

*Office of Environmental Management – Grand Junction*



Environmental Air Monitoring Data  
Quarterly Report for the Moab and  
Crescent Junction, Utah, Sites  
Second Quarter 2018  
(April through June 2018)

November 2018



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  
Second Quarter 2018  
(April – June 2018)**

**Revision 0**

**November 2018**



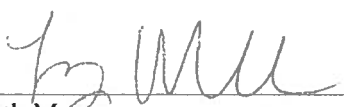
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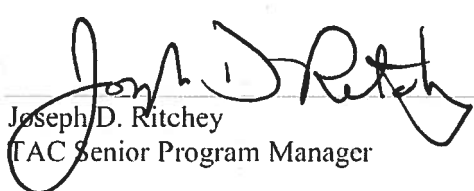
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## Revision History

| Revision | Date          | Reason for Revision |
|----------|---------------|---------------------|
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## **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 Quarter of 2018. 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 3, “Radiation Protection of the Public and the Environment,” which states DOE radiological activities must be conducted in a manner that does not cause a total effective dose to the public exceeding 100 millirems (mrem) in a year (yr). 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 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 three picocuries per liter (pCi/L) of radon or its decay products, excluding background, at the site boundary.

Compliance with DOE O 458.1 may be demonstrated by calculating the 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 established an MEI for each of the Project sites.

## **3.0 Results for April through June 2018**

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.

### **3.1 Moab Site**

Previous quarterly reports have included results associated with station 0120. All data collection instrumentation was removed from this location at the end of the first quarter 2018; therefore, there are no data associated with this location included in this report.

#### **3.1.1 Radon**

Based on five years of data 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 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 publically 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.

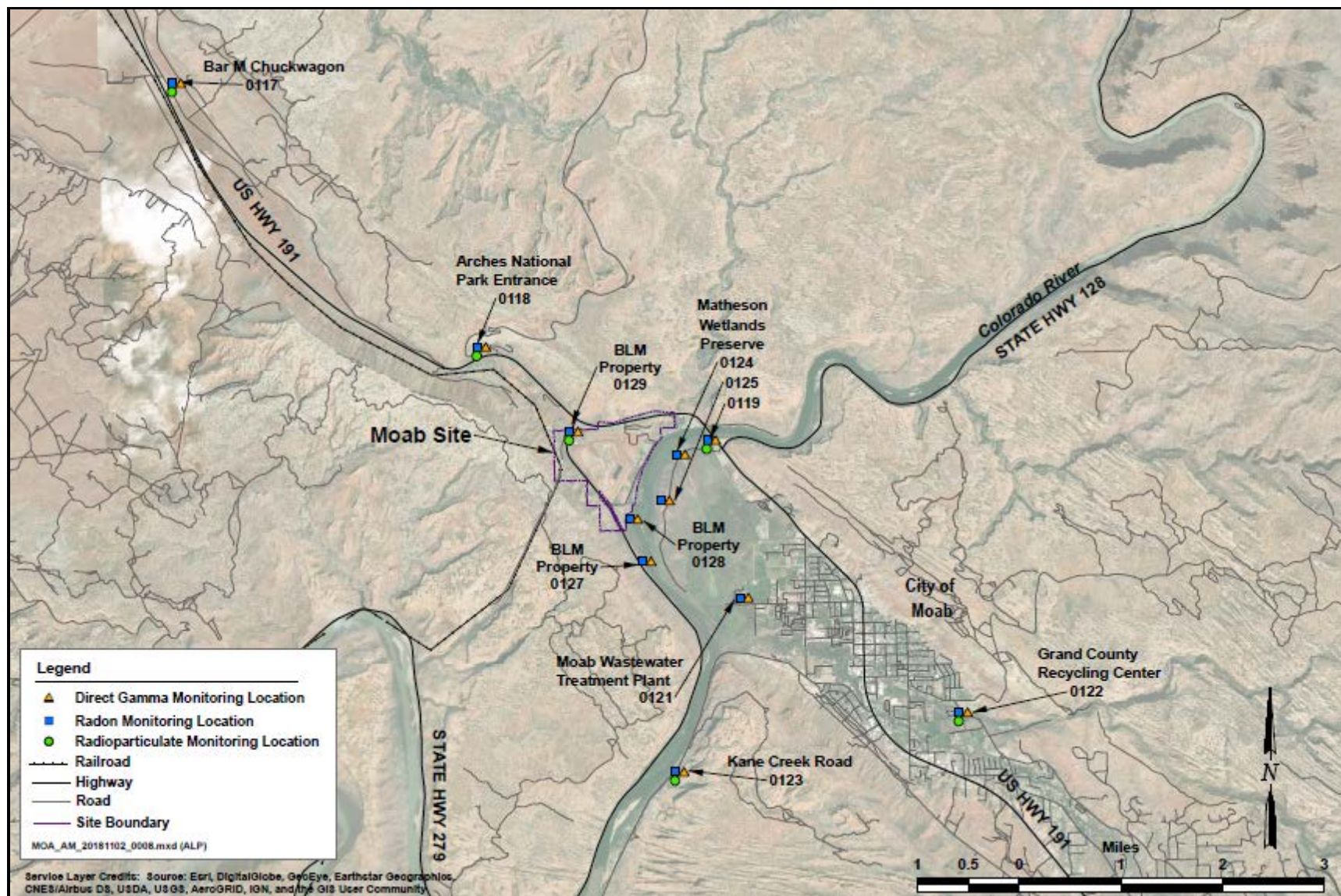
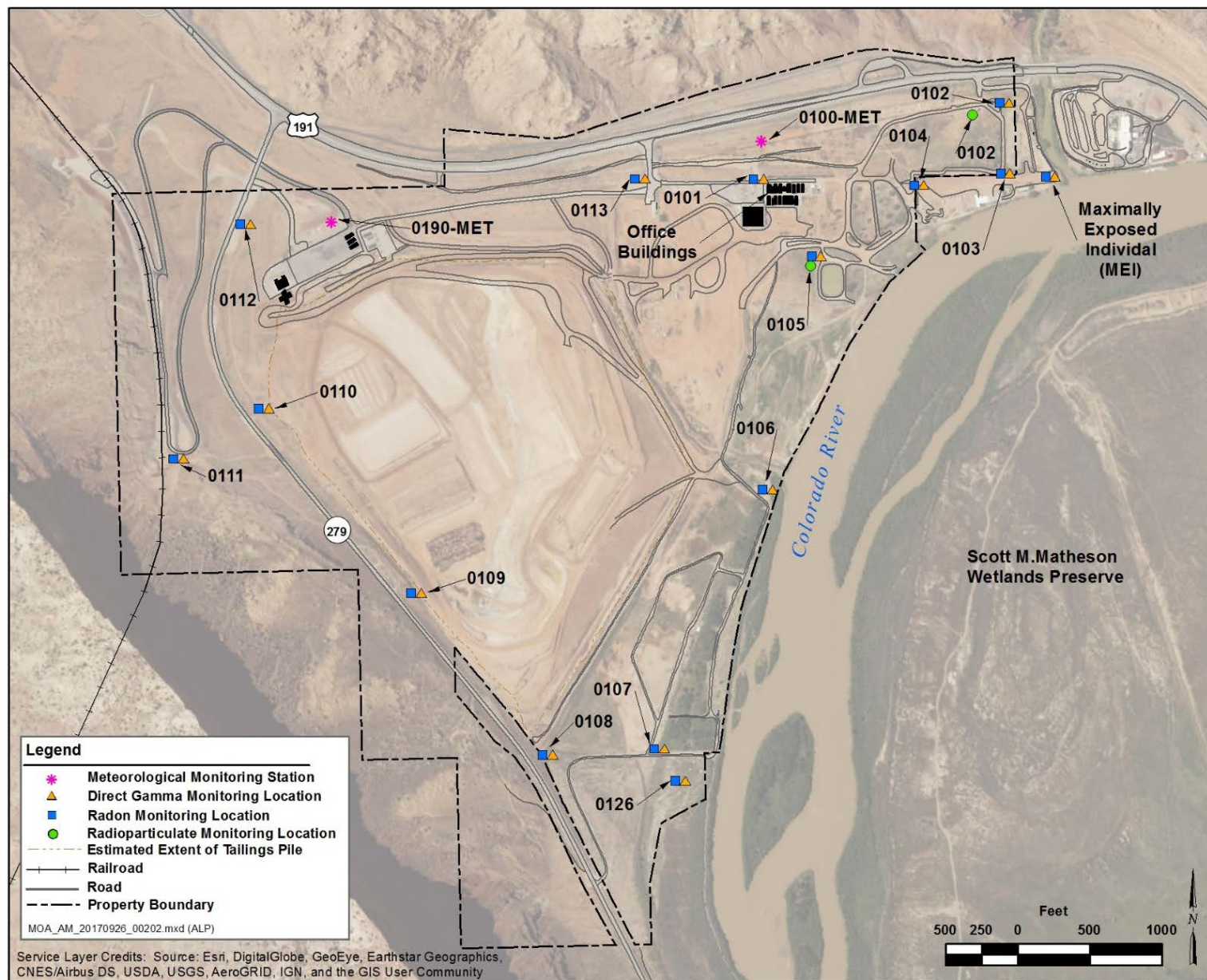


