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Moab UMTRA Project
Annual Site Environmental Report
For Calendar Year 2020

Revision 0

September 2021

U.S. Department of Energy

Office of Environmental Management

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Moab UMTRA Project
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Revision 0

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9/28/2021

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Revision History

Revision	Date	Description
0	September 2021	Initial issue.

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Tables

Acronyms and Abbreviations

AARST	American Association of Radon Scientists and Technologists
AEA	Atomic Energy Act
ASER	Annual Site Environmental Report
ASL	Analytical Service Level
ASME	American Society of Mechanical Engineers
bgs	below ground surface
bkgd	background
BLM	Bureau of Land Management
CA	Contamination Area
CAA	Clean Air Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DNR	Department of Natural Resources (Utah Division of Forestry, Fire, and State Lands)
DOE	U.S. Department of Energy
DOECAP	Department of Energy Consolidated Audit Program
DOE O	DOE Order
DOT	Department of Transportation
EISA	Energy Independence and Security Act
EM	Environmental Management
EMS	Environmental Management System
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FFCA	Federal Facilities Compliance Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
ft	feet
IA	interim action
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
km	kilometers
lb	pounds
LL	Lessons Learned
MBTA	Migratory Bird Treaty Act
MEI	Maximally Exposed Individual
mg/L	milligrams per liter
MOA	memorandum of agreement
MOU	memorandum of understanding
mrem	millirems
mSv	millisievert
N	nitrogen
N/A	not analyzed
NELAP	National Environmental laboratory Accreditation Program
NEPA	National Environmental Policy Act

NESHAP	National Emissions Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NQA	Nuclear Quality Assurance
NRPP	National Radon Proficiency Program
NS	not sampled
ORP	Oxidation-Reduction Potential
pCi/L	picocuries per liter
QA	Quality Assurance
QAP	Quality Assurance Program
RAC	Remedial Action Contractor
RCRA	Resource Conservation and Recovery Act
REM	Roentgen Equivalent Man
RRM	Residual Radioactive Material
RRR	Rim to Rim Restoration
SDWA	Safe Drinking Water Act
SME	Subject Matter Expert
Sv	Sievert
TAC	Technical Assistance Contractor
ted	Total Effective Dose
TLD	Thermoluminescent Dosimeter
TSCA	Toxic Substances Control Act
U	Uranium
UAC	Utah Administrative Code
UDEQ	Utah Department of Environmental Quality
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
UPDES	Utah Pollutant Discharge Elimination System
US-191	U.S. Highway 191
USC	United States Code
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
yr	year

Executive Summary

The Annual Site Environmental Report (ASER) serves as the principal document for communicating environmental protection performance information to the public. It is also the primary mechanism for documenting compliance with U.S. Department of Energy's (DOE's) requirements for radiation protection of the public and environment at its sites.

This ASER presents information pertaining to environmental activities conducted on the DOE Moab Uranium Mill Tailings Remedial Action (UMTRA) Project during calendar year 2020. This report includes Project activities conducted at the Moab site located near Moab, Utah, and the Crescent Junction, Utah, disposal site, located approximately 30 miles north of the Moab site.

The Project has six major programs including: Environmental Restoration, Environmental Compliance, Environmental Radiological Protection, Groundwater, Revegetation, and Quality Assurance (QA). Brief descriptions of these programs are provided below.

Environmental Restoration Program
The scope of the UMTRA Project is to relocate uranium mill tailings and other contaminated materials from a former uranium-ore processing facility and from off-site properties known as vicinity properties in Moab, Utah, to an engineered disposal cell constructed near Crescent Junction, UT.

Environmental Compliance Program
The Project must operate in compliance with various federal environmental statutes, some of which are enforced at the state level through permits. During 2020, the Project remained in compliance with all regulations and permits, and there were no notices of violation. Section 2.0, Compliance Summary, addresses principle regulatory requirements and their implementation status on the Project.

DOE sites must use an ISO14001 conforming Environmental Management System (EMS) as a platform to implement programs with objectives that contribute to sustainability goals. The Project's EMS is a structured process for reducing the environmental consequences of Project activities, and to maximize beneficial use of finite resources and minimize wastes. DOE's EMS integrates training and awareness of key environmental aspects, objectives and impacts into the core functions of the contractor's Integrated Safety Management System (ISMS) to ensure continuous improvement.

Revegetation
The purpose of the Revegetation Program at the Moab Site is to revegetate remediated areas with resilient, native vegetation and to stabilize and to improve the top soil, which lacks nutrients after remediation activities. Section 3.2 covers the Moab Site Revegetation Program.

Environmental Radiological Protection Program
The Project monitors radiological emissions to ensure DOE activities are protective of the public and the environment. The environmental air monitoring network consists of on-site and off-site sampling locations. The Project monitors concentrations of radon and direct gamma radiation and selected airborne radioparticulates. Samples are analyzed quarterly at 37 locations.

Radiological dose to the public did not exceed the DOE Order 458.1 dose limits from any radiological releases in 2020. Section 4.1 addresses the population dose and dose to the maximum exposed individual (MEI).

Groundwater Program

The Groundwater Program at the Moab site is designed to limit ecological risk from contaminated groundwater discharging to the Colorado River. River protection is accomplished through a multifaceted approach. An interim action (IA) groundwater remediation system includes extraction of contaminant mass, primarily ammonia and uranium, near the uranium mill tailings pile and injection of fresh water closer to the river to protect critical habitat areas for endangered fish species. Groundwater and surface water monitoring measures IA system performance. During 2020, operation and monitoring of the IA system continued.

The groundwater program is currently working on developing the final Groundwater Compliance Action Plan to determine a long-term strategy. Section 6.0 addresses the Groundwater Program.

QA Program

The Project ensures the quality of its environmental data through implementation of contractor QA Plans, which include validation of data collection and sample analysis. Section 7.0 addresses the Moab Site QA Program.

Key Activities in 2020

The Project shipped more than 943,423 tons of residual radioactive material (RRM) from the Moab site to the Crescent Junction disposal site during 2020. The cumulative total through 2020 was 11.2 million tons.

Document Availability

This document may be viewed in its entirety on the DOE Moab Project website at *www.gjem.energy.gov/* and in the public reading room in the Grand County Public Library in Moab. Hard copies may be obtained by contacting the Moab Federal Cleanup Director at (970) 257-2115 or at the address below.

U.S. Department of Energy
200 Grand Avenue, Suite 500
Grand Junction, CO 81501

Comments or questions regarding this document may also be directed to the Project at (800) 637-4575. Members of the public who wish to comment on this document or who have questions are encouraged to contact DOE at the above phone number or by email at *publicaffairs@gjemtac.doe.gov.*

1.0 Introduction

1.1 Site Locations

The Moab site is located about three miles northwest of Moab in Grand County, Utah (Figure 1). The 480-acre site is bordered on the north and west by sandstone cliffs. U.S. Highway 191 (US-191) parallels the northern site boundary, and State Route 279 transects the western portion of the property. Arches National Park has a common property boundary with the Moab site north of US-191. The Colorado River forms the eastern boundary. The Moab Wash, an ephemeral stream, runs northwest to southeast through the site and joins the Colorado River. The Scott M. Matheson Wetlands Preserve lies directly across the river from the site. Figure 2 shows Moab site features.

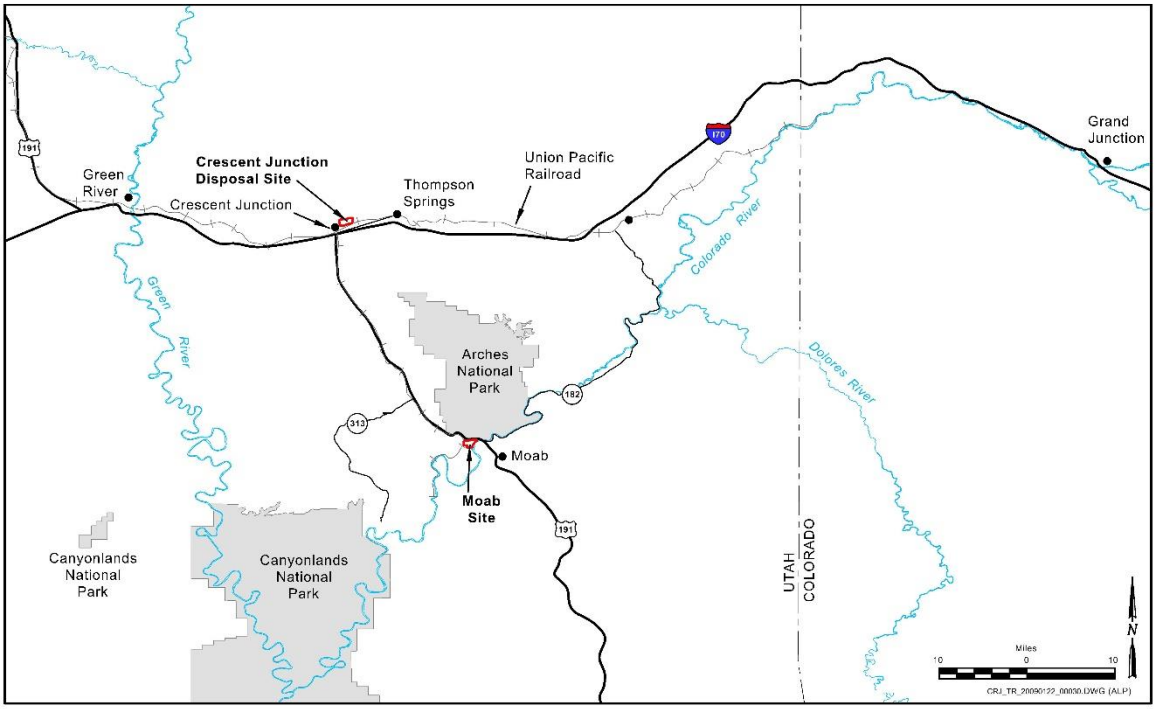

Figure 1. Location of Moab and Crescent Junction Sites

The Crescent Junction disposal site is also located in Grand County, northeast of the junction of Interstate 70 and US-191, approximately 30 miles north of the Moab site (Figure 1). It is the location for disposal of the Moab site RRM. Through a series of temporary withdrawals of public domain land and a permanent land transfer by the Department of the Interior, DOE currently owns 500 acres of land and has another 936 acres in a 20-year withdrawal (beginning in 2009) near Crescent Junction for the disposal cell and surrounding support areas. Figure 3 shows Crescent Junction site features.

