September 28, 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)	)	

JOINT RESPONSE TO THE BOARD'S PROPOSED FACTUAL STIPULATION

In accordance with the Board's Memorandum and Order dated September 18, 2018,[1] the parties have reviewed the Board's proposed factual stipulation (Section I of the September 18 Order) and have consulted on edits to the Board's proposal that would allow the parties to reach consensus. Attachment A to this pleading contains a redline/strikeout version of the September 18 Order[2] showing edits to Section I that have been agreed upon by the parties, along with some explanatory comments. Attachment B contains a clean version of the same document. Counsel will also be providing Microsoft Word versions of these documents to the Board clerk via e-mail.

Respectfully submitted,

/Signed (electronically) by/
Marcia J. Simon
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Dated at Rockville, MD
This 28th day of September, 2018.

[1] Memorandum and Order (Request to Stipulate to Factual Background) at 1, 12 (September 18, 2018) (unpublished) ("September 18 Order").

[2] The certificate of service from the September 18 Order has been deleted to avoid confusion.

ATTACHMENT A

EDITS TO PROPOSED STIPULATION IN SEPTEMBER 18 ORDER

(REDLINE/STRIKEOUT VERSION)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before the Licensing Board:

G. Paul Bollwerk, III, Chairman
Dr. Richard E. Wardwell
Dr. Thomas J. Hirons

In the Matter of	Docket No. 40-8943-MLA-2
CROW BUTTE RESOURCES, INC.	ASLBP No. 13-926-01-MLA-BD01
(Marsland Expansion Area)	September 18, 2018

MEMORANDUM AND ORDER
(Request to Stipulate to Factual Background)

Based on the parties' prefiled submissions and the previous uncontested rulings of the licensing board in the pending Renewal Site proceeding,[1] the Licensing Board proposes the following background factual information be stipulated to by parties Oglala Sioux Tribe (OST), Crow Butte Resources, Inc. (CBR), and the Nuclear Regulatory Commission (NRC) staff.

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[1] Crow Butte Res., Inc. (In Situ Leach Facility, Crawford, Neb.), LBP-16-13, 84 NRC 271 (2016), petition for Commission review pending. The citations to the prefiled submissions are provided in the expectation that the admissibility of those portions of the documents will not be contested and therefore provide the supporting basis for the stipulated information. To the degree the stipulated information is later incorporated into the Board's initial decision regarding admitted Contention 2, the citations would be updated to reflect the status of the documents as admitted exhibits. Also, in accord with the Board's previous direction, see Licensing Board Memorandum and Order (Providing Administrative Directives Associated with Evidentiary Hearing and Limited Appearance Session) (July 27, 2018) at 11 (unpublished), the page citations in this Board issuance are to the actual page numbers in the cited documents rather than the portable document format (.pdf) pagination of the prefiled exhibit.

I. PROPOSED STIPULATION

A. ~~Mining~~ In Situ Uranium Recovery (ISR) Operations at the Marsland Expansion Area

Crow Butte Resources, Inc. (CBR) operates an ISR facility near Crawford, Nebraska under NRC source materials license SUA-1534.[2] The proposed Marsland Expansion Area (MEA) site is located in southwestern Dawes County, Nebraska, approximately 11 miles south-southeast of the ~~original~~ existing CBR in situ recovery (ISR) ~~mining site~~facility.~~,~~[3] ~~which is currently the subject of a license renewal proceeding before the agency.~~[4] The proposed MEA license area is approximately 4622 acres,[5] which has the potential to encompass 11 ~~mining~~ mine units (MUs) ~~with a total disturbed area of approximately 1754 acres~~ based on applicant CBR's current knowledge of available reserves.[6] The total potential disturbed area over the life of the project is estimated to be up to 1754 acres.[7]

Consistent with the ~~renewal site~~configuration at the existing CBR ISR facility, wells within

Commented [A1]: The NRC regulates uranium milling, not uranium "mining." This edit and related edits elsewhere in the document reflect this.

Although the NRC does not refer to ISR activities as mining, the Staff does use the term "mine unit" as a synonym for "wellfield."

Commented [A2]: None of the parties has used the term "renewal site" to refer to the existing CBR ISR facility. The parties believe "existing CBR ISR facility" is a more appropriate description.

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[2] The renewal of CBR's license in 2014 was the subject of a hearing before a different licensing board. Petitions for review from the CBR license renewal proceeding are pending before the Commission.

[3] Prefiled ex. CBR006, [CBR], Technical Report, [MEA] at 1-3 (June 2017) (consolidated) [hereinafter Tech. Rep.] (ADAMS Accession No. ML18229A259); Prefiled ex. NRC008, Division of Decommissioning, Uranium Recovery, & Waste Programs, Office of Nuclear Material Safety and Safeguards (NMSS), Safety Evaluation Report, License Amendment for the [CBR] [MEA] In-Situ Recovery Project, Dawes County, Nebraska at 19 (Jan. 2018) [hereinafter SER] (ADAMS Accession No. ML18229A331).

~~[4] See Renewal Site, LBP-16-13, 84 NRC 271.~~

[5] Prefiled ex. CBR005-R, [CBR], Application for Amendment of USNRC Source Materials License SUA-1534, [MEA], Crawford, Nebraska, Environmental Report at 1-3, tbl. 3.5-2 (rev. Apr. 25, 2014) (consolidated) [hereinafter ER] (ADAMS Accession No. ML18242A687); Prefiled ex. NRC006, Division of Fuel Cycle Safety, Safeguards & Environmental Review, NMSS, Environmental Assessment for the [MEA] License Amendment Application at 1-1, 2-5, 3-42 (Apr. 2018) [hereinafter EA] (ADAMS Accession No. ML18229A329).

