

**CAMECO RESOURCES  
CROW BUTTE OPERATION**



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March 29, 2022

USPS PRIORITY MAIL  
SIGNATURE CONFIRMATION

Mr. Jim Macy, Director  
Nebraska Department of Environment and Energy  
P.O. Box 98922  
Lincoln, NE 68509-8922

Class III UIC Permit NE0122611  
Mine Unit 2 Restoration Status

Dear Mr. Macy:

In accordance with the approved Crow Butte Resources, Inc., d/b/a Cameco Resources-Crow Butte Operation (CBO), Groundwater Restoration Plan, CBO is submitting analytical data concerning Mine Unit 2 at the Crow Butte Uranium Project. Split samples were collected from the restoration wells with the Nebraska Department of Environment and Energy (NDEE) on February 8, 2022. This data provides supporting documentation that retreatment efforts have been successful in returning Mine Unit 2 to the approved restoration goals. Upon NDEE approval, CBO plans to place Mine Unit 2 back into the stability phase of restoration.

Commercial operation of Mine Unit 2 began March 1992. Mining was completed in January 1996 and restoration activities began. The restoration plan for this mine unit was submitted to NDEQ on December 5, 1995 and was approved by letter dated December 15, 1995. Injection of lixiviant into this mine unit was ceased on January 2, 1996.

In February 2009, CBO contracted with a third-party hydrogeologist to develop a restoration flow model for Mine Units 2 through 5. The ground water flows were simulated using MODFLOW2000. The groundwater flow model was calibrated to pre-mining conditions using water level data collected prior to mining activities in January 1983. The calibrated groundwater flow model was used to optimize restoration in Mine Unit 2 given certain practical limitations on treatment rates, disposal capacity, and existing well injection and extraction rates. Based on this model, eight additional restoration wells were installed to remediate the excursion of lixiviant along the perimeter monitor wells PR-8 and PR-15.

Stability monitoring was performed over the course of the next several years. In 2020, sampling in Mine Unit 2 indicated that there was a pocket of groundwater within the mine unit that had elevated concentrations of uranium and total dissolved solids. The source of this water was a pocket of groundwater along the Mine Unit 2/Mine Unit 4 boundary that was not actively mined during the operational phase of mining. On August 3, 2020, Crow Butte Operation informed the NDEE by letter that Mine Units 2 and 4 were to be removed from stability monitoring and placed



back into restoration to spot treat affected portions of the Mine Units. Mine Unit 2 was placed back into restoration to treat this area with reverse osmosis permeate and sodium sulfide reductant.

Restoration was performed as described in the Groundwater Restoration Plan, utilizing groundwater transfer, treatment, and recirculation. The total gallons used in each phase through the end of December 2021 are as Follows:

Restoration Phase	Total Gallons	Pore Volumes
Transfer	515,900,920	23.86
Treatment (IX)	37,622,280	1.74
Treatment (RO)	384,755,198	17.79
Recirculation	29,838,360	1.38

CBO is required by the NDEE UIC Permit to determine the baseline groundwater quality for a list of 27 water quality parameters. The baseline average for each well is determined for each parameter. These well averages are then used to determine the overall mine unit average for each parameter. Baseline for Mine Unit 2 was determined prior to mining operations and submitted for approval by the regulatory agencies.

NDEE restoration goals are based upon state groundwater standards. For those parameters that have a numerical groundwater standard established in Title 118 of the NDEE Rules and Regulations<sup>1</sup> or in other established documents, restoration must successfully return the groundwater to that standard. If the baseline preoperational mean for the mine unit exceeds the standard for any parameter, the restoration goal for that parameter is set at the baseline mean plus two standard deviations. Where no standard is established (calcium, potassium, magnesium and sodium) the restoration value is set at one order of magnitude above baseline mean. The restoration value for total carbonate shall not exceed 50% of the total dissolved solids.

All parameters in Mine Unit 2 have met the NDEE restoration goals on a mine unit average. CBO obtained composite samples from the restoration wells on February 8, 2022. This sampling indicated that all parameters met the restoration goals.

