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Moab UMTRA Project Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Second Quarter (April – June 2022)

Revision 0

November 2022

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Moab UMTRA Project
Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Second Quarter 2022 (April - June 2022)

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Review and Approval

11/1/2022

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Revision History

Revision	Date	Description
0	November 2022	Initial issue.

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Acronyms and Abbreviations

DOE	Department of Energy
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MEI	maximally exposed individual
met	Meteorology
mrem	millirem
O	Order
pCi	picocurie
pCi/L	picocurie per liter
SAP	Sampling Analysis Plan
TED	total effective dose
TLD	thermoluminescent dosimeter
UMTRA	Uranium Mill Tailings Remedial Action

1.0 Introduction

The purpose of this Report is to present the results of environmental air monitoring at the U.S. Department of Energy (DOE) Moab Uranium Mill Tailings Remedial Action (UMTRA) Project sites during the second calendar quarter of 2022. The Project sites consist of the former uranium ore-processing mill located three miles north of Moab, Utah**,** and the disposal site located near Crescent Junction, Utah.

2.0 Regulatory Requirements

This Report demonstrates compliance with DOE Order (O) 458.1, Admin Chg. 4, "Radiation Protection of the Public and the Environment," which states DOE radiological activities must be conducted in a manner that does not cause total effective dose (TED) to the public to exceed 100 millirems (mrem) in a year, or an equivalent dose to the lens of the eye exceeding 1,500 mrem in a year, or an equivalent dose to the skin or extremities of 5,000 mrem in a year. This limit excludes doses from background radiation, radon gas and its decay products in air, occupational doses, and medical exposures.

For the Project, the total effective dose is the sum of the direct gamma radiation (minus background) and radioactive particulate material (radioparticulate) exposure. DOE O 458.1 also specifies releases of radioactive material to the atmosphere from DOE activities shall not exceed an annual average concentration of 3 picocuries per liter (pCi/L) of radon or its decay products, excluding background, at the site boundary.

Compliance with DOE O 458.1 is demonstrated by calculating the total effective dose to the maximally exposed individual (MEI) or the representative person or group from the public likely to receive the highest radiation dose based on exposure pathways and parameters. The Project has established a MEI for the Moab and Crescent Junction Project sites.

3.0 Monitoring Network Changes

In 2019 a self-assessment of the Environmental Air Monitoring program was conducted. The assessment identified several areas for improvement. The environmental air monitoring network has been modified to improve data quality and enhance compliance to DOE O 458.1. These changes include new air monitoring station layouts to the gamma and radon networks, updated radioparticulate dose calculations to include human breathing rate and updated dose conversion factors, updates to the Project's MEI with the addition of a representative person in Moab, updates to the background for gamma and radon at both project sites, and the addition of alarm levels.

4.0 Sampling Methods and Background Values

Monitoring data is reported quarterly for radon, direct gamma radiation, and site specific radioparticulates. Off-site monitoring locations for the Moab site are shown on Figure 1, and on-site and MEI locations are shown on Figure 2. Monitoring locations for the Crescent Junction sites are shown on Figure 3. All background values are subtracted from results in this report.

