

**Old Church Rock Mine
Eastern Abandoned Uranium Mine Region**

**OCRM Removal Assessment
Appendix H
Background Investigation Report**

Response, Assessment, and Evaluation Services

Contract No. EP-S9-17-03

Task Order 0035

August 25, 2023

Submitted to

U.S. Environmental Protection Agency

Submitted by

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TETRA TECH

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ATTACHMENTS

Attachment H-1: Photographic Log
Attachment H-2: PROUCL Output

ACRONYMS AND ABBREVIATIONS

amsl	Above mean sea level
ASTM	ASTM International
AUM	Abandoned uranium mine
bgs	Below ground surface
BSA	Background study area
BTV	Background threshold value
COPC	Contaminant of potential concern
COV	Coefficient of variation
cpm	Counts per minute
DL	Detection limit
DQO	Data quality objective
ERG	Environmental Restoration Group, Inc.
GOF	Goodness of fit
GPS	Global Positioning System
K-40	Potassium-40
KM	Kaplan-Meier
m	Meter
m ²	Square meter
MDA	Minimal detectable amount
MDC	Minimum detectable concentration
MDL	Method detection limit
mg/kg	Milligrams per kilogram
NaI	Sodium iodide
ND	Nondetect
NRCS	National Resource Conservation Service
OCRM	Old Church Rock Mine
ppm	Parts per million
Qa	Quaternary alluvium
QL	Quantitation limit
Ra-226	Radium-226
Ra-228	Radium-228
RL	Reporting limit

ACRONYMS AND ABBREVIATIONS (CONTINUED)

ROS	Regression Order Statistics
RPD	Relative percent difference
RSD	Relative standard deviation
SAP	Sampling and analysis plan
SDG	Sample delivery group
TENORM	Technologically enhanced naturally occurring radioactive material
Th-228	Thorium-228
Th-230	Thorium-230
Th-232	Thorium-232
TPU	Total propagated uncertainty
U-234	Uranium-234
U-235	Uranium 235
U-238	Uranium-238
UCL	Upper confidence limit
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTL	Upper tolerance limit
UTL95-95	95 percent upper tolerance limit with 95 percent coverage
WH	Wilson Hilferty
XRF	X-ray fluorescence

EXECUTIVE SUMMARY

This site-specific investigation report regarding Background Study Area (BSA)-02 presents the field sampling methods, results, and statistical evaluation of a gamma radiation survey, X-ray fluorescence (XRF) survey, and soil sampling event during November 2022. BSA-02 was selected as a reference site to represent pre-mining and undisturbed conditions within the Old Church Rock Mine (OCRM) area in the Eastern Abandoned Uranium Mine (AUM) Region of the Navajo Nation near Gallup, McKinley County, New Mexico. The geology at BSA-02 is characterized by Quaternary alluvium (Qa), and the soils are described as Sparank-San Matero-Zia series (symbol 230) with typical topographic relief ranging from 0 to 3 percent slopes. BSA-02 was selected as an appropriate reference site for the OCRM area because it is within the same geologic unit and hosts the same and similar soil types. Gamma radiation surveys and surface soil sampling at BSA-02 conformed to methods outlined in the OCRM removal assessment sampling and analysis plan (SAP) (Tetra Tech 2022). The gamma radiation survey was completed at a 100 percent density by use of 2-meter transects within the survey boundary, and 30 surface soil samples were collected for analysis for metals and radionuclides listed in [Table H-ES-1](#). A comprehensive analysis occurred to determine background concentrations of individual analytes and gamma radiation levels in order to establish background threshold values (BTV) for the analytes listed in [Table H-ES-1](#). The analysis involved use of the statistical software ProUCL version 5.2 for robust computations of upper statistical limits.

Table H-ES-1. Individual Background Threshold Values for BSA-02

Analyte	# of Non-Detects	Minimum	Maximum	Average	Standard Deviation	BTV	Units
Aluminum	0	10,400	18,800	15,440	1,727	19,274	mg/kg
Antimony ¹	30	0.33	3.5	NA	NA	NA	mg/kg
Arsenic	0	4.5	6.8	5.7	0.55	7.0	mg/kg
Barium	0	119	175	136	13	165	mg/kg
Beryllium	0	0.74	1.1	0.97	0.10	1.2	mg/kg
Cadmium	0	0.12	0.17	0.15	0.013	0.18	mg/kg
Calcium	0	5,690	8,680	6,814	614	8,177	mg/kg
Chromium	0	9.1	15	12	1.3	15.1	mg/kg
Cobalt	0	5.9	8.8	7.6	0.73	9.2	mg/kg
Copper	0	11	16	14	1.5	17.0	mg/kg
Iron	0	14,400	21,500	18,367	1,699	22,138	mg/kg
Lead	0	12	18	15	1.6	18.8	mg/kg
Lithium	0	10	17	14	1.5	17.6	mg/kg
Magnesium	0	3,670	4,780	4,283	280	4,905	mg/kg
Manganese	0	209	273	248	17	2,856	mg/kg
Molybdenum	0	0.28	0.40	0.34	0.035	0.41	mg/kg
Nickel	0	7.8	12	10	1.0	12.4	mg/kg
Selenium	0	1.4	2.8	2.0	0.37	2.8	mg/kg
Silver ¹	30	0.10	0.61	NA	NA	NA	mg/kg
Sodium	0	52	76	67	6.3	81.2	mg/kg
Thallium	0	0.16	0.26	0.22	0.023	0.27	mg/kg
Thorium	0	6.6	11	9.4	1.0	11.6	mg/kg
Uranium	0	0.87	1.3	1.1	0.10	1.4	mg/kg
Vanadium	0	21	32	27	2.6	32.6	mg/kg
Zinc	0	44	64	54	5.3	66.1	mg/kg
Radium-226	0	1.1	1.9	1.6	0.18	2.0	pCi/g
Radium-228	0	1.1	2.2	1.7	0.29	2.3	pCi/g
Potassium-40	0	18	24	21	1.1	23.2	pCi/g
Thorium-232	0	1.1	2.2	1.7	0.3	2.3	pCi/g
Raw Gamma	NA	10,300	16,400	13,216	784	14,555	cpm

Notes:

¹ Average, standard deviation, and BTV could not be calculated via KM Method because all values in the dataset were non-detects.

BTV Background threshold value

cpm Counts per minute

KM Kaplan-Meier

mg/kg Milligrams per kilogram

NA Not applicable

pCi/g Picocuries per gram



1.0 INTRODUCTION

As part of the desktop study presented in the Old Church Rock Mine (OCRM) removal assessment sampling and analysis plan (SAP), two background study areas (BSA) were identified within 0.5 mile of OCRM. The BSAs, BSA-01 and BSA-02, were both scanned with gamma scanning equipment. The gamma scanning results between the two were nearly indistinguishable and so BSA-02 was selected as a reference site to represent pre-mining and undisturbed conditions because BSA-02's geology and soil are similar to that of OCRM's and sits farther away from the next nearest geology. The purpose of this report is to answer the following study question as part of the data quality objective (DQO) process in the removal assessment SAP:

Study Question: What are the background levels of gamma radiation and what are the background concentrations of radionuclides and metals in soils and sediment that are representative of unimpacted conditions at each site?

This site-specific investigation report regarding BSA-02 summarizes BSA-02 field sampling methods; results of the gamma radiation survey, X-ray fluorescence (XRF) survey, and soil sampling; and analysis and interpretation of gamma radiation and analytical results. Although gamma radium survey results from BSA-01 also are included in this report to document its similarity to BSA-02, the analysis and interpretation of soil analytical data herein refer strictly to BSA-02.

2.0 SITE SETTING

This section describes the site setting of BSA-02.

2.1 SITE IDENTIFICATION AND SETTING

BSA-02 is the representative background site for OCRM. BSA-02 is approximately 0.5 mile south and upwind of OCRM, and can be accessed from OCRM by foot. Topographically, the BSA-02 area is flat and at the same approximate elevation of 6,800 feet above mean sea level (amsl) as OCRM. The location of and access route to BSA-02 are shown on [Figure H-1](#).

Tetra Tech team geologists and engineers visited BSA-02 on November 15, 2022 and observed no evidence of mining-related activity. [Attachment H-1](#) to this report is a photographic log from the background investigation study.

2.2 GEOLOGY AND SOILS

The geology at BSA-02 and OCRM is characterized by Quaternary alluvium (Qa). The alluvium soil at BSA-02 is described as the Sparank-San Matero-Zia series (symbol 230). The Sparank-San Matero-Zia series has a typical topographic relief ranging from 0 to 3 percent slopes, is well drained, and consists of fan and stream alluvium derived from sandstone and shale. The soils at OCRM include the Sparank-San Matero-Zia series and similar soil types. Other soil types present at OCRM are fan, slope, and eolian alluvium also derived from sandstone and shale.

Maps of the geology and soils of BSA-02 and OCRM are shown on [Figure H-2](#) and [Figure H-3](#), respectively.

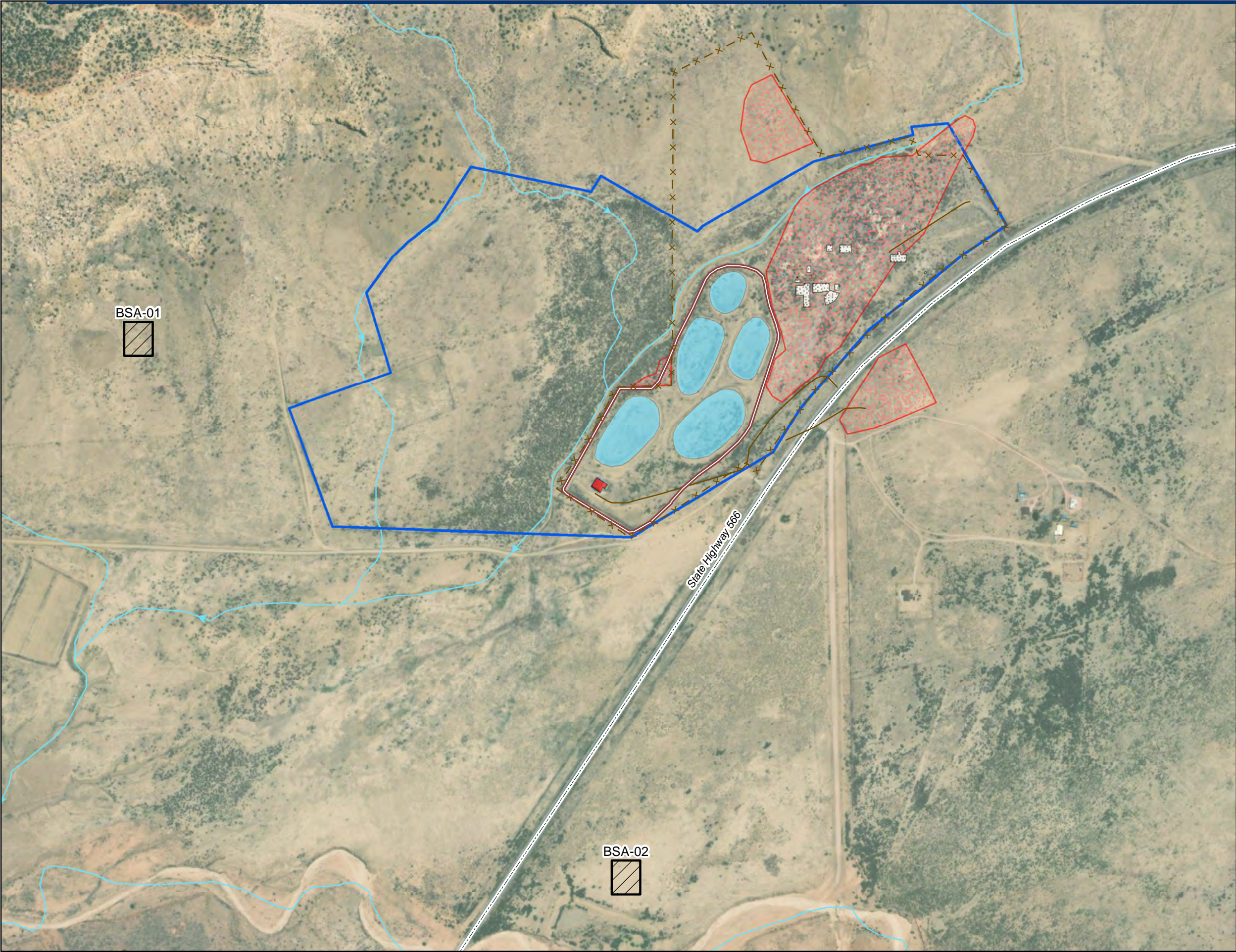
2.3 ECOLOGY

The landscape surrounding BSA-02 consists of flat to gently dipping sedimentary rocks eroded into mesas, valleys, and deep canyons. The area has a mild north-northwesterly aspect with slopes ranging from 1.5 to 3.5 percent, is at average elevation of 6,805 feet amsl, and receives approximately 9 inches of annual precipitation (United States Department of Agriculture [USDA] 2018). While the area does not benefit significantly from run-on moisture, the sandy soils capture moisture from both winter precipitation and intense summer thunderstorms with minimal runoff. Vegetation production is bimodal, with peaks in April and August (National Resource Conservation Service [NRCS] 2012). Evidence of grazing was observed during field surveys which, in combination with drought, can destabilize soil surface crust, and make the area susceptible to loss of topsoil from aeolian erosion.

The vegetation and environmental conditions of BSA-02 are representative of the Colorado Plateau Mixed Bedrock Canyon and Tableland ecological system (CES304.765) (United States Geological Survey [USGS] 2005). Vegetation within the area surrounding BSA-02 is a sparse shrubland with scattered short-statured juniper (*Juniperus sp.*). Total cover from juniper is less than 5 percent. Shrubs within this area include rabbitbrush (*Chrysothamnus sp.*), big sagebrush (*Artemisia tridentata*), broom snakeweed (*Gutierrezia sarothrae*), and yucca (*Yucca sp.*), which cumulatively provide approximately 8 percent cover. Herbaceous composition includes species adapted to grazing pressure in sandy soils such as fluffgrass (*Dasyochloa pulchella*) and Indian

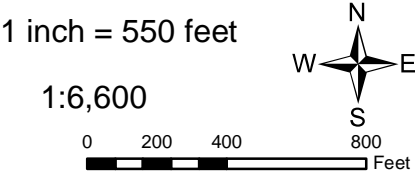


ricegrass (*Achnatherum hymenoides*), which cumulatively provide less than 5 percent cover. Forb and annual grass cover is negligible.



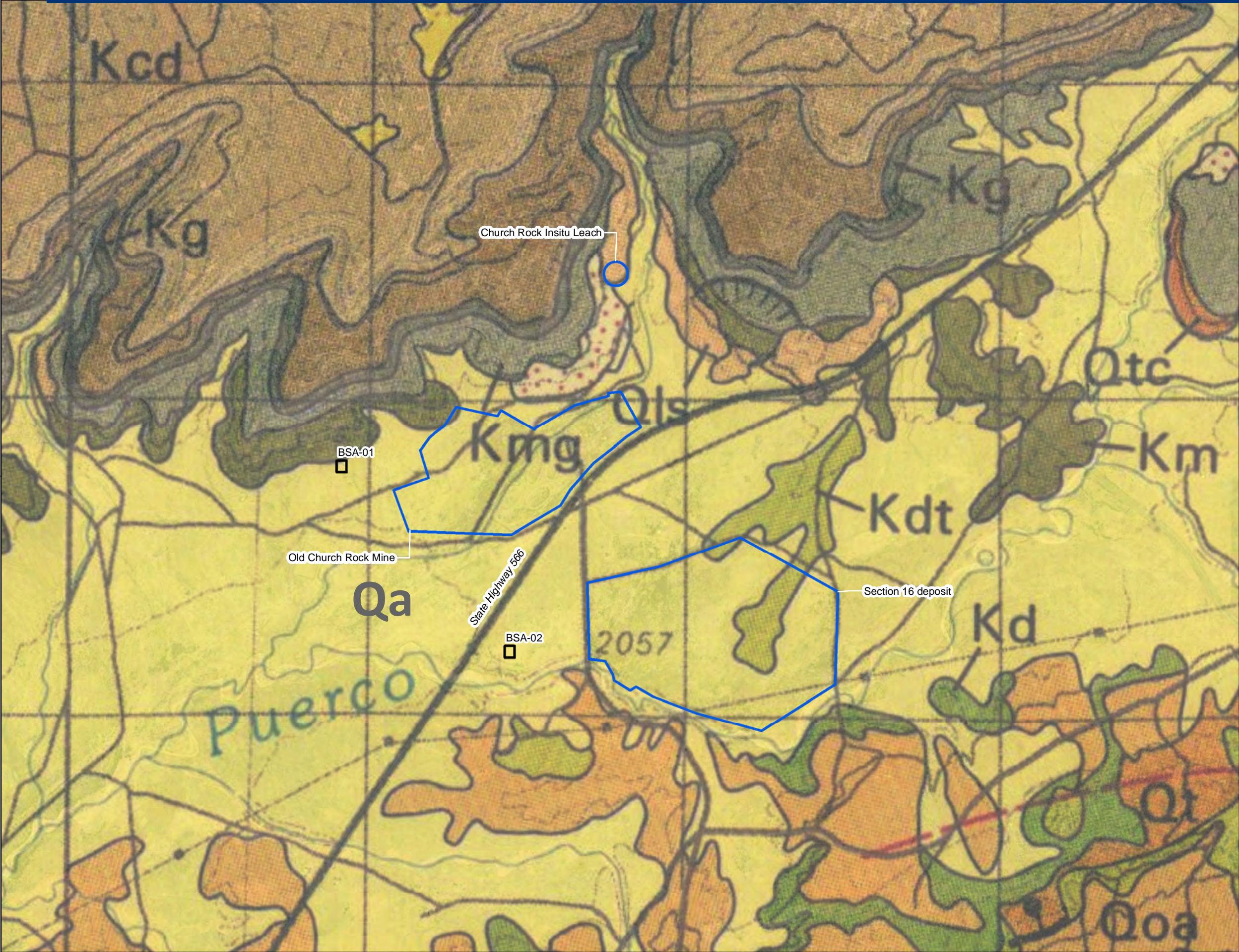
- Background Study Area
- AUM Site Boundary
- Site Features**
- Berm
- Fenced Boundary
- Facility Road
- Concrete Pad
- Former Pond
- Ion Exchange Building
- Suspected Waste Disposal
- Community Road
- Surface Water Pathway¹

Notes:
¹All surface water pathways drain to the Puerco River.
AUM Abandoned uranium mine



OLD CHURCH ROCK MINE AUM
BACKGROUND STUDY AREA
SITE LOCATION AND ACCESS

Prepared For: U.S. EPA Region 9		Prepared By:	
		 TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612	
Task Order No.: 0035		Contract No.: EP-S9-17-03	
Location: CHURCH ROCK CHAPTER NAVAJO NATION		Date: 1/25/2023	
Coordinate System: NAD 1983 State Plane New Mexico West FIPS 3003 Feet Transverse			Figure No.: H-1



Abandoned Uranium Mine Site

Background Study Area

Geologic Units¹

Alluvial Deposits (Qa)

Older Alluvium (Qoa)

Talus Deposits (Qt)

Tallus Depoists and Colluvium, Undivided (Qtc)

Landslide Deposits (Qls)

Dalton Sanstone Member, unnamed lower tongue, and Borrego Pass Lentil of Crevasse Canyon Formation, and Mulatto Tongue of Mancos Share, Undivided (Kcd)

Dilco Coal Member of Crevasse Canyon Formation (Kcdi)

Main Body Gallup Sandstone (Kg)

Lower Tongues of Gallup Sandstone, and Unnamed Tongues of Mancos Shale, Undivided (Kmg)

Twowells Tongue of Dakota Sandstone and Whitewater Arroyo Tongue of Mancos Shale, Undivided (Kdt)

Main Body of Dakota Sandstone (Kd)

Note:

¹Dillinger (1990).

1 inch = 1,600 feet

1:19,200

0

800

1,600

3,200

Feet

N

W

E

S

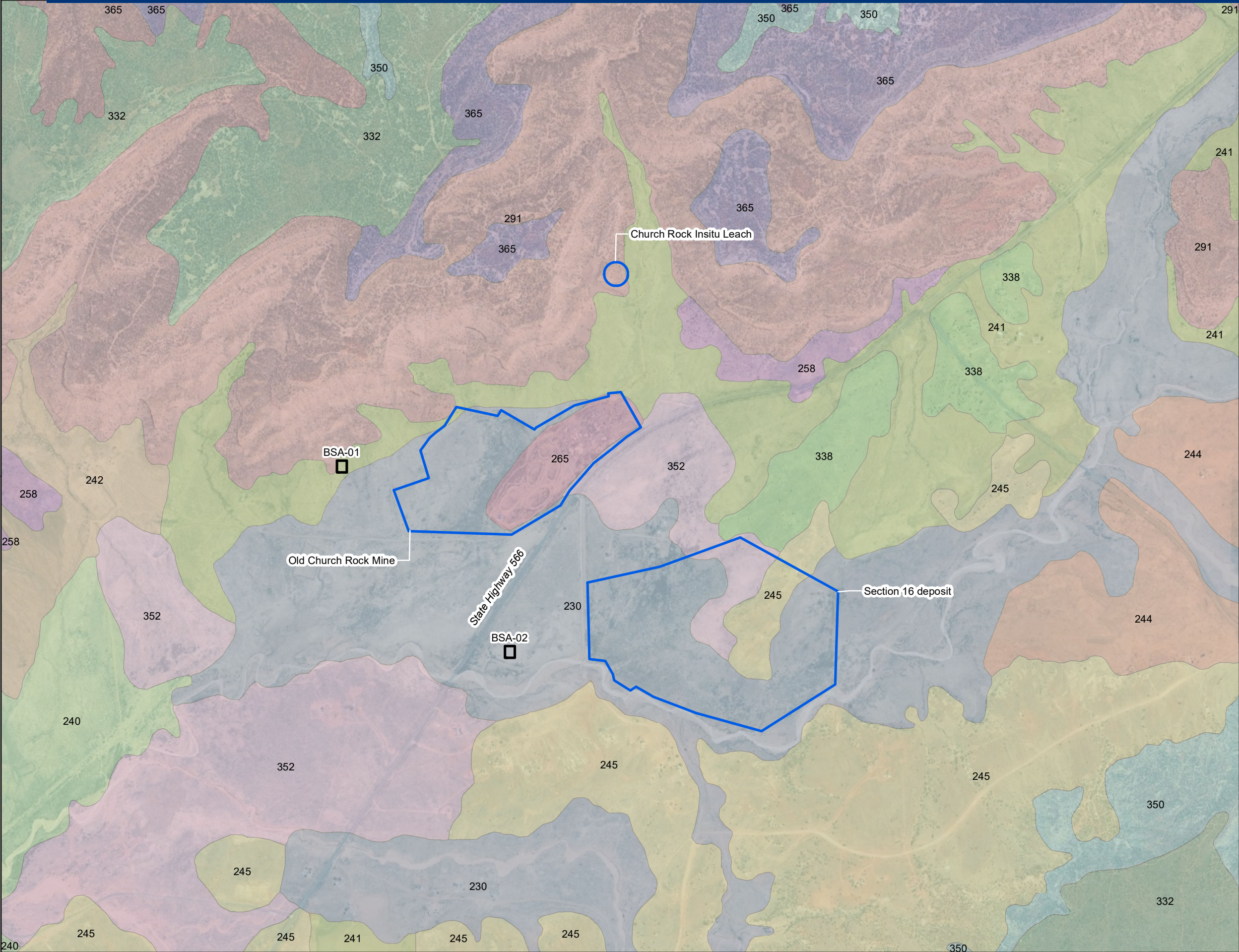
OLD CHURCH ROCK MINE

GEOLOGY

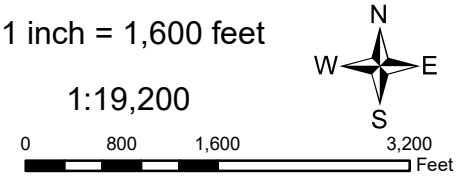
<div>Prepared For: U.S. EPA Region 9</div> <div></div>	<div>Prepared By:</div> <div><div><div>Tt</div><div>TETRA TECH</div><div>1999 Harrison Street, Suite 500</div><div>Oakland, CA 94612</div></div></div>
<div>Task Order No.:</div> <div>0035</div>	<div>Contract No.:</div> <div>EP-S9-17-03</div>
<div>Location:</div> <div>CHURCH ROCK CHAPTER</div> <div>NAVAJO NATION</div>	<div>Date:</div> <div>1/25/2023</div>
<div>Coordinate System:</div> <div>NAD 1983 State Plane New Mexico</div> <div>West FIPS 3003 Feet Transverse</div>	<div>Figure No.:</div> <div>H-2</div>

Contract No. EP-S9-17-03, Task Order 0035

H-5



- Abandoned Uranium Mine Site
- Background Study Area
- Soil Units**
- Breadsprings and Nahodish soils,
0 to 2 percent slopes (240)
- Buckle fine sandy loam,
1 to 8 percent slopes (244)
- Buckle-Gapmesa-Barboncito complex,
1 to 6 percent slopes (245)
- Eagleye-Atchee-Rock outcrop complex,
2 to 35 percent slopes (258)
- Evpark-Arabrab complex,
2 to 6 percent slopes (332)
- Gish-Mentmore complex,
1 to 8 percent slopes (242)
- Mentmore loam,
1 to 8 percent slopes (241)
- Rock outcrop-Eagleye-Atchee complex,
35 to 70 percent slopes (291)
- Sparank-San Mateo-Zia complex,
0 to 3 percent slopes (230)
- Toldohn-Vessilla-Rock outcrop complex,
8 to 35 percent slopes (350)
- Uranium mined lands (265)
- Vessilla-Rock outcrop complex,
2 to 15 percent slopes (365)
- Zia sandy loam,
1 to 5 percent slopes (352)
- Zyme-Lockerby association,
5 to 35 percent slopes (338)



OLD CHURCH ROCK MINE
SOILS

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Task Order No.: 0035		Contract No.: EP-S9-17-03	
Location: CHURCH ROCK CHAPTER NAVAJO NATION		Date: 1/25/2023	
Coordinate System: NAD 1983 State Plane New Mexico West FIPS 3003 Feet Transverse			Figure No.: H-3

3.0 METHODS

This section presents field sampling and background data interpretation methods for the investigation at BSA-02.

