U.S. Department of Energy
200 Grand Avenue
Grand Junction, CO 81501

November 1, 2016

MOAB-00013-17

WM0D11D

Ms. Kimberly Conway
U.S. Nuclear Regulatory Commission
Division of Decommissioning, Uranium Recovery, and Waste Programs
Office of Nuclear Material Safety and Safeguards
11545 Rockville Pike
Mail Stop T-8F05
Rockville, MD 20852-2738

Subject: Application of Supplemental Standards for Historical Highway in Moab, Utah, Moab Uranium Mill Tailings Remedial Action (UMTRA) Project

Dear Ms. Conway:

Enclosed for your review and concurrence is the Application of Supplemental Standards for the Historical Highway in the Utah Department of Transportation (UDOT) right-of-way that underlies the portion of the North Moab Canyon Recreation Trail on the U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project site in Moab, Utah.

DOE is proposing a no remediation alternative, and application of supplemental standards using 40 CFR 192.21 criterion (b), excessive environmental harm relative to long-term benefits, as the justification.

Please respond to this letter indicating NRC's concurrence of the supplemental standards application. Should you have any questions, feel free to call me at (970) 257-2115.

Sincerely,

Donald R. Metzler
Moab Federal Project Director

cc w/enclosure:
K. Grimes, CBC
R. Torgerson, UDOT
P. Goble, UDEQ
L. Shenton, Grand County
J. Peach, DOE
K. Wethington, DOE
W. Ryan, TAC
R. Hopping

NMSS01

DOE-EM/GJ2200

Office of Environmental Management – Grand Junction

MOAB UTAH

UMTRA Project

Moab UMTRA Project Historical Highway Right-of-Way Supplemental Standards Application

November 2016

U.S. Department of Energy

Office of Environmental Management

Prepared by the Technical Assistance Contractor under contract number DE-EM0002067 and the Remedial Action Contractor under contract number DE-DT0011049 for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

Moab UMTRA Project
Historical Highway Right-of-Way Supplemental Standards Application

November 2016

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1.0 Introduction

The Moab Uranium Mill Tailings Remedial Action (UMTRA) Project site in Utah is being cleaned up to U.S. Environmental Protection Agency (EPA) standards in 40 Code of Federal Regulations Part 192 (40 CFR 192), "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings." These standards allow for the application of supplemental standards if one or more criteria in 40 CFR 192.21 are met. The purpose of this document is to propose application of supplemental standards for a portion of the Utah Department of Transportation (UDOT) historical highway right-of-way and inaccessible areas that lie within the Moab site just south of the northern property boundary.

1.1 Location

Figure 1 shows the location of the proposed supplemental standards area, which lies in Section 27, T25S, R21E, in Grand County, Utah. The area addressed in this Application is approximately 107,000 square feet (ft^2).

1.2 Major Physical Features

Much of the proposed supplemental standards area is currently covered with asphalt pavement, some of which dates to the 1950s or before as part of the former state highway. In 2010, the former highway, including the portion associated with this supplemental standards area, was converted to the North Moab Canyon Recreation Trail, which is maintained by Grand County.

Residual radioactive material (RRM) in this area is likely windblown tailings from the former millsite or pieces of ore lost during truck transport on the highway to the nearby ore-buying station or to the mill when it was in operation. Contaminated soils outside the proposed supplemental standards area within the historical highway right-of-way were remediated in August and September 2006 and are addressed in the *Moab Site Project Completion Report Appendix Package Highway 191 Phase 2* (DOE-EM/GJ1471-2007).

1.3 Land Use

Arches National Park abuts the northern property boundary of the Moab site. Because of the proximity of the proposed supplemental standards area to Arches and conversion of the former highway to a recreational trail, the U.S. Department of Energy (DOE) assumes future use of this area will remain as recreational. Attachment 1 consists of a letter signed by UDOT indicating its concurrence with this Supplemental Standards Application.