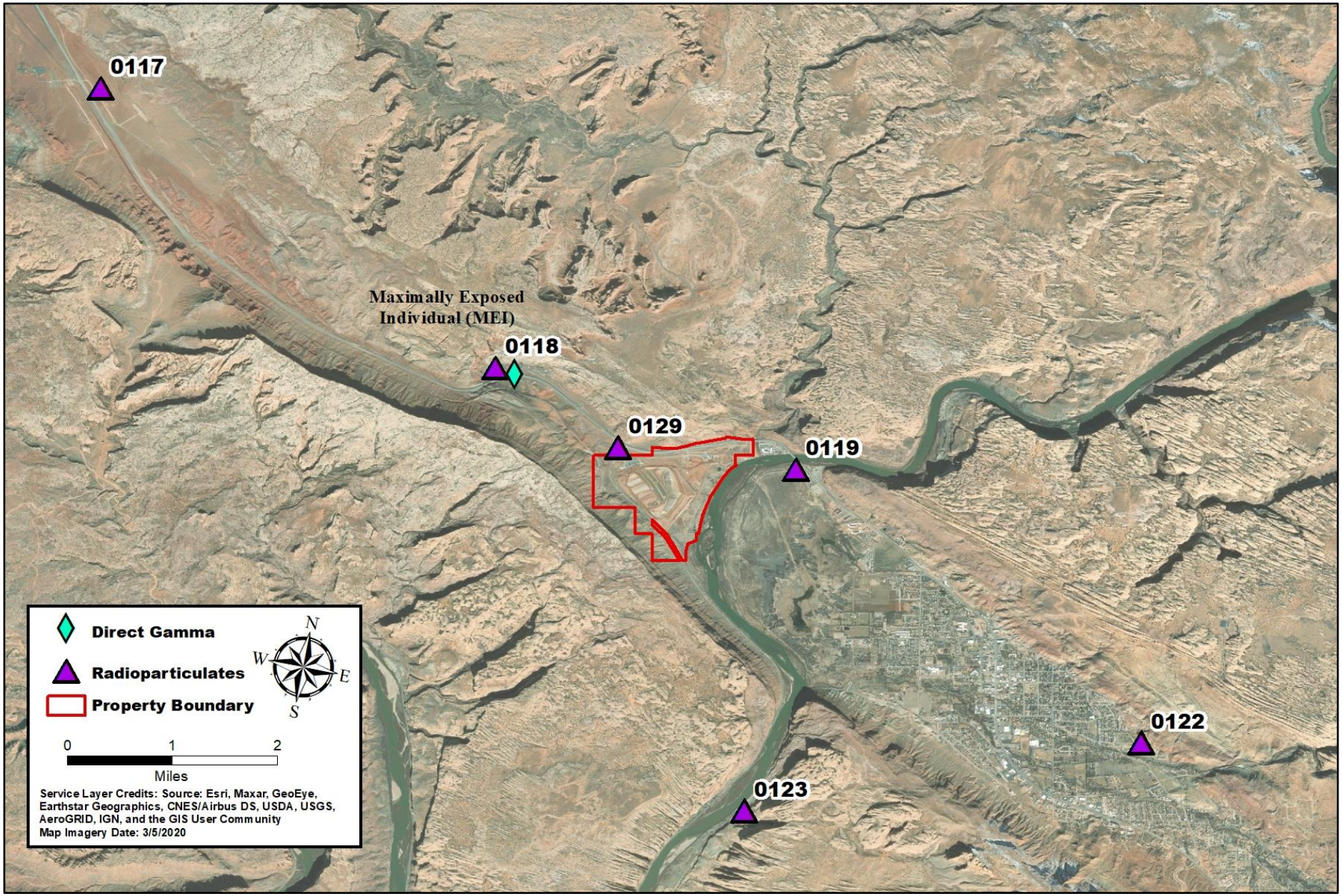

Figure 1. Moab Off-site Environmental Air Monitoring Locations

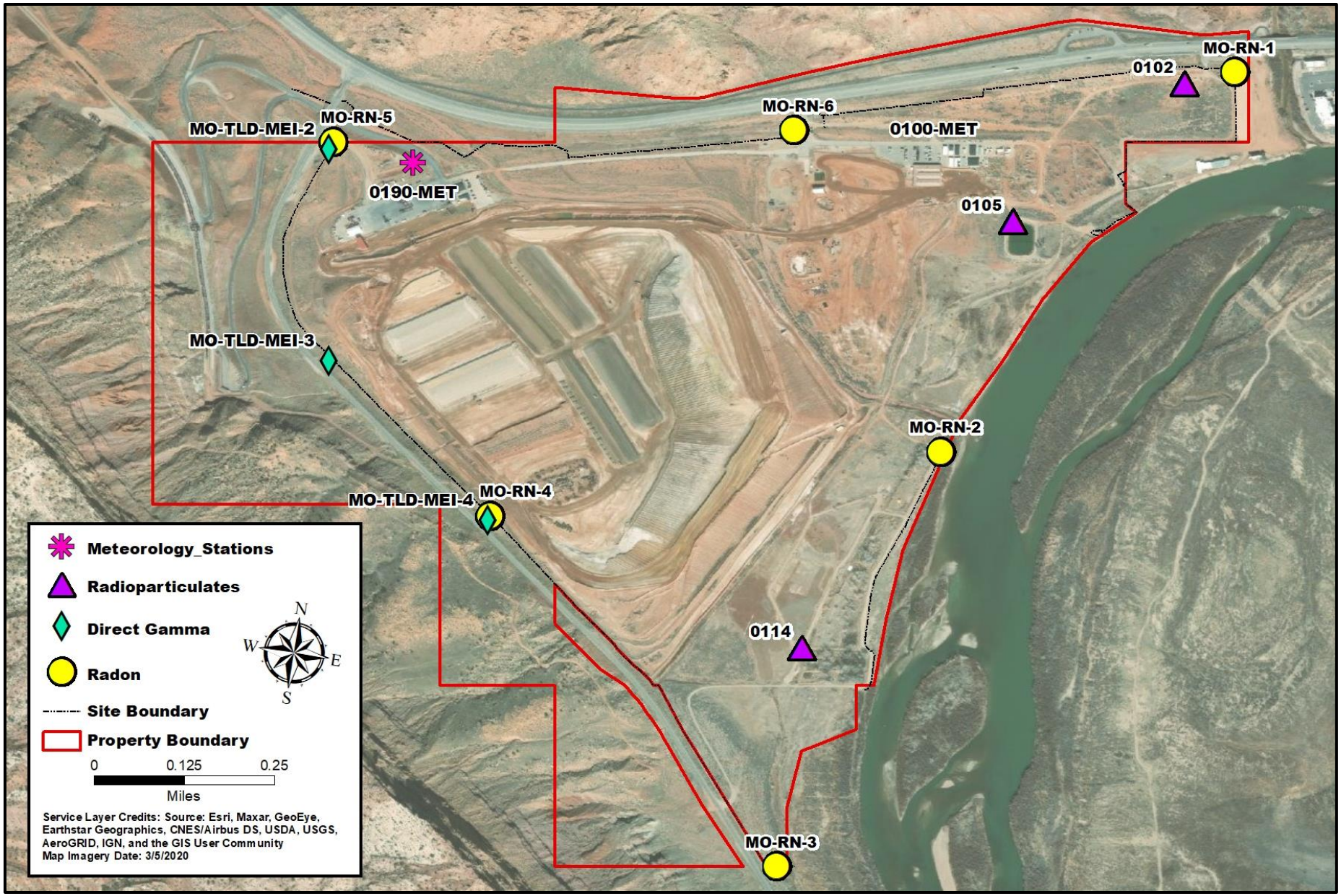

Figure 2. Moab On-site and Maximally Exposed Individual Environmental Air Monitoring Locations