Figure 1. Moab Off-site Environmental Air Monitoring Locations



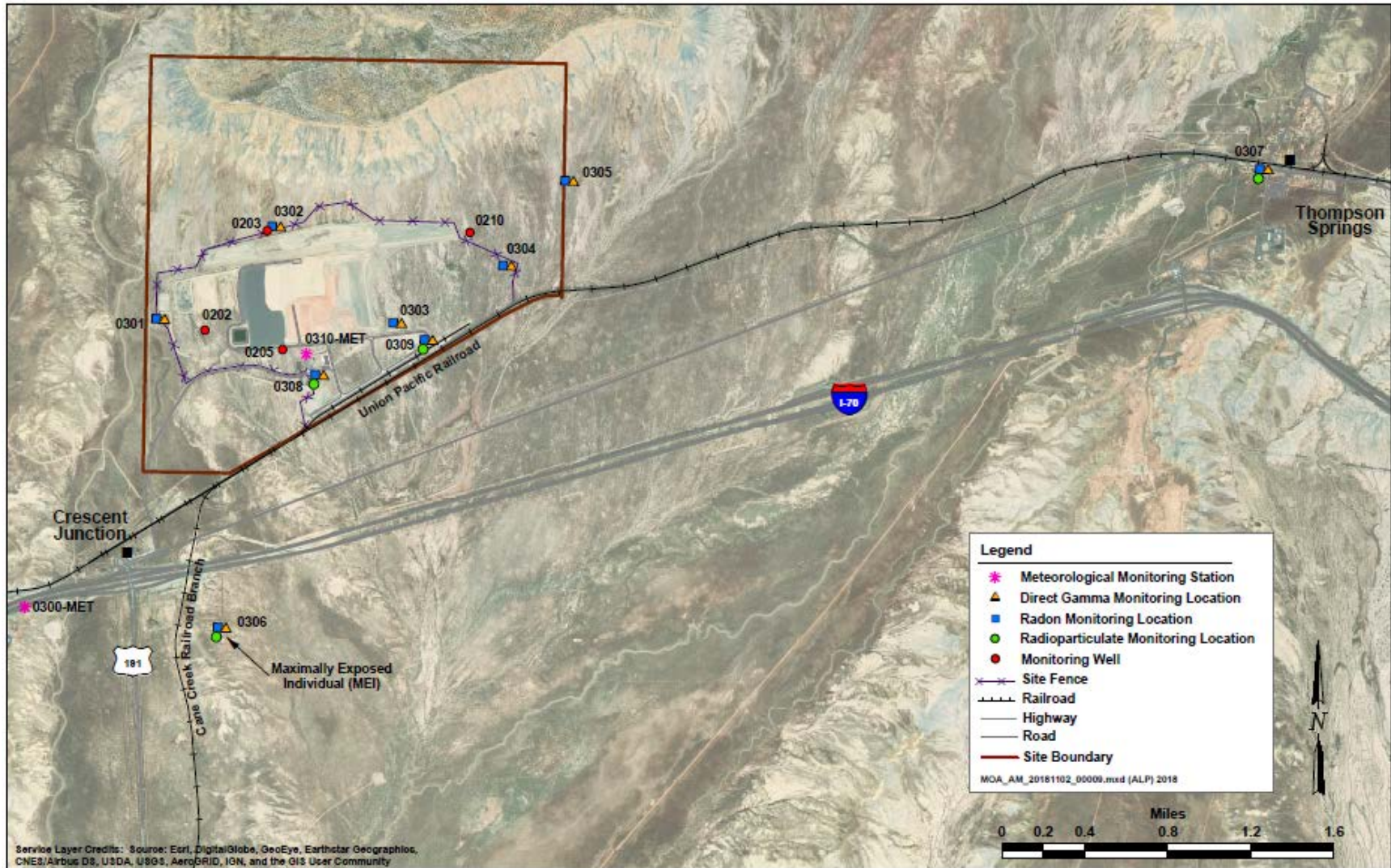


Figure 3. Crescent Junction Site Environmental Air Monitoring Locations

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

| Station Number            | 3rd Quarter 2017 (pCi/L) | 4th Quarter 2017 (pCi/L) | 1st Quarter 2018 (pCi/L) | 2nd Quarter 2018 (pCi/L) | Annual Average Concentration Based on Four Quarters (pCi/L) |
|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------------------------------|
| <b>On-site Locations</b>  |                          |                          |                          |                          |                                                             |
| <b>0101</b>               | 1.4                      | 7.0                      | 2.6                      | 1.9                      | <b>3.2</b>                                                  |
| <b>0102</b>               | 0.6                      | 3.4                      | 1.6                      | 0.7                      | <b>1.6</b>                                                  |
| <b>0103</b>               | 0.7                      | 4.2                      | 1.7                      | 1.0                      | <b>1.9</b>                                                  |
| <b>0104</b>               | 1.1                      | 5.4                      | 2.5                      | 1.1                      | <b>2.5</b>                                                  |
| <b>0105</b>               | 1.2                      | 6.4                      | 2.6                      | 1.4                      | <b>2.9</b>                                                  |
| <b>0106</b>               | 1.4                      | 7.3                      | 3.6                      | 1.9                      | <b>3.6</b>                                                  |
| <b>0107</b>               | 1.4                      | 6.2                      | 3.2                      | 1.8                      | <b>3.2</b>                                                  |
| <b>0108</b>               | 2.4                      | 7.4                      | 3.2                      | 2.4                      | <b>3.9</b>                                                  |
| <b>0109</b>               | 1.8                      | 2.7                      | 1.4                      | 1.3                      | <b>1.8</b>                                                  |
| <b>0110</b>               | 1.4                      | 2.2                      | 1.1                      | 1.0                      | <b>1.4</b>                                                  |
| <b>0111</b>               | NDA                      | 1.1                      | 0.6                      | 0.5                      | <b>0.7</b>                                                  |
| <b>0112</b>               | 2.1                      | 3.3                      | 1.3                      | 1.7                      | <b>2.1</b>                                                  |
| <b>0113</b>               | 2.2                      | 7.5                      | 3.1                      | 2.6                      | <b>3.9</b>                                                  |
| <b>0126</b>               | 1.2                      | 5.5                      | 2.7                      | 1.4                      | <b>2.7</b>                                                  |
| <b>Off-site Locations</b> |                          |                          |                          |                          |                                                             |
| <b>0117</b>               | <0.4                     | 0.6                      | <0.4                     | <0.4                     | <b>0.5</b>                                                  |
| <b>0118</b>               | 0.7                      | 1.1                      | 1.5                      | 0.5                      | <b>1.0</b>                                                  |
| <b>0119</b>               | 0.5                      | 1.7                      | 1.0                      | 0.5                      | <b>0.9</b>                                                  |
| <b>0121</b>               | <0.4                     | 0.9                      | 0.4                      | <0.4                     | <b>0.6</b>                                                  |
| <b>0122</b>               | <0.4                     | <0.4                     | 0.4                      | <0.4                     | <b>0.4</b>                                                  |
| <b>0123</b>               | <0.4                     | 1.2                      | <0.4                     | <0.4                     | <b>0.8</b>                                                  |
| <b>0124</b>               | 0.5                      | 2.6                      | 1.4                      | 0.5                      | <b>1.3</b>                                                  |
| <b>0125</b>               | 0.7                      | 2.4                      | 1.5                      | 0.8                      | <b>1.4</b>                                                  |
| <b>0127</b>               | 0.5                      | 1.8                      | 0.8                      | 0.7                      | <b>1.0</b>                                                  |
| <b>0128</b>               | 1.4                      | 5.2                      | 2.3                      | 1.3                      | <b>2.6</b>                                                  |
| <b>0129</b>               | 1.6                      | 3.3                      | 1.5                      | 1.2                      | <b>1.9</b>                                                  |
| <b>MEI</b>                | 0.5                      | 3.5                      | 1.9                      | 0.6                      | <b>1.6</b>                                                  |

NDA= No data available, sensor missing or damaged

As displayed in Table 1, on-site locations 0108 and 0113 (both with an annual average of 3.9 pCi/L) exceeded the 3.7 pCi/L annual average. These two annual average exceedances are the result of the high radon concentrations measured at these two locations during the fourth quarter 2017 (7.4 and 7.5 pCi/L, respectively).

As discussed in the *Moab UMTRA Project Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Fourth Quarter 2017 (October – December 2017)* (DOE-EM/GJTAC2260), radon concentrations typically peak during the fourth quarter. Drought conditions likely further impacted the results, as relative humidity data in the fourth quarter 2017 was on average one-half of the relative humidity measured during the 2013 through 2016 fourth quarters. No member of the public occupies any of these locations for a sufficient amount of time to cause the individual to receive a dose in excess of the annual limit.

The five Moab locations that have the highest annual average radon concentrations in the first quarter of 2018 (0101, 0106, 0107, 0108, and 0113) are displayed in Figure 4. This graph displays the annual average concentrations since the first quarter of 2016 for these locations. Second quarter 2018 data show the results were lower compared to the previous quarter. No off-site annual average concentration exceeded the 3.0 pCi/L plus background annual limit.