Based on the current and assumed future land use, the following types of users could receive a public dose from the RRM in this supplemental standards area: walkers, bicyclists, and trail workers. The most likely user of the trail with the greatest potential exposure was determined to be an adult walker. The trail is also used for bicycling; however, because it takes longer to traverse the trail on foot, using a trail walker's exposure in the dose assessment was considered more conservative. Individuals maintaining the trail, such as mowing adjacent grass or spraying weeds, were also evaluated to have less exposure time than a trail walker. Repairs to the trail may be necessary and could expose workers to underlying contaminated soils. The workers would be subject to somewhat higher exposure rates; however, on an annual basis, their exposure time would be less than the adult walker; therefore, the resulting dose would also be less.

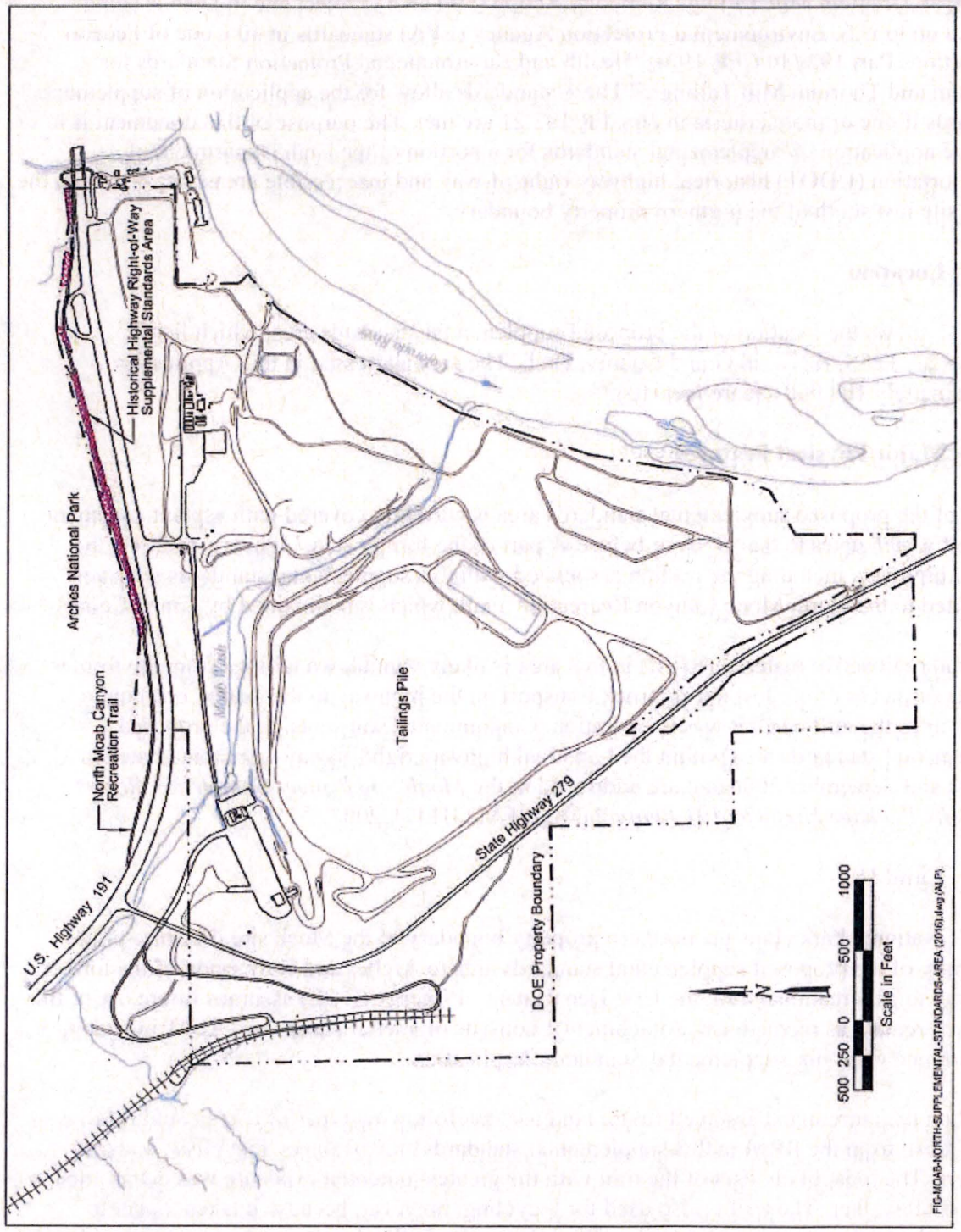

Figure 1. Proposed Supplemental Standards Area Location Map

2.0 Applicable EPA Criterion

Supplemental standards are being proposed for the above-described area based on the following criterion in 40 CFR 192.21:

(b) Remedial actions to satisfy the cleanup standards for land, §192.12(a), and groundwater, §192.12(c), or the acquisition of minimum materials required for control to satisfy §§192.02(b) and (c), would, notwithstanding reasonable measures to limit damage, directly produce health and environmental harm that is clearly excessive compared to the health and environmental benefits, now or in the future. A clear excess of health and environmental harm is harm that is long-term, manifest, and grossly disproportionate to health and environmental benefits that may reasonably be anticipated.

3.0 Summary of Public Dose Assessment

Appendix A details the assessment of potential public dose to the RRM in the proposed supplemental standards area based on exposure to an adult trail walker as the most likely user.

Radiological data used in the assessment are based on direct gamma exposure-rate measurements taken in March 2016 and on-site laboratory analysis of soils collected during the site characterization conducted in August 2005 and documented in *Radiological Assessment for Non-Pile Areas of the Moab Project Site* (DOE-EM/GJ901-2005). Plate 1 shows the soil sample locations from the radiological assessment that fall within the proposed supplemental standards area.