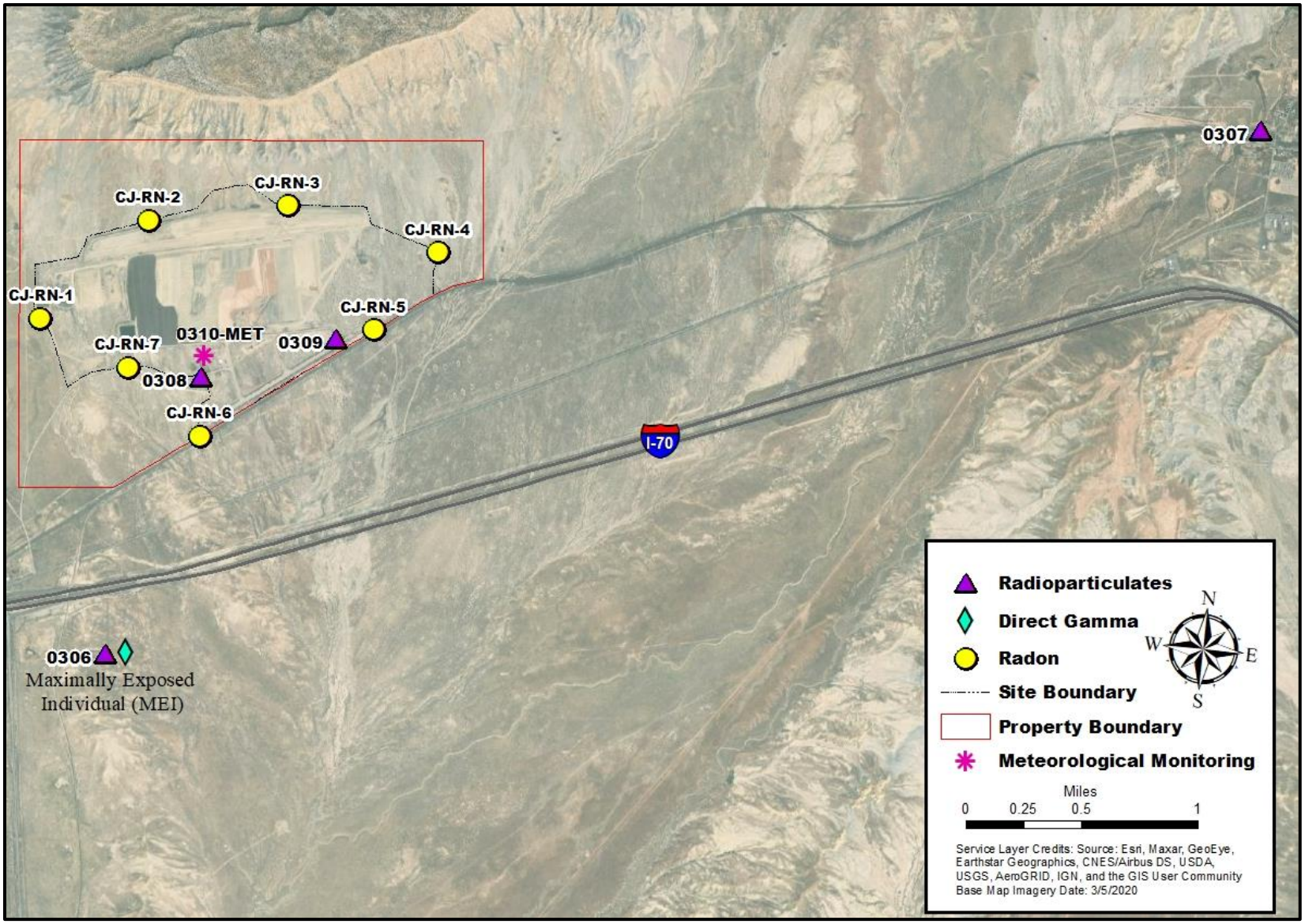

Figure 3. Crescent Junction Site Environmental Air Monitoring Locations

4.1 Meteorology

Meteorological data were collected from the on-site meteorological stations and downloaded from the Vista Data Vision online database, where meteorological data are uploaded from the Site. Hourly averages are analyzed. Meteorology (met) stations are serviced annually. Moab and Crescent Junction met stations measures wind speed and direction, temperature, and precipitation. Precipitation is collected with both a heated rain gauge and a manual rain gauge.

