

Office of Environmental Management – Grand Junction



Moab UMTRA Project
Environmental Air Monitoring Data Quarterly
Report for the Moab and Crescent Junction,
Utah, Sites Fourth Quarter 2020
(October through December 2020)

Revision 0

April 2021



U.S. Department
of Energy

Office of Environmental Management

**Moab UMTRA Project
Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent
Junction, Utah, Sites Fourth Quarter 2020 (October – December 2020)**

Revision 0

Review and Approval

4/8/2021

X Stephanie R Lein

Stephanie Lein
TAC Environmental Air Quality Technician
Signed by: Department of Energy

4/8/2021

X Elizabeth Moran

Elizabeth Moran
TAC Environmental Manager
Signed by: ELIZABETH MORAN (Affiliate)

4/9/2021

X Swaine Skeen

Swaine Skeen
TAC Senior Program Manager
Signed by: Swaine Skeen

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Acronyms and Abbreviations

DOE	Department of Energy
MEI	maximally exposed individual
mrem	millirems
pCi	picocurie
pCi/L	picocurie per liter
SAP	Sampling Analysis Plan
TED	total effective dose
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 fourth quarter of 2020. 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 1, “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 an MEI for the Moab and Crescent Junction Project sites.

3.0 Results for October through December 2020

Monitoring data are reported quarterly for radon, direct gamma radiation, and select 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 site are shown on Figure 3. Based on results from the *Moab UMTRA Project Fourth Quarter 2019 Environmental Air Monitoring Report*, and Rapidos and Radtrack² detector comparison from 2019, the air program has moved forward with using Rapidos radon monitors.

3.1 Moab Site

There are a total of 27 air monitoring stations equipped with radon and gamma detectors associated with the Moab site. Fifteen of these stations are located within the site boundary, while the additional 12 are located at relevant locations off-site. Of these 27 stations, three on-site and six off-site stations are also equipped with air sampling pumps to measure air radioparticulates.