[6] ER at 1-3; EA at 2-5.

[7] EA at 2-5.

each MU will be arranged in 7-spot patterns with a central production well surrounded by six injection wells spaced at between 65 and 150 feet (ft.) from each other in a hexagonal pattern.[8] Under the a license condition s of its existing license, whichthat also apply applies to the MEA,[9] CBR is authorized to inject lixiviant that contains either sodium carbonate or sodium bicarbonate, carbon dioxide, and either oxygen and/or hydrogen peroxide at the renewal siteexisting CBR ISR facility, and CBR has not requested a different lixiviant composition for the MEA.[10] From the MUs, CBR would extract uranium-bearing water from the subsurface via a production well and pipe the uranium-bearing water to the satellite facility located within the MEA for processing by loading the uranium onto ion exchange (IX) resins.[11] The loaded resins would then be transported by tanker truck to the central processing facility (CPF) at the existing renewal site for elution, drying, and packaging as yellowcake.[12] Barren resin would be returned to the MEA satellite building by tanker truck.[13] CBR would begin aquifer restoration activities in an active MEA MU when uranium recovery permanently ceases in that wellfield.[14]

B. Undisputed Regional Local Geologic Setting

1. General Stratigraphic Units

Starting from the youngest to oldest and including the thickness of the unit underlying

[8] Tech. Rep. at 3-11; SER at 66.

[9] SER at 72.

[10] Tech. Rep. at 3-3 (citing Prefiled ex. CBR009, Technical Report Tables at tbl. 3.1-5 (ADAMS Accession No. ML18229A265)); SER at 1672.

[11] Tech. Rep. at 3-29; SER at 16; EA at 1-2. "Satellite facility" as used in this the EA refers to the 1.8-acre (0.73 hectare (ha)) area shown in EA figure 1-1. EA at 1-3, fig. 1-1, 4-26.

[12] Tech. Rep. at 1-5.

[13] Id. at 1-5, 3-22; SER at 16.

[14] Tech. Rep. at 1-8 (citing Prefiled ex. CBR008-R, Technical Report Figures at fig. 6.1-1 (ADAMS Accession No. ML18242A688) [hereinafter Tech. Rep. Figs.]); SER at 77SER at 150; Ex. NRC009 at 11 (License Condition 10.1.5).

Commented [A3]: In footnote, edits reflect that TR at 3-3 and Table 3.1-5 do not appear to be appropriate supporting citations for this statement. Page 72 of the SER describes the lixiviant makeup (SER page 72 is reflected in LC 10.1.1) and also explains that the LC applies to the MEA.

Commented [A4]: In footnote, edits reflect that originally cited documents/pages do not appear to support the statement made.

Commented [A5]: The application and staff review documents use "local" to refer to the conditions at the MEA site. This section is primarily discussing conditions "within the MEA," so the parties believe "local" is appropriate.

Commented [A6]: The edits in the first two paragraphs of this section reflect the fact that "stratigraphy" is different from "hydrostratigraphy." The hydrostratigraphic functions should not be discussed when describing the stratigraphic units.

the MEA, the geologic units within the MEA are (1) the alluvium (less than 30 ft. thick); (2) the Arikaree Group (40 to 160+ ft. thick); (3) the Brule Formation (350 to 550 ft. thick); (4) the Upper and Middle Chadron Formations (360 to 450 ft. thick); (5) the Basal Chadron /Chamberlain Pass Formation (BC/CPF) (20 to 90 ft. thick);[15] and (6) the Pierre Shale (750 to greater than 1000 ft. thick).[16] The White River Group, which is referenced in the parties' testimony, includes, from youngest to oldest, the Brule Formation overlying the Upper and Middle units of the Chadron Formation, and the BC/CPF.[17]

These geologic units are consistent with regional units.[18] Further details of the hydrostratigraphic functions and properties for each formation are provided below starting with the youngest and ending with the oldest deposits.

The hydraulic conductivity of a formation is a measure of the ease or difficulty for groundwater to flow through the porous geologic media.[19] As such, the stratigraphic

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[15] Consistent with the Renewal Site proceeding, rather than using the historic terminology of the "Basal Chadron" for this formation or the more recent name of "Chamberlain Pass Formation," this formation will be referred to as the "Basal Chadron/Chamberlain Pass Formation." See Renewal Site, LBP-16-13, 84 NRC at 288–89 n.43; see also id. at 399–403 (indicating parties' experts agreed to use of this nomenclature, recognizing that its use did not affect the operation of the existing CBR ISR facility nor was there any disagreement that adopting the BC/CPF label did not change the hydrogeologic characterization of the formation).

[16] Tech. Rep. at 2-43 to -55; SER at 29–33.

[17] Prefiled ex. OST004, Testimony of Mike Wireman at 3 (ADAMS Accession No. ML18230A869); Tech. Rep. at 2-45; SER at 28.

[18] SER at 29; see also id. at 28.

[19] EA at 3-6.

units are subdivided or combined into "hydrostratigraphic" units based on ~~their~~ factors such as hydraulic conductivity, aquifer thickness, and transmissivity (hydraulic conductivity multiplied by thickness of the unit).[20] Hydrostratigraphic units that can transmit sufficient quantities of water of sufficient quality to provide beneficial use are described as aquifers.[21] Hydrostratigraphic units of low transmissivity are termed "aquitards," which, as described in greater detail below, may act as confining units.[22] Definitions of the aquifer parameters are as follows:[23]

K: hydraulic conductivity ~~(a.k.a. permeability)~~ – measure of the ~~ease or difficulty for groundwater flow~~ability of a porous material to transmit water, expressed as ~~distance/time~~groundwater discharge (volume) per unit area under a unit hydraulic gradient (e.g., cubic foot/square foot-day ~~(ft^3./ft^2-day)~~, cubic centimeter/square centimeter-sec ~~(cm^3/cm^2-sec) centimeter/second (cm./sec.)~~). Hydraulic conductivity is sometimes referred to as permeability.

