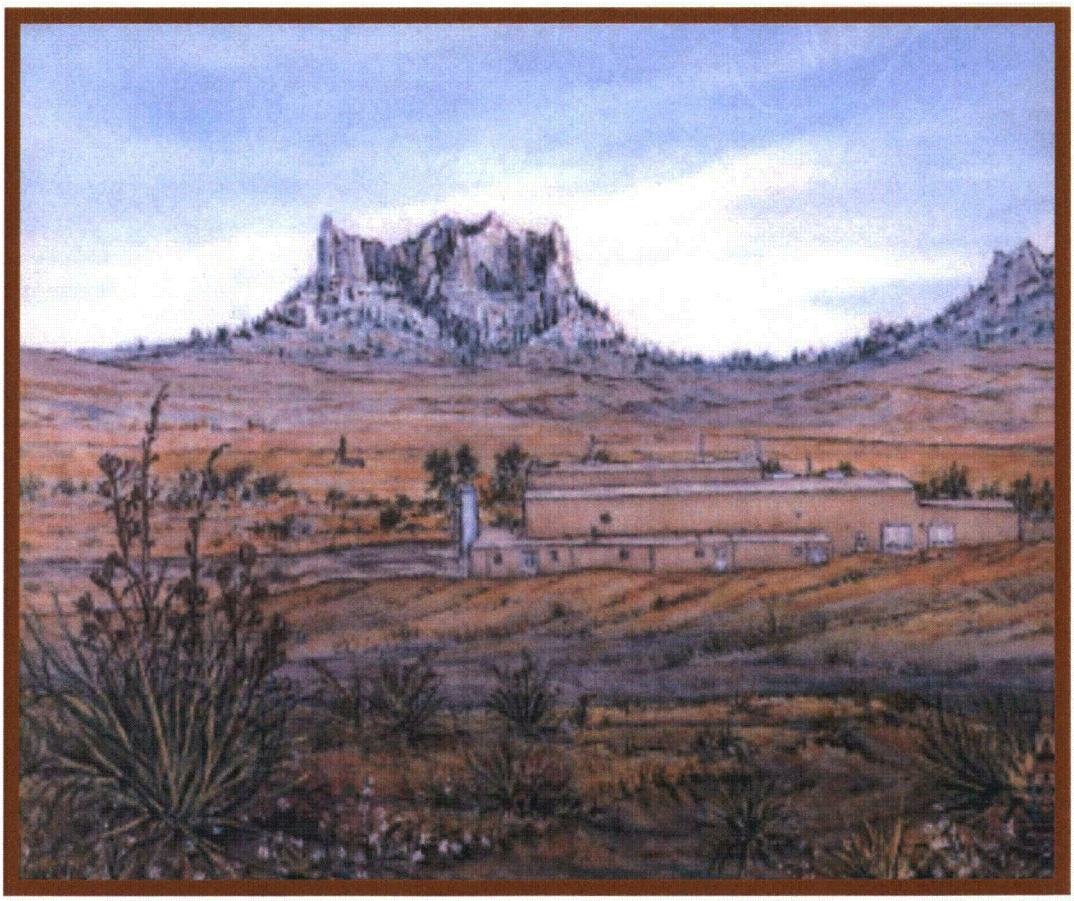
# Application for Amendment of USNRC Source Materials License SUA-1534 Marsland Expansion Area Crawford, Nebraska

## Volume I Technical Report

## Response to Request for Additional Information (RAI) Dated July 03, 2013



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**December 2013**

| Section 2 – Site Characterization | |
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| **RAI 1** Description of Deficiency Staff cannot confirm boundaries of restricted area and location of fences because of conflicting information.<br>Basis for Request NUREG-1569, Acceptance Criterion 2.1.3(3), states that maps should be provided that show the exclusion area boundaries and fences. The staff identified the following conflicting information in the TR:<br>The inset in Figure 1.7-5 of the TR identifies a chain-link fence around a restricted area. However, this identification of the restricted area conflicts with the text in Section 5.6.2 of the TR where it states, "the security fence surrounding the satellite facility serves as a control for industrial/property protection purposes with the restricted area noted in red on Figures 1.7-5 and 5.7-2." As the legend for Figure 1.7-5 of the TR indicates the red markings are for the Proposed MEA, this statement appears incorrect. In addition, Figure 5.7-2 of the TR identifies the restricted area as only being portions of the building and does not appear to include the entire fenced in satellite area as identified in Figure 1.7-5 of the TR.<br>Section 2.1 of the TR states that Figure 1.7-5 of the TR shows the proposed location of fencing, among other items. Section 5.7-2 of the TR states, "the fencing around the well field will control access and protect industrial property," but no fencing around the well fields is identified in Figure 1.7-5 of the TR.<br>Request for Additional Information The text and/or figures should be revised to clearly identify what is considered to be part of the restricted area and to correctly identify any fencing mentioned in the application. In addition, a description of the type of fencing, if not already identified, should be included. | Cameco Response: Figure 1.7-5 was revised to delete the incorrect reference to the restricted area fencing around the satellite building and to clarify the license boundary. There will be no fencing around the satellite building; only perimeter fencing will be present. Section 2.1 was revised to delete the reference to the fencing shown on Figure 1.7-5. Section 5.6 was revised to clarify proposed fencing associated with controlled and restricted areas. |
| **RAI 2** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.1.3(4).<br>Basis for Request NUREG-1569 in Section 2.1.2 states that the scale and clarity of the maps should be adequate to conduct the necessary environmental and safety reviews. Section 2.1 of the TR references Figure 1.3-1 as a primary reference to indicate topographical figures, drainage and surface water features; nearby population centers; political boundaries; and principal highways, railroads, transmission lines, and waterways. Because of lack of a complete legend and lack of contrast to allow identification of separate items in Figure 1.3-1, it is difficult to identify all roads, railroads, etc. In addition, the large pink gridlines obscure or completely hide some of these items (e.g, political boundaries, a road going directly through the Marsland site, etc.). | Cameco Response: Figure 1.3-1 was revised in order to improve the contents of the legend and drawing, which should help with defining all of the features depicted on the map. Other figures have also been reviewed and revised for better clarity. Other figures in the document that also provide features of interest that are not presented in this particular figure, such as Figures 1.3-2, 1.4-1, 1.7-3, 1.7-5, 2.2-1, 2.2-2, 2.2-3, 2.2-4, 2.7-1, 2.7-4, 2.7-6, 2.8-1, 2.8-2, 2.9-2, 2.9-3, 2.9-8 and 4.2-1. |

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| Request for Additional Information Please provide an appropriate legend and more clearly mark the map with contrasting colors so that the items in NUREG-1569, Acceptance Criterion 2.1.3(4), can be readily identified. The use of separate maps to highlight these items may also help clarify their locations. A map without gridlines or another method of identifying gridline (e.g., hash line) should also be used to avoid obscuring underlying highlights. Other maps using gridlines should also be reviewed and revised, as necessary, to ensure the gridlines are not obscuring pertinent information. | |
| **RAI 3** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.2.3(1)(b).<br>Basis for Request NUREG-1569, Acceptance Criterion 2.2.3(1)(b), states that projected life of facility water use should be provided. In Section 2.2.4 of the TR, the applicant states that "future water use within the MEA and AOR will likely be a continuation of present use" and that "it is unlikely that any irrigation will be developed within the license area." However, as the applicant appears to only lease the land and not own the land, there appears to be no controls over the installation of new wells in the MEA or AOR.<br>Request for Additional Information Please provide information on if and how the development of new wells in the MEA or AOR during facility operations will be identified or prevented. Also, if new wells are installed by other than the applicant, please describe any actions that will be taken to protect those wells. If any new wells in or near the MEA have been identified since the survey the license application is based on was completed approximately August 23, 2011), please provide information about those wells. | Cameco Response: By operation of the leases, no new wells will be installed within the license area without CBR permission.<br>There is no obligation to prevent new wells from being installed in the Area of Review. The Nebraska Department of Natural Resources registered well database will be reviewed annually, and where appropriate, arrangements will be made to monitor any new wells.<br>Between August 23, 2011 and September 16, 2013, no new private wells have been registered within the AOR. Section 2.2.4 was revised accordingly. |
| **RAI 4** Description of Deficiency The applicant did not provide complete private ground-water well information.<br>Basis for Request NUREG-1569, Acceptance Criterion 2.2.3(1)(c), states that for existing ground-water wells, well depth, ground-water elevations, flow rates, drawdown, and description of the producing aquifer(s) should be provided. The applicant did not provide this information for all existing wells.<br>Request for Additional Information Please provide flow rates, well depth elevations, well casing depth elevations, and static ground water elevations, drawdown elevations, and a further description of the producing aquifers (e.g., confined or unconfined) for all existing ground-water wells used as either a domestic drinking water supply or for agricultural purposes that lie within the MEA or within 1 kilometer of the MEA. Please describe the use of wells designated as "other" that are located in the MEA. | Cameco Response: The availability of this information is largely dependent on the age of the well, and how recently it may have been operated. Well owners were asked to provide whatever information they may have, and that information is presented in Appendix A.<br>The two wells labeled "other" were installed by CBR for drilling water. The wells are registered in the landowner's name as they will revert to the landowner when operations are complete. Section 2.2.4 was modified accordingly. |

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| **RAI 5** Description of Deficiency Staff cannot confirm the value of the MILDOS default mixing height of 100 m proposed by the applicant.<br>Basis for Request The applicant defines the mixing height as the height of the atmosphere above the ground that is well mixed due either to mechanical turbulence or convective turbulence, noting that the layer above this height is stable. Staff observes that this definition is consistent with the definition given by Holzman (refer to page 3 of EPA, 19721).<br>On page 2-91 of the TR, the applicant stated that the MILDOS default mixing height is 100 m and used this default value in its dose calculations. However, on page 2.7 of NUREG/CR-2011, *MILDOS – A Computer Program for Calculating Environmental Radiation Doses from Uranium Recovery Operations*, US NRC1981, a default mixing height of 1000 m is recommended.<br>Request for Additional Information Please provide the following information:<br>A. Provide the reference for the 100 m default mixing height value, or correct the statement in the TR regarding the default value of the mixing height; and<br>B. Revise MILDOS calculations if the default value is different than what was originally used, or demonstrate that the calculations used are conservative. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been resolved by the revisions to Section 2.5.3.8 submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. |
| **RAI 6** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.5.3(1).<br>Basis for Request NUREG-1569, Acceptance Criterion 2.5.3(1), states, in part: "The on-site program should be designed in accordance with Regulatory Guide (RG) 3.63, 'Onsite Meteorological Measurement Program for Uranium Recovery Facilities—Data Acquisition and Reporting' (NRC, 1988)." RG 3.63 provides guidance on the siting of meteorological instruments, including the effects from, and the location of, instruments in relationship to natural or man-made obstructions.<br>Staff has found no discussion on the characteristics of the site where the MEA meteorological instruments are, or were, located which would address the siting guidance in RG 3.63.<br>Request for Additional Information Please provide a description of the location of the MEA meteorological instruments (topography, obstructions or lack thereof, etc.) consistent with RG 3.63. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been resolved by the revisions to Section 2.5.3.7 submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. |

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| **RAI 7** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.5.3(2). | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI |

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| Basis for Request NUREG-1569, Acceptance Criterion 2.5.3(2), states, in part: "The impacts of terrain and nearby bodies of water on local meteorology are assessed, and the occurrence of locally severe weather is described and its impact considered." While staff found a discussion on severe thunderstorms in TR Section 2.5.1, staff found no discussion on any consideration of potential impacts of severe weather on MEA operations.<br>Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 2.5.3(2), please provide a discussion on the occurrence of locally severe weather and a consideration of its impacts, or provide a location in the TR where this can be found. | had been resolved by the revisions to Section 7.5.6.1 submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. |
| **RAI 8.A.** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.5.3(3).<br>Basis for Request NUREG-1569, Acceptance Criterion 2.5.3(3), states: "The meteorological data used for assessing impacts are substantiated as being representative of expected long-term conditions at and near the site." In addition, RG 3.63 provides guidance on determining the long-term representativeness of the onsite meteorological data collected over a minimum of 12 months. This includes various aspects of the National Weather Service meteorological station chosen for comparison.<br>In TR Section 2.5.1, the applicant indicated that the Scottsbluff meteorological station was chosen as the regional station to most represent MEA meteorology. This appears to be based mainly on distance (less than 50 miles) and the availability of hourly data for the last 15 years.<br>Request for Additional Information Please address the following issues related to determining the long-term representativeness of the MEA meteorological data:<br>A. Consistent with RG 3.63, please provide additional information on why the Scottsbluff station was chosen to represent the vicinity of the MEA site, including geographical and topographical descriptions, etc. | Cameco Response: In the public meeting dated September 4, 2013, NRC requested more discussion of the factors that lead to the selection of Scottsbluff over the other locations with Met stations. In addition to the revisions to Section 2.5.1 and Appendix S submitted by Cameco on June 26, 2013, further justification for selection of the Scottsbluff Met station is provided in revisions to Appendix S. |
| **RAI 8.B.** The Scottsbluff station has only 15 years of data. This is not consistent with the RG 3.63 recommendation for long-term analysis (e.g., 30 years). Please provide justification for using only 15 years of data. | Cameco Reponse: In the public meeting dated September 4, 2013, NRC requested additional justification for using 15 years instead of 30 years for the long-term analysis. In addition to the new Appendix S submitted by Cameco on June 26, 2013, further justification for use of 15 years data is provided in revisions to Appendix S. |

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| **RAI 8.C.1.** TR Figures 2.5-30 and 2.5-31 provide a statistical analysis of the 15-yr and baseline-year wind speed and wind direction for the Scottsbluff meteorological station. Please provide the following information on these analyses:<br>1. NUREG-1475, Rev.1, *Applying Statistics*, US NRC 2011, describes linear regression as a model that relates a dependent variable to a single, or multiple, independent variable(s). Please explain the validity of the proposed linear regressions when there appears to be no independent variable and it is unclear to staff what the regression equations in Figures 2.5-30 and 2.5-31 represent. | Cameco Response: In the public meeting dated September 4, 2013, NRC expressed concern that the regression analysis failed to include both dependent and independent variables. To that end, in addition to the new Appendix S submitted by Cameco on June 26, 2013, further discussion of the regression analysis is provided in revisions to this appendix. |
| **RAI 8.C.2.** TR Figures 2.5-30 and 2.5-31 provide a statistical analysis of the 15-yr and baseline-year wind speed and wind direction for the Scottsbluff meteorological station. Please provide the following information on these analyses:<br>2. p-values for the linear regression equations presented in TR Figures 2.5-30 and 2.5-31. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been resolved by the revisions submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. |
| **RAI 9.(a)** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Basis for Request Staff did not find information that is necessary to allow for an understanding of the project's geologic setting and likely ability of the strata to isolate production fluids consistent with Criteria 1 and 6 in Section 2.6.3 of NUREG-1569. Specifically,<br>(a) TR Section 2.6 (page 2-216) describes the pre-mining exploratory drilling program, but does not provide the number of drill holes, logging methods, and drill hole abandonment/plugging procedures.<br>(b) TR Section 2.6.1.3 (page 2-227) does not mention the Niobrara River structural feature in TR Figure 2.6-12 (page 2-313). According to Stout et al. (1971), this structural feature is a fault located south of the MEA site along the Niobrara River. The Bureau of Reclamation3 indicates that the Nebraska Geological Survey mapped this fault along the length of the river valley at the site of Box Butte Dam.<br>Request for Additional Information<br>(a) Please provide information on the pre-mining exploratory boring program (e.g., the number of drill holes, logging methods, and abandonment/plugging procedures).<br>NRC additional clarification dated October 23, 2013: Staff indicated that assurance of the proper plugging of all pre-mining exploratory drill holes must be provided. | Cameco Response: CBR has an on-going exploratory drilling program that to date has completed more than 1,800 drill holes in the MEA. A descriptive lithologic report based upon examination of the drill cuttings has been completed for nearly all of these holes. Descriptions of the depth, color, textures, and grain sizes for each horizon are summarized and correlated with geophysical logs completed within the same hole. Drill cutting samples are collected every 5 to 10 feet. Geophysical logs completed for each hole generally consist of a gamma ray, spontaneous potential (SP), and resistivity logging suite.<br>In addition to the exploratory boring program, CBR has completed seven core holes within the MEA (two in 2011; five in 2013). Data obtained from these cores (including lithologic descriptions, particle size distribution, and mineralogy via x-ray diffraction) have been incorporated into the applicable discussions of stratigraphy, lithology, and hydraulic properties. The locations of the core holes are illustrated on Figure 2.6-4 and the coring program is summarized in Table 2.6-3. Exploratory borings (including core holes) are plugged |

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| | and abandoned in compliance with the State of Nebraska Title 135 Mineral Exploration Permit that requires NDEQ approval. This permit allows for exploratory drilling within the boundaries of the permit, and has a surety bond to cover reclamation and hole abandonment costs if the permit holder is unable to fully abandon or reclaim the drill locations. Section 6.2.1.3 has been revised to include the text taken from Attachment 2 of the current NDEQ Class III UIC permit for Crow Butte. The new text in the application details the procedure for proper abandonment of exploratory drill holes |
| **RAI 9.(b).** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Request for Additional Information<br>(b) Please provide information pertaining to Niobrara River structural feature and any other known geological structural features in the vicinity of the MEA. Within and near the MEA, please further demonstrate the location of the Niobrara River fault that is proposed by Stout et. al. (1971). This demonstration should include structural contour maps of the tops of the Basal Chadron and the Upper Chadron. Additionally, please further demonstrate (1) the fault's structural form (e.g. fault or fold, (2) the natural confinement of the Basal Chadron Sandstone where the Nibrara River Structural Feature is located at and/or in close proximity to the MEA, (3) whether the ground water in the Basal Chadron is leaking through the Niobrara structural feature to the overlying aquifer, and (4) that the structural feature is not a concern for the Marsland operation. (Amended RAI provided in NRC letter dated October 23, 2013).<br>NRC additional clarification dated October 23, 2013: Within and near the MEA, please further demonstrate the location of the Niobrara River fault that is proposed by Stout et.al. (1971). This demonstration should include structural contour maps of the tops of the Basal Chadron and the Upper Chadron. Additionally, please demonstrate (1) the fault's structural form (e.g. fault or fold), (2) the natural confinement of the Basal Chadron Sandstone where the Niobrara Structural Feature is located and/or in close proximity to the MEA, (3) whether ground water in the Basal Chadron is leaking | Cameco Response: In the public meeting dated September 4, 2013, NRC requested additional discussion of Niobrara structural features and provided further clarification in its correspondence dated October 23, 2013.<br>Please note that Figure 2.6-12 referenced in the NRC comment is now Figure 2.6-16 due to the addition of new figures in Section 2.6. The Niobrara River structural feature has been added to the figure.<br>The Niobrara River Fault as mapped by DeGraw (1971, in Stout et al. [1971]) is located south of the MEA (see Figure 2.6-15). The Stout et al. (1971) publication is a guidebook that was published by the Nebraska Geological Survey and is the likely source of mapping alluded to by Bureau of Reclamation on their Box Butte Dam website (http://www.usbr.gov/projects/Facility.jsp?fac_Name=Box+Butte+Dam).<br>Additional discussion of the Niobrara River Fault has been added to Section 2.6.1.3 of the report. In summary, DeGraw (1971) does not provide discussion of the data supporting his interpretation of the Niobrara River Fault, nor does he discuss fault offset or |

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| through the Niobrara structural feature to the overlying aquifer, and (4) that the structural feature is not a safety concern for the Marsland operation. | formations affected. Structural contour mapping of the pre-Tertiary surface presented by DeGraw (1969) does not present data that clearly indicate the presence of a fault graben parallel to the Niobrara River. Structural contour maps of the top of the upper Chadron Formation and top of the basal sandstone of the Chadron Formation at MEA are presented as Figures 2.6-11 and 2.6-13, respectively. The pre-Tertiary surface within the MEA boundary is represented by a structural contour map of the top of the Pierre Shale, which is presented as Figure 2.6-13.<br><br>As shown on Figure 2.6-15, the Agate Springs Fault Complex is roughly parallel to the Niobrara River Fault and is within the graben mapped by DeGraw (1971). Approximately 60 feet of throw is observed in Arikaree Group deposits along the Agate Springs Fault (Hunt 1990), but the vertical extent of the fault appears to be unresolved beyond that which can be observed in outcrop. Similar offset of Arikaree Group sediments in the southern MEA is not apparent in data presented in cross-sections (Figures 2.6-3a through 2.6-3n).<br><br>Cameco has reviewed subsurface geologic data south of MEA to determine if this feature or related faults (similar to those of the Agate Springs Fault Complex) are located within the southern AOR. Review of subsurface geologic data between the southern MEA and approximately 10 miles south of the Niobrara River indicates that the regional south-southeast sloping Pierre Shale surface continues with no discernable break. Evidence of fault offset of the top of the Pierre Shale or of younger formations in that area is not observed.<br><br>As a result, neither Cameco's proprietary data, nor data published by DeGraw (1969, 1971) are sufficient to conclusively determine the nature of the Niobrara River |

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| | Fault proposed by DeGraw (1971).<br>As shown in cross-section A-A' (Figure 2.6-3a), the thickness of the confining unit composed of the upper Chadron Formation and middle Chadron Formation overlying the basal sandstone of the Chadron Formation maintains a generally consistent thickness of approximately 700 feet from north-to-south across the MEA. An isopach map of the confining unit is also presented as Figure 2.6-8. In the southernmost MEA (the portion of the MEA closest to the Niobrara River Fault), the confining unit is interpreted to be approximately 650 to 700 feet thick. Local variations in formation thickness observed throughout the MEA are generally attributed to incision during deposition of the overlying Brule Formation. As discussed in Section 2.7.2.3, particle size distribution (i.e., grain size analysis) of six core samples collected from the upper Chadron Formation and middle Chadron Formation indicate estimated hydraulic conductivities that range from 1.7x10-5 to 5.9x10-5 cm/sec.<br>Groundwater within the basal sandstone of the Chadron Formation exhibits significantly different geochemical characteristics (e.g., TDS, conductivity) than water found within the Arikaree and Brule aquifers. Table 2.9-4 summarizes the results of baseline groundwater sampling from these aquifers. These data do not support a conclusion that the Niobrara River Fault represents a significant preferential flow pathway by which groundwater is currently travelling from the basal sandstone of the Chadron Formation to either the Brule Formation or Arikaree Group.<br>The structural feature in question (Niobrara River Fault, as proposed by DeGraw [1971]) is not considered to present a concern to MEA operations for the following reasons: |

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| | 1. Available data do not corroborate the presence of the Niobrara River Fault within the MEA boundary as mapped by DeGraw (1971).<br>2. Sufficient evidence does not exist to conclude that the Niobrara River Fault intersects the basal sandstone of the Chadron Formation within the MEA boundary.<br>3. Pump test data do not indicate hydraulic connectivity between the basal sandstone of the Chadron Formation and overlying aquifers that could potentially exist along the Niobrara River Fault within the MEA boundary.<br>4. Geochemical characteristics of groundwater collected from the Arikaree Group and Brule Formation are substantially different than for water collected from the basal sandstone of the Chadron Formation, indicating a lack of cross-contamination due to leakage along the Niobrara River Fault within the MEA boundary. |
| **RAI 10** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Basis for Request CBR provides geologic information from borings collected from the MEA. However, CBR presents mineralogical information that originates from the main facility. Please provide mineralogical information from the MEA or demonstrate that the mineralogy for the MEA is comparable to that of the main facility. This information is necessary for geochemical evaluations of the site and an assessment of CBR's ability to restore groundwater to baseline. It is particularly important to understand the quantity of the mineral phases (i.e., uraninite, pyrite, calcite, and goethite) that are commonly used in geochemical analysis to support remediation strategies and restoration time frames.<br>Request for Additional Information Please provide mineralogical information from the MEA or demonstrate that the mineralogy for the MEA is comparable to that of the main facility. | Cameco Response: Mineralogical data based on x-ray diffraction analysis of core samples collected from MEA in 2011 and 2013 are provided as Appendices G-1 and G-2, respectively. Discussion of mineralogy by geologic unit based on these results has been added to the revised text in Sections 2.6-1 and 2.7.2.2. |
| **RAI 11** Description of Deficiency The information provided in TR Section 2.9.3.2 does | Cameco Response: CBR has included new |

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| not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.7.2 and acceptance criteria in Section 2.7.3 of NUREG 1569.<br>Basis for Request NUREG-1569, Acceptance Criterion 2.7.3(5), states: "The applicant has provided an assessment of seasonal and the historical variability for potentiometric heads and hydraulic gradients in aquifers and water levels of surface-water bodies. This assessment should include water levels or water potentials measurements over at least one year and collected periodically to represent any seasonal variability."<br>The applicant indicated that water level measurement events were conducted at Brule and Basal Chadron monitoring wells on February 22, 2011, and on August 12, 2011.<br>Potentiometric maps were provided for the February 22, 2011, water levels measurements. Consistent with NUREG-1569, Acceptance Criterion 2.7.3(5), staff did not find one year of seasonal water level data in the application.<br>Request for Additional Information Please provide one year of seasonal water level data for the Brule and Basal Chadron monitoring wells. For each monitoring event, please provide potentiometric maps of the potentiometric surface. Additionally, please provide time period when irrigation wells near MEA are active and their rates of groundwater extraction.<br>NRC additional clarification dated October 23, 2013: Staff indicated that the number of sampling wells that CBR has identified may not be adequate to demonstrate hydraulic effects from agricultural water wells. | potentiometric maps for the Arikaree Group, Brule Formation, and basal sandstone of the Chadron Formation based on water levels recorded during October (fall) of 2013 as Figures 2.9-4 through 2.9-6, respectively. These maps include data collected from newly drilled wells and are the first of a cohesive quarterly monitoring program that will evaluate seasonal water level changes across the MEA. The fourth consecutive quarterly monitoring event will be completed in the summer of 2014. Monitoring conducted during the irrigation season will provide further information about potential hydraulic effects from nearby agricultural wells.<br>Agricultural wells near MEA are primarily utilized for irrigation water between mid-May and early August, with lesser volumes of water extraction lasting into September. These wells are metered, but data are only collected annually; therefore, daily, weekly, and monthly extraction rates are unavailable. Flow rates for wells estimated by well users are provided in Appendix A. |
| **RAI 12.A** Description of Deficiency Staff can't complete its evaluation of NUREG-1569, Acceptance Criterion 2.9.3(1).<br>Basis for Request 10 CFR Part 40, Appendix A, Criterion 7, requires: "At least one full year prior to any major site construction, a preoperational monitoring program must be conducted to provide complete baseline data on a milling site and its environs. Throughout the construction and operating phases of the mill, an operational monitoring program must be conducted to measure or evaluate compliance with applicable standards and regulations; to evaluate performance of control systems and procedures; to evaluate environmental impacts of operation; and to detect potential long-term effects."<br>RG 4.14 provides guidance on preoperational environmental monitoring at uranium mills. NUREG-1569, Acceptance Criterion 2.9.3(1), states: "Monitoring programs to establish background radiological characteristics, including sampling frequency, | Cameco Response: In the public meeting dated September 4, 2013, NRC requested additional siting justification for the air monitors, specifically, consideration of where maximum concentrations are expected. To that end, in addition to the revisions to Section 2.9.2.1 submitted by Cameco on June 26, 2013, further siting justification is provided in Section 2.9.2.1 as well as revisions to Figure 7.3.2 depicting the locations and the estimated doses. |

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| sampling methods, and sampling location and density are established in accordance with pre-operational monitoring guidance provided in Regulatory Guide 4.14, Revision 1, Section 1.1 (NRC, 1980). Air monitoring stations are located in a manner consistent with the principal wind directions reviewed in Section 2.5 of the standard review plan."<br>During its review, staff found multiple examples of gaps in data presentation on the proposed preoperational effluent environmental monitoring program for the MEA. Staff requires additional information on, or clarification of, noted deficiencies in the background radiological section to draw its safety conclusions.<br>Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA:<br>A. Please provide criteria consistent with RG 4.14, Regulatory Position 1.1.1, used for determining air monitoring locations, or indicate where this information can be found in the application. | |
| **RAI 12.B.** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA:<br>B. Surface water and sediment sampling point N-2 appears to be over three miles from the south site boundary. This location does not appear to be consistent with RG 4.14 (i.e., not immediately downstream of the area of influence). Please provide a surface water and sediment sampling location for N-2 that is consistent with Acceptance Criterion 2.9.3(1) or justification for an alternate program. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been satisfied by the email to T. Lancaster dated 8/27/2013. Consistent with that email, Section 2.9.4.3 was revised to address the change in the location N-2 for river sampling, Section 2.9.5.3, was revised to clarify the fish sampling location, and Section 2.9.7.1, to reflect the change in river sediment sampling. This was confirmed in the NRC letter dated October 23, 2013. |
| **RAI 12.C.** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA:<br>C. Please submit the results of the preoperational/preconstruction monitoring program described in TR Section 2.9, including the survey discussed in TR Section 2.9.5.2, or a revised schedule for these items. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Figure 2.9-1 submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. Cameco has again updated Figure 2.9-1 to reflect the current schedule. |
| **RAI 12.D.** Description of Deficiency The information provided in TR Section 2.~~6~~9 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569. | Cameco Response: The calibration records for the first year of monitoring for air samplers are included in Appendix V-1. |

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| Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA:<br>D. Please provide the calibration records for the air samplers used during the first year of monitoring. | |
| **RAI 12.E.** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA:<br>E. Please provide the laboratory reports for all radiological baseline monitoring results. | Cameco Response: All of the radiological baseline monitoring results for air, surface water, groundwater, sediment and fish tissue were reported in the Cameco 6/26/2013 submittal. The laboratory analytical reports for groundwater samples were included in Appendix J. Laboratory analytical reports for air (particulates, radon and gamma), Niobrara river surface water, Niobrara River and ephemeral sediments, and Niobrara River fish tissue were not included in the 6/26/2013 submittal. Therefore, these analytical reports are now included in: Appendices U (air particulate), V-2 (radon), and V-3 (gamma); Appendix W-1 and W-2 (surface water and sediments, respectively) and Appendix X (fish tissue) of the current December 2013 submittal. |
| **RAI 12.F.** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA:<br>F. In TR Section 2.9.6, the applicant stated that transects will be made across the MEA to collect surface and subsurface soil samples in areas of the proposed well field. While general guidance in RG 4.10 was followed in preparing the proposed baseline soil sampling program, staff cannot determine that the full extent of operations within the proposed MEA will have the necessary baseline soil sampling performed to meet 10 CFR Part 40, Appendix A, Criterion 7, requirements. Please provide a more detailed description of where surface and subsurface oil sampling will be performed. | Cameco Response: A sampling plan with details on where and how surface and subsurface soil sampling will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. Section 2.9.6 has been revised accordingly. |
| **RAI 12.G.1.** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Request for Additional Information Please address the following issues regarding the | Cameco Response: A sampling plan with details on where and how direct radiation monitoring will occur will be submitted for NRC review in January 2013. |

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| proposed preoperational environmental monitoring program for the MEA:<br>G. In TR Section 2.9.8, the applicant described its baseline direct radiation monitoring program. Please provide the following:<br>(1) As noted in staff's review of the baseline soil sampling program, staff cannot determine that the full extent of operations within the proposed MEA will have the necessary baseline direct radiation monitoring performed to meet 10 CFR Part 40, Appendix A, Criterion 7, requirements. Please provide a more detailed description of where direct radiation monitoring will be performed. | Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. Section 2.9.8.1 was revised accordingly. |
| **RAI 12.G.2.** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA:<br>G. In TR Section 2.9.8, the applicant described its baseline direct radiation monitoring program. Please provide the following:<br>(2) In TR Section 2.9.8, the applicant stated: "The type of survey instrument and procedures would be as described below..." However, there is no text provided that addresses these issues. Please provide the type of survey instrument used for performing baseline direct radiation monitoring and the procedures used, as indicated in TR Section 2.9.8. | Cameco Response: A sampling plan with details on where and how surface and subsurface soil sampling will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. The plan will provide details on the type of instrumentation and procedures used. |
| **RAI 12.H.** Description of Deficiency The information provided in TR Section 2.6 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 2.6.2 and using acceptance criteria in Section 2.6.3 of NUREG-1569.<br>Request for Additional Information Please address the following issues regarding the proposed preoperational environmental monitoring program for the MEA:<br>H. RG 4.14 provides recommended values for the lower limit of detection (LLD) for radionuclides in various environmental media. The applicant provided a description of its laboratory measurements in regards to significant figures reported for environmental media measurements in TR Appendix Q. Several reported LLD values are not within RG 4.14 recommended values, even after taking into account the applicant's rationale described in TR Appendix Q (i.e., reporting LLD values with one significant figure, consistent with RG 4.14).<br>The following examples are not consistent with RG 4.14 recommended LLD values: | Cameco Response:<br>Table 2.9-5<br>On June 26th Cameco provided a revised Table 2.9-5 which included another additional round of sampling for Well 723. The well was not operational in the first and second quarter of 2012 and could not be sampled. Like Well 723, Well 721 is also completed in the Brule and is across the road, several hundred feet away. Data are available from the spring of 2013 for Well 721 which provides adequate seasonal Brule characterization in this area.<br>Table 2.9-26 (Table 2.9-29 in the revisions) and Table 2.9-27 (Table 2.9-30 in the revisions) |

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| | Recommended | Reported |
| Table 2.9-5 – Radiological Analysis for Private Water Supply Wells | | |
| March 2011 Well 723, Pb-210 (pCi/L) (dissolved) | 1 | 1.6 |
| Table 2.9-26 – Niobrara River Dissolved Radiological Water Quality | | |
| March 2011 sample at N1 for Th-230 (pCi/L) | 0.2 | 0.3 |
| April 2011 sample at N1 for Pb-210 (pCi/L) | 1 | 1.6 |
| July 2011 sample at N2 for Th-230 (pCi/L) | 0.2 | 0.4 |
| October 2011 sample at N1 for Th-230 (pCi/L) | 0.2 | 0.3 |
| Table 2.9-27 - Niobrara River Suspended Radiological Water Quality | | |
| June 2011 sample at N1 for Pb-210 (pCi/L) | 1 | 9 |
| Table 2.9-33 – Total Radionuclides and Metals in Tissue of Northern Pike | | |
| Ra-226 (microCi/kg) | $5 \times 10^{-8}$ | $2 \times 10^{-7}$ |
| Th-230 (microCi/kg) | $2 \times 10^{-7}$ | $8 \times 10^{-6}$ |
| Please provide all environmental media samples with measured values that have an LLD consistent with RG 4.14 or justification for an alternate program. | | |

The relocation of surface water sampling location N-2 requires 1 year of concurrent sampling at both locations. See revised Figure 2.9-1 for the schedule.

Table 2.9-33 (Table 2.9-37 in the revisions)

Additional fish tissue samples will be collected during the winter of 2013/2014 and early summer 2014. See revised Figure 2.9-1 for the schedule.

**RAI 13** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 2.9.3(2).

Basis for Request 10 CFR Part 40, Appendix A, Criterion 7, requires: "At least one full year prior to any major site construction, a preoperational monitoring program must be conducted to provide complete baseline data on a milling site and its environs. Throughout the construction and operating phases of the mill, an operational monitoring program must be conducted to measure or evaluate compliance with applicable standards and regulations; to evaluate performance of control systems and procedures; to evaluate environmental impacts of operation; and to detect potential long-term effects." RG 4.14 provides guidance on the preoperational and operational aspects of effluent and environmental monitoring at uranium mills. NUREG-1569, Acceptance Criterion 2.9.3(2), states: "Soil sampling is conducted at both a 5-cm [2-inch] depth as described in Regulatory Guide 4.14, Section 1.1.4 (NRC, 1980) and 15 cm [6 in] for background decommissioning data." During its review, NRC staff found no 15-cm soil samples proposed in the TR.

Request for Additional Information Please provide justification for not performing soil samples at 15-cm depths, or indicate where this can be found in the TR.

Cameco Response: A sampling plan with details on where and how surface and subsurface soil sampling will occur will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. Section 2.9.6 has been revised accordingly.