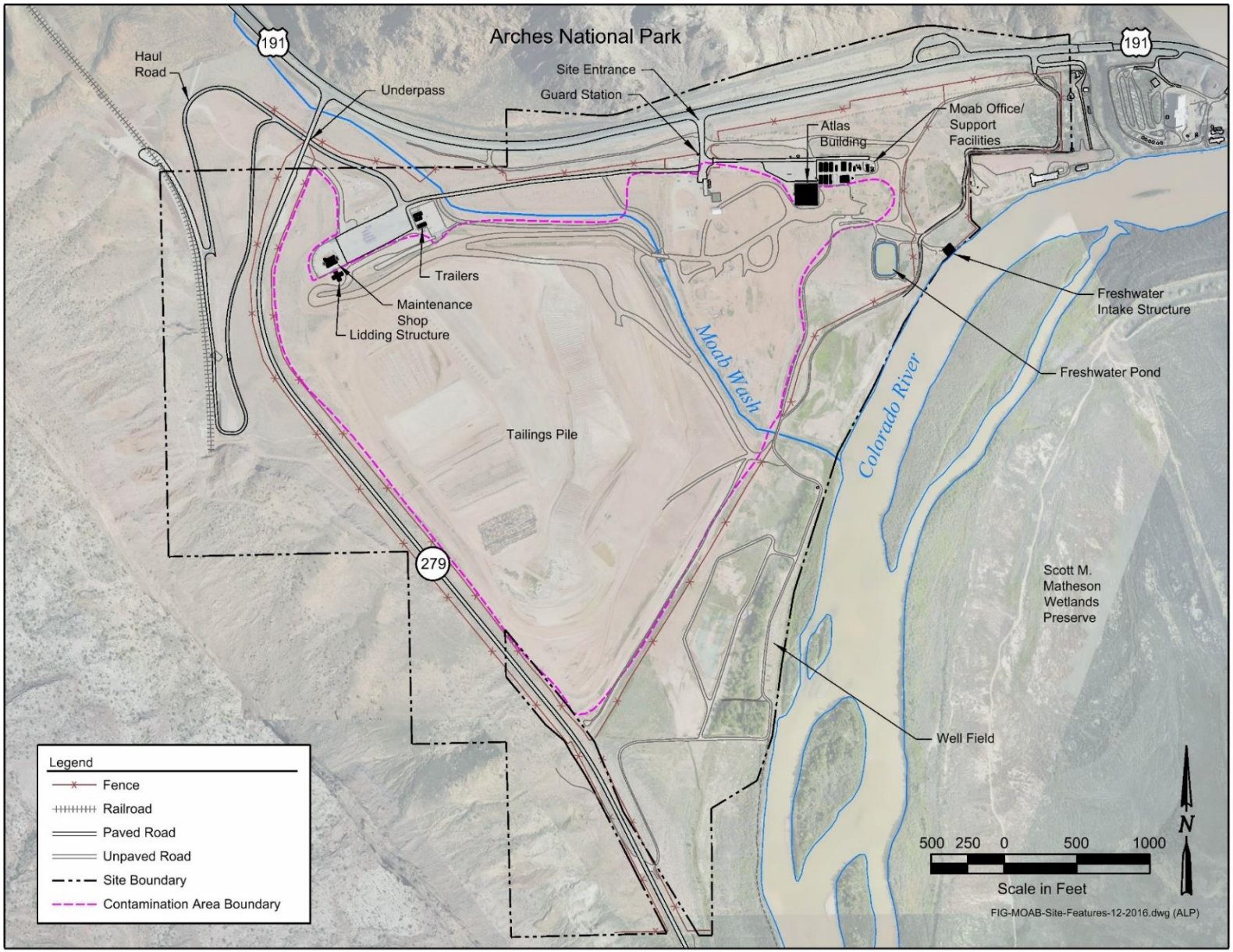

Figure 2. Moab Site Features

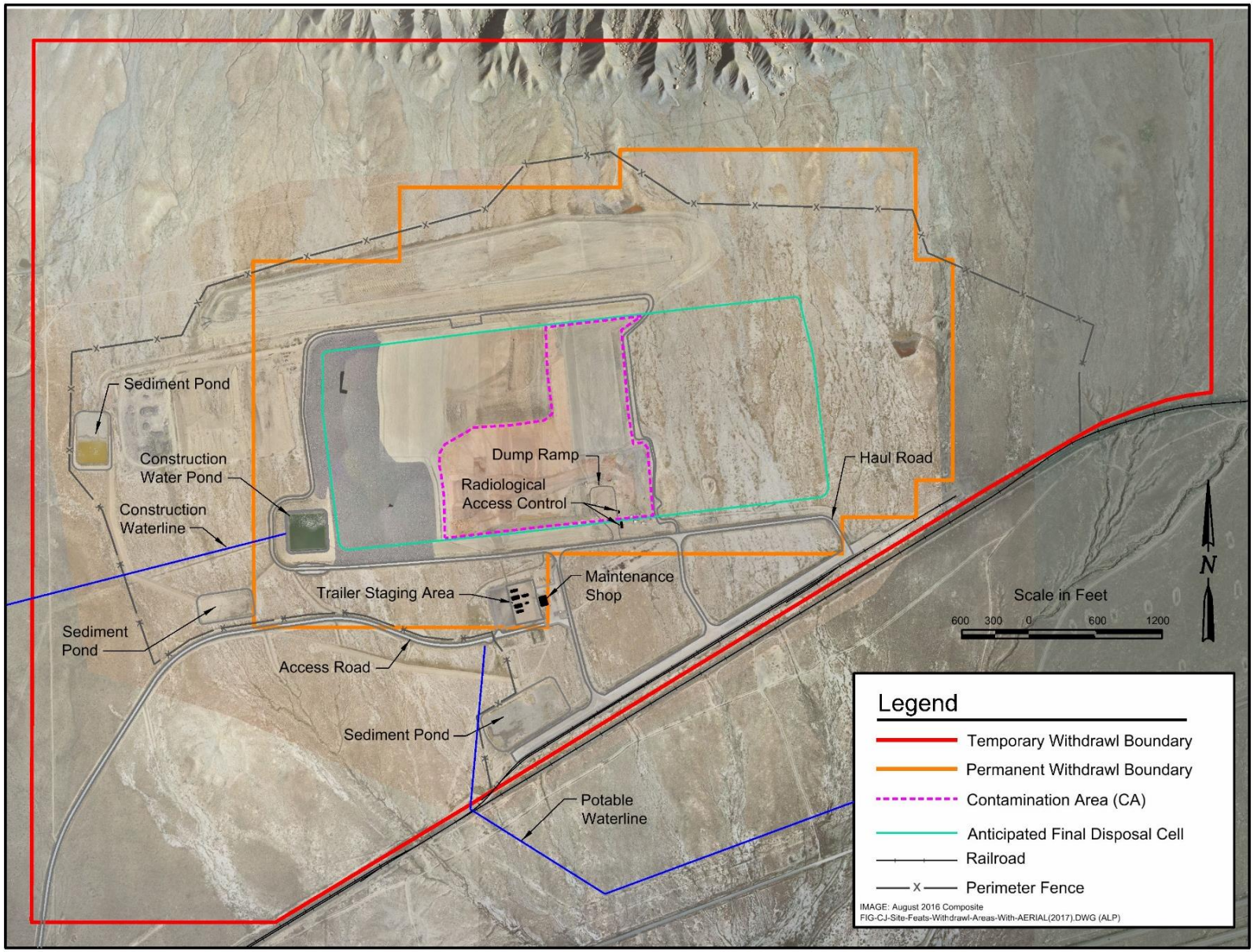

Figure 3. Crescent Junction Site Features

1.2 Site History

The Moab mill operated under various private owners from 1956 through 1984. The tailings created by the milling operations were pumped to an unlined impoundment in the western portion of the property. The tailings accumulated over time, forming a pile up to 90 feet thick. The eastern toe of the pile lies 750 feet from the Colorado River. When processing operations ceased, an estimated 16 million tons (12 million cubic yards) of RRM were present in the pile, which occupied about 130 acres at the site. An interim cover was placed on the pile in 1995.

Congress enacted the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (Public Law 106-398), and in October 2001, ownership and cleanup responsibility for the Moab site were transferred to DOE. The Project is managed by the DOE Office of Environmental Management (EM) located in Grand Junction, Colorado (see Figure 1). The legislation stipulated that the Moab site undergo remediation as a Title I site under Title 42 United States Code Section 7901 (42 USC 7901), the Uranium Mill Tailings Radiation Control Act (UMTRCA).

In July 2005, DOE published the *Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah, Final Environmental Impact Statement* (FEIS) (DOE/EIS-0355). The FEIS presented the preferred remediation alternatives. In September 2005, DOE issued the *Record of Decision for the Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah* (6450-01-P), which detailed the selection of the preferred alternatives and basis for that decision. The first phase of the disposal cell was constructed in 2008; RRM shipments to the cell began in April 2009.

1.3 Project Mission

The Project's mission is to safely relocate uranium mill tailings and other process-related wastes, collectively known as residual radioactive material (RRM), from the former uranium ore-processing facility (mill site), and off-site contaminated properties known as vicinity properties in Moab, to an engineered disposal cell constructed near Crescent Junction. The RRM is primarily transported by rail. The mission also includes active remediation of contaminated groundwater at the Moab site.

1.4 Primary Operations and Project Activities

Primary operations and Project activities at the sites include:

- Excavating and conditioning RRM at the Moab site.
- Transporting RRM to the Crescent Junction disposal cell by rail.
- Excavating the Crescent Junction disposal cell.
- Placing and compacting RRM from the Moab site and vicinity properties in the cell.
- Placing interim and final cell cover layers.
- Operating an IA groundwater remediation system at the Moab site, including groundwater extraction and freshwater injection.
- Monitoring contaminants of concern in air, soil, groundwater, and surface water.
- Revegetating remediated areas and maintaining vegetation in remediated areas.

1.5 Environmental Setting

Meteorology
At the Moab site, the 2020 average annual temperature was approximately 59ºF. December was the coldest month, with low temperatures averaging 19ºF, and August was the warmest month, with high temperatures averaging 101ºF. The total rainfall was approximately 3.7 inches. At the Crescent Junction site, the average annual temperature was approximately 58ºF. December was the coldest month, with low temperatures averaging 11ºF, and August was the warmest month, with high temperatures averaging 97ºF. The total rainfall was approximately 3.4 inches.

Geology and Hydrology
The primary hydrogeologic unit present at the Moab site consists of unconsolidated alluvium on the valley floor flanked by consolidated sandstones and shale on the canyon walls. The Moab site is susceptible to flooding from the Colorado River during runoff of spring snowmelt in the Rocky Mountains and from thunderstorms in the drainage basin of the Moab Wash.

The Colorado River generally reaches a maximum flow between late May and early June. Groundwater underlying the site moves from northwest to southeast, discharging to the Colorado River during base flows.

The Crescent Junction site is on a gently south-sloping surface of unconsolidated alluvium underlain by consolidated Mancos Shale. The site lies at the base of the Book Cliffs to the north. Surface drainage flows to ephemeral washes located to the south of the site that ultimately drain to the Green River. Groundwater underlying the Crescent Junction site occurs intermittently in sand lenses in the alluvium and in fractures in the Mancos Shale.

1.6 Area Demographics

Moab is the Grand County government seat and the principal city of southeastern Utah, with a population of about 5,268 (2020 estimate, U.S. Census Bureau, *https://data.census.gov*). In addition to Moab, the communities of Crescent Junction and Thompson Springs, also in Grand County, are affected by relocation of RRM to the Crescent Junction site.

The population of Grand County is about 9,754 (2020 estimate, U.S. Census Bureau). Grand County's major economic base is tourism. Southeastern Utah has the nation's largest concentration of national and state parks, monuments, and recreation areas.

2.0 Compliance Summary

UMTRCA required the promulgation of cleanup standards now codified by the U.S. Environmental Protection Agency (EPA) at Title 40 Code of Federal Regulation Part 192 (40 CFR 192), "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," and assigned the U.S. Nuclear Regulatory Commission to oversee the cleanup and issue licenses for the completed disposal cells.

RRM at the Moab site contains contaminants in concentrations that could be hazardous to the environment and public health and that exceed EPA standards. Remediation of the Moab site and disposal at the Crescent Junction site are conducted in compliance with these standards.

RRM, specifically defined in 40 CFR 192.01, "Definitions," is waste in the form of tailings resulting from the processing of ores for the extraction of uranium and other valuable constituents of the ores; and activities. RRM requiring cleanup at the Moab site includes uranium mill tailings, contaminated soil, debris from dismantling the mill buildings and associated structures, equipment, remnants of processing ponds, disposal trenches, and other wastes.

2.1 Compliance Status

The Project is committed to protecting the environment while conducting its mission. It operated without any notices of environmental violations during 2020. Table 1 summarizes federal and state environmental regulations and their implementation status on the Project.

2.2 Other Major Environmental Issues and Actions

DOE uses external and internal assessments, surveillances, and management assessments to evaluate environmental compliance and implement corrective actions. The Project QA organization performed and/or coordinated assessments in 2020 to verify system descriptions and compliance with procedures and regulations.

Adapting to Climate Change
The Project actively controls the water level in the Moab freshwater pond and the Crescent Junction construction water pond, reducing vulnerability during drought conditions. The *Moab UMTRA Project Flood and Drought Mitigation Plan* (DOE-EM-GJ1940) incorporates specific actions to protect the site from these natural hazards. Due to the comparatively short-term completion date for the Project, no additional climate change adaptation efforts are currently planned; however, the Project's environmental control plans are annually reviewed and revised as needed based upon changing weather conditions.

Reporting During the COVID-19 Pandemic Public Health Emergency
The Project remained fully operational in 2020 during the COVID-19 pandemic. A mask requirement, social distancing, a telework option, and a no ride share policy was put into place to protect the workers.

2.3 Continuous Release Reporting

Not applicable to the Project.

2.4 Unplanned Releases

No unplanned radiological or non-radiological releases occurred in 2020.

Table 1. Principle Regulatory Requirements and Status for the Moab Project

Federal or State Requirement	What it Covers	2020 Implementation Status
Environmental Restoration and Waste Management		
RCRA, FFCA	RCRA governs the generation, storage, handling, and disposal of hazardous wastes. In 1992, RCRA was amended by the FFCA, which required DOE to take a number of actions to manage mixed waste handled at its facilities.	All waste generated within the CA is considered RRM, the cleanup and management of which is regulated by UMTRCA, not RCRA; however, waste generated outside the CA is considered non-RRM and, therefore, can be regulated by RCRA. During 2020, no RCRA wastes were generated outside the CA. The Project maintains a Very Small Quantity Generator status.
NEPA	NEPA requires federal agencies to follow a prescribed process to anticipate impacts on the environment of proposed major federal actions and alternatives. DOE codified its implementation of NEPA in 10 CFR 1021, "National Environmental Policy Act Implementing Procedures."	NEPA reviews have been periodically conducted to ensure proposed Project activities are within the original bounds of the FEIS. During 2020, three Categorical Exclusions were completed for Ra-226 soil sampling, freshwater pond clean-out, and burn box operations.
TSCA	TSCA was enacted to regulate the manufacturing and distribution of certain chemical substances and/or mixtures. TSCA specifically addresses the importation, use, and disposal of asbestos, polychlorinated biphenyls, radon, and lead-based paint.	All waste generated within the CA is considered RRM, the cleanup and management of which is regulated by UMTRCA, not TSCA; however, waste generated outside the CA is considered non-RRM and, therefore, can be regulated by TSCA. During 2020, no TSCA wastes were generated outside the CA.
FIFRA	FIFRA governs the distribution, sale, and use of pesticides. This act categorizes pesticides as either restricted or general use.	During 2020, the only herbicide used onsite was Milestone® for Russian knapweed. Other herbicides present onsite and are safely stored. All pesticides onsite are general-use.
Radiation Protection		
UMTRCA, Floyd D. Spence Act	Title I of UMTRCA requires DOE to establish a remedial action program and authorizes DOE to stabilize, dispose of, and control RRM, including contaminated groundwater, in accordance with cleanup standards promulgated in 40 CFR 192. UMTRCA is the primary law governing site cleanup and disposal for the Project.	During 2020, the Project excavated and disposed of RRM and contaminated groundwater in compliance with 40 CFR 192.