T: transmissivity – ~~unit rate of water flow calculated as~~ the product of the hydraulic conductivity and aquifer thickness with units of distance squared per time ($ft.^2$/day)

Q: groundwater ~~flow quantity~~discharge – hydraulic conductivity multiplied by the hydraulic gradient and cross-sectional area ($ft.^3$/day)

S: storativity – describes the volume of water released from storage per unit change in hydraulic head per unit area in a confined aquifer (dimensionless number)

Sy: specific yield – volume of water that an unconfined aquifer releases from storage for a unit drop in the water table level (dimensionless number)

S_s: specific storage – calculated as the storativity divided by aquifer thickness (dimensionless number)

i: hydraulic gradient – slope of the water table or potentiometric surface calculated as the difference in water level elevation over a unit distance (dimensionless number)

ϕ: porosity – ratio of volume of void space ~~and~~ to the total volume of the aquifer (dimensionless number)

ϕ_h: hydraulic porosity – applies to turbulent flow in porous media, which is not significant in the operational setting of this application

ϕ_e: effective porosity – percentage of void space within a rock matrix that is

Commented [A7]: The parties do not object to including this definition, as edited; however, the term is not found on the cited pages of Exs. NRC001 or NRC006.

Commented [A8]: The parties do not object to including this definition; however, the definition is not found in the cited pages of Exs. NRC001 or NRC006. (Specific yield is defined on page 4-16 of the EA as "the drainable porosity of an unconfined aquifer.")

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[20] Id.

[21] Id.

[22] Id.

[23] EA at 4-16 to 4-17; Prefiled ex. NRC001, NRC Staff's Initial Testimony at 19–20 (ADAMS Accession No. ML18229A318).

interconnected and allows fluid to flow through it, noting that the remaining porosity consists of isolated or unconnected pores (dimensionless number)

2. Alluvium and Upper Aquifers

Surficial alluvium, discontinuous within the MEA, consists of fragments of locally outcropping sedimentary rocks, sand, gravel, and sandy soil horizons and may include weathered portions of the Arikaree Group.[24] Where present, these alluvial deposits for the MEA range from less than 3 ft. to approximately 30 ft. in thickness.[25]

The Arikaree Group (Arikaree), the surficial ~~strata~~ unit at the MEA where the alluvium is absent, overlies the Brule Formation (Brule).[26] The Arikaree ~~consists of~~contains numerous interbedded channel and floodplain deposits along with ~~windblown layers~~eolian volcanoclastics.[27] Based on grain size analysis of core samples, the interbedded layers within the unit include coarse to fine-grained sandstones with mudstones and siltstones.[28] Over the MEA, the Arikaree Group generally ranges between 40 ft. to over 160 ft. in thickness, with an average thickness of 105 ft. and increasing in thickness from south to north.[29] The coarse- to fine-grained sandstones represent locally water-bearing units that are interbedded with low-permeability mudstone units and vary widely in extent, ranging between 10 ft. to several hundred feet wide and up to 50 ft. thick.[30] The Arikaree is a surficial aquifer at the MEA.

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[24] Tech. Rep. at 2-42; SER at 33.

[25] Tech. Rep. at 2-42; SER at 33 (citing Tech. Rep. Figs. at figs. 2.6-3a to -3n).

[26] Tech. Rep. at 2-43; SER at 33.

[27] Tech. Rep at 2-43; Tech Rep. Figs. at figs. 2.6-3a to -3n; SER at 33.

[28] Tech. Rep. at 2-43; SER at 33.

[29] Tech. Rep. at 2-43; Tech. Rep. Figs. at fig. 2.6-6; SER at 33.

[30] Tech. Rep. at 2-80; SER at 33.

The Brule Formation in the region overlies the Chadron Formation and, in turn, is overlain by sandstones of the Arikaree Group.[31] The Brule consists of an uppermost ~~brown~~Brown ~~siltstone~~ Siltstone member underlain by siltstones with isolated beds of sandstone and volcanic ash (the Whitney member).[32] Beneath ~~this~~ these upper siltstone layers of the Brule are other clayey siltstones, claystones, sandstones and volcanic ashes (the Orella member).[33] At the MEA, the Brule Formation is predominated by the uppermost ~~brown~~ Brown ~~siltstone~~ Siltstone ~~layer~~and Whitney members.[34] At the base of the Brown Siltstone member are ~~This layer is underlain by~~ thick, fine to medium-grained sandstones, which are present across the entire MEA.[35] These sandstones constitute the first overlying aquifer above the production zone.[36]

The overall thickness of the Brule Formation in the MEA ranges from approximately 350 to 550 ft., generally thinning from north to south across the MEA.[37]

3. Upper Confining Units (UCU)

The Brule Formation is separated from the underlying BC/CPF by the Middle and Upper Chadron confining units.[38] The Middle Chadron is clay-rich with interbedded bentonitic clay and sand,[39] while the Upper Chadron is a bentonitic clay grading downward to green and red clay,

[31] Tech Rep. at 2-45; Tech. Rep. Figs. at fig. 2.6-1; SER at 49.

[32] Tech. Rep. at 2-45 to -46; SER at 32.

[33] Tech. Rep. at 2-46; SER at 32.

[34] Tech. Rep. at 2-45; SER at 32.

[35] Tech. Rep. at 2-45; SER at 32.

[36] Tech. Rep. at 2-46; SER at 32.