**RAI 14** Description of Deficiency The information provided in TR Section 2.9.3 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures

Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the

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| in Section 2.9.2 and acceptance criteria in Section 2.9.3 of NUREG 1569, and using Regulatory Guide 4.14.<br>Basis for Request TR Section 2.9.3 (p. 2-394) states: "Water quality analyses for private water wells provided in this section is for March 25 to December 20, 2012. Groundwater samples for the CBR monitor wells were collected from March 4 to May 3, 2011 for the Brule monitor wells and March 12 to April 11, 2011 for CBR Chadron monitor wells. Quarterly groundwater sampling will continue until 1 year of data have been obtained and reported to the NRC."<br>Staff has not received the above-referenced quarterly groundwater sampling results for private wells consistent with RG 4.14.<br>Request for Additional Information Please provide one year of quarterly sampling results for private wells consistent with RG 4.14. For private wells located at or within 2 km of the MEA that have not been included in this sampling program, please sample these wells quarterly for one year or provide justification for not sampling these wells. | RAI had been satisfied by the updates to Section 2.9.3 submitted by Cameco on June 26, 2013. |
| **Section 3 – Description of Proposed Facility** | |
| **RAI 15(a)** Description of Deficiency The information provided in TR does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 3.1.2 and acceptance criteria in Section 3.1.3 of NUREG 1569.<br>Basis for Request In accordance with NUREG 1569, Section 3.1.3 Criterion (5)(f), the application did not provide an acceptable analysis of the ground water hydraulic effects of nearby agricultural wells. Specifically,<br>(a) Considering the possible occurrence of regulated material releases to the overlying aquifer (e.g., from a potential surface spill or a potential well casing failure) within the MEA, the application does not provide an analysis of the possible ground water hydraulic effects that nearby agricultural wells (well locations are shown in TR Figure 2.7-6 as indicated by TR Table 2.2-11 and TR Appendix A) may have on the migration of potential MEA regulated material releases in the overlying ground water zone toward these wells. Thus, staff cannot confirm whether the applicant's monitoring, containment, corrective action programs for potential MEA regulated material releases into the overlying aquifer will be protective of the agricultural wells and other private wells (located between MEA operations and the agricultural wells).<br>Request for Addition Information<br>(a) Please provide an analysis of the hydraulic effects that nearby agricultural wells may have on the migration of potential MEA regulated material releases in the overlying ground water zone toward these wells. This analysis should further define | Cameco Response: Cameco has added a new Section 3.1.3.1 and incorporated a new Appendix AA into the license application in response to this RAI. With one exception, the private wells in the immediate vicinity of the Marsland facility are low yield. The one exception is Well 732. Well 732 is a high capacity well that serves two center pivot irrigation systems to the east and south east of the MEA. Cameco analyzed the potential hydrologic impacts to Well 732 resulting from a hypothetical shallow casing leak in the overlying aquifer at the MEA In-Situ Recovery (ISR) wellfields. As noted above the analysis is discussed in Section 3.1.3 and presented in its entirety in Appendix AA.<br>The report concluded that "(b)ased on the results of this analysis, MEA wellfields are not located within the capture zone of irrigation well 732. A shallow casing leak within the MEA wellfields will not impact irrigation well 732 at any time in the future given similar operating conditions."<br>The report also concluded that "given the location of |

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| the hydrostratigraphy within the Arikaree and Brule formations and should be centered on the protection of agricultural wells and other private wells (located between MEA operations and the agricultural wells) from potential MEA regulated material releases to the overlying aquifer. Results of this analysis should be used to demonstrate the effectiveness of the applicant's proposed monitoring, containment, and corrective action programs for addressing possible MEA regulated material releases into the overlying groundwater zone. | other domestic wells in the area... it is reasonable to conclude there are no other wells outside the MEA boundary that will be impacted by a potential release of MEA regulated material to the shallow aquifer."<br>By virtue of the leases, all existing private wells inside the license boundary are under Cameco control and Cameco will not allow the lessors to use the wells once operations have commenced in the vicinity. For existing private wells inside the license boundary and near active wellfields, all wells being actively used by Cameco will be monitored bi-weekly. This will ensure immediate identification of the private wells inside the license boundary on hypothetical shallow casing leaks. |
| **RAI 15.(b)** Description of Deficiency The information provided in TR does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 3.1.2 and acceptance criteria in Section 3.1.3 of NUREG 1569.<br>Basis for Request In accordance with NUREG 1569, Section 3.1.3 Criterion (5)(f), the application did not provide an acceptable analysis of the ground water hydraulic effects of nearby agricultural wells. Specifically,<br>(b) Staff is uncertain whether active agricultural wells (locations shown in Figure 2.7-6 as indicated by TR Table 2.2-11 and TR Appendix A) tap an unconfined or confined aquifer. Staff observes that if confining conditions exist, the application will need to demonstrate that the downward hydraulic influence of active agricultural wells (e.g., private well 732 shown in TR Figure 2.7-6) will not have an adverse effect of hydraulic containment of MEA production fluids in the Basal Chadron Formation beneath the MEA.<br>Request for Addition Information<br>(b) Please further demonstrate that the ground water hydraulic influence of nearby agricultural wells will not have an adverse effect on the hydraulic containment of MEA production fluids within the Basal Chadron Formation beneath the MEA. | Cameco Response: Pumping test data show that the basal sandstone of the Chadron Formation is hydraulically isolated from the overlying Arikaree Group and Brule Formation aquifers due to the presence of several hundred feet of claystones, mudstones, and siltstones of the upper Chadron Formation and middle Chadron Formation. Estimated hydraulic conductivity data based on particle size distribution analysis of core samples from the upper confining zone discussed in Section 2.7.2.2 support the effectiveness of these confining units indicated by the pumping test. No agricultural wells are completed in the basal sandstone of the Chadron Formation. Groundwater extraction by agricultural wells completed in the Arikaree Group or Brule Formation will have no influence on the containment of production fluids within the basal sandstone of the Chadron Formation. |
| **RAI 16** Description of Deficiency The information provided in TR Section 3.1 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in 3.1.2, and acceptance criteria in Section 3.1.3 of NUREG-1569.<br>Basis for Request The erosion and drainage characterization in TR Section 3.1.3.3 (p. 3-14) and TR Appendix K do not provide peak flows for surface drainage (e.g., during | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been satisfied by the revisions to Section 3.1.4 submitted by Cameco on June 26, 2013 except that NRC had not completed its evaluation of potential impacts |

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| potential flooding events) at MEA. This missing information is necessary for staff to perform an independent review of floods and surface water velocities at the MEA consistent with Section 3.1.3 of NUREG-1569.<br>Request for Additional Information Please provide peak flows for surface drainage at the MEA. | to structures. The NRC letter dated October 23, 2013 stated the revisions were adequate. |
| **RAI 17** Description of Deficiency The information provided in TR Section 3.1 and 6.1 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 3.1.2 and acceptance criteria in Section 3.1.3 of NUREG-1569.<br>Basis for Request Staff cannot confirm drawdown-distance estimates that are based on the estimated volumes of water that will be pumped during ground water sweep operations. This information is necessary to determine the impact of operations on ground-water flow patterns and aquifer levels consistent with NUREG-1569, Section 3.1.3.<br>Request for Additional Information Please provide drawdown-distance estimates that are based on the estimated volumes of water that will be pumped during ground water sweep operations and compare to the information from existing operations. | Cameco Response: Consistent with the email to Thomas Lancaster at the NRC dated 8/27/2013, a discussion of the drawdown analysis and resulting estimates for the MEA is provided in Section 7.2.5. In the NRC letter dated October 23, 2013, NRC stated that the response was satisfactory pending staff's independent verification of the estimate. |
| **RAI 18** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 3.2.3(3).<br>Basis for Request NUREG-1569, Acceptance Criterion 3.2.3(3), states that the description of the satellite processing facility should include size, type, and location of ventilation and filtration equipment. Although the description of the ventilation systems is discussed in broad terms in Section 4 of the TR including approximate locations, no details are provided (e.g., diagrams or information about flow rates, etc.) are provided.<br>Request for Additional Information Please provide detailed descriptions, including figures or diagrams, of the ventilation system to allow the adequacy of the system to be evaluated, or identify where this information is already provided. | Cameco Response: In response to forthcoming license conditions for the license renewal at the Crow Butte operation, Cameco commissioned a report entitled Air Ventilation, Air Surveys and Air Exchange Measurements for Plant Facilities at Crow Butte, NE and Smith Ranch Wy, August 14, 2013. Cameco has attached this report as Appendix Y. The report represents a detailed evaluation of current ventilation practices at Cameco ISR facilities.<br>Cameco is revising the text of the Marsland license application to make it clear that ventilation at the Marsland satellite facility will be designed and operated in the same manner as the Crow Butte facility. Consistent with the existing plant and report cited above, The MEA ventilation design will target four to five air exchanges per hour. In addition, the design will be provided to NRC for written verification. Four to five air exchanges per hour will be more than adequate, because the MEA will not involve pond water |

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| | treatment, elution or precipitation of uranium, or drying and packaging of yellowcake.<br>The performance of the existing Crow Butte ventilation system is discussed fully in the context of RAI 20 and 21. |
| **RAI 19** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 3.3.3.<br>Basis for Request NUREG-1569, Acceptance Criterion 3.3.3, requires descriptions of instrumentation and control. Although applicant provides a general overview of instrumentation and control in Section 3.3 of the TR, little specifics are provided. The applicant states that detailed information about the instrumentation and controls will be developed as part of the final design activities prior to construction and made available to NRC for review prior to any construction activities.<br>Request for Additional Information Please provide a description of the instrumentation and control systems. | Cameco Reponse: The instrumentation and controls at the MEA will be configured like the existing Crow Butte plant. Other than newer equipment, the interaction of the operators, computers, instrumentation, alarm systems and process equipment will not change. This consideration has been clarified in Section 3.3.<br>In addition, CBR has revised both Sections 3.1.3 and 3.3 to clarify that the manifold in each wellhouse is alarmed at 90 to 95 psi to ensure that the pressure remains below the 100 psi maximum injection pressure at the wellhouse manifold at all times. This provides a buffer between the maximum pressure and the 125 psi integrity test level that is demonstrated in every well. As noted in the application, due to line losses, the actual pressure at the wellhead is lower than the pressure monitored in the wellhouse manifold. |
| **Section 4 - Effluent Control Systems** | |
| **RAI 20** Description of Deficiency Elevated radon progeny levels experienced at the main facility are not addressed in the Marsland application.<br>Basis for Request NUREG-1569, Acceptance Criterion 4.1.3(3), states, in part: "The application provides a demonstration that adequate ventilation systems are planned for process buildings to avoid radon gas buildup..." Consistent with NUREG-1569, Appendix A, staff examined the historical operations at the main facility relevant to effluent control systems. As documented in the 2011 inspection report (ML11216A179), the applicant experienced elevated radon progeny levels in the Central Processing Plant.<br>Request for Additional Information Please provide a description of efforts to determine the cause of, and mitigation efforts to reduce the elevated levels , radon progeny in the main facility as they may relate to the construction of the Marsland satellite facility. In particular, please discuss any additional efforts to maintain airborne radon progeny levels as low as is reasonably achievable (ALARA) within the | Cameco Response: Contemporaneous with the construction and startup of the pond water treatment system in mid-2010, for the first time in several years Cameco exceeded 25 percent of the allowable limits for radon daughters in the CPF. Exceeding this action level triggered weekly instead of monthly radon daughter monitoring.<br>An investigation was conducted and two potential sources were identified: the pond water treatment system and the bicarbonate mix tank. The pond water treatment area did not have hard-piped exhaust ventilation and although the bicarbonate mix tank had hard-piped exhaust ventilation that ventilation capacity was shared with other radon sources. In an effort to |

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| Marsland satellite facility. | maintain ALARA radon progeny levels, Cameco installed independent hard-piped ventilation systems in both of these areas. This additional ventilation capacity was assessed by the report identified in RAI 19, immediately above. Since August 2012, radon progeny has not exceeded 25 percent of the allowable limit in the CPF. Although the existing MEA application already states that "separate ventilation systems will be installed for all indoor non-sealed process tanks and vessels where radon-222 or process fumes would be expected", Section 4.1.2.3 of the application has been revised to specifically identify areas where hard-piped ventilation will be required. To ensure the radon progeny levels are ALARA, Cameco is now including the bicarbonate mix tank as an example of an area requiring dedicated ventilation capacity. |
| **RAI 21** Description of Deficiency The applicant did not provide specific information regarding accident conditions related to the ventilation systems. In addition, it did not provide safety impacts of system failures or identify contingencies for such occurrences related to the ventilation systems.<br>Basis for Request NUREG-1569, Acceptance Criterion 4.1.3(4), states: "The application demonstrates that the effluent control systems will limit exposures under both normal and accident conditions. The application also provides information on the health and safety impacts of system failures and identifies contingencies for such occurrences. In TR Section 4.1.3, the applicant refers to its SHEQMS, Volume VIII, Emergency Manual, for responses to emergency situations that could occur at the site in the event of effluent system failures, but neither provides details on the safety impacts from these failures nor identifies contingencies for such occurrences.<br>Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 4.1.3(4), please provide details on accident conditions related to the ventilation systems. Specifically, please provide information on the health and safety impacts of ventilation system failures and identify contingencies for such occurrences for staff to evaluate NUREG-1569, Acceptance Criterion 4.1.3(4), or indicate where this information can be found in the application. | Cameco Response: First, some basics attributes of the ventilation system are important to this discussion. The ventilation system at the CPF and the one proposed for the MEA are not complex, and in this simplicity, the potential for significant problems are greatly reduced. Fundamentally, all ventilation fans run continuously and are inspected daily. Failures are rare and are readily observable. Replacement fan motors can be quickly sourced and failures can be quickly remedied.<br>When a fan fails, or is shut down for maintenance, negative pressure remains within the building by virtue of the many other fans that continue to operate. Failure of the largest single fan (#5 Duct) at the CPF would result in only a 13 percent reduction in total capacity.<br>SOP P.16 for the CPF addresses repair and maintenance of current ventilation systems. This SOP will be revised to also address MEA ventilation. A copy of the SOP and associated inspection form has been provided under |

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| | separate cover for NRC information, under a request for confidentiality.<br>In response to shutdown of a fan, Cameco immediately begins a process to return the fan to service. In the meantime, Cameco can respond with additional personal protective equipment, fans and by setting up radon progeny monitoring in the vicinity to detect real time radon progeny levels during the maintenance or repair process.<br>In summary, elevated radon levels are the primary health and safety impact of ventilation system failure. Given the redundant fans and Cameco's use of additional PPE and engineering controls, the dose impacts from system failures are maintained ALARA.<br>Section 4.1.3 of the application has been revised accordingly. |
| **RAI 22.(a).** Description of Deficiency The information provided in TR Sections 3.1 and 4.2 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Sections 3.1.2 and 4.2.2 and acceptance criteria in Section 3.1.3 and 4.2.3 of NUREG-1569.<br>Basis for Request Staff cannot confirm the following information, which is necessary to allow the staff to evaluate the applicant's operations in terms of generation and disposal of wastes consistent with the guidance in NUREG-1569, Section 3.1.3, item (5)(e); and Section 4.2.3, items (1) and (6).<br>(a) Estimates for the volume of wastewater expected to be generated during the ground water sweep and ground water treatment phases.<br>Request for Additional Information Please provide:<br>(a) Estimates for the volume of wastewater expected to be generated during the ground water sweep and ground water treatment phases. | Cameco Response: Please review the information presented in new Section 3.1.7 entitled MEA Water Balance, the new Figure 3.1-7 and the new Appendix T submitted by Cameco on June 26, 2013. |
| **RAI 22.(b).** Description of Deficiency The information provided in TR Sections 3.1 and 4.2 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Sections 3.1.2 and 4.2.2 and acceptance criteria in Section 3.1.3 and 4.2.3 of NUREG-1569.<br>Basis for Request Staff cannot confirm the following information, which is necessary to allow the staff to evaluate the applicant's operations in terms of generation and | Cameco Response: Well drilling fluid and well development water are discussed in Section 4.2.1.1, which has been revised to provide additional detail. Specifically, "well drilling fluids" are used to lubricate and cool the drill bit, remove drill cuttings from the borehole, and to seal the borehole walls to minimize |

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| disposal of wastes consistent with the guidance in NUREG-1569, Section 3.1.3, item (5)(e); and Section 4.2.3, items (1) and (6).<br>Request for Additional Information Please provide:<br>(b) The method for disposal of the drill cuttings for all MEA project wells. | fluid loss into the surrounding formation. "Well development water" is the water and solids generated during the under-reaming, air-lifting and well rehabilitation phases of well installation.<br>Well drilling fluid is captured and disposed in the drill pit. Once the well has been cased, any well development water is captured in water trucks and discharged into a cone-bottom tank at the satellite plant. That tank will feed a belt filter or other separation equipment, with the water being discharged into the DDW tank. The solids will be collected and handled as 11.e(2) waste. As a backup to this system, the well fluids would be transported to the existing evaporation ponds at Crow Butte.<br>Solid drill cuttings will be captured within earthen drill pits. Upon completion of the hole, the pits will be filled in and the dirt mounded to allow for subsidence. Later, topsoil will be applied and the site and any surface disturbance will be leveled to conform with the surrounding area. Disposal of drilling cuttings in an approved disposal pit is allowed by Nebraska Administrative Code (NAC) Title 135, Chaper 5, paragraph 002.02E. |
| **RAI 22.(c).** Description of Deficiency The information provided in TR Sections 3.1 and 4.2 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Sections 3.1.2 and 4.2.2 and acceptance criteria in Section 3.1.3 and 4.2.3 of NUREG-1569.<br>Basis for Request Staff cannot confirm the following information, which is necessary to allow the staff to evaluate the applicant's operations in terms of generation and disposal of wastes consistent with the guidance in NUREG-1569, Section 3.1.3, item (5)(e); and Section 4.2.3, items (1) and (6).<br>Request for Additional Information Please provide:<br>(c) The method for disposal of the purged water for baseline and monitoring well sampling during plant operations. | Cameco Response: Upon well completion all water generated is discharged to the surface with the exception of well workovers or excursions. When a baseline well is on excursion, the purge water is collected and disposed in the wastewater disposal system or taken to the evaporation ponds at the CPF. This is allowed by the NDEQ because the monitor wells are hydrologically separated from the confined basal sandstone of the Chadron Formation. Section 4.2.1.7 was revised accordingly. |
| **RAI 23** Description of Deficiency The application did not contain 10 CFR 20.2002 | Cameco Response: Cameco believes that most of the |

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| analysis of the deep disposal well consistent with NUREG-1569, Acceptance Criterion 6.1.3(13).<br>Basis for Request NUREG-1569, Acceptance Criterion 6.1.3(13), states, in part: "Proposals for disposal of liquid waste from process water by injection in deep wells must meet the regulatory provisions in 10 CFR 20.2002 and demonstrate that doses are ALARA and within the dose limits in 10 CFR 20.1301. The injection facility should be described in sufficient detail to satisfy the NRC need to assess environmental impacts. Specifically, proposals must include: (i) a description of the waste, including its physical and chemical properties important to risk evaluation; (ii) the proposed manner and conditions of waste disposal; (iii) an analysis and evaluation of pertinent information on the nature of the environment; (iv) information on the nature and location of other potentially affected facilities; and (v) analyses and procedures to ensure that doses are ALARA, and within the dose limits in 10 CFR 20.1301."<br>Request for Additional Information Please provide 10 CFR 20.2002 analysis of the deep disposal well that is consistent with NUREG-1569, Acceptance Criterion 6.1.3(13). | requested information has been provided. In addition to the revisions to Sections 3.1.7, 4.2.1.7, 7.2.5, 7.2.5.2 and 8.3.1.3 submitted by Cameco on June 26, 2013, where appropriate the text in these sections will be enhanced to address both RAI 23 and RAI 24<br>As a matter of information:<br>(i) Please see Tables 4.2-1 and 4.2-2.<br>(ii) Please see revisions to Section 4.2.1.7 submitted by Cameco on June 26, 2013. In addition, Cameco has again revised Section 4.2.1.7 to include information regarding:<br>a. What the Class I permit will allow<br>b. Additional information on alarms<br>c. Wastewater surge<br>d. Potential environmental impacts<br>(iii) The only other potentially affected facility is the existing Crow Butte operation. The cumulative impacts were addressed in Section 7.2.5.2 and the deep disposal well alternative is evaluated in Section 8.3.1.3.<br>(iv) In the response to RAI 20, Cameco has committed to include the recent upgrades to the ventilation systems at the CPF in the Marsland design. This commitment will ensure doses related to deep disposal well activities within the satellite facility remain ALARA. Additional discussion of the deep disposal wellhouse has been provided. |
| **RAI 24** Description of Deficiency The information provided in TR Section 4.2 does not meet the applicable requirements of 10 CFR Part 40 that will be protective of human health and the environment. The application indicates that surface impoundments (i.e., ponds) will not be constructed at the MEA and a series of six storage tanks (each 50,000 gallons in capacity) will be used to provide surge capacity between the satellite plant and the MEA deep disposal well (DDW). The applicant also identified trucking contaminated wastewater off-site for disposal in an emergency situation. Considering that page 3-10 of the application identifies an annual DDW flow rate of 35,500,000 | Cameco Response: In the public meeting dated September 4, 2013, NRC requested language stating that the schedule is based upon two deep disposal wells at Marsland, and a description of what the Class I permit will allow. Please see the revisions to Section 3.1.7 and 4.2.1.7, respectively.<br>As a matter of information:<br>a) See response to RAI 23, above. |

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| gallons per year (approximately 67.5 gallons per minute) and Figure 3.1-5 identifies a 120 gpm flow rate to the DDW, the 300,000 gallons of surge capacity would provide between 1.5 and 3 days of backup. It is not clear to the staff whether the proposed volume of the tank storage (300,000 gallons) will provide adequate surge capacity. Based on the above referenced conflicting DDW flow rates, staff is also unclear on the DDW disposal rate estimated for MEA.<br>Additionally, the application does not provide engineering and design aspects of the surge tanks and associated infrastructure (tank construction, secondary containment and any radiation protection implications). This information is necessary to determine if CBR's MEA operation will be protective of human health and the environment.<br>Request for Additional Information Please provide:<br>(a) better clarity of the anticipated DDW disposal.<br>(b) additional information that demonstrates that the tanks provide adequate surge capacity.<br>(c) a further discussion of other options for disposal of wastewater if the DDW suddenly is not available for an extended period of time.<br>(d) additional information concerning the engineering and design aspects of the tanks and associated infrastructure (e.g., tank construction, secondary containment, and any radiation protection implications). | b) See response to RAI 23, above.<br>c) Please see the prior revisions to Sections 3.1.6 submitted by Cameco on June 26, 2013.<br>d) Like the CPF, no additional tanks besides those within the satellite plant are planned to support deep disposal well operation. As such, the tank construction, secondary containment and radiation protection issues have already been addressed in the current description of the satellite plant.<br>In addition, Cameco provided to NRC a copy of the Class I Permit application and an electronic version of the Appendix T spreadsheet. |
| **Section 5 – Operations** | |
| **RAI 25** Description of Deficiency The applicant did not show integration between construction and plant management as part of the organizational structure.<br>Basis for Request NUREG-1569, Acceptance Criterion 5.1.3(2), states that the organization structure should show integration among groups that support the operation and maintenance of the facility, and if the facility is new, the integration between plant construction and plant management should be detailed. Although there will be construction of a new satellite facility and well fields, the applicant did not describe the integration between plant construction and plant management.<br>Request for Additional Information Please describe in the text or include in the organizational charts how construction will interface with plant management or indicate where this information can be found. | Cameco Response: Under separate cover, for information purposes CBR is providing the Cameco Resources SHEQ Management System, *Contractor Management Program*, Document Number CR-CMP, Revision Number 3, March 4, 2013 pursuant to a request for confidentiality. Because construction will be performed by outside contractors who are supervised by CBR and Cameco Resources staff, this program will control all Cameco interactions with its subcontractors.<br>In addition, a new Section 5.1.10 has been added revised to introduce the main elements of that program. |
| **RAI 26** Description of Deficiency Staff cannot complete its evaluation of NUREG- | Cameco Response: In Attachment 1 please find a list of |

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| 1569, Acceptance Criterion 5.5.3(2)<br>Basis for Request NUREG-1569, Acceptance Criterion 5.5.3(2), states: "The training program is acceptable if it meets the following criteria: It is consistent with Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure, Revision 3" (NRC, 1999). This guide provides guidance for protection of the fetus." RG 8.13, Regulatory Position C.2, provides guidance on the content of instruction concerning prenatal radiation exposure.<br>In TR Section 5.5.1.3, the applicant discusses instructions regarding prenatal exposure risks in general, but does not provide specifics on these instructions for staff to evaluate their consistency with RG 8.13. RG 8.13, Regulatory Position C.3, provides guidance on a licensee's policy on declared pregnant women.<br>The applicant did not provide its policy on declared pregnant women.<br>Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.5.3(2), please provide the following information:<br>1. the content of instruction concerning prenatal radiation exposure, and<br>2. the applicant's policy on declared pregnant women | topics covered in the video entitled Radiation and Pregnancy: A Decision to Declare, Radiological Testing Services, LLC, 1998. This video is currently shown to all female workers and supervisors during initial radiation training and to female workers again upon declaration. This or an equivalent instruction will be provided.<br>In addition to the video or equivalent instruction, the female workers are provided a copy of Regulatory Guide 8.13 and its appendix which is reviewed with the trainer and any questions are answered. Receipt of prenatal radiation exposure training is documented. Please see the form in Attachment 2.<br>Consistent with Regulatory Guide 8.13, Appendix A, it is CBR policy to accommodate pregnant workers when possible. To that end, CBR uses the following approach to address potential and actual prenatal exposure risks. CBR's policies on declared pregnant women are consistent with Regulatory Guide 8.13, Appendix A. Specifically:<br>• Instructions<br>o all female new hires<br>o supervisors in charge of female workers<br>o video instruction<br>o provision of RG 8.13 and its appendix and review with worker<br>o opportunity to ask questions<br>o possible effect on job status may involve adjustment of work duties as necessary<br>o review worker- specific exposure monitoring (e.g. dosimetry, bioassay where appropriate) following declaration<br>• Written declaration<br>o view video again and review RG 8.13<br>o review worker- specific exposure monitoring (e.g. dosimetry, bioassay where appropriate) following |

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| | declaration<br>• Possible effect on job status<br>o may involve adjustment of work duties as necessary<br>The text of Section 5.5.1.3 has been revised accordingly. |
| **RAI 27** Description of Deficiency The applicant did not provide details on its ventilation equipment related to minimum performance specifications and frequencies of tests and inspections.<br>Basis for Request<br>NUREG-1569, Acceptance Criterion 5.7.1.3 (4), states, in part: "The applicant describes minimum performance specifications for the operation of the effluent controls and the frequencies of tests and inspections to ensure proper performance to specifications..."<br>The applicant stated in TR Section 5.7.1.1 that ventilation equipment will be inspected for proper operation as recommended in RG 3.56 and that this equipment will be inspected during radiation safety inspections as discussed in TR Section 5.3.1.<br>Staff observes that RG 3.56 does not specifically address ventilation systems and only provides a general description of maintenance and testing, relying on manufacturer's recommendations and minimum timeframes. In addition, the applicant does not address ventilation systems operations in its radiation safety inspections discussed in TR Section 5.3.1.<br>Request for Additional Information Please provide details on the applicant's testing, maintenance, and inspection program for ventilation systems at the Marsland satellite facility, including wellhouse ventilation units. Specifically, please provide minimum performance specifications and frequencies of tests, inspections, and maintenance activities for these ventilation systems or indicate where this information can be found in the application.<br>Consistent with RG 3.56, please also describe any specialized training for those performing inspections on the ventilation systems. | Cameco Response: As noted above, the ventilation systems in use at the CPF are not complex. Like the CPF, the MEA ventilation system will be designed with a combination of doors, wall fans and hard-piped ventilation systems that will achieve four to five air exchanges per hour. This may be supplemented with box fans when needed. Consistent with the CPF, this will ensure reduction of radon progeny to ALARA levels.<br>The 10 foot by 30 foot well houses are continuously ventilated using 800 CFM wall or ceiling fans. The fans are visible from the door so that operability is verified prior to entry.<br>Daily inspections identify fans that require maintenance or have failed. Testing is not routinely performed as function is readily observable and the fans at the CPF are proven to have very long life expectancy.<br>Specialized training is not required to assess the operational status of the ventilation units.<br>As noted in response to RAI 27, Cameco has provided a copy of SOP P.16 and the associated inspection form as well as updates to Section 4.1.3. |
| **RAI 28** Description of Deficiency The applicant did not provide information on beta survey instruments.<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.2.3(3), states: "Monitoring equipment is identified by type, sensitivity, calibration methods and frequency, availability, and planned use to protect health and safety. The ranges of sensitivity for the proposed external radiation monitors are consistent with those appropriate to the | Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations. |

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| facility operation."<br>In TR Section 3.3, the applicant discusses various survey equipment but does not address equipment for performing beta surveys. In TR Section 5.7.2, the applicant discusses beta surveys, but does not discuss instruments for performing these surveys.<br>Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.2.3(3), please provide a description of beta monitoring equipment for the applicant's external radiation monitoring program identified by type, sensitivity, calibration methods and frequency, availability, and planned use to protect health and safety, or indicate where this information can be found in the application. | |
| **RAI 29** Description of Deficiency The applicant did not provide any specifics on its ALARA policy.<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.2.3(7), states: "Radiation doses will be kept as low as is reasonably achievable by following Regulatory Guide 8.10 (NRC, 1977) and Regulatory Guide 8.31 (NRC, 2002b)." RG 8.10, Regulatory Position C.1.a, recommends that plant personnel should be made aware of management's commitment to keep occupational exposures ALARA and that the commitment should appear in policy statements, instructions to personnel, and similar documents.<br>In TR Section 4.1.4, the applicant stated that it maintains a strict ALARA policy to keep exposures to all radioactive materials as low as possible as defined in SHEQMS, Volume IV, Health Physics Manual. However, the applicant did not provide any specifics from this reference or others, such as ALARA exposure goals and action levels associated with exposures to radioactive materials.<br>Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.2.3(7), please provide specific information on the applicant's ALARA policy statements, instructions, or other similar documents, including goals and action levels, as it relates to exposures to radioactive materials. | Cameco Response: CBR is providing Volume IV, SHEQMS Health Physics Manual under separate cover and under a request for confidentiality.<br>Specifically, the management commitment to ALARA is evidenced by:<br>• Management ALARA responsibilities are required reading during initial training, §2.5.3<br>• Documented annual ALARA audit §2.5.4.2<br>• Topic and possible test question in initial and annual radiation safety training<br>In the interest of ALARA exposures, CBR has established action level at 25 percent of the exposure limit for:<br>• Facility equipment and design, §2.5.10<br>• Radon progeny, §3.7<br>• Surface contamination control, §5.4<br>• Bioassay, §8.5.6<br>• Yellowcake slurry shipment (50 percent of action levels requires resurvey), §9.6.4.4 |
| **RAI 30** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 5.7.2.3(5).<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.2.3(5), states: "Plans for documentation of radiation exposures are consistent with the approach in Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1" (NRC, 1992b)." In TR Section 5.7.2, the applicant discusses its | Cameco Response: CBR is providing a copy of the documentation used for radiation exposures under separate cover and under a request for confidentiality. |

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| external radiation exposure monitoring program, but does not provide information on its documentation for external radiation exposure monitoring.<br>Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.2.3(5), please provide information on the applicant's documentation for external radiation exposure monitoring. | |
| **RAI 31** Description of Deficiency The applicant did not provide a drawing with proposed airborne uranium particulate sampling locations.<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.3.3(1), states: "The applicant provides one or more drawings that depict the facility layout and the location of samplers for airborne radiation. Locations are based, in part, on a determination of airflow patterns in areas where monitoring is needed, and determination of monitoring locations is consistent with Regulatory Guide 8.30, "Health Physics Surveys in Uranium Recovery Facilities," (NRC, 2002a)."<br>In TR Section 5.7.3.1, the applicant stated that one location near the resin transfer station will be sampled monthly for airborne uranium particulates. However, on Figure 5.7-2, there is no indication of an airborne uranium particulate sampling location.<br>Request for Additional Information Please provide, or update (e.g., Figure 5.7-2), a drawing with the proposed airborne uranium particulate sampling location or indicate where this can be found in the application. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been satisfied by the revisions to Figure 5.7-2 submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. |

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| **RAI 32** Description of Deficiency The applicant did not provide information on beta survey instruments.<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.3.3(3), states: "Monitoring equipment is identified by type, sensitivity, calibration methods and frequency, availability, and planned use to protect health and safety. The ranges of sensitivity for the proposed external radiation monitors are consistent with those appropriate to the facility operation."<br>In TR Section 3.3, the applicant discusses various survey equipment but does not address equipment for performing beta surveys.<br>Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.3.3(3), please provide a description of beta monitoring equipment for the applicant's airborne radiation monitoring program identified by type, sensitivity, calibration methods and frequency, availability, and planned use to protect health | Cameco Response: Please see response to RAI 28, which appears identical to RAI 32. |

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| and safety, or indicate where this information can be found in the application. | |
| **RAI 33** Description of Deficiency Staff cannot complete its evaluation of NUREG-1569, Acceptance Criterion 5.7.6.3(4).<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.6.3(4), states: "Monitoring equipment by type, specification of the range, sensitivity, calibration methods and frequency, availability, and planned use is adequately described. The application demonstrates that the ranges of sensitivity for monitoring equipment will be appropriate to expected facility operation." In TR Section 5.7.6, the applicant provides a description of survey equipment to be used in its contamination control program. However, it does not address the issues related to NUREG-1569, Acceptance Criterion 5.7.6.3(4).<br>Request for Additional Information Please address the following issues related to the proposed survey equipment described in TR Section 5.7.6:<br>A. Please provide the information requested in NUREG-1569, Acceptance Criterion 5.7.6.3(4).<br>B. Staff observes that the proposed Ludlum Model 44-38 probe is rated with a beta cutoff energy of 200 keV (refer to ADAMS accession No. ML13086A183). Some of the uranium decay products have beta energies that are below this cutoff energy. Please provide information on how surface contamination with beta-emitting radionuclides will be evaluated.<br>C. Please state whether the practice of washing the soles of shoes prior to exiting the restricted area will be used at the MEA. If this practice will be used, please demonstrate the minimum detectable concentration for contamination surveyed on the wet soles of shoes. | Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations. |
| **RAI 34** Description of Deficiency The applicant did not address NUREG-1569, Acceptance Criterion 5.7.6.3(6).<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.6.3(6), states: "The licensee will ensure that radioactivity on equipment or surfaces is not covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 5.7.6.3-1 of this standard review plan before application of the covering. A reasonable effort will be made to minimize the contamination before the use of any covering."<br>Request for Additional Information Please address NUREG-1569, Acceptance Criterion 5.7.6.3(6), for operations or indicate where this can be found in the application. | Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations. |

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| **RAI 35** Description of Deficiency The applicant did not address NUREG-1569, Acceptance Criterion 5.7.6.3(7).<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.6.3(7), states: "The radioactivity of the interior surfaces of pipes, drain lines, or duct work will be determined by making measurements at all traps and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or duct work."<br>Request for Additional Information Please address NUREG-1569, Acceptance Criterion 5.7.6.3(7), for operations or indicate where this can be found in the application. | Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations. |
| **RAI 36** Description of Deficiency The applicant did not address NUREG-1569, Acceptance Criterion 5.7.6.3(9).<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.6.3(9), states: "Appropriate criteria are established to relinquish possession or control of equipment or scrap having surfaces contaminated with material in excess of the limits specified in Table 5.7.6.3-1:<br>(a) The applicant will provide detailed information describing the equipment, or scrap; the radioactive contaminants; and the nature, extent, and degree of residual surface contamination.<br>(b) The applicant will provide a detailed health and safety analysis that reflects that the residual amounts of contaminated materials on surface areas, together with other considerations such as prospective use of the equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.<br>(c) The applicant includes materials created by special circumstances including, but not limited to, the razing of buildings, transfer of structures or equipment, or conversion of facilities to a long-term storage facility or to standby status."<br>Request for Additional Information Please address NUREG-1569, Acceptance Criterion 5.7.6.3(9), for operations or indicate where this can be found in the application. | Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations. |
| **RAI 37.A.1** Description of Deficiency Staff cannot verify the applicant's MILDOS calculations for the maximally exposed individual and its basis for not collecting vegetation, food, and fish samples during operations for the environmental monitoring program.<br>Basis for Request 10 CFR Part 40, Appendix A, Criterion 7, requires, in part: "...Throughout the construction and operating phases of the mill, an operational | Cameco Response: The MILDOS model was rerun and the report was revised to eliminate the duplicate reduction in source term. Please see the revisions to Appendix M. |