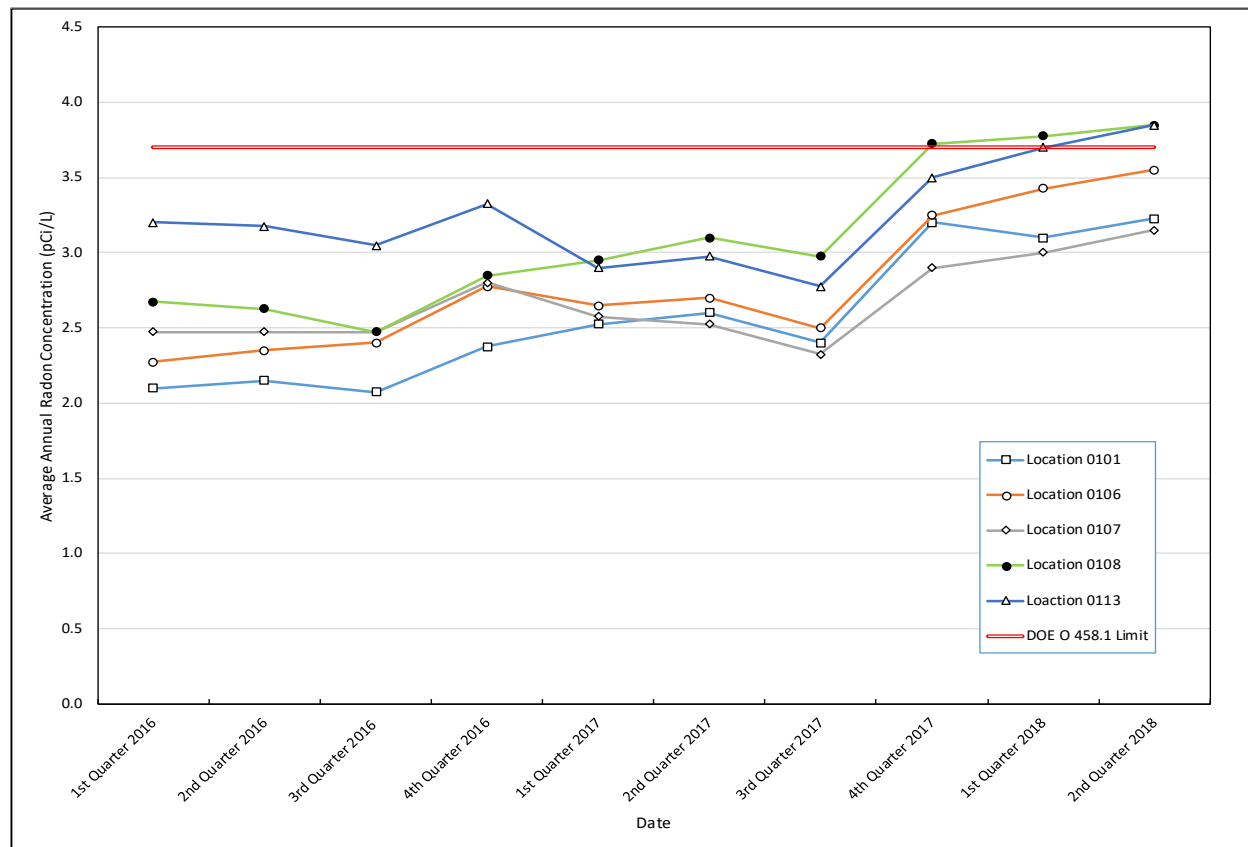


Figure 4. Moab Locations with Highest Second Quarter 2018 Average Annual Radon Concentrations

### 3.1.2 Direct Gamma Radiation

The average annual background (based on five years of data between 2003 and 2008) direct gamma radiation effective dose for the Moab area was established as 82 mrem. Table 2 shows quarterly and annual gamma results for the past year, including background, at on- and off-site locations. These samples were sent to a new laboratory for analysis starting in the second quarter of 2018, and the results are reported rounded off to the nearest mrem. Second quarter analytical results were in general lower compared to the first quarter 2018 results.

These readings represent the gamma dose an individual would receive from occupying a location for an entire year.

### 3.1.3 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 is considered to be from the Project.

Samples to determine the concentrations of total uranium, actinium-227, thorium-230, radium-226, and polonium-210 are collected at nine monitoring locations at or near the Moab site. Because 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). The analytical results are used to calculate effective dose from the inhalation of radioparticulates.

Table 3 shows calculated quarterly and annual effective dose from inhalation of radioparticulates for the past year for the Moab site. As expected, stations closest to the site operations (0105 and 0129) show higher results compared to the nearby surrounding stations (0118 and 0119). Results for the first quarter 2018 are lower compared to the previous quarter.

The sampling pump at location 0117 was operational only 42 hrs (as opposed to the standard 168 hrs) between May 2 and May 9, which translates into the sampling representing only 93 percent of the air particulates that were actually present. The doses of each isotope (calculated from the concentration detected by the analytical laboratory) were increased 7 percent, and these second quarter 2018 values are presented in Table 3. \