Table 1. Principle Regulatory Requirements and Status for the Moab Project (continued)

Federal or State Requirement	What it Covers	2020 Implementation Status
Radiation Protection (*continued*)		
DOE O 458.1 Admin Chg 4, "Radiation Protection of the Public and the Environment"	DOE O 458.1 is the key DOE order for public radiation protection. The order establishes requirements for DOE operations to protect members of the public and the environment from undue risk from radiation.	During 2020, the Project monitored radiological emissions. Project activities did not result in any dose to the public that exceeded the limits in DOE O 458.1.
DOE O 435.1, "Radioactive Waste Management"	This order was implemented to ensure all DOE radioactive waste is managed in a manner that protects workers, public health and safety, and the environment.	During 2020, the Project managed RRM in compliance with DOE O 435.1.
AEA	The AEA requires the management, processing, and utilization of radioactive materials in a manner that protects public health and the environment.	UMTRCA amended the AEA and authorized the EPA to establish health and environmental standards for the disposal of uranium mill waste.
Air Quality and Protection		
CAA	CAA establishes the requirements for facility air quality and air emissions.	The CAA is enforced at the state level through fugitive dust control plans prepared for the sites.
UAC R307-205-8,"Emission Standards; Fugitive Emissions and Fugitive Dust; Tailings Piles and Ponds"	This state administrative code establishes minimum work practices and emission standards for sources of fugitive emissions and fugitive dust.	During 2020, EPA Method 9-certified individuals diligently monitored opacity and implemented controls outlined in the site fugitive dust control plans.
40 CFR 61, NESHAP	The CAA establishes emission standards for hazardous air pollutants associated with various industrial processes codified as NESHAP.	The Project is not required to report under the NESHAP program as there are no NESHAP-regulated air emissions associated with the Project sites.
Water Quality and Protection		
33 USC 1251, CWA/NPDES	Under the CWA, the NPDES was designed to regulate and control pollutants from industrial wastewater and storm water discharges, both of which can have negative impacts on the quality of U.S. surface waters. The federal discharge requirements are implemented by UPDES, an equivalent state system.	As required by UPDES Storm Water General Permits (see Table 2), DOE prepared and continues to implement site storm water pollution prevention plans. The NOI's were renewed for 2020 by UDEQ. During 2020, no discharges were noted under UPDES.

Table 1. Principle Regulatory Requirements and Status for the Moab Project (continued)

Federal or State Requirement	What it Covers	2020 Implementation Status
Water Quality and Protection (*continued*)		
Storm Water Management and EISA	Under Section 438 of EISA, federal agencies have requirements to reduce storm water runoff from federal development projects to protect water resources.	During 2020, the Project conducted monthly inspections to ensure storm water controls were intact and storm water runoff was managed according to the plans. In addition, inspections were conducted after a 0.5" or greater rainfall event, which is required by the permit.
42 USC 300f, SDWA	The SDWA establishes minimum drinking water standards and monitoring requirements.	The provisions of the SDWA are not directly relevant to the Project sites because neither groundwater nor surface water at or near the sites is used as a public drinking water supply. DOE did not engage in any activities that affected drinking water supply sources. Remediation wells are designated as a temporary withdrawal point. During 2020, a Temporary Change Application was received from the Utah Department of Natural Resources, Division of Water Rights (see Table 2).
Other Environmental Statutes		
U.S. DOT Special Permit	Authorizes the transportation in commerce of non-DOT-specification bulk packages containing RRM from the Moab site and vicinity properties to the Crescent Junction disposal cell.	During 2020, the Project remained in compliance with the Special Permit.
DOE O 231.1B Admin Chg 1, "Environmental, Safety and Health Reporting"	DOE O 231.1B requires timely collection, reporting, analysis, and dissemination of data on environmental issues that could adversely affect the health, safety, and security of the public or workers, the environment, DOE operations, or DOE credibility.	This ASER summarizes Project environmental activities and protection performance during 2020.
NHPA	MOAs are in place among DOE, the Utah State Historic Preservation Office, the Utah DOT, and the Bureau of Land Management for protection of cultural and historic resources at the Project sites.	No impacts were noted during 2020.
40 CFR 112, Oil Pollution Prevention	The Project meets the criteria in 40 CFR 112 for oil storage and due to its location near the Colorado River, the facility could reasonably be expected to discharge oil into or near the navigable waters of the United States.	The Project maintains a Spill Prevention, Control, and Countermeasures Plan and conducts quarterly visual inspections of the outside oil storage containers.

Table 1. Principle Regulatory Requirements and Status for the Moab (continued)

Federal or State Requirement	What it Covers	2020 Implementation Status
Other Environmental Statutes (*continued*)		
ESA	The ESA prohibits activities that would jeopardize the continued existence of an endangered or threatened species or cause adverse modification to a critical habitat.	The Project reviewed work activities for potential impacts on threatened or endangered species. The Biological Opinion anticipates three age-0 Colorado pikeminnow, one age-0 humpback chub, one age-0 razorback sucker, and one age-0 bonytail could be taken annually through the completion of remediation. No known take occurred in 2020. Critical fish habitat was protected by interception of contaminated groundwater and injection of fresh water in wells near the Colorado River.
E.O. 13751, "Safeguarding the Nation from the Impacts of Invasive Species"	E.O. 13751 calls on federal agencies to prevent the introduction, establishment, and spread of invasive species and to eradicate and control populations of invasive species that are established.	Invasive weeds are controlled with bio-based herbicides and mechanical methods. Section 3.2 summarizes the Project's invasive weed control efforts.
MBTA	The MBTA implements various treaties and conventions among the U.S. and several other countries for the protection of migratory birds. Under the act, taking, killing, or possessing migratory birds, their body parts, nests, or eggs is unlawful.	During 2020, no endangered, threatened, or candidate species were noted on the Project sites.
DOE O 436.1, "Departmental Sustainability"	DOE O 436.1 requires all DOE sites to implement sound stewardship practices protective of the air, water, land, and other natural resources impacted by DOE operations. It also requires DOE sites to cost effectively meet or exceed compliance with applicable environmental, public health, and resource protection laws, regulations, and DOE requirements.	The Project developed an annual Site Sustainability Plan and has implemented an EMS that has been incorporated in contractor's ISMS to promote sound stewardship practices and to ensure compliance with this order.
42 USC 11001, EPCRA	EPCRA requires facilities with large quantities of hazardous or toxic chemicals, including petroleum products, to prepare emergency plans and report their inventories to EPA, the state, and local emergency planning groups.	The Project operated in accordance with emergency planning and reporting requirements and submitted Tier II Emergency and Hazardous Chemical Inventory Reports for 2020.

Table 1. Principle Regulatory Requirements and Status for the Moab Project (continued)

Federal or State Requirement	What it Covers	2020 Implementation Status
Other Environmental Statutes (*continued*)		
EO 11988, "Floodplain Management"	DOE's implementing regulations in 10 CFR 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements," identify the requirements of EO 11988 for actions that may affect floodplains. Portions of the Moab site fall within the 100-year floodplain of the Colorado River.	Activities conducted in the floodplain during 2020 were limited to irrigation and weed control.
EO 11990, "Protection of Wetlands"	10 CFR 1022 implements the requirements of EO 11990 for actions that may affect wetlands.	Project activities performed in 2020 that could enhance jurisdictional wetlands included storm water controls, revegetation, and erosion control. A 404 permit is pending closure based on success criteria concerning revegetation.

2.5 Summary of Permits

Table 2 shows the active Project permits during 2020.

Table 2. Active Permits for the Moab Project

Permits	Issuing Agency	No. of Permits
UPDES Construction General Permits: Moab UTR359185, UTRC00000 Crescent Junction UTR359187	State of Utah, Department of Environmental Quality, Division of Water Quality	2
Temporary Change Applications to change points of diversion to support groundwater actions and a non-use application to extract water from the Colorado River	State of Utah, Department of Natural Resources, Division of Water Rights	2
Stream Channel Alteration Permit	State of Utah, Department of Natural Resources, Division of Water Rights	1
Highway rights-of-way and encroachment permits for roads, pipelines, and gates	State of Utah, U.S. DOT	8
Special Permit SP-14283 for DOE to transport RRM and party status for the RAC	U.S. DOT	1
Scientific Research and Collecting Permit ARCH-2021-SCI-0006	National Park Service	1
Asbestos Landfill Permit	State of Utah, Department of Environmental Quality, Division of Air Quality	1
Conditional Use Permit	Grand County Council	1
404 Permit to construct and maintain pump station on the Green River SPK-2007-632	U.S. Army Corps of Engineers	1

2.6 ASER Reporting During COVID 19 Pandemic

The Moab and Crescent Junction Sites remained fully operational during the 2020 COVID-19 pandemic public health emergency. There were no environmental non-conformances that resulted from the pandemic.

3.0 Environmental Management System

The framework of the Project's EMS is based on the "Plan-Do-Check-Act" cycle of the International Organization for Standardization (ISO) Standard 14001:2015, "Environmental Management Systems," to ensure continuous improvement. The Project's EMS is addressed in the first three core functions of Integrated Safety Management System (ISMS): define the scope of work, analyze the hazards, and develop and implement hazard controls. The ISMS includes environmental protection in the definition of safety. Once implemented, programs must be assessed and any problems corrected to improve the effectiveness of the management system and to improve overall performance.

The EMS programs, processes, and procedures defines how the DOE, as implemented by the Technical Assistance Contractor (TAC) and Remedial Action Contractor (RAC), integrates environmental management controls into work activities, and oversees execution of EMS within EM federal and contractor activities. The EMS dictates environmental and sustainability values for ensuring protection to the environment, worker, and public health, consistent with the requirements of ISO 14001:2015 and DOE Order 436.1, "Departmental Sustainability."

The main objectives of the EMS are as follows:

- Implement, maintain, and continually improve the EMS.
- Execute conformance to ISO 14001:2015.
- Establish roles and responsibilities for key management and EMS positions.
- Apply a standardized method to incorporate environmental concerns into the Moab UMTRA Project utilizing the ISO 14001:2015 EMS as a guide.
- Identify and comply with all applicable environmental laws, regulations, and other requirements.
- Support and implement the Moab UMTRA Project Environmental Policy.
- Identify project-related environmental aspects and environmental objectives relative to site activities.
- Adhere to the DOE's ISMS with all work-related safety and compliance controls.

These objectives apply to everyone working on behalf of DOE. All employees and subcontractors are expected to comply with environmental requirements dictated in the EMS and report environmental concerns to management. Managers promote environmental stewardship, site-wide sustainability practices, and take prompt action to address concerns.

As part of the work planning process, the Project uses an environmental aspects checklist to consider environmental and human health impacts (adverse or beneficial) of new activities. The Project determines the likelihood of an environmental aspect that could occur and the consequences if it does, using a risk table associated with the environmental aspects registry. The Project also determines if the environmental aspect is significant, and if aspects have or could

have a significant impact on the environment, the Project, or the Project's mission. In 2020, the Project considered environmental aspects of new activities, but none were determined significant.

In 2020, the EMS improved aspects in the following areas:

- Reduced risk to the facility by meeting compliance obligations.
- Increased fiscal efficiency through on-site reuse/recycling of materials. For example, when excess sediment was cleaned out from the freshwater pond, the sediment was used to amend areas of under-performing soil in the well field.
- Greater recognition of environmental issues by presenting compliance/environmental topics to Project employees.
- Empowerment of individuals to contribute to improving the organization's environmental footprint through the Project Environmental Policy, engagement with internal stakeholders, and team meetings to discuss Project environmental issues.
- Completed EMS-related Management Assessments on storm water pollution prevention, spill prevention and countermeasures, migratory birds, chemical storage, and the EMS Manual.
- The environmental objectives were updated to include sustainability goals.
- Improved personnel health and safety through compliance training, by incorporating environmental hazards and controls into the Integrated Work Planning process, spill prevention controls, and complying with the Hazardous Communication protocol.
- Minimized water use through the use of native, drought-resistant plants for revegetation activities and teamed with the National Park Service for a native plant salvage.