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| monitoring program must be conducted to measure or evaluate compliance with applicable standards and regulations; to evaluate performance of control systems and procedures; to evaluate environmental impacts of operation; and to detect potential long-term effects."<br>10 CFR 20.1301(a) requires, in part: "(a) Each licensee shall conduct operations so that – (1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contributions from background radiation, from any administration the individual has received, from exposure to individuals administered radioactive material and released under § 35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with § 20.2003..." 10 CFR 20.1302(b) requires, in part: "A licensee shall show compliance with the annual dose limit in § 20.1301 by — (1) Demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit..." NUREG-1569, Acceptance Criterion 5.7.7.3(1), states: "The proposed airborne effluent and environmental monitoring program is consistent with Regulatory Guide 4.14, Sections 1.1 and 2.1 (NRC, 1980) and as low as is reasonably achievable requirements as described in Regulatory Guide 8.37, Section 3 (NRC, 1993)".<br>RG 4.14, Section 2.1, provides guidance for conducting an operational environmental monitoring program including the collection of vegetation, food, and fish samples. Furthermore, RG 4.14 provides guidance that these media are relevant when a significant pathway to man is identified in individual licensing cases. A significant pathway is defined in RG 4.14, Footnote (o) to Tables 1 and 2, when a predicted dose to an individual would exceed 5 percent of the applicable radiation protection standard.<br>RG 3.51, Calculational Models for Estimating Radiation Doses to Man from Airborne Radioactive Materials Resulting from Uranium Milling Operations, provides guidance on calculating dose for individuals including ingestion of vegetables, milk and meat.<br><u>Request for Additional Information</u><br>A. In TR Sections 5.7.7.5 and 5.7.7.6, the applicant stated that it will not collect vegetation, livestock, crop, or vegetable garden samples as part of its operational environmental monitoring program based on the results of its MILDOS calculations presented in TR Appendix M. In order for staff to verify the technical bases for this | |

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| approach, please address the following issues:<br>1. In Appendix M1, page 7 of the report by Noel Savignac, the applicant describes the MILDOS operational input data. In addition to the assumed values of one percent for the radon venting rate of the wellfields (refer to NUREG-1569, Appendix D, and TR Appendix M, Table 2 of the report by Noel Savignac) and 20 percent of the radon released from the purge water, the applicant appears to further reduce the radon effluent by applying a 25 percent (radon venting from header houses) and 75 percent (radon venting from satellite plant) proportion factor in one scenario, and a 10 percent (radon venting from header houses) and 90 percent (radon venting from satellite plant) proportion factor in another scenario. Please provide additional clarification and justification for this apparent additional reduction in radon effluent concentration over and above the MILDOS-assumed value for wellfield venting and the applicant-assumed value for purge water venting. | |
| **37.A.2.** In Appendix M2, the applicant calculates the maximum dose to man from the vegetation pathway. Please address the following issues regarding the vegetation pathway analysis:<br>a. The applicant stated that it used the food production rate for Colorado from RG 3.51, Table 7, page 35, as Nebraska was not listed in this table. Staff observes that this tabulated data is from 1973 and that guidance on page 24 of RG 3.51 states that if other means are not available, it is acceptable to assume that regional agricultural productivity will remain in constant proportion to the U.S. population. Consistent with RG 3.51, please provide a discussion on efforts to derive site-specific (e.g., State, regional) agricultural productivity data and comparison of the tabulated agricultural productivity data with the U.S. population to derive an appropriate proportion factor.<br>b. The applicant calculated the maximum dose to an individual using the ratios of population exposures to vegetation, milk, and meat pathway to the total population exposure times the maximum resident dose at the Marsland operation. This approach does appear to address the requirements of 10 CFR 20.1302(b), dose to an individual, or be consistent with RG 3.51, Regulatory Position C.2, which provides guidance for dose calculations for individuals. Please provide justification for applying a population exposure ratio to derive a maximum individual exposure. | Cameco Response: Consistent with the Powertech Dewey Burdock alternate proposal at ML11208B714, Cameco proposes to take a soil sample from each garden in the area of review and then apply concentration factors to estimate the radionuclide concentrations in vegetables. Similar to Dewey Burdock, the large quantity of vegetables required to meet LLDs would decimate each home owner's crop. The specifics of this alternate approach are presented as revisions to Section 2.9.5.2. |

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| c. Staff observes that the maximum resident dose at the Marsland operation was calculated assuming the highest radon air concentrations during operations. For maximum total individual dose, this approach appears consistent with RG 3.51, Regulatory Position C.2 which states that the 1-yr exposure period is taken to be the year when environmental concentrations resulting from plant operations are expected to be at their highest level. However, the applicant stated that the dose from the vegetation pathway was calculated from the consumption of vegetables, meat, and/or milk that may have been impacted by the release of radon and its decay products on vegetation or forage from uranium in situ operations. Staff observes that the maximum vegetation concentrations will not necessarily occur during the same timeframe as the maximum radon air concentrations.<br>Consistent with RG 3.51, please provide the exposure period resulting in the maximum radiation dose from the vegetation pathway and reanalyze the maximum individual dose from the vegetation pathway if necessary. | |
| **37.B**. In TR Section 5.7.7.6, the applicant stated that it will not collect fish samples as part of its operational environmental monitoring program based on the results of the MILDOS analysis for vegetation uptake.<br>Staff observes that the correlation between vegetation uptake and the potential for a significant fish pathway is unclear. Consistent with RG 4.14, Section 2.1, please provide a direct dose analysis for the fish pathway to enable staff to determine if a significant pathway to man from fish exists or not. | Cameco Response: The incorrect vegetation uptake language has been removed from Section 5.7.7.6.<br>In addition, alternative language in Section 5.7.7.6 was modified to trigger operational fish sampling if upward trends in radionuclides are observed in sediment samples as the result of surface spills at the site. This alternative approach is justified because surface water flow is absent, the distance to the Niobrara River is significant, and the absence of sufficient fish in the Niobrara River above Box Butte Reservoir for sampling. It should also be noted that the perimeter monitoring wells and excursion control practices preclude a groundwater pathway to fish in the Niobrara River. |
| **37.C.** In Appendix M1, page 15 of the report by Noel Savignac, the applicant provides the maximum occupational dose using 1500 hours onsite for a full time worker. Staff observes that a normal work week is 40 hours, resulting in a more typical 2000 hours onsite during the year. This is also the number of hours assumed for a working year in the DAC and ALI values given in 10 CFR Part 20, Appendix B (refer to the Introduction to Appendix B to Part 20). Please provide a justification for assuming 1500 hours onsite for a full time | Cameco Response: The revised MILDOS-AREA assessment (Appendix M) presents the radiation doses for a 2,000-hour per year onsite full-time worker. |

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| worker. | |
| **RAI 38** Description of Deficiency The applicant did not provide the criteria used for determining the proposed locations for the airborne effluent monitoring stations.<br>Basis for Request NUREG-1569, Acceptance Criterion 5.7.7.3(2), states: "The proposed locations of the airborne effluent monitoring stations are consistent with guidance in Regulatory Guide 4.14, Sections 1.1.1 and 2.1.2 (NRC, 1980). The license applicant adequately considers site-specific aspects of climate and topography in determining the number and locations of off-site airborne monitoring stations and environmental sampling areas. The criteria used in selecting sampling locations should be given. All sampling locations should be clearly shown relative to the proposed facility, nearest residences, and population centers on topographic maps of the appropriate scale."<br>Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 5.7.7.3(2), please provide the criteria used for determining the proposed locations for the airborne effluent monitoring stations. | Cameco Response: Please see response to RAI 12.A., above. |
| **Section 6 – Ground-water Quality Restoration, Surface Reclamation, and Facility Decommissioning** | |
| **RAI 39** Description of Deficiency The information provided in TR Section 6.1 does not meet the applicable requirements of 10 CFR Part 40, using the review procedures in Section 6.1.2 and acceptance criteria in Section 6.1.3 of NUREG-1569.<br>Basis for Request CBR's technical basis for the proposed MEA flare factor (20%) is operational experience and hydrological modeling at nearby commercial ISR operation. Consistent with NUREG-1569, Section 6.1.3(2), the applicant did not propose a vertical and horizontal flare factors for the MEA, nor did it provide a technical basis that is specific to MEA.<br>Request for Additional Information Please propose vertical and horizontal flare factors or justification for proposing one flare factor for MEA. Also, provide a technical basis for the proposed flare factor(s). | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Section 6.1.4.1 submitted by Cameco on June 26, 2013. This was confirmed in the NRC letter dated October 23, 2013. |
| **RAI 40** Description of Deficiency The applicant did not provide a commitment to implement pre-reclamation survey programs for diversion ditches, surface impoundments, and transportation routes.<br>Basis for Request NUREG-1569, Acceptance Criterion 6.2.3(2), states that the pre-reclamation radiological survey program survey areas should include diversion ditches, surface impoundments, and transportation routes. Although in Section 6.2 of the TR, the third bullet states that the applicant will do radiological survey of all | Cameco Response: Section 6.2, pages 6-12 and 6-13 were revised to include a commitment to implement pre-reclamation survey programs for diversion ditches, surface impoundments (if any), and transportation routes. |

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| facilities, equipment, and materials on the site to identify the potential for personnel exposure during decommissioning, the list does not include the areas identified as missing. Although Section 6.4.5 of the TR states the applicant will adopt survey and sample protocols on a case by case basis, this appears to only apply to temporary ditches and impoundments and appears to only address confirmation of restoration rather than pre-reclamation surveys.<br>Request for Additional Information Please provide a commitment to implement pre-reclamation survey programs for diversion ditches, surface impoundments, and transportation routes, or identify where this commitment is already discussed. | |
| **RAI 41** Description of Deficiency In TR Section 6.4, the applicant refers to its RESRAD calculations in TR Appendix N for Marsland site-specific cleanup criteria. However, staff can't verify that the applicant utilized Marsland site-specific input data (e.g., soil type, wind speed, precipitation, etc.) for RESRAD appropriate for the site.<br>Basis for Request NUREG-1569, Acceptance Criterion 6.4.3(1), states: "The cleanup criteria for radium in soils are met as provided in 10 CFR Part 40, Appendix A, Criterion 6(6)." This criterion states that the design requirements for longevity and control of radon releases apply to any portion of a licensed and/or disposal site unless such portion contains a concentration of radium in land, averaged over areas of 100 m2, which as a result of byproduct material, does not exceed the background level by more than:<br>(i) 5 picocuries per gram (pCi/g) of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over the first 15 cm [5.9 in.] below the surface, (ii) 15 pCi/g of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over 15-cm [5.9-in.] thick layers more than 15 cm [5.9 in.] below the surface."<br>NUREG-1569, Acceptance Criterion 6.4.3(3), states: "Acceptable cleanup criteria for uranium in soil, such as those in Appendix E of this standard review plan, are proposed by the pplicant.<br>This is the radium benchmark dose approach of 10 CFR Part 40, Appendix A, Criterion 6(6)." NUREG-1569, Acceptance Criterion 6.4.3(4), states: "For areas that already meet the radium cleanup criteria, but that still have elevated thorium levels, the applicant proposes an acceptable cleanup criterion for thorium-230. One acceptable criterion is a concentration that, combined with the residual concentration of radium-226, would result in the radium concentration (residual and from thorium decay) that would be present in 1,000 years meeting the radium cleanup standard." | Cameco Response: A sampling plan with details on where and how Marsland site-specific cleanup criteria are to be determined will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Any required sampling will be conducted in late spring or early summer of 2014, prior to construction. |

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| NUREG-1569, Acceptance Criterion E2.1.3(2), states, in part: "...The code/calculation input data are appropriate for the site and represent current or long-term conditions, whichever is more applicable to the time of maximum dose. When code default values are used, they are justified as appropriate (representative) for the site..."<br>Request for Additional Information Please address the following issues related to the soil cleanup criteria for the MEA:<br>A. In TR Section 6.4.1, the applicant stated that the ALARA goal for natural uranium in the top 15 cm soil layer is 150 pCi/g averaged over *more than* 100 m2. The averaging of radionuclides over more than 100 m2 is not consistent with the requirements of 10 CFR Part 40, Appendix A, Criterion 6(6) or NUREG-1569, Acceptance Criterion 6.4.3(1). Please provide a justification for averaging the natural uranium concentration over more than 100 m2.<br>B. Consistent with NUREG-1569, Acceptance Criteria 6.4.3(3) and E2.1.3(2), please confirm that site-specific parameters relevant to the MEA (e.g., soil type, wind speed, precipitation, etc.) were used for the RESRAD analysis and thus deriving the radium benchmark dose. If the MEA site-specific parameters are different from what was analyzed, please provide a relevant RESRAD and radium benchmark dose analysis.<br>C. In TR Section 6.4, the applicant refers to its analysis of Th-230 at its main facility for the Marsland analysis without assessing if this analysis is applicable to the MEA. Consistent with NUREG-1569, Acceptance Criterion 6.4.3(4), please provide a MEA site-specific discussion on Th-230, or indicate where this information can be found. | |
| **RAI 42** Description of Deficiency In TR Section 6.4.2, the applicant provided a gamma action level of 17,900 cpm as the level corresponding to the Marsland soil cleanup criterion. In TR Appendix N, the applicant described its derivation of the gamma action level of 17,900 cpm. However, the gamma action level was derived from data at the main facility (i.e., background levels, etc.) and there is no justification addressing why this data can be applied to Marsland, an unrelated land area.<br>Basis for Request NUREG-1569, Acceptance Criterion 6.4.3(5), states: "The survey method for verification of soil cleanup is designed to provide 95-percent confidence that the survey units meet the cleanup guidelines. Appropriate statistical tests for analysis of survey data are described in NUREG–1575, 'Multi-Agency Radiation Survey and Site Investigation Manual' (NRC, 2000)."<br>Request for Additional Information Consistent with NUREG-1569, Acceptance Criterion 6.4.3(5), please provide a technical justification for applying a gamma action level of 17,900 cpm to the Marsland facility when data used to derive this action level | Cameco Response: RAI 42 - A sampling plan with details on where and how a Marsland site-specific gamma action level is to be determined will be submitted for NRC review in January 2013. Following resolution of any issues, the application will be revised to highlight the elements of that plan. Sampling will be conducted in late spring or early summer of 2014, prior to construction. |

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| is based on site-specific data for the main facility, an unrelated land area. | |
| **ADMINISTRATIVE ISSUES** | |
| **Section 1 – Proposed Activities** | |
| **Admin §1 #1.** In Figure 1.7-5, the inset map identifies the road passing the site as Squaw Mountain Road. The main map identifies the road as Squaw Mound Road. The road's name should be corrected as appropriate. | Cameco Response: Figure 1.7-5 was revised to provide the correct name - Squaw Mound Road. |
| **Section 2 – Site Characterization** | |
| **Admin §2 #1.** In Section 2.1, the application states that Figure 1.7-2 shows the Restricted Areas for the current license area. This is not readily identified in Figure 1.7-2. It appears that this reference may have been intended for Figure 1.1-1 of the ER. This statement should be removed from the text or the restricted area should be identified in Figure 1.7-2 or the proper figure should be included in the TR. | Cameco Response: Figure 1.7-2 has been revised to show the Restricted Areas for the current license area. |
| **Admin §2 #2.** In Section 2.2.2.5, the second paragraph states that there are four abandoned wells in the AOR. Figure 2.2-3 shows that there are five (Porter 1, Royal 1, Chicoine 1, Chicoine 1A, and Smith 1-A). The text in Section 2.2.2.5 should be corrected. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been satisfied by the revisions to Section 2.2.2.5 submitted by Cameco on June 26, 2013. |
| **Admin §2 #3.** In Table 2.2-10, no units are provided. These should be added to the table. In addition, the table identifies the average well depth as 530.21, whereas the text in Section 2.2.4 indicates that the primary water supply is between 50 to 350 feet bgs. Similarly, the table identifies the average static level as 174.90, but the text in Section 2.2.4 indicates it ranges from 50 to 150 feet bgs. These inconsistencies should be corrected or explained. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Table 2.2-10 submitted by Cameco on June 26, 2013. |
| **Admin §2 #4.** Figure 3.2-1 provides a diagram showing the satellite facility equipment layout; however, certain equipment shown in the diagram are not listed in the table legend (e.g., P-101 to P-120, RO-100, and F-100). In addition, T-114 is identified in the table legend, but cannot be located on the diagram. Missing items should be added to the legend and T-114 should be added to the diagram or corrected. | Cameco Response: Figure 3.2-1 was deleted and replaced with Figure 5.7-2. The table legend and figure were corrected to match. |
| **Admin §2 #5.** TR Table 2.5-2 indicates that the source for hourly temperature data for Scottsbluff Airport is from 1961 through 2011. This data appears identical to temperature data in Figure 2.5-2 that is from hourly data from 1996 through 2011. Please confirm the dates which were used for deriving Table 2.5-2 and Figure 2.5-2. | Cameco Response: Table 2.5-2 was revised with the correct time-period of 1996 through 2011. |
| **Admin §2 #6.** TR Section 2.5-2 refers to Table 2.5-3 for temperatures for the Scottsbluff Airport site. The correct reference appears to be Table 2.5-2. Please change reference as appropriate. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been satisfied by the revisions to Section |

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| | 2.5-2 submitted by Cameco on June 26, 2013. |
| **Admin §2 #7.** The summer wind rose (Figure 2.5-21) appears to be composed of two separate timeframes from 2010 and 2011. Please clarify the timeframe for the summer wind rose in Figure 2.5-21. | Cameco Response: The timeframe of 9/07/2010 to 8/29/2011 for the summer wind rose was added as a notation in Figure 2.5-21. Because the monitoring year spans parts of two calendar years, the summer wind rose software program used all of the available summer data from both years. This turned out to be September of 2010 (beginning with the 7th), July of 2011, and August of 2011 (up to the 29th). Therefore, the summer months are extracted from the stated date range. |
| **Admin §2 #8.** TR Section 2.5.3-4 (Precipitation) reports precipitation in inches. TR Figure 2.5-25 reports precipitation in millimeters. The values appear identical. Please clarify what the correct precipitation units are. | Cameco Response: Figure 2.5-25 was revised with the correct precipitation units (inches). |
| **Admin §2 #9.** TR Table 2.5-7 appears to be a tabulation of site-specific meteorological data (wind) from August 2010 to August 2011. However, the reference at the bottom of the table-credits the National Climatic Data Center (1996 – 2011) as the source of the information. Please clarify the source and timeframe of the meteorological data in Table 2.5-7. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been satisfied by the revisions to Table 2.5-7 submitted by Cameco on June 26, 2013. |
| **Admin §2 #10.** For TR Table 2.5-8, Marsland Expansion Area Wind Summary, please provide units for the columns "Average", "Maximum", and "Minimum" under the wind direction portion of the table. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Table 2.5-8 submitted by Cameco on June 26, 2013. |
| **Admin §2 #11.** Section 2.5.1 of the TR indicates that the MEA site-specific meteorological station coordinates and period of operation can be found in Table 2.5-1. NRC staff cannot locate this information in Table 2.5-1. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Table 2.5-1 submitted by Cameco on June 26, 2013. |
| **Admin §2 #12.** Please confirm the TR table where the MEA site-specific meteorological station coordinates and period of operation can be found. | Cameco Response: The MEA site-specific meteorological station coordinates are provided in Table 2.5-1. The period of operation for the MEA site-specific meteorological station is provided in 2.9.2.1. |
| **Admin §2 #13.** Cross-sections provided in Figures 2.6-3a to 2.6-3n are incorrectly labeled with repeating elevations of 3400 and 3500. Please provide these figures with correct elevations. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been satisfied by the revisions to Figures 2.6-3a through 2.6-3n submitted by Cameco on June 26, 2013. |

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| **Admin §2 #14.** The legend of the Structure Map provided in Figure 2.6-10 is incorrectly labeled with "groundwater elevation" and "groundwater potentiometric surface." Please revise this figure. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Figure 2.6-10 (Table 2.6-13 in the revisions) submitted by Cameco on June 26, 2013. |
| **Admin §2 #15.** In TR Section 2.9.2.1, the applicant stated that the local wind direction is predominantly from south-southwest direction approximately 45 percent of the time. This statement appears inconsistent with the previous statement in TR 2.5.3.3 regarding the northnorthwesterly and northwesterly winds and TR Figure 2.5-20 and Table 2.5-7 that indicates the south-southwest winds occur with a relative frequency of 5.3 percent of the time. Please provide clarification on the predominant wind direction. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Section 2.9.2.1 submitted by Cameco on June 26, 2013. |
| **Admin §2 #16.** TR Section 2.9.2.1 indicates that the local meteorological station was operated from August 28 through August 29, 2011. Please confirm the year that the MEA meteorological station initiated data collection. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Section 2.9.2.1 submitted by Cameco on June 26, 2013. |
| **Admin §2 #17.** Please provide a consistent description of the preoperational and operational environmental surface water monitoring plan consistent with RG 4.14.<br>(a) TR Section 2.9.4.3 and Tables 2.9-26 and 2.9-27 indicate that surface waters will be sampled on a monthly basis. However TR Table 2.9-35 indicates that surface water samples will be performed on a quarterly and semiannual basis.<br>(b) TR Section 5.7.8.3 indicates that operational samples will include Po-210. TR Table 5.7-1 does not include Po-210 as an analyte.<br>(c) TR Table 5.7-1 indicates two samples will be collected from designated ephemeral drainages. This appears inconsistent with "Note a" in TR Table 2.9-35 and sample collection points in TR Figure 2.7-4. | Cameco Response: As stated in the responses for 2.17 a), b), and c), clarifications have been provided for the preoperational and operational environmental surface water monitoring plan consistent with RG 4.14. Surface water samples at N-1 and N-2 have been collected monthly for a 12-month period. This sampling also included Po-210 and Pb-210, which are required to be sampled semi-annually as per RG 4.14. Table 2.9-35 (revised to Table 2.9-41 due to table changes in Section 2.9) has been revised to be consistent with RG 4.14 preoperational monitoring requirements. Future sampling will consist of monthly sampling for suspended and dissolved natural uranium, Ra-226, and Th-230, and semi-annually for suspended and dissolved Pb-210 and Po-210. Figure 2.9-1 has been updated to present the remaining preoperational monitoring tasks. Table 5.7-1 was revised to include Po-210 as an additional analyte that will be monitored in accordance with RG 4.14 operational monitoring requirements. |

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| | The description of the sampling of ephemeral drainages in Table 5.7-1 has been revised to clarify that two surface water samples (upstream and downstream) for each designated ephemeral drainage (total of three drainages, total of 6 samples) will be collected quarterly when runoff flow is available. |
| **Section 5 – Operations** | |
| **Admin §5 #1.** Section 5.1.3 of the TR identifies the "General Manager of Nebraska" being responsible for all uranium production activity at the MEA. Elsewhere the application uses the term "General Manager of Operations" and Figure 5.1-1 uses the term "Crow Butte Resource, Inc. General Manager." If these positions all refer to the same position, the same term should be used for clarity; otherwise, these positions should be identified in Figure 5.1-1 and described, as appropriate. | Cameco Response: Sections 5.1.2 (page 5-1) and 5.1.3 (page 5-2) were revised for consistency. The correct title is General Manager, Crow Butte Resources, Inc. |
| **Admin §5 #2.** Section 5.1.5 of the TR identifies the SHEQ manager as having a secondary reporting requirement to the President. Figure 5.1-1 indicates that the secondary reporting is to the Director of SHEQ. The figure or text should be corrected, as appropriate. | Cameco Response: Section 5.1.5 and Figure 5.1-1 were revised to clarify that the SHEQ Manager does not have secondary reporting responsibilities to the Director of Safety, Health, Environment and Quality (SHEQ) or to the President of Cameco Resources, Inc. |
| **Admin §5 #3.** The applicant did not provide details of its qualification program for designees approving Radiation Work Permits (RWPs) and Standing Radiation Work Permits (SRWPs) in the absence of the RSO. In TR Section 5.2.1.2, the applicant stated that qualified designees will review and approve RWPs and SRWPs in the absence of the RSO, but did not provide any description of its qualification program for such designees. Please provide a description of the qualifications of the designees that will be allowed to review and approve RWPs and SRWPs in the absence of the RSO. | Cameco Response: The minimum training requirements have been added to Section 5.4.1 in accordance with RG 8.31. |
| **Admin §5 #4.** The applicant did not provide minimum amount of specialized training required for the RSO qualifications. License Condition 9.12 of the applicant's current license (Amendment No. 26, ADAMS accession No. ML110320358) requires the applicant to follow the guidance set forth in Regulatory Guide 8.31. NUREG-1569, Acceptance Criterion 5.4.3(1), states, in part: "The personnel meet minimum qualifications and experience for radiation safety staff that are consistent with Regulatory Guide 8.31, Section 2.4 (NRC, 2002)." In TR Section 5.4.1, the applicant discusses specialized training in general but does not specify a minimum amount of this training for the RSO qualifications. Consistent with RG 8.31, please provide a minimum amount of specialized training required for the RSO qualifications. | Cameco Response: This issue is currently being addressed in the context of Draft License Conditions to the underlying license for the Crow Butte facility. Cameco will revise the Marsland application to comport with the revisions to the underlying license prior to operations. |

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| **Admin §5 # 5**. In TR Section 5.7.3, the applicant refers to Figure 2.9-2 for the proposed airborne sampling location for the satellite facility. However, Figure 2.9-2 is title Location of Environmental Air Sampling Stations at the MEA. The correct figure appears to be Figure 5.7-2, titled Proposed Operational Radiological Monitoring Locations for Satellite Facility. Please provide the correct reference for the figure with the proposed airborne sampling locations. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Section 5.7.3 submitted by Cameco on June 26, 2013. |
| **Admin §5 #6**. In TR Section 5.7.4.2, the applicant refers to TR Section 5.7.3.2, CBR Site-Specific DAC, for the radon daughter concentration surveys. However, TR Section 5.7.3.2 discusses the CBR site-specific DAC. The correct reference appears to be TR Section 5.7.3.3, Radon Daughter Concentration Monitoring. Please confirm the correct reference for the discussion on the radon daughter concentration surveys. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been satisfied by the revisions to Section 5.7.3.2 submitted by Cameco on June 26, 2013. |

| Section 6 - Ground-Water Quality Restoration, Surface Reclamation, and Facility Decommissioning | |
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| **Admin §6 #1.** In Section 6.2 of the TR, it states: "CBR will, prior to final decommissioning of an area, submit to the NRC and NDEQ a detailed decommissioning plan for their review and approval at least 12 months before final decommissioning." The term "before final decommissioning" is unclear as to whether it means onset or completion of decommissioning. This statement should be revised to make it clear that it means before the onset of final decommissioning which is consistent with Section 6.2.3(7) of the SRP and License Condition 12.5. | Cameco Response: The text of Section 6.2, page 6-13, paragraph 3, was revised to clarify that a decommissioning plan will be submitted to the NRC and NDEQ and approved before the onset of final decommissioning. |
| **Admin §6 #2.** In TR Section 6.4.3, the applicant cited an outdated guidance document. NUREG-1569, Acceptance Criterion 6.4.3(5), states: "The survey method for verification of soil cleanup is designed to provide 95-percent confidence that the survey units meet the cleanup guidelines. Appropriate statistical tests for analysis of survey data are described in NUREG–1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (NRC, 2000)." NUREG-1757, Consolidated NMSS Decommissioning Guidance, Volume 2, Table 1.5, lists NUREG/CR-5849 as a superseded document. In TR Section 6.4.3, the applicant refers to draft NUREG/CR-5849 for its statistical tests related to its surface soil cleanup and sampling plan. Consistent with NUREG-1569, Acceptance Criterion 6.4.3(5), please provide a relevant reference for the statistical tests related to the Marsland surface soil cleanup and sampling plan. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated that the RAI had been satisfied by the revisions to Section 6.4.3 submitted by Cameco on June 26, 2013. |
| **Appendix A - Water User Survey Information** | |
| **Admin Appendix A** The value for the casing depth is the same as the value for the well depth within data presented for Wells 736 and 737 and the units of measure for some of the Appendix A data is not provided. Please clarify or revised. | Cameco Response: No response required. In the public meeting dated September 4, 2013, NRC stated the RAI had been satisfied by the revisions in Appendix A submitted by Cameco on June 26, 2013. Well completion data for 736 and 737 was updated based on information from NDNR water well retrieval database. The spreadsheet headings have been updated with units. |

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### Radiation and Pregnancy: A Decision to Declare, DVD, 25 Minutes, 1998

Based on the NRC's Regulatory Guide 8.13, this video program looks at the pote effects of occupational radiation exposure to the pregnant worker's embryo/fetus. Begi with a summary of genetics, this training video discusses the effects of radiation expos on the embryo/fetus and the requirements for declaring the pregnancy to initiate the 500 millirem (5 millisieverts) fetal limit for the duration of the gestation period.

Using parallel overviews of both genetics and radiation protection, this video looks at the significant changes that have taken place in both fields. A brief history of genetics is presented, from Thomas Morgan and his fruit flies to H.J. Muller and the genetic mutations caused by radiation. Also included are Watson, Crick and Franklin and their discovery of the structure of DNA.

While these advances on the genetic front were being made, equally important advances in the understanding of radiation and radioactivity were taking place: Wilhelm Röntgen and the discovery of x-rays, the first r protection recommendations, the standardization of measurements, the skin erythema dose, and the conclusion that the embryo/fetus of a pregnant radiation worker should b as a "visitor."

Topics covered in this video:

- A declared pregnant woman is defined in NRC Regulations Title 10, Code of Federal Regulations as a woman who has voluntarily informed her employe in writing, that she is pregnant.
- Requirements for declaring pregnancy to initiate the 500 millirem fetal limit for t duration of the pregnancy.
- Potential outcomes of declaring the pregnancy.
- Will I be able to continue to perform my normal job functions?
- What if I can't?
- Will I lose my job?
- Do I have to declare my pregnancy in writing?
- Can I revoke my written declaration?

This video is intended for all female radiation and non-radiation workers of childb age and their supervisors.

Attachment 1 (continued)

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Attachment 2

ACKNOWLEDGEMENT OF HEALTH PHYSICS TRAINING AND INSTRUCTION

As required by Part 19 of the Code of Federal Regulations, I have been instructed in the required information contained in Part 19 and have been administered a Health Physics Training Program that includes the following topics:

1. Nature of radioactivity and the specifics of uranium radioactivity.
2. Proper handling procedures to minimize contamination with uranium product.
3. The proper use of personnel monitoring and radiological protective equipment.
4. Detection of area and personnel contamination and appropriate decontamination procedures.
5. Emergency procedures for dealing with personnel exposure, ingestion, or inhalation situations.
6. Instruction concerning prenatal radiation exposure.

I understand these instructions and agree to comply with all applicable procedures of the Crow Butte Project.

Signed _____ Date _____

Printed Name _____ Company _____

Instructor _____

CROW BUTTE RESOURCES, INC.

**Technical Report**
**Marsland Expansion Area**

## Nuclear Regulatory Commission

## Technical Report

### Response to Request for Additional Information (RAI) – July 03, 2013

### Revised Text [Redline/Strikeout Version]

## Volume I

Marsland Expansion Area

December 2013

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**ACRONYMS AND ABBREVIATIONS**

| | |
|---|---|
| ACL | Alternative Concentration Limit |
| AERMOD | AMS/EPA Regulatory Model |
| ALARA | As Low as Reasonably Achievable |
| ALI | Annual Limit on Intake |
| AMS | American Meteorological Society |
| amsl | above mean sea level |
| ANSI | American National Standards Institute |
| AOR | area of review |
| API | American Petroleum Institute |
| ASOS | automated surface observing systems |
| ASTM | ASTM International |
| ATV | all-terrain vehicle |
| AWWARF | American Water Works Association Research Foundation |
| BBS | Breeding Bird Society |
| BEA | Bureau of Economic Analysis |
| bgs | below ground surface |
| BLM | Bureau of Land Management |
| BMP | Best Management Practice |
| BNSF | Burlington Northern Santa Fe |
| BPT | best practicable technology |
| $CaCO_3$ | calcium carbonate |
| CAD | computer-aided design |
| CBR | Crow Butte Resources, Inc. |
| CDERA | Caribbean Disaster Emergency Response Agency |
| CEDE | Committed Effective Dose Equivalent |
| cfm | cubic feet per minute |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| CGA | Compressed Gas Association |
| $cm^2$ | square centimeter |
| cm/sec | centimeters per second |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| COOP | Cooperative Observer Program |
| CPF | Central Processing Facility |
| CPM | counts per minute |
| CPS | counts per second |
| CRSO | Corporate Radiation Safety Officer |
| CSC | Chadron State College |
| D/W/Y | day/week/year |

| | |
|---|---|
| DAC | derived air concentration |
| dBA | A-weighted decibels |
| DDE | deep dose equivalent |
| DDW | deep disposal well |
| DEM | digital elevation model |
| DFIRM | Digital Floodplain Insurance Rate Map |
| DLG | Digital Line Graph |
| DOE | Department of Energy |
| dpm | disintegrations per minute |
| DOT | Department of Transportation |
| DPS | Distinct Population Segment |
| DQO | Data Quality Objective |
| dpm | disintegrations per minute |
| DUSA | Dension Mines, USA |
| EA | Environmental Assessment |
| Eh | oxidation-reduction potential |
| EIS | Environmental Impact Statement |
| ELI | Energy Laboratories, Inc. |
| EPA | U.S. Environmental Protection Agency |
| ESA | Ecological Study Area |
| ESRI | Earth Sciences and Resources Institute |
| ET | evapotranspiration |
| FEMA | Federal Emergency Management Agency |
| FESA | Federal Endangered Species Act |
| ft amsl | feet above mean sea level |
| ft/day | feet per day |
| $ft^2$/day | square feet per day |
| $ft^3$ | cubic feet |
| g | gravity |
| GAM(NAT) | natural gamma |
| GIS | Geographic Information System |
| GNIS | Geographical Names Information System |
| gpd | gallons per day |
| gpd/ft | gallons per day per foot |
| gpm | gallons per minute |
| GPS | Global Positioning System |
| GR | gamma ray |
| $H_2O_2$ | hydrogen peroxide |
| $H_2S$ | hydrogen sulfide |
| HDPE | high-density polyethylene |
| HMR | Hazardous Materials Regulation |

| | |
|---|---|
| HPRCC | High Plains Regional Climate Center |
| HPT | Health Physics Technician |
| HUC | hierarchal hydrologic unit (hydrologic unit code) |
| HWA | Hayden-Wing Associates |
| $i$ | exposure period |
| ICRP | International Commission on Radiological Protection |
| I$r$ | annual intake of radionuclide $r$ by inhalation |
| ISO | International Organization for Standardization |
| ISR | in-situ recovery |
| IX | ion exchange |
| JFD | joint frequency distribution |
| km | kilometers |
| LAN | local area network |
| lbs | pounds |
| LDE | Lens Dose Equivalent |
| LLD | lower limit of detection |
| LSA | Low Specific Activity |
| LULC | land use and land cover |
| Ma | million years ago |
| $m^2$ | square meters |
| m/s | meters per second |
| MARSSIM | Multi-Agency Radiation Survey and Site Investigation Manual |
| MBTA | Migratory Bird Treaty Act |
| MCL | Maximum Contaminant Level |
| md | millidarcies |
| MDC | Minimum Detectable Concentration |
| MEA | Marsland Expansion Area |
| Meq/L | milliequivalents per liter |
| MeV | million electron volts |
| $mg/cm^2$ | milligrams per square centimeter |
| mg/L | milligrams per liter |
| Mgal/day | million gallons per day |
| $mi^2$ | square miles |
| MILDOS-AREA | calculation of radiation dose from uranium recovery operations |
| MIT | mechanical integrity testing |
| MM | Mercalli Modified |
| mm | millimeters |
| mph | miles per hour |
| mR/hr | milliRoentgens per hour |
| mRem | millirem |
| mRem/yr | millirem per year |

| | |
|---|---|
| mSv | milliSievert |
| MU | mine unit |
| n | number of exposure periods in the year |
| NA | not applicable |
| $Na_2S$ | Sodium sulfide |
| $NACO_3$ | Sodium Carbonate |
| $NaHCO_3$ | sodium bicarbonate |
| NAAQS | National Ambient Air Quality Standards |
| NAD 1927 | North American Datum of 1927 |
| NaI | sodium iodide |
| NAIP | National Agricultural Imagery Program |
| NaOH | sodium hydroxide |
| NASS | National Agricultural Statistics Service |
| NBELF | Nebraska Board of Educational Lands and Funds |
| NCCPE | Nebraska's Coordinating Commission for Postsecondary Education |
| NCDC | National Climate Data Center |
| NDA | Nebraska Department of Agriculture |
| NDE | Nebraska Department of Education |
| NDED | Nebraska Department of Economic Development |
| NDEQ | Nebraska Department of Environmental Quality |
| NDHHS | Nebraska Department of Health and Human Services |
| NDNR | Nebraska Department of Natural Resources |
| NDOL | Nebraska Department of Labor |
| NDOR | Nebraska Department of Roads |
| NED | national elevation dataset |
| NEPA | National Environmental Policy Act |
| NFPA | National Fire Protection Association |
| NGPC | Nebraska Game and Parks Commission |
| NGS | National Geodetic Society |
| NHD | national hydrography database |
| NHPA | National Historic Preservation Act |
| NLCD | national land cover data |
| NNHP | Nebraska Natural Heritage Program |
| NNLP | Nebraska Natural Legacy Project |
| $NO_2$ | nitrogen dioxide |
| NOAA | National Ocean and Atmospheric Administration |
| NOGCC | Nebraska Oil and Gas Conservation Commission |
| NOI | Notice of Intent |
| NOU | Nebraska Ornithologists Union |
| $NO_x$ | nitrogen oxides |
| NPDES | National Pollution Discharge Elimination System |