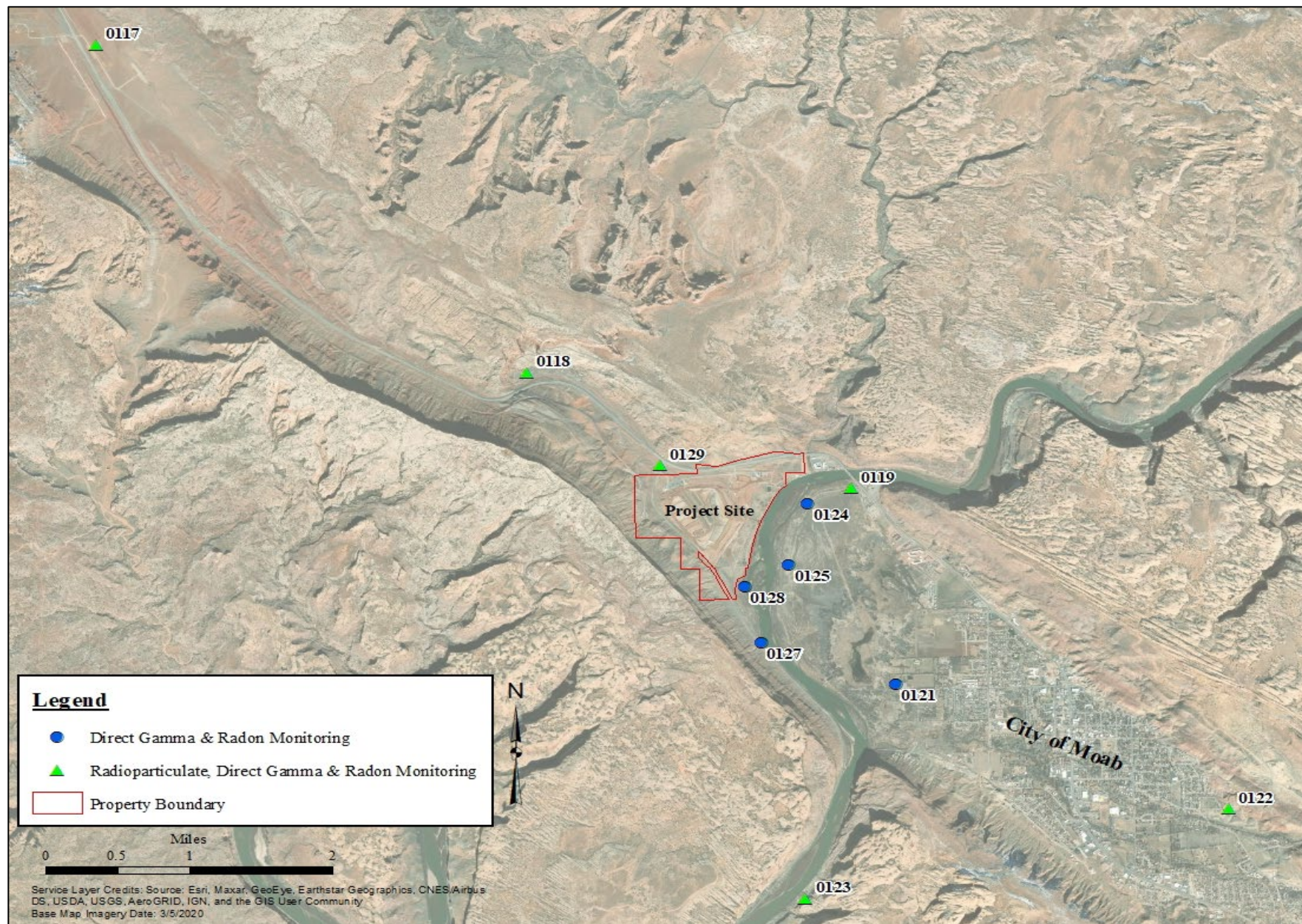


Figure 1. Moab Off-site Environmental Air Monitoring Locations

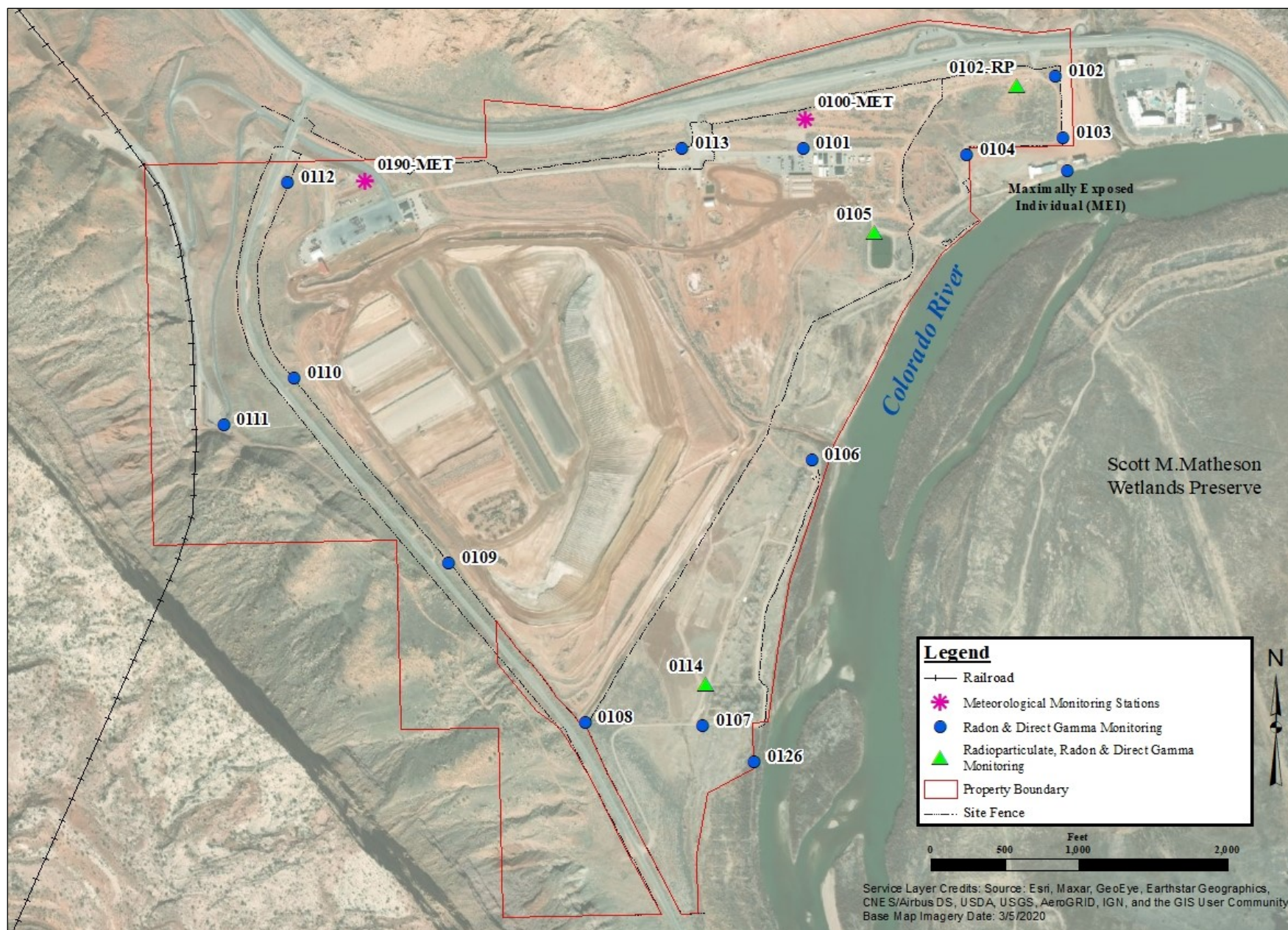


Figure 2. Moab On-site and Maximally Exposed Individual Environmental Air Monitoring Locations

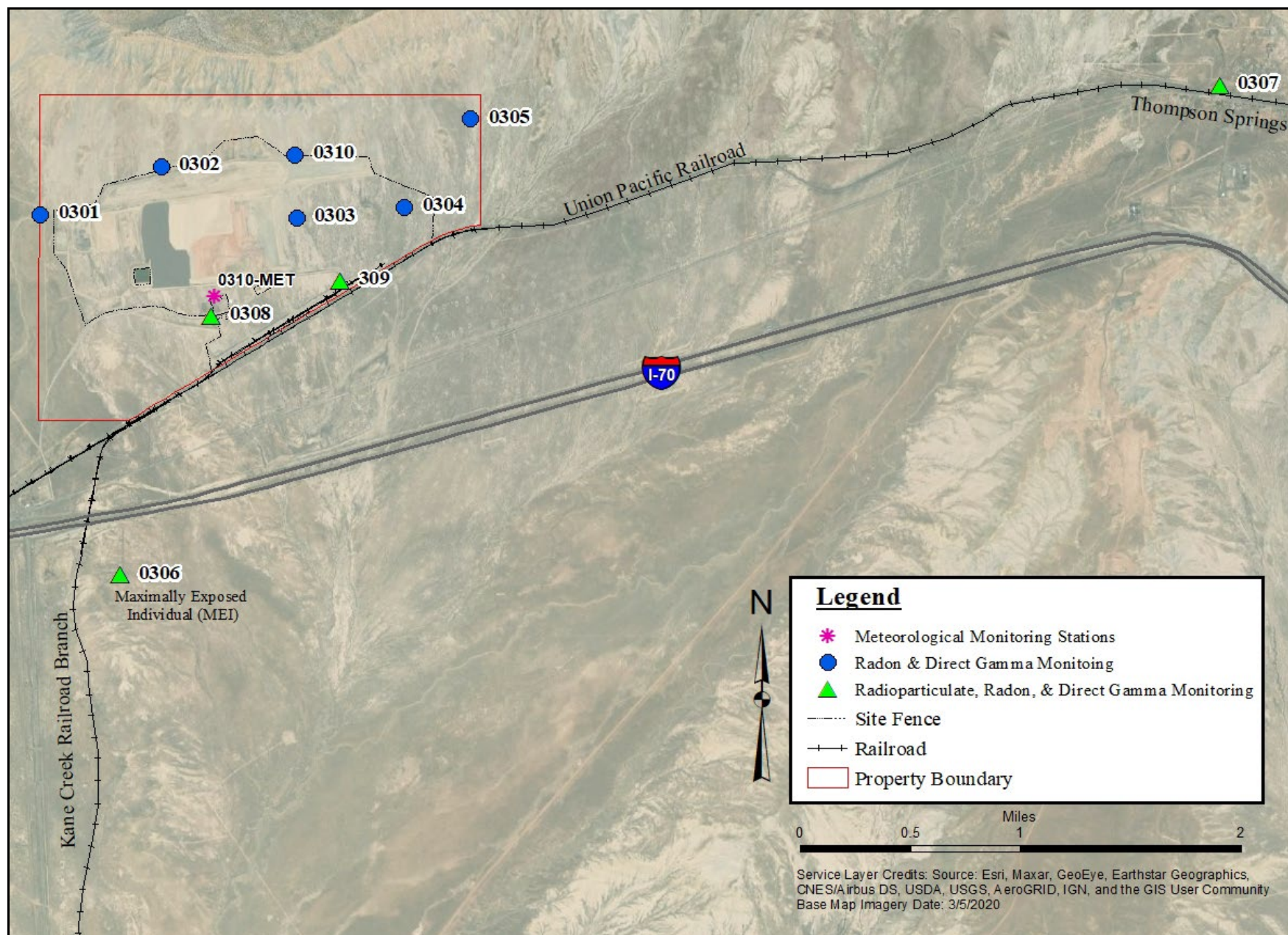


Figure 3. Crescent Junction Site Environmental Air Monitoring Locations

3.1.1 Meteorological Analysis

Meteorological data were collected from the on-site meteorological station (northwest portion of the site) and downloaded from the Vista Data Vision online database, where meteorological data are uploaded from the site. Hourly averages were analyzed. Figure 4 displays the wind rose for this quarter, with the wedges on the wind rose showing which direction the wind is coming from. In fourth quarter 2020, the winds were primarily out of the northwest with the strongest winds from the southeast. The average temperature for the quarter was 45°F. The lowest recorded temperature for the quarter was 13°F, and the highest was 87°F.