[37] Tech Rep. Figs. at figs. 2.6-3a to -3n (cross section), 2.6-7 (isopach map).

[38] Tech. Rep. at 2-41; SER at 48.

[39] Tech. Rep. at 2-48; SER at 31.

with some interbedded sandstone intervals.[40] The contact between the Upper and Middle Chadron is difficult to ascertain due to similarities in grain size and geophysical log responses.[41]

The thickness of the Upper and Middle Chadron units range from approximately 360 to 450 ft. and generally thins toward the south across the MEA.[42] Geophysical logging indicates that the Middle and Upper Chadron units are laterally continuous throughout the MEA.[43]

The ~~X-ray diffraction (XRD) analyses of both the Upper Chadron and Middle Chadron core samples and~~ grain size analysis from the MEA indicated the Upper/Middle Chadron samples are classified as siltstone, with more than 50 percent of the sample grain sizes reported to fall in the silt-clay fraction range, indicating the low-permeability nature of these units.[44] X-ray diffraction~~RD~~ analyses indicate that the chemical compositions of core samples from the Middle Chadron are highly similar to the Pierre Shale (e.g., predominantly mixed-layered illite/smectite or montmorillonite with quartz), which would be expected if the Pierre Shale was a contributing source of materials for the overlying Middle Chadron.[45]

4. Basal Chadron/Chamberlain Pass Formation (BC/CPF)

This ~~layer~~formation, which overlies the thick Pierre Shale and hosts the uranium ~~production zone~~ore body in localized channels, is a coarse-grained sandstone interbedded with thin silt and clay beds of varying thickness.[46] The BC/CPF is laterally continuous throughout the MEA, ~~ranges in~~occurs at depths ranging from approximately 850 to 1200 ft. below ground surface

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[40] Tech. Rep. at 2-48; SER at 31.

[41] Tech. Rep. at 2-49; SER at 31.

[42] Tech. Rep. at 2-49; see also Tech. Rep. Figs. at fig. 2.6-8; SER at 31.

[43] SER at 31; Tech Rep. Figs. at figs. 2.6-3a to -3n.

[44] Tech. Rep. at 2-47 to -49; SER at 31–32.

[45] Tech. Rep. at 2-84.

[46] Tech. Rep. at 2-49; SER at 30.

(bgs), and varies from approximately 20 to 90 ft. in thickness.[47] The MEA production zone is a roll front deposit with uranium mineral species present at concentrations ranging from 0.11 percent to 0.33 percent triuranium octoxide (U_30_8), with an average ore grade of 0.17 percent.[48] Based on the similar regional deposition of the currently licensed renewal site with the MEA (whereby the ore bodies in the two areas are within the same geologic unit and have the same mineralization source), the MEA ore body is expected to be similar mineralogically and geochemically to that of the ore body at the ~~currently licensed~~existing CBR ISR facility.[49]

5. Pierre Shale Lower Confining Unit (LCU)

The Pierre Shale is a thick, homogeneous black marine shale with low permeability that represents one of the most laterally extensive formations of northwest Nebraska. It ~~ranges in depth from approximately 870 to 1290 ft. bgs (based on the depth and thickness of the BC/CPF),[50] and~~ can be up to 1500 feet thick in the Dawes County area.[51] The regional estimates of the Pierre Shale's hydraulic conductivity ~~is of~~range from 10^{-7} to 10^{-12} cm./sec.[52] and there has been no observed transmissivity between vertical fractures in the Pierre Shale (which appear to be short and not interconnected).[53] During the Renewal Site proceeding, there was no dispute among the parties that the very low permeability of the Pierre Shale in the LCU prevents ~~mining liquids~~ISR production fluids from flowing downward from the base of the BC/CPF Aquifer, and as an undisputed regional hydrogeologic condition, the base of the

[47] Tech. Rep. at 2-50; Tech Rep. Figs. at figs. 2.6-3a to -3n, 2.6-9; SER at 67.

[48] Tech. Rep. at 2-55; SER at 31.

[49] Tech. Rep. at 2-55; SER at 31.

~~[50] Tech. Rep. at 2-50; SER at 52.~~

[51] Tech. Rep. at 2-52.

[52] Id. at 2-53.

[53] Id.; ER at 3-43.

Commented [A9]: CBR stated in the TR that the BC/CPF occurs at depths from 850 to 1200 feet bgs, but there is no comparable statement about the top of the Pierre Shale.

The numbers in this sentence appear to have been calculated by taking the stated ranges for the top of the BC/CPF (850 to 1200 ft bgs) and adding the minimum and maximum stated thicknesses of the BC/CPF (20 to 90 feet) to get 870 (850+20) and 1290 (1200+ 90).

Rather than rely on that calculation approach, the parties agree that this part of the sentence can be dropped because the range of depths at which the Pierre Shale occurs is not important.

Commented [A10]: The parties recognize that this terminology was used in LBP-16-13. However, because this is not written as a direct quote, "mining liquids" is changed for reasons discussed in the first comment on page 2.