4.2 Direct Gamma Radiation

Direct Gamma is monitored at the Project's Maximum Exposed Individual (MEI) at Moab and Crescent Junction. As a best management practice the Project also monitors a representative person at the Moab Site. Background direct gamma is measured and calculated as a rolling annual sum. For second quarter 2022 the background is 84 mrem for Moab and the background for Crescent Junction is 92.5 mrem, based on three years of data collected from 2006 to 2009 (like on previous reports) because there was not a current full years' worth of data collected yet for this report.

The MEI for the Moab Project Site is Arches National Park, and the MEI for Crescent Junction is a resident located within one mile of the site. The representative person for the Moab Project Site is a hypothetical person that rides a bike past the Site along State Route 279. It is not possible or practical to monitor if a person has the assumed living habits in the scenario presented in this representative person evaluation. However, considering the high recreational activity of the area, it is not unreasonable to assume that somebody in the local community would take part in an activity that would cause them to receive a dose from the Site while in this area. Therefore, conservative calculations of the representative person will include the exposure scenario of:

- Recreational bicycling 5 days/week for 50 weeks/year.
- Estimated round trip travel distance along the roadway is 2.8 miles.
- 14 minutes round trip to travel 2.8 miles, which equates to and occupancy time of 3,500 minutes/year.

4.3 Radon

The Radon network consists of 13 radon stations on the Moab and Crescent Junction site boundaries. This is consistent with requirements in DOE O 458.1. Background radon for the Moab and Crescent Junction projects site is 0.6 pCi/L. Locations with duplicate cups were averaged for the quarter and treated as the final result for that location.

4.4 Radioparticulates

The radioparticulate monitoring network for the Moab site consists of nine continuous air samplers: six off site (Figure 1) and three on site (Figure 2). The radioparticulates for the Crescent Junction networks consists of four stations: two off site and two on site (Figure 3). The radionuclides of concern on the Project are those inherent in the process of extracting uranium during the milling process when the mill was operational. The background dose from inhalation of radioparticulates was not determined. However, because the radionuclides of concern are known to be directly linked to the tailings pile, all radioparticulates measured at the Project's monitoring stations are assumed to be from the Project.

5.0 Moab Results

5.1 Meteorological Analysis

Meteorological data were collected from the on-site meteorological station (0190-Met) and downloaded from the Vista Data Vision online database, where meteorological data are uploaded and stored from the Site. Figure 4 displays the wind rose for this quarter, with the wedges on the wind rose showing the direction the wind was coming from. In second quarter 2022, the winds were primarily out of the southeast and northwest. The average temperature for the quarter was 69°F. The lowest recorded temperature for the quarter was 29°F, and the highest was 105°F. The Site received 0.78 inches of precipitation during second quarter 2022. Figure 5 presents the Moab ten-year average (based on data collected from 2011 through 2021) along with 2021 and 2022 cumulative precipitation.