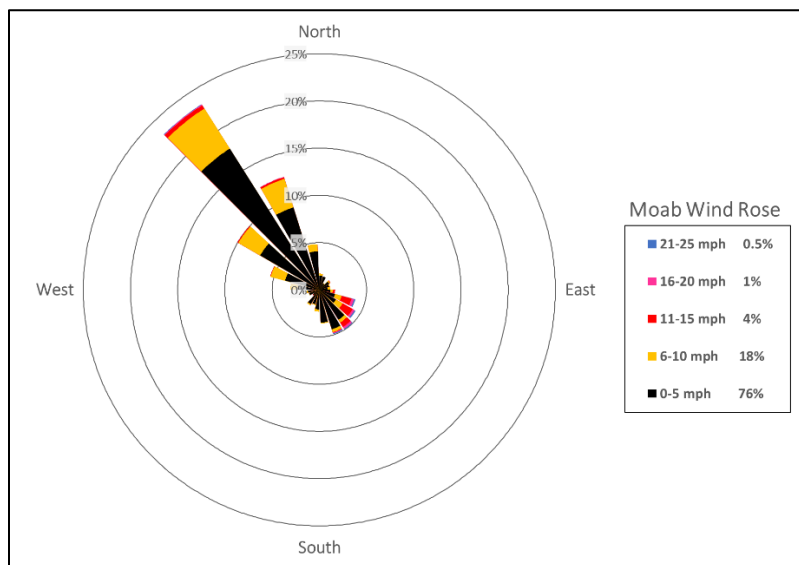


Figure 4. Moab Wind Rose for Fourth Quarter 2020

The site received 0.88 inches of precipitation during fourth quarter 2020. Figure 5 presents the Moab average (based on data collected from 2010 through 2019), 2019, and 2020 cumulative precipitation. As this graph displays, the 2020 precipitation was approximately one-half the site's nine-year average. The total annual precipitation for 2020 was 3.73 inches.

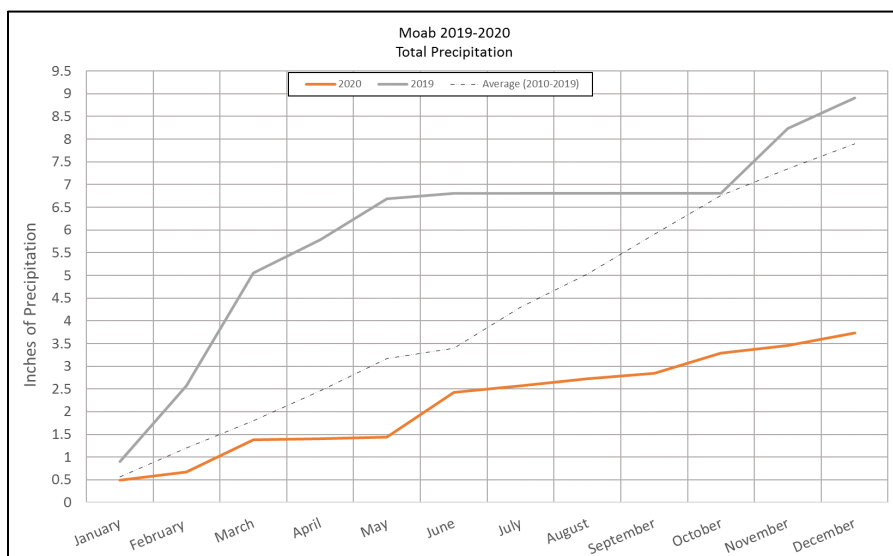


Figure 5. Moab Average, 2019, and 2020 Cumulative Precipitation

3.1.2 Radon

Based on five years of data collected between 2003 and 2008 from stations 0117 and 0123, the average background concentration of radon in the Moab area was established as 0.7 pCi/L. Therefore, the Project's annual average radon emission limit at the Moab site boundary is 3.7 pCi/L. On-site monitoring locations close to the site boundary or publicly accessible areas are used to demonstrate compliance at the boundary. Table 1 shows quarterly and annual radon results for the past year (including background) for on- and off-site locations.

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

Station Number	First Quarter 2020 (pCi/L)	Second Quarter 2020 (pCi/L)	Third Quarter 2020 (pCi/L)	Fourth Quarter 2020 (pCi/L)	Annual Average Concentration Based on Four Quarters (pCi/L)
On-site Locations					
0101	1.9	1.4	2.8	5.1	2.8
0102	1.0	0.8	1.5	2.8	1.5
0103	1.2	0.8	1.4	3.0	1.6
0104	1.7	1.1	2.3	4.5	2.4
0105	1.7	1.4	2.5	5.2	2.7
0106	3.2	1.8	3.1	6.6	3.7
0107	2.5	1.5	2.6	5.0	2.9
0108	2.3	1.9	3.6	5.5	3.3
0109	1.0	1.2	1.9	2.2	1.6
0110	1.0	1.2	2.1	2.1	1.6
0111	0.4	0.5	0.9	1.0	0.7
0112	1.0	1.3	2.5	2.8	1.9
0113	1.6	1.4	3.3	5.1	2.9
0114	3.3	1.9	2.9	5.6	3.4
0126	2.1	1.3	2.1	4.2	2.4
Off-site Locations					
0117	0.3	0.2	0.4	0.7	0.4
0118	0.4	0.3	0.8	0.9	0.6
0119	0.6	0.4	0.9	1.5	0.9
0121	0.3	0.2	0.7	0.9	0.5
0122	0.2	<0.1	0.4	0.5	0.3
0123	0.2	0.2	0.4	0.7	0.4
0124	0.8	NS	1.1	2.2	1.4
0125	1.0	0.7	1.2	2.3	1.3
0127	0.5	0.4	0.9	1.7	0.9
0128	1.7	1.3	1.9	4.1	2.3
0129	1.0	1.1	2.1	2.6	1.7
MEI	1.1	0.6	1.4	2.8	1.5

Background has not been subtracted from annual values

NS = No Sample collected from this location, detector missing upon collection (unknown cause)

NA = Not Applicable, insufficient data to calculate a representative annual average

The Moab locations with the highest annual average radon concentrations as of fourth quarter 2020 are displayed in Figure 6. Locations 0101, 0106, 0107, 0108, 0113, and 0114 continue to have the highest annual average from the last quarter. When compared to the previous quarter, the data indicate fourth quarter 2020 concentrations at all of the on-site locations increased as much as 3.5 pCi/L, and as much as 2.2 pCi/L at all off-site locations.