Deleted: N-N . neutron-neutron¶

| | |
|---|---|
| NPS | National Park Service |
| NRC | Nuclear Regulatory Commission |
| NRCS | National Resources Conservation Service |
| NREL | National Renewable Energy Laboratory |
| NRPH | National Register of Historic Places |
| NRS | Nebraska Revised Statutes |
| NSHS | Nebraska State Historical Society |
| NTEA | North Trend Expansion Area |
| NTU | nephelometric turbidity unit |
| NVLAP | National Voluntary Laboratory Accrediation Program |
| NWI | National Wetlands Inventory |
| NWS | National Weather Service |
| $O_2$ | gaseous oxygen |
| OSHA | Occupational Safety and Health Administration |
| OSLD | optically stimulated luminescence dosimeter |
| PBL | performance-based license |
| PBLC | Performance-Based License Condition |
| pCi/L | picoCuries per liter |
| person-Rem/yr | person-Rem per year |
| PFYC | potential fossil yield classification system |
| $PM_{10}$ | particulate matter measuring 10 micrometers or less in diameter |
| $PM_{2.5}$ | particulate matter measuring 2.5 micrometers or less in diameter |
| PPE | personal protective equipment |
| ppm | parts per million |
| PPMP | Preoperational/Preconstruction Monitoring Program |
| PSD | Prevention of Significant Deterioration |
| psi | pounds per square inch |
| PVC | polyvinyl chloride |
| QA | quality assurance |
| QA/QC | Quality Assurance/Quality Control |
| QAM | Quality Assurance Manual |
| QC | quality control |
| rad/d | rad per day |
| RCRA | Resource Conservation and Recovery Act |
| R&D | research and development |
| Rem | Roentgen equivalent man |
| RES | single point resistance |
| RFFA | reasonable forseeable future actions |
| RG | Regulatory Guide |
| RL | reporting limit |
| RMP | Risk Management Program |

| | |
|---|---|
| RO | reverse osmosis |
| ROI | radius of influence |
| RPPA | Respiratory Protection Program Administrator |
| RSO | Radiation Safety Officer |
| RUSLE | Revised Universal Soil Loss Equation |
| RWP | radiation work permit |
| SCDA | sequential control and data acquisition |
| SCS | Soil Conservation Service |
| SDE | shallow dose equivalent |
| SDR | Standard Deviation Ratio |
| SER | Safety Evaluation Report |
| SERP | Safety and Environmental Review Panel |
| SH | State Highway |
| SHEQMS | Safety, Health, Environment and Quality Management System |
| SHPO | State Historic Preservation Office |
| $SO_2$ | sulfur dioxide |
| SOP | standard operating procedure |
| SP | spontaneous potential |
| SPCC | Spill Prevention, Control, and Countermeasure |
| SRWP | Standing Radiation Work Permit |
| SS | stainless steel |
| SSC | structure, system, or component |
| SSURGO | soil survey geographic database |
| su | standard unit |
| SWMA | State Wildlife Management Area |
| SWPPP | Storm Water Pollution Prevention Plan |
| TCEA | Three Crow Expansion Area |
| TCP | Traditional Cultural Properties |
| TCR | The Chadron Record |
| TDS | total dissolved solids |
| T&E | threatened and endangered |
| TEDE | Total Effective Dose Equivalent |
| TER | Technical Evaluation Report |
| THC | total hydrocarbon |
| TLD | thermoluminescent dosimeter |
| TMDL | total maximum daily load |
| TSP | total suspended particulates |
| TSS | total suspended solids |
| $U_3O_8$ | uranium oxide |
| µCi/ml | microCurie per milliliter |
| UCL | Upper Control Limit |

| | |
|---|---|
| UDC | uranyl dicarbonate |
| U-nat | natural uranium |
| $\mu g/m^3$ | micrograms per cubic meter |
| UIC | underground injection control |
| µmhos/cm | micromhos per centimeter |
| UMTRCA | Uranium Mill Tailings Radiation Control Act |
| UNRI | Urban Natural Resource Institute |
| µR/hr | microRoentgens per hour |
| US | United States |
| USACE | United States Army Corps of Engineers |
| USBR | United States Bureau of Reclamation |
| USCB | United States Census Bureau |
| USDA | United States Department of Agriculture |
| USFS | United States Forest Service |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| USLE | universal soil loss equation |
| UTC | uranyl tricarbonate |
| VMT | vehicle miles travelled |
| VOC | volatile organic compound |
| VRM | visual resource management |
| VTPD | vehicle trips per day |
| WFC | Wyoming Fuel Company |
| WL | Working Level; measured concentration of radon decay products |
| WLM | working level month |
| WRCC | Western Regional Climate Center |
| WSA | Wilderness Study Area |
| $x$ | number of radionuclides of interest |
| XRD | x-ray diffraction |
| $yd^3$ | cubic yards |
| ZOEI | zone of endangering influence |

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# 1 PROPOSED ACTIVITIES

## 1.1 Licensing Action Requested

Crow Butte Resources, Inc. (CBR) makes this application to the United States Nuclear Regulatory Commission (NRC) to amend Radioactive Source Materials License SUA-1534, for development of additional uranium *in-situ* recovery (ISR) operations in Dawes County, Nebraska. The area proposed for use as a satellite facility to the main CBR Central Processing Facility (CPF) is referred to as the Marsland Expansion Area (MEA).

By letter dated Nov. 27, 2007, CBR applied for a renewal of Source Materials License No. SUA-1534 for the CPF. This renewal will allow for the continued operation of the current CPF. The NRC issued a draft license by letter dated May 23, 2011. Following comments by CBR, the NRC issued a second draft of the CBR renewal license on August 11, 2011. As part of the licensing process, the NRC issued a Safety Evaluation Report (SER) for the license renewal dated December 2012 (NRC 2012a). The SER documents the safety portion of the NRC staff's review of the license renewal application, as amended, and includes an analysis to determine CBR's compliance with these and other applicable 10 Code of Federal Regulations (CFR) Part 40 requirements, and applicable requirements set forth in 10 CFR Part 40, Appendix A (NRC 2012a). The SER also evaluates CBR's compliance with applicable requirements in 10 CFR Part 20, "Standards for Protection against Radiation." An Environmental Assessment (EA) is also being prepared in parallel with the SER to address environmental impacts of the proposed action, which complies with NRC's implementation regulations for the National Environmental Policy Act (NEPA; NRC 2012a). While the license renewal is pending, the current license remains in effect.

The application is presented primarily in the NRC format found in NRC Regulatory Guide (RG) 3.46, *"Standard Format and Content of License Applications, Including Environmental Reports, For In Situ Uranium Solution Mining"* (June 1982). NRC document NUREG-1569, *Standard Review Plan for In Situ Leach Uranium Extraction License Applications* (June 2003) was followed to ensure that all information is provided to allow NRC Staff to complete their review of this amendment application.

## 1.2 Crow Butte Uranium Project Background

The original CPF was developed by Wyoming Fuel Company, which constructed an R&D Facility in 1986. The project was subsequently acquired and operated by Ferret Exploration Company of Nebraska until May 1994, when the name was changed to Crow Butte Resources, Inc. This change was only a name change and not an ownership change. CBR is the owner and operator of the Crow Butte Project.

The land (fee and leases) at the CPF is held by Crow Butte Land Company, which is a Nebraska corporation. All of the officers and directors of Crow Butte Land Company are U.S. Citizens. Crow Butte Land Company is owned by CBR, which is the licensed operator of the facility. CBR, which does business as Cameco Resources, is also a Nebraska corporation. All of its officers are U.S. citizens, as are two thirds of its directors. CBR is owned by Cameco US Holdings, Inc., which is a U.S. corporation registered in Nevada. For Cameco US Holdings, three quarters of the officers are U.S. citizens, as are two thirds of the directors. Cameco US Holdings is held by

Cameco Corporation, which is a Canadian corporation that is publicly traded on both the Toronto and New York Stock Exchanges.

The R&D Facility was located in N½ SE¼ of section 19, Township (T) 31 North (N), Range (R) 51 West (W). Operations at this facility were initiated in July 1986, and mining took place in two wellfields (WF-1 and WF-2). Mining in WF-2 was completed in 1987, and restoration of that wellfield has been completed. WF-1 was incorporated into Mine Unit 1 of current operations.

The current production wellfield is located within the current license area as shown in **Figure 1.7-2**. The main production facility is located in section 19, T31N, R51W, Dawes County, Nebraska. The current license area occupies approximately 2,861 acres, and the surface area affected over the estimated life of the project is approximately 2,000 acres.

CBR has successfully operated the current production area since commercial operations began in 1991. Production of uranium has been maintained at design quantities throughout that period with no adverse environmental impacts. Groundwater restoration for Mine Unit 1 has been completed and approved by the NRC and Nebraska Department of Environmental Quality (NDEQ), with NRC issuing the final approval on February 12, 2003. The operating history and timelines for the current production area are discussed in more detail in Section 1.7.

## 1.3 Site Location and Description

The proposed MEA is located within sections 26, 35, 36 of T30N, R51W; sections 1, 2, 11, 12, 13 of T29N R51W; and sections 7, 18, 19, 20, 29, 30 of T29N, R50W. The project area encompasses 4,622.3 acres. The MEA satellite facility is located approximately 11.1 miles (17.9 km) south-southeast of the CPF (centerpoint of MEA satellite building to centerpoint of CPF building) and approximately 4.6 miles (7.4 km) northeast of the community of Marsland (centerpoint of MEA satellite building to centerpoint of Town of Marsland). **Figure 1.3-1** shows the locations of the current license area and the proposed MEA.

All of the mineral resources leased within the MEA are privately owned, with the exception of the SW ¼ section of section 36 of T30N, R51W. This quarter section is designated as State Trust Land and is a small part of the nearly 1,300,000 acres of land now held in Trust for Nebraska's K-12 public schools. The Trustee of Nebraska's School Trust lands is the Board of Educational Lands and Funds (NBELF 2010). The surface and mineral rights are leased by Cameco from the State of Nebraska. There are no federal surface lands or minerals in the MEA license boundary. **Figure 1.3-2** shows surface land ownership in the proposed MEA.

## 1.4 Ore Body Description

Similar to the CPF, uranium will also be recovered from the basal sandstone of the Chadron Formation. The depth of the ore body in the MEA ranges from 800 to 1,250 feet below ground surface (bgs). The ore body width varies from approximately 1,000 feet to 4,000 feet. The ore body ranges in grade from 0.11 percent to 0.33 percent uranium oxide ($U_3O_8$), with an average grade estimated at 0.22 percent $U_3O_8$. The ore-grade uranium deposits underlying the MEA are depicted in **Figure 1.4-1**.

## 1.5 Solution Mining Method and Recovery Process

The ISR process for uranium recovery consists of an oxidation step which occurs underground. Gaseous oxygen ($O_2$) or hydrogen peroxide ($H_2O_2$) is used to oxidize the uranium, and bicarbonate is used for dissolution. The uranium-bearing solution is recovered from the wellfield, and the uranium is extracted in the CPF process building. The CPF process uses the following steps:

- Loading of uranium complexes onto ion exchange (IX) resin
- Reconstitution of the solution by the addition of bicarbonate and $O_2$
- Elution of the uranium complexes from the resin
- Drying and packaging of the uranium

### 1.5.1 Advantages of ISR Uranium Mining

ISR uranium mining is a proven technology that has been demonstrated commercially in Wyoming, Texas, and at Crow Butte in Nebraska. ISR mining of uranium is environmentally superior to conventional open pit and underground uranium mining because:

- ISR mining results in significantly less surface disturbance because mine pits, waste dumps, haul roads, and tailings ponds are not needed.
- ISR mining carries a much lower water demand than conventional mining and milling, avoiding the water usage associated with pit dewatering, conventional milling, and tailings transport.
- The lack of heavy equipment, haul roads, waste dumps, and other features results in very little air quality degradation.
- Fewer employees are needed at ISR mines, thereby reducing transportation and socioeconomic concerns.
- Aquifers are not excavated, but remain intact during and after ISR mining.
- Tailings ponds are not used, thereby eliminating a major groundwater pollution concern.
- The majority of other contaminants (e.g., heavy metals) remain where they occur naturally instead of being relocated to waste dumps and tailings ponds with additional environmental concern.

### 1.5.2 Ore Amenability to the ISR Mining Method

Amenability of the uranium deposits in the current CBR license area to ISR mining was demonstrated initially through core studies. Results of the core studies were confirmed in the R&D project at the CPF site using bicarbonate/carbonate leaching solutions with $O_2$. Reports concerning the results of the R&D activities, including restoration of affected groundwater, were previously submitted to NRC and the NDEQ.

The information and experience gained during these pilot programs formed the basis for the commercial uranium ISR mining operations. The current operation, including the successful restoration of groundwater in Mine Unit 1, demonstrates that such a program can be implemented at the MEA with minimal short-term environmental impacts and with no significant risk to the

public health or safety. The remainder of this application describes the mining and reclamation plans for the current CBR license area and the MEA, and the concurrent environmental monitoring programs employed to ensure that any impact to the environment or public is minimal.

## 1.6 Operating Plans, Design Throughput, and Production

The CPF is licensed for a flow rate of 9,000 gallons per minute (gpm), excluding restoration flow, under License No. SUA-1534. Total annual production is limited to 2,000,000 pounds of yellowcake.

Uranium extracted from the Marsland wellfield will be processed at a satellite facility located within the MEA. The MEA will operate at an overall average production flow rate of 6,000 gpm (excluding 1,500 gpm for restoration). The anticipated bleed rate is assumed to be 0.5 to 2.0 percent of the total mining flow. The MEA will operate with an expected annual production rate of approximately 600,000 pounds (lbs) $U_3O_8$. Indicated ore reserves as $U_3O_8$ for the MEA are 6,161,679 lbs, with an additional inferred estimate of 3,389,518 lbs. Total reserves for the MEA are currently estimated at 9,551,197 lbs. The uranium extracted from the MEA will be loaded onto IX resin in the MEA satellite facility, which will then be transported by tanker truck to the main plant for elution, precipitation, drying, and packaging. Barren resin will be returned to the MEA satellite facility by tanker truck. The MEA operations are discussed in more detail in Section 3. The proposed MEA occupies approximately 4,622.3 acres. Over the life of the project, an estimated 1,753 acres may be impacted.

## 1.7 Proposed Operating Timelines

### 1.7.1 Current Production Area

Sufficient reserves in the current license area have been estimated to allow mining operations to continue until the end of 2015. Completion of groundwater restoration in the current license area is scheduled for 2033, with site restoration completed by 2038. Projected production and restoration timelines for the CPF are shown on **Figure 1.7-1**. The current status of the 11 mine units (MUs) are shown in **Table 1.7-1**. In 2010, the total annual production rate for the CPF was 592,541 pounds $U_3O_8$, and in 2009 it was 700,000 pounds $U_3O_8$. Additional mine unit plans are developed approximately 1 year prior to the planned commencement of new mining operations. For the current production area, production is ongoing in Mine Units 7, 8, 9, 10, and 11. Mine Unit 1 has been restored, and restoration is occurring in Mine Units 2, 3, 4, 5, and 6. The layout of the current and planned mine units in the current license area is shown on **Figure 1.7-2**.

### 1.7.2 Marsland Expansion Area

The proposed MEA project site map and project timeline are shown on **Figures 1.7-3** and **1.7-4,** respectively. There is a potential for 11 MUs, with construction for Mine Unit 1 (MU-1) to commence in 2014. Production for the project (all MUs) will start in 2015 and terminate in 2033. Restoration in designated MUs will commence in the year 2020 and will be completed in 2039. Site reclamation will be completed in 2040.

The MEA will be subdivided into an appropriate number of MUs (**Figure 1.7-5**). Each MU will contain a number of wellhouses where injection and recovery solutions from the satellite plant building are distributed to the individual wells. The injection and production manifold piping from the MEA satellite facility to the wellhouses will be either polyvinyl chloride (PVC) or high-density polyethylene (HDPE) with butt-welded joints or an equivalent. Pressure switches will be installed to each injection manifold in the wellhouse to alert the plant and wellfield operators of increasing manifold pressures. Pressure gauges, pressure shutdown switches, and pressure transducers will be used to monitor and control trunkline pressures. Oxidizer will be added to the injection stream, and all injection lines off of the injection manifold will be equipped with totalizing flowmeters, which will be monitored in the satellite Control Room. The MEA wellfield will be designed in a manner consistent with the existing CPF wellfield. More detailed information about the site operations is discussed in Section 3.

### 1.7.3 Three Crow Expansion Area Timeline

On July 12, 2010, CBR submitted a Class III UIC Application and Aquifer Exemption Petition for the proposed Three Crow Expansion Area (TCEA), which will be used as a satellite facility supporting the CPF. On August 3, 2010, CBR submitted a request to the NRC for an amendment to Source Materials License SUA-1534 for the development of the TCEA. In 2011, CBR advised the NDEQ and NRC of a possible change from a full satellite facility (production of impregnated resin for transport to the main CPF) to use of pipelines to transport all process fluids from the TCEA to the CPF. If feasible, the revised license would allow for construction and operation of these process pipelines. CBR requested that the NRC and NDEQ suspend review of the respective TCEA applications so that CBR could supplement the applications with the alternate approach (Leftwich 2011; ML111160020). By letter dated October 11, 2012, CBR provided the NRC with a Notice of Intent to restart the TCEA application process, with the use of a satellite facility (Leftwich 2012; ML12299A211). The only major change in the proposed TCEA satellite facility is that surge/evaporation ponds are deemed to no longer be required to support deep disposal well (DDW) operations. The satellite facility will operate without surge/evaporation ponds or surge tanks.

TCEA construction is planned for completion in 2016, with production from 2016 to 2032, restoration from 2023 to 2038, and completion of final site reclamation in 2039.

### 1.7.4 North Trend Expansion Area Timeline

The proposed North Trend Expansion Area (NTEA) will consist of a support satellite facility for the CPF. CBR has received approval from the NDEQ for a Class III Underground Injection Control (UIC) permit (NDEQ 2011a) and an aquifer exemption (NDEQ 2011b) that will allow for construction and operation of the satellite facility for ISR mining of the proposed NTEA. A radioactive source material license amendment for the NTEA is pending before the NRC for the proposed NTEA. Current plans are for this project to be constructed in 2023, production from 2024 into 2032, with groundwater restoration activities ongoing from 2029 through 2039. Final site reclamation would be completed in 2041.

## 1.8 Waste Management and Disposal

### 1.8.1 Liquid Waste

Alternative wastewater disposal options that were considered were deep disposal well (DDW) injection, surge/evaporation ponds, point source discharge, and/or land application. In addition, surge/evaporation ponds and surge tanks were evaluated as waste management facilities to support the selected DDW alternative.

The proposed method of disposal will be DDW injection without supporting surge/evaporation ponds or surge tanks. The justification for this proposed action is discussed in Sections 3.1.7 and 4.2.1.7. There are currently no plans for any point source discharges or land application of wastewaters. However, the land application option could be applied in the future if such disposal is deemed feasible and more beneficial for a specific wastewater stream. Any such action would require an NRC license amendment and a discharge permit from the NDEQ. The alternatives considered for the waste disposal options are discussed in Section 8.

Operation of the MEA satellite facility will result in the following liquid waste streams:

- **Water generated during well development** - This water is recovered groundwater similar to well development water currently produced at the CPF. This water will be disposed of in an onsite DDW.
- **Liquid process waste** - The operation of the satellite facility results in one primary source of liquid waste - a production bleed. This bleed will be routed to an onsite DDW.
- **Aquifer restoration** - Restoration of **the affected aquifer** (which commences following mining operations) results in the production of wastewater similar to that produced during current restoration activities at the CPF (See **Figure 6.1-1**). This wastewater will be disposed of in an onsite DDW.

Domestic sewage will be disposed of in an onsite wastewater treatment (i.e., septic) system permitted by the NDEQ under the Class V UIC Regulations.

Based on the proposed project development schedule and the water balance of the MEA project, liquid waste disposal methods used will be phased for the MEA operations. For approximately the first 6 years of operation (2015 through 2020), the MEA operations will discharge wastewaters to storage tanks located in the satellite building, which will discharge to two onsite DDWs. There will be no evaporation ponds or large surge tanks, because the project can be safely operated in a sound environmental manner without them (see discussions in Sections 3.1.7 and 4.2.1.7). The proposed waste management system will be sufficient to handle the total quantities of wastewaters that will be generated and will require disposal.

Restoration flows will increase in 2021 to the extent that additional wastewater management and controls will be needed, because the increased flows are expected to exceed the capacity of two DDWs. CBR will use the first 5 to 6 years of operations to assess the maximum injection rates of the DDWs and the overall efficiency of the waste management system. Efforts will be made to maximize the DDW injection rates, minimize the amounts of wastewaters generated during production and restoration that require disposal, better quantify actual site wastewater flows, and further assess viable waste management alternatives and environmental implications. This time

period will allow CBR time to develop an updated waste management system that will provide for the most optimum long-term economic and technical viable approach to managing liquid wastes. Additional wastewater management systems to be evaluated will include additional DDWs, surge tanks, surge/evaporation ponds, land application, wastewater treatment with a permitted discharge, and process optimizations/modifications to minimize liquid waste generation.

CBR will submit an evaluation for proposed changes to the waste management system for NRC written verification and if necessary submit a license amendment request.

Sources and methods of handling liquid wastes are discussed in more detail in Section 4. Disposal alternatives for liquid 11e.(2) byproduct materials are discussed in Section 8.3.1.3.

### 1.8.2 Solid Waste

Solid wastes generated consist of wastes such as spent resin, resin fines, filters, miscellaneous pipe and fittings, and domestic trash. These wastes are classified as contaminated 11e.(2) byproduct material or non-contaminated waste according to radiological survey results. Contaminated byproduct waste that cannot be decontaminated is packaged and stored until it can be shipped to a licensed 11e.(2) byproduct material waste disposal site or licensed mill tailings facility. Non-contaminated solid waste is collected regularly on the site and disposed of in a sanitary landfill permitted by the NDEQ.

CBR currently has a contractual agreement with Dension Mines (USA) Corp. (DUSA) for the disposal of 11e.(2) byproduct materials at DUSA's White Mesa Mill site located near Blanding, Utah (CBR and DUSA 2010). The White Mesa Mill is licensed by the NRC to allow the disposal of byproduct material generated as a result of operations at licensed uranium ISR facilities by placement of the byproduct material in the White Mesa Mill's tailings impoundment. For this agreement, the maximum annual volume for disposal is 3,823 cubic meters (5,000 yds) of byproduct, which is a common maximum volume for agreements with the White Mesa Mill. Unless terminated by either party, the contract shall be automatically renewed each year for a maximum of four additional periods (i.e., up to June 30, 2015 at the latest). At the end of this period, Cameco can seek renewal for a designated period of time. Should Cameco contract with a new disposal facility, Cameco will notify the NRC in accordance with License Condition 9 of SUA-1534.

Additional discussions of solid wastes are presented in Section 4.2.

### 1.8.3 Contaminated Equipment

Materials and equipment that become contaminated as a result of normal operations are decontaminated if possible and disposed of by conventional methods. Equipment and materials that cannot be decontaminated are treated in the same manner as other contaminated solid waste discussed in Section 1.8.2.

## 1.9 Groundwater Restoration

Restoration activities will be carried out at the MEA concurrent with mining activities. The restoration process will be similar to that used to restore the wellfield at the current CBR license area, and will consist of four basic activities:

- **Groundwater transfer**- groundwater is transferred between the MU commencing restoration and an MU commencing production or another water source.
- **Groundwater sweep**- water is pumped from the wellfield with no injection, which results in an influx of baseline quality water from the wellfield perimeter.
- **Groundwater treatment**- water from production wells is pumped to the satellite plant, where combinations of IX, reverse osmosis (RO), filtration, and other treatment methods take place.
- **Wellfield recirculation** - water is recirculated by pumping from the production wells and reinjecting the recovered solution. This will homogenize the quality of the aquifer.

Following these restoration phases, a groundwater stabilization monitoring program is initiated. Once the restoration values are reached and maintained, restoration is deemed complete. Results are documented in a Restoration Report and submitted to the NDEQ and the NRC for approval. Groundwater restoration is described in more detail in Section 6.

## 1.10 Decommissioning and Reclamation

At the completion of mine life and after groundwater restoration has been completed, all injection and recovery wells will be plugged and the site decommissioned. Decommissioning will include satellite facility disassembly and disposal and land reclamation of all disturbed areas. Applicable NRC Regulatory Guidelines will be followed. Decommissioning and reclamation are discussed in more detail in Section 6.

## 1.11 Surety Arrangements

CBR maintains an NRC-approved financial surety arrangement consistent with 10 CFR 40, Appendix A, Criterion 9 to cover the estimated costs of reclamation. Crow Butte maintains an Irrevocable Standby Letter of Credit issued by the Royal Bank of Canada in favor of the State of Nebraska in the present amount of $35,398,802. The surety amount is revised annually in accordance with the requirements of SUA-1534. The latest approved surety update is dated November 12, 2013, and is included as Amendment No. 27 to the NRC license. CBR's current surety is $43,223,280, and has been approved by the NRC.

By letter dated September 30, 2013, Cameco submitted an annual update to the Surety Estimate for the CBR uranium mine Surety Estimate for the year 2014 (Leftwich 2013). The proposed 2014 Surety Estimate is $44,719,032, an increase of $1,495,752 over the 2013 Surety Estimate of $43,223,280, approved on November 12, 2013.

The surety amount will be revised to reflect the estimated costs of reclamation activities for the MEA as development activities proceed. At Marsland, the 2013 estimated surety amount for the

**Deleted:** March 6, 2012

**Deleted:** 6

**Deleted:** (NRC 2012b)

**Deleted:** 35,398,802

**Deleted:** CBR maintains a letter of credit for the full surety amount, which is revised annually and submitted to the staff as well as the NDEQ.

**Deleted:** Crow Butte Resources, Inc., shall continuously maintain an approved surety instrument for the Crow Butte project, in favor of the State of Nebraska, in the amount of no less than $35,398,802 for the purpose of complying with 10 CFR 40, Appendix A, Criterion 9, until a replacement is authorized by both the State of Nebraska and NRC.

first wellfield put into operations is $2,286,647. Detailed discussions of the MEA surety can be found in the 2013 update of the MEA Environmental Report.

## 1.12 References

Crow Butte Resources (CBR) and Dennis Mines (USA) (DUSA) Corporation (CBR and DUSA). 2010. Byproduct Disposal Agreement for Disposal of CBR Byproduct Waste at White Mesa Mill. June 1.

Leftwich, Josh. 2011. Memorandum from Josh Lefwich, Director of Radiation Safety and Licensing, Cameco Resources, Inc. to Ronald Burrows, U.S. Nuclear Regulatory Commission Regarding CBR request to suspend NRC review of the TCEA application due to possible use if pipelines in lieu of full satellite facility. April 14. (ML111160020).

Leftwich, Josh. 2012. Letter from Josh Lefwich, Director of SHEQ, Cameco Resources, Inc. to Andrew Persinko, Deputy Director, Decommissioning & Uranium Recovery License Directorate, Division of Waste Management and Environmental Management Program, U.S. Nuclear Regulatory Commission Regarding Notice of Intent to restart TCEA application process.. October 11. (ML12299A211).

Leftwich, Josh. 2013. Letter from Director of SHEQ, Cameco Resources, Inc. to Michael Linder, Director, Nebraska Department of Environmental Quality, Lincoln, Nebraska Regarding 2014 Surety Estimate. cc: Ronald Burrows, Fuel Cycle Licensing Branch, U.S. Nuclear Regulatory Commission. September 30.

Nebraska Board of Educational Land and Funds (NBELF). 2010. Sixty-Seventh Biennial Report. 2008-2010. September 30.

Nebraska Department of Environmental Quality (NDEQ). 2011a. Class III Underground Injection Control (UIC) Permit for North Trend Expansion Area. Effective August 11, 2011.

NDEQ. 2011b. Aquifer Exemption Order Granting Approval of CBR Request for Exemption for Portion of Chadron Formation at North Trend Expansion Area. April 7.

U.S. Nuclear Regulatory Commission. (NRC). 2012a. Safety Evaluation Report, License Renewal of the Crow Butte Resources ISR Facility, Dawes County, Nebraska, Materials License No. SUA-1534. Docket No. 40-8943. December.

NRC. 2012b. Letter from Keith I. McConnell, Deputy Director, Decommissioning and Uranium Recovery Licensing Directorate, Division of Waste Management and Environmental Protection, Office of Federal and State Materials and Environmental Management Programs, US Nuclear Regulatory Commission to Thomas P. Young, Vice-President of Operations, Cameco Resources Regarding License Amendment No. 26 Regarding 2011 Surety Update, Crow Butte Resources Inc., Crawford, Nebraska, Source Materials License SUA-1534 (TAC No. J00634). March 6.

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**Table 1.7-1 Current Crow Butte Production Area Mine Unit Status**

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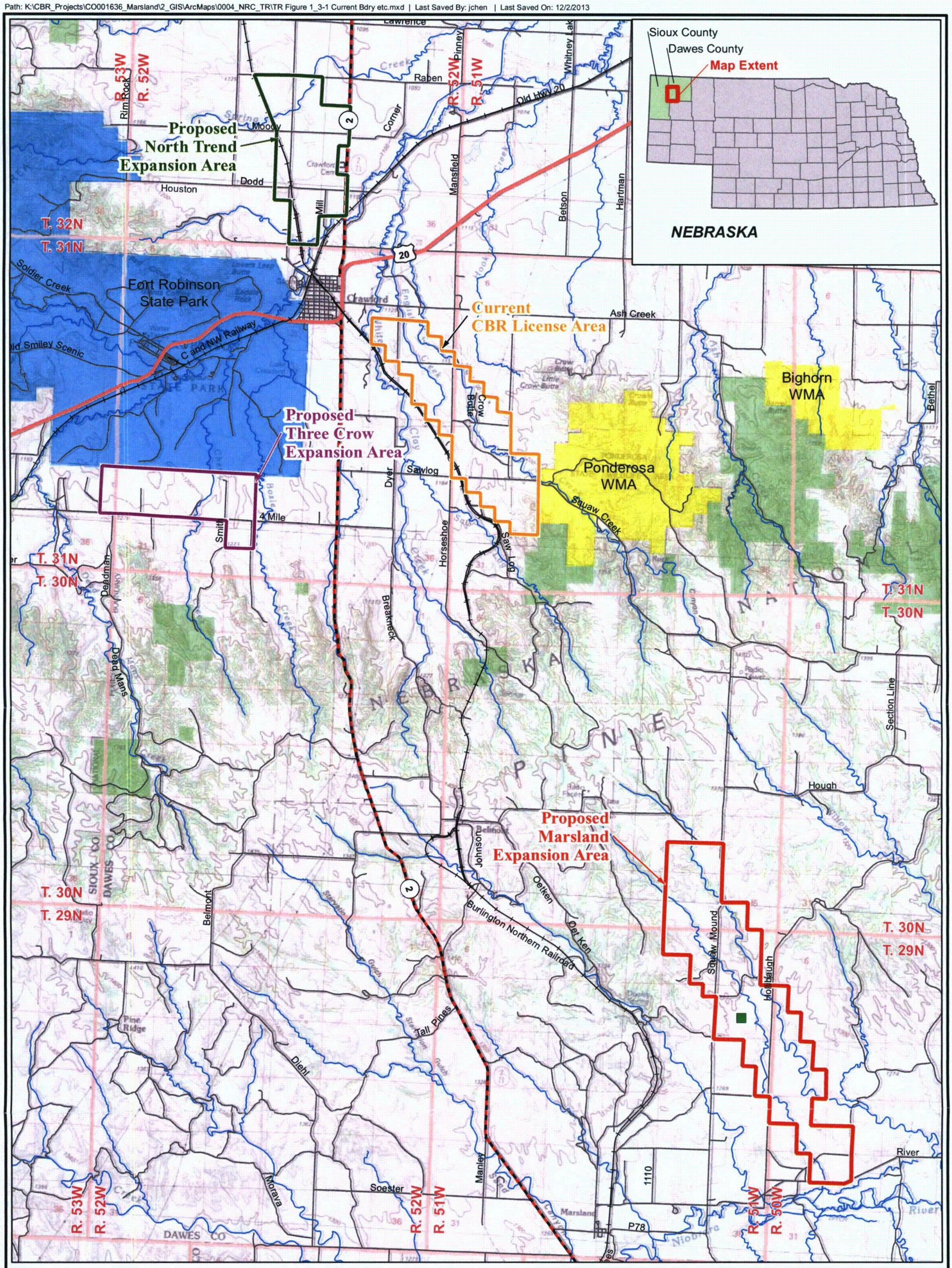


**LEGEND**

- Proposed Marsland Satellite Facility Site
- Proposed Marsland Expansion Area
- Proposed Three Crow Expansion Area
- Proposed North Trend Expansion Area
- Current CBR License Area
- Township/Range
- WMA-Wildlife Management Area
- Fort Robinson State Park
- Nebraska National Forest
- Railroad
- U.S. Highway
- State Highway
- Roads, Other
- Stream

N

0 1 2

Miles

*PROJECTION: NAD 1983, STATE PLANE NEBRASKA NORTH, FIPS 2600*
*SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE*

CROW BUTTE RESOURCES, INC.

**FIGURE 1.3-1**
**CROW BUTTE RESOURCES INC.**
**CURRENT LICENSE AREA**
**AND PROPOSED EXPANSION AREAS**

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: J. CEARLEY

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
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www.arcadis-us.com

**Figure 1.3-2 Marsland Expansion Area Land Ownership**

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**Figure 1.4-1 Marsland Expansion Area Estimated Ore Body**

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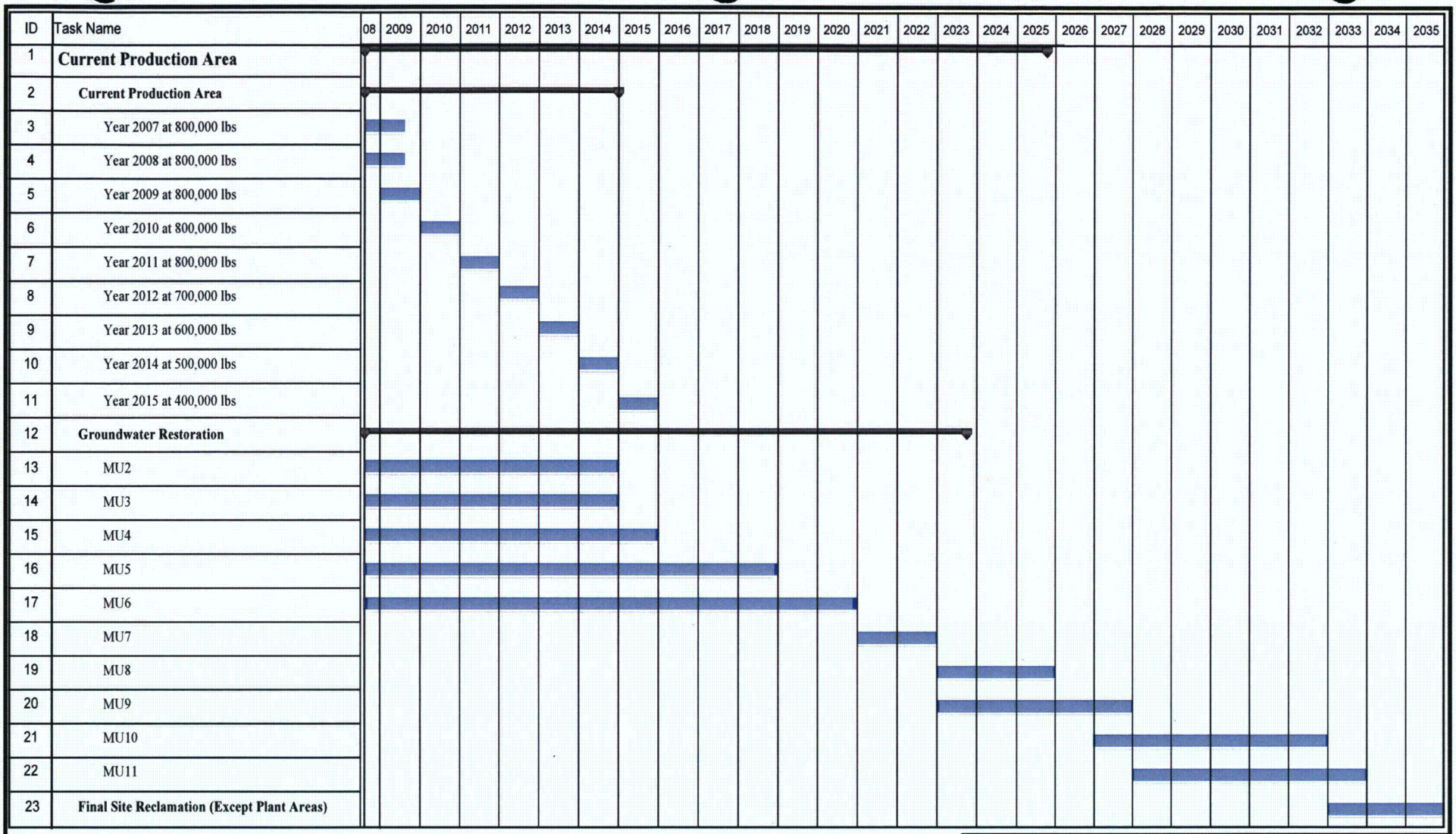


Task

Group By Summary

CROW BUTTE RESOURCES, INC.