3.1 Environmental Operating Experience and Performance Measurement

Sharing of lessons learned (LL) gained from site operational experience is consistent with the purpose and objectives of DOE O 210.2A, "DOE Corporate Operating Experience Program" and provide a component of continuous improvement to the EMS. LL are derived from work activities, assessments, and events, both positive and negative, which can be used to enhance or improve all aspects of operations, including environmental aspects. When lessons are learned at DOE sites, they are documented and shared so others can learn from them. The DOE LL database is reviewed weekly and applicable LL are distributed to managers for incorporation in work planning.

Key performance indicators for environmental objectives are established and environmental performance is monitored, evaluated, and measured through the sustainability dashboard and contractor assurance systems, environmental objective progress tracking, and plans. These systems establish comprehensive and integrated oversight processes to ensure work performance meets applicable requirements for environment, safety, and sustainability. In addition, any opportunities to meet EM and/or Project objectives utilizing green and sustainable remediation practices are evaluated in part based upon a balance of environment, social, and economic factors for a holistic approach.

3.2 Accomplishments

Revegetation
Revegetation efforts are focused on two main goals: 1) promoting desirable native vegetation, and 2) managing non-native weed species. Accomplishments for 2020 are as follows:

Promoting desirable native vegetation:

- Seeded approximately 11 acres in underperforming areas with native grass seed mix of 4 different salt-tolerant species.
- Planted approximately 150 pollinator species in "pollinator plot", including penstemon, globemallow, daisies, and desert willow.
- Continued to water native grasses that were salvaged from a Canyonlands National Park construction site.
- Developed strategic partnerships with U.S. Geological Survey (USGS), National Park Service (NPS), Western Colorado University, Utah Division of Forestry, Fire, and State Lands (DNR) and Rim to Rim Restoration (RRR) to promote accomplishment of restoration goals and benefit the greater restoration community.
- Designated new revegetation zones, based on similar current vegetative composition and/or ecological potential (total of 27 zones).
- Established Memorandum of Understanding (MOU) with U.S. Geological Survey (USGS).
- Collaborated with USGS to design and install 336 experimental plots in well field for restoration and research purposes, testing various seed mixes, soil amendments, treatment and watering methods.
- Participated in Watershed Restoration Initiative grant with RRR where different federal, state, and local agencies along the Colorado River corridor collaborate on restoration projects. The Moab UMTRA Project site acquired native seed mix from the State of Utah Division of Forestry, Fire, and State Lands to be seeded on the site property, a shared boundary between the state and UMTRA.
- Composted tree trimmings from on-site pruning/thinning activities and kochia from weeding to use as soil amendment.
- Significantly reduced weed cover, specifically kochia, through mowing at appropriate times, allowing native bunch grasses to flourish.
- Maintained native bunch grasses by using selective herbicide (i.e., Milestone) in areas of noxious weeds (i.e., Russian knapweed).
- Started felling dead and dying cottonwood trees in previously flood irrigated plots.
- Processed trees and vegetative debris into wood chips using chipper/shredder.
- Burn box was borrowed from the Bureau of Land Management (BLM) and used to burn vegetative debris too large for the chipper/shredder and to reduce trips to the landfill.
- Started improvement project of the cottonwood hedgerows by removing grasses built up along trunks, improving tree wells and irrigation system.
- Successfully transplanted native bunch grasses from cottonwoods hedgerows to other underperforming areas onsite.
- Continued repairing irrigation as necessary and removed damaged irrigation no longer relevant to current site conditions and goals. Modifications to existing irrigation systems

have been done to be more sustainable and relevant to Project goals. Planned and began implementation of irrigation upgrades to 75 horse-power system.

Managing non-native weed species:

A comprehensive weed inventory and mapping of the Moab UMTRA Project site was conducted in June and July 2020 by a revegetation technician. Based on current knowledge, no previous weed inventories or survey had been done for the Moab UMTRA Project site before 2020.

A Moab UMTRA site-specific target weed list was created with a total of 60 weed species (51 noxious weed species and 9 invasive species of concern), compiling noxious weed species and weed species of ecological impact and/or of management concern.

Results show the Moab UMTRA Project site currently has 7 different noxious weed species and 9 different invasive weed species of ecological and/or management concern present onsite.

Regarding the seven noxious weeds present onsite, six are considered Class 3 and one species is Class 4, according to the State of Utah weed classification as per the Utah Noxious Weed Act (Utah Code 4-17-101 et seq.):

1. Bermuda grass (*Cynadon dactalon*) – Class 3*
2. Canada thistle (*Cirsium arvense*) – Class 3
3. Field bindweed (*Convolvulus arvensis*) – Class 3
4. Perennial pepperweed (*Lepidium latifolium*) – Class 3
5. Russian knapweed (*Acroption repens*) – Class 3
6. Russian olive (*Elaeagnus angustifolia*) – Class 4**
7. Tamarisk/salt cedar (*Tamarix ramosissima*) – Class 3

* Class 3-- Contain; declared noxious known and established populations that pose a threat to agricultural industry and agricultural products and should not enter commercial channels.

** Class 4-- Prohibited; declared noxious species that pose a threat to nursey and greenhouse industry; detrimental to humans, animals, or the environment.

Further results from the 2020 weed inventory and mapping show the following:

- Tamarisk is the most wide-spread and extensive noxious weed, present in 24 of the 27 zones. Most tamarisk are scattered saplings along with mature thickets along the Colorado River.
- Russian knapweed occurs in 16 zones and is a mix of large, sparsely covered patches along with smaller, yet densely covered, infestations.
- Russian olive is present in 15 zones and primarily consists of saplings with a few mature trees near the Colorado River. Most are scattered individuals rather than dense patches.
- Perennial pepperweed is present on-site. Small infestations with moderate cover are interspersed throughout the site. This is a high priority species for rapid response before the population becomes established.
- The remaining three noxious weed species (Bermuda grass, Canada thistle, field bindweed) are in small (<200 square ft), contained patches.

Treatments and control strategies for each species are outlined in the *Moab UMTRA Project Revegetation and Weed Control Plan, Revision 7* (DOE-EM/GJTAC1655). Revegetation personnel continue to control noxious weeds with mowing, hand-pulling, and herbicide.

When possible, noxious weeds are eliminated before they drop seeds, which mitigates their prevalence. Moab UMTRA revegetation staff collaborated with DOE Legacy Management in fall of 2020 to learn best management practices and spray Russian knapweed onsite.

The nine different invasive weed species of ecological and/or management concern include: bull thistle (*Cirsium vulgare*), crested wheatgrass (*Agropyron cristatum*), halogeton (*Halogeton glomeratus*), kochia (*Bassia scoparia*), tumbleweed/Russian thistle (*Salsola tragus*), tumbling mustard (*Sisymbrium altissimum*), wooly mullein (*Verbascum thapsus*), yellow salsify (*Tragopogon dubius*), and yellow sweet clover (*Melilotus officinalis*).

Noxious weeds have always been an issue on the Project and by working with a Subject Matter Expert and using various techniques, such as mowing, there has been less dependence on the use of herbicide.

Awards
The Project was the recipient of a 2020 EPEAT Purchaser Award for the purchase of 103 EPEAT registered electronics and the Project received a Gold and Prime GreenBuy Award by purchasing fourteen products in seven categories. The Project also received an Honorable Mention DOE Sustainability Award for plant salvage activities in conjunction with Canyonlands National Park.

4.0 Environmental Radiological Protection Program and Dose Assessment

4.1 Radiological Discharges and Doses

This section presents results of the calculated radiation dose to the public from Project operations in 2020. Compliance with DOE O 458.1 may be demonstrated by calculating the dose to the maximally exposed individual (MEI), the representative person or group from the public likely to receive the most radiation dose based on exposure pathways and parameters.

The Project established an MEI for each site. The maximum dose the public receives is calculated based on the MEI data and offsite monitoring locations. The DOE public dose limit is 100 millirems/year (mrem/yr) above background received through all the pathways, such as inhalation, ingestion, and direct radiation. A summary of the 2020 public radiation dose applicable to both the Moab and Crescent Junction sites compared to the DOE public dose limit is shown in Table 3.

Table 3. Moab Project 2020 Public Radiation Dose

Pathway	Maximum Annual Dose to MEIs in mrem (mSv)	% of DOE 100 mrem/yr Limit	Estimated Collective (Population) Dose in person-rem (Sv)	Population Within 50 miles (~80 km)	Estimated Bkgd Radiation Population Dose in person-rem
Air	28.83 (0.288)*	28.83	515 (5.15)*	~16,317	1,423
Water	N/A	N/A	N/A	N/A	N/A
Other Pathways	N/A	N/A	N/A	N/A	N/A

Table 3. Moab Project 2020 Public Radiation Dose (continued)

All Pathways	28.83 (0.288)*	28.83	515 (5.15)*	~16,317	1,423

*Background Subtracted

Note: 1 rem = 0.01 Sv

Note: 1 mrem= 0.01 mSv

Note: 1000 mrem = 1 rem

The air pathway includes inhalation and direct gamma radiation.

4.2 Clearance of Property Containing RRM

Remediation of Moab site contaminated soils (off-pile areas) not associated with the tailings pile and of vicinity properties is part of the Project scope to reduce potential health and environmental risks from historical uranium ore processing at the site. In 2020, DOE did not perform any off-pile or vicinity property remediation.

4.3 Radiation Protection of Biota

DOE O 458.1 requires protection of biota from adverse effects due to radiation and radioactive material released from DOE operations. Biota are aquatic animals and terrestrial plants and animals that may be found at the Moab and Crescent Junction sites.

Moab RRM contains low levels of radioactivity, and the chemical composition (salt and pH) of the tailings pile materials limits vegetative growth. There are similar conditions at the Crescent Junction site.

The estimated radiological dose to biota from RRM at the Project sites is generally indistinguishable from naturally occurring radioactive material found in the surrounding environment. Therefore, the Project does not currently monitor the effects of radiological doses to biota and has no plan to monitor these effects.

4.4 Unplanned Radiological Releases

No unplanned radiological releases occurred in 2020.

4.5 Environmental Radiological Monitoring

Before tailings removal and disposal operations began, DOE initiated environmental air monitoring at and near the Moab and Crescent Junction sites. This was performed to collect baseline data and assess the potential for radiation dose to members of the public that could result from site operations. The Project's current air monitoring network measures radon, direct gamma radiation, and airborne radioparticulates at on-site and off-site locations around the Project sites. Moab monitoring locations are shown in Figures 4 and 5. Crescent Junction locations are shown in Figure 6.

Environmental air monitoring results are used to demonstrate compliance with DOE O 458.1. DOE O 458.1 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, and an annual total effective dose (TED) to exceed 100 mrem above background, excluding dose from radon and its decay products.

Established background monitoring locations sites were sufficiently placed to ensure air quality is not influenced by airborne contaminants associated with Project operations. Data from stations 0117 and 0123 collected between 2003 and 2008 were used to establish an average background radon concentration in the Moab area of 0.7 pCi/L and a background direct gamma radiation effective dose of 82 mrem/yr.

Data collected from monitoring stations in the Crescent Junction area from 2006 to 2009, before tailings shipments began, were used to establish a background radon concentration of 0.9 pCi/L and a background direct gamma radiation effective dose of 92.5 mrem/yr. The effective background dose from inhalation of radioparticulates was not determined for either site and was assumed to be zero.

Environmental air monitoring data are published in quarterly reports that are posted on the DOE Project website at *www.gjem.energy.gov/* and are available in the Moab public reading room. End-of-year monitoring results for 2020 for the Moab site are shown in Table 4 and for Crescent Junction in Table 5. Background values have been subtracted from data. During third quarter 2020 radon and direct gamma monitoring station 0303 was permanently removed due to disposal cell expansion operations. A new station was place to measure radon and direct gamma on the northern site boundary, 0310. Since there has not been a full year's worth of data from this station, radon and direct gamma measurements are at or below background levels for 2020, and have been noted in the table.

4.5.1 Radon

DOE O 458.1 established a limit of 3.0 pCi/L above background for radon concentrations at the DOE property boundary. During 2020, radon was measured at 37 locations (23 on site, 12 off site, and two MEIs) using alpha-sensitive detectors (e.g., radon cups). Radon cups were exposed for a period of approximately 90-days (three months). After collection, the radon cups were sent to an off-site laboratory for analysis. As shown in Tables 4 and 5, one location reached the 3.0 pCi/L annual limit but was not in exceedance of the DOE limit.

4.5.2 Direct Gamma Radiation

As uranium decays, several of the decay products emit gamma radiation. Residual radioactive RRM at the Moab site is a source of direct gamma radiation. During 2020, direct gamma radiation was measured at the same 37 locations (23 on site, 12 off site, and two MEIs) using thermoluminescent dosimeters exposed for approximately 90-days (three months).