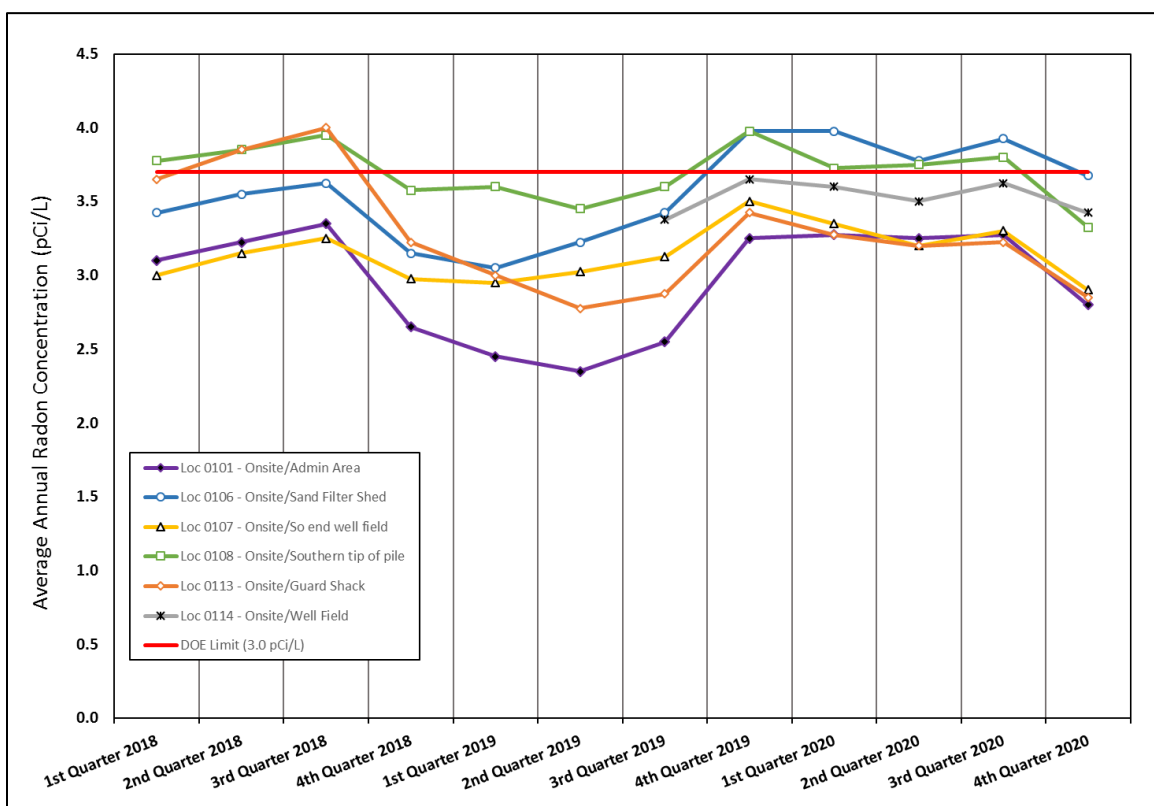


Figure 6. Moab Locations with Highest Fourth Quarter 2020 Average Annual Radon Concentrations

3.1.3 Direct Gamma Radiation

The average annual background (based on five years of data collected between 2003 and 2008) of direct gamma radiation effective dose for the Moab area was established as 82 mrem/year. Table 2 provides quarterly and annual gamma results for the past year, including background, at on- and off-site locations. The annual gamma dose represents the dose an individual would receive from occupying a location for an entire year.

Compared to the previous quarter, this quarter's analytical results indicate the dose increased at 11 on-site locations by as much as 3 mrem, while three on-site locations decreased by as much as 12 mrem. The off-site results indicate nine stations increased by as much as 3 mrem while one location decreased by as much as 1 mrem. One on-site and two off-site locations results indicated no change from the previous quarter.

Table 2. Gamma Radiation Effective Doses for the Moab Site for the Past Year

Station Number	First Quarter 2020 (mrem)	Second Quarter 2020 (mrem)	Third Quarter 2020 (mrem)	Fourth Quarter 2020 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations					
0101	43	45	43	44	175
0102	28	25	26	27	106
0103	28	25	25	28	106
0104	31	29	27	30	117
0105	29	27	28	31	115
0106	37	34	37	38	146
0107	35	31	30	32	128
0108	43	46	46	46	181
0109	111	112	119	112	454
0110	102	96	108	96	402
0111	41	38	39	40	158
0112	49	52	53	52	206
0113	41	46	43	44	174
0114	36	34	34	36	140
0126	33	29	28	31	121
Off-site Locations					
0117	30	27	26	28	111
0118	26	25	24	25	100
0119	28	26	25	25	104
0121	26	27	22	24	99
0122	25	23	20	22	90
0123	24	23	20	23	90
0124	30	NS	27	29	NA
0125	31	30	29	32	122
0127	29	28	27	26	110
0128	29	27	28	29	113
0129	34	33	33	33	133
MEI	28	24	27	28	107

Background has not been subtracted from annual values

NS = No Sample collected from this location, TLD missing upon collection (unknown cause)

NA = Not Applicable, insufficient data to calculate a representative annual dose

3.1.4 Radioparticulates

The effective background dose from inhalation of radioparticulates was not determined, so all effective dose from radioparticulates measured at the Project's monitoring stations are assumed to be from the Project. Table 3 provides the calculated quarterly and annual effective dose from inhalation of radioparticulates for the past year for the Moab site. Filters were analyzed for concentrations of total uranium, actinium-227, thorium-230, radium-226, and polonium-210. Since actinium-227 and protactinium-231 are assumed to be in equilibrium, the concentration of protactinium-231 is estimated by dividing the analyzed actinium-227 concentration by a correction factor of 0.614, which is consistent with the Moab UMTRA Project Health Physics Plan (DOE-EM/GJ3003).