3.1 GAMMA RADIATION SURVEY

A gamma radiation survey at BSA-02 conformed to methods outlined in the OCRM Removal Assessment SAP (Tetra Tech 2022). Field staff used a Ludlum Model 44-10 (or equivalent) 2- by 2-inch sodium iodide (NaI) gamma scintillation detector coupled to a Ludlum Model 3000 ratemeter/scaler set in ratemeter mode. The detectors were coupled with an Environmental Restoration Group, Inc. (ERG) Model 105 Global Positioning System (GPS). The ERG Model 105 GPS consists of a Juniper Mesa 2 field computer and sub-meter accurate geode GPS receiver (or equivalent). The surveys were conducted on foot at approximately 1 meter (m) per second along 2-m transects within the BSA-02 survey boundary. Detector height was 1 m above ground surface. Consistent with recommendations in NUREG-5849 (Nuclear Regulatory Commission [NRC] 1992), the gamma measurements were processed after acquisition by (1) overlaying 100-square-meter (m²) grids across BSA, and (2) estimating the average of the gamma measurements within each grid. Results of the gamma radiation survey are in [Section 4.1](#).

3.2 SOIL SAMPLING

Soil sampling at BSA-02 followed methods outlined in the OCRM removal assessment SAP (Tetra Tech 2022). Thirty surface soil samples collected by use of a stainless steel trowel within 0 to 6 inches below ground surface (bgs) were analyzed for metals and radionuclides. Soil sample locations were selected from the approximate centroid of an unbiased systematic sampling grid (10 x 10 m) over a 0.75-acre tract of land.

The grid identification of each 100 m² sampling grid is shown at the upper corner of each grid on [Figure H-4](#). Surface soil sample locations are shown on [Figure H-4](#). Coordinates and associated laboratory sample delivery group information pertaining to each soil sample location are listed in [Table H-1](#).

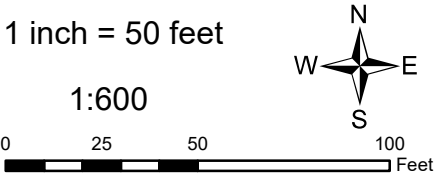
Field duplicates were collected at frequency of one per 20 samples. All samples were analyzed for 25 different metals, and radionuclides (potassium-40 [K-40], radium-226 [Ra-226], radium-228 [Ra-228], thorium-232 [Th-232], and uranium-238 [U-238]). In addition to these analytes, two soil samples from BSA-02 also were selected for analyses for isotopic uranium and isotopic thorium. The purpose of analyzing a subset of samples for isotopic uranium, and isotopic thorium was to evaluate the uranium series equilibrium. The evaluation of uranium series equilibrium will inform interpretation of fate and transport of radionuclides. Laboratory methods applied were:

- Metals via United States Environmental Protection Agency (USEPA) Method 6020
- K-40, Ra-226, Ra-228, Th-232, U-238 via USEPA Method 901.1 (EH300)
- Isotopic uranium and thorium via ASTM International (ASTM) method D3972 (HASL 300).



- Soil Sample Locations**
- Surface Soil (0-6 inches bgs)
 - Survey Unit Grid Cell (100 m²)
 - Background Study Area

Notes:
bgs Below ground surface
m² Square meter



**OLD CHURCH ROCK MINE
BSA-02
SOIL SAMPLE LOCATIONS**

Prepared For: U.S. EPA Region 9		Prepared By:	
		 TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612	
Task Order No.: 0035		Contract No.: EP-S9-17-03	
Location: CHURCH ROCK CHAPTER NAVAJO NATION		Date: 1/25/2023	
Coordinate System: NAD 1983 State Plane New Mexico West FIPS 3003 Feet Transverse			Figure No.: H-4

Table H-1. Summary of BSA-02 Soil Sample Locations

Sample ID	Latitude ¹	Longitude ¹	Laboratory ID	
OCRM-B02-SS01-01-111622	35.61307966	-108.5573664	601828001	601835001
OCRM-B02-SS02-01-111622	35.61307613	-108.5572453	601828002	601835002
OCRM-B02-SS03-01-111622	35.61307452	-108.557143	601828003	601835003
OCRM-B02-SS04-01-111622	35.61307743	-108.5570252	601828004	601835004
OCRM-B02-SS05-01-111622	35.6130806	-108.5569077	601828005	601835005
OCRM-B02-SS06-01-111622	35.61298823	-108.5573641	601828011	601835011
OCRM-B02-SS07-01-111622	35.61298655	-108.5572531	601828010	601835010
OCRM-B02-SS08-01-111622	35.61299656	-108.5571292	601828009	601835009
OCRM-B02-SS09-01-111622	35.61298595	-108.5570394	601828008	601835008
OCRM-B02-SS10-01-111622	35.61298455	-108.5569258	601828006	601835006
OCRM-B02-SS11-01-111622	35.61289275	-108.5573528	601828012	601835012
OCRM-B02-SS12-01-111622	35.61289344	-108.5572415	601828013	601835013
OCRM-B02-SS13-01-111622	35.61290314	-108.5571311	601828014	601835014
OCRM-B02-SS14-01-111622	35.61289734	-108.5570154	601828015	601835015
OCRM-B02-SS15-01-111622	35.61289444	-108.5569171	601828016	601835016
OCRM-B02-SS16-01-111622	35.61280822	-108.5573419	601838002	601840002
OCRM-B02-SS17-01-111622	35.61280543	-108.557253	601838001	601840001
OCRM-B02-SS18-01-111622	35.61280652	-108.5571466	601828020	601835020
OCRM-B02-SS19-01-111622	35.61281036	-108.557026	601828019	601835019
OCRM-B02-SS20-01-111622	35.61280498	-108.5569152	601828017	601835017
OCRM-B02-SS21-01-111622	35.612713	-108.5573476	601838003	601840003
OCRM-B02-SS22-01-111622	35.61271115	-108.5572421	601838004	601840004
OCRM-B02-SS23-01-111622	35.61271863	-108.557134	601838005	601840005
OCRM-B02-SS24-01-111622	35.61271929	-108.5570195	601838006	601840006
OCRM-B02-SS25-01-111622	35.61272413	-108.5569059	601838007	601840007
OCRM-B02-SS26-01-111622	35.61263639	-108.5573601	601838012	601840012
OCRM-B02-SS27-01-111622	35.61263221	-108.5572341	601838011	601840011
OCRM-B02-SS28-01-111622	35.61262694	-108.557132	601838010	601840010
OCRM-B02-SS29-01-111622	35.61262709	-108.5570212	601838009	601840009
OCRM-B02-SS30-01-111622	35.61261777	-108.5569125	601838008	601840008

Note:

¹ WGS84 Coordinate System

Soil sampling results are in [Section 4.2](#). Copies of all lab reports are in Appendix G to the removal assessment report. A soil verification report including all lab data is in Appendix D to the removal assessment report.

3.3 DETERMINATION OF BACKGROUND THRESHOLD VALUES

Background evaluation studies involve determinations of site-specific, background-level, constituent concentrations to establish background threshold values (BTV) (USEPA 2022). Comparing site-specific chemical and radiological BTVs to datasets acquired at historical mining sites allows determination of whether and to what extent historical mining operations have impacted those sites. Moreover, the comparative analysis is useful for identification of site-specific contaminants of potential concern (COPC). As part of this background evaluation, Tetra Tech used the USEPA-funded statistical software ProUCL version 5.2 for robust computations of upper statistical limits. The ProUCL Version 5.2 Technical Guide (USEPA 2022) was referenced to develop a process for determination of upper statistical limits for selection of BTVs as outlined in [Section 3.3.5](#).

The main objective of ProUCL software is to compute rigorous and reproducible statistics to help decision makers and project teams make decisions regarding a polluted site that are cost-effective and protective of human health and the environment (USEPA 2022). Because site-specific BTVs were to be used for decision making (i.e., identification of COPCs, determination of contamination with respect to background), careful analysis of outliers and data distributions occurred. The following subsections describe upper statistical limits, treatments of uncensored datasets, censored datasets, outliers, and sample size determination.

3.3.1 Upper Limits

For both parametric (normal, gamma, lognormal) and nonparametric distributions, the upper limits selected were the 95 percent upper tolerance limit with 95 percent coverage (UTL95-95) following the process outlined in [Section 3.3.5](#).

3.3.2 Treatment of Uncensored Datasets

An uncensored dataset is a dataset without any nondetect (ND) results. ProUCL provides goodness of fit (GOF) tests for normal, lognormal, and gamma distributions of uncensored datasets. Tetra Tech applied GOF testing in ProUCL to all analytes of interest detected at BSA-02. All uncensored datasets were analyzed by use of the ProUCL 5.2 statistical software package following guidance in Chapter 3 of the ProUCL Technical Guide (USEPA 2022), which focuses on computing upper limits to estimate BTVs based on datasets with no nondetects. Sometimes, multiple parametric distributions were identified within a single dataset; therefore, the following rules were followed as recommend by ProUCL:

1. A normal distribution was always selected over a lognormal or a gamma distribution if it appeared or approximated a normal distribution. For normally distributed data, the Normal UTL95-95 is selected as the BTV.
2. A gamma distribution was always selected over a lognormal distribution if a dataset did not appear to follow normal distribution. If a dataset approximated a normal distribution but appeared to follow a gamma distribution, the gamma distribution was selected. The Wilson Hilferty (WH) UTL95-95 was selected as the BTV for gamma distributed uncensored datasets.

3. If the data appeared only lognormally distributed, the lognormal UTL95-95 was selected as the BTV. If the dataset approximated a gamma distribution but appeared to follow a lognormal distribution, the lognormal distribution was selected.
4. If a dataset exhibited no discernible parametric distribution, the nonparametric upper statistical limit was selected.

3.3.3 Treatment of Censored Datasets

A censored dataset includes censored data (nondetects). ProUCL has GOF tests for normal, lognormal, and gamma distributions in left-censored datasets with nondetects. It is not easy to assess and verify the distribution of datasets with NDs, especially when multiple detection limits (DL) are present and those DLs exceed detected values (USEPA 2022). As for uncensored full datasets, skewness and data distribution of detected values are important in selecting appropriate estimates of BTVs for datasets with NDs. For datasets with NDs, it is important to determine the distribution and skewness of the dataset obtained by excluding NDs (USEPA 2022). This information aids selection of appropriate parametric or nonparametric methods to compute the various upper limits that account for NDs and adjust for data variability and skewness (USEPA 2022). ProUCL has GOF tests for normal, lognormal, and gamma distributions. The GOF tests in ProUCL include: (1) exclusion of all NDs, (2) replacement of NDs by their DL/2, and (3) Regression Order Statistics (ROS) methods. Notably, developers of ProUCL do not recommend the substitution method in any situation (i.e., replacement of NDs by their DL/2).

Analytical results from soil samples are in [Section 4.2](#). For the purposes of this background evaluation, regarding the censored datasets, ND values for a particular analyte at a BSA were set to the DL (method detection limit [MDL] or minimum detectable concentration [MDC]), not the reporting limit (RL) or quantitation limit (QL). This approach was selected because the inferred upper limits determined by ProUCL generally are more conservative for analyses of censored datasets by use of the DL than by use of the RL. The substitution method (i.e., DL/2) was not used for selection of BTVs during this project.

A number of guidelines for selecting BTVs from ProUCL output were used for determination of upper statistical limits of censored datasets, as follows:

- A normal distribution (of detected results) was always selected over a lognormal or a gamma distribution.
- A gamma distribution (of detected results) was always selected over a lognormal distribution.
- When detected data followed a normal distribution, use of Kaplan-Meier (KM) estimates in normal equations was selected (as recommended by developers of ProUCL) for computing upper limits (i.e., upper tolerance limit [UTL]) by application of the same principles as presented in [Section 3.3.2](#).
- When detected data followed a gamma distribution, the KM UTL95-95 was selected as the BTV by application of the same principles as presented in [Section 3.3.2](#).

- When detected data followed a lognormal distribution, use of KM estimates in lognormal equations was selected for computing upper limits (i.e., UTL) by application of the same principles as presented in [Section 3.3.2](#).
- For censored datasets in which detected data followed no discernible pattern, the nonparametric upper limit UTL 95-95 was selected as the BTV.

To summarize, all censored datasets were analyzed by use of the ProUCL 5.2 statistical software package following guidance in Chapter 5 of the ProUCL Technical Guide (USEPA 2022), which focuses on computing upper limits to estimate BTVs based on datasets with ND results.

3.3.4 Treatment of Outliers

A number of explanations are possible for presence of outliers within an analytical dataset, including laboratory error or sampling of a different population than the main, dominant, background population. Outliers distort most statistics of interest, including UTLs. Therefore, computations of decision statistics, such as BTVs, should be based on datasets representing the dominant population, and computations of distorted statistics via accommodation of a few low probability outliers should not occur (USEPA 2022). ProUCL provides classical outlier testing procedures including the Dixon test and the Rosner test. These tests often are marred by “masking effects” in the presence of multiple outliers (USEPA 2022). Therefore, ProUCL recommends always accompanying these outlier tests with graphical displays including probability plots and individual value plots.

Classical outlier tests were performed on the laboratory analytical datasets. No classical outlier tests were performed on the field-collected gamma data.

BSAs selected for this study to represent the background population of interest (i.e., established background dataset) were visually inspected by field staff to ensure (1) no evidence of anthropogenic activities related to mining at these sites, and (2) no presence of areas of technologically enhanced naturally occurring radioactive material (TENORM). Therefore, a criterion for an analytical dataset to have “statistical outliers” was set at 1 percent significance by application of either of the classical outlier tests in ProUCL.

When an outlier was identified at a 1 percent significance, further analysis was warranted. The criterion for decision making was that if the maximum concentration was two times the second highest concentration or greater, the sample containing the highest concentration was considered anomalous, was removed from the analysis, and ProUCL was rerun. For these situations in which the maximum concentration exceeds the second highest concentration by three times or more, the maximum sample is considered a “visual outlier.” No outliers were removed for BTV calculations for any of the analytes in the background dataset for BSA-02.

3.3.5 Procedures for Determination of Background Threshold Values

As described earlier, USEPA-funded statistical software ProUCL 5.2 was the primary tool for selection of BTVs for analytes within the BSA. Tetra Tech followed guidance in the ProUCL Technical Guidance Manual for determining BTVs and navigating ProUCL 5.2 statistical software. All ProUCL output is provided in [Attachment H-2](#). All upper limits selected for the

BTVs were obtained by use of ProUCL; detailed reasoning is conveyed for most manual selections of BTVs that did occur. [Section 4.0](#) presents field sampling results. [Section 5.0](#) presents selected BTVs for each analyte of interest and includes graphical displays of the datasets as individual value plots, probability plots, and histograms.

3.4 X-RAY FLUORESCENCE SURVEY

An XRF survey at BSA-02 conformed to methods outlined in the OCRM Removal Assessment SAP (Tetra Tech 2022). Thirty XRF measurements were taken for analysis for metals. XRF measurement locations align with the surface soil sampling locations, described in [Section 3.2](#), which were selected within an unbiased systematic sampling grid (10 x 10 m) over a 0.75-acre tract of land.

The grid identification of each 100 m² sampling grid is shown at the upper corner of each grid on [Figure H-4](#). XRF measurement locations were co-located with soil sample locations, shown in green on [Figure H-4](#). Field duplicates were collected at frequency of one per 20 samples. The evaluation of uranium series equilibrium will inform interpretation of fate and transport of radionuclides.

XRF survey results are in [Section 4.3](#).

4.0 FIELD SAMPLING RESULTS

This section presents gamma radiation survey results and soil sampling results.

4.1 GAMMA RADIATION SURVEY RESULTS

On November 15, 2022, a gamma radiation survey at BSA-02 occurred by application of the methods outlined in [Section 3.1](#). Summary statistics for the raw and grid-averaged gamma radiation survey results are listed in [Table H-2](#). A raw gamma radiation survey map and grid-averaged gamma radiation survey map are on [Figure H-5](#) and [Figure H-6](#), respectively. Gamma radiation ranged from 10,300 to 16,400 counts per minute (cpm).

Table H-2. Summary Statistics of Gamma Radiation Survey Results

Summary Statistic	Units	Raw Gamma Radiation Levels	Grid-Averaged Gamma Radiation Levels ¹
Number of Measurements	#	1,587	30
Minimum	cpm	10,300	12,650
Maximum	cpm	16,400	13,823
Average	cpm	13,216	13,231
Median	cpm	13,300	13,222
Standard Deviation	cpm	784	267
90 th Percentile	cpm	14,100	13,581
95 th Percentile	cpm	14,400	13,780
99 th Percentile	cpm	15,000	13,823
Relative Standard Deviation (RSD)	%	6%	2%

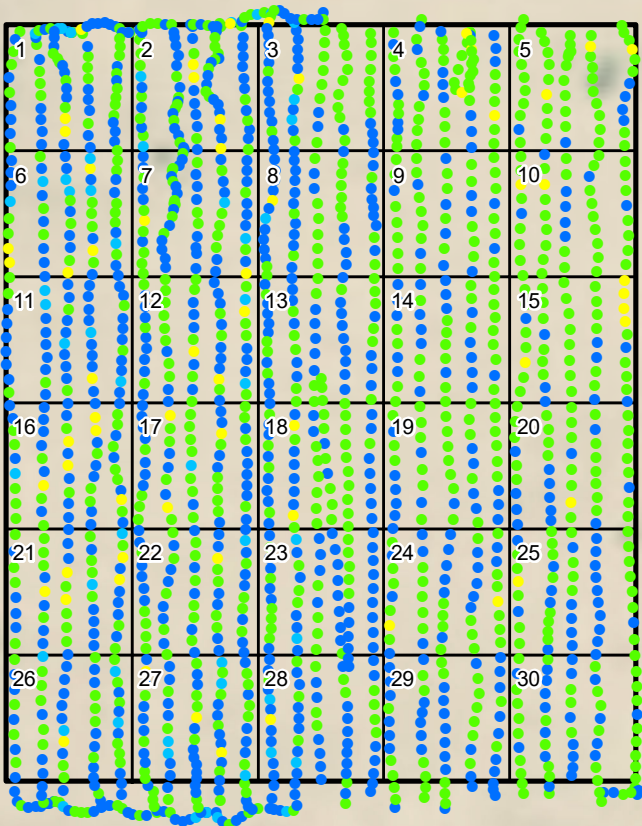
Notes:

¹ Grid-averaged gamma radiation was determined for each 100 m² grid.

cpm Counts per minute

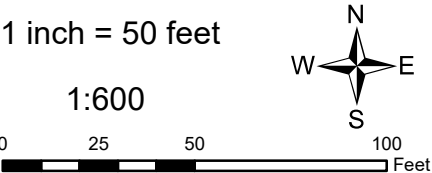
m² Square meter

Results of the raw gamma radiation survey indicate gamma radiation levels ranging between 10,300 and 16,400 cpm. Average and median gamma radiation levels are 13,216 and 13,000 cpm, respectively. The standard deviation of the gamma radiation level is 784 cpm, and the relative standard deviation [RSD] (also referred to as the coefficient of variation [COV]) is 6 percent.



Gamma Reading (cpm)		
● ≤ 11,500		≤ Q1
● 11,500 - 13,228		Q1 - Avg
● 13,228 - 14,548		Avg - BTV ¹
● 14,548 - 29,096		BTV - 2 x BTV
● 29,096 - 72,740		2 x BTV - 5 x BTV
● 72,740 - 181,850		5 x BTV - 12.5 x BTV
● 181,850 - 250,000		12.5 x BTV - 17 x BTV
● >250,000		17 x BTV>
□ Survey Unit Grid Cell (100 m ²)		
□ Background Study Area		

Notes:
¹BTV is based on the 95 percent upper tolerance limit with 95 percent coverage of the background dataset.
Avg Average value of the background dataset
BTV Background threshold value
cpm Counts per minute
m² Square meter
Q1 Twentyfifth percentile of the background



OLD CHURCH ROCK MINE
BSA-02
RAW GAMMA RADIATION SURVEY

Prepared For: U.S. EPA Region 9		Prepared By:	
		 TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612	
Task Order No.: 0035		Contract No.: EP-S9-17-03	
Location: CHURCH ROCK CHAPTER NAVAJO NATION		Date: 2/2/2023	
Coordinate System: NAD 1983 State Plane New Mexico West FIPS 3003 Feet Transverse			Figure No.: H-5



1 13,119	2 13,061	3 13,209	4 13,581	5 13,823
6 13,044	7 13,005	8 13,025	9 13,531	10 13,573
11 12,650	12 13,100	13 13,096	14 13,326	15 13,780
16 13,283	17 13,263	18 13,391	19 13,412	20 13,470
21 13,235	22 13,175	23 13,037	24 13,270	25 13,317
26 13,065	27 12,841	28 12,823	29 13,115	30 13,307

Grid Averaged Gamma Rate (cpm)

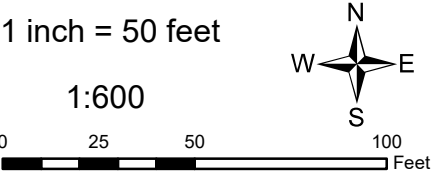
≤ 11,500	≤ Q1
11,500 - 13,228	Q1 - Avg
13,228 - 14,548	Avg - BTV ¹
14,548 - 29,096	BTV - 2 x BTV
29,096 - 72,740	2 x BTV - 5 x BTV
72,740 - 181,850	5 x BTV - 12.5 x BTV
181,850 - 250,000	12.5 x BTV - 17 x BTV
> 250,000	17 x BTV>

Survey Unit Grid Cell (100 m²)

Background Study Area

Notes:
¹BTV is based on the 95 percent upper tolerance limit with 95 percent coverage of the background dataset.

Avg	Average value of the background dataset
BTV	Background threshold value
cpm	Counts per minute
m ²	Square meter
Q1	Twentyfifth percentile of the background



OLD CHURCH ROCK MINE
BSA-02
GRIDDED AVERAGE GAMMA
RADIATON SURVEY

Prepared For: U.S. EPA Region 9	Prepared By:
	<div>TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612</div>
Task Order No.: 0035	Contract No.: EP-S9-17-03
Location: CHURCH ROCK CHAPTER NAVAJO NATION	Date: 2/2/2023
Coordinate System: NAD 1983 State Plane New Mexico West FIPS 3003 Feet Transverse	Figure No.: H-6

4.2 SOIL SAMPLING RESULTS

Thirty surface soil samples were collected within 0 to 6 inches bgs, as shown on [Figure H-4](#). Geospatial coordinates of soil sample locations and associated laboratory sample delivery group (SDG) IDs are listed in [Table H-1](#). Two laboratory SDGs for each sample included one for metals analysis and one for radionuclide analysis. Surface soil sampling analytical results are presented in this report.

Furthermore, the laboratory analytical reports provided by the laboratory include 25 metals. Results for the metal analytes are listed in [Table H-3](#). Descriptive summary statistics for metals are listed in [Table H-4](#), based on detected concentrations only.

[Table H-5](#) lists analytical laboratory results for radionuclides of interest. Every sample was analyzed for Ra-226, Ra-228, K-40, Th-232, and U-238. A subset of samples also was analyzed for isotopic uranium, which includes uranium-238 (U-238), uranium-235/236 (U-235), and uranium-233/234 (U-234). This same subset of samples also was analyzed for isotopic thorium, which includes thorium-228 (Th-228), thorium-230 (Th-230), and thorium-232 (Th-232). Notably, although analytical results for these radioisotopes (i.e., isotopic uranium, isotopic thorium) appear in this report, BTVs are not calculated for these analytes. Descriptive summary statistics regarding the radionuclides of interest are listed in [Table H-6](#).

Copies of all lab reports appear in Appendix G. A soil verification report including all laboratory results is in Appendix D. [Section 5.0](#) analyzes and interprets data from the gamma radiation survey and analytical soil sampling at BSA-02, and presents final selections of site-specific BTVs for all analytes of interest.