The total dose for the walker, under the conservative assumptions made, is 0.96 millirems per year (mrem/yr) including background. This is far below the 100 mrem/yr above background limit DOE established as acceptable dose to the public in DOE Order 458.1 Admin Chg 3, "Radiation Protection of the Public and the Environment."

4.0 Remediation Alternatives

Two alternatives were considered to address the remaining RRM.

4.1 Alternative 1—No Remediation (Supplemental Standards)

No additional work is required under this alternative. The public dose associated with this alternative is summarized in Section 3.0. This alternative would minimize disturbance of the historical highway right-of-way along the Moab site northern property boundary. No additional costs would be incurred if this alternative is chosen.

4.2 Alternative 2—Full Remediation

Implementing this alternative would require removal of all contaminated soils in excess of the EPA standards for radium-226 (Ra-226) (5 picocuries per gram [pCi/g] above background in surface soils and 15 pCi/g above background in subsurface soils). The area is approximately 107,000 ft^2 (2.5 acres) and the estimated volume of material to be removed based on a 6-inch average contamination depth would be 2,000 cubic yards. Under this alternative, the already low exposure to the public due to the RRM would be further reduced.

5.0 Recommendation

The contaminated soils remaining in the right-of-way and inaccessible areas within the proposed supplemental standards area would not pose a significant present or future health risk to the public due to the very low exposure levels and limited exposure time. Remediation of this area would pose an unacceptable harm to the environment compared to the health and environmental benefits.

Based on the conservative assessment of public dose presented in this document, DOE recommends that Alternative 1—No Remediation be approved for the proposed supplemental standards area.

6.0 References

40 CFR 192 (Code of Federal Regulations), "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."

DOE (U.S. Department of Energy), *Moab Site Project Completion Report Appendix Package Highway 191 Phase 2,* DOE-EM/GJ1471-2007.

DOE (U.S. Department of Energy) Order 458.1 Admin Chg 3, "Radiation Protection of the Public and the Environment."