The attached table provides analytical data for the Mine Unit 2 restoration wells. The results for all parameters are from the February 2022 composite sampling.

Based upon the analytical results, CBO believes that restoration efforts have been successful in restoring Mine Unit 2 to the approved restoration goals. Upon approval from the NDEE, Mine Unit 2 will be shut in for the stability phase of restoration.

<sup>1</sup> Title 118 – Ground Water Quality Standards and Use Classification, NDEQ July 29, 1996.

# CROW BUTTE RESOURCES, INC.



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If you have any questions or require any further information, please do not hesitate to call me at (308) 665-2215 ext. 117.

Sincerely,  
Cameco Resources  
CROW BUTTE OPERATION

Casey Yada  
SHEQ Coordinator

Attachments: As Stated

cc: Sue Dempsey – NDEE Drinking Water and Ground Water Division Administrator  
Ron Burrows – NRC  
CBO File  
ec: Dave Miesbach – NDEE Ground Water Unit Supervisor  
Amanda Osborn – NDEE Program Coordinator  
CR – Electronic File



## Mine Unit 2 Restoration Results

Parameter	Title 118 Groundwater Standard <sup>2</sup>	MU-2 Baseline Mean	MU-2 Standard Deviation	MU-2 NDEQ Restoration Value <sup>3</sup>	MU-2 Average Water Quality February 2022
Ammonium (mg/L)	10.0	0.37	0.07	10.0	0.07
Arsenic (mg/L)	0.05	<0.001	N/A	0.05	0.023
Barium (mg/L)	1.0	<0.1	N/A	1.0	<0.1
Cadmium (mg/L) <sup>1</sup>	0.005	<0.007	N/A	0.005	<0.005
Chloride (mg/L)	250.0	208.6	30.8	250.0	64.0
Copper (mg/L)	1.0	<0.013	N/A	1.0	<0.01
Fluoride (mg/L)	4.0	0.67	0.04	4.0	0.5
Iron (mg/L)	0.3	<0.045	N/A	0.3	0.05
Mercury (mg/L)	0.002	<0.001	N/A	0.002	<0.001
Manganese (mg/L)	0.05	<0.01	N/A	0.05	0.01
Molybdenum (mg/L)	1.0	<0.073	N/A	1.0	0.1
Nickel (mg/L)	0.15	<0.037	N/A	0.15	<0.05
Nitrate (mg/L)	10.0	<0.039	N/A	10.0	<0.1
Lead (mg/L)	0.05	<0.035	N/A	0.05	<0.001
Radium (pCi/L)	5.0	234.5	411.8	1058.0	97.8
Selenium (mg/L)	0.05	<0.001	N/A	0.05	<0.001
Sodium (mg/L)	N/A	410.8	18.2	4108	194.0
Sulfate (mg/L)	250.0	348.2	10.3	369.0	106
Uranium (mg/L)	5.0	0.046	0.037	5.0	0.864
Vanadium (mg/L)	0.2	<0.07	N/A	0.2	<0.1
Zinc (mg/L)	5.0	<0.026	N/A	5.0	<0.01
pH (Std. Units)	6.5 - 8.5	8.32	0.2	6.5 - 8.5	8.4
Calcium (mg/L)	N/A	13.4	2.4	134.0	7.0
Total Carbonate (mg/L)	N/A	366.9	13.3	585.0	255
Potassium (mg/L)	N/A	12.6	2.5	126.0	8.0
Magnesium (mg/L)	N/A	3.5	0.4	35.0	1
TDS (mg/L)	N/A	1170.4	41	1170.4	590.0

<sup>1</sup> Standard for Cadmium lowered in modification to UIC permit dated March 9, 2001 following NDEQ approval of Mine Unit 1 restoration.

<sup>2</sup> Title 118 numerical standards in effect at the time the Notice of Intent was filed with the NDEQ.

<sup>3</sup> Restoration values based on Title 118 numerical standards and well field averages at the time the Notice of Intent was submitted to the NDEQ.

N/A = Not Applicable