BC/CPF Aquifer is the low-permeability Pierre Shale that acts as an LCU for the BC/CPF.[54]

C. Undisputed Regional Hydro~~geo~~logic Conditions ~~in the MEA~~

1. Surface Water Resources

The Niobrara River flows easterly through a point approximately 0.4 miles south of the southernmost MEA mine unit (MU-F).[55] The Niobrara River originates in eastern Wyoming near Manville, in Niobrara County, and flows in an east-southeast direction into western Nebraska.[56] The river flows across Sioux County in Nebraska, east through the Agate Fossil Beds National Monument, passing the town of Marsland and ~~to the south of the proposed MEA, continuing through~~ the southern boundary of the MEA, and through the 1600 acre Box Butte Reservoir, which is located approximately three miles to the east of the southeast corner of the MEA license boundary.[57] There are no apparent direct drainages from the MEA to the reservoir.[58] ~~While t~~The primary purpose of the reservoir is to facilitate irrigation.[59]~~, the~~ The Box Butte Reservoir has altered the hydrology of the Niobrara River by diverting water for irrigation.[60]

From the reservoir, the river flows east across northern Nebraska, and joins the Snake River approximately 13 miles southwest of Valentine, Nebraska.[61] The Niobrara River is a small

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[54] Renewal Site, LBP-16-13, 84 NRC at 296–97.

[55] Tech. Rep. at 2-77; EA at 3-18.

[56] Tech. Rep. at 2-77; EA at 3-19.

[57] Tech. Rep. at 2-77 to -78; EA at 3-19.

[58] Tech. Rep. at 2-78.

[59] EA at 3-19.

[60] EA at 3-19.

[61] SER at 45; see also Tech. Rep. Figs. at figs. 2.7-2 to -3.

size stream of limited areal extent with an average flow rate of 29 cubic feet per second (cfs).[62] The annual average stream flows at four gaged Niobrara River sites are decreasing over time.[63] While stream data indicates that the Niobrara River is gaining water from west to east, the mean flows have decreased with time.[64] Groundwater is the primary source of flow into the Niobrara River in the vicinity of the MEA and, in this area of the river, the discharge of the river is steady and persistent, with overbank flooding uncommon except during winter ice jams.[65]

2. ~~Subsurface W~~Groundwater Resources

Descriptions of the regional hydrostratigraphic units underlying the MEA and the region are provided for both the aquifers and confining units underlying the MEA.[66] The relevant regional aquifers ~~relevant to this safety evaluation~~ are in the Arikaree Group and the Upper Brule Formation (both of which are unconfined, surficial aquifers), and in the deeper, confined BC/CPF.[67] In the vicinity of the MEA, water has been observed in the Arikaree Group, Brule Formation, and the sandstone of the BC/CPF.[68] Alluvial deposits are discontinuous at the MEA and have not been shown to contain usable amounts of water.[69]

Separating the BC/CPF sandstone aquifer from the ~~surficial unconfined~~overlying

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[62] SER at 21.

[63] EA at 3-21.

[64] Id.

[65] Id.

[66] Tech. Rep. at 2-79 to -81. Aquifers are geological formations "with sufficient permeability and porosity to significantly transmit and store groundwater," and confining units are "strata with insufficient permeability (e.g., shale units) that hydraulically separate aquifers." SER at 48.

[67] SER at 48.

[68] Tech. Rep. at 2-79.

[69] Id.

aquifers in the ~~Upper~~ Brule Formation and the Arikaree Group are the remaining members of the Chadron and Brule Formations, which collectively are identified as the UCU to the BC/CPF sandstone aquifer.[70] The LCU beneath the BC/CPF sandstone aquifer is the Pierre Shale.[71]

II. REACHING PARTY AGREEMENT ON STIPULATION

In a joint filing to be provided to the Board by Friday, September 28, 2018, the parties should indicate whether they disagree with any portion of the above factual background statement and, in the event of such a disagreement, they should consult and submit proposed alternative wording.

It is so ORDERED.

FOR THE ATOMIC SAFETY
AND LICENSING BOARD

/RA/

G. Paul Bollwerk, III, Chairman
ADMINISTRATIVE JUDGE

Rockville, Maryland

September 18, 2018

[70] Id. at 2-79, 2-84 to -85.

[71] Id. at 2-52, 2-79, 2-84 to -86.

ATTACHMENT B

EDITS TO PROPOSED STIPULATION IN SEPTEMBER 18 ORDER

(CLEAN VERSION)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before the Licensing Board:

G. Paul Bollwerk, III, Chairman
Dr. Richard E. Wardwell
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Consistent with the configuration at the existing CBR ISR facility, wells within each MU will be arranged in 7-spot patterns with a central production well surrounded by six injection wells spaced at between 65 and 150 feet (ft.) from each other in a hexagonal pattern.[7] Under a

[2] The renewal of CBR's license in 2014 was the subject of a hearing before a different licensing board. Petitions for review from the CBR license renewal proceeding are pending before the Commission.

[3] Prefiled ex. CBR006, [CBR], Technical Report, [MEA] at 1-3 (June 2017) (consolidated) [hereinafter Tech. Rep.] (ADAMS Accession No. ML18229A259); Prefiled ex. NRC008, Division of Decommissioning, Uranium Recovery, & Waste Programs, Office of Nuclear Material Safety and Safeguards (NMSS), Safety Evaluation Report, License Amendment for the [CBR] [MEA] In-Situ Recovery Project, Dawes County, Nebraska at 19 (Jan. 2018) [hereinafter SER] (ADAMS Accession No. ML18229A331).

[4] Prefiled ex. CBR005-R, [CBR], Application for Amendment of USNRC Source Materials License SUA-1534, [MEA], Crawford, Nebraska, Environmental Report at 1-3, tbl. 3.5-2 (rev. Apr. 25, 2014) (consolidated) [hereinafter ER] (ADAMS Accession No. ML18242A687); Prefiled ex. NRC006, Division of Fuel Cycle Safety, Safeguards & Environmental Review, NMSS, Environmental Assessment for the [MEA] License Amendment Application at 1-1, 2-5, 3-42 (Apr. 2018) [hereinafter EA] (ADAMS Accession No. ML18229A329).

[5] ER at 1-3; EA at 2-5.

[6] EA at 2-5.