On collection, the dosimeters were sent to an off-site laboratory for analysis. These results (Tables 4 and 5) represent the gamma dose an individual would receive from occupying a location for an entire year. As expected, the highest results were associated with locations closest to the tailings pile. While these values are high, no member of the public occupies that area long enough to receive a dose that is above the DOE limit.

The gamma dose is combined with the air radioparticulate dose to calculate the total effective dose (Section 4.5.4). There are only 13 locations where the air radioparticulate data are collected compared to the 37 locations where gamma doses are measured. Even without adding the

radioparticulate dose, it is evident based on the results provided in Table 4 that some of the Moab locations (in particular on-site locations 0109, 0110) would exceed the total effective dose limit without adding the dose associated with the radioparticulates. However, the doses represent 100% occupancy and the public does not consistently occupy any of these locations. The MEI is below the annual limit at both sites.

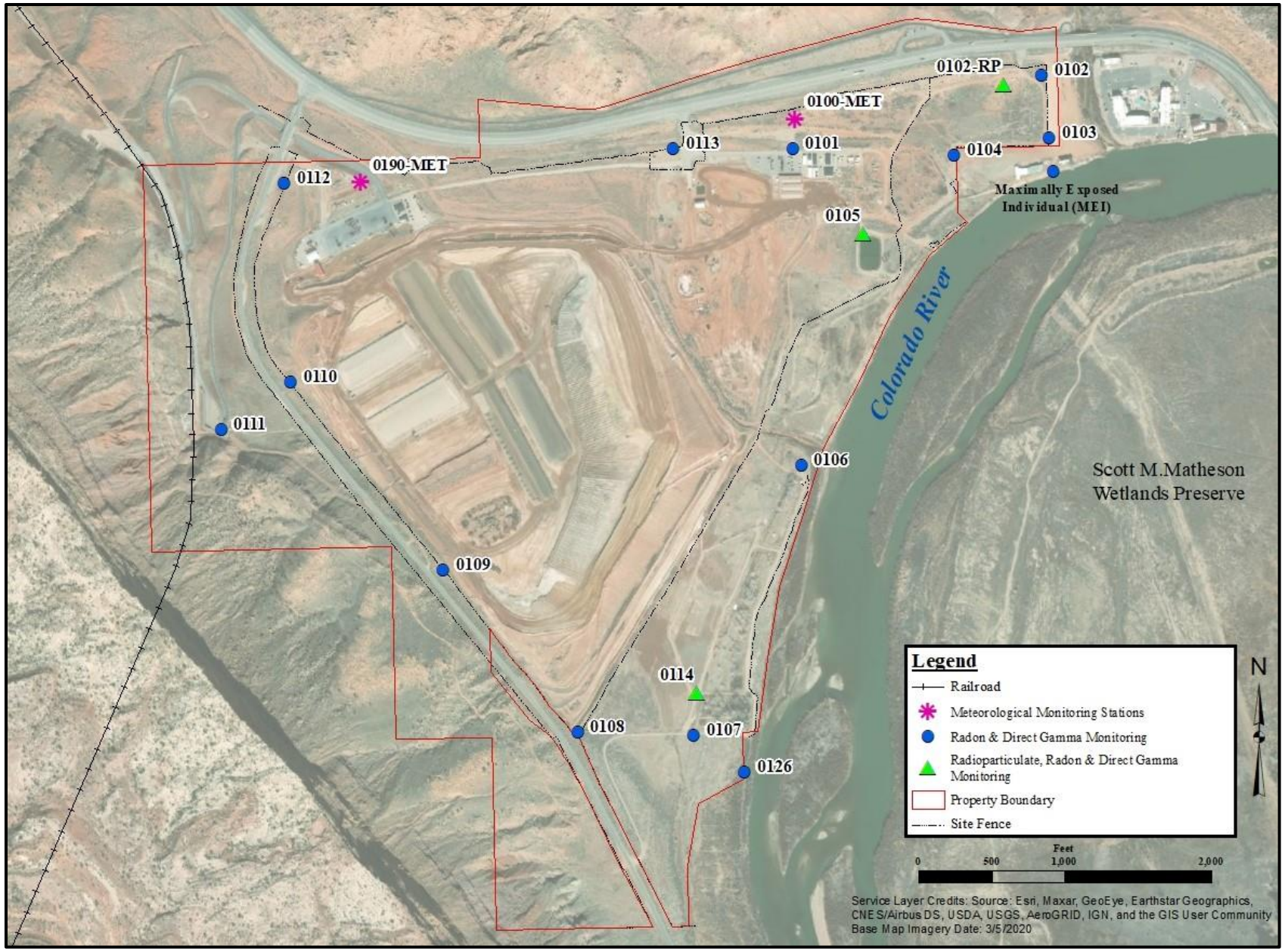

Figure 4. Moab On-site and MEI Environmental Air Monitoring Locations

Figure 5. Moab Off-site Environmental Air Monitoring Locations

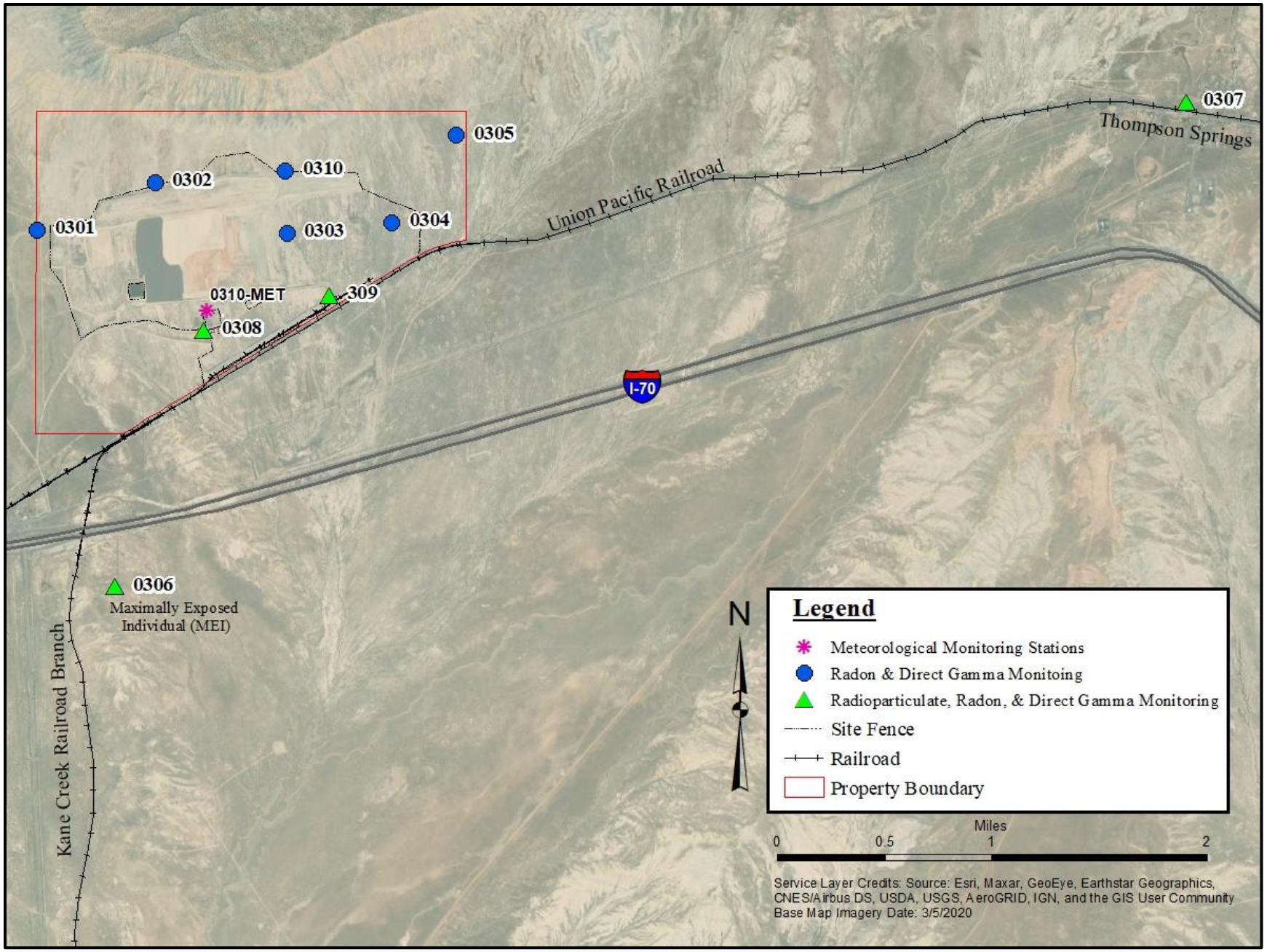

Figure 6. Crescent Junction Site Environmental Air Monitoring Locations

Table 4. Environmental Air Monitoring Data at the end of 2020 for the Moab Site

Station Number	Annual Average Radon Concentration (pCi/L)	Annual Direct Gamma Radiation Effective Dose (mrem/yr)	Annual Radioparticulate Effective Dose (mrem/yr)
On-site Locations			
0101	2.1	93	N/A
0102	0.8	24	3.83
0103	0.9	24	N/A
0104	1.7	35	N/A
0105	2.0	33	4.99
0106	3.0	64	N/A
0107	2.2	46	N/A
0108	2.6	99	N/A
0109	0.9	372	N/A
0110	0.9	320	N/A
0111	At or below background	76	N/A
0112	1.2	124	N/A
0113	2.2	92	N/A
0114	2.7	58	7.32
0126	1.7	39	N/A
Off-site Locations			
0117	At or below background	29	3.38
0118	At or below background	18	2.78
0119	0.2	22	3.13
0121	At or below background	17	N/A
0122	At or below background	8	3.02
0123	At or below background	8	3.03
0124	0.7	4*	N/A
0125	0.6	40	N/A
0127	0.2	28	N/A
0128	1.6	31	N/A
0129	1.0	51	6.73
MEI	0.8	25	3.83[1]

Background values were subtracted

[1]MEI dose obtained using closest monitoring station 0102.
N/A – No radioparticulate stations to calculate TED
* Annual sum based on 3 quarters due to a damaged TLD during second quarter

Table 5. Environmental Monitoring Data at the end of 2020 for the Crescent Junction Site

Station Number	Annual Average Radon Concentration (pCi/L)	Annual Direct Gamma Radiation Effective Dose (mrem/yr)	Annual Radioparticulate Effective Dose (mrem/yr)
On-site Locations			
0301	At or below background	16.5	N/A
0302	At or below background	18.5	N/A
0303*	1.2	5.5	N/A
0304	At or below background	21.5	N/A
0305	At or below background	22.5	N/A
0308	1.4	27.5	3.99
0309	0.6	19.5	4.72
0310*	At or below background	At or below background	N/A
Off-site Locations			
0306[1]	At or below background	13.5	2.44
0307	At or below background	26.5	2.55

Background values were subtracted
[1]MEI location

N/A – No radioparticulate stations to calculate TED

*Air Station 0303 was removed and air station 0310 was added during third quarter. Data is based on two quarters worth of data.

4.5.3 Radioparticulates

Although the milling process recovered about 95 percent of the uranium, the RRM contains several other naturally occurring radioactive elements. In 2020, air samplers measured radioparticulates at 13 locations (four on site, seven off site, and two MEIs).

Air filters were collected weekly and submitted as a composite sample on a quarterly basis. The filters were analyzed for specific radionuclides that are common isotopes of RRM, including total uranium, thorium-230, radium-226, polonium-210, and actinium-227. It was possible to calculate the protactinium-231 concentration based on the actinium-127 results.

4.5.4 Total Effective Dose

The annual total effective dose at the end of 2020 was 28.8 mrem to the Moab MEI and 15.9 mrem to the Crescent Junction MEI. These values are below the annual 100 mrem limit. 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.

Values were calculated by subtracting the background dose of 82 mrem from the Moab MEI gamma radiation dose and the background dose of 92.5 mrem from the Crescent Junction MEI, and then adding the respective radioparticulate doses.

5.0 Environmental Non-radiological Program Information

5.1 Non-radiological Environmental Monitoring

The Project manages storm water at the sites through controls specified in site-specific storm water pollution prevention plans (see Table 1). Air opacity is monitored at the sites by Project personnel certified to EPA Method 9. In accordance with Utah Administrative Code R307-205-8, the fugitive dust must not exceed 20% opacity.

DOE operates two meteorological monitoring stations at the Moab site and two at or near the Crescent Junction site (see Figures 4 and 6, respectively). These stations enable DOE to monitor site-specific meteorological conditions and events and provide a valuable resource for assessing impacts resulting from any unplanned release of airborne contamination. Meteorological parameters monitored include air temperature, relative humidity, solar radiation, wind speed, wind direction, and precipitation. An extended drought in 2020 impacted the freshwater intake structure. A secondary pump had to be placed to obtain fresh water for site operations. Other than the drought, no abnormal weather events impacted the site.

