of the MEA.[78] As the Staff explains, there is no need to assess the response of the entire site because, as demonstrated by CBR's cross-sections, the hydrostratigraphic units are uniform and the Basal Chadron Sandstone aquifer is continuous across the entire site.[79] Furthermore, the aquifer pumping test is only one component of the site characterization data used to describe the hydrological conceptual model,

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[72] Ex. NRC014 at A.18.

[73] *Id.*

[74] *Id*.

[75] *Id.* As the Staff notes, there are several observations from the pumping test indicating confinement that are independent of the Theis curve analysis, *id*., which the OST does not challenge.

[76] The Cooper-Jacob time-drawdown analysis is an approximation to the Theis analysis. Ex. NRC014 at A.18. Also, the Staff recognizes that use of early-time data might show a deviation that mimics recharge, but reiterates that use of such data is inappropriate. *Id*. at A.17, A.18.

[77] Ex. OST003 at 2; Ex. OST004 at 4.

[78] Ex. NRC014 at A.21.

[79] *Id*.

and only one of the bases for demonstrating confinement at the MEA.[80] Dr. Kreamer also asserts that the analysis of the test results was influenced by water drawn from off-site locations.[81] As the Staff explains, the drawdowns observed in the furthest monitoring wells during the test are a response to decreases in pressure and are unrelated to water movement from off-site, and the late-time data in those wells did not indicate any influences significantly different than those observed in middle-time data.[82]

Dr. Kreamer asserts that wells may not have been fully screened in the Basal Chadron Sandstone aquifer, or may have been partially screened in other formations, because the reported range of screened intervals (22 to 50 feet) is inconsistent with the identified maximum and minimum thicknesses (21 and 91 feet) based on data points from the isopach map.[83] However, as the Staff explains, these maximum and minimum values do not reflect the thicknesses at the actual locations of the observation wells.[84] When location is taken into account, the associated thicknesses for all wells but one (Monitor-5) are less than 50 feet.[85] Moreover, Dr. Kreamer's assertion is contradicted by CBR's well completion reports, which indicate the wells were fully screened within the Basal Chadron Sandstone aquifer.[86]

Dr. Kreamer repeatedly asserts in his testimony that CBR inappropriately used the Theis and Cooper-Jacob analysis methods, which rely on assumptions that he claims are not reflected

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[80] *Id*. In addition, CBR is required by license condition to conduct aquifer pumping tests for each wellfield as it is constructed to further verify the conceptual model. *Id*.

[81] Ex. OST003 at 2.

[82] Ex. NRC014 at A.20.

[83] Ex. OST003 at 2.

[84] Ex. NRC014 at A.22.

[85] *Id.*

[86] *Id*.

by actual conditions at the MEA site.[87] Specifically, he claims that the Basal Chadron Sandstone aquifer at the MEA is not homogeneous and isotropic, is not confined and of infinite extent and does not have effective uniform thickness.[88] In response, the Staff explains that these are widely used and accepted methods that have been adopted in ASTM standards and, in practice, have been applied to heterogeneous and anisotropic aquifers. As the Staff explains further, all geologic systems are heterogeneous and isotropic at some scale, and if the assumptions were strictly adhered to, the methods could never be used.[89]

With respect to the MEA specifically, the assumption of a homogeneous, isotropic aquifer is reasonable because the size and duration of the MEA test allowed averaging of hydraulic behavior over the ROI, which minimizes the impact of small-scale anisotropy and heterogeneity.[90] Furthermore, as the Staff explains, CBR's site characterization data, including subsurface data and the potentiometric surface data for the Basal Chadron Sandstone aquifer, indicate no significant heterogeneity that would impact the aquifer pumping test results.[91] With regard to the assumption of a confined aquifer with infinite lateral extent, the Basal Chadron Sandstone is by definition a confined aquifer because its potentiometric surface rises above its top elevation.[92] Furthermore, CBR's site-specific and regional cross-sections demonstrate that the Basal Chadron Sandstone is present over the entire MEA site and well beyond.[93] Finally,

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[87] Ex. OST003 at 5-7.

[88] *Id.*

[89] Ex. NRC014 at A.23. According to a standard industry reference, the assumptions associated with these methods do not severely limit their use. *Id*.; Ex. NRC016 at PDF 3.

[90] Ex. NRC014 at A.23.

[91] *Id*. The Staff also refutes Dr. Kreamer's assertion that further analysis of anisotropy is necessary to meet the objectives of the aquifer pumping test. Heterogeneity and anisotropy are unrelated to demonstrating confinement, and, in any event, there is no indication of significant anisotropy at the MEA. *Id.* at A.24.

[92] *Id.* at A.23.

[93] *Id.*

with regard to effective uniform thickness, the reported variation in thickness within the Basal Chadron Sandstone aquifer (about 30 to 90 feet) is expected in sedimentary systems and will not preclude obtaining reliable results.[94]

Finally, Dr. Kreamer claims that a statement in the MEA aquifer pumping test report mischaracterizes previous testing results for the existing Crow Butte License area because it states that previous testing at that location indicates the Basal Chadron Sandstone is "relatively homogeneous and isotropic."[95] This statement, which was included in the report to provide historical context, applies to a site 11 miles away.[96] Neither the statement, nor Dr. Kreamer's ensuing discussion, is relevant to the interpretation of the results of the MEA aquifer pumping test and, more generally, to the demonstration of confinement at the MEA.[97] The only mention of MEA test data in Dr. Kreamer's discussion of this claim is his statement that all of the MEA response curves show departures from the Theis curve consistent with leakage.[98] Otherwise, he simply repeats arguments he made in testimony at the 2015 Crow Butte license renewal hearing, where he reanalyzed aquifer pumping test data from tests conducted at the existing Crow Butte license area to match early time data and asserted that this showed recharge boundaries.[99] Again, these analyses of other data have no bearing on the interpretation of the MEA aquifer pumping test or the demonstration of confinement at the MEA.

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[94] *Id.* at A.23. Dr. Kreamer also asserts that assuming homogeneity and isotropy "wrongly implies the local geology is simple." Ex. OST003 at 5. However, CBR's subsurface investigation results provide ample evidence that the local stratigraphy is relatively uniform and uncomplicated. Ex. NRC014 at A.23.

[95] Ex. OST003 at 3.

[96] Ex. NRC014 at A.25.

[97] *Id*.

[98] Ex. OST003 at 3.

[99] *Id.* at 3-5. Citing Kruseman and de Ridder (Ex. CBR029 at PDF 16), the Staff explains in A.17 of its rebuttal testimony why matching early time data is inappropriate. Ex. NRC014 at A.17.

V. Conclusion

In sum, Dr. Kreamer and Mr. Wireman do not identify material deficiencies in the application or in the EA's description of hydrogeological site characterization information or the Staff's findings and conclusions regarding the confinement of the Basal Chadron Sandstone aquifer. As the Staff explains in its rebuttal testimony, information they assert is missing from the MEA application or the EA is actually presented in those documents. Further, the additional information and analyses called for by Dr. Kreamer and Mr. Wireman are immaterial to the Staff's conclusion regarding the confinement of the production zone aquifer. As the Staff explains in its initial and rebuttal testimony, there are multiple lines of evidence described in the application and the EA to support the Staff's conclusions regarding confinement at the MEA. Accordingly, because the record shows that the MEA application and the EA complied with the requirements of NEPA, the Board should resolve Contention 2 in favor of the Staff and CBR.

Respectfully submitted,

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Dated at Rockville, Maryland
this 5th day of September, 2018.