**FIGURE 1.7-1**
**CURRENT PRODUCTION AREA**
**MINE UNIT TIMELINE**
**EFFECTIVE AS OF JULY 1, 2013**

PROJECT: CO001636.00001 MAPPED BY: JC CHECKED BY: JEC

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K:\CBR_Projects\CO001636_Marsland\3_IMAGES\IllustratorTR Figure 1_7-1 Current Production Area Schedule_v10012013.ai @ 10/01/2013

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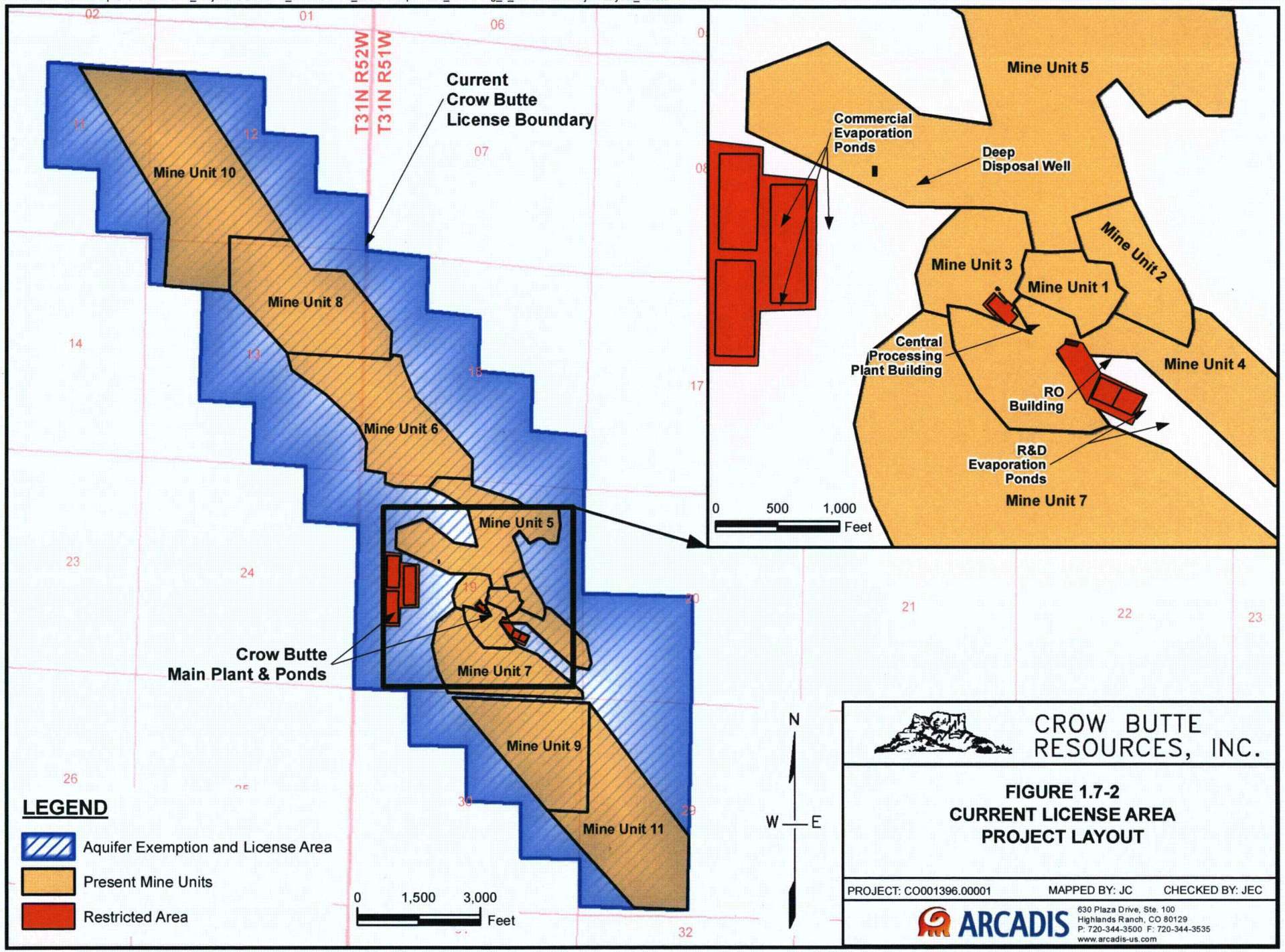


CROW BUTTE RESOURCES, INC.

**FIGURE 1.7-2**
**CURRENT LICENSE AREA**
**PROJECT LAYOUT**

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC


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**Figure 1.7-3 Project Location Map, ZOEI and AOR**

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**Figure 1.7-4 Marsland Expansion Area Mining and Restoration Timeline**

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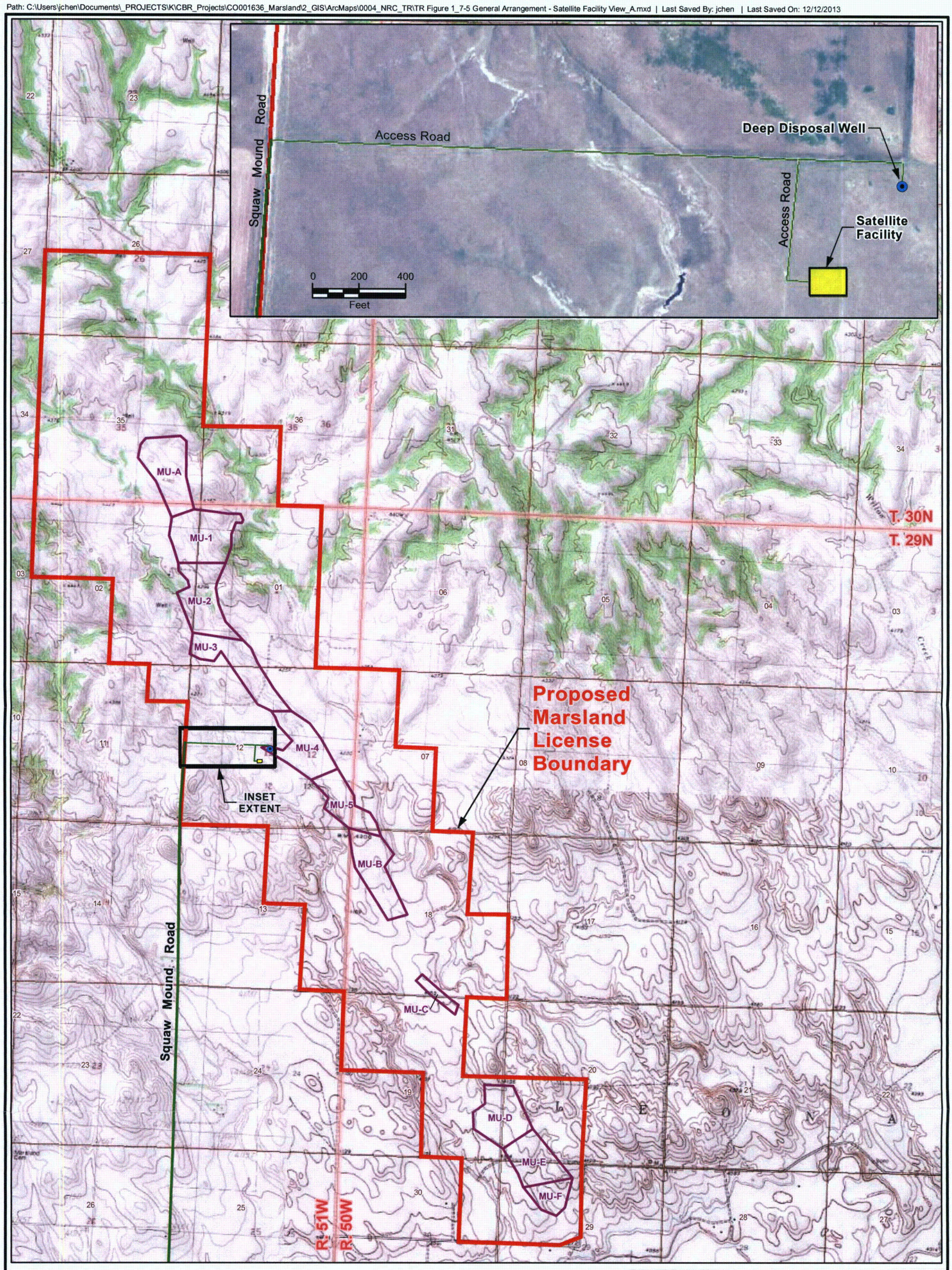
Path: C:\Users\jchen\Documents_PROJECTS\K\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0004_NRC_TR\TR Figure 1_7-5 General Arrangement - Satellite Facility View_A.mxd | Last Saved By: jchen | Last Saved On: 12/12/2013




**LEGEND**

- Proposed Deep Disposal Well
- Squaw Mound Road
- Access Road
- Satellite Facility (Restricted Area)
- Mine Unit
- Proposed Marsland License Boundary

N

0 1,500 3,000
Feet

*PROJECTION: NAD 1983, STATE PLANE NEBRASKA NORTH, FIPS 2600*
*SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE*

CROW BUTTE RESOURCES, INC.

**FIGURE 1.7-5**
**GENERAL ARRANGEMENT**
**SATELLITE FACILITY VIEW**

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JEC

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# 2 SITE CHARACTERISTICS

## 2.1 Site Location and Layout

The location of the current license area is sections 11, 12, 13, 24 of T31N, R52W and sections 18, 19, 20, 29, 30 of T31 N, R51W, Dawes County, Nebraska. The proposed MEA is located in sections 26, 35, 36 of T30N, R51W; sections 1, 2, 11, 12, and 13 of T29N, R51W; and sections 7, 18, 19, 20, 29, and 30 of T29N, R50W. The MEA is located approximately 4.6 miles (7.4 km) northeast of the unincorporated community of Marsland, Nebraska (centerpoint of MEA satellite building to centerpoint of Town of Marsland; **Figure 1.7-3**).

The maps used in this and other sections of this amendment application are Vector 7.5-minute quad maps. These are computer-aided design (CAD)/geographic information systems (GIS) drawings that depict each road, stream, and contour line as an individual entity. The layers in these maps were derived from the U.S. Census Bureau TIGER/Line data, U.S. Geological Survey (USGS) Digital Line Graph (DLG) Data, USGS Digital Elevation Model (DEM) data, Bureau of Land Management (BLM) Section Line data, National Geodetic Survey (NGS) Benchmark data, and USGS Geographical Names Information System (GNIS) data. This base map was then used for each of the figures prepared for this document with the addition of the pertinent information for that figure.

The longitudes and latitudes for the site boundary vertices and satellite facility are identified in **Table 2.1-1**. The datum for all topography maps in this application was North American Datum of 1983 (NAD 1983), and the geographic coordinate reference system (projection) was: *NAD_1983_StatePlane_Nebraska_North_FIPS_2600 (US_Foot).*

**Figure 1.7-3** shows the general area surrounding the proposed project area, including the proposed MEA, Area of Review (AOR) and Zone of Endangering Influence (ZOEI).

**Figure 1.7-2** shows the general project site layout and Restricted Areas for the current license area including the CPF building area, the RO facility, the current mine unit boundaries, and the R&D and commercial evaporation ponds.

**Figure 1.7-5** shows the proposed location of the satellite facility, mine units, access roads, and DDW within the MEA. The latitude and longitude for the center of the satellite facility is provided in **Table 2.1-1**.

**Deleted:** fencing,

**Deleted:** , and restricted areas

**Figure 5.7-2** shows the proposed MEA satellite building and the designated restricted area.

**Figure 1.3-1** shows the proposed MEA project location in relation to the CPF and proposed NTEA and TCEA. This figure shows topographical features; drainage and surface water features; nearby population centers; political boundaries; and principal highways, railroads, transmission lines, and waterways.

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**Table 2.1-1 Latitude and Longitude and Coordinates for Marsland License Boundary and Satellite Facility**

| Layer | Geographic Projection: NAD 83 (Degrees) | | Geographic Projection: NAD 27 (Degree) | | NAD1983 StatePlane Nebraska North FIPS 2600(US Foot) | | NAD1927 StatePlane Nebraska North FIPS 2601(US Foot) | |
|---|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | Latitude | Longitude | Northing | Easting | Northing | Easting |
| A | 42.4959 | -103.2345 | 42.4959 | -103.2340 | 986214 | 768453 | 440230 | 1128008 |
| A | 42.4957 | -103.2345 | 42.4957 | -103.2340 | 986145 | 768451 | 440161 | 1128006 |
| A | 42.4957 | -103.2296 | 42.4957 | -103.2291 | 986095 | 769765 | 440111 | 1129321 |
| A | 42.4884 | -103.2299 | 42.4884 | -103.2294 | 983444 | 769586 | 437459 | 1129139 |
| A | 42.4885 | -103.2250 | 42.4885 | -103.2245 | 983427 | 770914 | 437441 | 1130468 |
| A | 42.4809 | -103.2248 | 42.4810 | -103.2243 | 980670 | 770852 | 434685 | 1130405 |
| A | 42.4810 | -103.2296 | 42.4810 | -103.2291 | 980731 | 769563 | 434746 | 1129115 |
| A | 42.4739 | -103.2297 | 42.4739 | -103.2293 | 978161 | 769430 | 432176 | 1128981 |
| A | 42.4740 | -103.2149 | 42.4741 | -103.2144 | 978059 | 773427 | 432071 | 1132978 |
| A | 42.4666 | -103.2151 | 42.4666 | -103.2146 | 975348 | 773274 | 429360 | 1132823 |
| A | 42.4599 | -103.2149 | 42.4599 | -103.2144 | 972907 | 773242 | 426919 | 1132790 |
| A | 42.4591 | -103.2173 | 42.4591 | -103.2168 | 972635 | 772574 | 426647 | 1132122 |
| A | 42.4591 | -103.2245 | 42.4591 | -103.2241 | 972703 | 770633 | 426716 | 1130180 |
| A | 42.4591 | -103.2295 | 42.4591 | -103.2290 | 972750 | 769297 | 426765 | 1128845 |
| A | 42.4665 | -103.2295 | 42.4666 | -103.2290 | 975471 | 769397 | 429485 | 1128946 |
| A | 42.4665 | -103.2344 | 42.4666 | -103.2339 | 975519 | 768070 | 429534 | 1127619 |
| A | 42.4741 | -103.2345 | 42.4741 | -103.2341 | 978271 | 768138 | 432286 | 1127689 |
| A | 42.4740 | -103.2443 | 42.4741 | -103.2438 | 978352 | 765502 | 432369 | 1125052 |
| A | 42.4810 | -103.2443 | 42.4811 | -103.2438 | 980907 | 765597 | 434925 | 1125149 |
| A | 42.4811 | -103.2496 | 42.4811 | -103.2492 | 980966 | 764164 | 434985 | 1123716 |
| A | 42.4887 | -103.2494 | 42.4887 | -103.2489 | 983740 | 764329 | 437759 | 1123882 |
| A | 42.4886 | -103.2544 | 42.4887 | -103.2539 | 983778 | 762998 | 437797 | 1122551 |
| A | 42.4956 | -103.2542 | 42.4956 | -103.2537 | 986289 | 763143 | 440309 | 1122697 |
| A | 42.4954 | -103.2647 | 42.4954 | -103.2642 | 986336 | 760312 | 440357 | 1119866 |
| A | 42.5065 | -103.2644 | 42.5065 | -103.2639 | 990378 | 760549 | 444400 | 1120105 |
| A | 42.5064 | -103.2692 | 42.5065 | -103.2687 | 990402 | 759254 | 444424 | 1118811 |
| A | 42.5097 | -103.2690 | 42.5098 | -103.2686 | 991603 | 759327 | 445626 | 1118884 |
| A | 42.5097 | -103.2739 | 42.5097 | -103.2734 | 991631 | 758025 | 445654 | 1117582 |
| A | 42.5099 | -103.2739 | 42.5100 | -103.2734 | 991725 | 758032 | 445749 | 1117589 |
| A | 42.5172 | -103.2738 | 42.5172 | -103.2733 | 994360 | 758153 | 448384 | 1117712 |
| A | 42.5171 | -103.2835 | 42.5171 | -103.2831 | 994421 | 755527 | 448446 | 1115085 |
| A | 42.5244 | -103.2835 | 42.5244 | -103.2830 | 997082 | 755635 | 451107 | 1115195 |
| A | 42.5463 | -103.2834 | 42.5463 | -103.2829 | 1005052 | 755961 | 459078 | 1115525 |
| A | 42.5465 | -103.2639 | 42.5465 | -103.2634 | 1004932 | 761230 | 458955 | 1120795 |
| A | 42.5465 | -103.2637 | 42.5465 | -103.2632 | 1004932 | 761272 | 458955 | 1120838 |
| A | 42.5389 | -103.2637 | 42.5389 | -103.2633 | 1002164 | 761161 | 456187 | 1120724 |
| A | 42.5312 | -103.2638 | 42.5312 | -103.2633 | 999351 | 761048 | 453374 | 1120610 |
| A | 42.5314 | -103.2545 | 42.5314 | -103.2540 | 999330 | 763551 | 453351 | 1123113 |
| A | 42.5248 | -103.2544 | 42.5249 | -103.2539 | 996960 | 763475 | 450981 | 1123036 |
| A | 42.5246 | -103.2544 | 42.5246 | -103.2539 | 996874 | 763473 | 450895 | 1123033 |
| A | 42.5243 | -103.2544 | 42.5244 | -103.2539 | 996770 | 763469 | 450790 | 1123030 |
| A | 42.5244 | -103.2492 | 42.5244 | -103.2487 | 996740 | 764875 | 450760 | 1124436 |
| A | 42.5100 | -103.2492 | 42.5100 | -103.2487 | 991491 | 764681 | 445510 | 1124239 |
| A | 42.5100 | -103.2440 | 42.5101 | -103.2436 | 991461 | 766067 | 445480 | 1125625 |
| A | 42.5100 | -103.2392 | 42.5101 | -103.2387 | 991410 | 767368 | 445428 | 1126926 |
| A | 42.5031 | -103.2393 | 42.5031 | -103.2388 | 988886 | 767250 | 442903 | 1126807 |
| A | 42.5031 | -103.2344 | 42.5031 | -103.2340 | 988839 | 768558 | 442855 | 1128115 |
| A | 42.4959 | -103.2345 | 42.4959 | -103.2340 | 986214 | 768453 | 440230 | 1128008 |
| B | 42.5013 | -103.2555 | 42.5013 | -103.2550 | 988395 | 762875 | 442416 | 1122430 |

**Notes:**

A = Marsland Permit Boundary

B = Center of Satellite Facility

Revised December 2013

## 2.2 Uses of Adjacent Lands and Waters

This section evaluates the effects of the proposed uranium mining on the physical, ecological, and social characteristics of the surrounding environments. Land and water use in the current Crow Butte license area are discussed in the license renewal application previously submitted for NRC License Number SUA-1534 (NRC 2007a). Land and water use for the proposed NTEA are discussed in a license amendment application submitted to the NRC on May 30, 2007 (NRC 2007b). In addition, land and water use are discussed in a license amendment application for the proposed TCEA (NRC 2010), which is pending.

This section describes the nature and extent of present and projected land and water use and trends in population or industrial patterns. The information for the CPF was initially developed over a 9-month period in 1982 as part of the R&D License Application, updated in 1987 for the Commercial License Application, and in 1997 and 2007 during license renewal. The information for the MEA was developed in 2011. Preliminary data were obtained from several sources including previous licensing documents supported by field studies and interviews with various state and local officials.

NUREG 1569 requires a discussion of land and water use in the proposed MEA and within a 2.0-mile (3.3 km) distance from the site boundary. The NDEQ requires an assessment of a 2.25-mile (3.62 km) radius of the proposed project site boundary (AOR) for the Class III UIC application. Therefore, the NRC's 2.0-mile (3.2-km) radius has been extended to 2.25 miles (3.62 km) for consistency. Land use within the MEA and the 2.25-mile (3.62-km) AOR is illustrated on **Figure 2.2-1**.

Land use and water use data were updated from previous license applications by additional data collection and review, personal communications, and site reconnaissance. Population distribution characteristics were updated using current 2010 Census data and other applicable sources (USCB 2011).

Little change in land use has been noted in recent decades, reflecting the stagnant nature of economic activity and a slight decline in the populations of the City of Crawford and Dawes County.

### 2.2.1 General Setting

The MEA is located in southwestern Dawes County, Nebraska, just south of the Pine Ridge. The MEA is located approximately 4.6 miles (7.4 km) northeast of the community of Marsland (centerpoint of MEA satellite building to centerpoint of Town of Marsland; **Figure 2.2-1**). The main access route to the MEA is via State Highway (SH) 2/71 west of Marsland, then east along Niobrara Street and River Road, and then north on either Squaw Mound Road or Hollibaugh Road.

### 2.2.2 Land Use

Land use of the MEA and surrounding AOR is dominated by agricultural uses (**Figure 2.2-1 and Figure 2.8-1**). **Table 2.2-1** describes major land use types, including those depicted on **Figure 2.2-1**. Land use acreages for the AOR (**Table 2.2-2**) and MEA (**Table 2.2-3**) are presented in

**Figure 2.2-1** in 22-½ sectors centered on each of 16 compass points radiating out from the proposed satellite facility. Major land uses within the MEA and AOR are further discussed below.

Rangeland comprises the greatest land cover within the 2.25-mile (3.62-km) AOR (73 percent). Forest lands (13.4 percent), cropland (7.8 percent), and recreational land (3.3 percent) are the other significant land cover types. Less than 0.07 percent (30 acres) of the AOR is accounted for by wetlands. Scattered rural residences are mostly associated with agricultural operations.

Residential and commercial land uses in Dawes County are concentrated within the city limits of Crawford and Chadron and in the communities of Whitney and Marsland. Industrial land uses within the city limits of Crawford are generally associated with railroad facilities.

Within the MEA, rangeland is the dominant land use (80 percent), with cropland (10 percent) and forestland (7.8 percent) accounting for smaller areas.

2.2.2.1 Agriculture

Several of the soil types found in the vicinity of the MEA are classified as prime farmland. However, in Dawes County, soils are classified by the U.S. Natural Resource Conservation Service (NRCS) as prime farmland only if irrigated. According to 2009 Census of Agriculture for Nebraska, nearly 9 percent of Dawes County agricultural land is irrigated, and about 16 percent of harvested cropland acreage is irrigated (NASS 2009a). The remainder of the irrigated land is used for pasture, habitat, or rangeland (NASS 2009b). Irrigated land is found both in the MEA and in the AOR.

**Table 2.2-4** and **Table 2.2-5** show agricultural productivity and livestock inventory, respectively, within Dawes County. Wheat and forage are the major crops grown on croplands in Dawes County. Most of these crops are used for livestock feed, while the remaining crops are commercially sold. In 2010, total wheat production in Dawes County was 1,195,000 bushels, a decrease of 24 percent from 2009 production (NASS 2011). In 2010, 96,600 tons of forage was grown; this was a decrease of approximately 11 percent from the 2009 harvest. Non-livestock agricultural lands in Dawes County had a value of $13.61 per acre, indicating that crop production on existing farmed lands in the AOR have a potential value (assuming full use of lands) of $39,801 and $6,041 in the MEA (NASS 2009a).

In 2007, 69,429 head of livestock was reported in Dawes County (NASS 2009a). The livestock inventory for Dawes County indicates that cattle account for more than 90 percent of all livestock. Livestock, poultry, and their products account for approximately 75 percent of the total market value of all agricultural products sold in 2007; this is a slight decrease from 2002, when livestock accounted for approximately 86 percent of market value. In 2007, cash receipts for livestock and products totaled $34.3 million in Dawes County (NASS 2009a). Livestock, poultry, and their products had a value of $40.40 per acre, indicating that livestock production on rangeland within the AOR has a potential value (assuming full use of lands) of approximately $1.1 million and $145,448 in the MEA (NASS 2009a).

The market value of crops of $13.61 per acre was calculated as follows:

> Market value of crops, including nursery and greenhouse crops ÷ Land in Farms: $11,550,000 ÷848,753 acres = $13.61/acre.

The market value of livestock poultry, and their products of $40.40 was calculated as follows:

> Market value of livestock, poultry, and their products ÷ Land in farms
> $34,286,000 ÷ 848,753 acres = $40.40/acre

These values were calculated using the data from Table 1, County Summary Highlights: 2007 for Dawes County (NASS 2009a). The methodology used for the calculations are from a publication by Doris N. Petersan (Petersan 2005).

2.2.2.2 Recreation

There are no developed recreation facilities within the MEA or the AOR. The key recreational facilities within 50 miles (80 km) of the MEA, along with natural areas with recreational opportunities, are shown on **Figure 2.2-2** and listed in **Table 2.2-6**. **Table 2.2-6** includes the approximate distances from the proposed MEA satellite facility to the recreational facilities. In the vicinity of MEA, key natural areas with recreational opportunities include the Box Butte Reservoir State Recreation Area (SRA); Fort Robinson and Chadron State Parks; the Soldier Creek Wilderness Area; the Bighorn, Fort Robinson, Peterson, Ponderosa, and Chadron Creek Ranch Wildlife Management Areas (WMAs); Whitney Lake; and the Nebraska National Forest (Nebraska Game and Parks 2013). The Pine Ridge National Recreation Area is located approximately 1 mile (1.6 km) south of Chadron State Park and includes the Roberts Trailhead and Campground.

Recreational opportunities provided by federal and state lands in Dawes County have become an important component of the local economy. According to the Final Environmental Impact Statement for the Northern Great Plains Management Plans Revision (May 2001), the various state parks in northwest Nebraska, the Pine Ridge Ranger District of the Nebraska National Forest, and the Oglala National Grassland are increasingly becoming regional tourist destinations.

Participation in outdoor recreational activities is expected to increase nationwide. An increase in visitor use of recreation facilities in Dawes County would have beneficial effects on the local economy. Employment related directly to tourism and recreation is difficult to gauge, as the services provided for visitors can also be used by residents. The retail and leisure/hospitality industry sectors (arts, entertainment, recreation, accommodation, and food services) combined account for approximately 27 percent of jobs in Dawes County (USCB 2013).

The Agate Fossil Bed National Monument is located approximately 24 miles (38.6 km) from the MEA. The Agate Fossil Beds National Monument had approximately 9,409 visitors in 2012 (National Park Service 2013).

In 2008, the Nebraska National Forest had 181,000 visitors (USFS 2012). The Nebraska National Forest provides a wide range of other undeveloped backcountry recreation opportunities such as hunting, hiking, backpacking, fishing, horseback riding, off-highway motorized vehicle use, and wildlife observation. Camping and motorized travel/sightseeing are the two most popular recreation categories within the Pine Ridge Ranger District and the Oglala National Grassland.

**Deleted:** There are no developed recreation facilities within the MEA or the AOR. Recreational opportunities provided by federal and state lands in Dawes County have become an increasingly important component of the local economy. There are no developed recreation facilities within the MEA or the AOR. Nearby recreational facilities in Dawes County include the Ponderosa State Wildlife Management Area (SWMA), Chadron State Park, Soldier Creek Wilderness Area, the Red Cloud Picnic Area, trails in the Nebraska National Forest, Box Butte Reservoir State Recreation Area, and Fort Robinson State Park (DeLorme Maps 2005). Approximate distances from the proposed MEA satellite facility to local and regional recreational facilities are presented in **Table 2.2-6**.

The Pine Ridge District is an important destination for deer hunting, provides the most popular turkey hunting area in Nebraska, and includes the greatest number of miles of mountain biking trails in the state. The Ponderosa WMA is adjacent to the National Forest.

In 2010, there were more than 11.1 million visitors to Nebraska State Parks and Recreation Areas. The Nebraska State Parks and Recreation Areas generated almost $18 million of income and revenue (USCB 2012).

Fort Robinson State Park, the largest state park in Nebraska, includes portions of the Red Cloud Agency Historical Site and the White River Trail, the Fort Robinson WMA and the Peterson WMA. The park features a variety of developed recreation facilities, including the Soldier Creek and Red Cloud Campgrounds and other lodging facilities, trails, and museums. Approximately 345,923 people visited Fort Robinson State Park in 2010, 257,194 in 2011 and 370,821 in 2012 (NDED 2011; Nebraska Tourism Statistics 2012).

Chadron State Park was founded in 1921 and is Nebraska's oldest state park (Journey to Western Nebraska 2013). It encompasses nearly 1,000 acres of Pine Ridge wilderness and is located 9 miles (14.5 km) south of the City of Chadron on Highway 385. The park offers trout fishing, camping, hiking, mountain biking, bird watching, and horseback riding. Approximately 247,400, 280,200, and 298,350 people visited the park in 2010, 2011, and 2012, respectively (Journey to Western Nebraska 2013).

#### 2.2.2.3 Residential

In 2010, there were a total of 567 houses in the City of Crawford, with 470 occupied (334 owner-occupied and 136 renter-occupied), and 418 houses in the Town of Hemingford, with 315 occupied (253 owner-occupied and 82 renter-occupied; USCB 2011).

Based on site reconnaissance in May 2011 and a combination of Google Earth and Nebraska Department of Natural Resources (NDNR) aerial imagery of the area, there are two housing units in the MEA, only one of which was occupied at the time of the reconnaissance. The occupied residence is located in SW¼ NW¼ section 7, and the unoccupied residence is located in T29N, R50W and SE¼ NE¼ section 2, T29N, R51W, as shown on **Figure 2.2-3**. The AOR contains an additional 25 structures, of which seven are occupied. There are a total of eight occupied housing units within the MEA and the 2.25-mile (3.62-km) AOR.

**Table 2.2-7** shows the distance to the nearest residence within the 2.25-mile (3.62-km) AOR and to the nearest site boundary from the center of the MEA for each 22 ½ sector centered on each compass point. There are two residences within 1 mile (1.6 km) of the center point of the proposed MEA.

#### 2.2.2.4 Habitat

Habitat lands are those dedicated wholly or partially to the production, protection, or management of species of fish or wildlife. Significant areas classified as habitat nearest to the MEA include the Ponderosa SWMA, located approximately 5.2 miles (8.4 km) north of the MEA boundary; the Fort Robinson WMA, located 13.7 miles (22.0 km) northwest of the MEA boundary; and the Petersen WMA, located 13.8 miles (22.2 km) north-northwest. There is no land within the MEA used primarily for wildlife habitat. Wildlife habitat is a secondary use of rangeland, forestland,

and recreational land within the MEA and the 2.25-mile (3.62-km) AOR. An evaluation of habitat in the MEA is included in Section 2.8, with habitat types in the MEA shown in **Figure 2.8-1**.

2.2.2.5 Industrial and Mining

Numerous exploratory wells targeting mineral resources and hydrocarbons have been drilled in the MEA and the AOR. CBR has an ongoing exploratory drilling program that, to date, has completed more than 1,800 drill holes in the MEA. Besides CBR, Conoco, Amoco Minerals, Santa Fe Mining, and Union Carbide have also drilled exploratory test holes for uranium resources in the general area. With the exception of these exploratory wells, there are no other industrial facilities within the 2.25-mile (3.62-km) AOR.

There is one abandoned oil and gas exploratory well located within the MEA or the 0.25-mile (0.4-km) ZOEI, but four abandoned wells are present within the 2.25-mile (3.62-km) AOR (**Figure 2.2-4**). Based upon review of public records, all referenced oil and gas wells have been properly plugged and abandoned in accordance with the Nebraska Oil and Gas Conservation Commission regulations (NOGCC 2011). A discussion of oil and gas test holes pertinent to the MEA is presented in Section 2.6.1.1 (see Pierre Shale subheading under Montana Group).

The nearest operating uranium recovery facility is the CBR operations located approximately 11.1 miles (17.9 km) to the north-northwest of the MEA (centerpoint of CPF building to centerpoint of MEA satellite building; NRC 2011a). The location of the MEA site in relation to other proposed CBR satellite facilities is shown on **Figure 1.3-1**.

Project descriptions and locations of operating and proposed uranium recovery facilities in neighboring Wyoming and South Dakota can be found at the NRC website (NRC 2011a). The other uranium in-situ facilities nearest to the MEA in eastern Wyoming and western South Dakota in different stages of development are identified in **Table 2.2-8**. There are no existing or proposed uranium recovery facilities located within 75 miles (120.7 km) of the proposed MEA project. The nearest operating uranium recovery facility is the Power Resources, Inc. Smith Ranch/Highland Central Processing Plant in Wyoming, and the nearest proposed uranium in-situ facilities are Powertech Uranium Corporation's Dewey-Burdock facility located in Fall River and Custer Counties of South Dakota, and the Uranium One's Moore Ranch project located in Converse County, Wyoming. The NRC maintains a status of major uranium recovery licensing applications in the U.S., which is periodically updated (NRC 2013).

Other than CBR uranium recovery activities, there are no other known planned uranium recovery operations in Nebraska (NRC 2011b). There are two nuclear power reactors located in extreme eastern Nebraska that are more than 300 miles (482.8 km) from the proposed MEA project site. The nearest licensed nuclear fuel cycle facility (a gas centrifuge uranium enrichment facility) is located in Idaho Falls, Idaho and operated by AREVA Enrichment Services.

2.2.2.6 Commercial and Services

There are no known retail or commercial establishments within the MEA or the 2.25-mile (3.62-km) AOR. The nearest retail and commercial establishments are found in Crawford and Hemingford. The distance between the City of Crawford and the MEA (centerpoints of city and MEA satellite building) is 15.1 miles (24.3 km), and the distance between the Town of

Hemingford and the MEA (centerpoints of town and MEA satellite building) is 15.4 miles (24.8 km; **Figure 7.3-3**).

2.2.2.7 Transportation and Utilities

SH 2/71 runs to the west of the MEA. It converges with U.S. Highway 20 in the City of Crawford north-northwest of the MEA. The northern portion of the MEA is accessed from SH 2/71 via East Belmont Road; the southern portion of the MEA is accessed from SH 2/71 via River Road and Hollibaugh Road. The 2010 average daily traffic counts for a segment of Highway 2/71 near Marsland at the southern end of the MEA was 675 total vehicles, including 90 heavy commercial vehicles. Traffic levels on SH 2/71 increase to 695 total vehicles, including 90 heavy commercial vehicles in the vicinity of East Belmont Road (NDOR 2010). Secondary and private roads connect with East Belmont Road, River Road, Hollibaugh Road, and Squaw Mound Road to provide access to residences and agricultural lands within the MEA. No railways cross the MEA; a Burlington Northern Santa Fe rail line runs to the west of the MEA and through a small portion of the 2.25-mile (3.62-km) AOR between the MEA and SH 2/71.