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

| Station Number            | 3rd Quarter 2017 (mrem) | 4th Quarter 2017 (mrem) | 1st Quarter 2018 (mrem) | 2nd Quarter 2018 (mrem) | Annual Dose Based on Four Quarters (mrem) |
|---------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------------------------|
| <b>On-site Locations</b>  |                         |                         |                         |                         |                                           |
| <b>0101</b>               | 42.2                    | 47.5                    | 43.1                    | 40                      | <b>172.8</b>                              |
| <b>0102</b>               | 21.4                    | 29.0                    | 22.1                    | 23                      | <b>95.5</b>                               |
| <b>0103</b>               | 21.6                    | 27.5                    | 25.3                    | 23                      | <b>97.4</b>                               |
| <b>0104</b>               | 25.7                    | 33.8                    | 29.4                    | 26                      | <b>114.9</b>                              |
| <b>0105</b>               | 21.5                    | 29.5                    | 25.1                    | 23                      | <b>99.1</b>                               |
| <b>0106</b>               | 33.5                    | 44.1                    | 36.6                    | 32                      | <b>146.2</b>                              |
| <b>0107</b>               | 27.6                    | 31.1                    | 31.7                    | 27                      | <b>117.4</b>                              |
| <b>0108</b>               | 44.8                    | 52.2                    | 46.9                    | 40                      | <b>183.9</b>                              |
| <b>0109</b>               | 119.0                   | 129.1                   | 117.3                   | 116                     | <b>481.4</b>                              |
| <b>0110</b>               | 99.8                    | 105.8                   | 98.2                    | 104                     | <b>407.8</b>                              |
| <b>0111</b>               | 39.3                    | 42.6                    | 34.6                    | 36                      | <b>152.5</b>                              |
| <b>0112</b>               | 46.2                    | 61.7                    | 51.9                    | 45                      | <b>204.8</b>                              |
| <b>0113</b>               | 40.0                    | 53.9                    | 43.7                    | 40                      | <b>177.6</b>                              |
| <b>0126</b>               | 25.1                    | 32.6                    | 27.5                    | 28                      | <b>113.2</b>                              |
| <b>Off-site Locations</b> |                         |                         |                         |                         |                                           |
| <b>0117</b>               | 23.8                    | 26.6                    | 26.5                    | 24                      | <b>100.9</b>                              |
| <b>0118</b>               | 22.4                    | 25.5                    | 24.6                    | 22                      | <b>94.5</b>                               |
| <b>0119</b>               | 21.0                    | 26.1                    | 23.3                    | 25                      | <b>95.4</b>                               |
| <b>0121</b>               | 22.4                    | 25.9                    | 24.1                    | 22                      | <b>94.4</b>                               |
| <b>0122</b>               | 14.3                    | 21.7                    | 16.6                    | 21                      | <b>73.6</b>                               |
| <b>0123</b>               | 19.6                    | 22.8                    | 22.0                    | 21                      | <b>85.4</b>                               |
| <b>0124</b>               | 24.4                    | 31.2                    | 27.3                    | 23                      | <b>105.9</b>                              |
| <b>0125</b>               | 26.6                    | 36.3                    | 26.3                    | 27                      | <b>116.2</b>                              |
| <b>0127</b>               | 22.9                    | 30.1                    | 25.8                    | 25                      | <b>103.8</b>                              |
| <b>0128</b>               | 22.7                    | 33.0                    | 25.4                    | 25                      | <b>106.1</b>                              |
| <b>0129</b>               | 28.6                    | 37.6                    | 31.4                    | 30                      | <b>127.6</b>                              |

|            |      |      |      |    |              |
|------------|------|------|------|----|--------------|
| <b>MEI</b> | 20.7 | 28.6 | 27.7 | 24 | <b>101.0</b> |
|------------|------|------|------|----|--------------|

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

| Station Number       | Isotope          | 3rd Quarter 2017 (mrem) | 4th Quarter 2017 (mrem) | 1st Quarter 2018 (mrem) | 2nd Quarter 2018 (mrem) | Annual Dose Based on Four Quarters (mrem) |
|----------------------|------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------------------------|
| On-site Locations    |                  |                         |                         |                         |                         |                                           |
| 0102-RP <sup>1</sup> | Total Uranium    | 0.002                   | 0.004                   | 0.002                   | 0.003                   | 3.74                                      |
|                      | Thorium-230      | 0.037                   | 0.043                   | 0.020                   | 0.029                   |                                           |
|                      | Radium-226       | 0.044                   | 0.048                   | 0.029                   | 0.066                   |                                           |
|                      | Polonium-210     | 0.236                   | 1.058                   | 0.895                   | 0.374                   |                                           |
|                      | Actinium-227     | 0.035                   | 0.159                   | 0.100                   | 0.396                   |                                           |
|                      | Protactinium-231 | 0.008                   | 0.036                   | 0.023                   | 0.091                   |                                           |
| 0105-RP              | Total Uranium    | 0.005                   | 0.005                   | 0.002                   | 0.004                   | 4.71                                      |
|                      | Thorium-230      | 0.115                   | 0.061                   | 0.029                   | 0.077                   |                                           |
|                      | Radium-226       | 0.097                   | 0.079                   | 0.048                   | 0.176                   |                                           |
|                      | Polonium-210     | 0.326                   | 1.221                   | 0.741                   | 0.399                   |                                           |
|                      | Actinium-227     | 0.420                   | 0.233                   | 0.000                   | 0.420                   |                                           |
|                      | Protactinium-231 | 0.097                   | 0.054                   | 0.000                   | 0.097                   |                                           |
| Off-site Locations   |                  |                         |                         |                         |                         |                                           |
| 0117-RP <sup>2</sup> | Total Uranium    | 0.002                   | 0.004                   | 0.002                   | 0.003                   | 2.35                                      |
|                      | Thorium-230      | 0.017                   | 0.016                   | 0.010                   | 0.026                   |                                           |
|                      | Radium-226       | 0.002                   | 0.003                   | 0.025                   | 0.034                   |                                           |
|                      | Polonium-210     | 0.187                   | 0.708                   | 0.537                   | 0.315                   |                                           |
|                      | Actinium-227     | 0.179                   | 0.000                   | 0.170                   | 0.028                   |                                           |
|                      | Protactinium-231 | 0.041                   | 0.000                   | 0.039                   | 0.006                   |                                           |
| 0118-RP              | Total Uranium    | 0.002                   | 0.003                   | 0.003                   | 0.003                   | 3.24                                      |
|                      | Thorium-230      | 0.048                   | 0.024                   | 0.032                   | 0.069                   |                                           |
|                      | Radium-226       | 0.070                   | 0.030                   | 0.053                   | 0.022                   |                                           |
|                      | Polonium-210     | 0.228                   | 0.724                   | 0.684                   | 0.366                   |                                           |
|                      | Actinium-227     | 0.114                   | 0.163                   | 0.156                   | 0.280                   |                                           |
|                      | Protactinium-231 | 0.026                   | 0.038                   | 0.036                   | 0.064                   |                                           |
| 0119-RP              | Total Uranium    | 0.003                   | 0.003                   | 0.002                   | 0.003                   | 3.07                                      |
|                      | Thorium-230      | 0.032                   | 0.021                   | 0.016                   | 0.025                   |                                           |
|                      | Radium-226       | 0.057                   | 0.007                   | 0.044                   | 0.066                   |                                           |
|                      | Polonium-210     | 0.317                   | 0.684                   | 0.480                   | 0.350                   |                                           |
|                      | Actinium-227     | 0.221                   | 0.128                   | 0.079                   | 0.350                   |                                           |
|                      | Protactinium-231 | 0.051                   | 0.029                   | 0.018                   | 0.080                   |                                           |
| 0121-RP              | Total Uranium    | 0.003                   | 0.003                   | 0.002                   | 0.003                   | 3.14                                      |
|                      | Thorium-230      | 0.032                   | 0.023                   | 0.018                   | 0.037                   |                                           |
|                      | Radium-226       | 0.038                   | 0.039                   | 0.057                   | 0.053                   |                                           |
|                      | Polonium-210     | 0.228                   | 0.659                   | 0.627                   | 0.342                   |                                           |
|                      | Actinium-227     | 0.256                   | 0.210                   | 0.161                   | 0.168                   |                                           |
|                      | Protactinium-231 | 0.059                   | 0.048                   | 0.037                   | 0.039                   |                                           |
| 0122-RP              | Total Uranium    | 0.003                   | 0.003                   | 0.002                   | 0.003                   | 3.21                                      |
|                      | Thorium-230      | 0.021                   | 0.010                   | 0.015                   | 0.024                   |                                           |
|                      | Radium-226       | 0.224                   | 0.018                   | 0.031                   | 0.029                   |                                           |
|                      | Polonium-210     | 0.252                   | 0.651                   | 0.562                   | 0.342                   |                                           |
|                      | Actinium-227     | 0.147                   | 0.051                   | 0.326                   | 0.303                   |                                           |
|                      | Protactinium-231 | 0.034                   | 0.012                   | 0.075                   | 0.070                   |                                           |