Table H-3. Metals Laboratory Analytical Results for BSA-02

Site ID	Field Sample ID	Sample Date	Grid Location No.	Sample Depth (inches)	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium		Cobalt	
					Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q
BSA-02	OCRM-B02-SS01-01-111622	11/16/2022	1	0-6	10,400		0.39	U	4.5		121		0.74		0.17	B	7,320		9.1		5.9	
BSA-02	OCRM-B02-SS02-01-111622	11/16/2022	2	0-6	14,100		0.38	U	5.1		121		0.93		0.16	B	5,800		11		7.0	
BSA-02	OCRM-B02-SS03-01-111622	11/16/2022	3	0-6	16,200		0.39	U	5.8		129		0.98		0.15	B	6,630		13		8.3	
BSA-02	OCRM-B02-SS04-01-111622	11/16/2022	4	0-6	16,500		0.38	U	5.8		133		1.0		0.16	B	7,150		13		7.9	
BSA-02	OCRM-B02-SS05-01-111622	11/16/2022	5	0-6	17,100		0.35	U	5.8		131		1.0		0.16	B	7,040		13		8.3	
BSA-02	OCRM-B02-SS06-01-111622	11/16/2022	6	0-6	14,100		0.33	U	5.6		120		0.94		0.16	B	8,680		12		7.4	
BSA-02	OCRM-B02-SS07-01-111622	11/16/2022	7	0-6	18,800		0.41	U	6.4		136		1.1		0.17	B	6,360		15		8.8	
BSA-02	OCRM-B02-SS08-01-111622	11/16/2022	8	0-6	17,300		0.37	U	6.1		136		1.1		0.16	B	7,170		13		8.7	
BSA-02	OCRM-B02-SS09-01-111622	11/16/2022	9	0-6	14,900		0.38	U	5.8		132		0.99		0.17	B	7,430		12		8.0	
BSA-02	OCRM-B02-SS10-01-111622	11/16/2022	10	0-6	16,300		0.37	U	5.7		127		1.0		0.15	B	7,010		13		7.9	
BSA-02	OCRM-B02-SS11-01-111622	11/16/2022	11	0-6	16,500		0.40	U	5.6		127		1.0		0.14	B	5,850		13		7.5	
BSA-02	OCRM-B02-SS12-01-111622	11/16/2022	12	0-6	14,800		0.37	U	4.9		124		0.87		0.15	B	6,680		11		6.9	
BSA-02	OCRM-B02-SS13-01-111622	11/16/2022	13	0-6	17,400		0.39	U	6.0		127		1.1		0.17	B	6,270		13		8.1	
BSA-02	OCRM-B02-SS14-01-111622	11/16/2022	14	0-6	13,400		0.37	U	4.8		128		0.83		0.14	B	6,700		10		6.5	
BSA-02	OCRM-B02-SS15-01-111622	11/16/2022	15	0-6	16,800		0.36	U	5.6		138		1.0		0.16	B	7,050		13		7.9	
BSA-02	OCRM-B02-SS16-01-111622	11/16/2022	16	0-6	15,400		0.40	U	6.8		144		1.1		0.16	B	6,460		13		8.3	
BSA-02	OCRM-B02-SS17-01-111622	11/16/2022	17	0-6	16,500		0.39	U	6.5		175		1.1		0.16	B	7,360		14		8.3	
BSA-02	OCRM-B02-SS18-01-111622	11/16/2022	18	0-6	16,200		0.36	U	5.6		125		0.98		0.15	B	5,690		12		7.7	
BSA-02	OCRM-B02-SS19-01-111622	11/16/2022	19	0-6	14,300		3.5	U	5.3		126		0.89		0.15	B	6,780		11		7.1	
BSA-02	OCRM-B02-SS20-01-111622	11/16/2022	20	0-6	13,600		0.33	U	5.1		119		0.86		0.12	B	6,550		11		6.8	
BSA-02	OCRM-B02-SS21-01-111622	11/16/2022	21	0-6	13,000		0.34	U	5.3		142		0.81		0.14	B	7,960		10		7.8	
BSA-02	OCRM-B02-SS22-01-111622	11/16/2022	22	0-6	16,600		0.39	U	6.3		158		1.1		0.15	B	6,820		14		8.0	
BSA-02	OCRM-B02-SS23-01-111622	11/16/2022	23	0-6	15,400		0.39	U	5.9		145		0.97		0.15	B	6,390		13		7.4	
BSA-02	OCRM-B02-SS24-01-111622	11/16/2022	24	0-6	17,200		0.37	U	6.6		148		1.1		0.15	B	7,190		14		8.4	
BSA-02	OCRM-B02-SS25-01-111622	11/16/2022	25	0-6	14,000		0.34	U	5.9		141		0.93		0.13	B	6,840		12		7.4	
BSA-02	OCRM-B02-SS26-01-111622	11/16/2022	26	0-6	15,000		0.36	U	5.7		141		0.92		0.15	B	6,660		12		6.9	
BSA-02	OCRM-B02-SS27-01-111622	11/16/2022	27	0-6	15,400		0.37	U	6.1		150		0.95		0.14	B	6,530		12		7.5	
BSA-02	OCRM-B02-SS28-01-111622	11/16/2022	28	0-6	13,300		0.36	U	5.2		125		0.85		0.13	B	7,100		10		5.9	
BSA-02	OCRM-B02-SS29-01-111622	11/16/2022	29	0-6	16,900		0.39	U	6.4		151		1.0		0.14	B	6,250		14		8.0	
BSA-02	OCRM-B02-SS30-01-111622	11/16/2022	30	0-6	15,800		0.36	U	5.9		153		0.96		0.14	B	6,690		12		7.7	



Table H-3. Metals Laboratory Analytical Results for BSA-02 (Continued)

Site ID	Field Sample ID	Sample Date	Grid Location No.	Sample Depth (inches)	Copper		Iron		Lead		Lithium		Magnesium		Manganese		Molybdenum		Nickel	
					Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q
BSA-02	OCRM-B02-SS01-01-111622	11/16/2022	1	0-6	12		15,400		12		10		3,930		243		0.34	N	8.0	
BSA-02	OCRM-B02-SS02-01-111622	11/16/2022	2	0-6	13		18,100		14		13		3,880		254		0.33	N	9.5	
BSA-02	OCRM-B02-SS03-01-111622	11/16/2022	3	0-6	15		20,300		16		14		4,260		269		0.29	N	11	
BSA-02	OCRM-B02-SS04-01-111622	11/16/2022	4	0-6	15		20,000		15		15		4,350		262		0.30	N	11	
BSA-02	OCRM-B02-SS05-01-111622	11/16/2022	5	0-6	15		20,000		15		15		4,370		270		0.29	N	11	
BSA-02	OCRM-B02-SS06-01-111622	11/16/2022	6	0-6	14		17,900		14		14		4,480		250		0.32	N	10	
BSA-02	OCRM-B02-SS07-01-111622	11/16/2022	7	0-6	16		21,500		17		17		4,680		261		0.33	N	12	
BSA-02	OCRM-B02-SS08-01-111622	11/16/2022	8	0-6	16		19,800		16		16		4,430		260		0.31	N	12	
BSA-02	OCRM-B02-SS09-01-111622	11/16/2022	9	0-6	15		18,500		16		14		4,330		256		0.31	N	11	
BSA-02	OCRM-B02-SS10-01-111622	11/16/2022	10	0-6	15		18,800		15		14		4,220		253		0.28	N	11	
BSA-02	OCRM-B02-SS11-01-111622	11/16/2022	11	0-6	14		19,300		15		15		4,160		225		0.31	N	10	
BSA-02	OCRM-B02-SS12-01-111622	11/16/2022	12	0-6	13		17,500		14		13		4,190		263		0.33	N	9.2	
BSA-02	OCRM-B02-SS13-01-111622	11/16/2022	13	0-6	15		20,400		16		16		4,310		259		0.33	N	11	
BSA-02	OCRM-B02-SS14-01-111622	11/16/2022	14	0-6	12		16,400		12		12		3,670		214		0.35	N	8.5	
BSA-02	OCRM-B02-SS15-01-111622	11/16/2022	15	0-6	15		19,200		16		15		4,410		254		0.29	N	11	
BSA-02	OCRM-B02-SS16-01-111622	11/16/2022	16	0-6	15		19,600		18		16		4,550		250		0.36	N	11	
BSA-02	OCRM-B02-SS17-01-111622	11/16/2022	17	0-6	15		19,800		18		16		4,730		273		0.40	N	11	
BSA-02	OCRM-B02-SS18-01-111622	11/16/2022	18	0-6	14		19,000		15		14		3,970		251		0.31	N	10	
BSA-02	OCRM-B02-SS19-01-111622	11/16/2022	19	0-6	13		17,400		14		13		4,070		243		0.30	N	9.6	
BSA-02	OCRM-B02-SS20-01-111622	11/16/2022	20	0-6	12		16,400		13		13		3,790		211		0.31	N	9.2	
BSA-02	OCRM-B02-SS21-01-111622	11/16/2022	21	0-6	11		15,100		13		12		4,110		242		0.35	N	8.1	
BSA-02	OCRM-B02-SS22-01-111622	11/16/2022	22	0-6	14		19,100		17		16		4,560		256		0.37	N	11	
BSA-02	OCRM-B02-SS23-01-111622	11/16/2022	23	0-6	13		17,800		16		15		4,460		243		0.37	N	9.8	
BSA-02	OCRM-B02-SS24-01-111622	11/16/2022	24	0-6	15		20,000		18		16		4,780		270		0.37	N	11	
BSA-02	OCRM-B02-SS25-01-111622	11/16/2022	25	0-6	13		17,300		15		14		4,110		229		0.39	N	9.5	
BSA-02	OCRM-B02-SS26-01-111622	11/16/2022	26	0-6	12		16,900		15		14		4,430		246		0.37	N	9.1	
BSA-02	OCRM-B02-SS27-01-111622	11/16/2022	27	0-6	13		17,600		16		15		4,380		235		0.35	N	9.6	
BSA-02	OCRM-B02-SS28-01-111622	11/16/2022	28	0-6	11		14,400		13		13		3,930		209		0.33	N	7.8	
BSA-02	OCRM-B02-SS29-01-111622	11/16/2022	29	0-6	14		19,100		17		16		4,610		236		0.40	N	11	
BSA-02	OCRM-B02-SS30-01-111622	11/16/2022	30	0-6	13		18,400		16		15		4,340		249		0.39	N	9.9	



Table H-3. Metals Laboratory Analytical Results for BSA-02 (Continued)

Site ID	Field Sample ID	Sample Date	Grid Location No.	Sample Depth (inches)	Selenium		Silver		Sodium		Thallium		Thorium		Uranium		Vanadium		Zinc	
					Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q	Result (mg/kg)	Q
BSA-02	OCRM-B02-SS01-01-111622	11/16/2022	1	0-6	1.4		0.12	U	56		0.16	B	6.6		0.87		21	N	45	
BSA-02	OCRM-B02-SS02-01-111622	11/16/2022	2	0-6	1.7		0.12	U	58		0.20	B	8.3		0.98		23	N	52	
BSA-02	OCRM-B02-SS03-01-111622	11/16/2022	3	0-6	2.0		0.12	U	66		0.23	B	10		1.1		26	N	59	
BSA-02	OCRM-B02-SS04-01-111622	11/16/2022	4	0-6	1.9		0.11	U	74		0.23	B	9.7		1.3		27	N	57	
BSA-02	OCRM-B02-SS05-01-111622	11/16/2022	5	0-6	1.9		0.11	U	70		0.23	B	9.9		1.1		28	N	58	
BSA-02	OCRM-B02-SS06-01-111622	11/16/2022	6	0-6	1.9		0.10	U	69		0.21	B	9.0		1.1		26	N	53	
BSA-02	OCRM-B02-SS07-01-111622	11/16/2022	7	0-6	1.9		0.12	U	74		0.26	B	11		1.3		31	N	64	
BSA-02	OCRM-B02-SS08-01-111622	11/16/2022	8	0-6	2.0		0.11	U	74		0.24	B	10		1.2		28	N	60	
BSA-02	OCRM-B02-SS09-01-111622	11/16/2022	9	0-6	1.8		0.11	U	68		0.23	B	10		1.2		27	N	58	
BSA-02	OCRM-B02-SS10-01-111622	11/16/2022	10	0-6	1.7		0.11	U	74		0.23	B	9.6		1.2		27	N	56	
BSA-02	OCRM-B02-SS11-01-111622	11/16/2022	11	0-6	1.8		0.12	U	68		0.23	B	9.5		1.1		27	N	56	
BSA-02	OCRM-B02-SS12-01-111622	11/16/2022	12	0-6	1.5		0.11	U	63		0.21	B	8.5		1.0		26	N	50	
BSA-02	OCRM-B02-SS13-01-111622	11/16/2022	13	0-6	1.9		0.12	U	76		0.24	B	10		1.2		28	N	60	
BSA-02	OCRM-B02-SS14-01-111622	11/16/2022	14	0-6	1.5		0.11	U	60		0.19	B	7.9		1.1		23	N	45	
BSA-02	OCRM-B02-SS15-01-111622	11/16/2022	15	0-6	1.9		0.11	U	73		0.23	B	9.9		1.2		27	N	57	
BSA-02	OCRM-B02-SS16-01-111622	11/16/2022	16	0-6	2.8		0.61	U	71		0.24	B	11		1.2		29		61	
BSA-02	OCRM-B02-SS17-01-111622	11/16/2022	17	0-6	2.7		0.60	U	72		0.24	B	10		1.3		31		60	
BSA-02	OCRM-B02-SS18-01-111622	11/16/2022	18	0-6	1.8		0.11	U	68		0.21	B	9.4		1.2		26	N	55	
BSA-02	OCRM-B02-SS19-01-111622	11/16/2022	19	0-6	1.6		0.11	U	64		0.20	B	8.6		1.0		24	N	52	
BSA-02	OCRM-B02-SS20-01-111622	11/16/2022	20	0-6	1.6		0.10	U	65		0.20	B	8.5		1.1		24	N	48	
BSA-02	OCRM-B02-SS21-01-111622	11/16/2022	21	0-6	2.1		0.52	U	57		0.18	B	8.1		1.0		25		44	
BSA-02	OCRM-B02-SS22-01-111622	11/16/2022	22	0-6	2.5		0.59	U	73		0.23	B	10		1.2		30		57	
BSA-02	OCRM-B02-SS23-01-111622	11/16/2022	23	0-6	2.3		0.58	U	68		0.22	B	9.5		1.2		28		53	
BSA-02	OCRM-B02-SS24-01-111622	11/16/2022	24	0-6	2.7		0.57	U	75		0.24	B	11		1.2		31		59	
BSA-02	OCRM-B02-SS25-01-111622	11/16/2022	25	0-6	2.3		0.52	U	62		0.21	B	9.3		1.1		26		51	
BSA-02	OCRM-B02-SS26-01-111622	11/16/2022	26	0-6	2.3		0.54	U	64		0.21	B	8.8		1.0		27		49	
BSA-02	OCRM-B02-SS27-01-111622	11/16/2022	27	0-6	2.4		0.56	U	65		0.22	B	9.4		1.1		28		53	
BSA-02	OCRM-B02-SS28-01-111622	11/16/2022	28	0-6	1.9		0.55	U	52	B	0.18	B	7.5		0.95		24		44	
BSA-02	OCRM-B02-SS29-01-111622	11/16/2022	29	0-6	2.5		0.59	U	72		0.24	B	11		1.2		32		58	
BSA-02	OCRM-B02-SS30-01-111622	11/16/2022	30	0-6	2.3		0.55	U	65		0.22	B	9.6		1.2		28		54	

Notes:

B Either presence of analyte detected in the associated blank, or MDL/instrument detection limit < sample value < practical quantitation limit

BSA Background study area

LOD Limit of detection

MDA Minimal detectable amount

MDC Minimal detectable concentration

MDL Method detection limit

mg/kg Milligram per kilogram

N Metals – matrix spike sample recovery not within specified control limits.

Q Qualifier

U Analyte not detected at concentration above the MDL, MDA, MDC, or LOD.



Table H-4. Summary Statistics for Surface Soil Samples at BSA-02 (Metals)

Analyte	# of Surface Samples	# of Detects	# of Non-Detects	Minimum (mg/kg)	Maximum (mg/kg)	Average (mg/kg)	Median (mg/kg)	Standard Deviation (mg/kg)	90 th Percentile (mg/kg)	95 th Percentile (mg/kg)	99 th Percentile (mg/kg)	Relative Standard Deviation
Aluminum	30	30	0	10,400	18,800	15,440	15,600	1,727	17,210	17,355	18,394	11%
Antimony ¹	30	0	30	0.33	3.5	NA	NA	NA	NA	NA	NA	NA
Arsenic	30	30	0	4.5	6.8	5.7	5.8	0.55	6.4	6.6	6.8	10%
Barium	30	30	0	119	175	136	133	13	151	156	170	10%
Beryllium	30	30	0	0.74	1.1	0.97	0.98	0.10	1.1	1.1	1.1	10%
Cadmium	30	0	0	0.12	0.17	0.15	0.15	0.013	0.17	0.17	0.17	9%
Calcium	30	30	0	5,690	8,680	6,814	6,740	614	7,367	7,722	8,471	9%
Chromium	30	30	0	9.1	15	12	12.5	1.3	14	14	15	10%
Cobalt	30	30	0	5.9	8.8	7.6	7.7	0.73	8.3	8.6	8.7	10%
Copper	30	30	0	11	16	14	13.8	1.5	15.2	15.6	15.9	11%
Iron	30	30	0	14,400	21,500	18,367	18,650	1,699	20,030	20,355	21,181	9%
Lead	30	30	0	12	18	15	15	1.6	17	18	18	11%
Lithium	30	30	0	10	17	14	15	1.5	16	16	17	11%
Magnesium	30	30	0	3,670	4,780	4,283	4,335	280	4,617	4,708	4,766	7%
Manganese	30	30	0	209	273	248	251	17	269	270	272	7%
Molybdenum	30	30	0	0.28	0.40	0.34	0.33	0.035	0.39	0.40	0.40	10%
Nickel	30	30	0	7.8	12	10	10.3	1.0	11	11	12	10%
Selenium	30	30	0	1.4	2.8	2.0	1.91	0.37	2.5	2.7	2.7	19%
Silver ¹	30	0	30	0.10	0.61	NA	NA	NA	NA	NA	NA	NA
Sodium	30	30	0	52	76	67	67.8	6.3	74	75	76	9%
Thallium	30	30	0	0.16	0.26	0.22	0.22	0.023	0.24	0.24	0.26	10%
Thorium	30	30	0	6.6	11	9.4	9.6	1.0	11	11	11	11%
Uranium	30	30	0	0.87	1.3	1.1	1.1	0.10	1.2	1.3	1.3	9%
Vanadium	30	30	0	21	32	27	26.8	2.6	31	31	32	10%
Zinc	30	30	0	44	64	54	55.5	5.3	60	60	63	10%

Notes:
All summary statistics represent detected data only.
¹ Average, standard deviation, and BTV could not be calculated via KM Method because all values in the dataset were non-detects.
BSA Background study area
BTV Background threshold value
cpm Counts per minute
KM Kaplan-Meier
mg/kg Milligram per kilogram
NA Not applicable



Table H-5. Radionuclides Laboratory Analytical Results for BSA-02 (Lab Method EH300)

Field Sample ID	Sample Date	Grid Location No.	Sample Depth (inches)	Radium-226			Radium-228			Potassium-40			Thorium-232			Uranium-238		
				Activity (pCi/g)	TPU	Q	Activity (pCi/g)	TPU	Q	Activity (pCi/g)	TPU	Q	Activity (pCi/g)	TPU	Q	Activity (pCi/g)	TPU	Q
OCRM-B02-SS01-01-111622	11/16/2022	1	0-6	1.3	0.299		1.3	0.381		20	2.96		1.3	0.381		2.9	3.92	U
OCRM-B02-SS02-01-111622	11/16/2022	2	0-6	1.7	0.249		1.6	0.366		21	2.68		1.6	0.366		1.9	2.07	U
OCRM-B02-SS03-01-111622	11/16/2022	3	0-6	1.7	0.344		2.0	0.59		20	2.95		2.0	0.59		3.7	2.83	
OCRM-B02-SS04-01-111622	11/16/2022	4	0-6	1.6	0.262		1.3	0.379		21	2.77		1.3	0.379		0.89	2.71	U
OCRM-B02-SS05-01-111622	11/16/2022	5	0-6	1.7	0.265		1.9	0.377		22	2.76		1.9	0.377		1.6	2.28	U
OCRM-B02-SS06-01-111622	11/16/2022	6	0-6	1.5	0.296		1.5	0.421		21	2.68		1.5	0.421		1.3	2.8	U
OCRM-B02-SS07-01-111622	11/16/2022	7	0-6	1.8	0.274		2.0	0.394		20	2.55		2.0	0.394		0.78	2.33	U
OCRM-B02-SS08-01-111622	11/16/2022	8	0-6	1.7	0.3		2.2	0.454		20	2.9		2.2	0.454		0.094	2.08	U
OCRM-B02-SS09-01-111622	11/16/2022	9	0-6	1.9	0.256		2.0	0.44		20	2.74		2.0	0.44		0.000	2.83	UI
OCRM-B02-SS10-01-111622	11/16/2022	10	0-6	1.7	0.276		1.9	0.4		20	2.77		1.9	0.4		2.4	4.82	U
OCRM-B02-SS11-01-111622	11/16/2022	11	0-6	1.6	0.301		1.7	0.46		20	2.81		1.7	0.46		-0.27	3.11	U
OCRM-B02-SS12-01-111622	11/16/2022	12	0-6	1.7	0.259		1.6	0.506		22	2.72		1.6	0.506		0.000	1.45	UI
OCRM-B02-SS13-01-111622	11/16/2022	13	0-6	1.7	0.277		1.7	0.402		24	2.96		1.7	0.402		0.000	3.87	UI
OCRM-B02-SS14-01-111622	11/16/2022	14	0-6	1.4	0.232		1.5	0.414		21	2.85		1.5	0.414		1.8	4.15	U
OCRM-B02-SS15-01-111622	11/16/2022	15	0-6	1.6	0.222		1.7	0.465		22	2.85		1.7	0.465		2.1	2.6	
OCRM-B02-SS16-01-111622	11/16/2022	16	0-6	1.9	0.241		2.0	0.457		21	2.61		2.0	0.457		1.9	2.05	U
OCRM-B02-SS17-01-111622	11/16/2022	17	0-6	1.7	0.315		1.9	0.484		22	3		1.9	0.484		1.1	3.59	U
OCRM-B02-SS18-01-111622	11/16/2022	18	0-6	1.3	0.27		1.5	0.482		21	2.91		1.5	0.482		0.000	2.15	UI
OCRM-B02-SS19-01-111622	11/16/2022	19	0-6	1.5	0.289		1.2	0.439		22	2.81		1.2	0.439		0.000	2.9	UI
OCRM-B02-SS20-01-111622	11/16/2022	20	0-6	1.1	0.235		1.4	0.373		20	2.76		1.4	0.373		-0.20	3.34	U
OCRM-B02-SS21-01-111622	11/16/2022	21	0-6	1.3	0.263		1.2	0.453		22	2.82		1.2	0.453		1.5	1.43	
OCRM-B02-SS22-01-111622	11/16/2022	22	0-6	1.7	0.222		2.0	0.434		21	2.56		2.0	0.434		0.81	1.88	U
OCRM-B02-SS23-01-111622	11/16/2022	23	0-6	1.7	0.261		2.0	0.502		20	3.03		2.0	0.502		1.2	1.42	U
OCRM-B02-SS24-01-111622	11/16/2022	24	0-6	1.6	0.295		1.6	0.481		19	3.02		1.6	0.481		1.0	2.28	U
OCRM-B02-SS25-01-111622	11/16/2022	25	0-6	1.4	0.287		1.4	0.57		21	2.87		1.4	0.57		1.5	1.75	
OCRM-B02-SS26-01-111622	11/16/2022	26	0-6	1.6	0.285		1.7	0.547		20	2.8		1.7	0.547		1.7	2.27	U
OCRM-B02-SS27-01-111622	11/16/2022	27	0-6	1.4	0.233		1.7	0.362		21	2.54		1.7	0.362		2.3	1.25	
OCRM-B02-SS28-01-111622	11/16/2022	28	0-6	1.3	0.241		1.1	0.39		20	2.74		1.1	0.39		1.8	2.9	U
OCRM-B02-SS29-01-111622	11/16/2022	29	0-6	1.6	0.249		1.7	0.4		18	2.76		1.7	0.4		3.1	1.97	U
OCRM-B02-SS30-01-111622	11/16/2022	30	0-6	1.6	0.258		1.7	0.419		22	2.73		1.7	0.419		0.88	3.19	U
OCRM-B02-SS10-01-111622	11/16/2022	10	0-6	1.5	0.268		1.9	0.481		1.8	2.75		1.1	0.481		0.15	4.01	U
OCRM-B02-SS30-01-111622	11/16/2022	30	0-6	1.1	0.259		1.5	0.39		1.6	2.71		1.3	0.39		0.17	1.04	U

Notes:
BSA Background study area
EH300 Gamma spectrometry
LOD Limit of detection
MDA Minimum detectable amount
MDC Minimum detectable concentration
MDL Minimum detectable limit
pCi/g Picocurie per gram
Q Qualifier
TPU Total propagated uncertainty
U Analyte not detected at concentration above the MDL, MDA, MDC, or LOD.
UJ Results are considered a false positive due to high counting uncertainty.



Table H-6. Summary Statistics for Surface Soil Samples at BSA-02 (Radionuclides)

Analyte	# of Surface Samples	# of Detects	# of Non-Detects	Minimum (pCi/g)	Maximum (pCi/g)	Average (pCi/g)	Median (pCi/g)	Standard Deviation (pCi/g)	90 th Percentile (pCi/g)	95 th Percentile (pCi/g)	99 th Percentile (pCi/g)	Relative Standard Deviation
Radium-226	30	30	0	1.1	1.9	1.6	1.6	0.18	1.7	1.8	1.9	12%
Radium-228	30	30	0	1.1	2.2	1.7	1.7	0.29	2.0	2.0	2.2	17%
Potassium-40	30	30	0	18	24	21	21	1.1	22	22	23	5%
Uranium-238 (EH300)	30	5	20	-0.27	3.7	1.3	1.2	1.0	2.4	3.0	3.6	83%
Uranium-238 (HASL 300)	2	2	0	1.1	1.3	1.2						
Uranium-235/236	2	0	2	0.15	0.17	0.16						
Uranium-233/234	2	2	0	0.70	1.0	0.85						
Thorium-232 (EH300)	30	30	0	1.1	2.2	1.7	1.7	0.29	2.0	2.0	2.2	17%
Thorium-232 (HASL 300)	2	2	0	1.1	1.5	1.3						
Thorium-230	2	2	0	1.5	1.9	1.7						
Thorium-228	2	2	0	1.6	1.8	1.7						

Notes:
BSA Background study area
EH300 Gamma spectrometry
HASL 300 Alpha spectrometry
pCi/g Picocurie per gram

4.3 X-RAY FLUORESCENCE SURVEY RESULTS

Thirty XRF survey measurements were taken at locations co-located with surface soil samples, as shown on [Figure H-4](#). Geospatial coordinates of the co-located measurements are listed in [Table H-1](#).

