



Moab UMTRA Project Revegetation and Weed Control Plan

Revision 9

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U.S. Department
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Moab UMTRA Project Revegetation and Weed Control Plan

Revision 9

Review and Approval

1/11/2023

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Revision History

Revision	Date	Reason for Revision
0	April 2009	Initial issue.
1	September 2010	Update includes 2010 areas and future planning.
2	July 2014	Update includes 2014 areas and activities.
3	June 2017	Revision includes update to performance monitoring and activities and incorporation of the Weed Control Plan (formerly DOE-EM/GJTAC1406).
4	July 2018	Updated to include watering schedule and various new methodologies.
5	August 2019	Periodic update to reflect SME recommendations and associated procedures.
6	July 2020	Periodic update to establish revegetation zones and zone numbers.
7	February 2021	Revisions to include updated goals, priorities, 1-, 3-, and 5-year plans, and noxious weed management.
8	February 2022	Revision includes updates to 1-, 3-, and 5-year plans and tracking tools; addition of comparison tracking tool figures.
9	January 2023	Change document designation from TAC to RAC. Included Crescent Junction site, updated site locations and descriptions. Revised goals and 1-, 3-, and 5-year plans. Removed and/or updated noxious weed tables and figures. Technical herbicide information will be transferred to the <i>Moab UMTRA Project Revegetation Operations and Maintenance Manual for the Moab Site</i> (DOE-EM/GJTAC2262). Added new figure for repeat photo monitoring program. Updated references.

Contents

<i>Section</i>	<i>Page</i>
Acronyms and Abbreviations	v
1.0 Introduction	1
1.1 Background and Site Locations	1
1.2 Site Descriptions	2
1.3 Purpose and Scope	7
2.0 Revegetation Priorities and Planning	8
2.1 Revegetation Management Zones.....	8
2.2 Revegetation Management Priorities and One-, Three-, and Five-Year Plans.....	9
2.3 Revegetation Planning Assumptions	10
2.4 Jurisdiction and Regulatory Compliance in Revegetation Areas	11
3.0 Revegetation Implementation	16
3.1 Soil Characterization.....	16
3.2 Seedbed Preparation.....	16
3.3 Seeding, Seed Mixes & Planting	17
3.4 Watering	18
3.5 Revegetation Activities & Vegetative Debris.....	19
4.0 Weed Control	19
4.1 Weed Control Objectives.....	19
4.2 Weed Classification and Weed Lists	20
4.2.1 State of Utah	20
4.2.2 Grand County.....	21
4.2.3 Moab UMTRA Project Site	21
4.3 Current Noxious Weed Inventories, Surveys, and Results.....	21
4.4 Management of Noxious Weed & Weed Species of Concern.....	29
4.4.1 Prevention	29
4.4.2 Education and Personnel Training.....	29
4.4.3 Early Detection and Rapid Response.....	29
4.4.4 Management of Established Populations.....	30
4.4.5 Treatments.....	30
4.4.6 Herbicide Application, Handling, Storage, Spills, and Cleanup.....	31
4.4.7 Revegetation and Restoration	32
5.0 Monitoring and Evaluation	33
6.0 Strategic Partnerships	34
7.0 Records	36
8.0 Reference	36

Figures

<i>Figure</i>	<i>Page</i>
Figure 1. Workflow of Overall Revegetation and Weed Control Program	1
Figure 2. Location of Moab and Crescent Junction Sites	2
Figure 3. Moab Site Features	3
Figure 4. Crescent Junction Site Features.....	4
Figure 5. Revegetation Management Zones	8
Figure 6. Tracking Tool for Priorities for Noxious Weeds Only.....	27
Figure 7. Comparison of Previous and Current Tracking Tool of Priorities for Noxious Weeds Only.....	28
Figure 8. Example of Repeat Photo Program	34

Tables

<i>Table</i>	<i>Page</i>
Table 1. Revegetation One, Three, and Five-Year Plans for Moab and Crescent Junction Sites	9
Table 2. Environmental Compliance and Impacts on Revegetation Activities	12
Table 3. Updated Moab UMTRA Site-specific Target Weed List 2023	22
Table 4. Current Status of Noxious Weed Species Onsite & Summary of Weed Control Activities at the Moab Site	23
Table 5. Current Moab UMTRA Noxious Weed Presence, Treatment, and Priority Color-Coding Designations at the Moab Site	25
Table 6. Comparison of Previous and Current Number of Noxious Weed Species Present and Untreated at the Moab site	26