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

| Station Number                        | Isotope          | 3rd Quarter 2017 (mrem) | 4th Quarter 2017 (mrem) | 1st Quarter 2018 (mrem) | 2nd Quarter 2018 (mrem) | Annual Dose Based on Four Quarters (mrem) |
|---------------------------------------|------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------------------------|
| <b>Off-site Locations (continued)</b> |                  |                         |                         |                         |                         |                                           |
| <b>0123-RP</b>                        | Total Uranium    | 0.002                   | 0.003                   | 0.002                   | 0.003                   | <b>2.94</b>                               |
|                                       | Thorium-230      | 0.019                   | 0.014                   | 0.011                   | 0.032                   |                                           |
|                                       | Radium-226       | 0.207                   | 0.036                   | 0.019                   | 0.048                   |                                           |
|                                       | Polonium-210     | 0.260                   | 0.676                   | 0.480                   | 0.358                   |                                           |
|                                       | Actinium-227     | 0.182                   | 0.114                   | 0.000                   | 0.325                   |                                           |
|                                       | Protactinium-231 | 0.042                   | 0.026                   | 0.000                   | 0.075                   |                                           |
| <b>0129-RP</b>                        | Total Uranium    | 0.006                   | 0.005                   | 0.004                   | 0.006                   | <b>8.42</b>                               |
|                                       | Thorium-230      | 0.264                   | 0.093                   | 0.099                   | 0.293                   |                                           |
|                                       | Radium-226       | 0.202                   | 0.092                   | 0.132                   | 0.422                   |                                           |
|                                       | Polonium-210     | 0.407                   | 0.814                   | 0.733                   | 0.399                   |                                           |
|                                       | Actinium-227     | 1.072                   | 0.629                   | 0.466                   | 1.445                   |                                           |
|                                       | Protactinium-231 | 0.247                   | 0.145                   | 0.107                   | 0.333                   |                                           |

<sup>1</sup>MEI location, <sup>2</sup>Second quarter 2018 values adjusted

### 3.1.4 Total Effective Dose

The Project must ensure the annual effective dose to gamma radiation and radioparticulates from Project activities does not exceed 100 mrem above background. The annual total effective dose to the MEI was 22.74 mrem, which is well below the DOE limit.

This value was calculated by subtracting the background dose of 82 mrem from the MEI gamma radiation dose of 101.0 mrem and then adding the radioparticulate dose of 3.74 mrem for location 0102, the closest radioparticulate station to the MEI.

## 3.2 Crescent Junction Site

After mill tailings disposal began in the second quarter of 2009, Crescent Junction monitoring location 0306 became the MEI.

### 3.2.1 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. Locations 0301, 0305, and 0309 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. None of the on- or off-site stations exceeded the limit of 3.0 pCi/L above background and, in general, all results were lower compared to the previous quarter.

The five Crescent Junction locations that have the highest annual average radon concentrations in the second quarter of 2018 (0301, 0302, 0303, 0308, and 0309) are displayed in Figure 5. Similar to Figure 4, this graph displays the annual average concentrations for these locations since the first quarter of 2016.

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

| Station Number            | 3rd Quarter 2017 (pCi/L) | 4th Quarter 2017 (pCi/L) | 1st Quarter 2018 (pCi/L) | 2nd Quarter 2018 (pCi/L) | Annual Average Concentration Based on Four Quarters (pCi/L) |
|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------------------------------|
| <b>On-site Locations</b>  |                          |                          |                          |                          |                                                             |
| <b>0301</b>               | 0.4                      | 1.1                      | 0.6                      | 0.5                      | <b>0.7</b>                                                  |
| <b>0302</b>               | 0.6                      | 1.1                      | 0.7                      | <0.4                     | <b>0.7</b>                                                  |
| <b>0303</b>               | 0.6                      | 2.4                      | 1.1                      | 0.7                      | <b>1.2</b>                                                  |
| <b>0304</b>               | <0.4                     | 0.9                      | 0.7                      | <0.4                     | <b>0.6</b>                                                  |
| <b>0305</b>               | 0.5                      | 0.8                      | 0.5                      | <0.4                     | <b>0.6</b>                                                  |
| <b>0308</b>               | 1.5                      | 4.9                      | 3.0                      | 2.1                      | <b>2.9</b>                                                  |
| <b>0309</b>               | 0.6                      | 2.2                      | 1.3                      | 0.8                      | <b>1.2</b>                                                  |
| <b>Off-site Locations</b> |                          |                          |                          |                          |                                                             |
| <b>0306<sup>1</sup></b>   | <0.4                     | 0.7                      | 0.6                      | <0.4                     | <b>0.5</b>                                                  |
| <b>0307</b>               | <0.4                     | 0.5                      | <0.4                     | <0.4                     | <b>0.4</b>                                                  |