[7] Tech. Rep. at 3-11; SER at 66.

license condition that also applies to the MEA, CBR is authorized to inject lixiviant that contains sodium carbonate or sodium bicarbonate, carbon dioxide, oxygen and/or hydrogen peroxide at the existing CBR ISR facility, and CBR has not requested a different lixiviant composition for the MEA.[8] From the MUs, CBR would extract uranium-bearing water from the subsurface via a production well and pipe the uranium-bearing water to the satellite facility located within the MEA for processing by loading the uranium onto ion exchange (IX) resins.[9] The loaded resins would then be transported by tanker truck to the central processing facility (CPF) at the existing renewal site for elution, drying, and packaging as yellowcake.[10] Barren resin would be returned to the MEA satellite building by tanker truck.[11] CBR would begin aquifer restoration activities in an active MEA MU when uranium recovery permanently ceases in that wellfield.[12]

B. Undisputed Local Geologic Setting

1. General Stratigraphic Units

Starting from the youngest to oldest and including the thickness of the unit underlying the MEA, the geologic units within the MEA are (1) the alluvium (less than 30 ft. thick); (2) the Arikaree Group (40 to 160+ ft. thick); (3) the Brule Formation (350 to 550 ft. thick); (4) the Upper and Middle Chadron Formations (360 to 450 ft. thick); (5) the Basal Chadron /Chamberlain Pass Formation (BC/CPF) (20 to 90 ft. thick);[13] and (6) the Pierre Shale (750 to greater than 1000 ft.

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[8] SER at 72.

[9] Tech. Rep. at 3-29; SER at 16; EA at 1-2. "Satellite facility" as used in the EA refers to the 1.8-acre (0.73 hectare (ha)) area shown in EA figure 1-1. EA at 1-3, fig. 1-1, 4-26.

[10] Tech. Rep. at 1-5.

[11] Id. at 1-5, 3-22; SER at 16.

[12] SER at 150; Ex. NRC009 at 11 (License Condition 10.1.5).

[13] Consistent with the Renewal Site proceeding, rather than using the historic terminology of the "Basal Chadron" for this formation or the more recent name of "Chamberlain Pass Formation," this formation will be referred to as the "Basal Chadron/Chamberlain Pass Formation." See Renewal Site, LBP-16-13, 84 NRC at 288–89 n.43; see also id. at 399–403

thick).[14] The White River Group, which is referenced in the parties' testimony, includes, from youngest to oldest, the Brule Formation overlying the Upper and Middle units of the Chadron Formation, and the BC/CPF.[15]

These geologic units are consistent with regional units.[16] Further details of the hydrostratigraphic functions and properties for each formation are provided below starting with the youngest and ending with the oldest deposits.

The hydraulic conductivity of a formation is a measure of the ease or difficulty for groundwater to flow through the porous geologic media.[17] As such, the stratigraphic units are subdivided or combined into "hydrostratigraphic" units based on factors such as hydraulic conductivity, aquifer thickness, and transmissivity (hydraulic conductivity multiplied by thickness of the unit).[18] Hydrostratigraphic units that can transmit sufficient quantities of water of sufficient quality to provide beneficial use are described as aquifers.[19] Hydrostratigraphic units of low transmissivity are termed "aquitards," which, as described in greater detail below, may act as confining units.[20] Definitions of the aquifer parameters are as follows:[21]

(indicating parties' experts agreed to use of this nomenclature, recognizing that its use did not affect the operation of the existing CBR ISR facility nor was there any disagreement that adopting the BC/CPF label did not change the hydrogeologic characterization of the formation).

[14] Tech. Rep. at 2-43 to -55; SER at 29–33.

[15] Prefiled ex. OST004, Testimony of Mike Wireman at 3 (ADAMS Accession No. ML18230A869); Tech. Rep. at 2-45; SER at 28.

[16] SER at 29; see also id. at 28.

[17] EA at 3-6.

[18] Id.

[19] Id.

[20] Id.

[21] EA at 4-16 to 4-17; Prefiled ex. NRC001, NRC Staff's Initial Testimony at 19–20 (ADAMS Accession No. ML18229A318).

K: hydraulic conductivity – measure of the ability of a porous material to transmit water, expressed as groundwater discharge (volume) per unit area under a unit hydraulic gradient (e.g., cubic foot/square foot-day, cubic centimeter/square centimeter-sec). Hydraulic conductivity is sometimes referred to as permeability.

T: transmissivity –the product of the hydraulic conductivity and aquifer thickness with units of distance squared per time ($ft.^2$/day)

Q: groundwater discharge – hydraulic conductivity multiplied by the hydraulic gradient and cross-sectional area ($ft.^3$/day)

S: storativity – describes the volume of water released from storage per unit change in hydraulic head per unit area in a confined aquifer (dimensionless number)

Sy: specific yield – volume of water that an unconfined aquifer releases from storage for a unit drop in the water table level (dimensionless number)

S_s: specific storage – calculated as the storativity divided by aquifer thickness (dimensionless number)

i: hydraulic gradient – slope of the water table or potentiometric surface calculated as the difference in water level elevation over a unit distance (dimensionless number)

ϕ: porosity – ratio of volume of void space to the total volume of the aquifer (dimensionless number)

ϕ_h: hydraulic porosity – applies to turbulent flow in porous media, which is not significant in the operational setting of this application

ϕ_e: effective porosity – percentage of void space within a rock matrix that is interconnected and allows fluid to flow through it, noting that the remaining porosity consists of isolated or unconnected pores (dimensionless number)

2. Alluvium and Upper Aquifers

Surficial alluvium, discontinuous within the MEA, consists of fragments of locally outcropping sedimentary rocks, sand, gravel, and sandy soil horizons and may include weathered portions of the Arikaree Group.[22] Where present, these alluvial deposits for the MEA range from less than 3 ft. to approximately 30 ft. in thickness.[23]

The Arikaree Group (Arikaree), the surficial unit at the MEA where the alluvium is

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[22] Tech. Rep. at 2-42; SER at 33.