Appendices

<i>Appendix</i>	<i>Page</i>
Appendix A. State of Utah Noxious Weed List 2023	A-1
Appendix B. Grand County Noxious Weed List 2023	B-1

Acronyms and Abbreviations

AMSL	Above Mean Sea Level
BLM	Bureau of Land Management
BMP	best management practices
CA	Contamination Area
CAA	Clean Air Act
CFR	Code of Federal Regulations
CJ	Crescent Junction
CO	Colorado
CUP	Conditional Use Permit
CWA	Clean Water Act
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DNR	Division of Natural Resources
dS/m	decisiemens per meter
EMS	Environmental Management Standard
EO	Executive Order
ESA	Endangered Species Act
ET	Evapotranspiration
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, & Rodenticide Act
FFSL	Forestry, Fire, and State Lands
FSS	Final Status Survey
H&S	Health and Safety
LM	Legacy Management
MBTA	Migratory Bird Treaty Act
MOA	memorandum of agreement
MOU	memorandum of understanding
MSO	methylated seed oil
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	U.S. National Park Service
RAC	Remedial Action Contractor
RRR	Rim to Rim Restoration
SDS	safety data sheets
SME	subject matter expert
SOP	standard operating procedure
SURP	Southeast Utah Riparian Partnership
SWPPP	Storm Water Pollution Prevention Plan
TAC	Technical Assistance Contractor
UPDES	Utah Pollutant Discharge Elimination System
UMTRA	Uranium Mill Tailings Remedial Action
USACOE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
USU	Utah State University
UTV	utility terrain vehicle
WRI	Watershed Restoration Initiative

1.0 Introduction

The Moab Uranium Mill Tailings Remedial Action (UMTRA) Project Revegetation and Weed Control Plan outlines the vision, goals, priorities and planning, implementation, monitoring and evaluation for disturbed areas at the Moab and Crescent Junction sites for the next 5 years (2023-2027). The revegetation workflow is illustrated below (Figure 1).

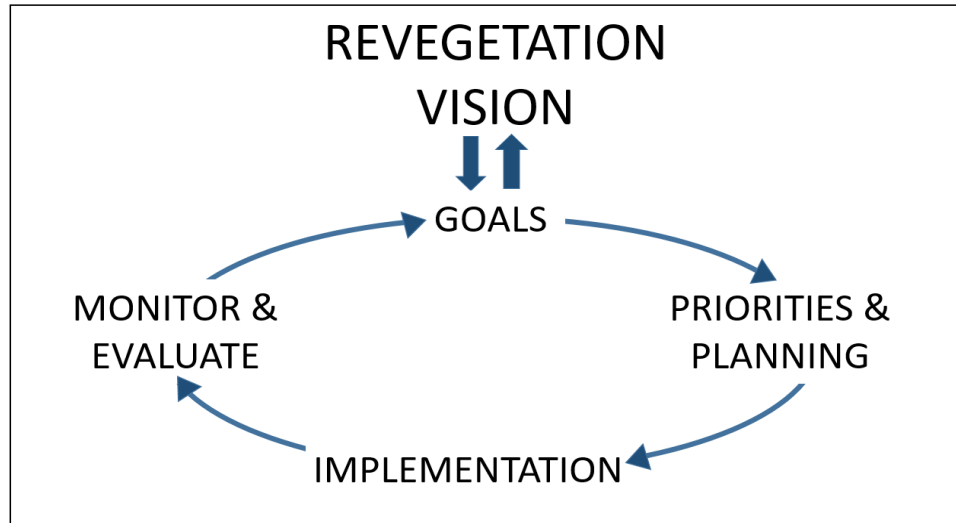


Figure 1. Workflow of Overall Revegetation and Weed Control Program

Both revegetation and weed control are critical in restoring the Project’s remediated areas to a sustainable, resilient, native ecosystem. Revegetating with desirable, native plant species stabilizes soil, decreases competition of weed species, minimizes fugitive dust production, reduces water-use, and controls storm water erosion and off-site transport of sediment. Native revegetation also promotes biodiversity, improves wildlife habitat and aesthetics, and encourages potential recreational opportunities.

Non-native weed species can be invasive and aggressive with the potential to cause significant damage to native ecosystems and/or cause economic losses. Invasive plants are a concern because of their potential to reduce native plant diversity, increase soil erosion, degrade wildlife habitat, damage watersheds, and adversely impact the general ecological health of native ecosystems (Idaho Power 2020). Ecological damage from uncontrolled weed infestations can be permanent, rendering lands unable to return naturally to their pre-invasion condition (Lowry et al. 2017).