<sup>1</sup>MEI location

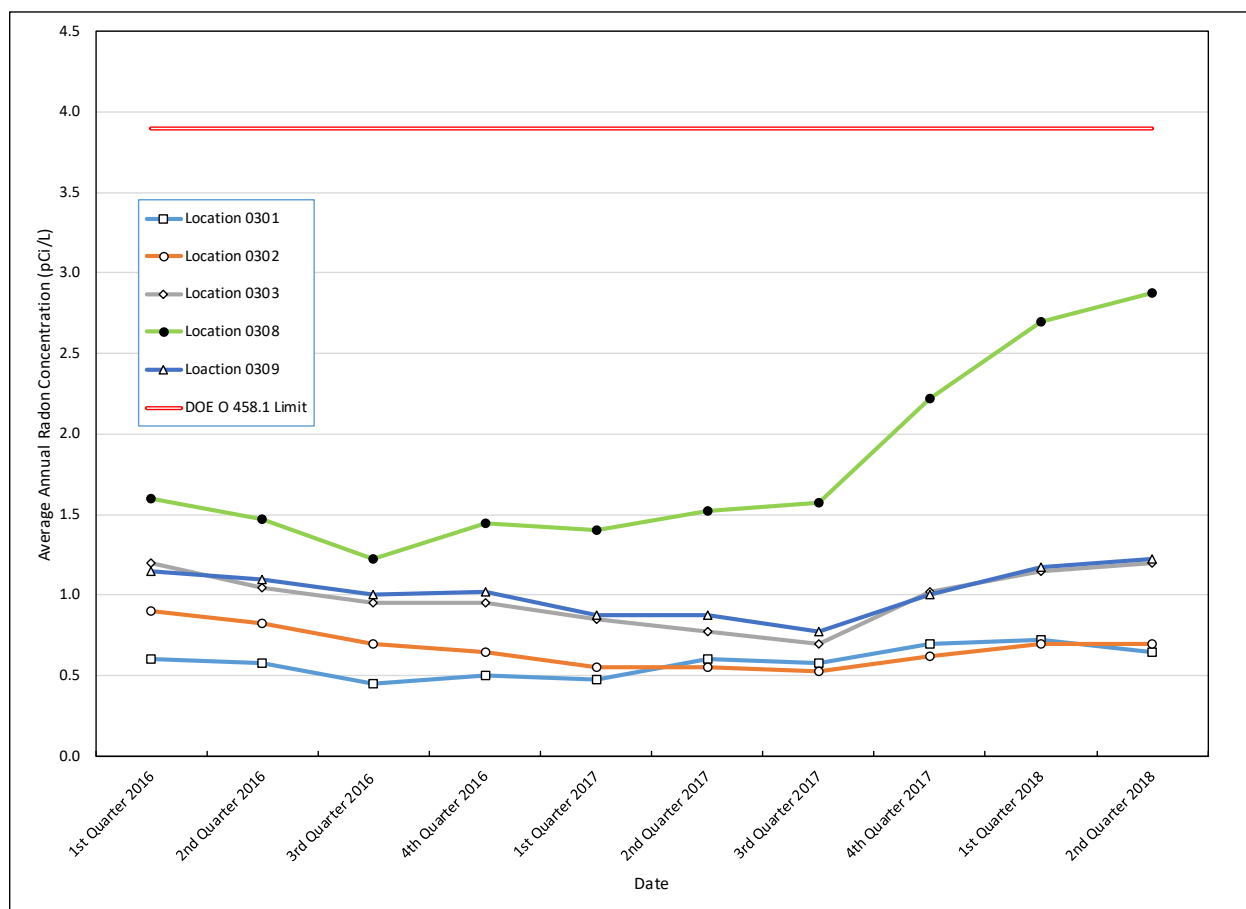


Figure 5. Crescent Junction Locations with Highest First Quarter 2018 Average Annual Radon Concentrations

### 3.2.2 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 from 2006 to 2009. Table 5 shows quarterly and annual results for the past year, including background, for on- and off-site locations.

These readings represent the gamma dose an individual would receive from occupying a location for an entire year.

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

| Station Number            | 3rd Quarter 2017 (mrem) | 4th Quarter 2017 (mrem) | 1st Quarter 2018 (mrem) | 2nd Quarter 2018 (mrem) | Annual Dose Based on Four Quarters (mrem) |
|---------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------------------------|
| <b>On-site Locations</b>  |                         |                         |                         |                         |                                           |
| <b>0301</b>               | 22.7                    | 27.4                    | 31.6                    | 24                      | <b>105.7</b>                              |
| <b>0302</b>               | 24.5                    | 25.3                    | 28.3                    | 24                      | <b>102.1</b>                              |
| <b>0303</b>               | 27.6                    | 31.8                    | 31.6                    | 31                      | <b>122.0</b>                              |
| <b>0304</b>               | 24.5                    | 24.9                    | 26.6                    | 25                      | <b>101.0</b>                              |
| <b>0305</b>               | 24.3                    | 28.0                    | 27.3                    | 25                      | <b>104.6</b>                              |
| <b>0308</b>               | 26.4                    | 27.8                    | 30.1                    | 25                      | <b>109.3</b>                              |
| <b>0309</b>               | 21.3                    | 26.1                    | 24.9                    | 24                      | <b>96.3</b>                               |
| <b>Off-site Locations</b> |                         |                         |                         |                         |                                           |
| <b>0306<sup>1</sup></b>   | 22.5                    | 24.7                    | 25.0                    | 23                      | <b>95.2</b>                               |
| <b>0307</b>               | 26.3                    | 28.0                    | 30.3                    | 25                      | <b>109.6</b>                              |

<sup>1</sup>MEI location

### 3.2.3 Radioparticulates

As with the Moab sampling results, the effective background dose from inhalation of radioparticulates at the Crescent Junction site was not determined, so all effective dose from radioparticulates measured at the Project's monitoring stations is considered to be from the Project. Samples to determine the 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 3.1.3) are collected at the four monitoring locations at or near the Crescent Junction site.