[23] Tech. Rep. at 2-42; SER at 33 (citing Tech. Rep. Figs. at figs. 2.6-3a to -3n).

absent, overlies the Brule Formation (Brule).[24] The Arikaree contains numerous interbedded channel and floodplain deposits along with eolian volcanoclastics.[25] Based on grain size analysis of core samples, the interbedded layers within the unit include coarse to fine-grained sandstones with mudstones and siltstones.[26] Over the MEA, the Arikaree Group generally ranges between 40 ft. to over 160 ft. in thickness, with an average thickness of 105 ft. and increasing in thickness from south to north.[27] The coarse- to fine-grained sandstones represent locally water-bearing units that are interbedded with low-permeability mudstone units and vary widely in extent, ranging between 10 ft. to several hundred feet wide and up to 50 ft. thick.[28] The Arikaree is a surficial aquifer at the MEA.

The Brule Formation in the region overlies the Chadron Formation and, in turn, is overlain by sandstones of the Arikaree Group.[29] The Brule consists of an uppermost Brown Siltstone member underlain by siltstones with isolated beds of sandstone and volcanic ash (the Whitney member).[30] Beneath these upper siltstone layers of the Brule are other clayey siltstones, claystones, sandstones and volcanic ashes (the Orella member).[31] At the MEA, the Brule Formation is predominated by the uppermost Brown Siltstone and Whitney members.[32] At the base of the Brown Siltstone member are thick, fine to medium-grained sandstones,

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[24] Tech. Rep. at 2-43; SER at 33.

[25] Tech. Rep at 2-43; Tech Rep. Figs. at figs. 2.6-3a to -3n; SER at 33.

[26] Tech. Rep. at 2-43; SER at 33.

[27] Tech. Rep. at 2-43; Tech. Rep. Figs. at fig. 2.6-6; SER at 33.

[28] Tech. Rep. at 2-80; SER at 33.

[29] Tech Rep. at 2-45; Tech. Rep. Figs. at fig. 2.6-1; SER at 49.

[30] Tech. Rep. at 2-45 to -46; SER at 32.

[31] Tech. Rep. at 2-46; SER at 32.

[32] Tech. Rep. at 2-45; SER at 32.

which are present across the entire MEA.[33] These sandstones constitute the first overlying aquifer above the production zone.[34]

The overall thickness of the Brule Formation in the MEA ranges from approximately 350 to 550 ft., generally thinning from north to south across the MEA.[35]

3. Upper Confining Units (UCU)

The Brule Formation is separated from the underlying BC/CPF by the Middle and Upper Chadron confining units.[36] The Middle Chadron is clay-rich with interbedded bentonitic clay and sand,[37] while the Upper Chadron is a bentonitic clay grading downward to green and red clay, with some interbedded sandstone intervals.[38] The contact between the Upper and Middle Chadron is difficult to ascertain due to similarities in grain size and geophysical log responses.[39]

The thickness of the Upper and Middle Chadron units range from approximately 360 to 450 ft. and generally thins toward the south across the MEA.[40] Geophysical logging indicates that the Middle and Upper Chadron units are laterally continuous throughout the MEA.[41]

The grain size analysis from the MEA indicated the Upper/Middle Chadron samples are classified as siltstone, with more than 50 percent of the sample grain sizes reported to fall in the

[33] Tech. Rep. at 2-45; SER at 32.

[34] Tech. Rep. at 2-46; SER at 32.

[35] Tech Rep. Figs. at figs. 2.6-3a to -3n (cross section), 2.6-7 (isopach map).

[36] Tech. Rep. at 2-41; SER at 48.

[37] Tech. Rep. at 2-48; SER at 31.

[38] Tech. Rep. at 2-48; SER at 31.

[39] Tech. Rep. at 2-49; SER at 31.

[40] Tech. Rep. at 2-49; see also Tech. Rep. Figs. at fig. 2.6-8; SER at 31.

[41] SER at 31; Tech Rep. Figs. at figs. 2.6-3a to -3n.

silt-clay fraction range, indicating the low-permeability nature of these units.[42] X-ray diffraction analyses indicate that the chemical compositions of core samples from the Middle Chadron are highly similar to the Pierre Shale (e.g., predominantly mixed-layered illite/smectite or montmorillonite with quartz), which would be expected if the Pierre Shale was a contributing source of materials for the overlying Middle Chadron.[43]

4. Basal Chadron/Chamberlain Pass Formation (BC/CPF)

This formation, which overlies the thick Pierre Shale and hosts the uranium ore body in localized channels, is a coarse-grained sandstone interbedded with thin silt and clay beds of varying thickness.[44] The BC/CPF is laterally continuous throughout the MEA, occurs at depths ranging from approximately 850 to 1200 ft. below ground surface (bgs), and varies from approximately 20 to 90 ft. in thickness.[45] The MEA production zone is a roll front deposit with uranium mineral species present at concentrations ranging from 0.11 percent to 0.33 percent triuranium octoxide (U_30_8), with an average ore grade of 0.17 percent.[46] Based on the similar regional deposition of the currently licensed renewal site with the MEA (whereby the ore bodies in the two areas are within the same geologic unit and have the same mineralization source), the MEA ore body is expected to be similar mineralogically and geochemically to that of the ore body at the existing CBR ISR facility.[47]

[42] Tech. Rep. at 2-47 to -49; SER at 31–32.