2.2.2.8 References

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### 2.2.3 Water Use Information

#### 2.2.3.1 Dawes County Water Use

Every 5 years since 1950, the USGS assesses U.S. water use (USGS 2005) and includes water use estimates for the State of Nebraska. The latest study examined usage in 2005. The USGS works in cooperation with local, state, and federal environmental agencies to collect and distribute water-use information. For Nebraska water use data, the USGS works in cooperation with the NDNR. The USGS's National Water-Use Information Program is responsible for compiling and disseminating the nation's water-use data (USGS 2013). Every 5 years, the USGS compiles these data at the county level to produce water-use information aggregated at the county, state, and national levels. The next report was scheduled to be issued in 2010, but due to delays, the next report completion and data availability is not expected until 2014 (USGS 2013). The State of Nebraska does not update the data in the above referenced USGS reports, so any more recent data listed in **Table 2.2-9** will not be available until the USGS issues its water use report in 2014. **Table 2.2-10** was updated to reflected information on non-abandoned registered water wells for Dawes County as of April 8, 2013.

Estimated water use in 2005 for Dawes County, Nebraska is presented in **Table 2.2-9** (USGS 2005). The total 2005 population for Dawes County was 8,636 people, with public supply groundwater and surface water use totaling 2,590,000 gallons per day (gpd). Irrigation using groundwater and surface water accounted for a total of 24,550,000 gpd to irrigate an estimated 13,000 acres. Essentially all of the rural residents of Dawes County use groundwater for their domestic supply.

A summary of the number and types of registered non-abandoned water wells located in Dawes County as of April 8, 2013 is presented in **Table 2.2-10.** Note that this table refers to registered wells. Under current Nebraska law, water supply wells used solely for domestic purposes and completed prior to September 9, 1993, do not have to be registered (NRS 2008). Therefore, there are a number of domestic/agricultural and agricultural unregistered wells located in Dawes County. CBR identifies such wells through interviews with landowners and local drillers.

There are a total of 5,828 registered water wells in Dawes County used for a variety of purposes, as described in **Table 2.2-10**. According to the NDNR, there are a total of 251 domestic and 232 livestock wells located in Dawes County (NDNR 2013a). There are 36 public water supply wells located in Dawes County. Livestock water wells make up the majority of the wells identified in the MEA.

### 2.2.4 Marsland Expansion Area Project Area

The town nearest to the MEA project site is Marsland, NE, which is located approximately 4.6 miles (7.4 km) southwest of the nearest MEA site (centerpoint of Town of Marsland to centerpoint of MEA satellite building). There is no public water supply system for Marsland. The residential homes scattered throughout the MEA area are supplied with domestic water from private wells. Private well use is discussed in more detail below.

Deleted: license boundary.

In general, groundwater supplies in the vicinity of the MEA are limited due to topography and shallow geology (University of Nebraska-Lincoln 1986). Groundwater quality in the vicinity near the MEA is generally poor (Engberg and Spalding 1978). Locally, groundwater is obtained from the Arikaree and Brule Formations. The primary groundwater supply is the Brule Formation, typically encountered at depths from approximately 50 to 350 feet bgs. In general, the static water level for Brule Formation wells in the MEA ranges from 50 to 150 feet bgs, depending on local topography (**Figures 2.6-3a** through **2.6-3n** and **1.4-1**).

Groundwater from the underlying basal sandstone of the Chadron Formation is not used as a domestic supply within the MEA because of the greater depth (800 to 1150 feet bgs) and inferior water quality. Gosselin et al. (1996) state that: (1) "*the sands near the bottom of the Chadron Formation yield sodium-sulphate water with high total dissolved solids,*" and (2) in proximity to "*uranium deposits in the Crawford area, groundwater from the Chadron Formation is not suitable for domestic or livestock purposes because of high radium concentrations.*" In addition, it is economically impractical to install water supply wells into the deeper basal sandstone of the Chadron Formation in the vicinity of the MEA, in contrast to the vicinity of the NTEA, where most basal sandstone of the Chadron Formation wells either flow at the surface or have water levels very close to surface elevation because of artesian pressure.

Based on a research study funded by the American Water Works Association Research Foundation (AWWARF), the average household water use annually (including outdoor) is approximately 409 gpd (Mayer et al. 1999). The results of the study suggested a daily indoor per capita water use of 69.3 gallons. According to the U.S. EPA, the average family of four can use 400 gallons of water every day; on average, approximately 70 percent of that water is used indoors (USEPA 2013). Because there is only one occupied residence located within the proposed MEA (NW¼ SW¼ section 7, T29N R50W), total water use would be expected at an average of approximately 400 gpd, using the U.S. EPA water use value. Eight occupied residences have been identified within the 2.25-mile (3.62-km) AOR. Therefore, water use would be expected to average at about 3,200 gpd for the entire area.

Another source of groundwater consumption in the AOR is private water well use for livestock watering. The Nebraska Resources Conservation Service (NRCS) located in Nebraska uses 0.45 animal units (AU) per acre and estimates the water consumption to be 15 to 20 gallons per day per animal (Teahon 2013a). An AU is defined as an animal equivalent of 1,000 pounds live weight, with or without an unweaned calf. There is an estimated 27,572.4 acres of rangeland located with the MEA AOR. Based on the NRCS values for calculating livestock water consumption in Dawes County, livestock consumption within the MEA AOR (assuming full use), would be 186,114 to 248,152 gallons per day. There are approximately 3,694.6 acres located within the MEA license boundary, and based on the NRCS livestock consumption calculation values, livestock consumption (assuming full use of available rangeland acreage) would range from 24,938 to 33,251 gallons per day.

CBR conducted an updated water user survey in 2010 and 2011 to identify and locate all private water supply wells within the 2.25-mile (3.62-km) AOR of the proposed MEA. The water user survey targeted the location, depth, casing size, depth to water, and flow rate of all wells within the area that were (or potentially could be) used as domestic, agricultural, or livestock water supply. **Table 2.2-11** and **Appendix A** list the active and abandoned water supply wells within the MEA and AOR. The locations of all active and abandoned water supply wells are depicted on **Figure 2.7-6** and **2.9-3.** Available NDNR water well registrations within the AOR are presented in **Appendix E-1** and available well abandonment records in the AOR are shown in **Appendix D-2**. The NDNR's water well retrieval database (NDNR 2013b) was reviewed on September 6, 2013, (Teahon 2013b) and no additional private water supply wells were identified to be installed or modified within the license boundary or AOR since the TR was submitted to the NRC by letter dated May 16, 2012.

There were a total of 134 active and inactive/unknown private water supply wells within the license boundary and associated AOR identified during the water user survey. There are a total of 97 active private water supply wells within the AOR and outside of the license boundary (**Table 2.2-11**). Within this grouping of active private wells, 12 are classified solely as agricultural use, four wells are classified as solely domestic use 13 wells – domestic/livestock, two wells – domestic/garden, one well – domestic/agricultural, and one well domestic/livestock/agricultural, one livestock/garden, and 63 wells classified as solely livestock use. One additional well has an unknown well use and status. It should be noted that 18 of these wells have multiple or mixed well use classifications. In terms of aquifer assignments, four wells are assigned to the Arikaree Group, 35 wells are assigned to the Arikaree/Brule, 30 wells are assigned to the Brule Formation, and 28 wells are unassigned.

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Within the MEA, there are a total of 13 active private water supply wells (**Table 2.2-11**). Within this grouping of active private wells, one is classified as domestic use, ten are classified as livestock use, and two wells, installed and used by CBR as driller water supply wells, have an "other" well use classification. In terms of aquifer assignments, three wells are assigned to the Arikaree Group, four wells are assigned to the Arikaree/Brule, four wells are assigned to the Brule Formation, and two wells are unassigned. Two wells within the MEA are designated as inactive. The NDNR water well retrieval database uses the code "other" for well uses defined as lake supply, fountain, geothermal, wildlife, wetlands, recreation, plant and lagoon, sprinkler, test, and other uses. (NDNR 2013b). For comparison, the following are water use designations used by the NDNR:

A Aquaculture
C Commercial/Industrial]
D Domestic
E Pit - Irrigation
G Ground Heat Exchanger Well - Closed Loop Heat Pump Well
H Heat Pump Well - Open Loop Heat Pump Well
I Irrigation
J Injection
L Observation (Groundwater Levels)

For well water uses that do not fall within these categories, the "other" well use code is used.

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For all of the active private wells described above that remain unassigned to a formation, information provided by the well owner and from nearby wells was insufficient to accurately determine the well completion depth. However, based on discussions with land owners and known completion depths of private water supply wells in the area, these wells have suggested well completions within the Arikaree Group or Brule Formation (**Table 2.2-11**). Well construction and water quality information for these wells are not available in the NDNR water well data retrieval database (NDNR 2011) or known by the well owner. Based on available information, all water supply wells within the MEA and AOR are completed in the relatively shallow Arikaree Group and Brule Formations, with no domestic or agricultural use of groundwater from the basal sandstone of the Chadron Formation (**Figure 2.7-6 and 2.9-3** and **Table 2.2-11**). Sampling results of these wells by CBR indicate water quality of Arikaree Group and/or Brule Formation aquifers. Based on water quality and the depth of the Arikaree Group and Brule Formation in the MEA Project area, it can be assumed that wells less than 285 feet in depth are located in the Arikaree Group and/or Brule Formation.

Two wells completed in the Brule Formation within the MEA are designated as inactive. Active private wells within the license boundary and 1.2-miles (2-km) radius of the license boundary have been sampled quarterly as part of the preoperational/preconstruction monitoring program (PPMP). There are currently 11 active private wells within the license boundary and an additional 41 active private wells with the 1.2-mile (2-km) radius of the license boundary (**Figure 2.9-3** and **Table 2.2-11**). The PPMP baseline groundwater sampling and analysis program for the private wells is discussed in Section 6.1.2.1. Wells were selected for sampling based on landowner approval for access to the wells and condition of the wells.

Based on population projections, future water use within the MEA and AOR will be a continuation of present use (see Section 2.3). There is one irrigation crop circle with a center pivot that extends into the license boundary (SE ¼ section of Section 18, T29N R50W; **Figure 7.3-2**). The nearest mine units to the crop circle are MU-B and MU-C, which are located, at the nearest points, 0.37 and 0.28 mile (0.59 and 0.45 km, respectively from the crop circle, respectively. This crop circle located within the license boundary may continue to be operated by the land owner, but the pivot will not be operated inside any MEA monitor well ring. There are no other lands within the license boundary that are irrigated, and no additional irrigation within the license boundary will occur during MEA operations. Irrigation within the MEA AOR is anticipated to be consistent with the past. Any further development would be expected to be limited due to limited water supplies, topography and climate. It is anticipated that the residents of Marsland and the surrounding area will continue to use water supplied exclusively by private wells.

By operation of the leases, no new wells will be installed within the license area without CBR permission. The NDNR registered well database will be reviewed annually, and where appropriate, arrangements will be made to monitor any new wells.

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**Deleted:** Nebraska Department of Natural Resources

In Nebraska, groundwater is subject to a combination of case law and statutory provisions administered by the Upper Niobrara White Natural Resource District and the courts when necessary (Kelly 2010). Case law has adopted the "rule of reasonable use" in combination with a correlative rights doctrine for allocation among groundwater users in times of shortage. In essence, the owner of land is entitled to groundwater under his land, but the owner may not extract groundwater in excess of reasonable and beneficial use upon the land, especially if such use impacts others who use the same groundwater. If the supply is insufficient for all owners, each is entitled to a reasonable proportion. Because there are no nearby users of basal sandstone of the Chadron Formation groundwater, conflict is unlikely.

#### 2.2.4.1 Wellhead Protection Area

The nearest town to the MEA project site is Marsland, NE. It is located approximately 4.6 miles (7.4 km) southwest of the MEA project (centerpoint of Town of Marsland to centerpoint of MEA satellite building). Marsland is an unincorporated community, with the only business being a U.S. Post Office. There are scattered homesites in the area, with domestic water being supplied by private wells. Approximately eight households and ten people can be found in the immediate area of Marsland (Key to the City 2011). There is no public water supply system; therefore, there is no wellhead protection plan. The other nearest communities to the proposed MEA are the Town of Hemingford, NE and City of Crawford, NE, which are located approximately 15.4 miles (24.8 km; centerpoints of Hemingford and MEA satellite building) and 15.1 miles (24.3 km; centerpoints of Crawford and MEA satellite building). The City of Crawford and Town of Hemingford have wellhead protection plans in place (NE IDs NE3101303 and NE3104505, respectively). However, these communities are located at a distance from the MEA that precludes any potential impacts from the MEA operations. A horizontal distance of 1,000 feet is the minimum required separation of a city water supply well (used for domestic, irrigation, stock, or heat pump purposes) from potential sources of contamination (NDHHS 2010). The minimum horizontal distances required for additional potential sources of contamination range from 10 to 1,000 feet and are provided in **Table 2.2-12**.

**Deleted:** license boundary.

**Deleted:** (19.3 km to the southeast)

**Deleted:** (18.5 km to the northwest), respectively, from the nearest license boundary of the MEA.

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**Table 2.2-1 Major Land Use Definitions**

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**Table 2.2-2 Present Major Land Use within a 2.25-Mile (3.62 km) Radius of the Proposed Marsland Expansion Area License Boundary**

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**Table 2.2-3 Present Land Use within the Proposed Marsland Expansion Area License Boundary**

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**Table 2.2-4 Agricultural Yields for Croplands in Dawes County 2010**

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**Table 2.2-5 Livestock Inventory for Dawes County 2007**

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**Table 2.2-6 Recreational Facilities Within 50 Miles (80 km) of the Proposed Marsland Expansion Area**

| Name of Recreational Facility | Distance From MEA Boundary (miles) |
|---|---|
| Box Butte Reservoir and Wildlife Area | ~3 |
| Ponderosa Wildlife Management Area | ~5 |
| Bighorn WMA | ~7 |
| Fort Robinson State Park | ~9 |
| Legend Buttes Golf Course | ~11 |
| Roberts Trailhead and Campground<br>Pine Ridge National Recreation Area | ~11 |
| Crawford City Park | ~12 |
| Peterson Wildlife Management Area | ~14 |
| Chadron Creek Ranch WMA | ~15 |
| Fort Robinson WMA | ~15 |
| Chadron State Park | ~16 |
| Soldier Creek and Red Cloud Campgrounds<br>Fort Robinson State Park | ~16 |
| Soldier Creek Wilderness Area<br>Nebraska National Forest | ~16 |
| Whitney Lake | ~16 |
| Ridgeview Country Club Golf Course<br>City of Chaldron | ~21 |
| Hudson-Meng Bison Bonebed | ~22 |
| Agate Fossil Beds National Monument | ~24 |
| Toadstool Geologic Park | ~24 |
| Bordeaux WMA | ~26 |
| Museum of the Fur Trade, City of Chadron | ~26 |
| Walgren Lake State Recreation Area | ~32 |
| Gilbert-Baker Wildlife Area | ~34 |
| Metcalf WMA | ~35 |
| Warbonnet Battlefield | ~35 |
| North Platte NWR | ~38 |

**Table 2.2-6 Recreational Facilities Within 50 Miles (80 km) of the Proposed Marsland Expansion Area**

| Name of Recreational Facility | Distance From MEA Boundary (miles) |
|---|---|
| Smith Lake WMA | ~39 |
| Nine Mile Creek WMA | ~40 |
| Arnold Trupp WMA | ~43 |

Sources: DeLorme 2005; Nebraska Game and Fish 2013

**Table 2.2-7 Distance to Nearest Residence and Site Boundary from Center of MEA for Each Compass Sector**

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**Table 2.2-8 Uranium Recovery Activities in Region of Proposed Marsland Expansion Area**

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**Table 2.2-9 USGS Estimated Water Use in Dawes County 2005**

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**Table 2.2-10 Summary of Non-Abandoned Registered Water Wells for Dawes County, NE on File as of August 23, 2011**

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**Table 2.2-11 Active, Inactive and Abandoned Water Supply Wells in the Marsland Expansion Area and 2.25-Mile Area of Review**

| Well No. | Estimated Depth (ft) | Formation | Well Use | Well Status |
|---|---|---|---|---|
| **ACTIVE AND INACTIVE WELLS** | | | | |
| **Wells Located Within License Boundary (13 active and 2 inactive)** | | | | |
| 700 | 180-200 | Brule | Livestock | Active |
| 701 | 180-200 | Brule | Livestock | Inactive |
| 705 | Unknown | Arikaree | Livestock | Active |
| 720 | 240 | Arikaree/Brule | Other [c] | Active |
| 721 | 360 | Arikaree/Brule | Other [c] | Active |
| 722 | 160 | Brule | Livestock | Active |
| 727 | 180 | Arikaree/Brule | Livestock | Active |
| 728 | 260 | Brule | Livestock | Active |
| 730 | Unknown | Unknown[a] | Domestic | Active |
| 731 | 180 | Brule | Livestock | Active |
| 733 | Unknown | Unknown[a] | Livestock | Active |
| 744 | 80 | Arikaree | Livestock | Active |
| 747 | 225 | Arikaree/Brule | Livestock | Active |
| 787 | 130 | Brule | Livestock | Inactive |
| 788 | 130-140 | Arikaree | Livestock | Active |
| **Wells Located Within 1 km Radius of License Boundary (25 active and 7 inactive)** | | | | |
| 702 | 180-200 | Brule | Livestock | Active |
| 703 | 280 | Brule | Domestic/Livestock | Active |
| 704 | Unknown | Unknown[a] | Livestock | Active |
| 707 | Unknown | Unknown[a] | Livestock | Active |
| 719 | 160 | Brule | Livestock | Active |
| 723 | 220 | Brule | Domestic/Livestock | Active |
| 724 | Unknown | Unknown[a] | Domestic/Livestock | Inactive |
| 725 | 240 | Brule | Livestock | Active |
| 729 | Unknown | Unknown[a] | Livestock | Inactive |
| 732 | 280 | Brule | Agricultural | Active |
| 735 | 375 | Brule[b] | Livestock | Active |
| 736 | 200 | Brule[b] | Agricultural | Active |
| 739 | 60 | Arikaree | Livestock/Garden | Active |
| 740 | 110 | Brule | Agricultural | Active |
| 741 | 190 | Brule | Agricultural | Active |
| 743 | 140 | Brule[b] | Livestock | Active |
| 745 | 140[c] | Brule | Livestock | Active |
| 746 | Unknown | Unknown[a] | Livestock | Active |
| 748 | Unknown | Unknown[a] | Livestock | Active |
| 749 | Unknown | Unknown[a] | Livestock | Inactive |
| 750 | Unknown | Unknown[a] | Livestock | Active |
| 752 | 200-300 | Brule | Domestic/Livestock | Active |
| 753 | 200-300 | Brule | Domestic/Livestock | Active |
| 754 | 200-300 | Brule | Livestock | Active |
| 755 | 200-300 | Brule | Livestock | Active |

**Table 2.2-11 Active, Inactive and Abandoned Water Supply Wells in the Marsland Expansion Area and 2.25-Mile Area of Review**

| Well No. | Estimated Depth (ft) | Formation | Well Use | Well Status |
|---|---|---|---|---|
| 756 | 200-300 | Brule | Livestock | Inactive |
| 759 | 200-300 | Brule | Livestock | Active |
| 777 | 60 | Arikaree | Domestic/Garden | Active |
| 778 | 60 | Arikaree | Livestock | Inactive |
| 802 | 180-200 | Brule | Livestock | Active |
| 834 | 300 | Brule | Domestic/Livestock | Inactive |
| 843 | 300 | Brule[b] | Livestock | Inactive |
| **Wells Located Between 1 and 2 km Radius (18 active and 6 inactive)** | | | | |
| 706 | Unknown | Unknown[a] | Livestock | Active |
| 714 | 135 | Brule[b] | Domestic/Livestock | Active |
| 715 | 135 | Arikaree | Agricultural | Active |
| 716 | 135 | Brule | Agricultural | Inactive |
| 734 | 300 | Brule[b] | Livestock | Active |
| 737 | 340 | Brule[b] | Agricultural | Active |
| 742 | 60 | Arikaree[b] | Livestock | Active |
| 760 | Unknown | Unknown[a] | Agricultural | Active |
| 790 | Unknown | Unknown[a] | Livestock | Inactive |
| 794 | 300 | Arikaree/Brule[b] | Domestic/Livestock | Active |
| 795 | 350 | Arikaree/Brule[b] | Domestic/Livestock | Active |
| 796 | 350 | Arikaree/Brule[b] | Domestic/Livestock | Inactive |
| 799 | 250 | Brule | Livestock | Active |
| 809 | 300 | Brule | Livestock | Active |
| 810 | >300 | Unknown[a] | Domestic/Livestock | Active |
| 811 | >300 | Unknown[a] | Domestic/Livestock | Active |
| 815 | 140 | Brule | Domestic | Active |
| 816 | 140 | Brule | Livestock | Inctive |
| 817 | 160 | Brule | Livestock | Inctive |
| 821 | 160 | Brule[b] | Livestock | Active |
| 835 | 300 | Brule | Livestock | Inactive |
| 836 | 220 | Brule | Livestock | Active |
| 841 | 220 | Brule[b] | Livestock | Active |
| 845 | Unknown | Unknown[a] | Domestic/Livestock | Active |
| **Wells Located Between 2 km Radius and AOR Boundary (54 active, 8 inactive and 1 unknown)** | | | | |
| 708 | Unknown | Unknown[a] | Livestock | Active |
| 709 | Unknown | Unknown[a] | Livestock | Active |
| 710 | Unknown | Unknown[a] | Livestock | Active |
| 711 | Unknown | Unknown[a] | Livestock | Active |
| 712 | Unknown | Unknown[a] | Livestock | Active |
| 713 | Unknown | Unknown[a] | Livestock | Active |
| 717 | 160 | Arikaree/Brule | Livestock | Active |
| 738 | 260 | Arikaree/Brule[b] | Livestock | Active |
| 751 | Unknown | Unknown[a] | Livestock | Active |
| 762 | 200-300 | Arikaree/Brule[b] | Livestock | Active |

**Table 2.2-11 Active, Inactive and Abandoned Water Supply Wells in the Marsland Expansion Area and 2.25-Mile Area of Review**

| Well No. | Estimated Depth (ft) | Formation | Well Use | Well Status |
|---|---|---|---|---|
| 763 | 200-300 | Arikaree/Brule[b] | Livestock | Active |
| 764 | 200-300 | Arikaree/Brule[b] | Livestock | Active |
| 765 | 200-300 | Arikaree/Brule[b] | Livestock | Active |
| 767 | 200-300 | Arikaree/Brule[b] | Livestock | Active |
| 768 | 200-300 | Arikaree/Brule[b] | Domestic | Active |
| 769 | 200-300 | Arikaree/Brule[b] | Livestock | Active |
| 771 | 200-300 | Arikaree/Brule[b] | Livestock | Active |
| 772 | 200-300 | Arikaree/Brule[b] | Livestock | Active |
| 773 | 200-300 | Arikaree/Brule[b] | Livestock | Active |
| 775 | 220 | Arikaree/Brule[b] | Livestock | Active |
| 776 | 200-300 | Arikaree/Brule[b] | Livestock | Active |
| 781 | 60 | Arikaree/Brule | Livestock | Active |
| 782 | 100 | Brule[b] | Agricultural | Active |
| 783 | 70 | Arikaree/Brule[b] | Domestic | Active |
| 784 | 40-60 | Arikaree/Brule[b] | Livestock | Inactive |
| 785 | 140 | Arikaree/Brule[b] | Livestock | Inactive |
| 786 | 140 | Arikaree/Brule[b] | Livestock | Inactive |
| 791 | Unknown | Unknown[a] | Livestock | Active |
| 792 | Unknown | Unknown[a] | Livestock | Active |
| 793 | 300 | Arikaree/Brule[b] | Livestock | Active |
| 798 | 200 | Brule | Livestock | Active |
| 800 | Unknown | Unknown[a] | Livestock | Active |
| 801 | 220 | Arikaree/Brule[b] | Domestic/Garden | Active |
| 803 | Unknown | Unknown[a] | Livestock | Active |
| 804 | Deep | Unknown[a] | Domestic/Livestock | Active |
| 805 | Shallow | Unknown[a] | Livestock | Inactive |
| 806 | Unknown | Unknown[a] | Livestock | Inactive |
| 808 | 160 | Arikaree/Brule[b] | Domestic/Livestock | Active |
| 812 | 260 | Unknown[a] | Domestic/Livestock | Active |
| 813 | 280 | Unknown[a] | Livestock | Active |
| 814 | Unknown | Unknown[a] | CBR Exploration | Inactive |
| 818 | 140 | Arikaree/Brule[b] | Livestock | Active |
| 819 | 140 | Arikaree/Brule[b] | Livestock | Active |
| 822 | 140 | Brule[b] | Livestock | Active |
| 823 | 100 | Arikaree/Brule[b] | Livestock | Active |
| 827 | Unknown | Unknown[a] | Livestock | Active |
| 828 | 160 | Arikaree/Brule[b] | Domestic | Active |
| 837 | 300 | Brule[b] | Livestock | Active |
| 838 | 300 | Arikaree/Brule[b] | Livestock | Active |
| 839 | 300 | Arikaree/Brule[b] | Livestock | Active |
| 840 | 300 | Arikaree/Brule[b] | Livestock | Active |
| 842 | 300 | Arikaree/Brule[b] | Livestock | Active |
| 846 | Unknown | Unknown[a] | Livestock | Active |
| 849 | Unknown | Unknown[a] | Livestock | Active |

**Table 2.2-11 Active, Inactive and Abandoned Water Supply Wells in the Marsland Expansion Area and 2.25-Mile Area of Review**

| Well No. | Estimated Depth (ft) | Formation | Well Use | Well Status |
|---|---|---|---|---|
| 850 | 200 | Arikaree/Brule[b] | Agricultural | Active |
| 851 | 140 | Arikaree/Brule[b] | Agricultural | Active |
| 853 | 150 | Arikaree/Brule[b] | Agricultural | Active |
| 856 | Unknown | Unknown[a] | Unknown | Unknown |
| 857 | 40 - 50 | Arikaree/Brule[b] | Domestic/Agricultural | Inactive |
| 858 | 200 | Arikaree/Brule[b] | Agricultural | Active |
| 859 | 120 | Arikaree/Brule[b] | Domestic | Inactive |
| 861 | 40 | Arikaree/Brule[b] | Domestic/Livestock/ Agricultural | Active |
| 862 | 155 | Arikaree/Brule[b] | Domestic/Agricultural | Active |
| **ABANDONED WELLS** | | | | |
| **Wells Located Within License Boundary** | | | | |
| 726A | 300 | Brule | Unknown | Abandoned |
| **Wells Located Within 1 km Radius of License Boundary** | | | | |
| 868A | Unknown | Unknown[a] | Unknown | Abandoned |
| 869A | Unknown | Unknown[a] | Unknown | Abandoned |
| **Wells Located Between 1 and 2 km Radius** | | | | |
| 867A | Unknown | Unknown[a] | Unknown | Abandoned |

[a] Information provided by well owner and information from nearby wells are insufficient to make a definitive determination of aquifer used. However, discussions with land owners and known completion depths of private water wells in the area suggest that these wells are completed within the Arikaree Formation or the Brule Formation.

[b] Information provided by well owner and information from nearby wells indicate that one or more aquifer is used, but cannot be specifically determined. Assigned formation based on available information.

[c] CBR driller water supply.

**Table 2.2-12 Minimal Horizontal Distance Separating a Municipal Water Well from Potential Sources of Contamination**

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**Figure 2.2-1 Marsland Expansion Area Land Use**

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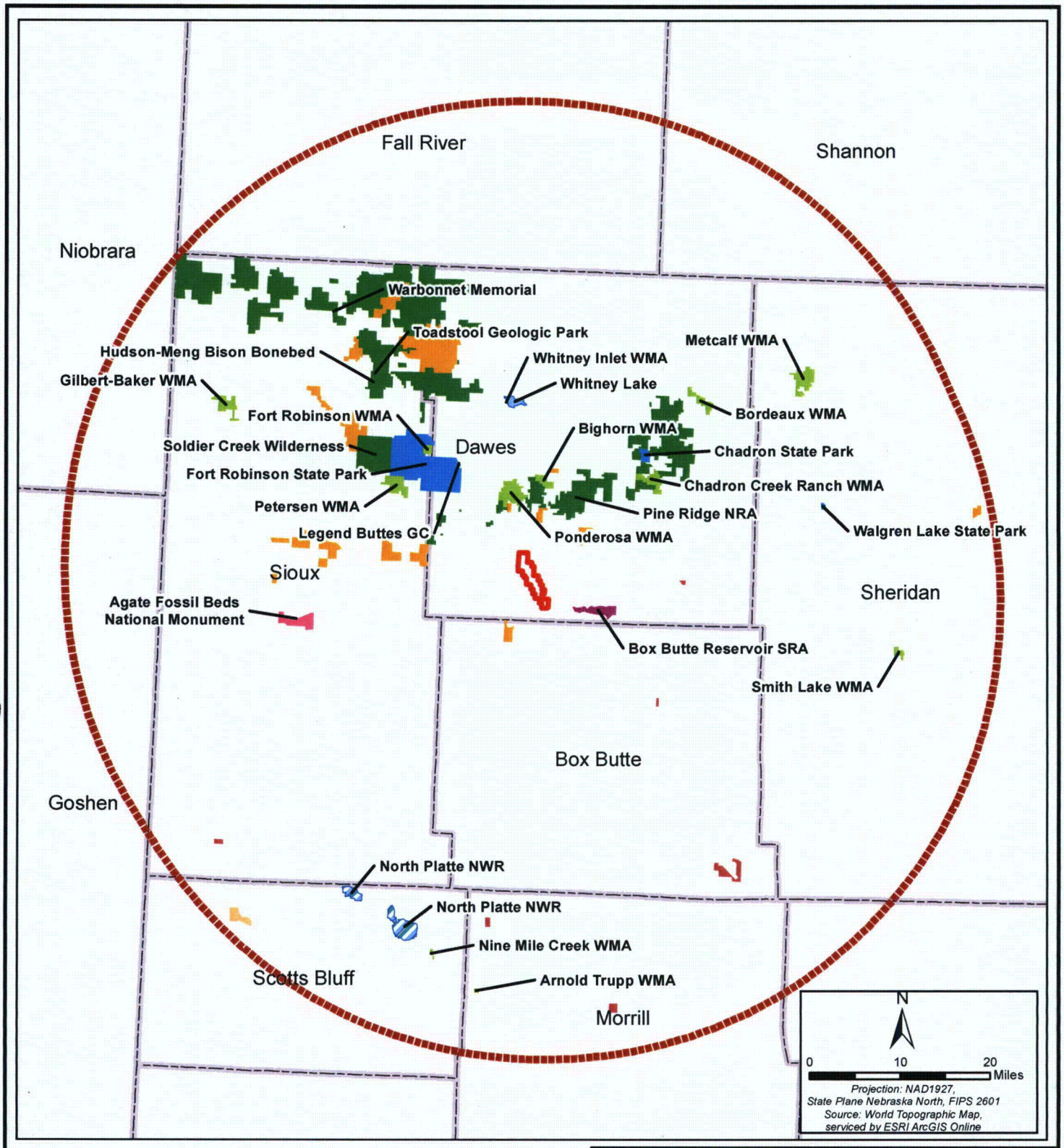


## LEGEND

- Agate Fossil Beds National Monument
- Proposed Marsland Expansion Area
- 50 Mile Radius
- Wildlife Management Area
- State Recreation Area
- State Park; Walgren Lake State Park
- Conservation Partner Lands
- Natural Resource District Area
- Nebraska National Forest
- National Wildlife Refuge
- Open Fields and Waters
- Whitney Lake

CROW BUTTE RESOURCES, INC.

**FIGURE 2.2-2**
**MARSLAND EXPANSION AREA**
**PROXIMITY TO RECREATION AREAS AND WILDLIFE MANAGEMENT AREAS**

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: CM

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

Document Path: ...Marsland\GIS\ArcMap_MXD\TR Figure 2_x Recreation Facilities.mxd

**Figure 2.2-3 Aerial Photo Depicting Location of Rural Residences and Other Land Features in the Area of Review**

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Figure 2.2-4 Marsland Expansion Area Location of Gravel Pits and Oil/Gas Test Holes

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## 2.3 Population Distribution

Information presented in this section concerns those demographic and social characteristics of the environments that may be affected by the proposed expansion of the Crow Butte Uranium Project to include operations in the MEA. Data were obtained through the 1980, 1990, and 2000 Decennial Census, with updates from the 2010 Census; various State of Nebraska government agencies; and other publicly available sources.

### 2.3.1 Demography

#### 2.3.1.1 Regional Population

The area within a 50-mile (80-km) radius of the project site includes portions of six counties in northwestern Nebraska, two counties in southwestern South Dakota, and two counties in eastern Wyoming. Because the 50-mile (80-km) radius extends only slightly into two very rural portions of Garden County in Nebraska and Niobrara and Goshen Counties in Wyoming, these areas are not discussed in detail beyond data summarized in **Table 2.3-1** through **Table 2.3-3**. **Figure 2.3-1** depicts significant population centers within a 50-mile (80-km) radius of the proposed MEA.

Historical and current population trends in the project area counties and communities are contained in **Table 2.3-1**. Most counties have experienced a decline in population since either the 1970 or 1980 Decennial Census; the exceptions are Shannon County, South Dakota and Goshen County, Wyoming, which have both seen population increases. All of the Nebraska counties comprising the project area experienced slight growth or actual population decline between 1960 and 1980, and population decline between 1980 and 2010. The state experienced its fastest growth since the 1920s during the years between 1990 and 2000. The total state population in 2010 was 1,826,000, which was a 6.7-percent increase over the 2000 population of 1,711,000. The Nebraska counties in the project area experienced little of the 15.7-percent growth spurt seen state-wide in the 1990-2010 period; only Scotts Bluff and Dawes Counties registered positive population growth in this time period, and that growth was less than 3 percent. In general, population trends for the past two decades show that population in urban areas is increasing, while population in rural areas is declining. Areas within 50 miles (80 km) of the project site that are defined as urban (all territory, population, and housing units in urbanized areas and in places of more than 2,500 persons outside of urbanized areas) by the U.S. Census 2000 are the Cities of Chadron and Alliance, Nebraska (USCB 2003a).

Dawes County grew slightly between 1990 and 2000, gaining 1.8 percent in population; this is attributed to growth in the City of Chadron, which more than offset the population declines in other communities in the county. This population growth has not offset the large loss of population that occurred in the 1980 to 1990 time period; the population today remains below its 1980 level. The City of Chadron and the City of Crawford are the nearest large communities in Dawes County to the project site. The City of Chadron is located approximately 25 miles (40 km) northeast of the project site; its 2010 population was recorded at 5,851 - an increase of 3.9 percent from 2000 (USCB 2011). The City of Crawford, within 15.1 miles (24.3 km) of the site (centerpoint of City of Crawford to centerpoint of MEA satellite building), had a 2010 population of 1,997 - an almost 10 percent decrease from 2000 (USCB 2011). The population declines in the City of Crawford were greater than the losses in most other communities and the county as a whole.

Sioux County has been losing population since the 1970 Decennial Census; the pace of these losses has fluctuated over the last 40 years, but has averaged approximately 10 percent per decade. The population decline was slowest in the 1990 to 2000 period due to a population increase of nearly 16 percent in the City of Harrison.

Box Butte County experienced a significant gain in population in the 1970 to 1980 timeframe, but has been losing population ever since. The population decline has averaged approximately 6 percent per decade since the 1980 Census, with the county losing 7 percent of its population since the 2000 Census. The Town of Hemingford, the nearest significant community in Box Butte County to the project site, has seen fluctuating population levels since the 1970 Census, although the Village lost approximately 19 percent of its population in the past decade.

Similarly, Sheridan County saw a gain in population in the 1970 to 1980 timeframe, but has been steadily losing population at an average rate of approximately 10 percent per decade since. This decline in population has been seen in the county's larger communities of Hay Springs and Rushville, both of which have similar rates of decline in their populations since 1980.

Scotts Bluff and Morrill Counties have experienced less severe population losses over the 1980 to 2010 timeframe, with losses of 6 and 1.1 percent per decade, respectively. The communities of Scotts Bluff and Minatare in Scotts Bluff County have experienced population growth of 0.7 and 2.1 percent, respectively, since the 2000 Census.

Within South Dakota, portions of Fall River and Shannon Counties fall inside the 50-mile (80-km) study area. Fall River County experienced population growth in the 1970 to 1980 period, but has lost more than 16 percent of its population in the last 30 years despite a small positive growth rate in the 1990 to 2000 period. The county-wide trends in population growth and loss are mirrored in the community of Oelrichs, which has lost more than 21 percent of its population since 1980. Shannon County, on the other hand, has grown by an average of better than 15 percent per decade since 1970; this growth has been realized in significant swings, with 38 percent growth in the 1970 to 1980 period followed by a 12.5 percent decline in population over the 1980 to 1990 period, which was then followed by a decade of nearly 26 percent growth from 1990 to 2000 and then 9 percent growth from 2000 to 2010. Much of the growth occurred in the Pine Ridge and Oglala Census Designated Places, which are urban areas as defined by the U.S. Census, but are not incorporated municipalities.