Careful, species-specific planning and long-term efforts are necessary to achieve desired results, especially in disturbed, arid ecosystems. The purpose of this document is to outline a plan that will promote good stewardship, conservation of natural resources, and improve resilient native ecosystems while complying with applicable federal, state, and local regulations.

1.1 Background and Site Locations

The Moab UMTRA Project site, owned by the Department of Energy (DOE), is a former uranium ore-processing facility located about 4 miles northwest of the city of Moab in Grand County, Utah (Figure 2).

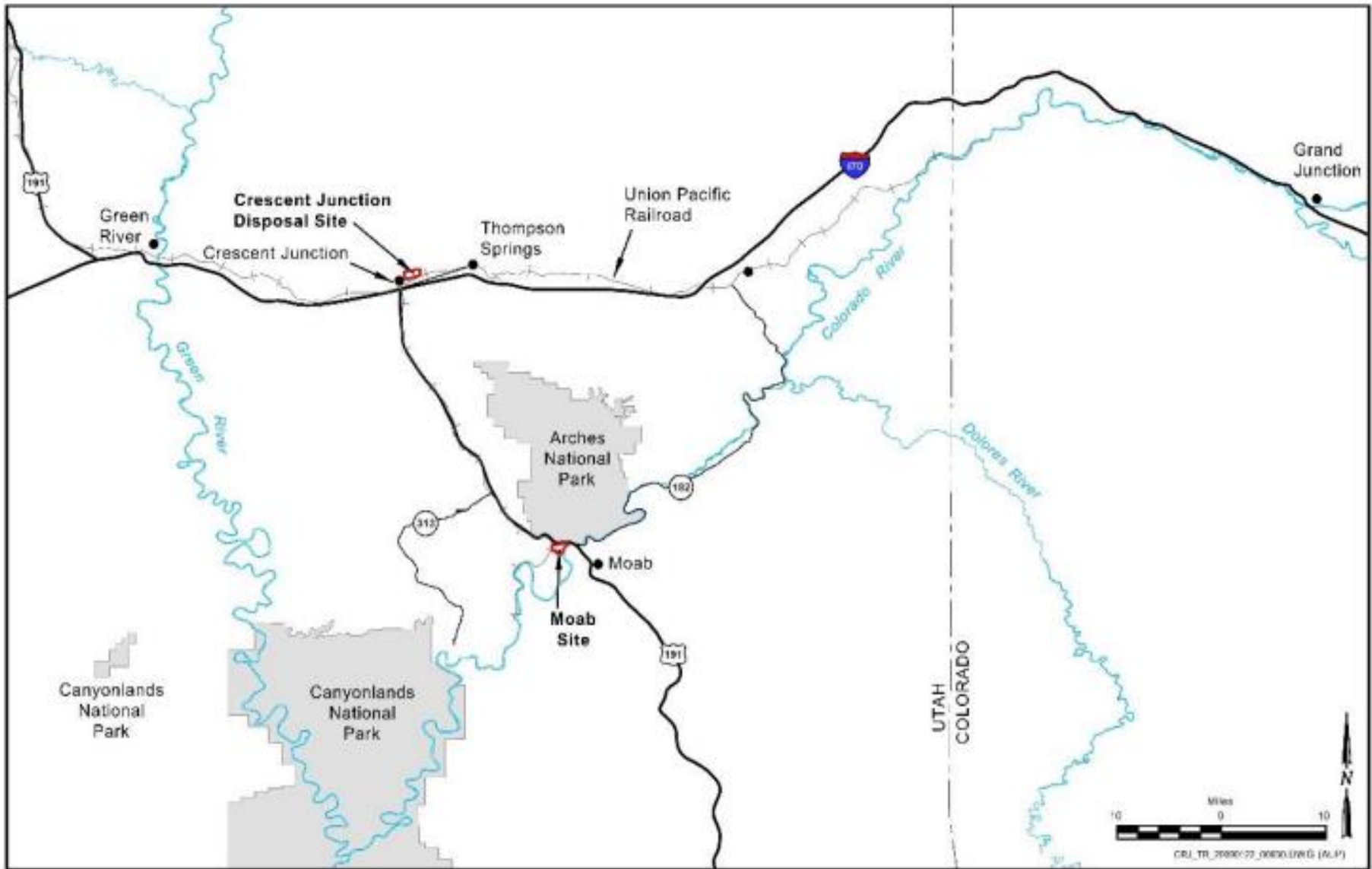


Figure 2. Location of Moab and Crescent Junction Sites

The Moab site encompasses 480 acres, of which approximately 130 acres are covered by a uranium mill tailings pile (Figure 3). The Moab Project mission is to safely relocate mill tailings and other process-related wastes, collectively known as residual radioactive material (RRM), from the former uranium ore-processing facility (mill site) in Moab site to an engineered disposal cell constructed near Crescent Junction, approximately 30 miles north (Figure 4). The mission also includes active remediation of contaminated groundwater at the Moab site.