Table 3. Radioparticulate Effective Doses for the Moab Site for the Past Year

Station Number	Isotope	First Quarter 2020 (mrem)	Second Quarter 2020 (mrem)	Third Quarter 2020 (mrem)	Fourth Quarter 2020 (mrem)	Annual Total Dose Based on Four Quarters (mrem)
On-site Locations						
0102-RP (MEI)	Total Uranium	0.002	0.003	0.003	0.003	3.83
	Thorium-230	0.008	0.032	0.045	0.043	
	Radium-226	0.022	0.034	0.057	0.088	
	Polonium-210	0.529	0.301	0.383	0.773	
	Actinium-227	0.105	0.280	0.303	0.536	
	Protactinium-231	0.024	0.064	0.070	0.123	
0105-RP	Total Uranium	0.003	0.004	0.005	0.005	4.99
	Thorium-230	0.027	0.104	0.141	0.160	
	Radium-226	0.033	0.070	0.114	0.101	
	Polonium-210	0.708	0.350	0.627	0.895	
	Actinium-227	0.124	0.096	0.490	0.629	
	Protactinium-231	0.028	0.022	0.113	0.145	
0114-RP	Total Uranium	0.003	0.005	0.006	0.004	7.32
	Thorium-230	0.067	0.157	0.208	0.115	
	Radium-226	0.088	0.037	0.154	0.141	
	Polonium-210	0.635	0.358	0.635	0.895	
	Actinium-227	ND	1.632	0.629	0.839	
	Protactinium-231	ND	0.375	0.145	0.193	
Off-site Locations						
0117-RP	Total Uranium	0.002	0.003	0.003	0.003	3.38
	Thorium-230	0.014	0.017	0.017	0.021	
	Radium-226	0.021	0.011	0.007	0.044	
	Polonium-210	0.545	0.252	0.358	0.602	
	Actinium-227	0.089	0.256	ND	0.839	
	Protactinium-231	0.020	0.059	ND	0.193	
0118-RP	Total Uranium	0.004	0.004	0.002	0.003	2.78
	Thorium-230	0.021	0.064	0.067	0.048	
	Radium-226	0.029	0.066	0.037	0.075	
	Polonium-210	0.440	0.277	0.326	0.562	
	Actinium-227	0.023	0.233	0.126	0.233	
	Protactinium-231	0.005	0.054	0.029	0.054	
0119-RP	Total Uranium	0.002	0.003	0.003	0.004	3.13
	Thorium-230	0.014	0.026	0.032	0.035	
	Radium-226	ND	0.009	0.019	0.023	
	Polonium-210	0.513	0.244	0.350	0.692	
	Actinium-227	0.023	0.154	0.326	0.443	
	Protactinium-231	0.005	0.035	0.075	0.102	
0122-RP	Total Uranium	0.003	0.003	0.003	0.003	3.02
	Thorium-230	0.020	0.029	0.020	0.024	
	Radium-226	0.018	0.038	0.023	0.048	
	Polonium-210	0.578	0.277	0.423	0.651	
	Actinium-227	ND	0.303	0.072	0.326	
	Protactinium-231	ND	0.070	0.017	0.075	

Table 3. Radioparticulate Effective Doses for the Moab Site for the Past Year (continued)

Station Number	Isotope	First Quarter 2020 (mrem)	Second Quarter 2020 (mrem)	Third Quarter 2020 (mrem)	Fourth Quarter 2020 (mrem)	Annual Total Dose Based on Four Quarters (mrem)
Off-site Locations (continued)						
0123-RP	Total Uranium	0.002	0.003	0.002	0.003	3.02
	Thorium-230	0.004	0.029	0.023	0.021	
	Radium-226	0.022	0.018	0.019	0.016	
	Polonium-210	0.545	0.391	0.342	0.602	
	Actinium-227	0.028	0.212	0.280	0.280	
	Protactinium-231	0.006	0.049	0.064	0.064	
0129-RP	Total Uranium	0.003	0.006	0.004	0.005	6.73
	Thorium-230	0.048	0.266	0.293	0.184	
	Radium-226	0.053	0.207	0.136	0.158	
	Polonium-210	0.529	0.317	0.358	0.635	
	Actinium-227	0.280	1.072	0.979	0.536	
	Protactinium-231	0.064	0.247	0.225	0.123	

ND = not detected; analyte concentration below detection limit

These analytical results are used to calculate the effective dose from the inhalation of radioparticulates. The annual dose associated with the stations closest to the site operations (0102, 0105, 0114, and 0129) is higher compared to the remaining stations. Seven stations saw an increase in annual dose (up to 1.2 mrem) compared to the previous quarter's annual dose, while two stations showed a decrease in dose, as much as 1.26 mrem.

3.1.5 Total Effective Dose

The Project must ensure the annual total effective dose to gamma radiation and radioparticulates from Project activities does not exceed 100 mrem above background. The MEI annual total effective dose for this quarter was 28.83 mrem, which is well below the DOE limit. This value was calculated by subtracting the background dose of 82 mrem from the MEI annual gamma radiation dose of 107 mrem and then adding the radioparticulate total dose of 3.83 mrem from location 0102, the closest radioparticulate station to the MEI. Nearly all of the dose to the MEI 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. Figure 7 shows total effective dose measured at the Moab site since 2018.