DOE (U.S. Department of Energy), *Radiological Assessment for Non-Pile Areas of the Moab Project Site,* DOE-EM/GJ901-2005.

Appendix A
Assessment of Potential Public Dose from RRM

Appendix A. Assessment of Potential Public Dose from RRM

Supplemental standards are sought for the 107,000 ft^2 portion of the DOE Moab site property that lies within the UDOT historical highway right-of-way.

The calculations in this assessment were performed to demonstrate compliance with DOE Order 458.1, which states that DOE activities will be conducted in a manner such that the public dose limit of 100 mrem/yr above background will not be exceeded. All doses calculated in this assessment are effective doses, which include the doses from radiation sources internal and/or external to the body.

1.0 Exposure Scenario

An adult walking along the trail was determined to be the most likely user, and also the user with the highest potential exposure. The length of the trail included in this supplemental standards area is approximately 2,700 ft. For conservatism with respect to estimating dose, a distance of 3,300 ft, or the entire length of the trail from one end of the supplemental standards area to the other, was considered affected. A walker was assumed to travel at 2 miles per hour along the trail, 5 days per week, 50 weeks per year, for a total annual exposure time of 78 hours (h).

1.1 Exposure Pathways

The exposure pathways considered reasonable for the exposure scenario include:

- Direct gamma exposure.
- Inhalation of radionuclides in dust.
- Ingestion of radionuclides in dust.

Exposure pathways explicitly not considered in this assessment include inhalation of radon, consumption of vegetation, and ingestion of water from sources in the supplemental standards area. Outdoor air typically contains very low levels of radon and the radon limit in DOE Order 458.1 is for indoor air. The other two pathways were not considered because of lack of edible vegetation and water sources in the area, respectively.

2.0 Dose Calculation

The annual total dose in millirems to an individual is the sum of the doses for each exposure pathway and is shown in the following equation:

$$D_T = D_G + D_D + D_S$$

Where:

D_T = annual total dose
D_G = dose from direct gamma radiation
D_D = dose from inhalation of radionuclides in airborne dust
D_S = dose from ingestion of radionuclides in airborne dust

2.1 Direct Gamma Radiation

The equation for calculating the direct gamma radiation dose is as follows:

$$D_G = [X][t][0.001]$$

Where:

D_G = annual direct gamma radiation dose (mrem)
X = average dose rate (microrems [µrem]/h)
t = time of exposure over one year (h)
A factor of 0.001 is applied to convert µrem to mrem.

A gamma dose-rate scan was conducted along the trail within the proposed supplemental standards area. Dose rates were recorded at waist level (3.3 ft above surface) every 6.5 feet. Table 1 shows each dose rate taken and the associated verification grid block (see Plate 1). The average dose rate over the length of the trail was 12 µrem/h.

Inserting the average dose rate of 12 µrem/h and the annual exposure time of 78 h into the equation results in $D_G = (12)(78)(0.001)$ or $D_G = 0.94$ mrem.

Table 1. Gamma Dose Rates along Trail

Verification Grid Block	Dose Rate (µrem/h)
LG-1	16
LG-2	12
LG-3	18
LH-1	15
LH-2	16
LH-3	13
MH-1	14
MH-2	13
MI-1	10
MI-2	14
MI-3	9
MI-4	10
MI-5	13
MJ-1	9
MJ-2	13
MJ-3	8
MJ-4	8
MJ-5	8
MK-1	10
MK-2	9
MK-3	8
MK-4	9
MK-5	12
ML-1	9
ML-2	13
Average	**12**

2.2 Inhalation of Dust

The equation for calculating the dust inhalation dose is as follows:

$$D_D = [t][I_{inh}][C_d]\sum([C_s][f_i][DC_{(inh)i}])[EF][0.037][100{,}000]$$

Where:

- D_D = inhalation dose from dust (mrem)
- t = time of exposure over one year (h)
- I_{inh} = inhalation rate (cubic meters [m^3]/h)
- C_d = dust concentration in air (grams [g]/m^3)
- C_s = average Ra-226 concentration in soil (pCi/g)
- f_i = fraction of each radionuclide *i* that is assumed to be in equilibrium with Ra-226 represented as a percent of the total (%)
- $DC_{(inh)i}$ = inhalation dose coefficient for each radionuclide *i* (sieverts/becquerels [Sv/Bq])
- EF = an enhancement factor to account for the possibility that the radionuclide concentration in airborne dust may be greater than the concentration in soil

To represent D_D in millirems, the following conversions are applied:
0.037 Bq = 1 pCi
100,000 mrem = 1 Sv

Table 3 shows the value of various terms used in the dust inhalation equation.

Table 3. Value of Terms in Dust Inhalation Equation

Term	Description	Value	Units	Conversion of Units
I_{inh}	Inhalation rate (light work)[1]	10	liters/minute	0.60 m^3/h
C_d	Dust concentration in air[2]	10.8	µg/m^3	0.0000108 g/m^3
EF	Enhancement factor[3]	2.1		

[1]Inhalation rate is based on light work as defined in EPA Exposure Factors Handbook Table 6-28.
[2]Dust concentration in air is based on Utah Department of Environmental Quality 98th percentile 24-h average Utah PM2.5 value for Hurricane, Utah, reporting station.
[3]Enhancement factor value is based on loam soil from Modeling the inhalation enhancement factor in prospective radiological risk assessment.

Soil samples collected during the assessment of non-pile areas of the Moab site in 2005 were analyzed using the Opposed Crystal System. Table 4 presents the Ra-226 concentration in soil at each sample location within the proposed supplemental standards area. Each sample is of the surface 6 inches. The average Ra-226 concentration was 12.96 pCi/g.

Table 5 shows the fraction of each radionuclide assumed to be in equilibrium with Ra-226 and the dose coefficient for each radionuclide. The interim term $[C_s][f_i][DC_{(inh)i}]$ for each radionuclide is also shown in Table 5.

Table 4. Concentrations of Ra-226 in Soil

Sample Location	Ra-226 (pCi/g)
R0408	24.92
R0413	21.25
R0414	7.20
R0415	6.13
R0408	24.92
R0422	14.27
R0423	6.38
R0531	8.11
R0532	17.74
R0433	17.18
R0434	18.08
R0435	17.39
R0536	6.06
R0540	24.41
R0543	18.53
R0454	10.08
R0462	6.65
R0475	12.21
R0476	11.78
R0479	5.43
R0480	5.42
Average	**12.96**

Appendix A. Assessment of Potential Public Dose from RRM (*continued*)

Table 5. Radionuclides Present Given as Percent of Total and as Dose Coefficients

Parameter	Radionuclide									
	U-238	**U-235**	**U-234**	**Th-230**	**Ra-226**	**Po-210**	**Pa-231**	**Ac-227**	**Th-227**	**Pb-210**
Fraction of Radionuclide f_i Present[1] (%)	1.29	0.06	1.26	31.40	31.40	31.40	1.39	0.85	0.91	0.05
Inhalation Dose Coefficient[2] $DC_{(inh)i}$ (Sv/Bq)	8.0×10^{-6}	8.5×10^{-6}	9.4×10^{-6}	1.0×10^{-4}	9.5×10^{-6}	4.3×10^{-6}	1.4×10^{-4}	5.5×10^{-4}	1.0×10^{-5}	5.6×10^{-6}
Inhalation Interim Term ([pCi Sv]/[g Bq])	1.3×10^{-6}	6.2×10^{-8}	1.5×10^{-6}	4.1×10^{-5}	3.9×10^{-5}	1.8×10^{-5}	2.5×10^{-5}	6.1×10^{-5}	1.2×10^{-6}	3.6×10^{-8}
Ingestion Dose Coefficient[2] $DC_{(ing)i}$ (Sv/Bq)	4.5×10^{-8}	4.7×10^{-8}	4.9×10^{-8}	2.1×10^{-7}	2.8×10^{-7}	1.2×10^{-6}	7.1×10^{-7}	1.1×10^{-6}	8.8×10^{-9}	6.9×10^{-7}
Ingestion Interim Term ([pCi Sv]/[g Bq])	7.5×10^{-9}	3.4×10^{-10}	8.0×10^{-9}	8.6×10^{-7}	1.1×10^{-6}	4.9×10^{-6}	1.3×10^{-7}	1.2×10^{-7}	1.0×10^{-9}	4.5×10^{-9}