5.2 Fire Protection Management and Planning

No unplanned wildland fires occurred at the sites in 2020. Dead vegetation, weeds, and windblown materials are cleared near buildings and equipment to minimize fire hazards. Weed control and limited removal of dead vegetation are performed in other areas of the sites.

For revegetation purposes, a burn box was recommended by an SME and was acquired on loan from the Bureau of Land Management. A burn box, which is a large metal bin with a separate lid, can hold approximately 7 cubic yards. It is a very efficient way of burning compared to open burning.

The burn box was utilized in 2020 for burning vegetation debris from onsite-- mostly logs and stumps too large for the wood chipper / shredder. A fire watch monitored the burn box at all times when it was being used. All fires were completely extinguished at the end of the day. No fires outside the burn box occurred.

5.3 Recreational Hunting and Fishing

There is no recreational hunting or fishing allowed on the Project sites.

6.0 Groundwater Protection Program

The groundwater beneath the Moab site was contaminated by former uranium milling operations.

The main objectives of the Groundwater Program are to reduce the ammonia and uranium contaminant mass and to protect young-of-year endangered fish species in suitable habitats of the Colorado River from site contaminants. The suitable habitat is protected through groundwater extraction near the tailings pile, freshwater injection along the riverbank, and surface water diversion directly to the habitat area.

Figures 7 and 8 show the ammonia and uranium plumes and surface water sampling locations at the Moab site, respectively. The ammonia concentration is highest at the toe of the tailings pile, and the uranium concentration is highest at the toe of the tailings pile and near the vicinity of the former uranium mill, just northeast of the pile. Monitoring results show the extent of contaminant plumes has not significantly changed in the past five years. Groundwater flow is toward the southeast, discharging to the Colorado River.

No new or emerging contaminants (per- and polyfluoroalkyl substances) have been identified on-site.

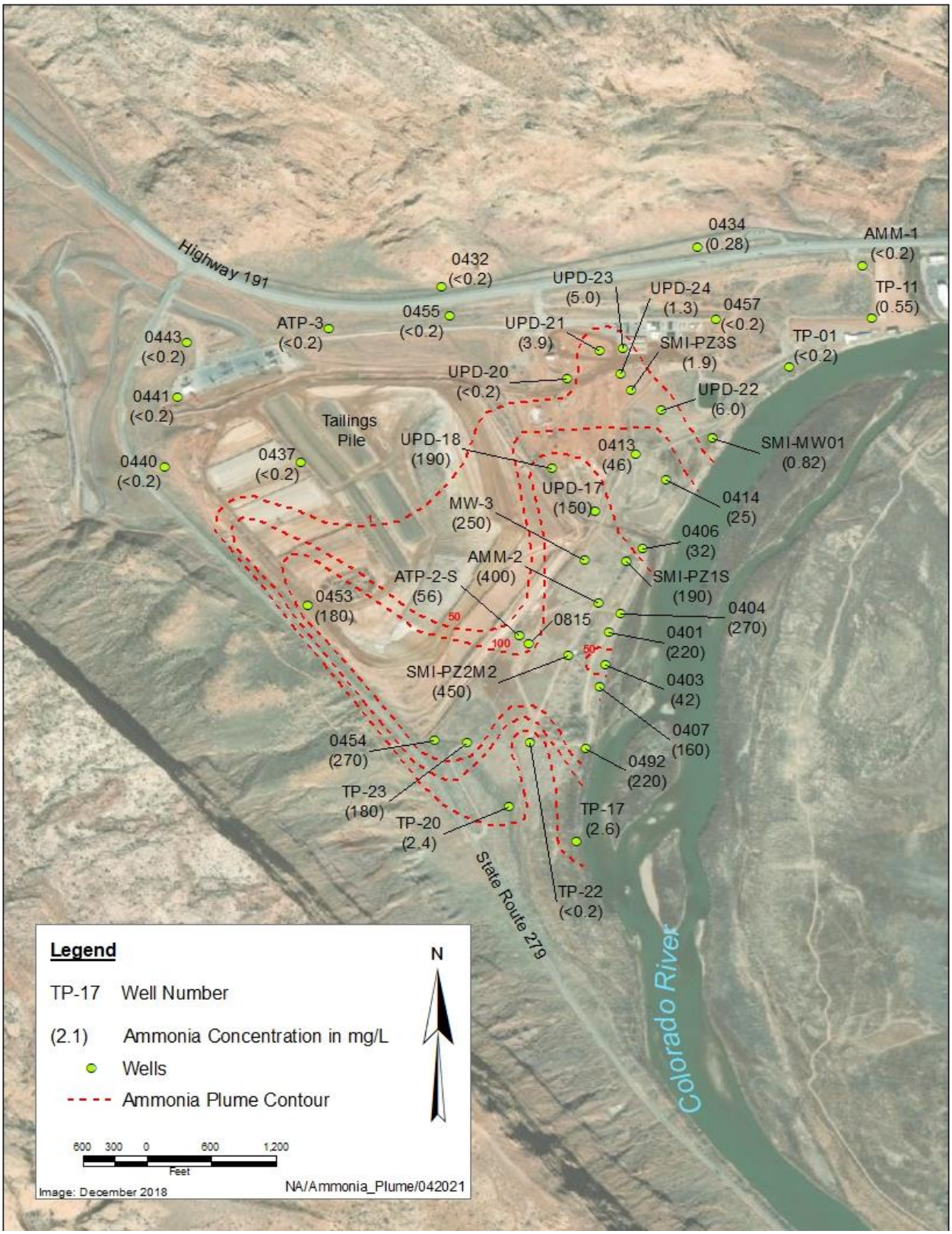

Figure 7. Ammonia Plume Contours and Select Monitoring Well Sampling Locations

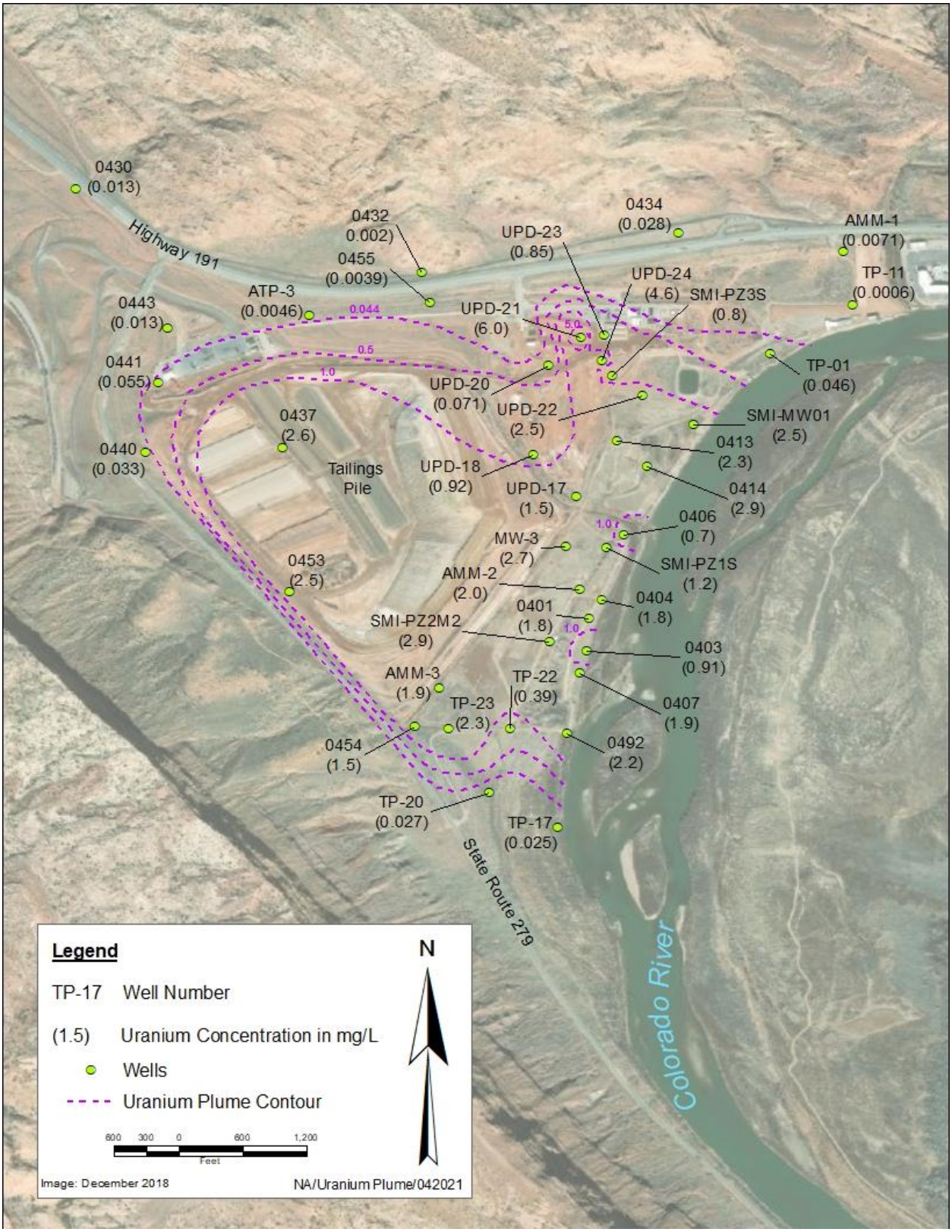

Figure 8. Uranium Plume Contours and Select Monitoring Well Sampling Locations

6.1 Groundwater

In 2020, eight extraction wells and ten injection wells were used to minimize contaminant discharge to the Colorado River. Extracted groundwater was pumped to a water storage tank located on the northeastern side of the tailings pile, where it was used as dust control inside the contamination area.

Samples were collected from extraction and monitoring wells to assess IA performance, and site-wide sampling events were completed in May/June 2020 and December 2020 through February 2021 to assess contaminant plumes. Groundwater samples were primarily analyzed for ammonia and uranium, with some select locations also analyzed for arsenic and selenium. Data results from sampling events are available on the Project website at www.gjem.energy.gov/ and in the Moab public reading room.

Table 6 shows the ammonia and uranium concentrations over the past five years at representative well location 0443, an observation well upgradient of the tailings pile, extraction well 0815, downgradient of the tailings pile, and 0403, an observation well near the riverbank. See Figure 7 for well locations.

Groundwater contaminant concentrations are impacted by the Colorado River flows, especially in wells located along the river bank. During an average runoff peak, Colorado River water flows into the subsurface and tends to dilute the groundwater. In an average year Colorado River experiences base flows from August through March. Once base flows are re-established, the contaminants tend to rebound to pre-peak flow levels. River flows especially impact the groundwater concentrations detected in samples collected from well 0403 (located on the river bank) and to a lesser extent well 0815 (located approximately 650 ft from the river bank).

Because the Colorado River experiences base flows the majority of the year, samples collected during this timeframe best represent the overall groundwater chemistry. For better comparison purposes and to display the concentration changes as the groundwater flows towards the river, Table 6 below provides groundwater ammonia and uranium concentrations during the river base flows.

Table 6. Representative Groundwater Well Sampling Results over Past Five Years

Year	Well 0443 (73 ft bgs)*		Well 0815 (22 - 52 ft bgs)*		Well 0403 (18 ft bgs)*	
	Ammonia Total as N (mg/L)	U (mg/L)	Ammonia Total as N (mg/L)	U (mg/L)	Ammonia Total as N (mg/L)	U (mg/L)
2016	0.1**	0.01	250	3.7	39	0.98
2017	0.1**	0.01	190	3.0	120	0.48
2018	1.0**	0.01	95	3.2	56	1.3
2019	0.1**	0.01	150	2.9	43	0.22
2020	0.2**	0.01	140	2.7	42	0.71

*denotes sample depth, ** denotes the result was at or below detection limit

Well 0443 is not affected by contamination in the tailings pile and shows consistent ammonia and uranium results at the detection limit or representative of natural concentrations. Wells 0403 and 0815 have been affected by the tailings pile. Ammonia concentrations in samples collected from

these two locations have fluctuated over the past five years, and the uranium concentrations are above the UMTRCA water quality standard of 0.044 milligrams per liter (mg/L).

Table 7 summarizes the 2020 sampling efforts at the Moab site. Table 8 shows the ranges of results for positive detection of the most significant constituents in surface water (ammonia and uranium) and groundwater (ammonia, arsenic, selenium, and uranium) samples collected in 2020.