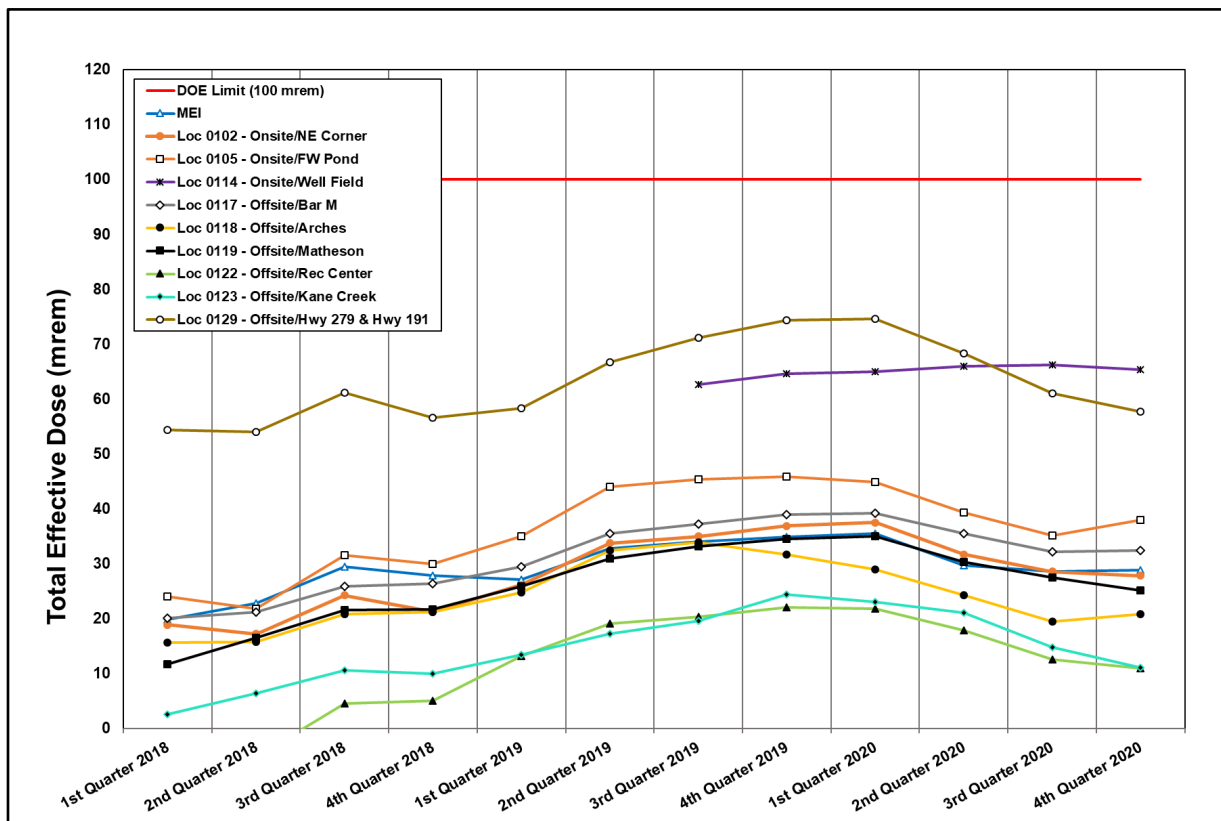


Figure 7. Total Effective Dose Measured at Moab Locations Since 2018

3.2 Crescent Junction Site

There are nine air monitoring stations associated with the Crescent Junction site, two located off-site and seven on-site. All nine are equipped with radon and gamma detectors. Two on-site and two off-site stations are also equipped with air sampling pumps to measure air radioparticulates. After mill tailings disposal began in the second quarter of 2009, the Crescent Junction monitoring location 0306 became the MEI. Due to disposal cell excavation activities in third quarter 2020, station 0303 was removed. One radon and direct gamma station was added to the northern site boundary fence and labeled as 0310.

3.2.1 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 from the site. Hourly averages were analyzed. Figure 8 displays the wind rose for this quarter, with the wedges on the wind rose showing which direction the wind is coming from. In fourth quarter 2020, the winds were variable with the prevailing wind out of the west/southwest. The site received 0.74 inches of precipitation during the fourth quarter 2020, and the total annual precipitation for 2020 was 3.6 inches. Figure 9 presents the Crescent Junction average (which is from 2010 through 2019), 2019, and 2020 cumulative precipitation. As this graph displays, the fourth quarter 2020 precipitation is less than one-half the site's nine-year average. The average temperature for the quarter was 48°F. The lowest recorded temperature for the quarter was 6°F, and the highest was 83°F.

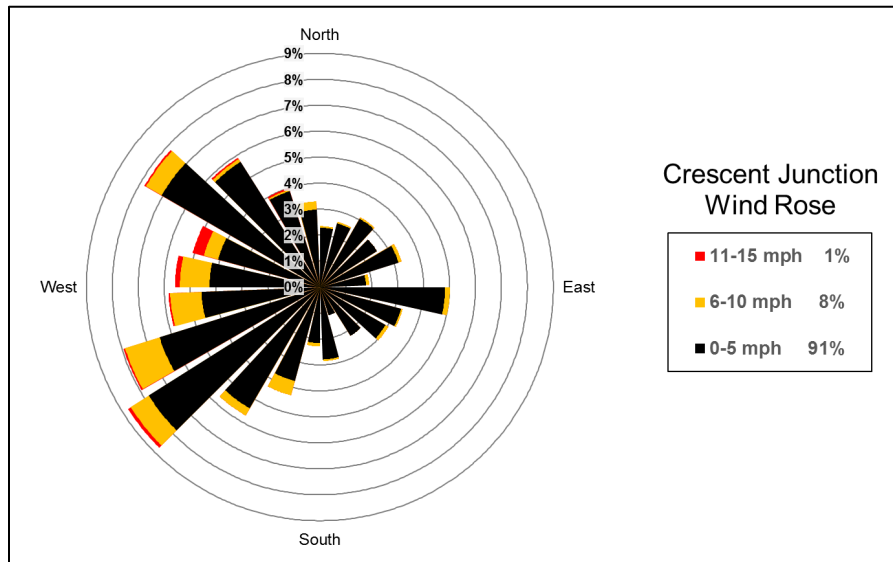


Figure 8. Crescent Junction Wind Rose for Fourth Quarter 2020

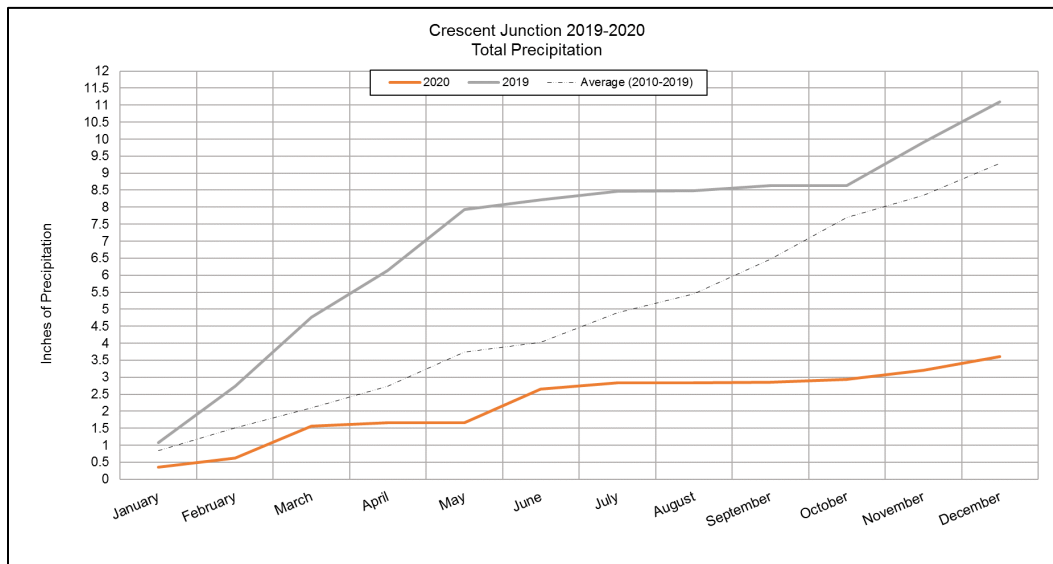


Figure 9. Crescent Junction Average, 2019, and 2020 Cumulative Precipitation

3.2.2 Radon

Based on three years of data from 2006 to 2009, the background concentration of radon in the Crescent Junction area was established as 0.9 pCi/L. Therefore, the Project must limit radon emissions at the Crescent Junction site boundary (withdrawal area) to 3.9 pCi/L. None of the on- or off-site stations exceeded the limit of 3.9 pCi/L in the fourth quarter 2020. Locations 0301 and 0305 are used to demonstrate compliance with the public dose limit in DOE O 458.1 at the site boundary. Table 4 shows quarterly and annual radon results for the past year, including background for on- and off-site locations.

Table 4. Radon Concentrations for the Crescent Junction Site for the Past Year

Station Number	First Quarter 2020 (pCi/L)	Second Quarter 2020 (pCi/L)	Third Quarter 2020 (pCi/L)	Fourth Quarter 2020 (pCi/L)	Annual Average Concentration Based on Four Quarters (pCi/L)
On-site Locations					
0301	0.4	0.3	0.5	0.7	0.5
0302	0.6*	0.4	0.7	1.1	0.7
0303	1.1*	0.8	NS	NS	NA
0304	0.4	0.4	0.8	1.0	0.7
0305	0.4	0.3	0.6	0.8	0.5
0308	1.5	1.2	2.2	4.4	2.3
0309	0.8	1.0	1.4	2.8	1.5
0310	NS	NS	0.7	1.0	NA
Off-site Locations					
0306 (MEI)	0.4	0.2	0.6	0.8	0.5
0307	0.3	0.2	0.4	0.7	0.4

Background has not been subtracted from annual values.