Descriptive summary statistics for metals are listed in [Table H-4](#) based on detected concentrations only. XRF spectrometry was unable to detect the laboratory analytes (metals) beryllium, cadmium, calcium, lithium, magnesium, sodium, and thallium, but was able to detect gold, mercury, rubidium, strontium, titanium, tungsten, and zirconium. However, because the latter set of analytes was not included in the laboratory analytical suite, XRF results for those analytes were excluded.

One XRF result from BSA02 was removed from the dataset. Grid X01 of BSA02 hosted an abnormally high uranium concentration, 7.6 parts per million (ppm), which field staff identified as an oddity in the field and which was confirmed to be an outlier via the Rosner Outlier test at 5 percent and 1 percent significance levels. While in the field, staff returned to Grid X01 and repeated the measurement twice at the location. The measurements were more aligned with the uranium concentrations measured in the rest of the BSA. Additionally, the uranium concentration of the soil sample collected at Grid X01, 0.87 mg/kg, was not an outlier from the rest of the BSA. For this reason, the XRF measurement OCRMBSA02X01 was replaced with the first rescan of the grid, OCRMBSA02X01A.

[Table H-7](#) summarizes the various readings and samples collected at BSA-02 Grid X01. [Table H-8](#) summarizes the XRF measurement statistics for BSA-02.

Table H-7. XRF and Soil Sample Results for BSA-02 Grid X01

Sample Type	Sample ID	Uranium Result	Units	RPD (U result vs U mean)
XRF	OCRMBSA02X01	8	ppm	227%
XRF	OCRMBSA02X01A	4.3	ppm	128%
XRF	OCRMBSA02X01B	<LOD	ppm	-
Soil Sample	BSA02-SS01-01-111622	0.87	mg/kg	79%

Notes:

LOD Limit of detection
 mg/kg Milligram per kilogram
 ppm Parts per million
 RPD Relative percent difference
 U Uranium
 XRF X-ray fluorescence



Table H-8. Summary Statistics for XRF Measurements at BSA-02

Analyte	n	n Nondetects	% Nondetects	RSD	Distribution	GOF	Statistical Outliers Present?	Outliers Removed?	BTV Selection Method	Final BTV Selected	BTV Units	Notes
Arsenic	30	0	0%	13%	Normal	Appear	No	No	Normal UTL 95-95	8.181	ppm	
Barium	30	30	100%	-	-	-	No	No	-	>LOD	ppm	No detections of analyte in background; any detections above the LOD measured in field will be considered above background
Cobalt	30	5	17%	29%	Normal	Appear	No	No	Normal UTL 95-95	61.14	ppm	
Chromium	30	0	0%	24%	Normal	Appear	Yes	No	Normal UTL 95-95	43.01	ppm	
Copper	30	0	0%	23%	Normal	Appear	No	No	Normal UTL 95-95	15.14	ppm	
Iron	30	0	0%	10%	Normal	Appear	No	No	Normal UTL 95-95	25012	ppm	
Manganese	30	0	0%	12%	Normal	Appear	No	No	Normal UTL 95-95	270.4	ppm	
Lead	30	0	0%	11%	Normal	Appear	No	No	Normal UTL 95-95	20.32	ppm	
Molybdenum	30	24	80%	15%	-	-	No	No	Maximum Recorded Value	1.61	ppm	>50% nondetects in background
Nickel	30	17	57%	41%	-	-	Yes	No	Maximum Recorded Value	19.93	ppm	>50% nondetects in background
Selenium	30	30	100%	-	-	-	No	No	-	>LOD	ppm	No detections of analyte in background; any detections above the LOD measured in the field will be considered above background
Thorium	30	0	0%	10%	Normal	Appear	No	No	Normal UTL 95-95	13.35	ppm	
Uranium	30	0	0%	24%	Gamma	Approximate	Yes	No	WH Approx Gamma UTL 95-95	5.195	ppm	
Vanadium	30	1	3%	18%	Normal	Appear	No	No	Normal UTL 95-95	97.28	ppm	
Zinc	30	0	0%	12%	Normal	Appear	No	No	Normal UTL 95-95	71.56	ppm	

Notes:
- Not applicable
BSA Background study area
BTV Background threshold value
GOF Goodness of fit
LOD Limit of detection
n Number of
RSD Relative standard deviation
UTL Upper tolerance limit
WH Wilson Hilferty
XRF X-ray fluorescence

5.0 DATA ANALYSIS AND INTERPRETATION

Tetra Tech used ProUCL 5.2 statistical software for determination of upper limits for selections of site-specific BTVs, as described in [Section 3.3](#). Minitab software also was used for more robust graphical analysis and for inference of parametric distributions not currently available in ProUCL. ProUCL was used for GOF testing and calculation of upper threshold or upper simultaneous limits to calculate gamma radiation BTVs and soil concentration BTVs. The following subsections convey development of BTVs for gamma radiation at BSA-02 and selections of BTVs for the analytes of interest at BSA-02.

5.1 GAMMA RADIATION SURVEY BACKGROUND THRESHOLD VALUES

As described in [Section 4.1](#), field staff performed a gamma radiation survey in November 2022 at BSA-02. A raw gamma radiation survey map and grid-averaged gamma radiation survey map are on [Figure H-5](#) and [Figure H-6](#), respectively. GOF testing on the raw dataset proceeded by use of ProUCL as described in [Section 3.3](#). The GOF tests in ProUCL indicated that gamma radiation levels at BSA-02 approximate a normal distribution. A frequency histogram of the raw gamma radiation dataset is on [Figure H-7](#). A probability plot fitted to a normal distribution is on [Figure H-8](#)—the trend is linear, indicating a strong fit with a normal distribution.

The computed normal UTL 95-95 for the raw gamma radiation levels was selected as the site-specific BTV for BSA-02. The site-specific BTV for gamma radiation is 14,555 cpm. As shown on [Figure H-8](#), 95.6 percent of the dataset falls below the BTV.

The BTV was used to identify additional survey locations at sites associated with this specific BSA (as described in [Section 1.0](#)). Areas of the sites were classified as Class 3 (unimpacted), Class 2 (potentially impacted), or Class 1 (impacted). This classification scheme is consistent with MARSSIM (USEPA 2000) for classifying radiologically contaminated sites.

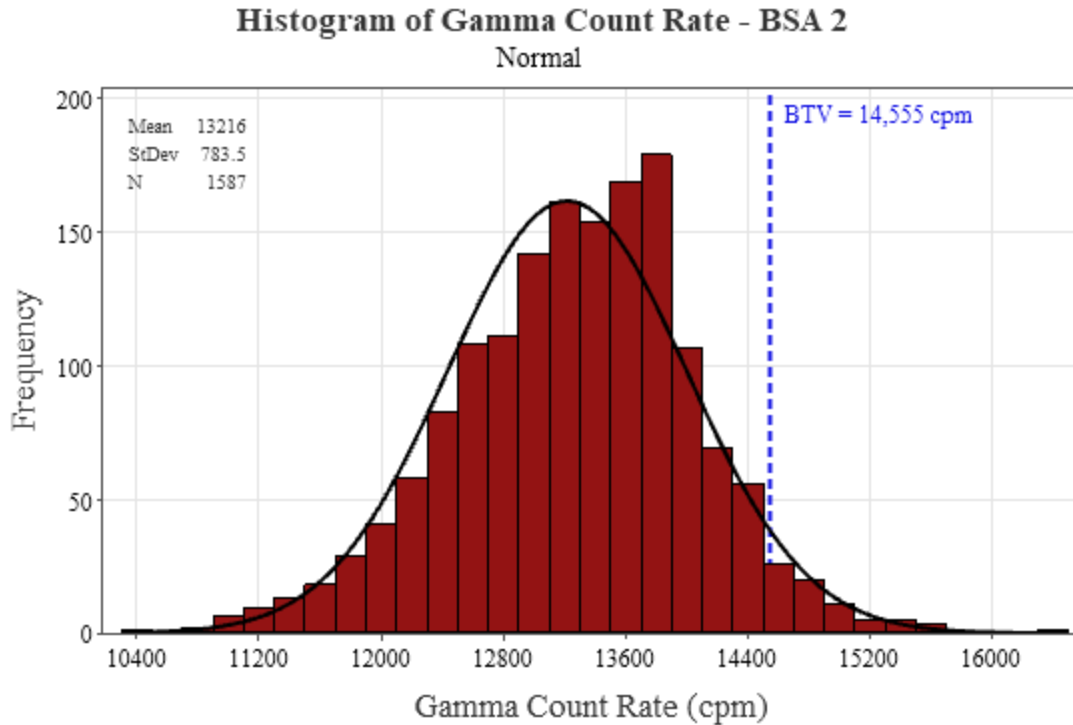


Figure H-7. Normal Histogram of BSA-02 Raw Gamma Radiation Survey Data

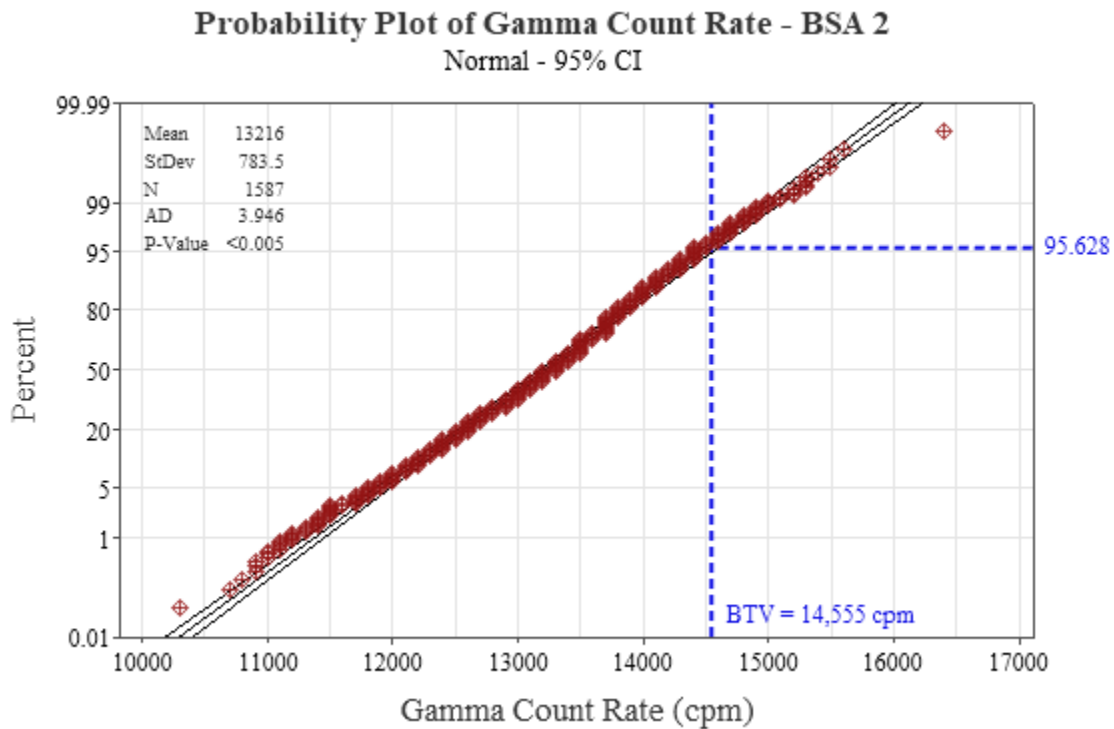


Figure H-8. Normal Probability Plot of BSA-02 Raw Gamma Radiation Survey Data

5.2 SOIL SAMPLING GRAPHICAL ANALYSIS

This section describes statistical and graphical analysis of site-specific BTVs for the analytes of interest at BSA-02. Each of the following nine subsections presents a detailed analysis and interpretation of selection of a BTV. The selected BTVs and upper confidence limits (UCL) for all analytes of interest at BSA-02 are listed in [Table H-9](#).

5.2.1 Arsenic

Analytical results and descriptive statistics for the 30 arsenic surface soil results are listed in [Table H-3](#) and [Table H-4](#), respectively. The selected BTVs for all analytes are listed in [Table H-9](#). All arsenic results from surface soil samples collected at BSA-02 were detectable concentrations (i.e., no NDs). A statistical and graphical analysis of the arsenic dataset for BSA-02 involved GOF and outlier testing in ProUCL. The Rosner outlier test found no potential outliers at the 1 percent significance level in the dataset. No visual outliers were identified for arsenic at BSA-02 per the criteria specified in [Section 3.3.4](#). Results of GOF testing in ProUCL indicated that arsenic appeared to follow a normal distribution.

The normal UTL95-95 of 7.0 mg/kg identified in ProUCL was selected as the BTV for arsenic at BSA-02. An individual value plot showing the arsenic concentrations at BSA-02 with the BTV plotted is on [Figure H-9](#). The box plot of the data is on [Figure H-10](#). A probability plot with the arsenic data fitted to the normal distribution is on [Figure H-11](#). By use of this parametric fit, 98.7 percent of the inferred population falls below the BTV. A histogram fitted to the normal distribution for arsenic data is on [Figure H-12](#).

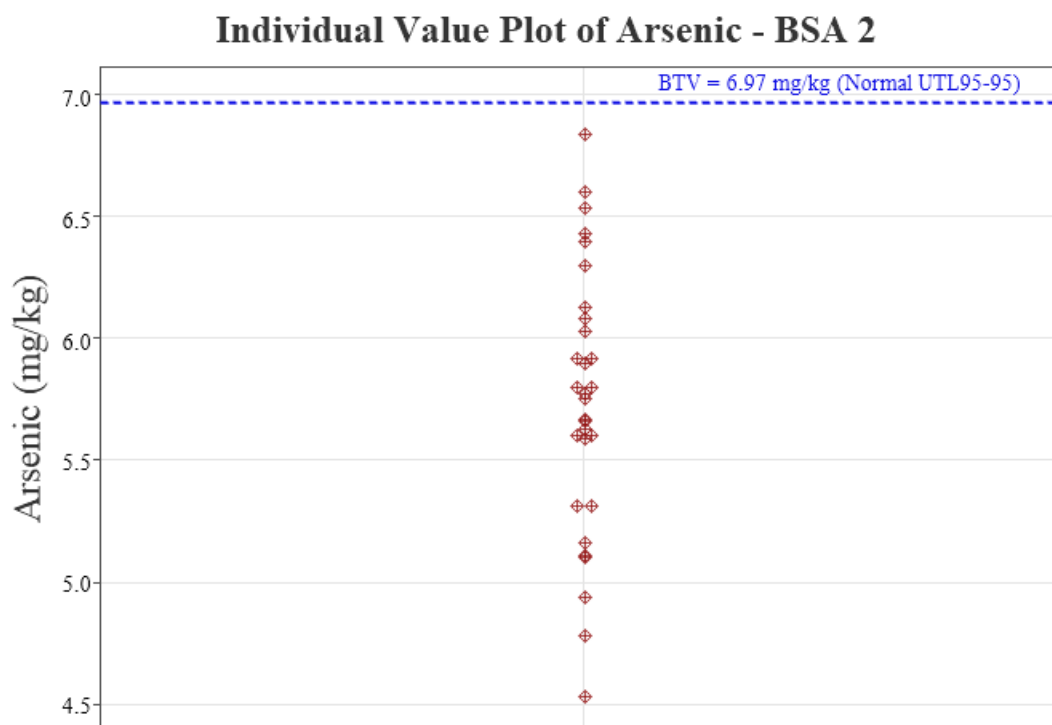
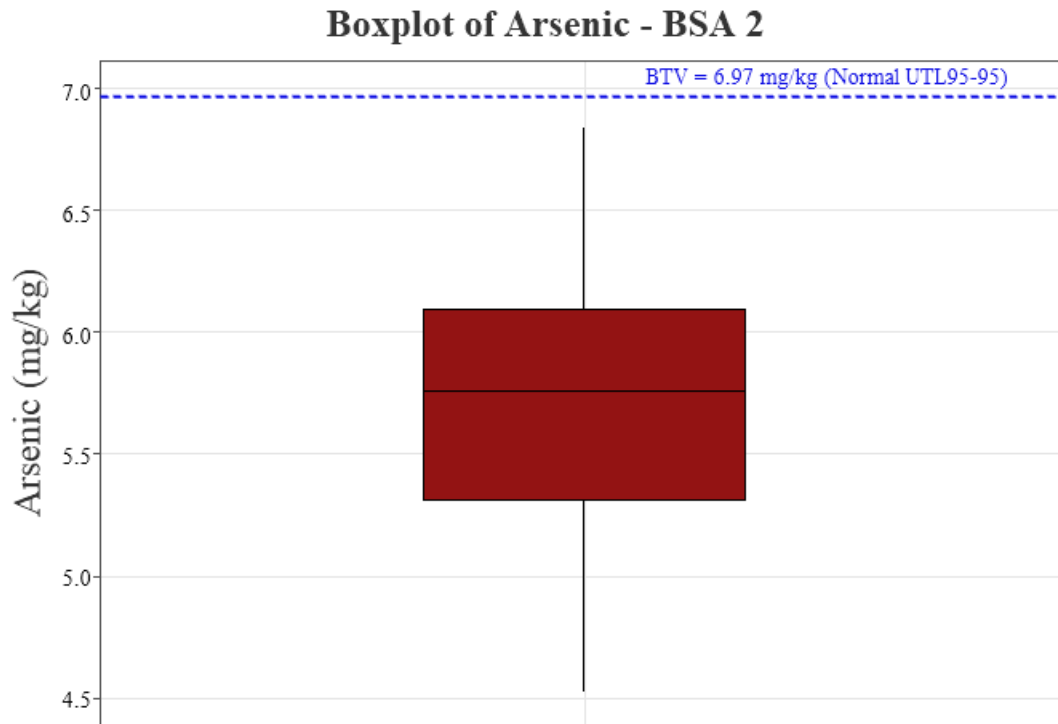
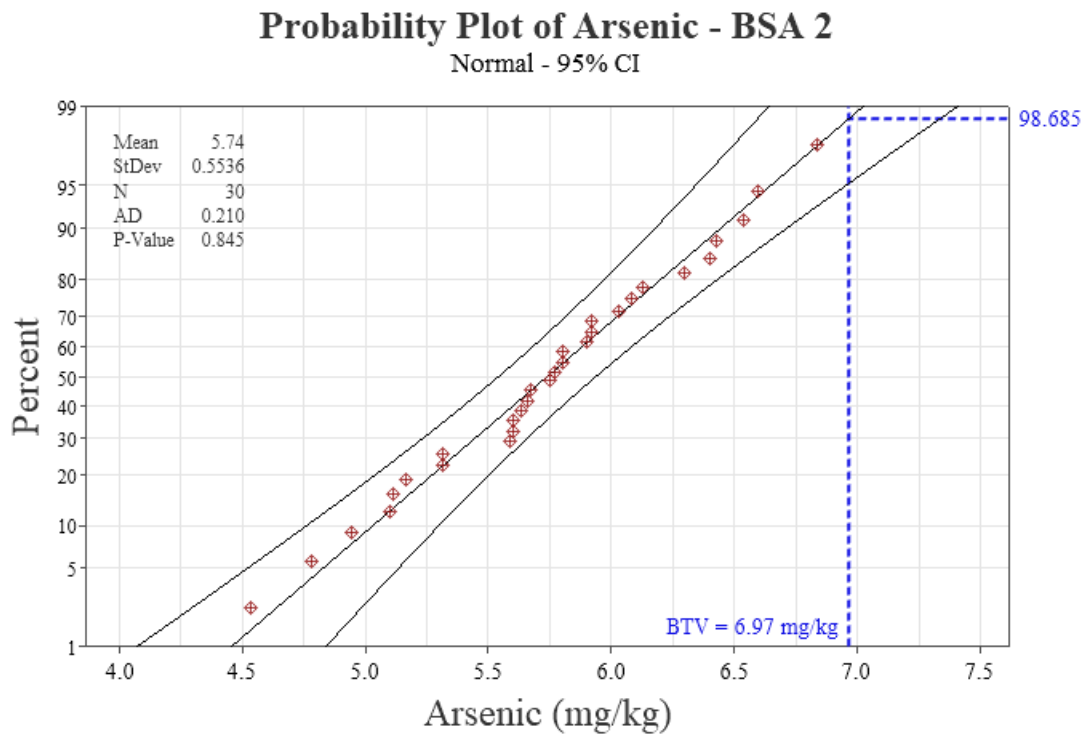


Figure H-9. Individual Value Plot of Arsenic at BSA-02

**Figure H-10. Box Plot of Arsenic at BSA-02****Figure H-11. Probability Plot of Arsenic Soil Concentrations at BSA-02 (Normal)**

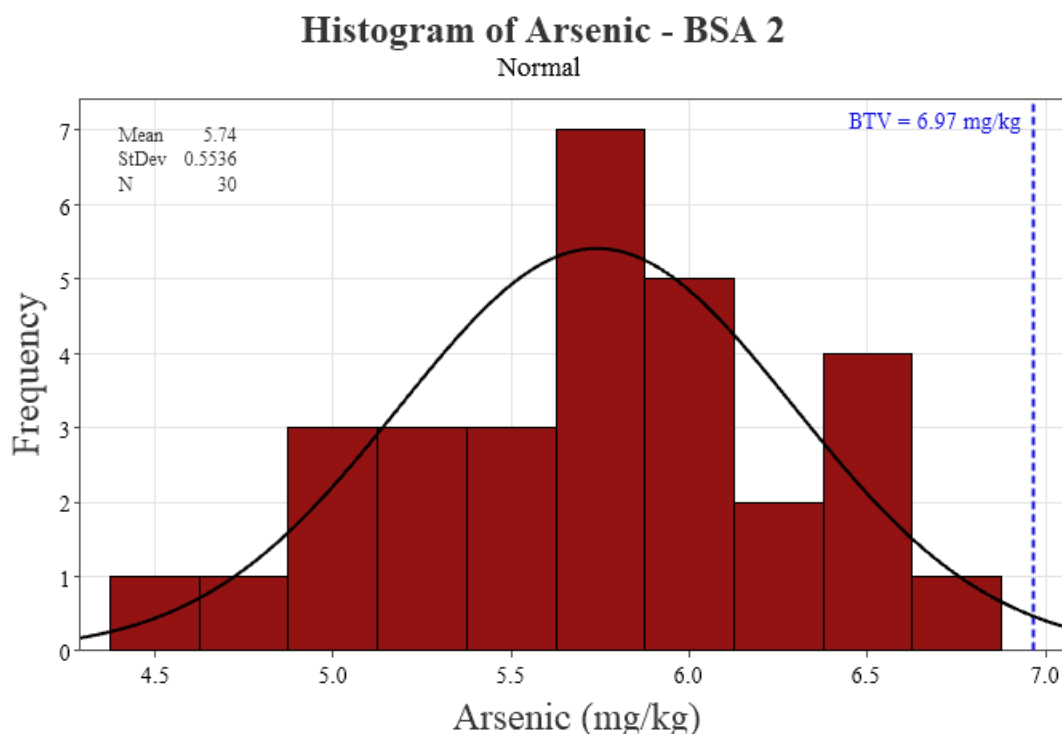


Figure H-12. Histogram of Arsenic Soil Concentrations at BSA-02 (Normal)

5.2.2 Lead

Analytical results and descriptive statistics for the 30 lead surface soil results are listed in [Table H-3](#) and [Table H-4](#), respectively. The selected BTVs for all analytes are listed in [Table H-9](#). All lead results from surface soils at BSA-02 were detectable concentrations (i.e., no NDs). A statistical and graphical analysis of the lead dataset from BSA-02 involved GOF and outlier testing in ProUCL. Results of the ProUCL GOF testing indicated that lead data at BSA-02 follows a normal distribution, and no outliers were identified by use of Rosner's outlier analysis. Visual inspection also identified no outliers.

The normal UTL95-95 of 19 mg/kg was selected as the BTV for lead at BSA-02. An individual value plot showing the spread of the lead surface soil concentration data obtained at BSA-02 is on [Figure H-13](#). The box plot of the data is on [Figure H-14](#). A normal probability plot showing lead surface soil concentrations at BSA-02 is on [Figure H-15](#). By use of this parametric fit, 98.8 percent of the inferred population falls below the BTV. A histogram with a fitted normal distribution of lead surface soil concentrations at BSA-02 is on [Figure H-16](#).