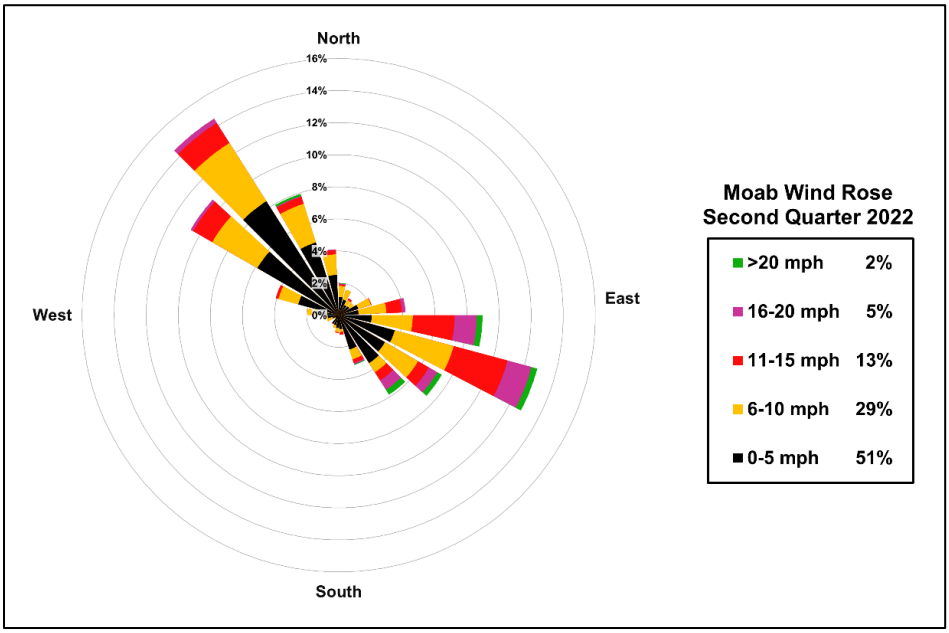

Figure 4. Moab Wind Rose for Second Quarter 2022

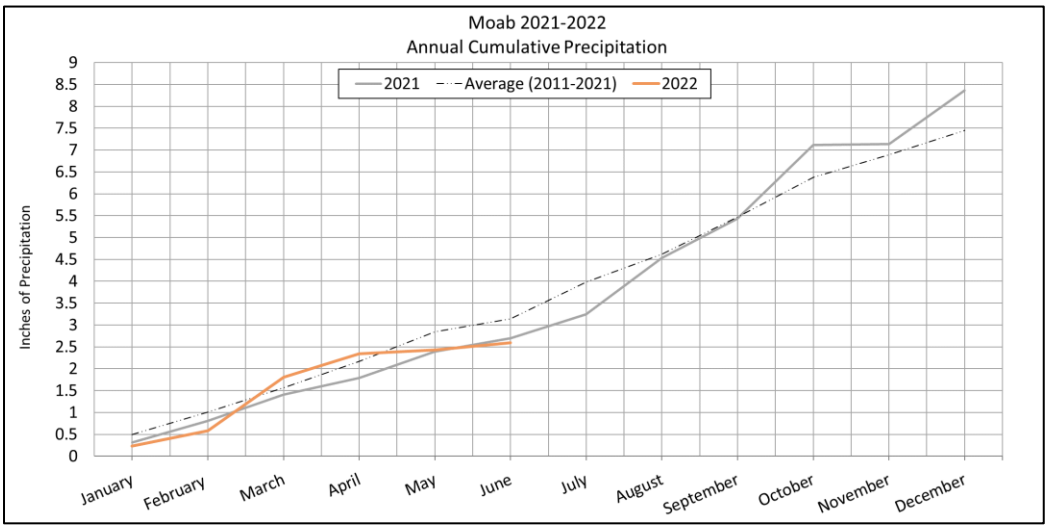

Figure 5. Moab Ten-Year Average, 2021, and Second Quarter 2022 Cumulative Precipitation

5.2 Radon

The Project's annual average radon emission limit at the Moab site boundary is 3.0 pCi/L. Table 1 shows quarterly and annual radon results for the past year at the site boundary. Background value of 0.6 pCi/L has been subtracted from the annual average. Historical data from the previous stations were used to complete the past two quarters data set. Station locations from the new network are located at or near old network locations. Therefore, historical data is preserved to compare with previous quarters.

Table 1. Quarterly Radon Concentrations for the Moab Site for the Past Year

Station Number	Third Quarter 2021 (pCi/L)	Fourth Quarter 2021 (pCi/L)	First Quarter 2022 (pCi/L)	Second Quarter 2022 (pCi/L)	Annual Average (pCi/L)
MO-RN-1	1.10	2.50	2.30	0.68	**1.05**
MO-RN-2	1.90	5.30	4.60	1.60	**2.74**
MO-RN-3	1.50	3.10	1.90	0.66	**1.19**
MO-RN-4	2.10	1.80	1.40	1.10	**1.00**
MO-RN-5	1.80	2.20	1.30	0.76	**0.92**
MO-RN-6	2.40	3.90	2.80	1.30	**2.00**

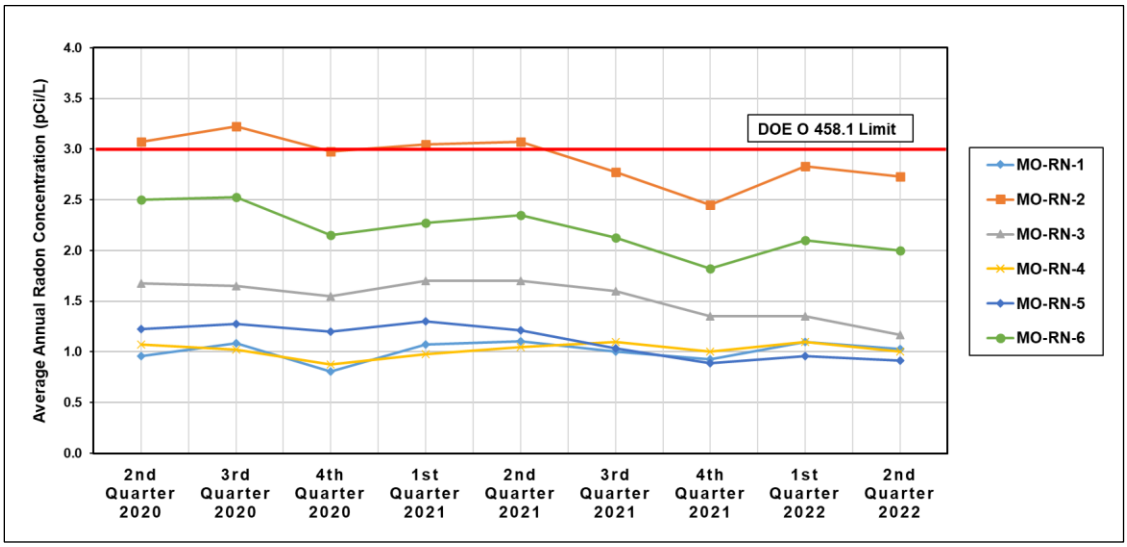

Figure 6. Moab Average Annual Radon Concentrations

5.3 Radioparticulates

Table 2 provides the quarterly and annual dose from inhalation of radioparticulates from the past year at the Moab site. Filters were analyzed at an accredited lab for concentrations of total uranium, actinium-227, thorium-230, radium-226, and polonium-210. Actinium-227 and protactinium-231 are assumed to be in equilibrium. Therefore, the concentration of protactinium-231 is calculated by multiplying the actinium-227 concentration lab results by a correction factor of 0.32, which is consistent with the *Moab UMTRA Project Health Physics Plan* (DOE-EM/GJ3003).