* = RadTrack² detector

NS = No Sample collected from this location

NA = Not Applicable, insufficient data to calculate a representative annual average

Compared to the previous quarter, the quarterly radon concentrations at all stations increased as much as 2.2 pCi/L. The Crescent Junction locations with the highest annual average radon concentrations during the fourth quarter are shown on Figure 10, which displays the annual average concentrations results for these locations since the first quarter of 2018.

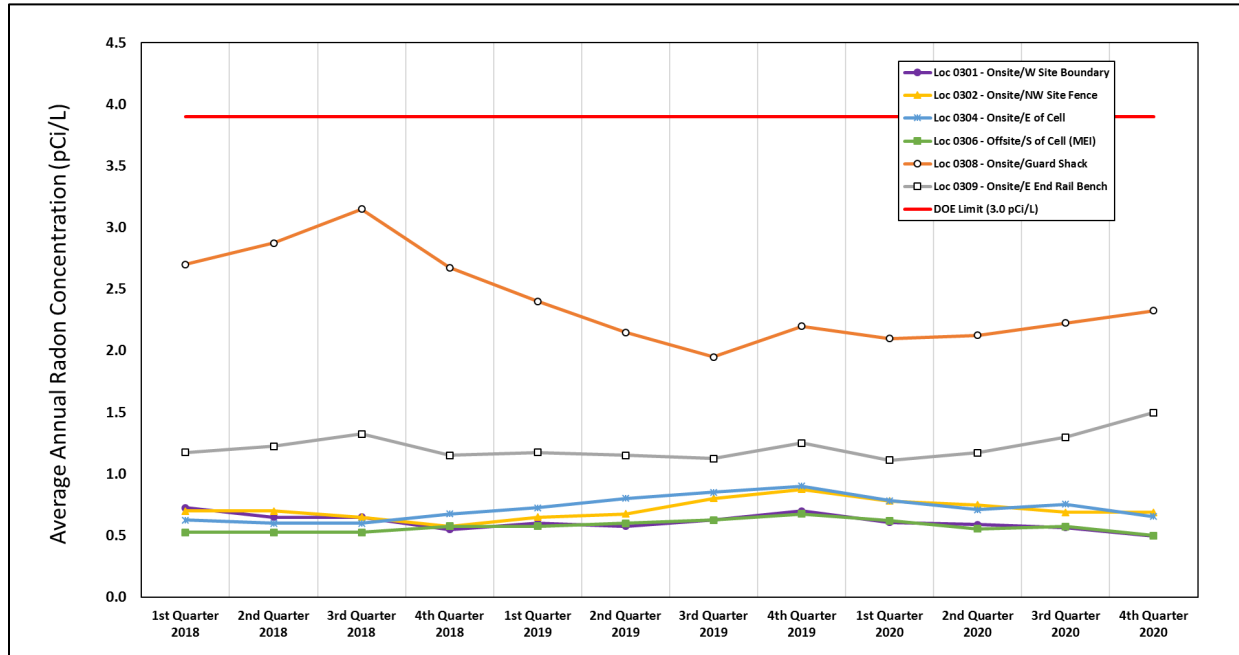


Figure 10. Crescent Junction Locations with Highest Fourth Quarter 2020 Average Annual Radon Concentrations

3.2.3 Direct Gamma Radiation

The average annual background direct gamma radiation exposure dose for the Crescent Junction area was established as 92.5 mrem based on three years of data collected from 2006 to 2009.

Table 5 shows quarterly and annual results for the past year, including background for on- and off-site locations. The annual gamma dose represents the dose an individual would receive from occupying a location for an entire year.

This quarter's analytical results compared to the previous quarter's indicated that the gamma radiation dose decreased at one on-site and one off-site location as much as 1.0 mrem. Four on-site locations and an off-site location indicated an increase in radiation dose, as much as 3 mrem. One on-site location indicated no change.

Table 5. Gamma Radiation Effective Doses for the Crescent Junction Site for the Past Year

Station Number	First Quarter 2020 (mrem)	Second Quarter 2020 (mrem)	Third Quarter 2020 (mrem)	Fourth Quarter 2020 (mrem)	Annual Total Dose Based on Four Quarters (mrem)
On-site Locations					
0301	27	28	27	27	109
0302	28	29	26	28	111
0303	44	54	NS	NS	NA
0304	29	29	27	29	114
0305	31	30	26	28	115
0308	32	29	29	30	120
0309	28	29	28	27	112
0310	NS	NS	27	29	NA
Off-site Locations					
0306 (MEI)	28	27	26	25	106
0307	32	30	27	30	119

Background has not been subtracted from annual values

NS = No Sample collected from this location

NA = Not Applicable, insufficient data to calculate a representative annual average

3.2.4 Radioparticulates

The effective background dose from inhalation of radioparticulates at the Crescent Junction site was not determined. Therefore, all effective dose measured at the Project's monitoring stations is assumed to be from the Project. Samples were collected at the four monitoring locations at or near the Crescent Junction site to determine the air particulate concentrations of total uranium, thorium-230, radium-226, polonium-210, actinium-227, and protactinium-231 (based on the actinium-227 concentration, as described in Section 3.1.4). Two Crescent Junction stations (0307 & 0308) saw an increase in annual dose, by as much as 0.14 mrem, while two other stations (0306 & 0308) saw a decrease (as much as 0.16 mrem). Table 6 shows radioparticulate effective doses for the Crescent Junction site for the past year.

Table 6. Radioparticulate Effective Doses for the Crescent Junction Site for the Past Year

Station Number	Isotope	First Quarter 2020 (mrem)	Second Quarter 2020 (mrem)	Third Quarter 2020 (mrem)	Fourth Quarter 2020 (mrem)	Annual Total Dose Based on Four Quarters (mrem)
On-site Locations						
0308-RP	Total Uranium	0.002	0.003	0.003	0.003	3.99
	Thorium-230	0.027	0.037	0.120	0.077	
	Radium-226	0.041	0.048	0.097	0.092	
	Polonium-210	0.529	0.309	0.366	0.562	
	Actinium-227	0.124	0.303	0.559	0.373	
	Protactinium-231	0.028	0.070	0.129	0.086	
0309-RP	Total Uranium	0.003	0.003	0.005	0.005	4.72
	Thorium-230	0.048	0.109	0.115	0.104	
	Radium-226	0.057	0.150	0.128	0.172	
	Polonium-210	0.456	0.293	0.456	0.586	
	Actinium-227	0.280	0.443	0.396	0.536	
	Protactinium-231	0.064	0.102	0.091	0.123	
Off-site Locations						
306-RP MEI	Total Uranium	0.002	0.002	0.002	0.002	2.44
	Thorium-230	0.008	0.016	0.015	0.013	
	Radium-226	0.012	0.015	0.037	0.039	
	Polonium-210	0.448	0.244	0.358	0.505	
	Actinium-227	0.047	0.133	0.280	0.131	
	Protactinium-231	0.011	0.031	0.064	0.030	
0307-RP	Total Uranium	0.002	0.003	0.002	0.002	2.55
	Thorium-230	0.012	0.019	0.013	0.008	
	Radium-226	0.020	0.013	0.019	0.017	
	Polonium-210	0.464	0.277	0.334	0.488	
	Actinium-227	ND	0.179	0.350	0.168	
	Protactinium-231	ND	0.041	0.080	0.039	