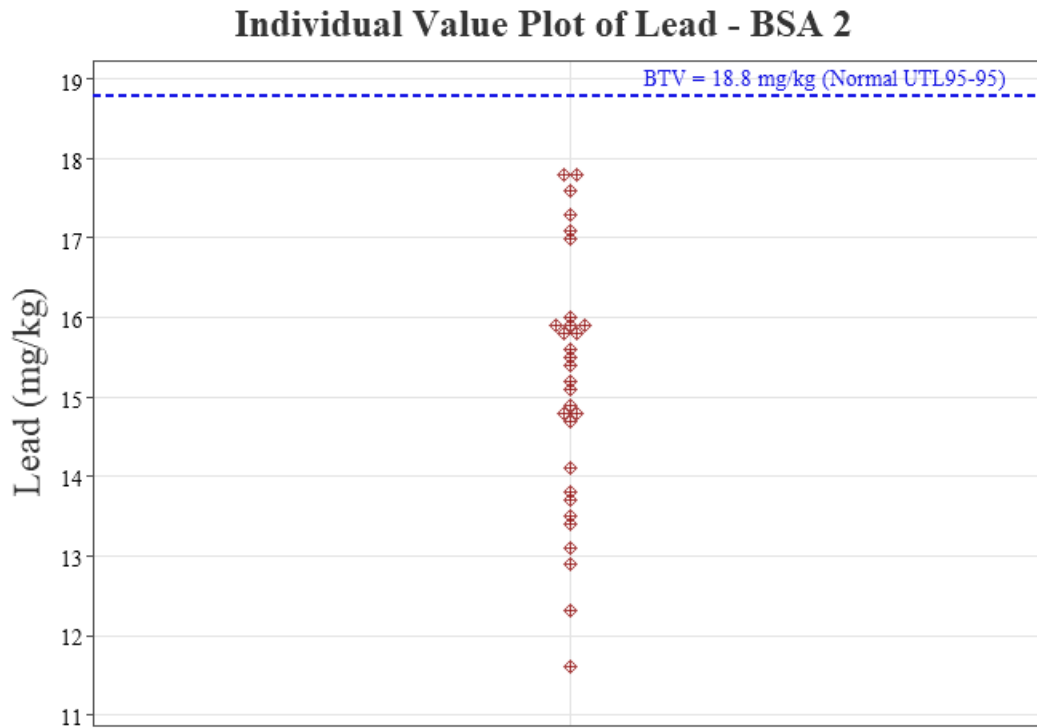


Figure H-13. Individual Value Plot of Lead at BSA-02

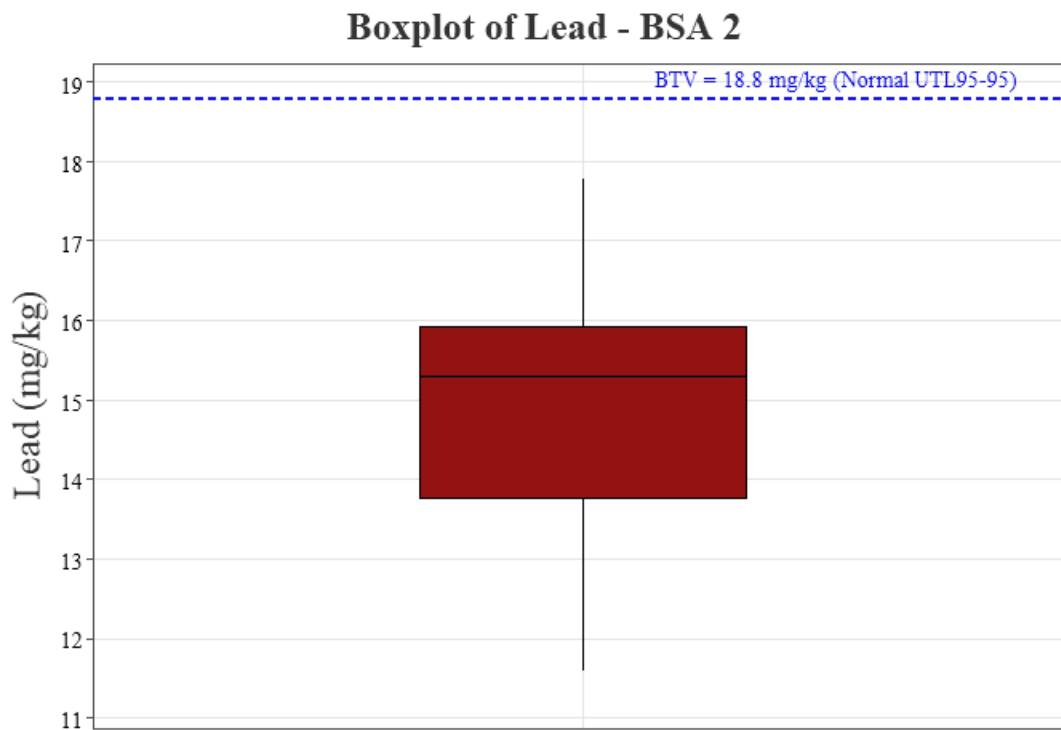


Figure H-14. Box Plot of Lead at BSA-02

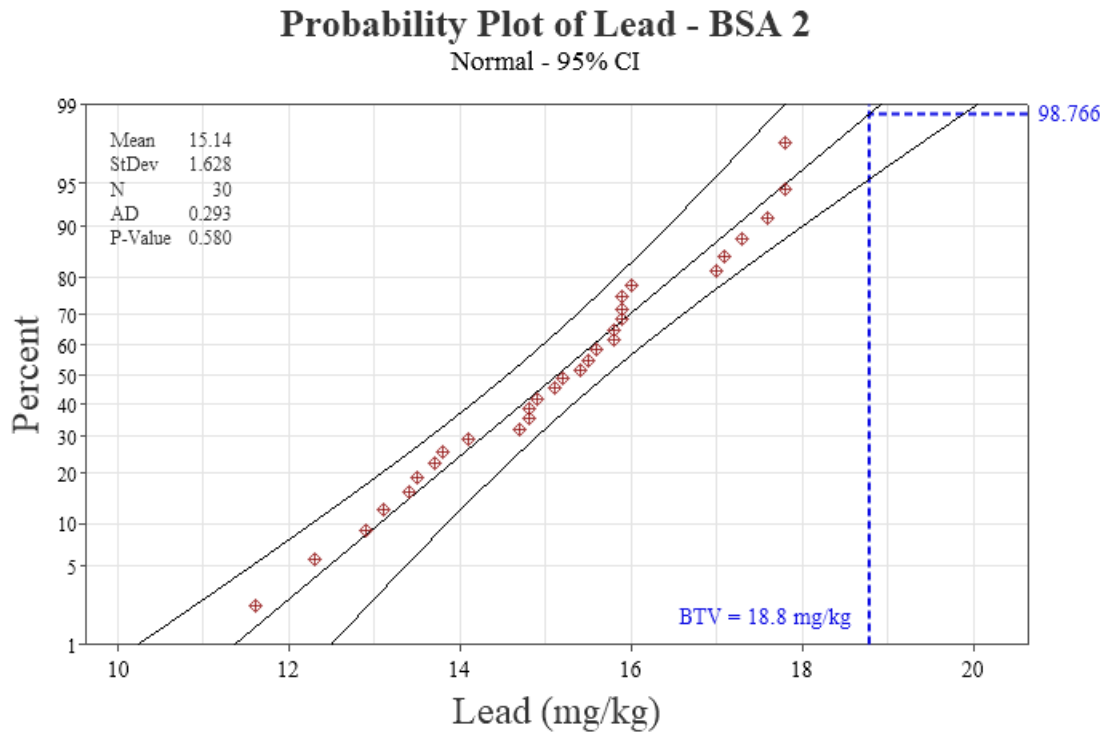


Figure H-15. Probability Plot of Lead Concentration at BSA-02 (Normal)

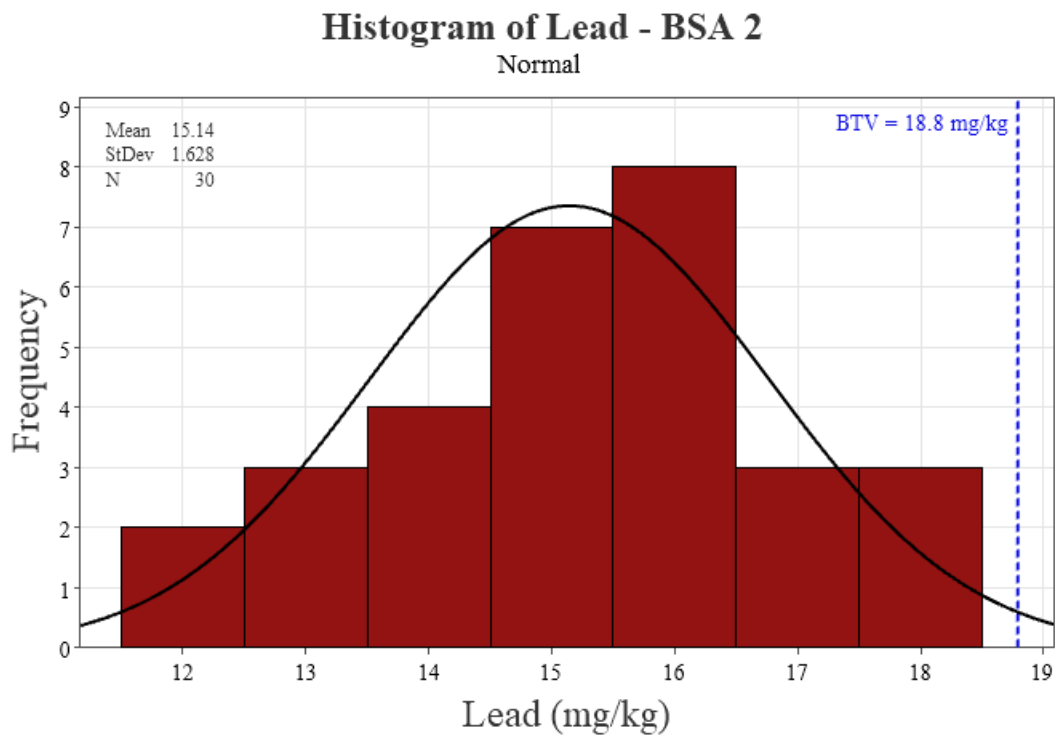


Figure H-16. Histogram of Lead Concentration at BSA-02 (Normal)

5.2.3 Molybdenum

Analytical results and descriptive statistics for the 30 molybdenum surface soil results are listed in [Table H-3](#) and [Table H-4](#), respectively. The selected BTVs for all analytes are listed in [Table H-9](#). All molybdenum results from surface soil samples collected at BSA-02 were detectable concentrations (i.e., no NDs). A statistical and graphical analysis of the molybdenum dataset for BSA-02 involved GOF and outlier testing in ProUCL. Results of the ProUCL GOF testing indicated that molybdenum data at BSA-02 appeared to follow a normal distribution. The Rosner outlier test determined that no potential outliers at the 1 percent significance level were present in the dataset.

The site-specific BTV for molybdenum was selected to be the normal UTL95-95 value of 0.41 mg/kg. An individual value plot with the full dataset is on [Figure H-17](#). The box plot of the data is on [Figure H-18](#). A normal probability plot showing molybdenum surface soil concentrations at BSA-02 is on [Figure H-19](#). Using this parametric fit, 98.6 percent of the inferred population falls below the BTV. A histogram with a fitted normal distribution of molybdenum surface soil concentrations at BSA-02 is on [Figure H-20](#).

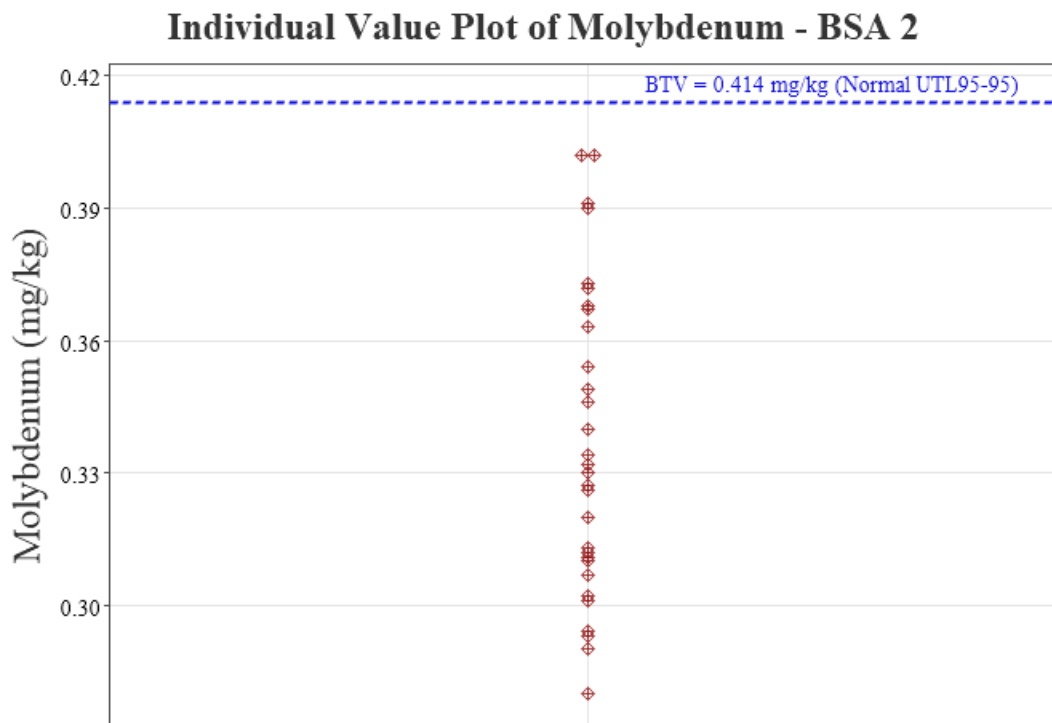
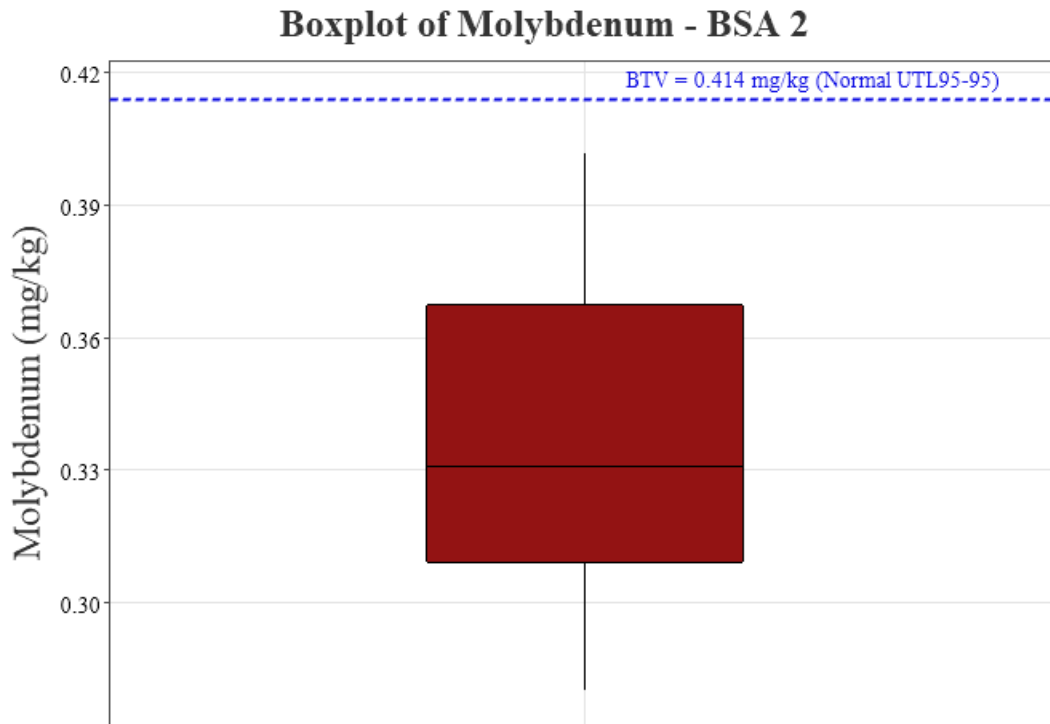
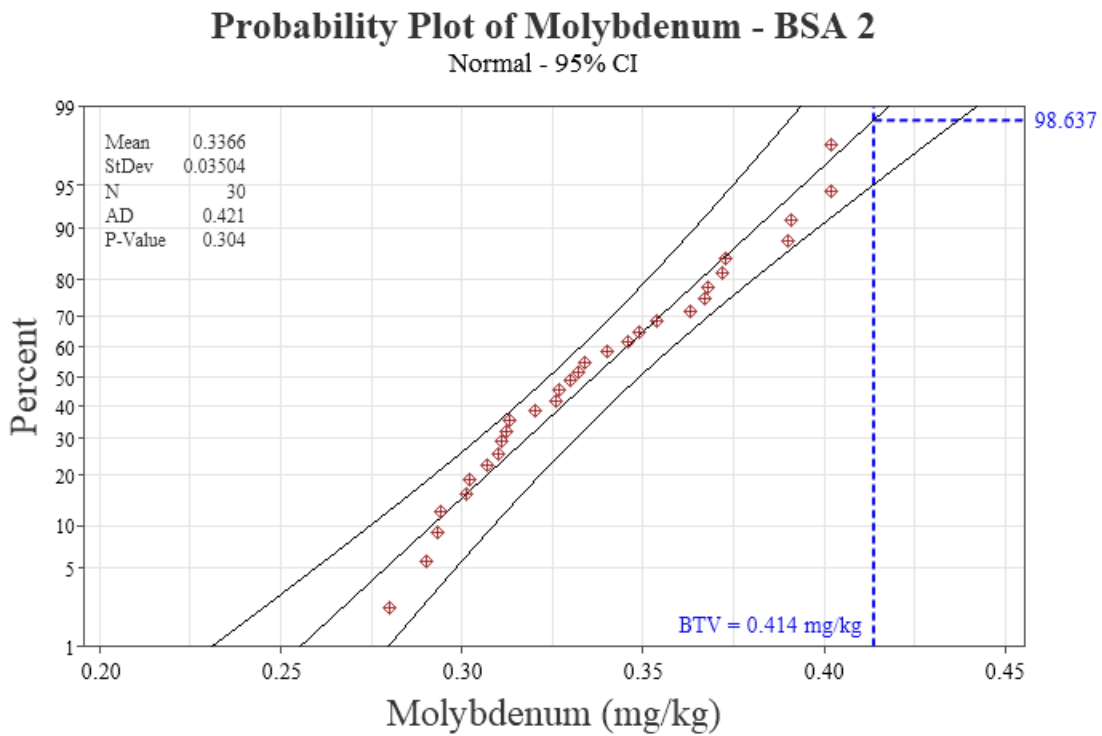


Figure H-17. Individual Value Plot of Molybdenum at BSA-02

**Figure H-18. Box Plot of Molybdenum at BSA-02****Figure H-19. Probability Plot of Molybdenum Concentration at BSA-02 (Normal)**

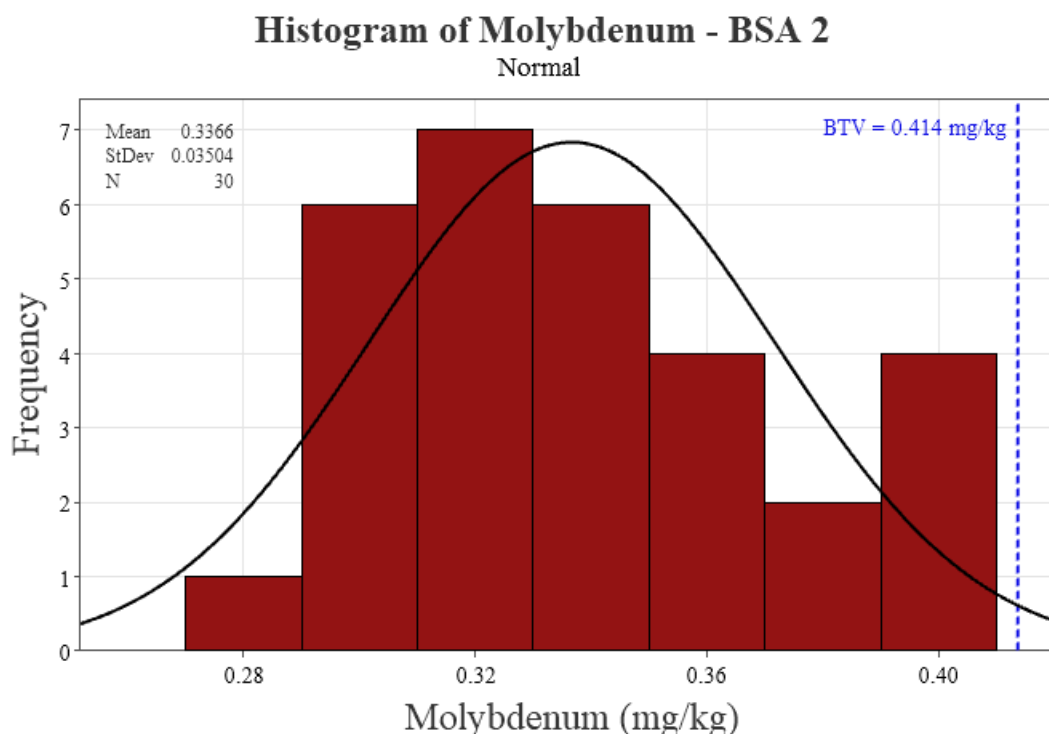


Figure H-20. Histogram of Molybdenum Concentration at BSA-02 (Normal)

5.2.4 Potassium-40

Analytical results and descriptive statistics for the 30 K-40 surface soil results are listed in [Table H-3](#) and [Table H-4](#), respectively. The selected BTVs for all analytes are listed in [Table H-9](#). All K-40 results from surface soils at BSA-02 were detectable concentrations (i.e., no NDs). A statistical and graphical analysis of the K-40 dataset from BSA-02 involved GOF and outlier testing in ProUCL. The Rosner outlier test identified one potential outlier at a 5 percent significance level, but not at a 1 percent significance level (OCRM-B02-SS13-01-111622). Determination was that this statistical outlier was likely part of the background population, and thus it was not removed from the final BTV selection analysis. No visual outliers were identified for K-40 at BSA-02 per the criteria identified in [Section 3.3.4](#). Results of the ProUCL GOF testing indicated that K-40 data at BSA-02 follows a normal distribution.

The normal UTL95-95 of 23 pCi/g was selected as the BTV for K-40 at BSA-02. An individual value plot showing the spread of the K-40 surface soil concentration data obtained at BSA-02 is on [Figure H-21](#). The box plot of the data is on [Figure H-22](#). A normal probability plot showing K-40 surface soil concentrations at BSA-02 is on [Figure H-23](#). By use of this parametric fit, 98.7 percent of the inferred population falls below the BTV. A histogram with a fitted normal distribution of K-40 surface soil concentrations at BSA-02 is on [Figure H-24](#).

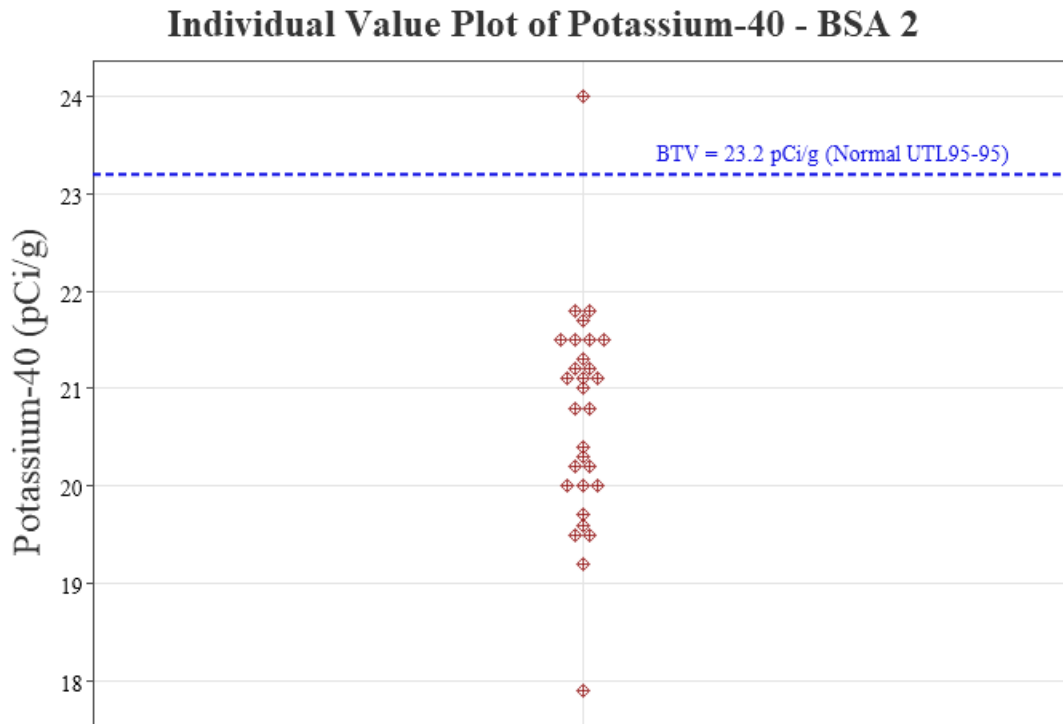


Figure H-21. Individual Value Plot of Potassium-40 Soil Concentrations at BSA-02

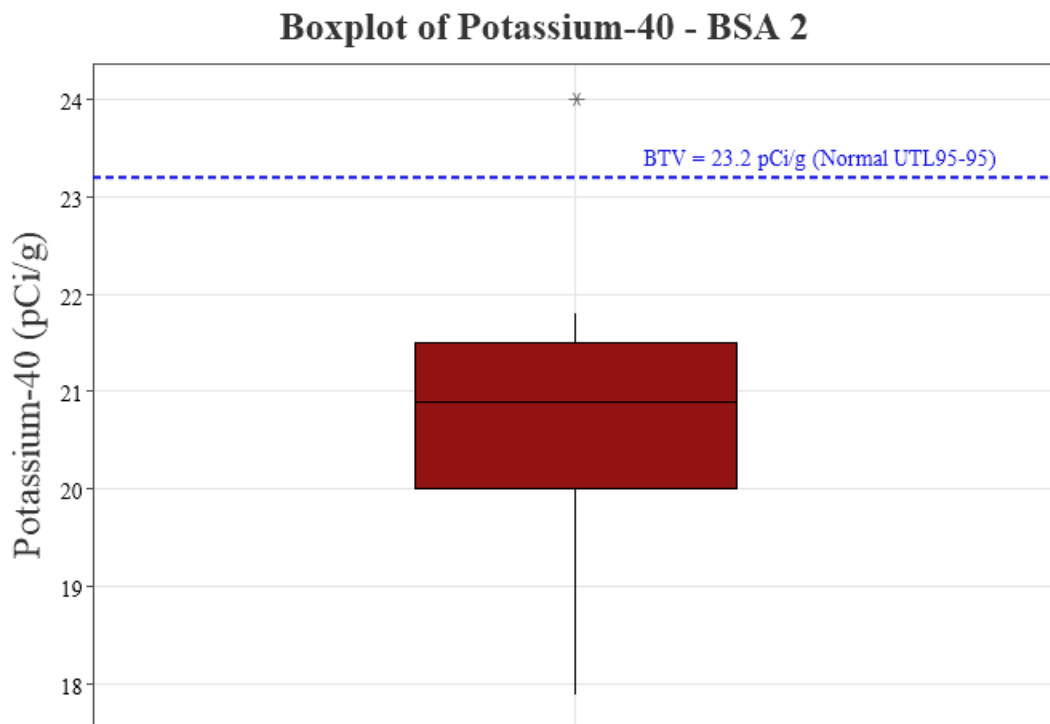


Figure H-22. Box Plot of Potassium-40 at BSA-02

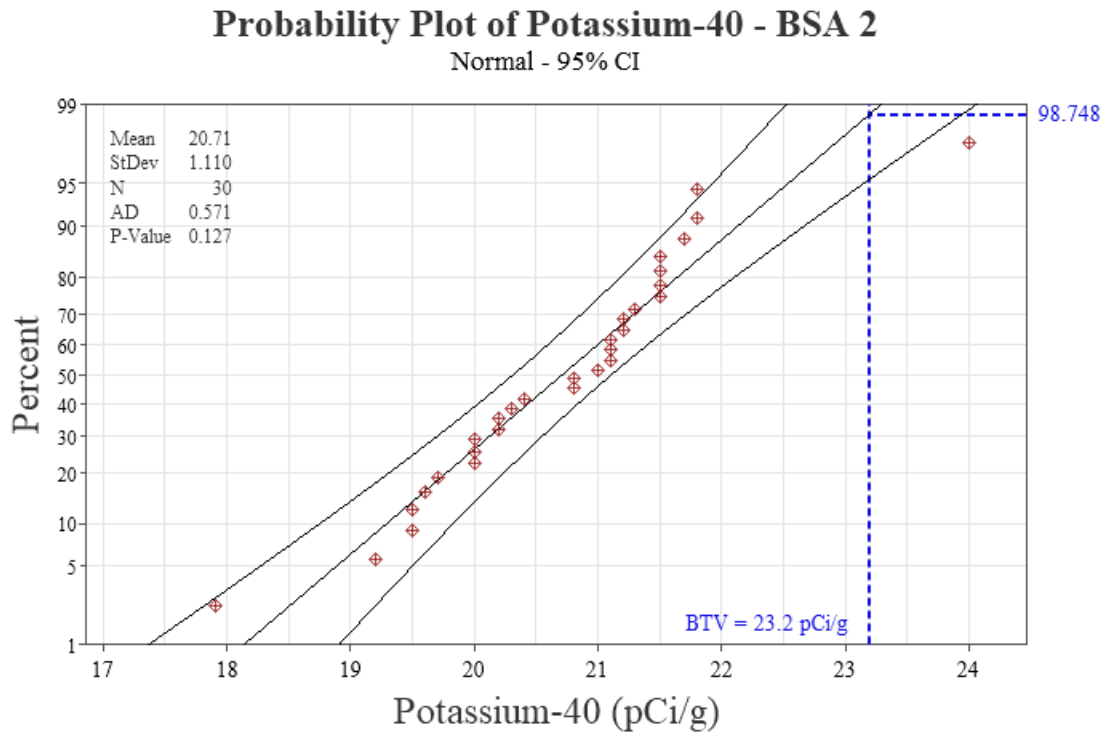


Figure H-23. Probability Plot of Potassium-40 Soil Concentrations at BSA-02 (Normal)