Polonium-210 was exempt from the calculations for the first quarter 2022 and third quarter 2021. Polonium-210 was also exempt from stations 102, 105, 122, 123 and 129 from the second quarter. The lab flagged the polonium values as a false high reading in the first and second quarter results. This occurs when concentrations are below the detection limit. Therefore, first and second quarter results are lower than previous quarters. Third quarter results from the lab were biased high due to having low chemical yields that resulted from high recovery values. A full explanation from third quarter can be found in the *Moab UMTRA Project Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Third Quarter 2021 (July-September 2021)* (DOE-EM/GJTAC3070).

Table 2. Radioparticulate Dose for Moab Site for the Past Year

Station Number	Third Quarter 2021 (mrem)	Fourth Quarter 2021 (mrem)	First Quarter 2022 (mrem)	Second Quarter 2022 (mrem)	Annual Total (mrem)
On Site Locations					
0102-RP	0.26	0.53	0.14	0.12	**1.06**
0105-RP	0.29	0.68	0.12	0.21	**1.30**
0114-RP	0.42	0.65	0.14	1.10	**2.30**
Off Site Locations					
0117-RP	0.08	0.45	0.01	0.27	**0.82**
0118-RP	0.14	0.57	0.07	0.45	**1.23**
0119-RP	0.07	0.57	0.06	0.22	**0.92**
0122-RP	0.16	0.31	0.03	0.10	**0.61**
0123-RP	0.07	0.41	0.06	0.10	**0.64**
0129-RP	0.50	0.87	0.25	1.12	**2.73**

5.4 Total Effective Dose

Total Effective Dose for the Project is calculated by subtracting the annual direct gamma background dose from the total annual dose from TLDs and adding the radioparticulate dose from the closest radioparticulate air station. Nearly all dose to the MEI and Representative Person is due to direct gamma radiation. The dose to the lens of the eye, skin, and extremities is the same as a full body dose and is below the regulatory limit of 1500 mrem in a year to the lens of the eye and 5000 mrem in a year to the skin or extremities.

The MEI annual total effective dose for this quarter was at or below background levels The Representative Person Dose is 7.18 mrem. Both doses are below the 100 mrem/year limit.

6.0 Crescent Junction Results

6.1 Meteorological Analysis

Meteorological data were collected from the on-site meteorological station and downloaded from the Vista Data Vision online database, where meteorological data are uploaded and stored from the Site. Figure 7 displays the wind rose for this quarter, with the wedges on the wind rose showing which direction the wind was coming from. In second quarter 2022, the prevailing winds were variable from the west. The site received 0.32 inches of precipitation. Figure 9 presents the Crescent Junction ten-year average precipitation (based on data collected from 2011 through 2021) and the total monthly precipitation from 2021 and 2022. The average temperature for the quarter was 64°F. The lowest recorded temperature for the quarter was 23°F, and the highest was 99°F.