Ac = actinium; Pa = Protactinium; Pb = lead; Po = polonium; Th = thorium; U = uranium

[1]Mixture of radionuclides present in mill tailings (from *Moab UMTRA Project Internal Dosimetry Technical Basis Manual,* DOE-EM/GJRAC1913).

[2]Dose coefficients are from the International Commission on Radiological Protection. The highest inhalation dose coefficient for an adult was used for each radionuclide because it results in the highest calculated dose.

Inserting the values into the inhalation dose equation results in:

$$D_D = [t][I_{inh}][C_d]\sum([C_s][f_i][DC_{(inh)i}])[EF][0.037][100{,}000]$$

$$\text{where } \sum([C_s][f_i][DC_{(inh)i}]) = 0.00055$$

$$D_D = [78][0.6][0.0000108][0.00055][2.1][0.037][100{,}000]$$

$$D_D = 0.0022 \text{ mrem}$$

2.3 Ingestion of Dust

The equation for calculating the ingestion dose is as follows:

$$D_S = [t][I_{ing}]\sum([C_s][f_i][(DC_{(ing)i}])[EF][0.037][100{,}000][0.0417]$$

Where:

- D_S = ingestion dose (mrem)
- t = time of exposure over one year (h)
- I_{ing} = ingestion rate (g/day) (equals 0.1 for this equation)
- C_s = average Ra-226 concentration in soil (pCi/g)
- f_i = fraction of each radionuclide *i* that is assumed to be in equilibrium with Ra-226 represented as a percent of the total (%)
- $DC_{(ing)i}$ = ingestion dose coefficient for each radionuclide *i* (Sv/Bq)
- EF = an enhancement factor to account for the possibility that the radionuclide concentration in airborne dust may be greater than the concentration in soil

To represent Ds in millirems, the following conversions are applied:
0.037 Bq = 1 pCi
100,000 mrem = 1 Sv
0.0417 days = 1 h

Table 5 shows the interim term $[C_s][f_i][DC_{(ing)i}]$ for each radionuclide.

Inserting the values into the equation results in:

$$D_S = [t][I_{ing}]\sum([C_s][f_i][(DC_{(ing)i}])[2.1][0.037][100{,}000][0.0417]$$

$$\text{where } \sum([C_s][f_i][DC_{(ing)i}]) = 0.0000071$$

$$D_S = [78][0.1][0.0000071][2.1][0.037][100{,}000][0.0417]$$

$$D_S = 0.018 \text{ mrem}$$

3.0 Results

The estimated annual total dose for an adult walker is presented in Table 6.

Table 6. Estimated Annual Total Dose

Parameter	Annual Dose (mrem)
External Direct Gamma Dose	0.94
Internal Inhalation Dose	0.0022
Internal Ingestion Dose	0.018
Annual Total Dose	**0.96**

4.0 Conclusion

The most probable future use of the historical highway right-of-way supplemental standards area is recreational. The above calculations demonstrate that members of the public who walk along the trail, which a part of the historical highway became, would receive a fraction of the 100 mrem/yr dose limit not including background even when conservative assumptions are used. Therefore, DOE recommends concurrence with this *Supplemental Standards Application.*

5.0 References

DOE (U.S. Department of Energy), *Moab UMTRA Project Annual Site Environmental Report for Calendar Year 2014*, DOE-EM/GJ2181.