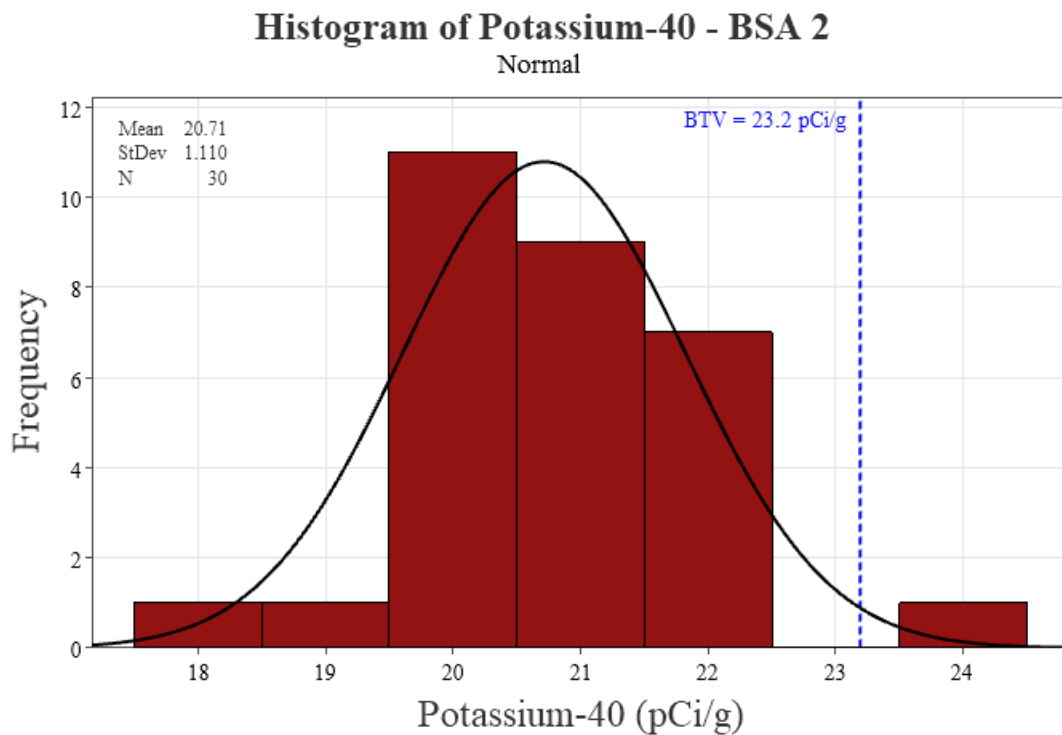


Figure H-24. Histogram of Potassium-40 Soil Concentrations at BSA-02 (Normal)

5.2.5 Radium-226

Analytical results and descriptive statistics for the 30 Ra-226 surface soil results are listed in [Table H-3](#) and [Table H-4](#), respectively. The selected BTVs for all analytes are listed in [Table H-9](#). All Ra-226 results from surface soils at BSA-02 were detectable concentrations (i.e., no NDs). A statistical and graphical analysis of the Ra-226 dataset from BSA-02 involved GOF and outlier testing in ProUCL. The Rosner outlier test identified no potential outliers. No visual outliers were identified for Ra-226 at BSA-02 per the criteria identified in [Section 3.3.4](#). Results of the ProUCL GOF testing indicated that Ra-226 data at BSA-02 follows a normal distribution.

The normal UTL95-95 of 2.0 pCi/g was selected as the BTV for Ra-226 at BSA-02. An individual value plot showing the spread of the Ra-226 surface soil concentration data obtained at BSA-02 is on [Figure H-25](#). The box plot of the data is on [Figure H-26](#). A normal probability plot showing Ra-226 surface soil concentrations at BSA-02 is on [Figure H-27](#). By use of this parametric fit, 98.7 percent of the inferred population falls below the BTV. A histogram with a fitted normal distribution of Ra-226 surface soil concentrations at BSA-02 is on [Figure H-28](#).

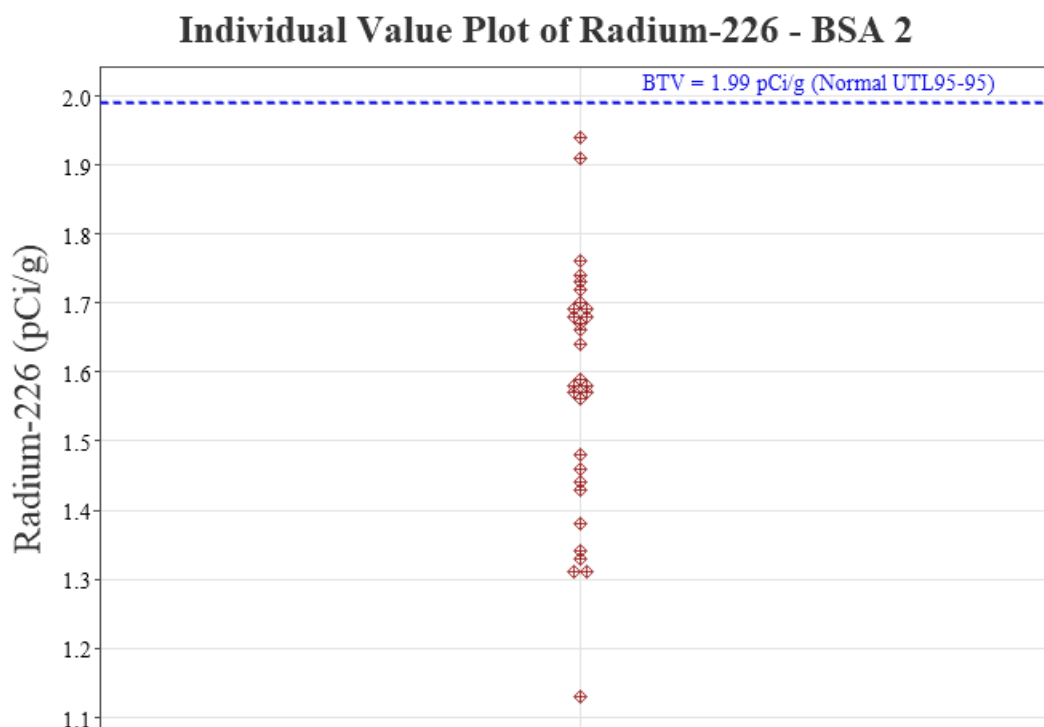


Figure H-25. Individual Value Plot of Radium-226 Soil Concentrations at BSA-02

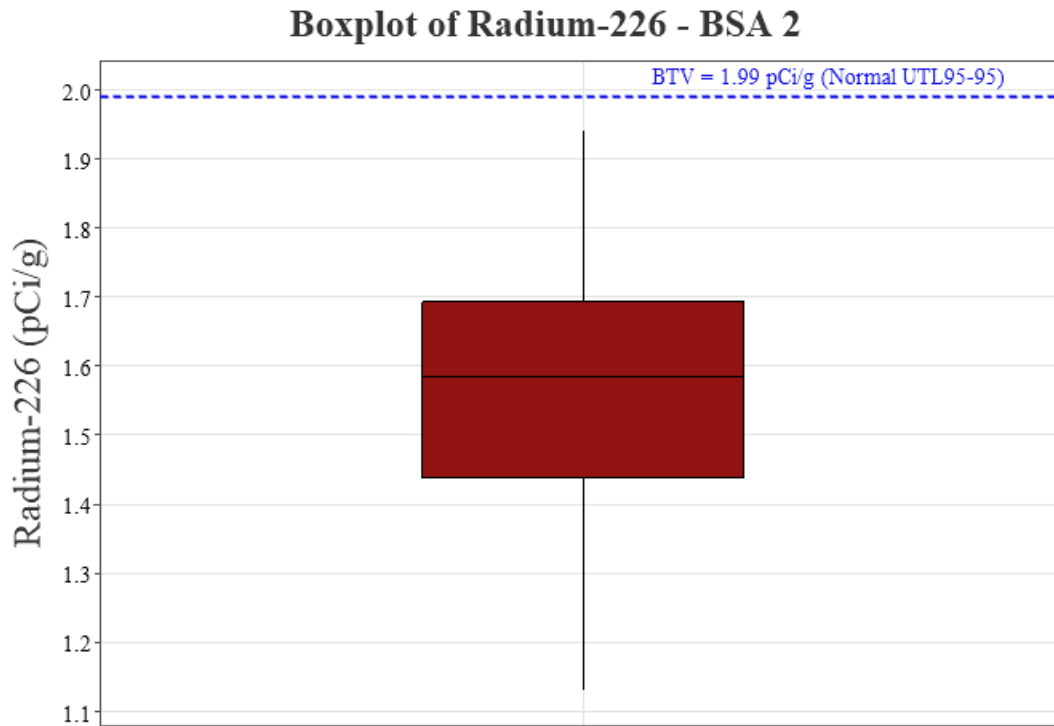


Figure H-26. Box Plot of Radium-226 at BSA-02

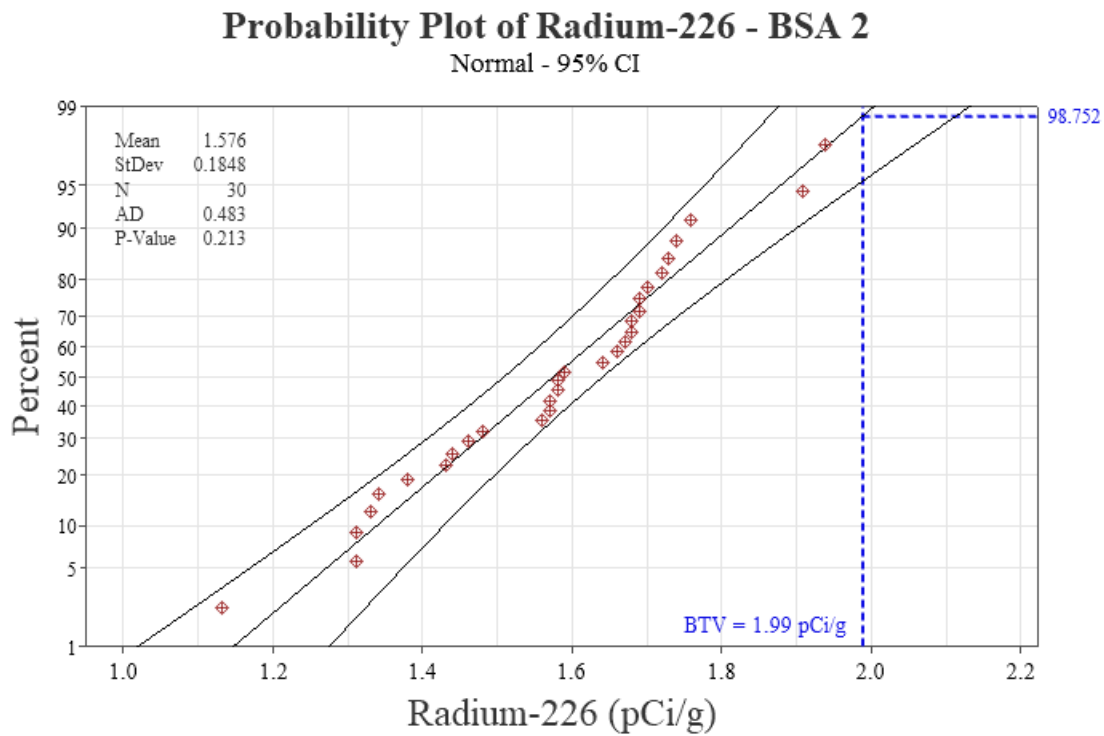


Figure H-27. Probability Plot of Radium-226 Soil Concentrations at BSA-02 (Normal)

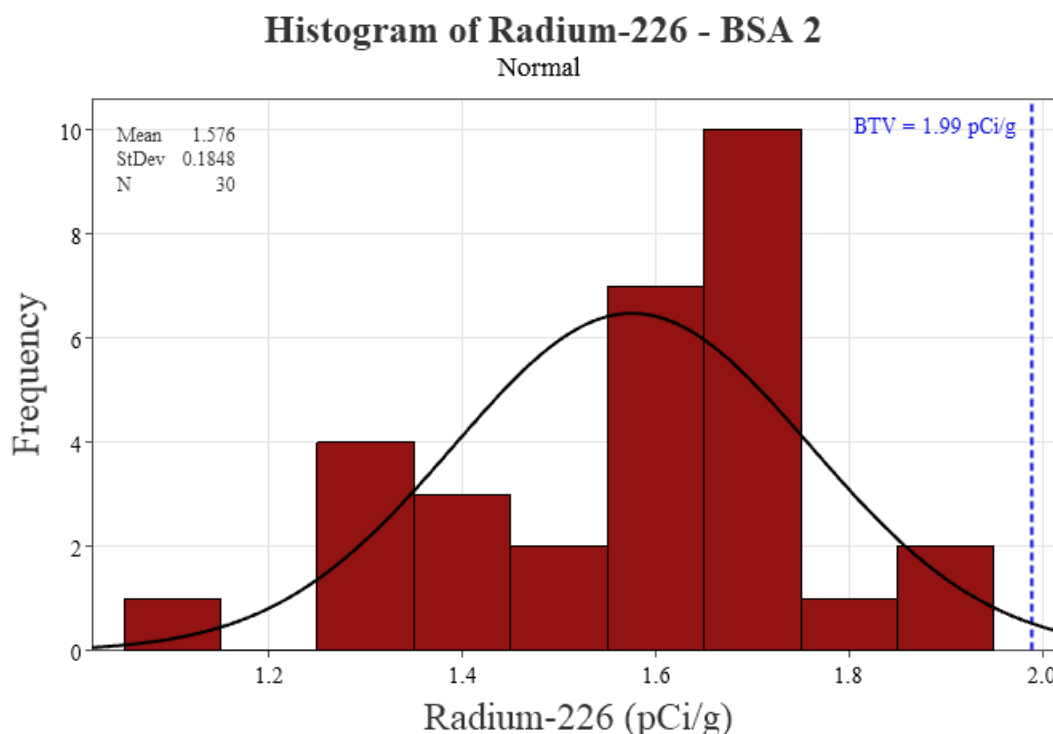


Figure H-28. Histogram of Radium-226 Soil Concentrations at BSA-02 (Normal)

5.2.6 Selenium

Analytical results and descriptive statistics for the 30 selenium surface soil results are listed in [Table H-3](#) and [Table H-4](#), respectively. The selected BTVs for all analytes are listed in [Table H-9](#). All selenium results in surface soil samples collected at BSA-02 were detectable concentrations (i.e., no NDs). A statistical and graphical analysis of the selenium dataset for BSA-02 involved GOF and outlier testing in ProUCL. Results of the ProUCL GOF testing indicated that selenium data at BSA-02 appeared to follow a normal distribution. No outliers were identified via the Rosner's outlier analysis. Visual inspection also occurred, and no outliers were identified.

The normal UTL95-95 of 2.8 mg/kg identified by ProUCL was selected as the BTV for selenium at BSA-02. An individual value plot on [Figure H-29](#) shows the full selenium dataset for surface soils at BSA-02 plotted with the BTV. The box plot of the data is on [Figure H-30](#). [Figure H-31](#) provides a probability plot for a normal distribution for selenium at BSA-02. By use of this parametric fit, 98.7 percent of the inferred population falls below the BTV. [Figure H-32](#) provides a histogram fitted to a normal distribution for selenium at BSA-02.

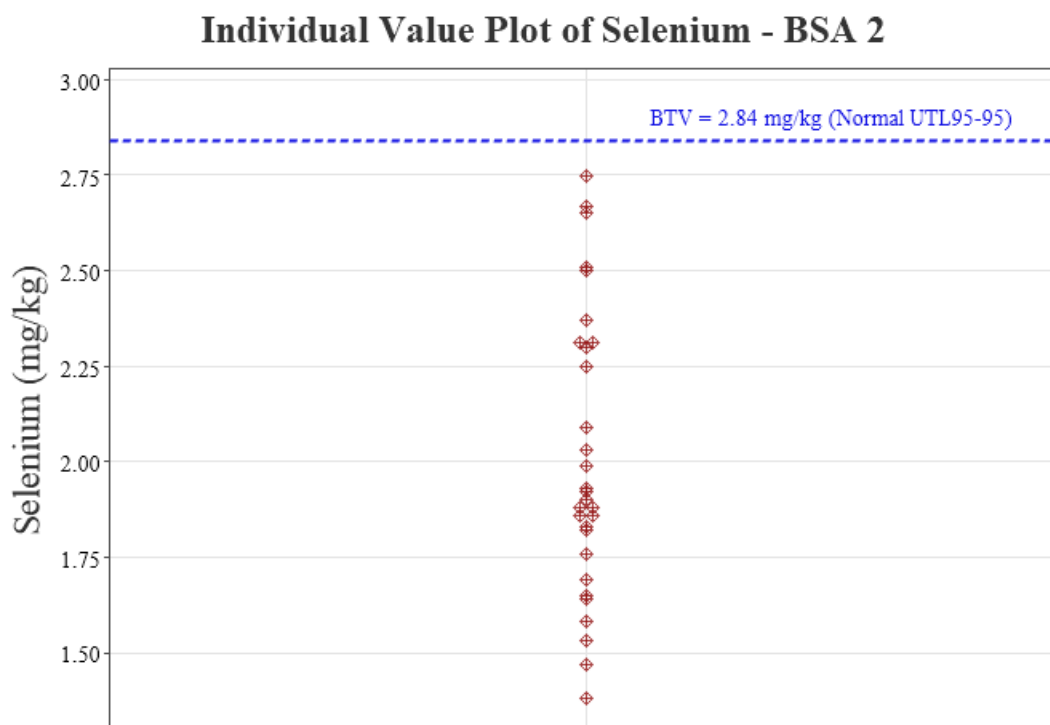


Figure H-29. Individual Value Plot of Selenium Concentrations at BSA-02

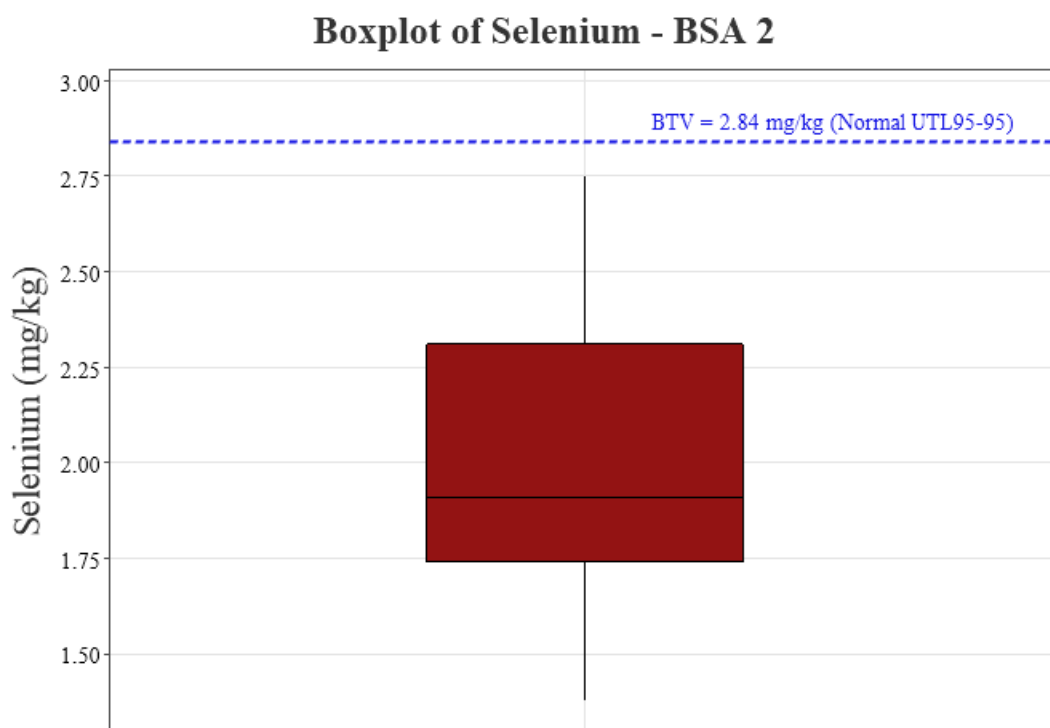


Figure H-30. Box Plot of Selenium at BSA-02

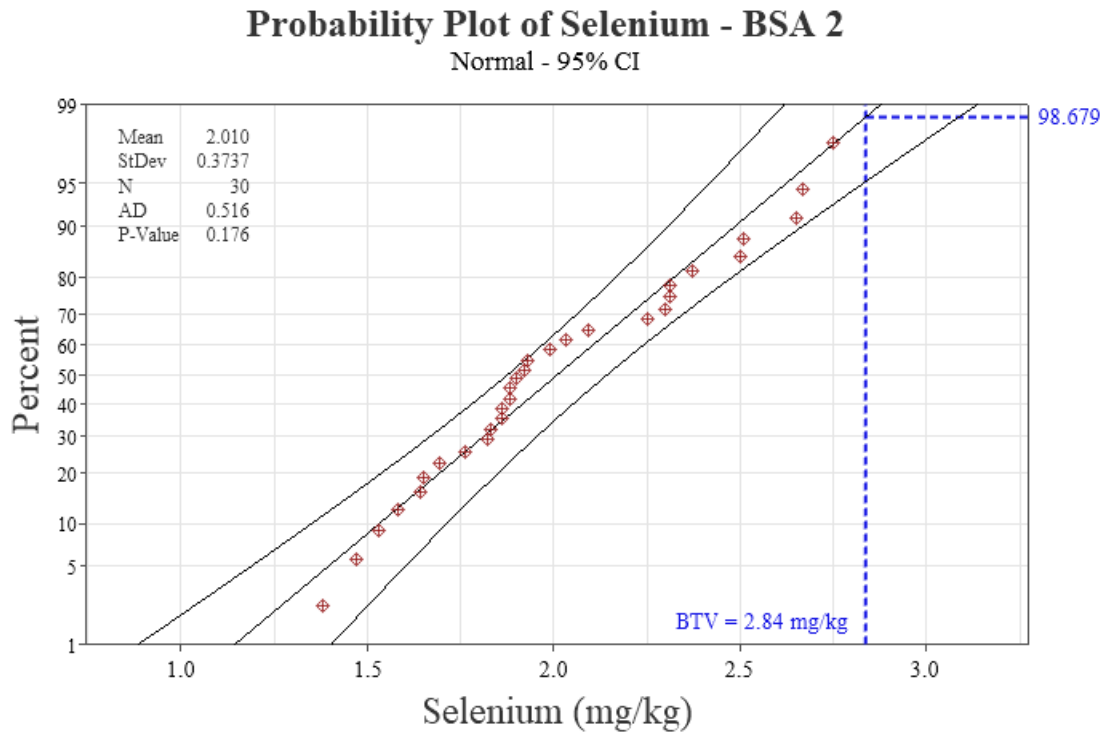


Figure H-31. Probability Plot of Selenium Concentrations at BSA-02 (Normal)

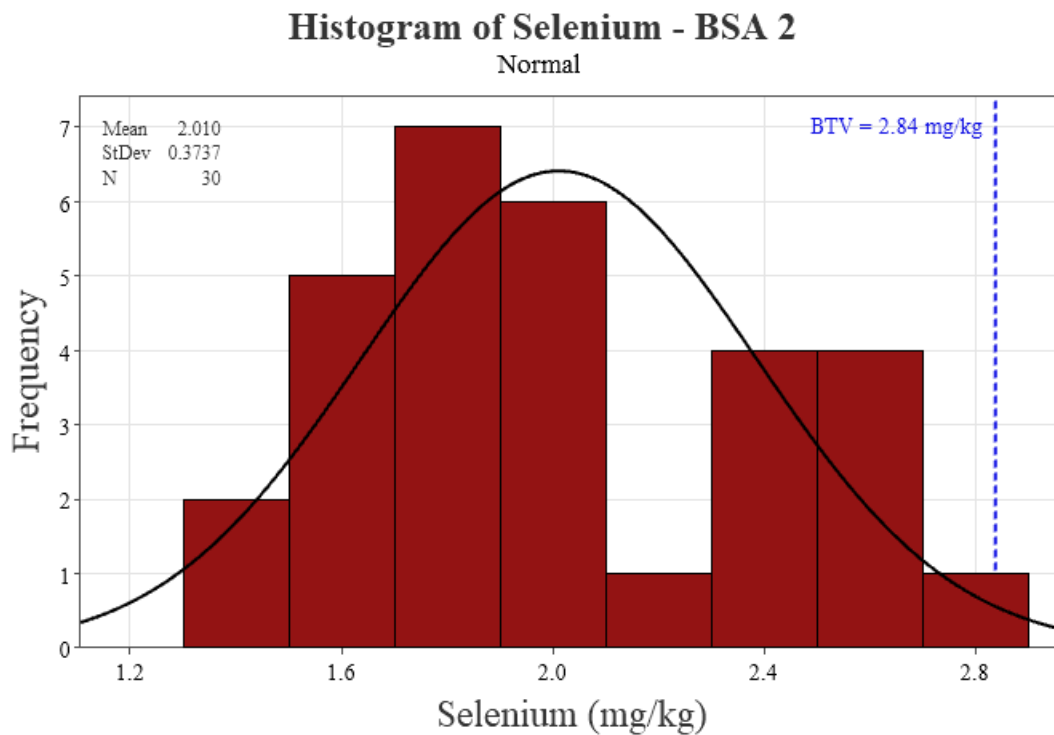


Figure H-32. Histogram of Selenium Concentrations at BSA-02 (Normal)

5.2.7 Thorium

Analytical results and descriptive statistics for the 30 thorium surface soil results are listed in [Table H-3](#) and [Table H-4](#), respectively. The selected BTVs for all analytes are listed in [Table H-9](#). All thorium results in surface soil samples collected at BSA-02 were detectable concentrations (i.e., no NDs). A statistical and graphical analysis of the thorium dataset for BSA-02 involved GOF and outlier testing in ProUCL. Results of the ProUCL GOF testing indicated that thorium data at BSA-02 appeared to follow a normal distribution. No outliers were identified via the Rosner's outlier analysis. Visual inspection also occurred, and no outliers were identified.