Table 7. 2020 Sample Collection/Analysis Summary

Surface Water Samples	
Number of Surface Water Locations	34
Number of Analyses Performed	130
Groundwater Samples	
Number of Locations	78
Number of Analyses Performed	386

Table 8. 2020 Sample Result Summary

Ranges of Results		
Analyte	**Minimum (mg/L)**	**Maximum (mg/L)**
Surface Water Samples		
Ammonia	0.001	118.6
Uranium	0.0021	0.048
Groundwater Samples		
Ammonia	0.2	1,900
Arsenic	0.00022	0.23
Selenium	0.00066	0.29
Uranium	0.00002	7.2

6.2 Surface Water

The Colorado River is the fundamental surface water feature. Ammonia is a concern because of its toxicity to aquatic life. The purpose of the freshwater injection and surface water diversion systems is to create a hydraulic barrier between the tailings pile and river side channels where suitable aquatic habitats can form. Approximately 5.4 million gallons of fresh water was injected into the subsurface adjacent to the Colorado River. The surface water diversion system was operational between late June and the end of September, with 14.4 mil gal of freshwater diverted into habitat areas.

Fourteen surface water samples were collected on site, upriver, and downriver (see Figure 9) for laboratory analysis at near peak flow (June) and base flow (January 2021) conditions. Another 94 surface water samples were collected when a suitable habitat (Figure 10) developed. Table 9 shows the un-ionized ammonia concentration at each of these habitat locations and the corresponding EPA acute and chronic criteria, and Tables 10 and 11 provide similar information for the site-wide locations and the habitat background locations, respectively. Where applicable, a 4-day average chronic criteria was applied to locations sampled over a longer time period.

Of these surface water samples collected from the habitat area, four exceeded both the acute and chronic criteria and 11 others had ammonia concentrations that exceeded the chronic criteria. It should be noted that the elevated ammonia concentrations from location SC02 (Tables 8 and 9) were part of a habitat that was present for less than one week. The surface water diversion

manifolds were deployed to this area as soon as these elevated concentrations were identified. However, by the time confirmation sampling was to be completed, this area was no longer considered a suitable habitat. In addition, all habitats that developed in 2020 were constantly monitored, and no dead fish were observed.

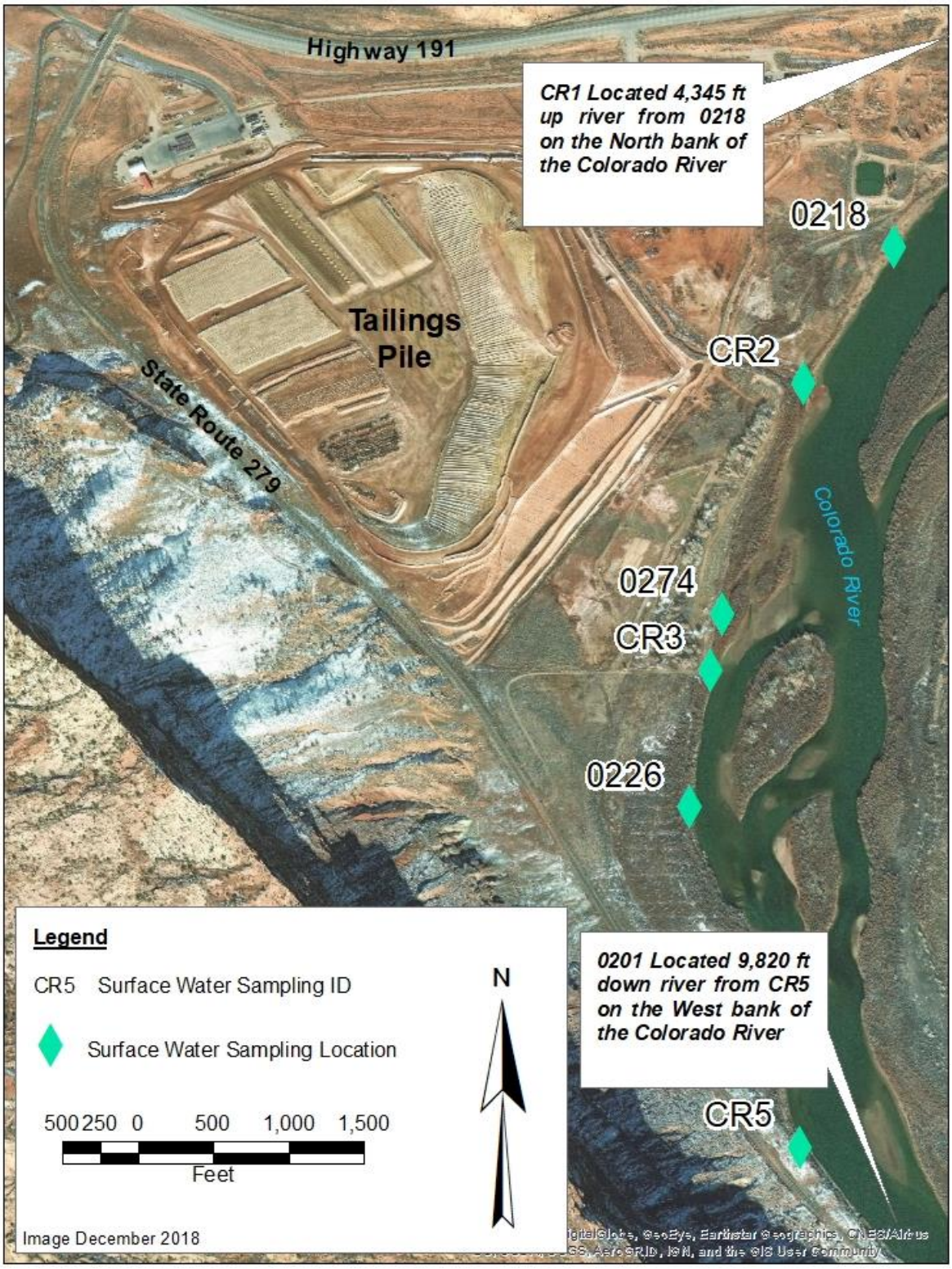

Figure 9. 2020 Site-wide Event Surface Water Sampling Locations

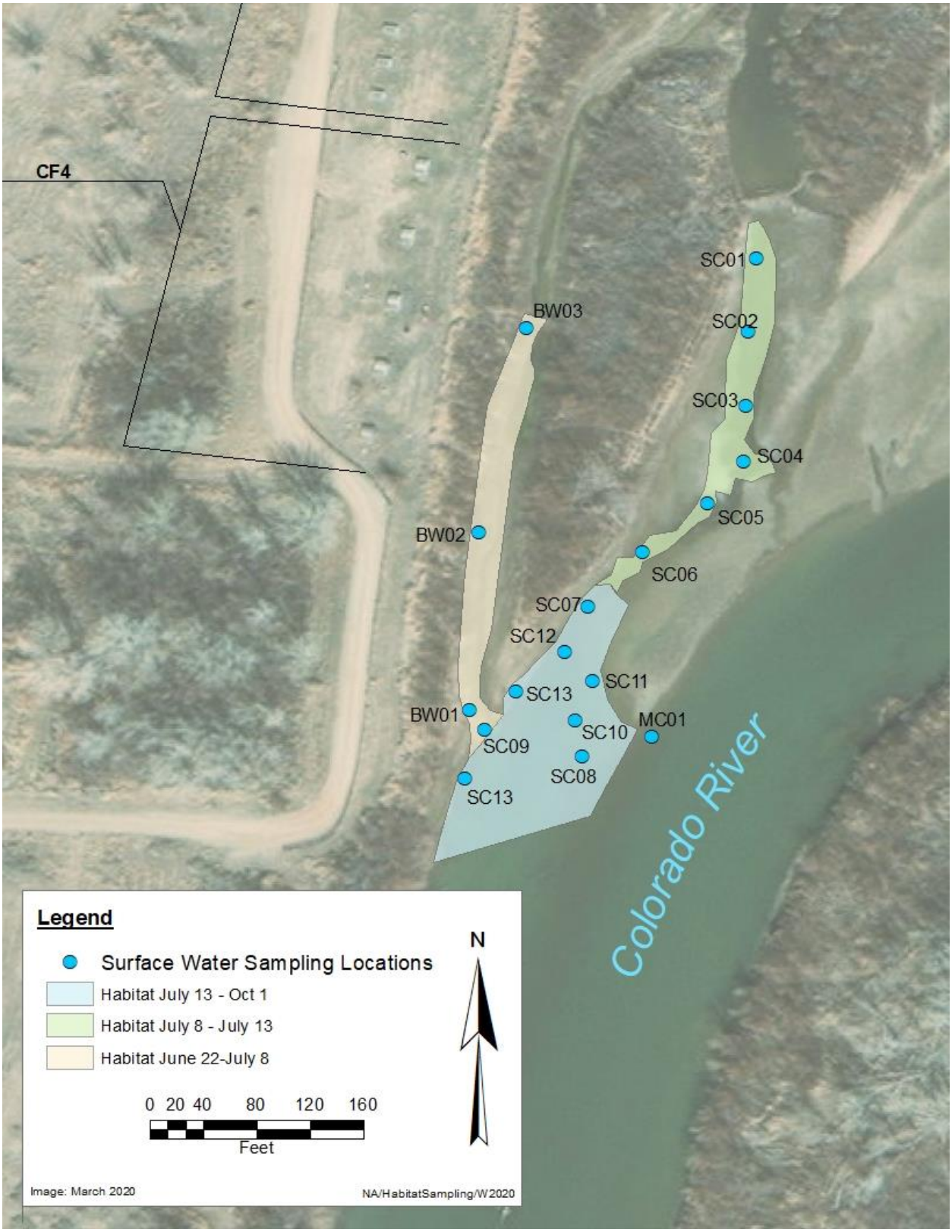

Figure 10. September 2020 Habitat Area Sampling Locations

Table 9. 2020 Ammonia Concentrations in Habitat Surface Water Samples Compared to EPA Criteria

Sample Location	Sample Date	Temperature (°C)	pH	Ammonia[1] (mg/L)	Acute Criteria[2] (mg/L)	Chronic Criteria[3] (mg/L)
BW01	6/24/2020	21.6	7.35	0.1148	24	1.3
	7/8/2020	22.9	8.05	0.959	6.8	0.55
BW02	6/24/2020	22.0	7.60	0.0348	18	1.1
	7/8/2020	23.2	8.10	0.06	6.8	0.55
BW03	6/24/2020	18.4	7.67	0.1871	15	1.3
	7/8/2020	23.8	8.11	0.084	6.2	0.52
SC01	7/8/2020	18.1	8.00	0.516	8.8	0.88
	7/9/2020	20.6	7.62	0.927	18	1.2
SC02	7/8/2020	17.7	7.26	51.1	27	1.8
	7/9/2020	23.4	6.90	118.6	38	1.6
SC03	7/8/2020	18.3	7.97	3.15	8.8	0.88
	7/9/2020	22.3	7.52	17.7	21	1.2
SC04	7/9/2020	23.1	7.64	15.56	17	1.1
SC05	7/9/2020	24.2	7.93	11.56	9.1	0.69
SC06	7/9/2020	24.7	7.88	20	8.4	0.65
SC07	7/14/2020	22.9	8.08	0.879	6.8	*1.53*
	7/15/2020	24.3	7.86	1.3	9.1	*1.53*
	7/30/2020	25.3	8.12	3.05	5.7	*1.53*
	8/4/2020	28.2	8.33	0.14	3	*1.08*
	8/11/2020	22.5	8.06	0.25	6.8	*1.08*
	8/20/2020	25.4	8.29	0.25	3.9	*1.08*
	8/25/2020	25.2	8.14	0.43	5.7	*1.08*
	9/3/2020	26.4	8.40	0.18	3	*1.53*
	9/9/2020	18.3	8.11	0.065	7.3	*1.53*
	9/17/2020	20.1	8.16	0.22	6	*1.53*
	9/23/2020	19.0	8.03	0.14	8.8	*1.53*
SC08	7/14/2020	23.8	8.27	1.01	4.2	*0.88*
	7/15/2020	24.5	8.27	0.91	3.9	*0.88*
	7/30/2020	24.7	8.36	0.2	3.2	*0.88*
	8/4/2020	28.0	8.50	0.37	2.1	*0.92*
	8/11/2020	22.2	8.22	1.63	6	*0.92*
	8/20/2020	24.1	8.25	0.43	4.2	*0.92*
	8/25/2020	24.0	8.26	0.11	4.2	*0.92*
	9/3/2020	24.4	8.39	0.1	3.4	*1.38*
	9/9/2020	17.1	8.24	0.031	4.9	*1.38*
	9/17/2020	20.0	8.23	0.12	4.9	*1.38*
	9/23/2020	18.7	8.23	0.48	6	*1.38*

Table 9. 2020 Ammonia Concentrations in Habitat Surface Water Samples Compared to EPA Criteria (continued)