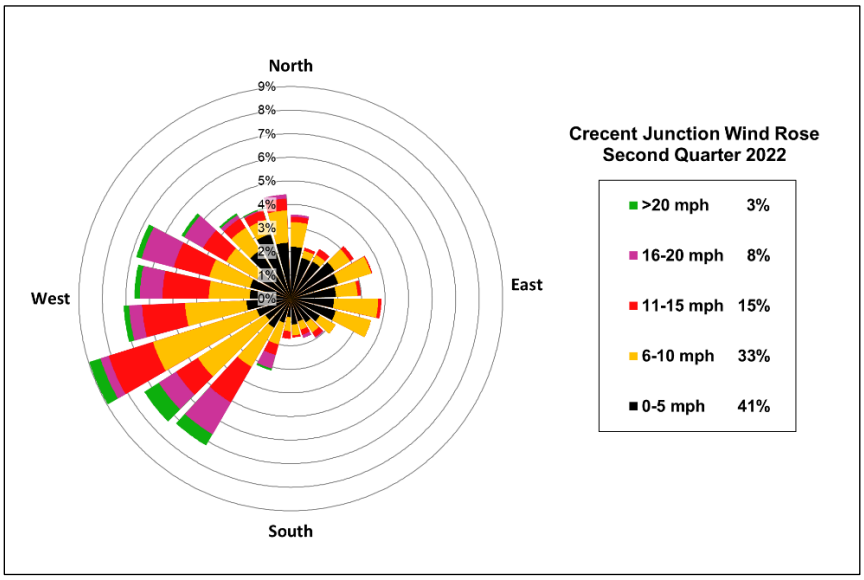

Figure 7. Crescent Junction Wind Rose for Second Quarter 2022

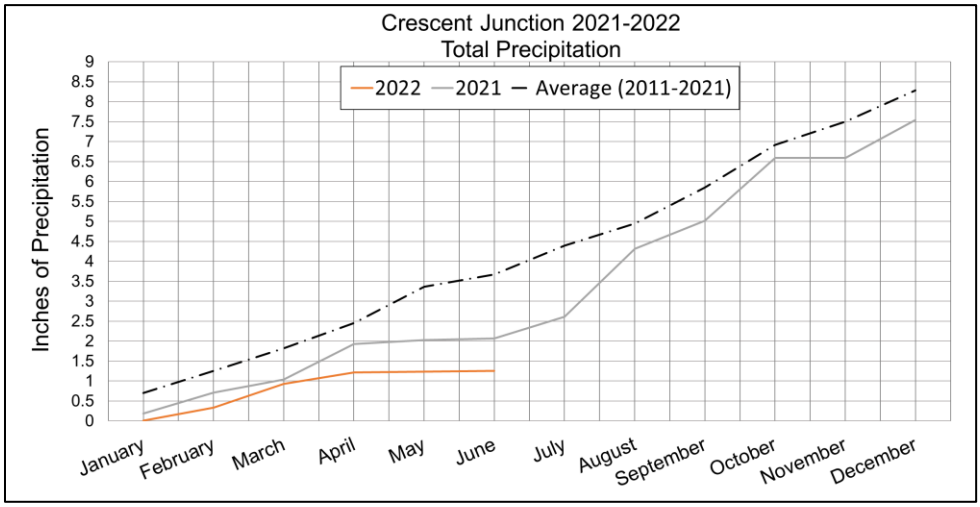

Figure 8. Crescent Junction Average, 2021, and Second Quarter 2022 Cumulative Precipitation

6.2 Radon

The Project's annual average radon emission limit at the Crescent Junction site boundary is 3.0 pCi/L. Table 3 shows quarterly and annual radon results for the past year at the site boundary. Background value of 0.6 pCi/L has been subtracted from the annual average. Historical data from the previous stations were used to complete the past three quarters data set. Station locations from the new network are located at or near old network locations. Therefore, historical data is preserved to compare with previous quarters.

Table 3. Radon Concentrations for the Crescent Junction Site for the Past Year

Station Number	Third Quarter 2021 (pCi/L)	Fourth Quarter 2021 (pCi/L)	First Quarter 2022 (pCi/L)	Second Quarter 2022 (pCi/L)	Annual Average (pCi/L)
CJ-RN-1	0.54	0.70	0.57	0.19	**0.00**
CJ-RN-2	0.57	0.89	0.81	0.30	**0.04**
CJ-RN-3	0.65	0.68	0.86	0.32	**0.03**
CJ-RN-4	0.76	0.92	0.84	0.26	**0.09**
CJ-RN-5	1.50	2.70	1.35	0.58	**0.93**
CJ-RN-6	ND	ND	1.95	0.65	**ND**
CJ-RN-7	ND	ND	1.40	0.65	**ND**

ND = No Data

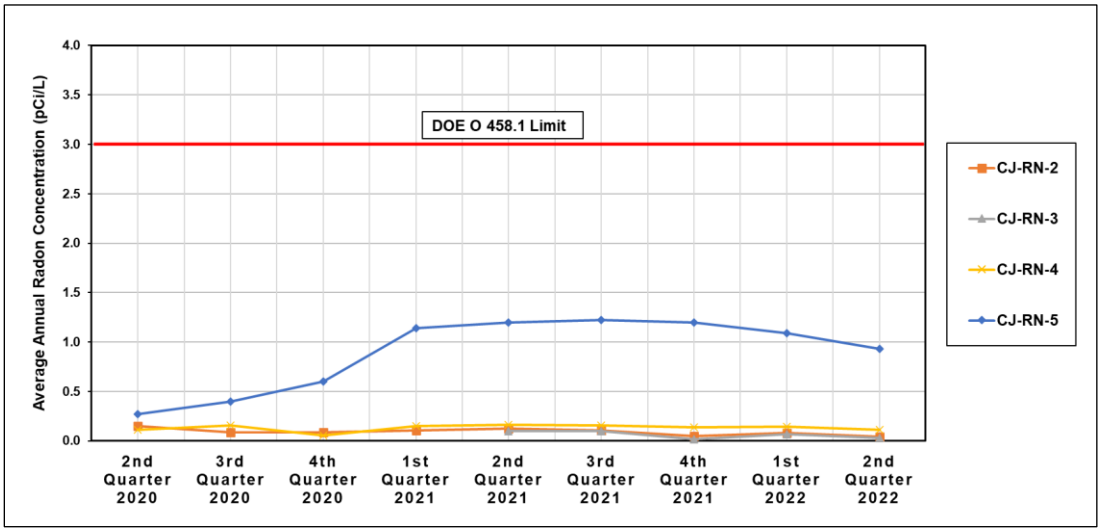

Figure 9. Crescent Junction Locations with Highest Second Quarter 2022 Average Annual Radon Concentrations

6.3 Radioparticulates

Table 4 provides the quarterly and annual dose from inhalation of radioparticulates from the past year at the Crescent Junction site. Filters were analyzed at an accredited lab for concentrations of total uranium, actinium-227, thorium-230, radium-226, and polonium-210. Actinium-227 and protactinium-231 are assumed to be in equilibrium. Therefore, the concentration of protactinium-231 is calculated by multiplying the actinium-227 concentration lab results by a correction factor of 0.32, which is consistent with the Moab UMTRA Project Health Physics Plan (DOE-EM/GJ3003).