ND = not detected; analyte concentration below detection limit

3.2.5 Total Effective Dose

The annual total effective dose to the Crescent Junction MEI was 15.94 mrem, which is well below the annual limit of 100 mrem. This is calculated by subtracting the background dose of 92.5 mrem from the MEI (location 0306) gamma radiation dose of 106 mrem, and then adding the radioparticulate dose of 2.44 mrem for the MEI. Figure 11 is a plot of the total effective dose from the four Crescent Junction locations since 2018. In Figure 11, the background was subtracted from the total effective dose calculations, therefore, the DOE limit is shown as 100 mrem. Nearly all of the dose to the MEI 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.

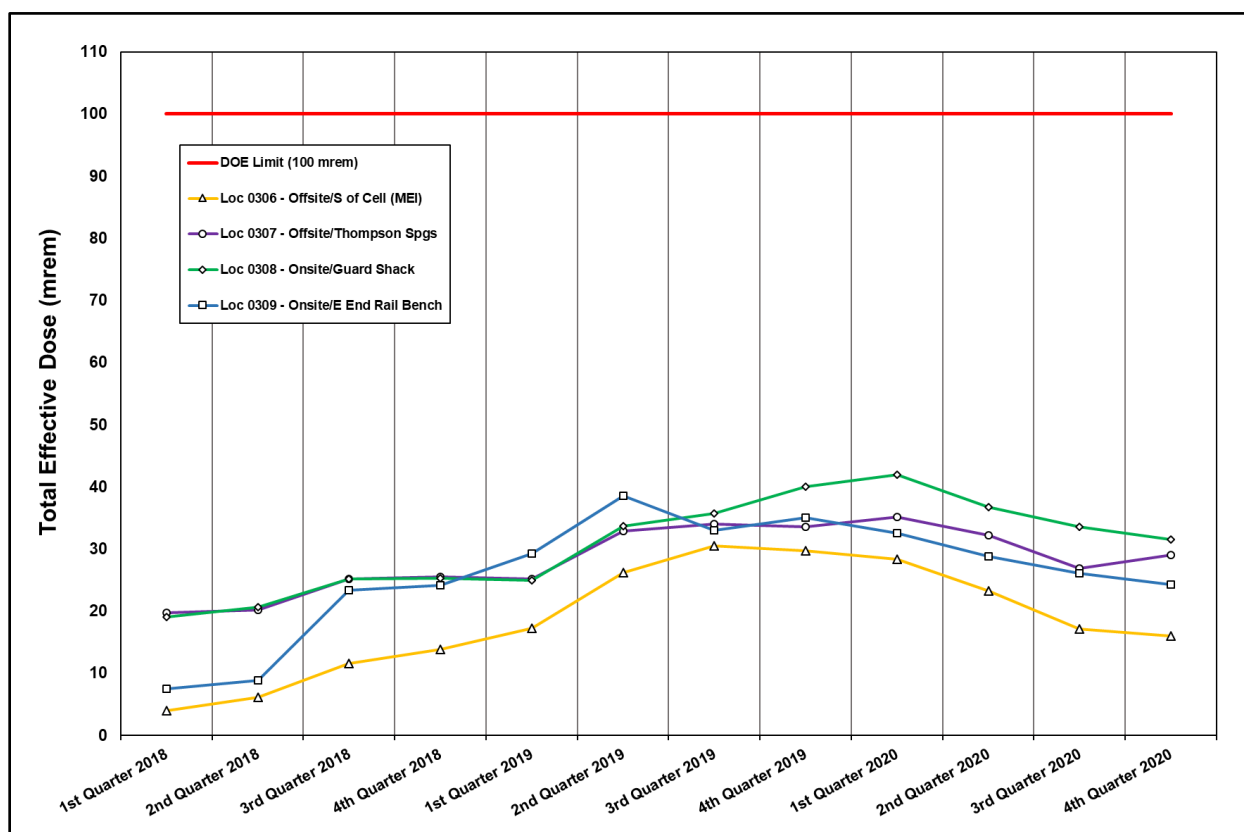


Figure 11. Total Effective Dose Measured at Crescent Junction Locations Since 2018

4.0 Data Assessment

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.

Due to order discrepancies in first quarter 2020, four stations in Crescent Junction were equipped with the previous Radtrack² radon detectors. To account for the Radtrack² lower detection limit, those monitors were placed at locations that historically had elevated radon concentrations. The stations have been identified in the tables accordingly.

4.1 Quality Assurance/Quality Control Sampling

Duplicate samples for radon were collected at Moab locations 0102, 0108, and 0111, and at Crescent Junction locations 0303 and 0308. In addition, duplicate direct gamma samples were collected at Moab locations 0102, 0108, and 0129 and Crescent Junction locations 0301 and 0305. All results associated with the duplicate sampling are provided in Table 7. No duplicate samples were collected for radioparticulate samples, per the SAP.

As Table 7 displays, the five locations that included duplicate radon samples were within 0.6 pCi/L of each other. The five locations equipped with duplicate gamma detectors were all within 2.0 mrem of each other. These radon and gamma duplicate results are within the acceptable ranges, and the data are considered valid based on these results.

Table 7. Duplicate Results for Fourth Quarter 2020

Location	Result	Duplicate Result
Moab		
Radon:	pCi/L	pCi/L
0102	2.8	3.0
0108	5.5	6.1
0111	1.0	1.0
Gamma:	mrem	mrem
0102	27	28
0108	46	46
0129	33	33
Crescent Junction		
Radon:	pCi/L	pCi/L
0310	1.0	1.1
0308	4.4	4.1
Gamma:	mrem	mrem
0301	27	29
0305	28	28

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 at or below background levels and was not subtracted from quarterly values. The Radonova lab subtracts the average transit exposure from the reported radon concentrations. The transit values are shown in Table 8.

Table 8. Shipment Control Sample Results for Fourth Quarter 2020

Sample	Result
Radon:	pCi/L
In-transit 1	11 +/- 7
In-transit 2	8 +/- 7
In-transit 3	3 +/- 7

4.2 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 the fourth quarter of 2020.

4.3 Summary

Data collected during the fourth quarter of 2020 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.

5.0 References

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 Fourth Quarter 2019 Environmental Air Monitoring Report* (DOE-EM/GJ3028).

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.