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

| Station Number           | Isotope          | 3rd Quarter 2017 (mrem) | 4th Quarter 2017 (mrem) | 1st Quarter 2018 (mrem) | 2nd Quarter 2018 (mrem) | Annual Dose Based on Four Quarters (mrem) |
|--------------------------|------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------------------------|
| <b>On-site Locations</b> |                  |                         |                         |                         |                         |                                           |
| <b>0308-RP</b>           | Total Uranium    | 0.002                   | 0.003                   | 0.002                   | 0.003                   | <b>3.88</b>                               |
|                          | Thorium-230      | 0.059                   | 0.040                   | 0.032                   | 0.061                   |                                           |
|                          | Radium-226       | 0.022                   | 0.070                   | 0.097                   | 0.092                   |                                           |
|                          | Polonium-210     | 0.260                   | 0.684                   | 0.627                   | 0.374                   |                                           |
|                          | Actinium-227     | 0.196                   | 0.212                   | 0.280                   | 0.490                   |                                           |
|                          | Protactinium-231 | 0.045                   | 0.049                   | 0.064                   | 0.113                   |                                           |
| <b>0309-RP</b>           | Total Uranium    | 0.003                   | 0.004                   | 0.003                   | 0.004                   | <b>5.03</b>                               |
|                          | Thorium-230      | 0.093                   | 0.088                   | 0.115                   | 0.117                   |                                           |
|                          | Radium-226       | 0.106                   | 0.158                   | 0.172                   | 0.229                   |                                           |
|                          | Polonium-210     | 0.301                   | 0.765                   | 0.627                   | 0.383                   |                                           |
|                          | Actinium-227     | 0.396                   | 0.443                   | 0.303                   | 0.373                   |                                           |
|                          | Protactinium-231 | 0.091                   | 0.102                   | 0.070                   | 0.086                   |                                           |

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

| Station Number             | Isotope          | 3rd Quarter 2017 (mrem) | 4th Quarter 2017 (mrem) | 1st Quarter 2018 (mrem) | 2nd Quarter 2018 (mrem) | Annual Dose Based on Four Quarters (mrem) |
|----------------------------|------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------------------------|
| <b>Off-site Locations</b>  |                  |                         |                         |                         |                         |                                           |
| <b>0306-RP<sup>1</sup></b> | Total Uranium    | 0.002                   | 0.002                   | 0.002                   | 0.002                   | <b>3.49</b>                               |
|                            | Thorium-230      | 0.014                   | 0.007                   | 0.009                   | 0.019                   |                                           |
|                            | Radium-226       | 0.017                   | 0.000                   | 0.022                   | 0.032                   |                                           |
|                            | Polonium-210     | 0.269                   | 0.643                   | 0.602                   | 0.334                   |                                           |
|                            | Actinium-227     | 0.280                   | 0.128                   | 0.676                   | 0.147                   |                                           |
|                            | Protactinium-231 | 0.064                   | 0.029                   | 0.156                   | 0.034                   |                                           |
| <b>0307-RP</b>             | Total Uranium    | 0.002                   | 0.003                   | 0.002                   | 0.003                   | <b>3.08</b>                               |
|                            | Thorium-230      | 0.014                   | 0.016                   | 0.009                   | 0.032                   |                                           |
|                            | Radium-226       | 0.079                   | 0.010                   | 0.036                   | 0.038                   |                                           |
|                            | Polonium-210     | 0.269                   | 0.545                   | 0.692                   | 0.326                   |                                           |
|                            | Actinium-227     | 0.212                   | 0.091                   | 0.163                   | 0.350                   |                                           |
|                            | Protactinium-231 | 0.049                   | 0.021                   | 0.038                   | 0.080                   |                                           |

<sup>1</sup>MEI location

The analytical results are used to calculate effective dose from the inhalation of radioparticulates. Table 6 shows quarterly and annual radioparticulate doses for the past year for the Crescent Junction site. The second quarter 2018 dose results are similar to previous quarters.

### 3.2.4 Total Effective Dose

The annual total effective dose to the MEI was 6.19 mrem, which is well below the annual limit of 100 mrem above background. This is calculated by subtracting the background dose of 92.5 mrem from the MEI (location 0306) gamma radiation dose of 95.2 mrem and then adding the radioparticulate dose of 3.49 mrem for the MEI.

## 4.0 Data Assessment

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

As described in Section 3.1.3, the second quarter 2018 dose values for location 0117 were increased 7 percent due to the air sampling pump malfunction that occurred between May 2 and 9, 2018.

### 4.1 Duplicate Sampling

Duplicate samples for radon were collected at Moab locations 0102, 0108, 0111, and 0121 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.

Table 7. Duplicate Results for Second Quarter 2018

| Location                 | Result | Duplicate Result |
|--------------------------|--------|------------------|
| <b>Moab</b>              |        |                  |
| Radon:                   | pCi/L  | pCi/L            |
| 0102                     | 0.7    | 0.8              |
| 0108                     | 2.4    | 2.2              |
| 0111                     | 0.5    | 0.5              |
| 0121                     | <0.4   | 0.6              |
| Gamma:                   | mrem   | mrem             |
| 0102                     | 23     | 21               |
| 0108                     | 40     | 42               |
| 0129                     | 30     | 29               |
| <b>Crescent Junction</b> |        |                  |
| Radon:                   | pCi/L  | pCi/L            |
| 0303                     | 0.7    | 0.7              |
| 0308                     | 2.1    | 1.9              |
| Gamma:                   | mrem   | mrem             |
| 0301                     | 24     | 23               |
| 0305                     | 25     | 25               |

## 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 second quarter of 2018.

## 4.3 Summary

Data collected during the second quarter of 2018 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 Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Fourth Quarter 2017 (October – December 2017)* (DOE-EM/GJTAC2260).

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 3, "Radiation Protection of the Public and the Environment."