Polonium-210 was exempt from the calculations for the first quarter 2022 and third quarter 2021. Polonium-210 was also exempt from station 306 from the second quarter. The lab flagged the polonium values as a false high reading in the first and second quarter results. This occurs when concentrations are below the detection limit. Therefore, first and second quarter results are lower than previous quarters. Third quarter results from the lab were biased high due to having low chemical yields that resulted from high recovery values. A full explanation from third quarter can be found in the *Moab UMTRA Project Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Third Quarter 2021 (July-September 2021)* (DOE-EM/GJTAC3070).

Table 4. Radioparticulate Effective Doses for the Crescent Junction Site for the Past Year

Station Number	Third Quarter 2021 (mrem)	Fourth Quarter 2021 (mrem)	First Quarter 2022 (mrem)	Second Quarter 2022 (mrem)	Annual Total (mrem)
On Site Locations					
0308-RP	0.21	0.48	0.11	0.31	**1.11**
0309-RP	0.17	0.63	0.25	0.54	**1.58**
Off Site Locations					
0306-RP	0.02	0.40	0.06	0.03	**0.51**
0307-RP	0.02	0.41	0.03	0.27	**0.73**

6.4 Total Effective Dose

Total Effective Dose for the Project is calculated by subtracting the annual direct gamma background dose from the total annual dose from TLDs and adding the radioparticulate dose from the closest radioparticulate air station. Nearly all dose to the MEI and Representative Person is due to direct gamma radiation. The dose to the lens of the eye, skin, and extremities is the same as a full body dose and is below the regulatory limit of 1500 mrem in a year to the lens of the eye and 5000 mrem in a year to the skin or extremities.

The dose to the MEI was at or below background levels for this quarter.

7.0 Data Quality

Radon detectors, thermoluminescent dosimeters used for continuous dose measurements, and radioparticulate sample filters were sent to qualified off-site laboratories for analyses in accordance with the *Moab UMTRA Project Environmental Air Monitoring Sampling and Analysis Plan* (SAP) (DOE-EM/GJTAC2219). Qualified Project personnel evaluated the analytical data received for consistency with other data points and Quality Assurance/Quality Control samples.

7.1 Transits

Control samples measured the dose for gamma and radon while being shipped from the site to the respective analytical laboratories. Transit values for direct gamma was an average of 42

mrem. Because the transit TLD received higher than background exposure it is likely TLD badges were exposed in transit and resulted in higher-than-normal readings. Therefore, the transit value has been subtracted from final results. The Radonova lab subtracts the average transit exposure from the reported radon concentrations. The radon and gamma transit values are shown in Table 8.

Table 5. Shipment Control Sample Results for Second Quarter 2022

Sample	Result
Radon:	pCi/L
In-transit 1	14 +/- 9
In-transit 2	18 +/- 9
In-transit 3	19 +/- 9
Gamma:	mrem
CONTROL Badge	41
Transit 1	43
Transit 2	41

7.2 Station Duplicates

Duplicate samples for radon were collected at Moab locations MO-RN-1, MO-RN-2, MO-RN-3, and at Crescent Junction locationsCJ-RN-4, CJ-RN-5, CJ-RN-6. All gamma stations are equipped with duplicate TLDs. All results associated with the duplicate sampling are provided in Table 6.

Table 6. Duplicate Results for Second Quarter 2022

Location	Result	Duplicate Result	Average Results
Moab			
Radon:	pCi/L	pCi/L	pCi/L
MO-RN-1	0.73	0.62	0.68
MO-RN-2	1.60	1.50	1.55
MO-RN-3	0.73	0.59	0.66
Gamma:	mrem	mrem	mrem
MO-MEI	4	0	2
MO-TLD-MEI-2	21	26	23.5
MO-TLD-MEI-3	86	86	86
MO-TLD-MEI-4	102	104	103
Crescent Junction			
Radon:	pCi/L	pCi/L	pCi/L
CJ-RN-4	0.27	0.24	0.26
CJ-RN-5	0.57	0.59	0.58
CJ-RN-6	0.57	0.73	0.65
Gamma:	mrem	mrem	mrem
CJ-MEI	0	5	2.5

7.3 Suspected Anomalies

All analytical data are reviewed for anomalous or outlying data points. Monitoring data are evaluated against historical and minimum/maximum values to determine if the reported data are within reasonable expected ranges. No anomalous data were noted for this quarter.

8.0 Conclusion

Data collected during the second quarter of 2022 met the applicable laboratory control criteria for their respective analyses. The results were within the acceptable limits associated with each matrix. Data in this report are considered validated and may be treated as final results. No regulatory limits were reached or exceeded.

9.0 References

DOE (U.S. Department of Energy), *Moab UMTRA Project Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Third Quarter 2021 (July-September 2021)* (DOE-EM/GJTAC3070)

DOE (U.S. Department of Energy), *Moab UMTRA Project Environmental Air Monitoring Sampling and Analysis Plan* (DOE-EM/GJTAC2219).

DOE (U.S. Department of Energy), *Moab UMTRA Project Health Physics Plan* (DOE-EM/GJ3003).

DOE (U.S. Department of Energy) Order 458.1, Admin Chg. 4, "Radiation Protection of the Public and the Environment.