The population declines in the counties within the 50-mile (80-km) radius reflect trends in the overall region, where population declines have been attributed to the declines in the rural farming-based economy and limited economic opportunities for youth. Persistent drought conditions have also contributed to the shrinking of the agriculture-based economy. Rural residents have been migrating to larger cities, depopulating the largely rural Great Plains states. Many of the people migrating out of the state are young adults and families, which results in fewer people of childbearing age, and therefore, fewer children. This trend also contributes to the increasing proportion of the elderly population in the state (UNRI 2008).

#### 2.3.1.2 Population Characteristics

2010 population by age and sex for counties within 50 miles (80 km) of the MEA is shown in **Table 2.3-2**. Overall, 74.5 percent of the population in the region is more than 18 years old. Fewer than 20 percent of the populations of Garden, Fall River, and Niobrara Counties are under

the age of 18; Shannon County has the youngest population, with nearly 40 percent of its population under the age of 18. Females slightly outnumbered males in all but four counties, with an overall population of 50.6 percent female to 49.4 percent male (USCB 2011).

In 2010, 81.5 percent of the population of the 11 counties was classified as white. American Indians comprised the largest non-white classification. The largest American Indian population is found in Shannon County, South Dakota, where American Indians comprise 96 percent of the 13,586 people in the county (USCB 2011).

2.3.1.3 Population Projections

The projected population for selected years by county within the 50-mile (80-km) radius of the Crow Butte Project Area is shown in **Table 2.3-3**. The population is expected to decrease or hold steady in all 11 counties surrounding the project area. These counties are primarily rural, with agriculture-based economies. It is anticipated that the declining population trends of the last two decades will continue into the foreseeable future for these counties as populations shift to more urban counties (e.g., Douglas, Lancaster, and Sarpy). The largest declines are projected for Dawes and Garden Counties, which are each expected to lose more than 20 percent of their current populations by the year 2030.

2.3.1.4 Seasonal Population and Visitors

According to the Final Environmental Impact Statement for the Northern Great Plains Management Plans Revision (May 2001), the various state parks in northwest Nebraska (the Pine Ridge Ranger District and the Oglala National Grassland) are increasingly becoming regional tourist destinations.

Approximately 345,923 people visited Fort Robinson State Park in 2010. This number represents a 25 percent decrease from 460,154 in 2007 and a 2 percent decrease from 356,352 in 1993 (NDED 2011). Approximately 50 percent of the visitors in 2002 were from other states, which is an increase in the number of out-of-state visitors from 1981, as the majority of 1981 visitors were Nebraskan families. It is likely that the decline of visitors from Nebraska has resulted from the overall decline of population in rural counties within a few hours commuting distance of the park.

There were 55,000 visitors to the Pine Ridge District of the Nebraska National Forest in 2001. Camping and motorized travel/sightseeing are the two most popular recreation categories within the Pine Ridge Ranger District and the Oglala National Grassland.

The forest provides a wide range of other undeveloped backcountry recreation opportunities such as hunting, hiking, backpacking, fishing, and wildlife observation. The district provides the greatest number of miles of mountain biking trails in the state. District trails also attract horseback riders and off-highway motorized vehicle use. The Pine Ridge is an important destination for deer hunting, and provides the most popular turkey hunting area in Nebraska.

One source of seasonal population in this region is Chadron State College, located approximately 21.6 miles (35 km) from the site. During the fall seasons of 2005, 2006, 2007, 2008, 2009, 2010, and 2011, the enrollment was 2,601, 2,767, 2,726, 2,769, 2,744, 2,759, and 2,609, respectively (CSC 2010a, 2010b, Haag 2012, and Universities.com 2010). The average enrollment from 1994 through 1999 was 2,944, with a range of 2,768 to 3,189 (NCCPE 2005). Enrollment from 2011

(2,609) versus this later average of 2,944 is a 0.11 percent reduction in student enrollment. A rising enrollment trend has been observed at the college since 2006, with an overall increase of near 30 percent during the period (Haag 2012). Actual enrollment values presented in this paragraph may vary depending on the time of the year of the enrollment count.

2.3.1.5 Schools

The City of Crawford is served by the City of Crawford Public School District. The Crawford High School and grade school are presently under capacity (Vogl pers. comm. 2010). Enrollment for the 2010-2011 school years was 138 in the grade school and 109 in the high school; this represents a decline of about 9.5 percent in total enrollment for both schools from the 2007-2008 school years (NDE 2011a).

The Town of Hemingford is served by the Hemingford Public Schools. Enrollment for the 2010-2011 school years was 219 in the grade school and 173 in the high school, an increase of more than 9 percent in total enrollment for both schools from the 2007-2008 school years (NDE 2011b). This enrollment level is lower than in past years, reflecting continuing pressures on population levels in the area.

Families moving into the Crawford or Hemingford School Districts as a result of the proposed MEA operations would not stress the current school system.

2.3.1.6 Sectorial Population

Existing population, as determined for the original analysis in the CBR commercial license application prepared in 1987 for the 50-mile (80-km) radius, was estimated for 16 compass sectors, by concentric circles of 0.6, 1.2, 1.9, 2.5, 3.1, 6.2, 12.4, 18.6, 24.9, 31, 37.3, 43.5, and 50 miles (1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70, and 80 km, respectively) from the site (a total of 208 sectors). 2010 US Census data were used; subtotals by sector and compass points as well as the total populations are shown in **Table 2.3-4**.

Population within the 50-mile (80-km) radius was estimated using the following techniques:

- U.S. Census 2010 data were used to estimate the total population within a 50-mile (80-km) radius, measured from the center of the proposed MEA site. The data were created by Geographic Data Technology, Inc., a division of Earth Sciences and Research Institute (ESRI), from Census 2000 boundary and demographic information for block groups within the United States.
- ArcInfo GIS was used to extract data from U.S. Census 2000 population estimates for 40 Census Tract Block Groups located wholly or partially within the 50-mile (80-km) radius from the approximate center of the MEA site. Urban areas within each county were generally assigned their own block group.
- To assign a population to each sector, a percentage area of each sector within one or more block groups was calculated for all of the block groups.
- 2010 U.S. Census of population estimates for cities and counties in Nebraska, South Dakota, and Wyoming were used to determine total urban population.

## 2.3.2 Local Socioeconomic Characteristics

### 2.3.2.1 Major Economic Sectors

In 2009, average annual unemployment rates in Dawes and Box Butte Counties decreased from the 2008 rates. **Table 2.3-5** summarizes unemployment rates and employment in the Nebraska project area counties, as well as the overall change in employment in economic sectors between 1994 and 2009. Dawes and Box Butte Counties exhibited unemployment rates at 4.4 percent in Dawes County and 6.8 percent in Box Butte County in 2009. The Dawes County unemployment rate was slightly lower than the statewide rate of 4.7 percent, whereas the Box Butte County rate was significantly higher (NDOL 2010).

The major economic sectors in the project area have changed little in recent years, although individual sectors have shifted in their relative proportion in the overall economy. The area continues to depend on trades, government, and services. Economic sectors in the City of Crawford area include farming, ranching, cattle feed lots, tourism, and retail sales.

Agriculture accounted for a significant portion (19.2 percent) of the total employed labor force in Dawes County in 2009. During the same time period, farm employment was 2.0 percent of total employment in Box Butte County. Retail trade accounted for 14.7 percent of total employment in Dawes County, followed by local government employment (12.6 percent), leisure and hospitality (11.1 percent), education and health services (9.8 percent), and state government (6.5 percent). Mining and construction accounted for 5.0 percent. In Box Butte County, the largest four non-farm employment sectors are local transportation, communication and utility services (20.2 percent); local government (17.7 percent); production (8.6 percent); and leisure and hospitality (8.0 percent; NDOL 2010).

While agriculture employment is not dominant, agriculture provides the economic base for the counties, as other economic sectors support the agricultural industry. Events that affect agriculture are generally felt throughout rural economies. According to the Nebraska Department of Economic Development (NDED 2010), farm employment in Nebraska is expected to decline by nearly 14,000 jobs (20 percent) between 2000 and 2045, while overall non-farm employment will increase by nearly 26 percent. The decrease in jobs in the agricultural sector could continue to fuel migration from rural counties to urban areas, resulting in overall declines in other sectors of the local economy as dollars spent from personal income and agricultural business expenditures move out of the counties.

Per capita personal income is the income received by persons from all sources, including wages and other income, over the course of 1 year. In 2010, personal income in Dawes County was $28,981, which was 74 percent of the state average of $39,332. The county ranks 87th out of 93 counties in the state (BEA 2011). In 2010, personal income in Box Butte County was $35,225, which was 89 percent of the state average of $39,332. Box Butte County ranks 58th out of 93 counties in the state.

### 2.3.2.2 Housing

Between 1970 and 1980, total housing units increased by 17 percent in Dawes County from 3,388 to 3,965 units (USCB 1990a). After a decline in total units during the 1980s, growth increased by 2.4 percent from 3,909 units in 1990 to 4,004 units in 2000, and then increased again by 6.2

percent to 4,252 units in 2010. The City of Chadron, the largest community in Dawes County and within 25 miles (40 km) of the project site, experienced a negligible increase (0.3 percent) in housing stock between 1980 and 1990, a 5 percent increase between 1990 and 2000, and a 4.4 percent increase to 2,559 units between 2000 and 2010. Between 1980 and 1990, the City of Crawford housing stock decreased by nearly 7 percent to 576 (USCB 2003a). The number of housing units continued to decline through 2010, when 567 units were reported.

Box Butte County, which borders Dawes County to the south, exhibited a 1 percent loss in total housing units between 1990 and 2000, when 5,488 units were counted in the 2000 Census; a similarly small loss of 10 units was reported in the following decade, with a total of 5,478 units reported in 2010. In the Town of Hemingford, 418 housing units were reported in 2010; this represents a slight decrease from the 438 units reported in 2000.

In 2000, Dawes and Box Butte Counties had homeowner vacancy rates of 1.7 and 1.4 percent, respectively. In 2010, these rates were 2.3 and 2.4 percent, respectively. As of June 2011, there were six single-family housing units for sale in the City of Crawford. Five of the units were listed at prices below $100,000. One unit was listed at a price higher than $250,000. Three new single-family housing units were constructed between 2006 and 2008 in the City of Crawford, and average new home construction costs were $70,000 (NPPD 2012); one permit was issued in 2009 for a home with a construction cost of $60,000. In Hemingford, one permit was issued in 2006 for a residence with a construction cost of $25,100. The median gross rent for the City of Crawford in 2009 was $440 per month; in the Town of Hemingford, the median gross rent was $344 (Advameg 2010).

The demand for rental housing did not change significantly between 1990 and 2000, as rental vacancy rates were 11.8 percent in Dawes County and 15.4 percent in Box Butte County in 2000 (USCB 2003c) compared with 1990 rental vacancy rates of 12.6 percent and 14.9 percent, respectively (USCB 1990b). Similar rates continue to be seen: the rental vacancy rate in Dawes County is currently 10.2 percent, and 17.7 percent in Box Butte County (USCB 2011).

High interest rates and tax rates were the major deterrents for potential homebuyers in the project area in the past. Current deterrents are economic uncertainty and unemployment, as home mortgage interest rates have recently been at historic lows.

The majority of housing demand expected over the next two decades in Dawes County is most likely to occur in the City of Chadron, reflecting a continued shift from rural to more urbanized environments.

The purchase of homes by Crow Butte employees provides the City of Crawford with ad valorem property taxes. The City of Crawford levies taxes at a dollar per hundred of valuation. In 2010, the total levy was 0.424539, which would result in taxes on a $50,000 property of approximately $212 per year. The Town of Hemingford levies taxes at a dollar per hundred of valuation. In 2010, the total levy was 0.98062, which would result in taxes on a $50,000 property of approximately $490 per year (NE Revenue 2010).

### 2.3.3 Environmental Justice

The 2010 Census provides population characteristics for Census Tracts, which contain Block Groups that are further divided into Blocks. The Blocks are the smallest Census areas that contain the race characteristics of the population in the MEA region. The MEA contains all or a portion of (or is adjacent to) 23 Blocks within Census Tract 9506 in Dawes County. Census Bureau-generated 2009 data on the poverty status of school district populations were used as a proxy.

The affected area selected for the Environmental Justice analysis includes the racial characteristics of the population within Census Tract Blocks within the MEA and the poverty status of students enrolled in local school districts.

The State of Nebraska was selected as the geographic area to compare the demographic data for the population in the affected Blocks. This determination was based on the need for a larger geographic area encompassing affected area Block Groups in which equivalent quantitative resource information is provided. The population characteristics of the MEA are compared with Nebraska population characteristics to determine whether there are concentrations of minority or low income populations in the MEA relative to the state.

According to the 2010 Census and summarized in **Table 2.3-6**, the combined population of the Census Block Groups within or adjacent to the MEA was 32. The entire population was white; with one individual identified as Hispanic. The next nearest minority populations reside within the City of Crawford, located approximately 15.1 miles (24.3 km) north-northwest of the MEA (centerpoint of City of Crawford to centerpoint of MEA satellite building), and the Town of Hemingford, located approximately 15.4 miles (24.8 km) south-southeast (centerpoint of Town of Hemingford to centerpoint of MEA satellite building). Races in the City of Crawford are white non-Hispanic (95.6%), American Indian (0.9%), Hispanic (1.0%), persons reporting two or more races (2.3%), and smaller percentages of other races. Races in the Town of Hemingford are white non-Hispanic (96.1%), American Indian (1.2%), Hispanic (4.6%), persons reporting two or more races (2.1%), and smaller percentages of other races. The total percentage is greater than 100 percent because Hispanics could be counted in other races.

No concentrations of minority populations were identified as residing in rural areas near the proposed MEA. There would be no disproportionate impact to any minority population from the construction and implementation of the MEA.

The schools located nearest the MEA are those in the City of Crawford (operated by Crawford Public Schools), the Town of Hemingford (operated by Hemingford Public Schools), and in the community of Marsland (the Pink Public School operated by the Sioux County Public Schools). 12.9 percent of all students aged 5 to 17 in the State of Nebraska are identified as living in families in poverty. This compares to 22.8 percent of students in the Crawford Public Schools, 13.8 percent in the Hemingford Public Schools, and 19.8 percent in the Sioux County Public Schools. These data indicate that more students in the vicinity of the MEA live in families in poverty than are found in the state as a whole. Lower income levels are characteristic of predominantly rural populations and small communities that serve as a local center of agricultural activity. No adverse environmental impacts would occur to the population within the MEA from

proposed Project activities; therefore, there would be no disproportionate adverse impact to populations living below the poverty level in these Block Groups.

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**Table 2.3-1 Historical and Current Population Change for Counties and Cities within 80 km of the Marsland Expansion Area, 1970-2010**

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**Table 2.3-2 Population by Age and Sex for Counties within the 80-Kilometer Radius of the Marsland Expansion Area 2010**

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**Table 2.3-3 Population Projections for Counties within an 80-Kilometer Radius of the Current Crow Butte Project Area 2000-2020**

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**Table 2.3-4 2010 Population within an 80-Kilometer Radius of the Marsland Expansion Area**

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**Table 2.3-5 Annual Average Labor Force and Employment Economic Sectors for Dawes and Box Butte Counties (1994 and 2009)**

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**Table 2.3-6 Population and Demographics for Census Blocks Overlain or Adjacent to the MEA with Populations Recorded in 2010 Census**

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**Figure 2.3-1 Significant Population Centers within an 80 km (50 mi) Radius of the Marsland Site**

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## 2.4 Regional Historic, Archeological, Architectural, Scenic, and Natural Landmarks

### 2.4.1 Historic, Archeological, and Cultural Resources

There have been few cultural resources investigations on private land in southern Dawes County. Cultural resources investigations have been more numerous around the White River and the Cities of Chadron and Crawford about 10 miles (16.1 km) to 15 miles (24.1 km) to the north, and the results of those surveys can provide a cultural context for comparison to the MEA. Known resources in that area include indigenous people, artifact scatters, faunal kill and processing sites, and camps; fur trade and other contact period sites; the Sidney-Deadwood Trail; historic railroads; historic farming sites; Fort Robinson; and the Cities of Chadron and Crawford. In the mid 1800s, this region was occupied predominantly by bands of Lakota Sioux and Cheyenne. In the 1870s, the Red Cloud Indian Agency was located at Fort Robinson west of Crawford. By 1878, the tribes had officially been relocated to reservations, but sporadic Lakota and Cheyenne resistance continued through the 1880s. The MEA is south of the Pine Ridge Escarpment near the Niobrara River, and the nearby Town of Marsland is small in comparison to the Cities of Chadron and Crawford. The Town of Marsland is located along the Sidney-Deadwood Trail, along one of the historic railroad corridors that also passed through Crawford, and along a major river that would have attracted fur trappers. The fur trade in northwest Nebraska was centered along the White and Niobrara Rivers.

The proposed MEA is located on private lands east of SH 2/71 and north of the Niobrara River. An archaeological files search through the Archaeology Division of the Nebraska State Historical Society (NSHS) indicated that there have been no previous archaeological investigations within 1 mile (1.6 km) of the MEA and that no archaeological sites have been previously reported. An architectural and structural properties search through the Nebraska State Historic Preservation Office (SHPO) indicated that four historic structures (DWOO-240, DWOO-241, DWOO-242, and DWOO-243) have been reported in the study area. Two of these structures are within the MEA and the other two are close to the MEA. A search of the BLM Public Land Patent Records indicates that nine patents were granted for lands in the MEA from 1891 to 1917. This is consistent with the completion of the Chicago, Burlington, and Quincy Railroad through Crawford in 1889, which made the land more accessible to homesteaders, and with a brief moist period in the region between 1910 and 1920. A search of the National Register of Historic Places (NRHP) online database for Dawes County yielded 11 sites in the northern portions of the county. None of these NRHP-listed sites is within 10 miles (16.1 km) of the MEA. Fort Robinson and the Red Cloud Indian Agency, about 15 miles (24.1 km) north-northwest of the MEA, are also listed as a National Historic Landmark.

ARCADIS completed an intensive pedestrian block cultural resources inventory of approximately 4,500 acres for the MEA during the period from November 2010 to February 2011 (Graves et al. 2011). The MEA was inventoried for the presence of euroamerican and indigenous peoples' properties (cultural resources that are listed or eligible for listing on the NRHP) and may be impacted by proposed mine development. Graves et al. (2011) recorded 15 newly discovered euroamerican historic sites and five euroamerican historic isolated finds and updated the documentation on two of the previously recorded historic farmstead sites (DWOO-242 and DWOO-243).

ARCADIS submitted the "Cameco Resources Marsland Expansion Area Uranium Project Cultural Resource Inventory" report and associated Nebraska Archeological Site Survey Forms to the Nebraska State Historic Preservation Society/State Historic Preservation Office on April 28, 2011 (Graves 2011), and SHPO concurrence was granted by the Deputy State Historic Preservation Officer on May 19, 2011. The SHPO approval was issued via a stamped concurrence on the April 28, 2011 submittal letter. CBR requested that ARCADIS complete a field survey of an additional 160 acres in section 36 T30N R51W completed during the original field investigation but not reported in the original report. The 160 acres was field investigated by ARCADIS on February 19, 2011, and no new cultural resources were discovered. One historic bridge (25DW362) was identified in section 36 T30N R51W and reported within the original cultural resource inventory report. An addendum to the original cultural resources report was prepared to address the additional 160 acres (Graves and Graves 2012). Historic site 25DW362 was recommended not eligible for listing on the NRHP with SHPO concurrence.

The Nebraska SHPO concurred with the findings of the addition to the cultural resources report that no archaeological, architectural, or historic context property resources will be affected by the proposed project (NSHS 2012). As stated in the SHPO concurrence letter, the SHPO's review does not constitute the opinions of any Native American Tribes that may have an interest in Traditional Cultural Properties potentially affected by this project.

No indigenous people sites or artifacts were found in the project area. Regardless, a process for tribal identification of Traditional Cultural Properties is being developed and will be implemented during review of the MEA Environmental Report to satisfy NEPA.

The newly recorded historic sites included six farmsteads (25DW359, 25DW360, 25DW361, 25DW365, 25DW366, and 25DW370), three artifact scatters (25DW357, 25DW363, and 25DW369), two cisterns (25DW358 and 25DW364), one corral and windmill (25DW367), one bridge (25DW362), one dugout depression and berm (25DW368), and one stone quarry (25DW371). All of these sites were recommended not eligible for the NRHP.

The previously recorded farmstead sites were recorded jointly by SHPO and NSHS as part of a historic building survey of Dawes County in 2005 as the B. Chapman House (DWOO-242; built about 1910) and an abandoned farmhouse (DWOO-243; built about 1890). Updated documentation was prepared for the two buildings in the survey area. This documentation included the completion of NSHS archaeological site survey forms that included documentation of associated artifacts and features in addition to the buildings. Updated documentation of the DWOO-242 included a concrete cistern, a storage shed, two modern propane tanks, and historic and modern artifacts. The house is well maintained and appears to be occupied. Site DWOO-243 is more extensive. This site includes two abandoned 1½-story farmhouses; a smaller 1-story house; two storage sheds; one stock shelter; one foundation with a chicken coop gate; two metal grain bins; abandoned vehicles, wagons, and farm implements; a network of fenced enclosures; and a large pile of historic debris.

All of the newly recorded historic sites were recommended not eligible for the NRHP and do not qualify as historic properties. Isolated finds are by definition not eligible for the NRHP. Historic farmstead DWOO-242 is recommended not eligible for the NRHP, but appears to be currently or recently occupied. Site DWOO-243 may have the potential to yield information important in history and may be potentially eligible for the NRHP. Avoidance of these two sites by project

actions is recommended. If these recommendations are followed, the proposed project will have no adverse effect on historic properties, and no further cultural resource investigations are recommended.

Specific information included in cultural resources investigations falls under the confidentiality requirement for archaeological resources under Section 304 of the National Historic Preservation Act (NHPA;16 U.S.C. 470w-3(a)). In addition, disclosure of such information is protected under Nebraska State Statute Section 84-712.05 (13 and 14). The cultural resources inventory report and Attachment A of that report have been marked "FOR OFFICIAL USE ONLY: DISCLOSURE OF SITE LOCATIONS IS PROHIBITED (43 CFR 7.18). In compliance with Nebraska SHPO, NRC NUREG-1569 Section 24, and NDEQ Title 122 Ch. 11 Sections 006.07, "These materials should be treated as confidential information for the purpose of public disclosure of this NRC license amendment." The cultural resources report will be submitted to the NRC and State of Nebraska SHPO under separate cover.

The NRC is responsible for the government-to-government NHPA Section 106 consultation for the Crow Butte project areas near Crawford, Nebraska. These project areas include the CBR current operation ISR facility license renewal and the proposed NTEA, TCEA, and MEA. As part of the NRC's ongoing efforts to identify historic properties of religious and cultural significance to Native American Tribes that could be affected by CBR's proposed projects, the NRC sent a letter, dated October 31, 2012, offering each consulting tribe an opportunity to participate in a field study to identify potential places of religious and cultural significance at these sites (NRC 2013). In support of the NRC's offering, CBR offered to open each of the four project areas for field inspection during the period of November 14 through December 7, 2012.

Two consulting Tribes accepted CBR's offer to open the CBR project areas during the November 14 through December 7, 2012 timeframe (NRC 2013). Tribal field crews completed coverage for the current operation, the TCEA, and the MEA for zones thought to potentially contain places of Tribal religious and cultural significance. The Santee Sioux Nation submitted a Traditional Cultural Properties Survey report on the behalf of the Crow Tribe of Montana and the Santee Sioux Nation for the Crow Butte operations (Santee Sioux Nation 2013). A report for this survey was submitted to the NRC; the survey did not result in the recognition of any historic property of potential significance for NRHP listing. A redacted copy of the report is included as an Appendix U to the ER.

### 2.4.2 Scenic Resources

#### 2.4.2.1 Introduction

The MEA is on private land that is not managed to protect scenic quality by any public agency. The MEA is located on generally level ground south of the Pine Ridge area of northwestern Nebraska, and may be visible from some public roads in the areas. The existing landscape and the visual effect of the proposed facilities have been inventoried and assessed for the proposed project using the BLM Visual Resource Management (VRM) system.

#### 2.4.2.2 Methods

The VRM system is the basic tool used by the BLM to inventory and manage visual resources on public lands. The VRM inventory process involves rating the visual appeal of a tract of land,

measuring public concern for scenic quality, and determining whether the tract of land is visible from travel routes or observation points.

The scenic quality inventory was based on methods provided in BLM Manual 8410 – Visual Resource Inventory (BLM 1986a). The key factors of landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications were evaluated according to the rating criteria, and provided with a score for each key factor (BLM 1986b). The criteria for each key factor ranged from high to moderate to low quality based on the variety of line, form, color, texture, and scale of the factor within the landscape. A score was associated with each rating criterion, with a higher score applied to greater complexity and variety for each factor in the landscape. The results of the inventory and the associated score for each key factor are summarized in **Table 2.4-1**. According to NUREG-1569; 2.4.3(7), if the visual resource evaluation rating is 19 or less, no further evaluation is required. The total score of the scenic quality inventory is 9; however, an analysis was prepared to reflect the growing concern some residents may have for the scenic resource, as Dawes County is expected to continue to develop tourism in the region.

VRM Classes

The elements used to determine the visual resource inventory class are the scenic quality, sensitivity levels, variety classes, and distance zones. Each of the elements used to identify the VRM Class is defined below:

**Scenic Quality** – Scenic quality is a measure of the visual appeal of a tract of land. In the visual resource inventory process, public lands are assigned an A, B, or C rating based on the apparent scenic quality, which is determined using seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications. During the rating process, each of these factors is ranked comparatively against similar features within the physiographic province.

**Sensitivity Level** – A degree or measure of viewer interest in the scenic qualities of the landscape. Factors to consider include 1) type of users, 2) amount of use, 3) public interest, 4) adjacent land uses, and 5) special areas. Three levels of sensitivity have been defined:

- Sensitivity Level 1 – The highest sensitivity level, referring to areas seen from travel routes and use areas with moderate to high use.
- Sensitivity Level 2 – An average sensitivity level, referring to areas seen from travel routes and use areas with low to moderate use.
- Sensitivity Level 3 – The lowest sensitivity level, referring to areas seen from travel routes and use areas with low use.

**Distance Zones** – Areas of landscapes denoted by specified distances from the observer, particularly on roads, trails, concentrated-use areas, rivers, and other locations. The three categories are foreground-middleground, background, and seldom seen.

- Foreground-Middleground – The area visible from a travel route, use area, or other observer position to a distance of 3 miles (4.8 km) to 5 miles (8.0 km). The outer boundary of this zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape and vegetation is apparent only in pattern or outline.

- Background - The viewing area of a distance zone that lies beyond the foreground and middleground. This area usually measures from a minimum of 3 miles (4.8 km) to 5 miles (8.0 km) to a maximum of about 15 miles (24.1 km) from a travel route, use area, or other observer position. Atmospheric conditions in some areas may limit the maximum to about 8 miles (12.9 km) or increase it beyond 15 miles (24.1 km).
- Seldom Seen – The area is screened from view by landforms, buildings, other landscape elements, or distance.

The visual resource inventory classes are used to develop VRM classes, which are generally assigned by the BLM through the resource management plan process. VRM objectives are developed to protect scenic public lands, especially those that receive the greatest amount of public viewing. The following VRM classes are objectives that outline the amount of disturbance an area can tolerate before it no longer meets the visual quality of that class.

- Class I Objective: To preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention.
- Class II Objective: To retain the existing character of the landscape. The level of change to the characteristic landscape should be low.
- Class III Objective: To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate.
- Class IV Objective: To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

The Scenic Quality, Sensitivity Level, and Distance Zone inventory levels are combined to assign a VRM Class to inventoried lands as shown in **Table 2.4-2**.

2.4.2.3 Affected Environment

The MEA lies mostly in the Sandy and Silty Tableland ecoregion, with the northern portion of the MEA lying in the Pine Ridge Escarpment; both are subregions of the Western High Plains ecoregion. The physiography of the Pine Ridge Escarpment is characterized by alternating ridges and valleys with entrenched channels and rock outcrops, with elevations increasing from the northeast to the southeast. Vegetation includes ponderosa pine woodlands with Rocky Mountain juniper, western snowberry, skunkbush sumac, choke cherry, and Arkansas rose. Mixed-grass prairie is also found, containing little bluestem, western wheatgrass, prairie sandreed, needle-and-thread, blue grama, and threadleaf sedge. The physiography of the Sandy and Silty Table is characterized by tablelands with areas of moderate relief, with some areas of isolated sand dunes, and canyons along stream valleys. Vegetation includes mixed-grass prairie containing blue grama, little bluestem, threadleaf sedge, and needle-and-thread, and some scattered Sand Hills prairie with sand reed and little bluestem (EPA 2011).

The MEA landscape is rural and agricultural in character, and is composed primarily of scenery that is common for the ecoregion. Vegetation cover consists of grassy meadows and croplands interspersed with shrubby riparian growth along drainages. The landscape colors are dominated by tan, gold, and green vegetation. The colors and values (degrees of lightness and darkness) of soils and vegetation are similar, exhibiting little contrast during most of the year, although the dark greens of Ponderosa pine visible in the background from the MEA exhibit striking color

contrasts throughout the year. The scenic quality of the MEA is enhanced by the backdrop of the slopes covered with Ponderosa pine in the Nebraska National Forest to the south.

The characteristic landscape of the MEA consists of flat to rolling hills dissected by tributaries of the Niobrara River, which is located south of the MEA. The terrain becomes progressively higher in elevation to the north. The MEA is blocked from view along the entirety of SH 2/71 by low ridges located close to the highway. Portions of the MEA are visible from E. Belmont Road, Squaw Mound Road, Hollibaugh Road, and River Road.

The visual character of the landscape includes human modification from a variety of land uses, including open lands, cropland, roadways, rural residences, and utility corridors. Open land used for grazing activities is the dominant land use in the MEA. The northern portion of the MEA is accessible from E. Belmont Road, and the southern portion from River Road. Both are gravel-surfaced county roads, which in turn connects to SH 2/71, one of the primary north-south roadways through Dawes County. Human modifications to the natural landscape evident in the MEA include private roads, rural residences, agricultural implements, and electric distribution lines.

2.4.2.4 MEA Visual Inventory

Most of the MEA is characterized by the low, rolling plains and agricultural land uses characteristic of the area in northwestern Nebraska. The scenic quality of the MEA landscape is typical of the ecoregion, and is rated as Class B. There are no Class A landscapes visible from the MEA.

Sensitive Viewing Areas

Sensitive viewing areas in the MEA include E. Belmont Road, River Road, Squaw Mound Road, and Hollibaugh Road (the primary transportation routes through and adjacent to the MEA) and rural residences. In general, residents and other users of the region are accustomed to viewing human modification in the rural landscape, but could be sensitive to increased levels of development.

The characteristic landscape of the MEA as viewed from any of the roads and the residences consists of a broad expanse of mixed-grass prairie and cropland with scenic backdrops to the north. The MEA is located more than 3.5 miles (5.6 km) east of State Highway 2/71 at its nearest point, and is not visible from the highway. Public use of county and private roads within the MEA is relatively low, with motorists falling into the categories of local ranchers and residents.

The greatest number of viewers of the proposed facilities would be traveling on either E. Belmont Road, River Road, Squaw Mound Road, or Hollibaugh Road. The majority of motorists on the road would be residents within and outside of the MEA. There is one occupied residence within the MEA. The MEA landscape is also within view of five residences within the 2.25-mile (3.62-km) AOR.

The level of use on E. Belmont Road, River Road, Squaw Mound Road, or Hollibaugh Road and residences within or near to the MEA is low to moderate, or a Sensitivity Level 2, due to the fact that River Road is one of only three routes into Box Butte Reservoir State Recreation Area. Viewers at isolated rural residences with views of the project area are few.

A potential sensitive viewing area is the Nebraska National Forest located north of the north boundary of the MEA. However, there are no developed campgrounds or other facilities within the National Forest that could view the MEA due to the topography of the area. Individuals hiking through the National Forest could view the MEA in the background. While the level of concern for scenic landscapes would be high for many park visitors, the MEA would not be visible from most of the National Forest.

VRM Class

Based on the project area Class B scenic quality; the Sensitivity Level 2 (Medium) as viewed from E. Belmont Road, River Road, Squaw Mound Road, or Hollibaugh Road, and residences; and the location of the project area in the background distance zone as seen from the Nebraska National Forest, the MEA has been assigned Class III for both the visual resource inventory and the VRM objective.

### 2.4.3 References

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**Table 2.4-1 Scenic Quality Inventory and Evaluation for the Marsland Expansion Area**

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**Table 2.4-2 Determining BLM Visual Resource Inventory Classes**

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## 2.5 Climate, Meteorology, and Air Quality

### 2.5.1 Introduction

The proposed MEA is located in a semi-arid or steppe climate. The area is characterized by abundant sunshine, low relative humidity, and sustained winds which lead to high evaporative demand. There are also large diurnal and annual variations in temperature. The region has cold, harsh winters; hot, dry summers; and relatively warm, moist springs and autumns. Temperature extremes range from roughly -25° F in the winter to 100° F in the summer. The "last freeze" occurs during late May and the "first freeze" in mid to late September. The area has a growing season of approximately 120 days (HPRCC 2011).

Yearly precipitation totals typically range from 13 to 16 inches. Migratory storm systems that originate in the Pacific Ocean release a majority of their moisture over the Rocky or Cascade Mountains. Major precipitation events can occur when these systems regain moisture already present in the area or moisture advected from the Gulf of Mexico. The region is prone to severe thunderstorm events throughout the spring and early summer months, and much of the precipitation is attributed to these events. In a typical year, the area will experience four or five severe thunderstorm events (as defined by the National Weather Service [NWS] criteria) and 40 to 50 thunderstorm days. Autumn stratiform rain events also contribute to precipitation totals, but to a lesser degree. Snow frequents the region throughout winter months (30 to 50 inches per year), but generally provides less moisture than rain events.

Windy conditions are fairly common to the area. Roughly 3 percent of the time, hourly wind speed averages exceed 25 miles (40.2 km) per hour (mph). The predominant wind directions are north-northwesterly and northwesterly, with the wind blowing from those directions roughly 25 percent of the time. Surface wind speeds are relatively moderate at a year-round, hourly average of 10 to 11 mph. Higher average wind speeds are encountered during the winter months, while summer months experience lower average wind speeds.

For the regional analysis, meteorological data have been compiled for 21 sites surrounding the MEA. Data were acquired for these sites through the Western Regional Climate Center (WRCC 2011) for Cooperative Observer Program (COOP) and Automated Surface Observation Stations (ASOS) operated by the NWS. Among these regional sites, the Scottsbluff Airport was selected as most representative of the MEA meteorology. Scottsbluff is less than 50 miles (80 km) south of the project site, with an elevation roughly 300 ft lower than the project area. It is also the closest NWS station to the project site that collects hourly wind and relative humidity data. Available hourly data from Scottsbluff represent the last 15 years.

Hourly data for the Scottsbluff weather station were only available from the National Climate Data Center (NCDC) in electronic form for years 1996 and later. In order to corroborate the conclusions drawn in this report regarding temporal representativeness, hourly data from the Chadron Airport have been compiled and analyzed. Only 12 years of NCDC hourly data were available for Chadron in electronic form, spanning the period from January 1, 2001 through December 31, 2012. The results of the Chadron data analysis are discussed in these responses as **Appendix S.** In addition, Appendix S presents the regression analyses for both Scottsbluff and Chadron, with associated p-values. For both sites, the conclusion reached is that the consistently

low p-values render the high coefficients of determination (near 1.0) statistically significant. The strong correlation implied between wind characteristics during the baseline monitoring year and wind characteristics over a longer period is real at both the Scottsbluff and the Chadron sites. One may infer that a similar relationship exists at the project site, some 30 miles (48.3 km) southwest of Chadron and 48 miles (77.2 km) north of Scottsbluff. This justifies the conclusion that the baseline year's wind data represent the long term.

For the site-specific analysis, meteorological data from the MEA meteorological station were used. These data were collected during the 1-year baseline monitoring period extending from August 24, 2010 through August 29, 2011. **Table 2.5-1** provides the station IDs, coordinates, and periods of operation for the regional and site-specific meteorological stations. The locations of the regional and MEA meteorological station are shown on **Figure 2.5-1**.