[43] Tech. Rep. at 2-84.

[44] Tech. Rep. at 2-49; SER at 30.

[45] Tech. Rep. at 2-50; Tech Rep. Figs. at figs. 2.6-3a to -3n, 2.6-9; SER at 67.

[46] Tech. Rep. at 2-55; SER at 31.

[47] Tech. Rep. at 2-55; SER at 31.

5. Pierre Shale Lower Confining Unit (LCU)

The Pierre Shale is a thick, homogeneous black marine shale with low permeability that represents one of the most laterally extensive formations of northwest Nebraska. It can be up to 1500 feet thick in the Dawes County area.[48] The regional estimates of the Pierre Shale's hydraulic conductivity range from 10^{-7} to 10^{-12} cm./sec.[49] and there has been no observed transmissivity between vertical fractures in the Pierre Shale (which appear to be short and not interconnected).[50] During the Renewal Site proceeding, there was no dispute among the parties that the very low permeability of the Pierre Shale in the LCU prevents ISR production fluids from flowing downward from the base of the BC/CPF Aquifer, and as an undisputed regional hydrogeologic condition, the base of the BC/CPF Aquifer is the low-permeability Pierre Shale that acts as an LCU for the BC/CPF.[51]

C. Undisputed Regional Hydrologic Conditions

1. Surface Water Resources

The Niobrara River flows easterly through a point approximately 0.4 miles south of the southernmost MEA mine unit (MU-F).[52] The Niobrara River originates in eastern Wyoming near Manville, in Niobrara County, and flows in an east-southeast direction into western Nebraska.[53] The river flows across Sioux County in Nebraska, east through the Agate Fossil Beds National Monument, passing the town of Marsland and the southern boundary of the MEA, and through the 1600 acre Box Butte Reservoir, which is located approximately three miles to the east of the

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[48] Tech. Rep. at 2-52.

[49] Id. at 2-53.

[50] Id.; ER at 3-43.

[51] Renewal Site, LBP-16-13, 84 NRC at 296–97.

[52] Tech. Rep. at 2-77; EA at 3-18.

[53] Tech. Rep. at 2-77; EA at 3-19.

southeast corner of the MEA license boundary.[54] There are no apparent direct drainages from the MEA to the reservoir.[55] The primary purpose of the reservoir is to facilitate irrigation.[56] The Box Butte Reservoir has altered the hydrology of the Niobrara River by diverting water for irrigation.[57]

From the reservoir, the river flows east across northern Nebraska, and joins the Snake River approximately 13 miles southwest of Valentine, Nebraska.[58] The Niobrara River is a small size stream of limited areal extent with an average flow rate of 29 cubic feet per second (cfs).[59] The annual average stream flows at four gaged Niobrara River sites are decreasing over time.[60] While stream data indicates that the Niobrara River is gaining water from west to east, the mean flows have decreased with time.[61] Groundwater is the primary source of flow into the Niobrara River in the vicinity of the MEA and, in this area of the river, the discharge of the river is steady and persistent, with overbank flooding uncommon except during winter ice jams.[62]

2. Groundwater Resources

Descriptions of the regional hydrostratigraphic units underlying the MEA and the region are provided for both the aquifers and confining units underlying the MEA.[63] The relevant

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[54] Tech. Rep. at 2-77 to -78; EA at 3-19.

[55] Tech. Rep. at 2-78.

[56] EA at 3-19.

[57] EA at 3-19.

[58] SER at 45; see also Tech. Rep. Figs. at figs. 2.7-2 to -3.

[59] SER at 21.

[60] EA at 3-21.

[61] Id.

[62] Id.

[63] Tech. Rep. at 2-79 to -81. Aquifers are geological formations "with sufficient permeability and porosity to significantly transmit and store groundwater," and confining units

regional aquifers are in the Arikaree Group and the Upper Brule Formation (both of which are unconfined, surficial aquifers), and in the deeper, confined BC/CPF.[64] In the vicinity of the MEA, water has been observed in the Arikaree Group, Brule Formation, and the sandstone of the BC/CPF.[65] Alluvial deposits are discontinuous at the MEA and have not been shown to contain usable amounts of water.[66]

Separating the BC/CPF sandstone aquifer from the overlying aquifers in the Brule Formation and the Arikaree Group are the remaining members of the Chadron and Brule Formations, which collectively are identified as the UCU to the BC/CPF sandstone aquifer.[67] The LCU beneath the BC/CPF sandstone aquifer is the Pierre Shale.[68]

II. REACHING PARTY AGREEMENT ON STIPULATION

In a joint filing to be provided to the Board by Friday, September 28, 2018, the parties should indicate whether they disagree with any portion of the above factual background statement and, in the event of such a disagreement, they should consult and submit proposed alternative wording.

It is so ORDERED.

FOR THE ATOMIC SAFETY
AND LICENSING BOARD

/RA/

G. Paul Bollwerk, III, Chairman

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are "strata with insufficient permeability (e.g., shale units) that hydraulically separate aquifers." SER at 48.

[64] SER at 48.

[65] Tech. Rep. at 2-79.

[66] Id.

[67] Id. at 2-79, 2-84 to -85.

[68] Id. at 2-52, 2-79, 2-84 to -86.

ADMINISTRATIVE JUDGE

Rockville, Maryland

September 18, 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)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing "JOINT RESPONSE TO THE BOARD'S PROPOSED FACTUAL STIPULATION" in the above-captioned proceeding have been served via the Electronic Information Exchange ("EIE"), the NRC's E-Filing System, this 28th day of September, 2018, which to the best of my knowledge resulted in transmittal of the foregoing to those on the EIE Service List for the above-captioned proceeding.

/Signed (electronically) by/

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