DOE (U.S. Department of Energy), *Moab UMTRA Project Internal Dosimetry Technical Basis Manual*, DOE-EM/GJRAC1913.

EPA (U.S. Environmental Protection Agency), Exposure Factors Handbook 2011 Edition, EPA/600/R-09/052F, September 2011.

International Commission on Radiological Protection (ICRP), Compendium of Dose Coefficients based on ICRP Publication 60, ICRP Publication 119, 2012.

M.A. Wasiolek, Modeling the inhalation enhancement factor in prospective radiological risk assessment, *Radioprotection*, Volume 44, Number 5, 2009.

UDEQ (Utah Department of Environmental Quality), Yearly Quicklook Summary Report as reported to the U.S. Environmental Protection Agency, 2015.

Attachment 1. Letter from Utah Department of Transportation

U.S. Department of Energy
200 Grand Avenue
Grand Junction, CO 81501

October 5, 2016

Mr. Rick Torgerson
Region Four Director
Utah Department of Transportation
210 West 800 South
Richfield, UT 84701

MOAB-00002-17

Subject: Concurrence with Application of Supplemental Standards for Historical Highway in Moab, Utah - Revision 2

Dear Mr. Torgerson:

This letter is to request your concurrence on an Application of Supplemental Standards for the historical highway in the Utah Department of Transportation (UDOT) right-of-way that underlies the portion of the North Moab Canyon Recreation Trail on the U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project site in Moab, Utah.

Residual radioactive materials, consisting of decomposed uranium ore and/or windblown mill tailings, exist under the former highway on the north side of the Moab UMTRA Project site (see Attachment 1). The soil contamination area involving the UDOT right-of-way is approximately 153,755 square feet, with a total estimated volume of 2,850 cubic yards that would require removal if supplemental standards were not applied.

Remediation of the soil contamination area would require disturbing the paved recreation trail and the historical highway to remove the residual radioactive materials. The U.S. Environmental Protection Agency cleanup standards for radium-226 in soil, codified in 40 Code of Federal Regulations Part 192.21 (40 CFR 192.21), allow residual radioactive materials to remain in place when one or more criteria are met. DOE is submitting an Application for Supplemental Standards to the U.S. Nuclear Regulatory Commission (NRC) for the portion of the historical highway shown in Attachment 1. DOE will be using 40 CFR 192.21 criterion (b) excessive environmental harm relative to long-term benefits as the justification for this application.

In applying for supplemental standards for the historical highway, the residual radioactive materials that would remain in place would not pose a significant present or future health or environmental risk.

Based on the analytical results for radium-226 of samples collected beneath the historical highway right-of-way, soils encountered during repair or replacement of the trail can be put back into the fill at the discretion of UDOT without any special containment measures beyond normal dust control and watering to mitigate dust.

Attachment 1. Letter from Utah Department of Transportation (continued)

DOE would like to obtain your concurrence on the Application of Supplemental Standards for the UDOT right-of-way indicated in Attachment 1 by signing where indicated on the following page. Please return a signed copy of this letter to me at the address above, preferably no later than October 14, 2016. If you have any questions, feel free to call me at (970) 257-2115.

Sincerely,

Donald R. Metzler
Moab Federal Project Director

I concur with the Application of Supplemental Standards for the historical highway in the UDOT right-of-way on the DOE Moab UMTRA Project site:

10/13/16

Rick Torgerson Date
UDOT

cc w/enclosure:
Robert Dowell, UDOT
Matt Reardon, CBC
Justin Peachi, MOAB
Ken Wethington, MOAB
Joe Ritchey, TAC
Wendee Ryan, TAC
Project File MOA 2.12 (C. Smith)