These sites have been analyzed collectively to evaluate regional climatic temperature and precipitation in the proposed project area. The NWS sites have also been incorporated into the snowfall discussion. The nearest available long-term monitoring site that continuously records all weather parameters is the Scottsbluff Airport. This site was analyzed for the regional wind summaries. At the project site, hourly average meteorological data include wind speed, wind direction, sigma theta, temperature, relative humidity, precipitation, and solar radiation. Evapotranspiration rates were calculated for both the Scottsbluff site and project site by applying Penman's equation to available solar radiation, wind speed, temperature, and relative humidity data. As solar radiation data were not available from the Scottsbluff data set, estimated monthly averages for solar radiation were obtained for the Scottsbluff area from the U.S. Department of Energy's National Renewable Energy Laboratory (NREL 1990).

In the information that follows, a regional overview is presented first. This section includes a discussion of the maximum and minimum temperatures and relative humidity, annual precipitation including snowfall estimates, a brief wind speed and direction summary, and a discussion of evapotranspiration rates. A combination of monitoring stations is analyzed for the regional overview of temperature, snowfall, and total precipitation.

A site-specific analysis follows the regional overview. Most of this analysis is based on the on-site monitoring. An in-depth wind analysis summarizes average wind speeds and directions, wind roses, wind speed frequency distributions, and a joint (wind speed and direction) frequency distribution to characterize the wind data for the MEA by atmospheric stability class. A discussion of monthly and seasonal data is included for the temperature, precipitation, evapotranspiration, and wind parameters. General upper atmosphere data from the NWS station at Rapid City, South Dakota are used to represent the project site.

The site-specific analysis includes a justification for using wind data from the baseline monitoring year to predict meteorological conditions over the long term. This is necessary to validate air sampling locations and MILDOS dispersion modeling inputs. The short- and-long term wind data from the Scottsbluff site are correlated for this purpose.

## 2.5.2 Regional

2.5.2.1 Temperature

The annual average temperature for the region is approximately 48° F (8.9° C). The Scottsbluff Airport meteorological station is considered to be representative of the region.

**Figure 2.5-2** shows monthly average temperatures for the Scottsbluff Airport site, along with the monthly maximum and minimum temperatures over the last 15 years. July has the highest average monthly temperature (74.5° F), followed by August. December records the lowest average temperatures for the year (26.0° F), followed by January. **Table 2.5-2** shows average, minimum, and maximum monthly temperatures for the Scottsbluff Airport site. Low temperatures in the region can drop to nearly -30° F, while high temperatures can reach around 107° F.

Large diurnal temperature variations occur in the region due in large part to its high altitude and low humidity.

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Figure 2.5-3 depicts the monthly diurnal temperature variation for the Scottsbluff Airport site from 1996 through August, 2011. Spring and summer daily variations of 30° F are common, with maximum temperature variations exceeding 40° F during extremely dry periods. Less daily variation is observed during the cooler portions of the year, as fall and winter have average variations of roughly 20° F. This can be attributed to the more stable atmospheric conditions in the region during the fall and winter months. Stable periods have much lower mixing heights and accompanying lapse rates, allowing for less temperature variation.

On a year-round basis, daily maximum temperatures in the project region average approximately 60° F, and daily minimum temperatures average approximately 33° F. July has the highest maximum temperatures, with averages near 90° F, while the lowest minimum temperatures are observed in January, with averages near 10° F (NCDC 2011). Annual average minimum and maximum temperatures are shown on **Figure 2.5-4** and **Figure 2.5-5**, respectively.

2.5.2.2 Relative Humidity

The Scottsbluff Airport site records relative humidity (dew point) data. The graph on **Figure 2.5-6** charts monthly average relative humidity values for this site. The Scottsbluff Airport data are from 1996 through August 2011. These data indicate that July has the driest air, with relative humidity averaging around 58 percent. The winter months of December, January, and February make up the most humid part of the year, with average relative humidity approaching 70 percent. The overall average relative humidity is 63 percent at Scottsbluff Airport.

Relative humidity is a temperature-based calculation which reflects the fraction of moisture present relative to the amount of moisture for saturated air at that temperature. Warmer air holds more moisture at saturation than colder air. Therefore, for a given amount of moisture in the air, relative humidity maximum values occur more frequently in the early mornings, while minimum values typically occur during the mid-afternoon hours. The summer months exhibit a much greater variation in relative humidity between morning and afternoon values due to greater temperature variations (**Figure 2.5-7**).

2.5.2.3 Precipitation

The region is characterized by moderately dry conditions. The Scottsbluff Airport received measurable (>0.01 in) precipitation on an average of 82 days per year between 1996 and 2011. Average annual precipitation during that period was 15.2 inches per year. In general, the project region has an annual average from 14 to 23 inches (**Figure 2.5-12**). Spring showers and thunderstorms produce nearly half of the precipitation at Scottsbluff Airport (**Figure 2.5-8**). May and June are typically the wettest months of the year; with most of the region receiving an average greater than 2 inches for each of those months (**Figure 2.5-9**). The region receives less precipitation in January than in any other month, averaging generally 0.5 inch or less. The winter months (December through February) typically account for less than 10 percent of the yearly precipitation totals. Only moderate precipitation occurs in late summer, when atmospheric conditions are more stable and the absence of convective activity limits storm development.

Severe weather does arise throughout the region, but is limited on average to five or six severe events per year. These severe events are generally split between hail and damaging wind events. Tornadoes can occur but are rare in western Nebraska.

Average annual snowfall varies throughout the region. Major snowstorms (more than 5 in/day) are relatively infrequent in the region. The region experiences fewer than three major snowstorms per year. Hay Springs, Nebraska has the highest annual snowfall of the sites closest to the project, with an average of 52 inches, while Sidney, Nebraska has the lowest averages at 30.7 inches per year. The interpolated values **(Figure 2.5-13)** show average snowfall of 30 to 60 inches per year in the project region.

Snowfall at the Scottsbluff Airport site averaged 38.2 inches per year over the last 15 years. Monthly average snow amounts are depicted on **Figure 2.5-10**, which shows the highest amount of snowfall in March. Monthly snowfall amounts in the overall region follow a similar pattern (**Figure 2.5-11**).

2.5.2.4 Wind Patterns

Year-round wind speeds in the area average between 8 and 11 mph. **Table 2.5-3** shows monthly average wind speeds for the Scottsbluff Airport site. The overall average wind speed at this site was 8.9 mph for the 1996 to 2011 period analyzed in this study. Mean monthly average wind speeds are lowest in the summer months and highest in April at nearly 11 mph.

**Table 2.5-3** also shows monthly maximum hourly wind speeds for the Scottsbluff Airport. High wind events are fairly common in this region; wind data from this site show every month recording peak hourly wind speeds greater than 30 mph during the 15-year period analyzed.

**Figure 2.5-14** graphs the Scottsbluff Airport 15-year monthly average and monthly maximum wind speeds listed in **Table 2.5-3.**

**Figure 2.5-15** shows the 15-year wind rose for the Scottsbluff Airport site. Predominant winds are generally from the west-northwesterly or northwesterly directions. These winds, often associated with storm fronts, dominate the late fall, winter, and early spring seasons. A secondary mode occurs from the east-southeasterly or easterly directions. These winds are generally associated with the summer season when regional high pressure dominates. The highest wind speeds tend to occur from the northwesterly direction. **Table 2.5-4** provides the same information as the wind rose, but in tabular form.

Winds at the Scottsbluff Airport site and throughout the region exhibit a diurnal pattern. **Figure 2.5-16** shows the pattern at Scottsbluff for each season of the year. Wind speeds peak during the early afternoon for the winter and fall seasons. During spring and summer, wind speeds peak in late afternoon. This is largely due to longer daylight hours and the predominant effect of solar heating on wind patterns. **Figure 2.5-16** also shows that the highest average wind speeds occur during the spring season, when the atmosphere tends to be least stable and storm systems are the strongest. The lowest wind speeds occur during summer, when the atmosphere is generally stable and storm systems are weak.

2.5.2.5 Heating, Cooling, and Growing Degree Days

**Figure 2.5-17** summarizes the monthly cooling, heating, and growing degree days for Scottsbluff, Nebraska (NWS meteorological monitoring site 257665). The data are assumed to be indicative of the project area due to its proximity and comparable elevation.

The heating and cooling degree days are included to show deviation of the average daily temperature from a predefined base temperature. In this case, 50° F has been selected as the base temperature for computation of growing degree days. The base temperature for computing heating and cooling degree days is 65° F. The number of heating degree days is computed by taking the average of the high and low temperatures occurring that day and subtracting it from the base temperature. The calculation for growing and cooling degree days is the same, except that the base temperature is subtracted from the average of the high and low temperatures for the day. Negative values are disregarded for both calculations.

As expected, the graphs of heating degree days and cooling degree days are inversely related, and the growing and cooling degree days are directly related. The maximum number of heating degree days occurs in December and January, at roughly 1,200 degree days. This coincides with the months having the lowest minimum average temperatures. Conversely, July registers the most growing degree days with nearly 700, and the most cooling degree days at fewer than 300. This also corresponds to July having the highest average temperature.

#### 2.5.2.6 Evapotranspiration

The project region is characterized by high evaporative demand during much of the year. This demand is related to dry air (low dew points), high daytime temperatures, and moderate wind speeds. **Figure 2.5-18** graphs monthly potential evapotranspiration (ET) rates, in inches of water per month, at the Scottsbluff Airport site. Potential ET is an estimate only, calculated using the Penman Equation (Jensen et al. 1990). Meteorological inputs to this equation include wind speed, barometric pressure, solar radiation, and temperature and humidity extremes.

For the Scottsbluff site, barometric pressure was estimated based on the elevation. Because solar radiation data were not available at this site, estimated monthly averages for solar radiation were obtained for the Scottsbluff area from the U.S. Department of Energy's National Renewable Energy Laboratory (NREL 1990). A flat-plate collector at zero degrees incline from horizontal represents the global solar radiation available at a given location. Wind speed, temperature, and humidity data for the ET calculation were obtained from the Scottsbluff Airport hourly database.

Potential ET values are highest in July, at 10 inches, and lowest in December and January, at 2 inches. Annual ET for this area is projected at 68.6 inches per year.

### 2.5.3 Site-Specific Analysis

#### 2.5.3.1 Introduction

The site-specific discussion of climate, meteorology, and air quality is limited to onsite meteorological data collected for the baseline monitoring period of August 2010 through August 2011. These onsite data are supplemented by meteorological data from the nearby Scottsbluff Airport site, collected during the 15-year period from 1996 through August 2011. The Scottsbluff site is included to incorporate wind monitoring results from a longer period of record and to demonstrate that, for this region, winds during the baseline monitoring period are representative of the longer term. The Scottsbluff site is located 48 miles (77.2 km) south of the MEA, with elevation and topographic features comparable to the project area. In both cases, the surrounding area is characterized by rolling hills and flat plains bordered by small ridges and breaks with

ephemeral drainages. With the exception of cultivated land, the vegetation types are mainly confined to native grasses with some sage brush and wooded areas.

2.5.3.2 Temperature

The annual average project site temperature is similar to the regional average temperature at approximately 46° F. The maximum temperature for the baseline monitoring year was 99° F, and the minimum temperature was -28° F.

**Figure 2.5-19** shows the monthly average, minimum, and maximum temperatures for the project site. **Table 2.5-5** provides the same data in tabular form. Daily average temperatures range from near 20° F in the winter months to above 70° in the summer months.

**Table 2.5-6** provides a meteorological summary for the MEA site for the baseline monitoring year. The averages, maximums, and minimums are specified for each parameter recorded at the site along with the data recovery rate for each. The recovery rates are greater than 97 percent for all parameters.

2.5.3.3 Wind Patterns

**Figure 2.5-20** presents a wind rose for the project site during the 12-month baseline monitoring period. **Table 2.5-7** presents the same information in tabular form. The predominant wind direction is north-northwesterly and northwesterly, with the highest wind speeds also coming from those directions. During periods of fair weather, particularly in late spring and summer, high pressure located over the northern plains produces moderate southeasterly winds in the project area. Synoptic weather systems generally interrupt this pattern, producing high north-northwesterly winds. **Figure 2.5-21** shows seasonal wind roses for the project area. Spring experiences the greatest variability in wind direction with secondary modes as a result of the synoptic scale transition period that occurs during this time. Low pressure regions develop on the lee side of the Rockies, bringing southeasterly winds during storm development. As the low pressure systems form and move off with the general atmospheric flow, winds switch to a north-northwesterly direction.

**Figure 2.5-22** presents a diurnal graph of wind speeds at the project site by season. For all seasons, wind speeds peak during the afternoon. Winds during the summer plateau at less than 12 mph, while the rest of the year experiences peak afternoon wind speeds averaging roughly 15 mph. Nighttime winds average 8 to 10 mph throughout the year.

**Figure 2.5-23** shows the time distribution of wind speeds at the project site. Half of the time, wind speeds are less than 8 mph, while winds exceed 18 mph 10 percent of the time.

The average wind speed for the project site was 10.6 mph over the 12 months of monitoring, slightly higher than the 8.9 mph long-term average at Scottsbluff. The monthly average and maximum hourly wind speeds at the project site are summarized in **Figure 2.5-24**. The graph shows higher wind speeds in the winter and spring, peaking in April.

**Table 2.5-8** provides a breakdown of wind speeds by wind direction. Wind speeds average near or above 12 mph when the wind blows from the northwest quadrant. A secondary maximum

occurs for southerly winds, averaging more than 10 mph. For all other directions, wind speeds average less than 10 mph.

The Joint Frequency Distribution (JFD) provides more detail on wind speed distribution by wind direction and atmospheric stability class. The distribution shows the frequencies of hourly average wind speed for each direction based on stability class. **Table 2.5-9** lists the annual JFD for the MEA. **Tables 2.5-10** through **2.5-13** list the seasonal JFDs. A majority of the winds at the project site fall into stability class D, which represents near neutral to slightly unstable conditions. The light winds which accompany stable environments are reflected in the stability class F summary.

2.5.3.4 Precipitation

**Figure 2.5-25** shows monthly precipitation at the project site during the baseline monitoring year. Total precipitation was 18 inches, although 10 inches fell during the abnormally wet month of May. Very little precipitation fell during the fall and winter months. Based on long-term records at other weather stations in the region, precipitation recorded during the baseline monitoring year at Marsland is probably not representative of the long term. An annual average precipitation of 15 inches is considered more likely.

2.5.3.5 Evapotranspiration

Daily ET rates were calculated for the project site by applying Penman's equation to recorded solar radiation, wind speed, temperature, and relative humidity data. These calculations were then summed for each month. **Figure 2.5-26** shows projected monthly ET at the project site during the baseline monitoring period. From these calculations, annual ET is computed at approximately 60 inches. This compares favorably to the long-term calculated average of 68 inches at the Scottsbluff Airport site.

2.5.3.6 Justification of Baseline Year as Representative of Long Term

The proposed project is situated in northwest Nebraska. The baseline meteorological monitoring period extended approximately 1 year, from August 24, 2010 through August 29, 2011. To demonstrate that this baseline year is representative of the longer-term wind conditions, the Scottsbluff Airport site was analyzed. Among the weather stations in this region, the Scottsbluff Airport was chosen to represent wind conditions in the vicinity of the project due to proximity, similar elevation, similar terrain, and the limited availability of hourly wind data in the region. Within a 50-mile (80 km) radius, only three of the numerous meteorological stations collect hourly wind data: Scottsbluff (48 miles [7.2 km] from the MEA site), Chadron (25 miles [40 km] from the MEA site), and Alliance (34 miles [54.7 km] from the MEA site). Although closest to the MEA site, Chadron is 800 ft. lower in elevation and on the opposite side of a prominent, east-west oriented ridge. Scottsbluff and Alliance are approximately 300 ft. lower in elevation than the MEA site. Both exhibit flat or mildly rolling terrain, reasonably similar to the MEA site. Neither site exhibits a long-term wind rose that strongly resembles the baseline-year wind rose from the MEA site (see **Figures 2-5-15**, **2.5-20** and **2.5-32**). However, the Scottsbluff wind rose more closely resembles the MEA site. It shows prominent winds from the northwesterly, north-northwesterly, and northerly directions that resemble the MEA site. These wind directions are not as prominent in the Alliance wind rose. Moreover, the Alliance wind rose shows dominant winds from the west, a feature lacking in both the Scottsbluff and MEA wind roses.

Either the Alliance or the Scottsbluff site would likely fulfill the purpose behind selecting a regionally representative meteorological station. Localized differences in wind patterns are typical of western Nebraska and eastern Wyoming, where even mild terrain differences influence the wind rose. However, the primary purpose of this exercise is interpreted to be the demonstration of temporal representativeness, not spatial representativeness. As discussed in **Appendix S**, even the Chadron site suffices for the temporal demonstration. If the baseline year at the regional weather station is shown to represent the long term at that location, this demonstration has been made. A similar temporal representation at the project site is then inferred because both locations are subjected to the same, regional climate regime.

Hourly wind data from Scottsbluff were available electronically through the National Climatic Data Center (NCDC) for a 15-year period. In order to validate the use of 15 years instead of 30, **Appendix S** presented a temporal comparison for the Chadron site similar to that given for the Scottsbluff site. Only 12 years of data were available for Chadron. The result was a strong linear correlation between baseline-year and longer-term wind speed and wind direction distributions, reinforcing the results obtained for Scottsbluff. It is believed that 30 years of data would not significantly change these results.

**Figure 2.5-27** shows wind roses for Scottsbluff (Scottsbluff 15-year vs baseline year wind roses). The wind rose on the left reflects 15 years of monitoring (1996 through August, 2011), while the one on the right reflects the MEA baseline monitoring period only. It can be seen that wind speeds and directions are very similar between the 15-year and 1-year monitoring periods.

**Deleted:** Scottsbluff is less than 50 miles (80 km) south of the project site, with an elevation roughly 300 ft lower than the project area. It is also the closest NWS station to the project site that logs hourly wind data. Available hourly data from Scottsbluff span from January 1, 1996 to the present and therefore represent the last 15 years.¶

**Figure 2.5-28** compares the wind direction frequency distributions between the 15-year and baseline periods at Scottsbluff. The percent of the time the wind blows from each of the 16 cardinal directions shown is quite similar for the two monitoring periods.

**Figure 2.5-29** compares the wind speed frequency distributions of the 15-year and baseline periods at Scottsbluff. The percent of the time the wind speed falls within each of the six wind speed classes shown is quite similar for the two monitoring periods.

In order to quantify this similarity, it is useful to isolate wind speed and wind direction variables in order to correlate short-term and long-term frequency distributions. IML Air Science has developed a statistical methodology for assessing the degree to which the distributions of wind speed class and wind direction frequencies from 1 year of monitoring at a particular location represent the long-term distributions at that same location.

For the joint frequency wind distribution used in the MILDOS-AREA model, wind speeds are divided into six classifications ranging from mild (0 to 3 mph) to strong (> 24 mph) as illustrated in **Table 2.5-9** and on **Figure 2.5-29**. Likewise, wind directions are divided into 16 categories corresponding to the compass directions illustrated in the wind roses presented above and on **Figure 2.5-28**.

The percent of the time that winds occur in each of the six wind speed categories can be calculated to produce a wind speed frequency distribution. The percent of the time that winds blow from each of the 16 directions can be calculated to produce a wind direction frequency distribution. For each parameter, the 1-year and 15-year distributions can then be compared.

Linear regression analysis provides a useful tool to assess the degree of correlation between short- and long-term distributions.

**Figure 2.5-30** presents this correlation for the wind speed distributions at Scottsbluff. Each point represents one of the six wind speed classes. The x coordinate corresponds to the percent of the 1-year period during which the wind speed fell in a given class, while the y coordinate corresponds to the percent of the 15-year period during which the wind speed fell in that same class.

The regression line (red) on **Figure 2.5-30** represents the least-squares fit to the six data points. The corresponding $R^2$ value of 94.5 percent implies very strong linear correlation. The linear slope of 0.98 further implies that short- and long-term wind speed frequencies not only correlate, but are substantially equivalent in magnitude.

A similar analysis can be performed for wind direction frequencies. **Figure 2.5-31** presents this correlation, again for the Scottsbluff Airport site. Each point represents one of the 16 wind direction categories. The x coordinate corresponds to the percent of the 1-year period during which the wind blew from a given direction, while the y coordinate corresponds to the percent of the 15-year period during which the wind blew from that same direction.

The regression line (red) on **Figure 2.5-31** represents the least-squares fit to the 16 data points. The corresponding $R^2$ value of 97.2 percent implies very strong linear correlation. The linear slope of 1.02 further implies that short- and long-term wind speed frequencies not only correlate, but are substantially equivalent in magnitude.

**Figures 2.5-30** and **2.5-31** offer conclusive evidence that the 2010-2011 baseline monitoring year adequately represents the last 15 years at Scottsbluff Airport. Because the 1-year wind data serve as reliable predictors of the long-term wind conditions at Scottsbluff, and because the MEA site experiences similar regional weather patterns, it is proposed here that the 1-year baseline monitoring represents long-term meteorological conditions at the MEA site.

2.5.3.7 Onsite Meteorological Instrument Specifications

**Table 2.5-14** lists the meteorological instruments employed at the MEA meteorological monitoring station. The table shows instrument models, accuracy specifications, and instrument heights above the ground. Appendix B to this document is an example of a calibration report for the meteorological instruments.

Meteorological data collection, management, and reporting methods at the project site conform to NRC atmospheric dispersion modeling requirements for uranium milling operations, and meet the acceptance criteria established in the NRC's NUREG-1569. The onsite monitoring program was developed according to RG 3.63, "Onsite Meteorological Measurement Program For Uranium Recovery Facilities – Data Acquisition and Reporting." Hourly average values for wind speed, wind direction, sigma theta, temperature, relative humidity, precipitation, and solar radiation are generated by field instruments and recorded by continuous data loggers. Data recovery exceeded 97 percent for the 12-month monitoring period. All hourly data have been downloaded to a relational database for quality assurance, statistical analysis, and reporting purposes.

The meteorological instruments are placed at a location in the MEA area that represents as closely as possible the long-term meteorological characteristics of the area measured. NRC RG 3.63 provides guidance acceptable to the NRC regarding the siting of meteorological instruments. The siting of the MEA meteorological instruments followed this NRC guidance in siting and is discussed in **Appendix R** of this document. This appendix addresses the NRC's siting conditions identified as being necessary to achieve meteorological data representative of the proposed project site.

2.5.3.8 Upper Atmosphere Characterization

Mixing height is the height of the atmosphere above the ground that is well mixed due either to mechanical turbulence or convective turbulence. The air layer above this height is stable. Higher mixing heights are associated with greater dispersion, all other parameters being the same. Stable periods have much lower mixing heights and accompanying lapse rates, allowing for less temperature variation. The MILDOS-AREA model uses mixing height, along with other wind parameters, to predict pollutant dispersion. Unstable air leads to more dispersion, which leads to lower predicted impacts on ambient air quality. The default mixing height used by MILDOS-AREA is 100 meters, a very conservative value given that typical mixing heights exceed 1,000 meters.

The nearest upper-air data available from the NWS are from Rapid City, South Dakota, approximately 108 miles (173.8 km) north of the project area. Average mixing heights were derived from the American Meteorological Society (AMS)/U.S. Environmental Protection Agency (EPA) Regulatory Model (AERMOD) calculations used for dispersion modeling, based on hourly data obtained from the NWS stations in Rapid City (upper air). The AERMOD calculation is based on a combination of mechanically and convectively driven boundary layer processes. The results of these calculations are provided for morning and afternoon in **Table 2.5-15**. The annual average mixing height is 1,110 meters.

The mixing or inversion heights are entered as inputs to the MILDOS-AREA model for pollutant dispersion modeling. For the MEA project, the MILDOS default value of 100 meters was used for both morning and afternoon mixing heights. Argonne National Laboratory has employed a default value of 100 meters for the annual average morning and afternoon atmospheric mixing heights (ANL 1998). Page 12 of the Guide states *Mixing Heights: annual average Morning and Afternoon atmospheric mixing height in meters. The default value is 100 m for both.* Therefore, this default value was used for MILDOS modeling of the MEA site.

Because this mixing height of 100 m is lower than the calculated mixing heights in **Table 2.5-15**, and lower mixing heights lead to less pollutant dispersion, the dosage concentrations calculated by the MILDOS model are conservatively high.

2.5.3.9 Bodies of Water and Special Terrain Features

The only significant body of water near the proposed MEA is the Niobrara River, which flows easterly through a point approximately 4 miles (6.4 km) south of the project site. The average flow rate at this location, however, is only 29 cubic ft/sec (USGS 2009). It is unlikely that the influence of such a small stream could be measured 4 miles (6.4 km) away with a standard humidity probe.

The nearest mountain ranges to the project site are:

- The Laramie Mountains, approximately 100 miles (160.9 km) to the west
- The Black Hills, approximately 65 miles (104.6 km) to the north

It is believed that, at these distances, the mountain ranges have minimal impact on meteorology in the project area. As discussed above, storms moving eastward from the Rocky Mountains generally relinquish moisture on the windward side of the mountains, creating a drier climate on the leeward side. This is mitigated, however, by occasional moist air masses moving into Nebraska and Wyoming from the Gulf of Mexico.

### 2.5.4 Conclusion

The proposed MEA near Crawford, Nebraska is located in a semi-arid or steppe climate. The area is characterized by abundant sunshine, low relative humidity, and sustained winds which lead to high evaporative demand. The region has large diurnal and annual variations in temperature.

Thirteen NWS meteorological stations were used to characterize regional weather patterns. The region experiences average daily maximum temperatures near 90° F in July and average daily minimum temperatures around 15° F in January. There are large diurnal and annual variations in temperature. The region has cold, harsh winters; hot, dry summers; and relatively warm, moist springs and autumns. Temperature extremes range from roughly -25° F in the winter to 100° F in the summer. The site average temperature is expected to be 46° F with extremes of -30° to +105° F. The region generally receives little precipitation, with annual averages between 13 and 16 inches. Spring and early summer precipitation events are responsible for the majority of the yearly average.

The region is characterized by annual average wind speeds of 9 to 12 mph. Winds at the project site are expected to average 10 to 11 mph annually, with summer averages dipping below 8 mph and winter averages exceeding 12 mph. The predominant wind directions are from the north-northwest and northwest.

The MEA meteorological station and the Scottsbluff Airport meteorological station were both analyzed in the site-specific analysis. The Scottsbluff site is included to validate the temporal representativeness of onsite wind data by incorporating wind monitoring results from a longer period of record. The Scottsbluff site is located 48 miles (77.2 km) south of the MEA, with elevation and topographic features comparable to the project area. The distribution of wind speeds and directions at Scottsbluff during the baseline monitoring period have been shown to closely represent long-term wind speeds and directions.

### 2.5.5 Air Quality

#### 2.5.5.1 National Ambient Air Quality Standards

The NDEQ air quality regulations are based on federal and/or state law, with the primary source of the authority for air quality regulations being the federal Clean Air Act (NDEQ 2003). The NDEQ adopts the majority of these federal regulations into Title 129 (Nebraska Air Quality of the Nebraska Administrative Code). The basic foundation of the NDEQ air program is the

National Ambient Air Quality Standards (NAAQS), which are concentrations of pollutants the EPA has established (and adopted by the NDEQ) as being protective of human health and the environment. The standards are established for six "criteria" pollutants: particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, and lead (**Table 2.5-16;** EPA 2013). The State of Nebraska is required to keep areas in compliance with the standards and restore compliance in any areas out of compliance. The NDEQ has several ambient air monitors located throughout the state to measure the concentrations of pollutants in the ambient air (NDEQ 2011). An area may be classified as nonattainment if the concentration of one or more criteria pollutants in an area is found to exceed the regulated or "threshold" level for one or more of the NAAQS. Those areas with concentrations of criteria pollutants below the levels established by the NAAQS are considered in attainment or unclassifiable.

On February 14, 2012, the EPA proposed thresholds for classifying nonattainment areas for the 2008 ozone NAAQS promulgated by the EPA on March 12, 2008 (EPA 2012). This proposal also addresses the timing of attainment dates for each classification and revokes the 1997 zone NAAQS 1 year after the effective date of designations for the 2008 ozone NAAQS for transportation conformity purposes only. The February 14, 2012 proposal establishes a necessary step to implement the 2008 NAAQS for ground-level ozone. The EPA set those standards at 0.075 parts per million (ppm) on March 12, 2008. When the rule is finalized, the Omaha/Council Bluffs area may be significantly impacted if its levels of ozone pollution are above the new regulatory limits.

There are no ambient air quality monitoring data for criteria pollutants in the proposed MEA license boundary or AOR. However, there are a limited amount of state and federal monitoring sites in the region of the MEA that can be used as levels representative of the region for the monitored parameters. These monitoring sites are maintained for a variety of purposes, including for regional background purposes by the NDEQ, as per Appendix D of 40 CFR Part 58. However, the parameters measured are limited to particulate and ozone monitoring.

Regional monitoring sites and parameters measured are presented in **Table 2.5-17**. The locations of the monitor sites in western Nebraska are shown on **Figure 2.5-33**. The data available at the time of preparation of this section are summarized in **Tables 2.5-18** through **2.5-25**. The results of this monitoring indicate that the regions being monitored, including the MEA area, are well within compliance of NAAQS standards.

2.5.5.2 Prevention of Significant Deterioration

In addition to the ambient air quality standards, there are national standards for the Prevention of Significant Deterioration (PSD) of air quality (40 CFR 51.166). The PSD program is administered by the States of Nebraska and South Dakota, with their programs designed to protect the air quality in area that are in attainment with the NAAQS and to prevent degradation of air quality in areas below the standard (designated as clean air areas). PSD differs from the NAAQS in that the NAAQS provides for maximum allowable concentrations of pollutants, while PSD requirements provide maximum allowable increases in concentrations of pollutants for areas already in compliance with the NAAQS. The PSD requirements establish allowable pollution "increments" that may be added to the air in each area while still protecting air quality. The increment is the maximum allowable deterioration of air quality. The maximum allowable increments applicable to Nebraska and South Dakota are shown in **Table 2.5-26.**

The allowable increments vary by location across the states. Those areas characterized as Class I (i.e., National Parks and Wilderness Areas) allow for less incremental pollution increase. Class III areas are planning areas set aside for industrial growth. The areas classified as Class II are essentially all other areas of the state not designated as Class I or Class III. There are no Class I National Park and Wilderness Areas in Nebraska. The Soldier Creek Wilderness Area, located north of Fort Robinson, is not designated as Class I. The State of South Dakota has two Class I Areas: Badlands and Wind Caves National Parks. The Wind Caves National Park is closer to the MEA, at a distance of approximately 75 miles (120.7 km).

No potential impacts to NAAQS parameters or PSD Class I, II, or III areas are expected to occur as the result of the MEA operations. The primary emissions from the proposed MEA will be tailpipe emissions of nitrogen oxides ($NO_x$), carbon monoxide (CO), sulfur dioxide ($SO_2$), non-methane-ethane volatile organic compounds (VOCs) and particulate matter with a diameter less than ten microns ($PM_{10}$) resulting from vehicle traffic within the MEA. The majority of the emissions generated during construction will be fugitive dust and vehicle combustion emissions. Effects of air emissions and impacts associated with construction and operations are discussed in Section 7.2.1.

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**Table 2.5-1 Meteorological Stations Included in Climate Analysis**

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**Table 2.5-2 Annual and Monthly Temperature Statistics for Scottsbluff Airport, NE**

| Month | Temperature Statistics (° Fahrenheit) | | | | |
|---|---|---|---|---|---|
| | Monthly Average | Monthly Maximum | Monthly Minimum | Average Daily High | Average Daily Low |
| Jan | 26.8 | 69 | -28 | 39.4 | 12.3 |
| Feb | 29.2 | 74 | -22 | 43.2 | 15.4 |
| Mar | 37.5 | 81 | -7 | 50.9 | 22.5 |
| Apr | 45.6 | 86 | 1 | 61.5 | 32.1 |
| May | 56.2 | 99 | 18 | 71.3 | 42.4 |
| Jun | 66.6 | 104 | 32 | 82.0 | 52.1 |
| Jul | 74.5 | 107 | 32 | 89.4 | 58.0 |
| Aug | 71.0 | 103 | 32 | 87.5 | 55.7 |
| Sep | 60.8 | 102 | 25 | 78.2 | 45.2 |
| Oct | 46.9 | 90 | 1 | 65.9 | 33.2 |
| Nov | 35.5 | 79 | -13 | 51.2 | 21.9 |
| Dec | 26.0 | 72 | -26 | 40.8 | 13.9 |

Source: National Climate Data Center 2011, hourly data from 1996 through 2011

**Table 2.5-3 Scottsbluff Airport Monthly Wind Parameters Summary**

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**Table 2.5-4 Scottsbluff Airport 15-Year Wind Frequency Distribution**

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**Table 2.5-5 Marsland Expansion Area Maximum, Minimum, and Average Monthly Temperatures**

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**Table 2.5-6 Marsland Meteorological Summary**

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**Table 2.5-7 Marsland Expansion Area Meteorological Station**

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**Table 2.5-8 Marsland Expansion Annual Wind Summary**

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**Table 2.5-9 Marsland Annual Joint Frequency Distribution**

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**Table 2.5-10 Marsland Winter Joint Frequency Distribution**

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**Table 2.5-11 Marsland Spring Joint Frequency Distribution**

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**Table 2.5-12 Marsland Summer Joint Frequency Distribution**

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**Table 2.5-13 Marsland Fall Joint Frequency Distribution**

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**Table 2.5-14 Marsland Onsite Meteorological Station Description**

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**Table 2.5-15 Rapid City Mixing Heights**

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**Table 2.5-16 EPA National Ambient Air Standards (NAAQS)**

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**Table 2.5-17 Nebraska and South Dakota Ambient Air Monitoring Network Near Marsland Expansion Area**

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**Table 2.5-18 Comparison of Ambient Particulate Matter ($PM_{10}$) Monitoring Data for Regional Monitoring Sites**

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**Table 2.5-19 $PM_{10}$ Annual Average Monitoring Data for South Dakota Monitoring Sites**

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**Table 2.5-20 $PM_{2.5}$ Annual Average Monitoring Data for Regional Monitoring Sites**

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**Table 2.5-21 Comparison of Ambient Particulate Matter ($PM_{2.5}$) Monitoring Data for Regional Monitoring Sites**

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**Table 2.5-22 Comparison of Sulfur Dioxide Values for Wind Cave and Badlands, SD Monitor Sites**

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**Table 2.5-23 Comparison of Nitrogen Dioxide 1-Hour 98$^{th}$ Percentile Concentrations for Wind Cave and Badlands, SD**

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**Table 2.5-24 Comparison of Nitrogen Dioxide Annual Average Values for Wind Cave and Badlands, SD Monitor Sites**

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**Table 2.5-25 Ozone Yearly 4th Highest 8-Hour Averages for Regional Monitoring Sites**

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**Table 2.5-26 Prevention of Significant Deterioration (PSD) of Air Quality Allowable Increments**

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Figure 2.5-1 Marsland Project Met Stations

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**Figure 2.5-2 Scottsbluff AP Monthly Temperatures**

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**Figure 2.5-3 Scottsbluff AP Seasonal Diurnal Temperature Variations**

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**Figure 2.5-4 Regional Annual Average Minimum Temperatures**

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**Figure 2.5-5 Regional Annual Average Maximum Temperatures**

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**Figure 2.5-6 Monthly Relative Humidity Statistics for Scottsbluff AP**

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**Figure 2.5-7 Diurnal Variation in Relative Humidity for Scottsbluff by Season**

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**Figure 2.5-8 Scottsbluff AP Monthly Average Precipitation**

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**Figure 2.5-9 Regional Monthly Average Precipitation**

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**Figure 2.5-10 Scottsbluff AP Monthly Snowfall**

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**Figure 2.5-11 Regional Monthly Average Snowfall**

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**Figure 2.5-12 Regional Annual Average Precipitation**

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Figure 2.5-13 Regional Annual Average Snowfall

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**Figure 2.5-14 Scottsbluff AP 15-Year Wind Speeds**

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**Figure 2.5-15 Scottsbluff AP 15-Year Wind Rose**

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**Figure 2.5-16 Scottsbluff AP Diurnal Wind Speeds by Season**

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**Figure 2.5-17 Scottsbluff AP Cooling, Heating, and Growing Degree Days**

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**Figure 2.5-18 Scottsbluff AP Potential Evapotranspiration**

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**Figure 2.5-19 Marsland Expansion Area Monthly Temperatures**

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**Figure 2.5-20 Marsland Expansion Area Wind Rose**

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