The normal UTL95-95 of 11.6 mg/kg identified by ProUCL was selected as the BTV for thorium at BSA-02. An individual value plot on [Figure H-33](#) shows the full thorium dataset for surface soils at BSA-02 plotted with the BTV. The box plot of the data is on [Figure H-34](#). [Figure H-35](#) provides a probability plot for a normal distribution for thorium at BSA-02. By use of this parametric fit, 98.6 percent of the inferred population falls below the BTV. [Figure H-36](#) provides a histogram fitted to a normal distribution for thorium at BSA-02.

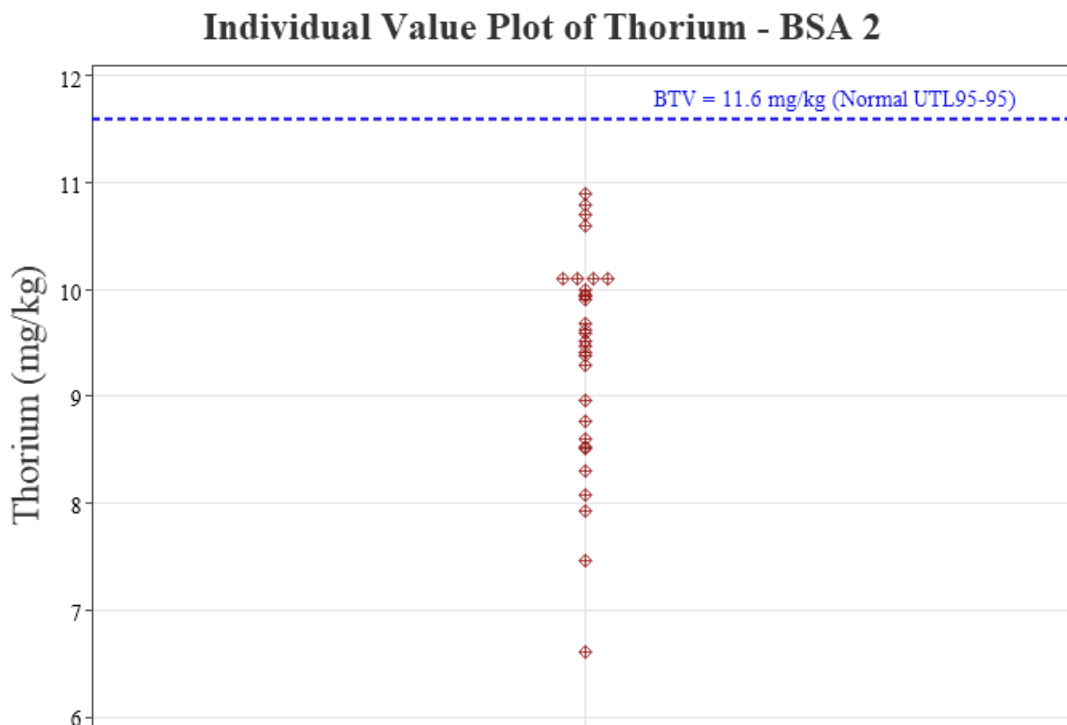


Figure H-33. Individual Value Plot of Thorium Soil Concentrations at BSA-02

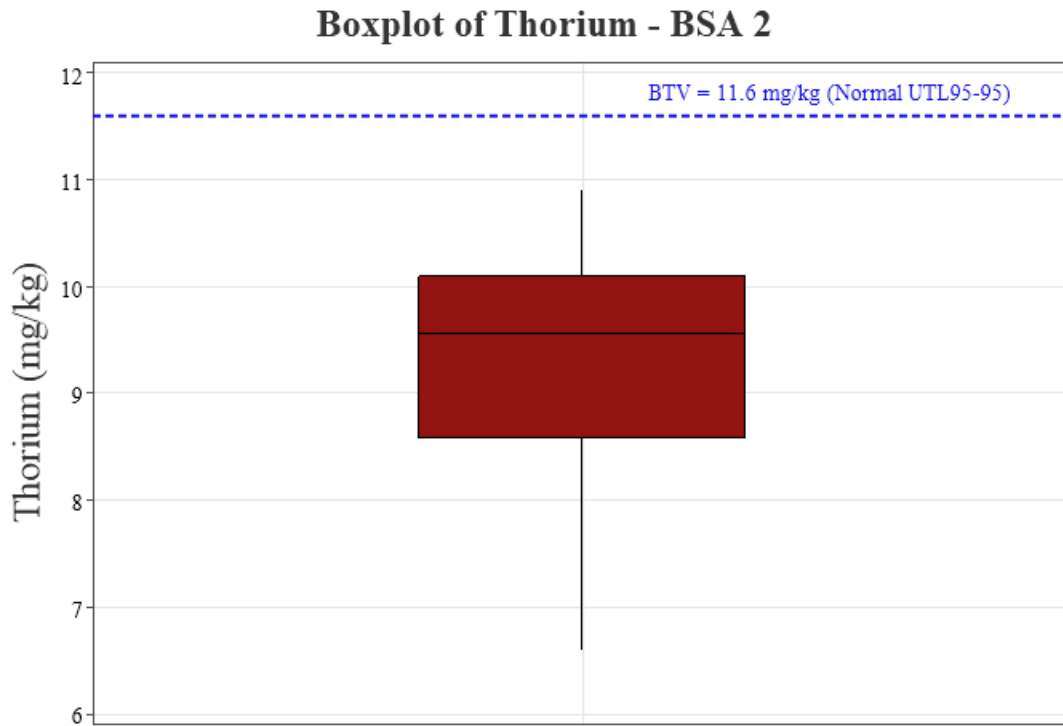


Figure H-34. Box Plot of Thorium at BSA-02

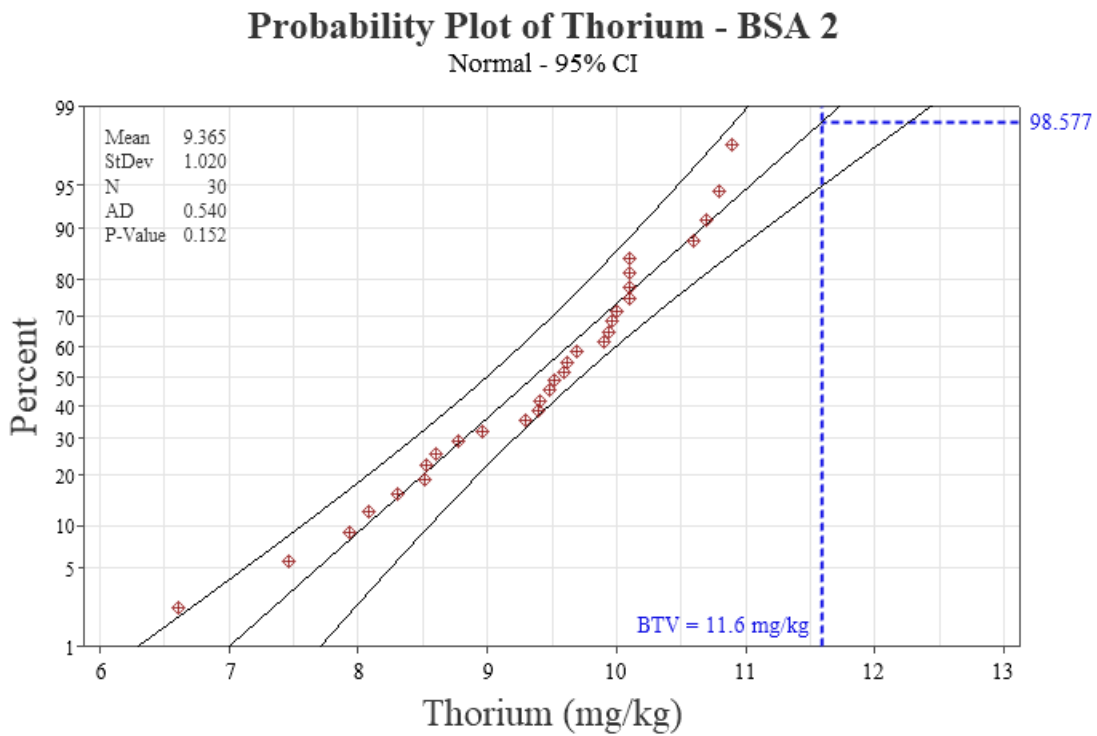


Figure H-35. Probability Plot of Thorium Soil Concentrations at BSA-02 (Normal)

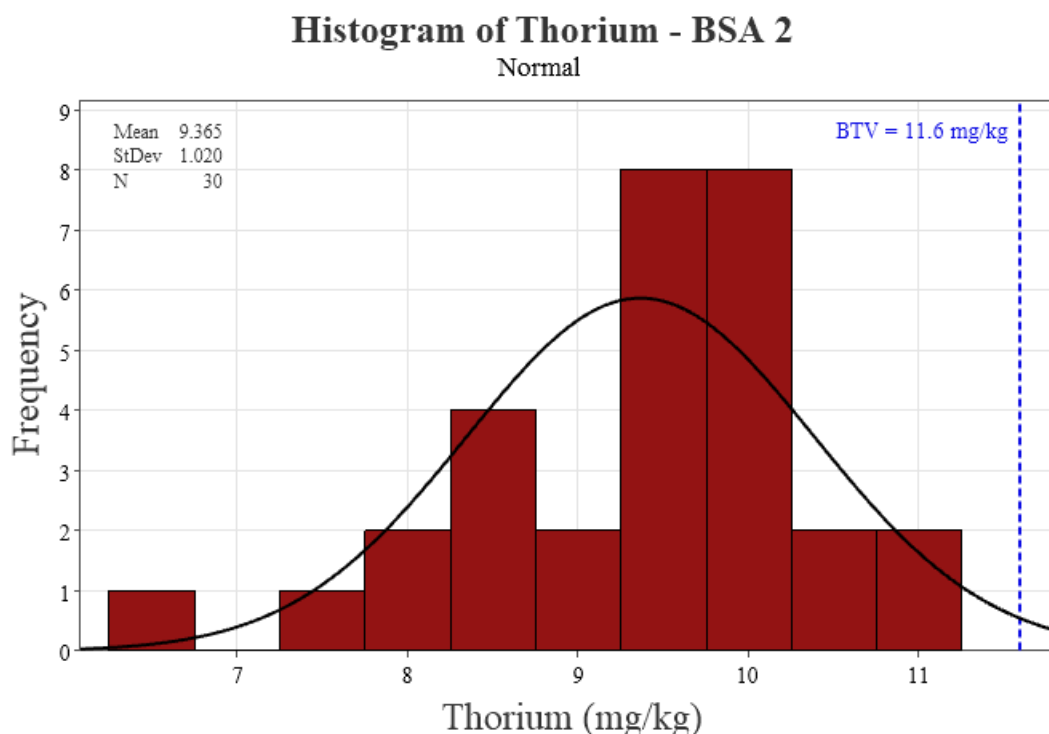


Figure H-36. Histogram of Thorium Soil Concentrations at BSA-02 (Normal)

5.2.8 Uranium

Analytical results and descriptive statistics for the 30 uranium surface soil results are listed in [Table H-3](#) and [Table H-4](#), respectively. The selected BTVs for all analytes are listed in [Table H-9](#). All uranium results from surface soils at BSA-02 were detectable concentrations (i.e., no NDs). A statistical and graphical analysis of the uranium dataset from BSA-02 involved GOF and outlier testing in ProUCL. Results of the ProUCL GOF testing indicated that uranium data at BSA-02 follows a normal distribution, and no outliers were identified by use of Rosner's outlier analysis. Visual inspection also identified no outliers.

The normal UTL95-95 of 1.4 mg/kg was selected as the BTV for uranium at BSA-02. An individual value plot showing the spread of the uranium surface soil concentration data obtained at BSA-02 is on [Figure H-37](#). The box plot of the data is on [Figure H-38](#). A normal probability plot showing uranium surface soil concentrations at BSA-02 is on [Figure H-39](#). By use of this parametric fit, 98.6 percent of the inferred population falls below the BTV. A histogram with a fitted normal distribution of uranium surface soil concentrations at BSA-02 is on [Figure H-40](#).

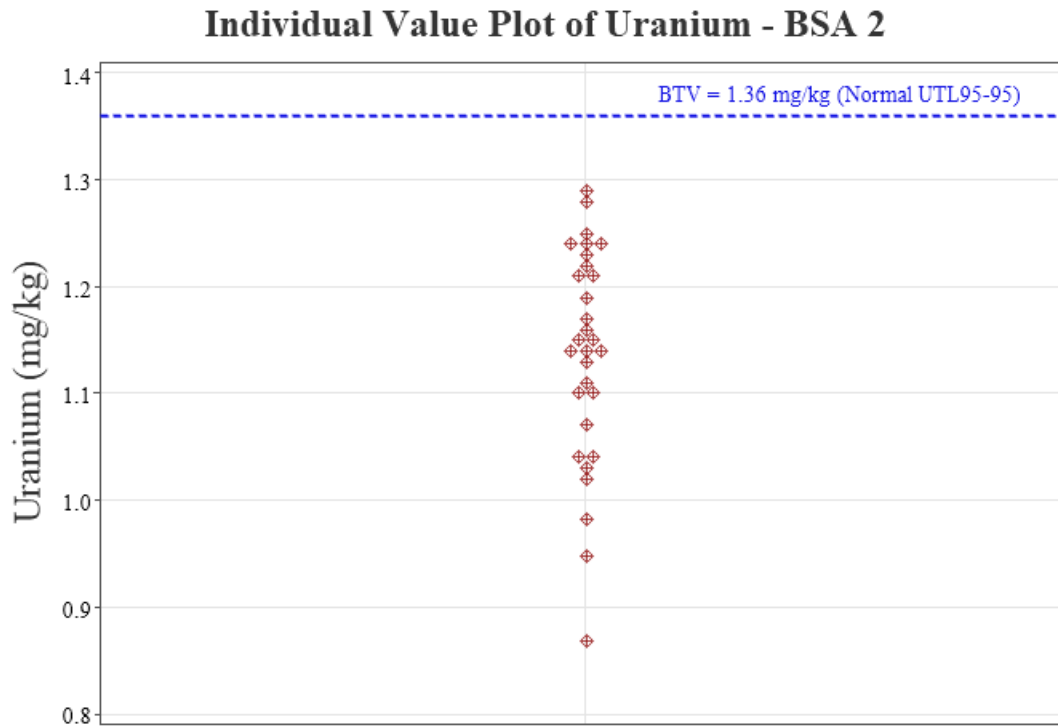


Figure H-37. Individual Value Plot of Uranium Soil Concentrations at BSA-02

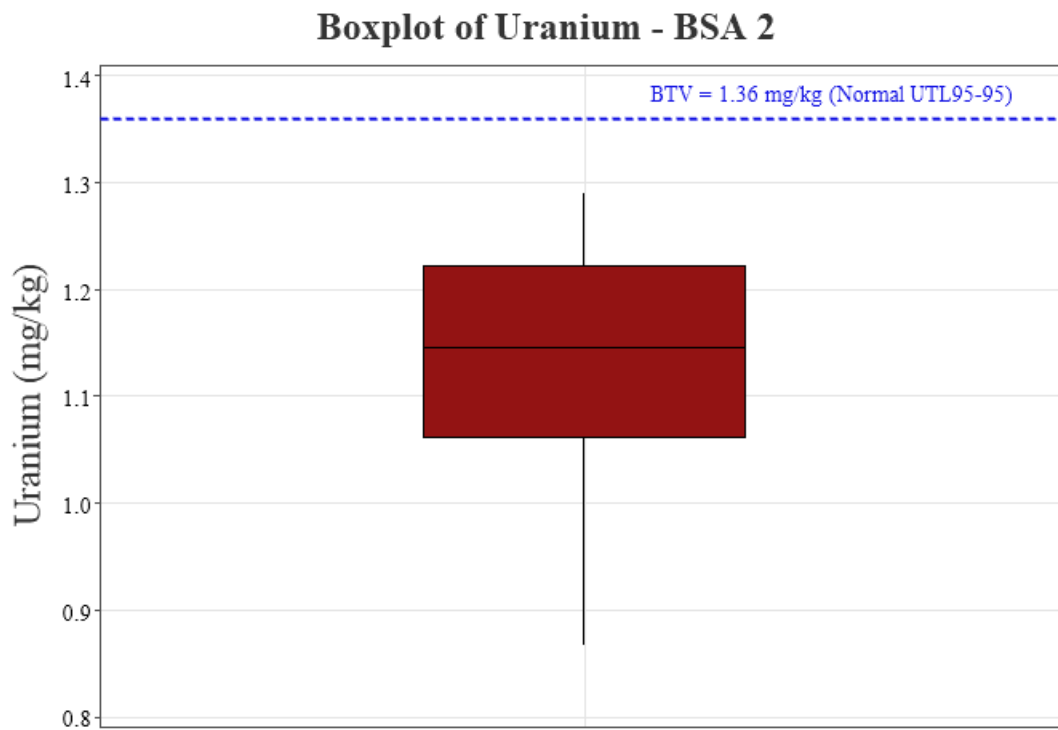


Figure H-38. Box Plot of Uranium at BSA-02

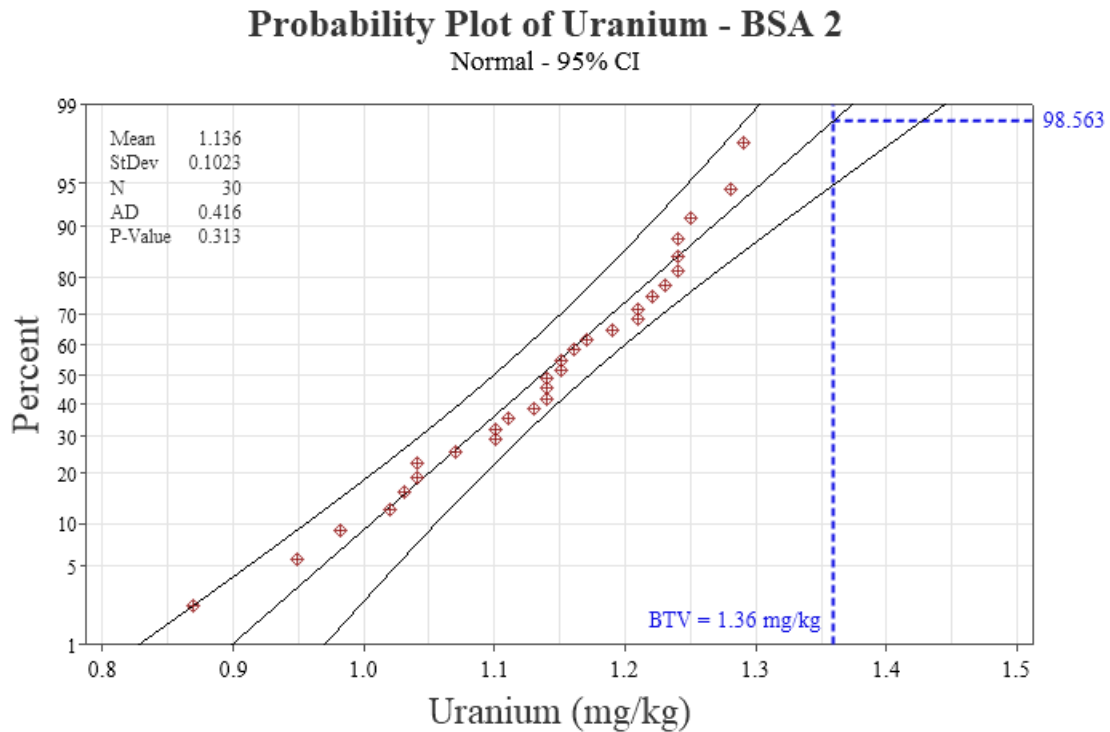


Figure H-39. Probability Plot of Uranium Soil Concentrations at BSA-02 (Normal)

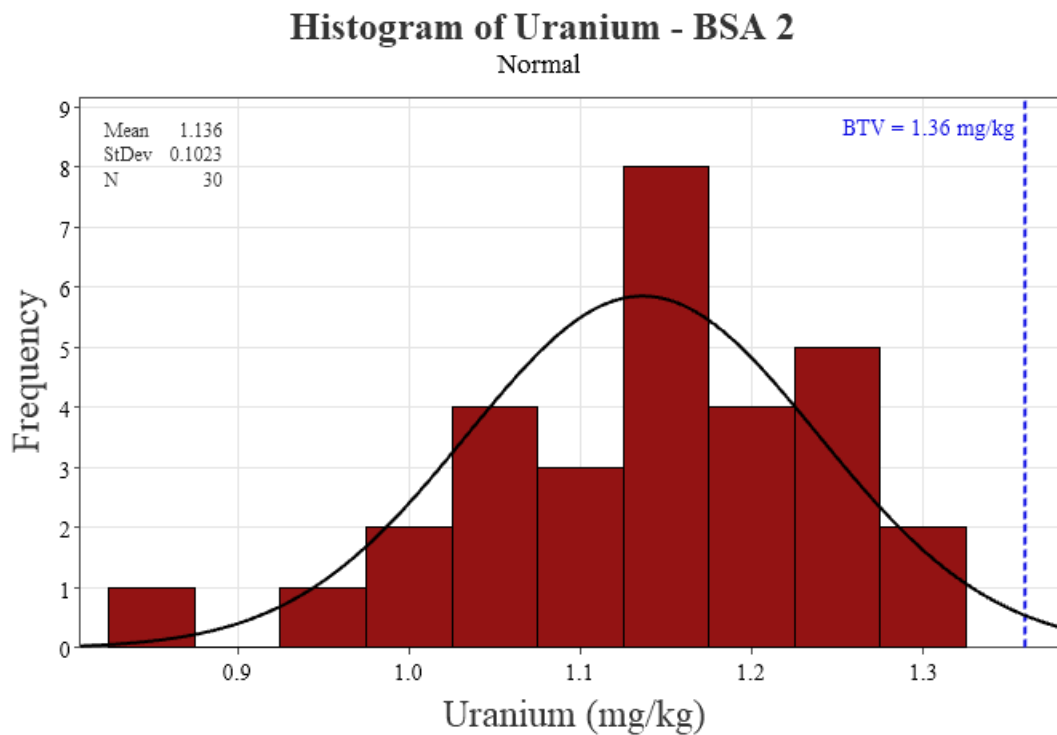


Figure H-40. Histogram of Uranium Soil Concentrations at BSA-02 (Normal)

5.2.9 Vanadium

Analytical results and descriptive statistics for the 30 vanadium surface soil results are listed in [Table H-3](#) and [Table H-4](#), respectively. The selected BTVs for all analytes are listed in [Table H-9](#). All vanadium results from surface soils at BSA-02 were detectable concentrations (i.e., no NDs). A statistical and graphical analysis of the vanadium dataset from BSA-02 involved GOF and outlier testing in ProUCL. Results of the ProUCL GOF testing indicated that vanadium data at BSA-02 follows a normal distribution, and no outliers were identified by use of the Rosner's outlier analysis. Visual inspection also identified no outliers.