Sample Location	Sample Date	Temperature (ºC)	pH	Ammonia[1] (mg/L)	Acute Criteria[2] (mg/L)	Chronic Criteria[3] (mg/L)
SC09	7/14/2020	23.3	8.25	0.916	4.6	*1.09*
	7/15/2020	24.5	8.36	0.86	3.2	*1.09*
	7/30/2020	24.4	8.13	0.49	6.2	*1.09*
	8/4/2020	28.8	8.41	0.7	2.3	*1.32*
	8/11/2020	20.2	7.91	0.27	11	*1.32*
	8/20/2020	24.2	8.06	0.56	6.2	*1.32*
	8/25/2020	23.2	8.16	0.16	5.6	*1.32*
	9/3/2020	25.2	8.36	0.17	3.2	*1.81*
	9/9/2020	17.9	8.11	0.072	7.3	*1.81*
	9/17/2020	19.8	7.89	0.01	11	*1.81*
	9/23/2020	19.3	7.92	0.11	11	*1.81*
SC10	7/30/2020	24.6	8.28	0.92	3.9	0.35
	8/4/2020	27.9	8.45	0.58	2.1	*1.31*
	8/11/2020	21.8	7.96	1.13	8.8	*1.31*
	8/20/2020	23.9	8.16	0.89	5.1	*1.31*
	8/25/2020	24.4	8.18	0.74	5.1	*1.31*
	9/3/2020	26.3	8.41	0.18	3	*1.24*
	9/9/2020	18.7	8.25	0.012	4.9	*1.24*
	9/17/2020	20.5	8.24	0.14	6	*1.24*
	9/23/2020	18.7	8.18	0.64	6	*1.24*
SC11	7/30/2020	24.6	8.25	0.63	3.9	0.35
	8/4/2020	28.8	8.24	0.21	2.8	*1.31*
	8/11/2020	21.4	7.93	0.72	11	*1.31*
	8/20/2020	23.7	8.10	0.52	6.2	*1.31*
	8/25/2020	24.1	8.12	0.81	6.2	*1.31*
	9/3/2020	26.3	8.38	0.18	3	*1.36*
	9/9/2020	18.5	8.21	0.008	4.9	*1.36*
	9/17/2020	20.6	8.22	0.39	6	*1.36*
	9/23/2020	19.0	8.10	0.34	7.3	*1.36*
SC12	7/30/2020	24.6	8.32	0.29	3.9	0.35
	8/4/2020	28.7	8.33	0.18	2.8	*1.14*
	8/11/2020	22.2	8.02	0.38	8.8	*1.14*
	8/20/2020	23.9	8.14	0.73	6.2	*1.14*
	8/25/2020	24.5	8.19	0.12	4.7	*1.14*
	9/3/2020	26.1	8.40	0.23	3	*1.56*
	9/9/2020	18.3	8.09	0.003	7.3	*1.56*
	9/17/2020	20.0	8.11	0.09	7.3	*1.56*
	9/23/2020	20.0	8.02	0.13	8.8	*1.56*

Table 9. 2020 Ammonia Concentrations in Habitat Surface Water Samples Compared to EPA Criteria (continued)

Sample Location	Sample Date	Temperature (ºC)	pH	Ammonia[1] (mg/L)	Acute Criteria[2] (mg/L)	Chronic Criteria[3] (mg/L)
SC13	7/30/2020	24.7	8.36	0.28	3.2	0.3
	8/4/2020	28.7	8.19	0.68	3.4	*1.38*
	8/11/2020	21.4	7.77	0.43	13	*1.38*
	8/20/2020	23.8	8.89	0.61	1.5	*1.38*
	8/25/2020	23.4	8.04	0.14	8.2	*1.38*
	9/3/2020	25.5	8.33	0.27	3.6	*2.13*
	9/9/2020	17.8	8.08	0.001	7.3	*2.13*
	9/17/2020	19.7	7.65	0.04	15	*2.13*
	9/23/2020	18.6	7.67	0.21	15	*2.13*
	7/30/2020	24.7	8.36	0.28	3.2	0.3
	8/4/2020	28.7	8.19	0.68	3.4	*1.38*

Notes: 1= Ammonia data was obtained on-site from a HACH SensIon Probe, 2 = U.S. EPA Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater State (Effective April 2013), Table N.4., Temperature and pH-Dependent Values, Acute Concentration of Total Ammonia as N (mg/L)
3 = U.S. EPA Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater State (Effective April 2013), Table 6. Temperature and pH-Dependent Values, Chronic Concentration of Total Ammonia as N (mg/L), *ITALIC values based on the 4-day average*

Table 10. 2020 Ammonia Concentrations in Site-wide Surface Water Samples Compared to EPA Criteria

Sample Location	Sample Date	Temperature (ºC)	pH	Ammonia (mg/L)	Acute Criteria[1] (mg/L)	Chronic Criteria[2] (mg/L)
201	6/11/2020	18.36	7.97	<0.2	8.8	0.88
	1/27/2021	1.21	7.38	<0.2	24	3.5
218	6/11/2020	18.27	8.01	<0.2	8.8	0.88
	1/27/2021	0.87	7.86	<0.2	11	2.1
226	6/11/2020	19.34	8.35	<0.2	4.1	0.52
	2/1/2021	2.45	8.48	<0.2	3.3	0.8
CR1	6/11/2020	17.46	7.72	<0.2	15	1.2
	1/27/2021	1.76	6.37	1.6	51	4.9
CR2	6/11/2020	18.58	7.98	<0.2	8.8	0.83
	1/27/2021	0.9	7.83	<0.2	13	2.3
CR3	6/11/2020	19.7	8.13	<0.2	7.3	0.67
	2/1/2021	2.33	8.35	0.35	4.1	0.95
CR5	6/11/2020	18.07	7.99	<0.2	8.8	0.88
	1/27/2021	0.69	7.57	<0.2	18	2.9

Notes: 1 = U.S. EPA Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater State (Effective April 2013), Table N.4., Temperature and pH-Dependent Values, Acute Concentration of Total Ammonia as N (mg/L)
2 = U.S. EPA Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater State (Effective April 2013), Table 6. Temperature and pH-Dependent Values, Chronic Concentration of Total Ammonia as N (mg/L)

Table 11. 2020 Ammonia Concentrations in Background Surface Water Samples Compared to EPA Criteria

Sample Location	Sample Date	Temperature (ºC)	pH	Ammonia[1] (mg/L)	Acute Criteria[2] (mg/L)	Chronic Criteria[3] (mg/L)
BG01	8/20/2020	23.78	8.41	0.29	3.4	0.32
BG02	8/20/2020	24.1	8.85	0.09	1.4	0.14
BG03	8/20/2020	24.09	8.92	0.08	1.4	0.14
BG04	8/20/2020	23.99	8.5	0.09	2.9	0.27
MC01	7/15/2020	24.23	8.3	0.13	4.2	0.38
MC01	7/30/2020	24.66	8.35	0.16	3.2	0.3
MC01	8/4/2020	27.48	8.49	0.06	2.2	0.22
MC01	8/11/2020	22.35	8.18	0.14	6	0.5
SWD01	7/15/2020	25.55	7.96	0.29	6.4	0.53
SWD01	7/30/2020	24.63	8.14	1.01	4.7	0.49

Notes: 1= Ammonia data was obtained on-site from a HACH SensIon Probe, 2 = U.S. EPA Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater State (Effective April 2013), Table N.4., Temperature and pH-Dependent Values, Acute Concentration of Total Ammonia as N (mg/L)
3= U.S. EPA Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater State (Effective April 2013), Table 6. Temperature and pH-Dependent Values, Chronic Concentration of Total Ammonia as N (mg/L)

7.0 Quality Assurance

Environmental monitoring conducted by the Moab UMTRA Project is performed in accordance with an established and comprehensive Quality Assurance Program (QAP). The QAP describes the measures used to ensure the quality of radiological and non-radiological data and complies with the requirements of American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA) consensus standards, "Quality Assurance Requirements for Nuclear Facility Applications," Title 10 Code of Federal Regulations Part 830 (10 CFR 830), "Nuclear Safety Management," Subpart A, "Quality Assurance Requirements," DOE O 414.1D, "Quality Assurance," and DOE Office of Environmental Management (EM) "EM Quality Assurance Program" (EM-QA-001). These requirements are flowed down through quality assurance (QA) implementing procedures and environmental sampling and analysis plans.

The degree of application of the QA requirements is dependent on the importance of the structures, systems, and components or activities affecting the safety of the operations and the health and safety of the worker, public, or the environment. This is accomplished through the "graded approach" process, which determines the appropriate level of effort necessary to attain and document the requirements.

7.1 Laboratory Analysis and Qualification

7.1.1 Analytical Laboratories

The Project flows-down QAP requirements to subcontracted, qualified analytical laboratories to ensure that the data produced is defensible, valid, reliable, and can be can used to support decision-making for clean-up, remediation and on-going operations. The following laboratories

were used for analysis of environmental samples in 2020: 1) ALS Environmental, Fort Collins Colorado, for radiological and non-radiological analytes; 2) Radonova, Westmont, Illinois, for radiological analytes; and 3) Mirion Technologies, Irvine, California, for radiological analytes. All samples were analyzed according to EPA-approved methods or by standard industry methods where no EPA methods are available. In addition, environmental technicians performed field monitoring for parameters including conductivity, pH, ORP, temperature, and turbidity.

7.1.2 Laboratory Qualification

ALS Environmental was qualified under the National Environmental Laboratory Accreditation Program (NELAP); ISO 17025:2005; the Department of Energy Consolidated Audit Program (DOECAP); State of Utah Environmental Laboratory Certification Program Certification; and Perry Johnson Laboratory Accreditation Certificate of Accreditation (DoD-ELAP). Radonova was qualified under the American Association of Radon Scientists and Technologists National Radon Proficiency Program (AARST NRPP); Radon Detector Performance Testing; ISO 17205; and ISO 9001. Mirion Technologies was qualified under the Remedial Action Contractor UMTRA DOELAP Audit Program.

7.1.3 Verification and Validation

Environmental data are verified and validated. Verification includes evaluating the completeness, correctness, and compliance of data against plans/procedures, methods, and contractual requirements. Data validation is used to determine if data meet the specific technical and quality control criteria established, and to establish the usability and extent of bias of any data not meeting those criteria through the evaluation of an analytical data package. A graded approach is applied to determine validation requirements and data is validated at a level corresponding to the analytical service level (ASL) specified. Certain data may require a higher level of confidence or defensibility and are obtained by specifying a higher ASL. These data require complete validation to meet the data use requirements.

7.2 Assessments and Issues Management

Effectiveness of the Environmental Program is routinely evaluated through implementation of a formal and comprehensive assessment program that includes audits, independent assessments, external certification, and self-assessments. Deficiencies identified are promptly identified, managed thorough a robust Issues Management Program, and corrected as soon as practicable. Completion of corrective actions and their effectiveness is verified and documented.

7.3 Records Management

All documentation created as a result of compliance with this ASER is considered a Project record and will be managed in accordance with the *Moab UMTRA Project Records Management Manual* (DOE-EM/GJ1545), which follows DOE orders, policies, and regulations for retention and maintenance of records.

8.0 References

10 CFR 830A, (Code of Federal Regulations), “Nuclear Safety Management,” “Quality Assurance Requirements,”

10 CFR 1021 (Code of Federal Regulations), “National Environmental Policy Act Implementing Procedures.”

10 CFR 1022 (Code of Federal Regulations), “Compliance with Floodplain and Wetland Environmental Review Requirements.”

40 CFR 61 (Code of Federal Regulations), “National Emission Standards for Hazardous Air Pollutants.”

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

33 USC 1251 (United States Code), Clean Water Act.

42 USC 7901 (United States Code), Uranium Mill Tailings Radiation Control Act.

42 USC 11001 (United States Code), Emergency Planning and Community Right-to-Know Act.

DOE (U.S. Department of Energy), *Moab UMTRA Project Flood and Drought Mitigation Plan* (DOE-EM/GJ1640).

DOE (U.S. Department of Energy), *Moab UMTRA Project Records Management Manual* (DOE-EM/GJ1545).

DOE (U.S. Department of Energy), Moab UMTRA Project Revegetation and Weed Control Plan (DOE-EM/GJTAC1655).

DOE (U.S. Department of Energy) Order 210.2A, “DOE Corporate Operating Experience Program.”

DOE (U.S. Department of Energy) Order 231.1B Admin Chg 1, “Environment, Safety and Health Reporting.”

DOE (U.S. Department of Energy) Order 414.1D Chg 1, “Quality Assurance.”

DOE (U.S. Department of Energy) Order 435.1, “Radioactive Waste Management.”

DOE (U.S. Department of Energy) Order 436.1, “Departmental Sustainability.”

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

DOE (U.S. Department of Energy), *Record of Decision for the Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah* (6450-01-P).

DOE (U.S. Department of Energy), *Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah, Final Environmental Impact Statement* (DOE/EIS-0355).

Executive Order 11988, “Floodplain Management.”

Executive Order 11990, “Protection of Wetlands.”

ISO (International Organization for Standardization) Standard 14001:2015, “Environmental Management Systems.”

Public Law 106-398, Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001.

UAC R307-205-8 (Utah Administrative Code), “Emission Standards; Fugitive Emissions and Fugitive Dust; Tailings Piles and Ponds.”

U.S. Census Bureau, *https://data.census.gov*.