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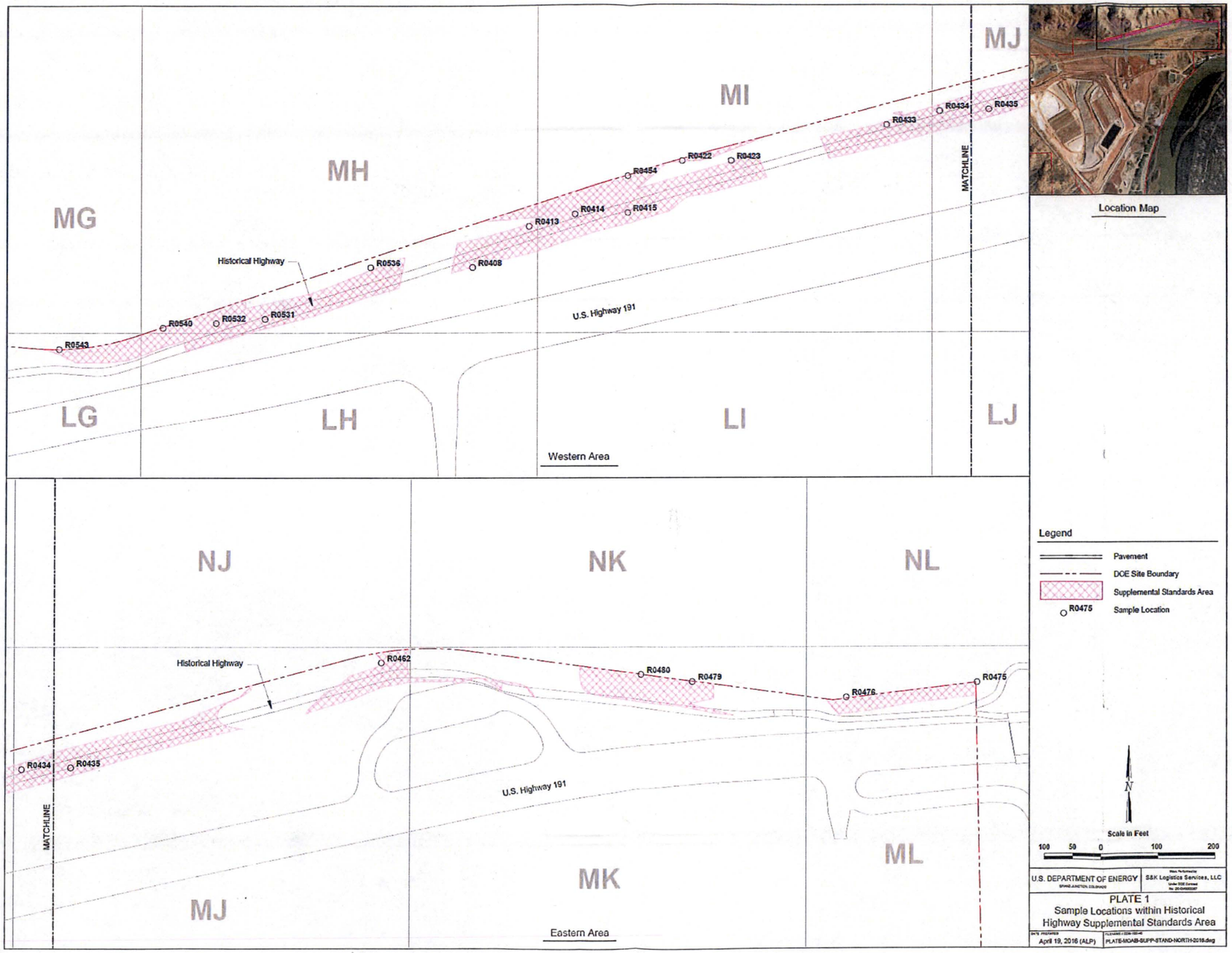

Plate 1. Sample Locations within Historical Highway Supplemental Standards Area