The normal UTL95-95 of 32.6 mg/kg was selected as the BTV for vanadium at BSA-02. An individual value plot showing the spread of the vanadium surface soil concentration data obtained at BSA-02 is on [Figure H-41](#). The box plot of the data is on [Figure H-42](#). A normal probability plot showing vanadium surface soil concentrations at BSA-02 is on [Figure H-43](#). By use of this parametric fit, 98.7 percent of the inferred population falls below the BTV. A histogram with a fitted normal distribution of vanadium surface soil concentrations at BSA-02 is on [Figure H-44](#).

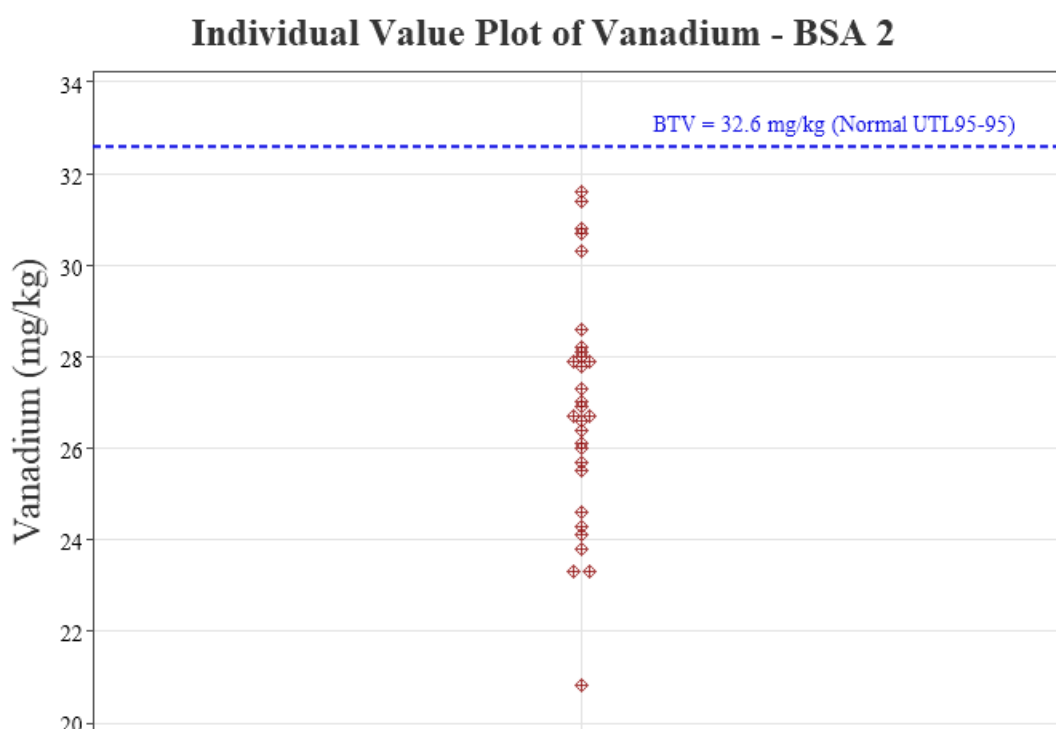
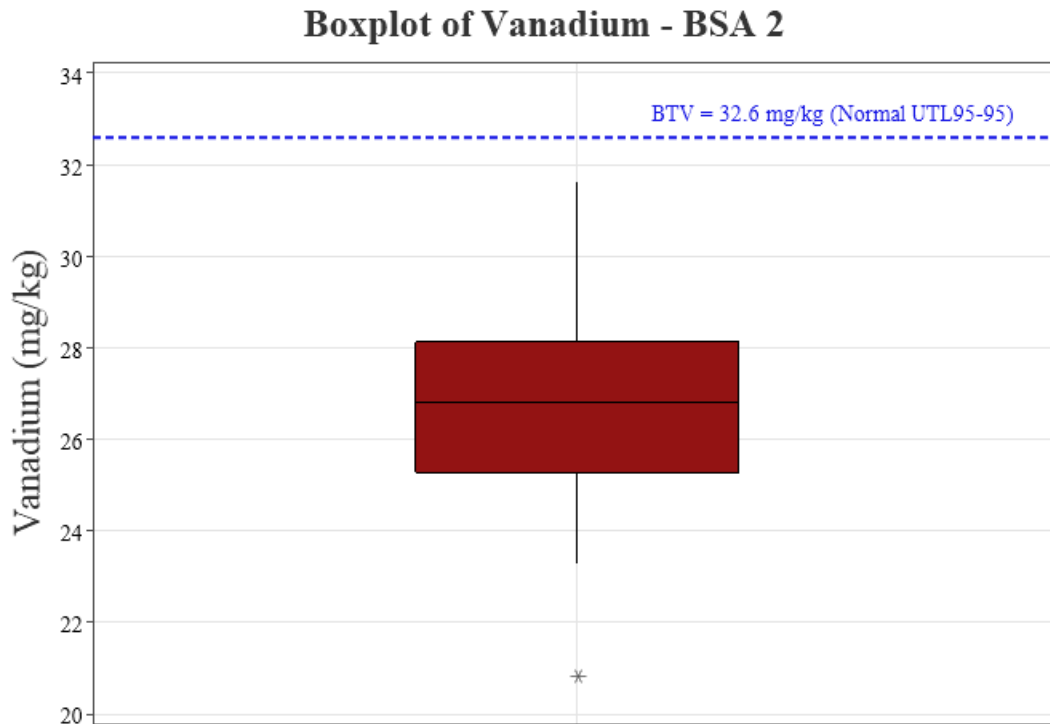
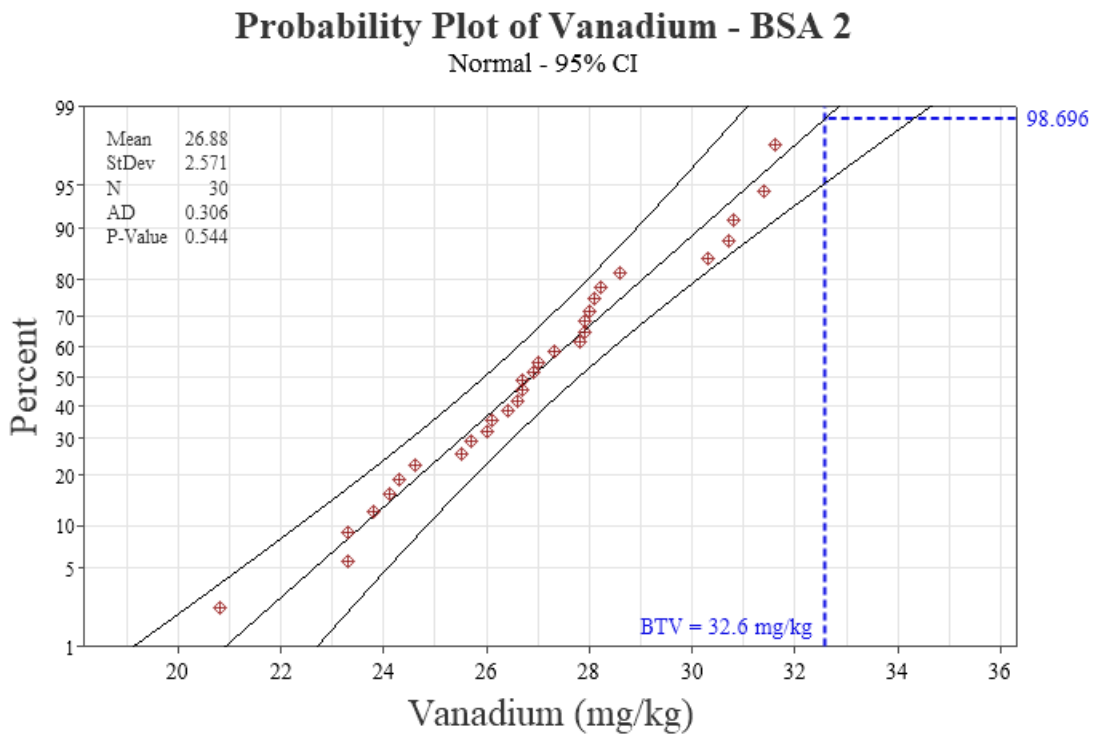


Figure H-41. Individual Value Plot of Vanadium Soil Concentrations at BSA-02

**Figure H-42. Box Plot of Vanadium at BSA-02****Figure H-43. Probability Plot of Vanadium Soil Concentrations at BSA-02 (Normal)**

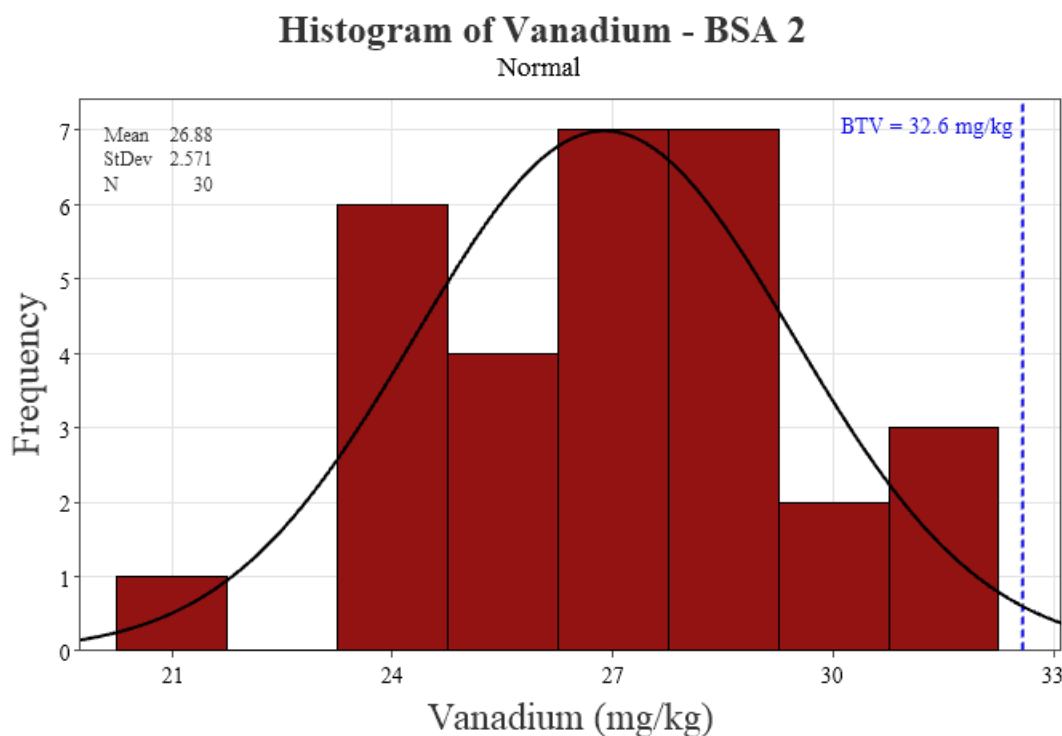


Figure H-44. Histogram of Vanadium Soil Concentrations at BSA-02 (Normal)

5.3 SOIL SAMPLING BACKGROUND THRESHOLD VALUES

The BTV selection process for the 29 analytes of interest at BSA-02 followed the data analysis procedures outlined in [Section 3.3](#). Selections of BTVs occurred following data processing in ProUCL, graphical analysis of each dataset in Minitab, and identification of outliers by both visual inspection and outlier testing in ProUCL. Outliers identified by ProUCL were determined to be representative of the background population for those analytes of interest, and therefore were retained in the ProUCL analysis.

Final site-specific BTVs selected for all analytes of interest are listed in [Table H-9](#). Out of the 29 analytes of interest, 27 appeared to follow or approximate a normal distribution in ProUCL at a 1 percent significance level. The remaining two analytes, antimony and silver, were undetected in all samples collected at BSA-02, and no BTV was calculated for these analytes. Datasets for the other 27 analytes evaluated were uncensored, containing no NDs.

5.4 X-RAY FLUORESCENCE SURVEY BACKGROUND THRESHOLD VALUES

The XRF selection process followed a method similar to that of the BTV selection process described in [Section 5.3](#) for soil sampling analytical results.

[Table H-10](#) summarizes the final site-specific XRF BTVs.



Table H-9. Site-Specific Background Threshold Values for BSA-02

Analyte	# of Nondetects	Relative Standard Deviation (%)	Statistical Outliers Present?	Outliers Removed? ¹	BTV Selection Method	Parametric Distribution for Graphical Display	Final BTV Selected	BTV Units
Aluminum	0	11%	Yes	No	Normal UTL95-95	Normal	19,274	mg/kg
Antimony	30	-	-	-	-	-	-	mg/kg
Arsenic	0	10%	No	No	Normal UTL95-95	Normal	7.0	mg/kg
Barium	0	10%	Yes	No	Normal UTL95-95	Normal	165	mg/kg
Beryllium	0	10%	No	No	Normal UTL95-95	Normal	1.2	mg/kg
Cadmium	0	9%	No	No	Normal UTL95-95	Normal	0.18	mg/kg
Calcium	0	9%	Yes	No	Normal UTL95-95	Normal	8,177	mg/kg
Chromium	0	10%	No	No	Normal UTL95-95	Normal	15.1	mg/kg
Cobalt	0	10%	No	No	Normal UTL95-95	Normal	9.2	mg/kg
Copper	0	11%	No	No	Normal UTL95-95	Normal	17.0	mg/kg
Iron	0	9%	No	No	Normal UTL95-95	Normal	22,138	mg/kg
Lead	0	11%	No	No	Normal UTL95-95	Normal	18.8	mg/kg
Lithium	0	11%	No	No	Normal UTL95-95	Normal	17.6	mg/kg
Magnesium	0	7%	No	No	Normal UTL95-95	Normal	4,905	mg/kg
Manganese	0	7%	No	No	Normal UTL95-95	Normal	2,856	mg/kg
Molybdenum	0	10%	No	No	Normal UTL95-95	Normal	0.41	mg/kg
Nickel	0	10%	No	No	Normal UTL95-95	Normal	12.4	mg/kg
Potassium-40	0	5%	Yes	No	Normal UTL95-95	Normal	23.2	pCi/g
Radium-226	0	12%	No	No	Normal UTL95-95	Normal	2.0	pCi/g
Radium-228	0	17%	No	No	Normal UTL95-95	Normal	2.3	pCi/g
Selenium	0	19%	No	No	Normal UTL95-95	Normal	2.8	mg/kg
Silver	30	-	-	-	-	-	-	mg/kg
Sodium	0	9%	No	No	Normal UTL95-95	Normal	81.2	mg/kg
Thallium	0	10%	No	No	Normal UTL95-95	Normal	0.27	mg/kg
Thorium	0	11%	No	No	Normal UTL95-95	Normal	11.6	mg/kg
Thorium-232	0	17%	No	No	Normal UTL95-95	Normal	2.3	pCi/g
Uranium	0	9%	No	No	Normal UTL95-95	Normal	1.4	mg/kg
Vanadium	0	10%	No	No	Normal UTL95-95	Normal	32.6	mg/kg
Zinc	0	10%	No	No	Normal UTL95-95	Normal	66.1	mg/kg

Notes:
¹ Outliers were identified by ProUCL (i.e., Dixon or Rosner) outlier tests but were representative of background and were included in analysis.
- Not applicable
BTV Background threshold value
mg/kg Milligram per kilogram
NA Not applicable
pCi/g Picocurie per gram
UTL Upper threshold limit



Table H-10. Site-Specific XRF Background Threshold Values for BSA-02

Analyte	# of Non-detects	Distribution	GOF	Statistical Outliers Present?	Outliers Removed?	BTV Selection Method	Final BTV Selected (ppm)	Notes
Arsenic	0	Normal	Appear	Yes	Yes	Normal UTL 95-95	8.217	
Barium	30	-	-	No	No	-	>LOD	No detections of analyte in background; any detections above the LOD measured in the field will be considered above background
Chromium	0	Normal	Appear	Yes	No	Normal UTL 95-95	43.32	
Cobalt	5	Normal	Appear	No	No	Normal UTL 95-95	61.7	
Copper	0	Normal	Appear	No	No	Normal UTL 95-95	15.21	
Gold	30	-	-	No	No	-	>LOD	No detections of analyte in background; any detections above the LOD measured in the field will be considered above background
Iron	0	Normal	Appear	No	No	Normal UTL 95-95	25130	
Lead	0	Normal	Appear	No	No	Normal UTL 95-95	20.42	
Manganese	0	Normal	Appear	Yes	No	Normal UTL 95-95	269.7	
Mercury	30	-	-	No	No	-	>LOD	No detections of analyte in background; any detections above the LOD measured in the field will be considered above background
Molybdenum	24	-	-	No	No	Maximum Recorded Value	1.61	Too few detects; maximum detected value used
Nickel	17	-	-	No	No	Maximum Recorded Value	19.93	Too few detects; maximum detected value used
Rubidium	1	Normal	Appear	No	No	Normal UTL 95-95	100.1	
Selenium	30	-	-	No	No	-	>LOD	No detections of analyte in background; any detections above the LOD measured in the field will be considered above background
Strontium	0	Normal	Appear	Yes	Yes	Normal UTL 95-95	111.9	
Thorium	0	Normal	Appear	No	No	Normal UTL 95-95	13.97	
Titanium	0	Normal	Appear	Yes	Yes	Normal UTL 95-95	3491	
Tungsten	30	-	-	No	No	-	>LOD	No detections of analyte in background; any detections above the LOD measured in the field will be considered above background
Uranium	0	Gamma	Approximate	Yes	Yes	WH Approx Gamma UTL 95-95	5.138	
Vanadium	1	Normal	Appear	No	No	Normal UTL 95-95	97.93	
Zinc	0	Normal	Appear	No	No	Normal UTL 95-95	71.81	
Zirconium	0	Normal	Appear	Yes	Yes	Normal UTL 95-95	328.6	

Notes:
- Not applicable
BTV Background threshold value
GOF Goodness of fit
LOD Limit of detection
ppm Parts per million
UTL Upper threshold limit
WH Wilson Hilferty

6.0 REFERENCES

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ATTACHMENT H-1: PHOTOGRAPHIC LOG

SURFACE SOIL SAMPLING PHOTOS

The following photos were taken during RAES Task Order 35 in November 2022.



PHOTOGRAPH 1

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS01

35.6130, -108.5573

DESCRIPTION:

Surface soil sample
OCRM-B02-SS01-
111622.



PHOTOGRAPH 2

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS02

35.6130, -108.5572

DESCRIPTION:

Surface soil sample
OCRM-B02-SS02-
111622.



PHOTOGRAPH 3

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS03

35.6130, -108.5571

DESCRIPTION:

Surface soil sample
OCRM-B02-SS03-
111622.



PHOTOGRAPH 4

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS04

35.6130, -108.5570

DESCRIPTION:

Surface soil sample
OCRM-B02-SS04-
111622.



PHOTOGRAPH 5

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS05

35.6130, -108.5569

DESCRIPTION:

Surface soil sample
OCRM-B02-SS05-
111622.



PHOTOGRAPH 6

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS06

35.6129, -108.5573

DESCRIPTION:

Surface soil sample
OCRM-B02-SS06-
111622.



PHOTOGRAPH 7

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS07

35.6129, -108.5572

DESCRIPTION:

Surface soil sample
OCRM-B02-SS07-
111622.



PHOTOGRAPH 8

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS08

35.6129, -108.5571

DESCRIPTION:

Surface soil sample
OCRM-B02-SS08-
111622.



PHOTOGRAPH 9

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS09

35.6129, -108.5570

DESCRIPTION:

Surface soil sample
OCRM-B02-SS09-
111622.



PHOTOGRAPH 10

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS10

35.6129, -108.5569

DESCRIPTION:

Surface soil sample
OCRM-B02-SS10-
111622.



PHOTOGRAPH 11

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS11
35.6128, -108.5573

DESCRIPTION:

Surface soil sample
OCRM-B02-SS11-
111622.



PHOTOGRAPH 12

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS12
35.6128, -108.5572

DESCRIPTION:

Surface soil sample
OCRM-B02-SS12-
111622.



PHOTOGRAPH 13

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS13

35.6129, -108.5571

DESCRIPTION:

Surface soil sample
OCRM-B02-SS13-
111622.



PHOTOGRAPH 14

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS14

35.6128, -108.5570

DESCRIPTION:

Surface soil sample
OCRM-B02-SS14-
111622.



PHOTOGRAPH 15

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS15

35.6128, -108.5569

DESCRIPTION:

Surface soil sample
OCRM-B02-SS15-
111622.



PHOTOGRAPH 16

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS16

35.6128, -108.5573

DESCRIPTION:

Surface soil sample
OCRM-B02-SS16-
111622.



PHOTOGRAPH 17

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS17

35.6128, -108.5572

DESCRIPTION:

Surface soil sample
OCRM-B02-SS17-
111622.



PHOTOGRAPH 18

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS18

35.6128, -108.5571

DESCRIPTION:

Surface soil sample
OCRM-B02-SS18-
111622.



PHOTOGRAPH 19

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS19
35.6128, -108.5570

DESCRIPTION:

Surface soil sample
OCRM-B02-SS19-
111622.



PHOTOGRAPH 20

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS20
35.6128, -108.5569

DESCRIPTION:

Surface soil sample
OCRM-B02-SS20-
111622.



PHOTOGRAPH 21

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS21
35.6127, -108.5573

DESCRIPTION:

Surface soil sample
OCRM-B02-SS21-
111622.



PHOTOGRAPH 22

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS22
35.6127, -108.5572

DESCRIPTION:

Surface soil sample
OCRM-B02-SS22-
111622.



PHOTOGRAPH 23

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS23

35.6127, -108.5571

DESCRIPTION:

Surface soil sample
OCRM-B02-SS23-
111622.



PHOTOGRAPH 24

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS24

35.6127, -108.5570

DESCRIPTION:

Surface soil sample
OCRM-B02-SS24-
111622.



PHOTOGRAPH 25

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS25

35.6127, -108.5569

DESCRIPTION:

Surface soil sample
OCRM-B02-SS25-
111622.



PHOTOGRAPH 26

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS26

35.6126, -108.5573

DESCRIPTION:

Surface soil sample
OCRM-B02-SS26-
111622.



PHOTOGRAPH 27

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS27

35.6126, -108.5572

DESCRIPTION:

Surface soil sample
OCRM-B02-SS27-
111622.



PHOTOGRAPH 28

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS28

35.6126, -108.5571

DESCRIPTION:

Surface soil sample
OCRM-B02-SS28-
111622.



PHOTOGRAPH 29

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS29

35.6126, -108.5570

DESCRIPTION:

Surface soil sample
OCRM-B02-SS29-
111622.



PHOTOGRAPH 30

DATE: 11/16/2022

LOCATION:

OCRM-B02-SS30

35.6126, -108.5569

DESCRIPTION:

Surface soil sample
OCRM-B02-SS30-
111622.

X-RAY FLUORESCENCE IN SITU PHOTOS



PHOTOGRAPH 1

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-
35.6128, -108.5573

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-.



PHOTOGRAPH 2

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-01

35.6130, -108.5573

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-01.



PHOTOGRAPH 3

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-02

35.6130, -108.5572

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-02.



PHOTOGRAPH 4

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-05

35.6130, -108.5569

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-05.



PHOTOGRAPH 5

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-06

35.6129, -108.5573

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-06.



PHOTOGRAPH 6

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-07

35.6129, -108.5572

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-07.



PHOTOGRAPH 7

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-08

35.6129, -108.5571

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-08.



PHOTOGRAPH 8

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-10

35.6129, -108.5569

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-10.



PHOTOGRAPH 9

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-11

35.6129, -108.5573

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-11.



PHOTOGRAPH 10

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-12

35.6129, -108.5572

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-12.



PHOTOGRAPH 11

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-13

35.6129, -108.5571

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-13.



PHOTOGRAPH 12

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-14

35.6129, -108.5570

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-14.



PHOTOGRAPH 13

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-15

35.6129, -108.5569

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-15.



PHOTOGRAPH 14

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-17

35.6128, -108.5572

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-17.



PHOTOGRAPH 15

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-19

35.6128, -108.5570

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-19.



PHOTOGRAPH 16

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-20

35.6128, -108.5569

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-20.



PHOTOGRAPH 17

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-21

35.6127, -108.5573

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-21.



PHOTOGRAPH 18

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-22

35.6127, -108.5572

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-22.



PHOTOGRAPH 19

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-23

35.6127, -108.5571

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-23.



PHOTOGRAPH 20

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-24

35.6127, -108.5570

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-24.



PHOTOGRAPH 21

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-25

35.6127, -108.5569

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-25.



PHOTOGRAPH 22

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-27

35.6126, -108.5572

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-27.



PHOTOGRAPH 23

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-28

35.6126, -108.5571

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-28.



PHOTOGRAPH 24

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-29

35.6126, -108.5570

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-29.



PHOTOGRAPH 25

DATE: 11/16/2022

LOCATION:

111622-OCRM-
BSA02-30

35.6126, -108.5569

DESCRIPTION:

XRF measurement at
111622-OCRM-
BSA02-30.

ATTACHMENT H-2: PROUCL OUTPUT