Refer to the *Moab UMTRA Project Annual Site Environment Report for Calendar Year 2021* (DOE-EM/GJ3082) for more details about site history and background.

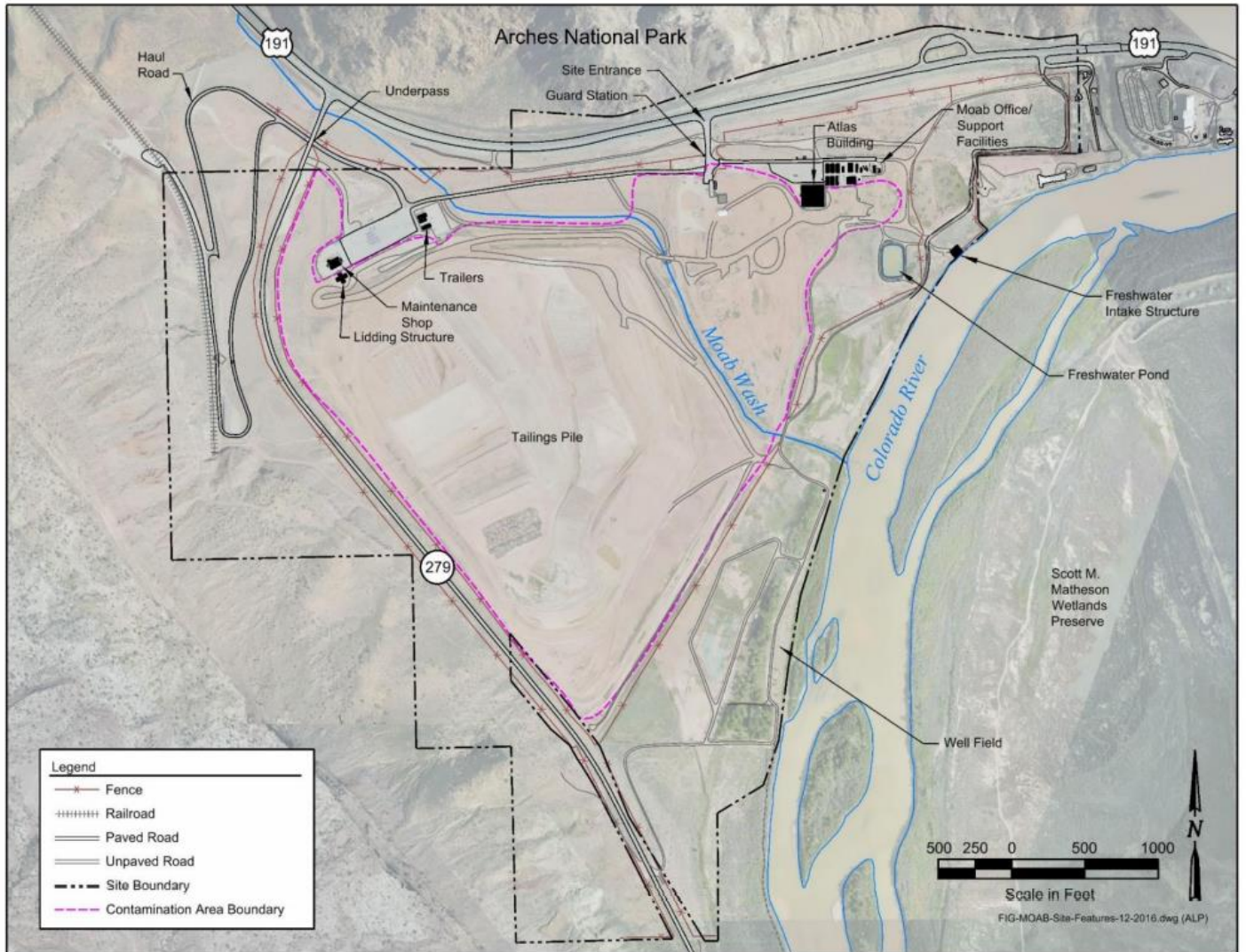


Figure 3. Moab Site Features

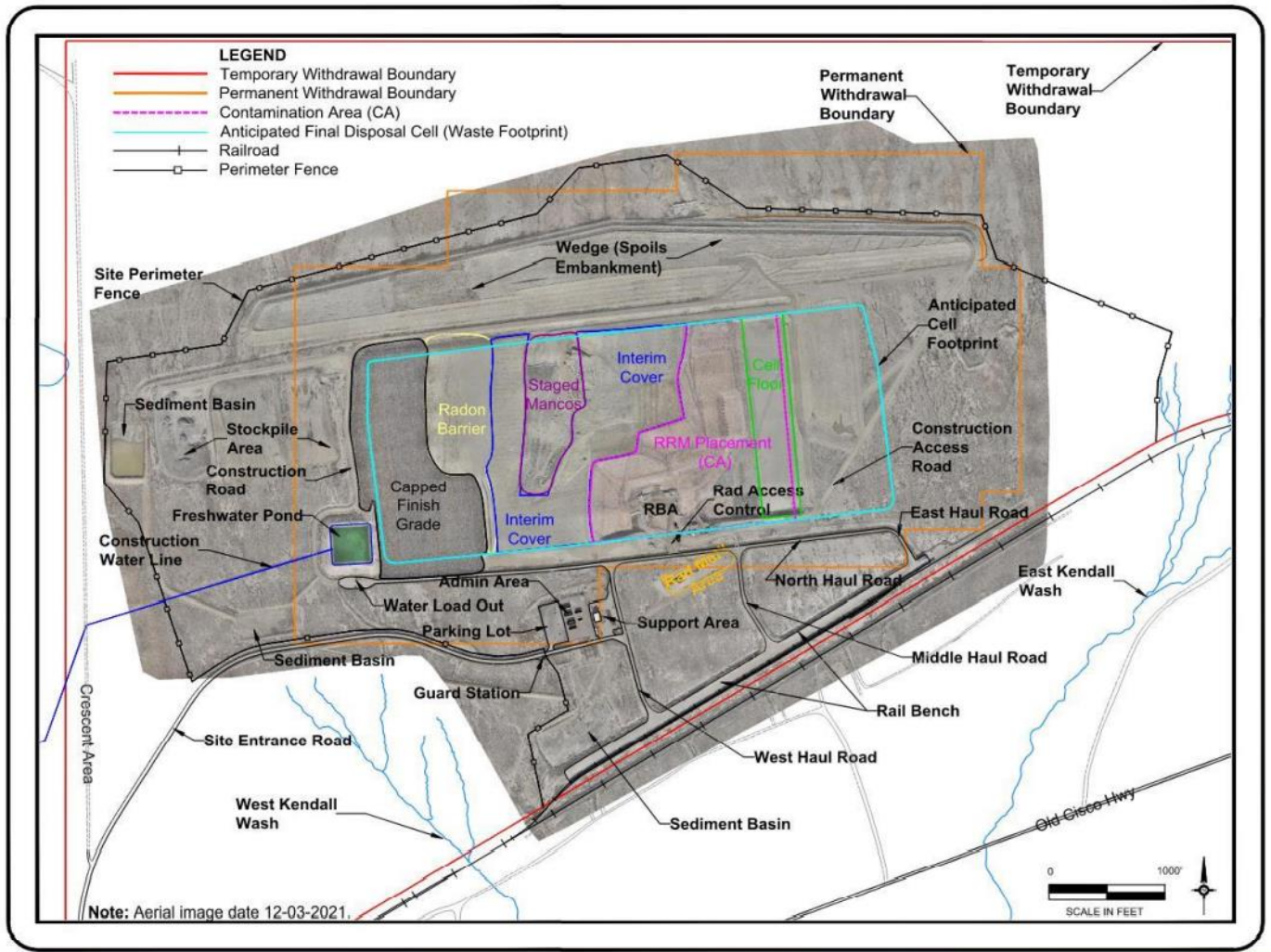


Figure 4. Crescent Junction Site Features

1.2 Site Descriptions

Moab Site

The Moab revegetation area consists of approximately 185 acres (formerly 135 acres), surrounding the Contamination Area (CA) to the north, northeast, east, and southeast (Figure 3).

The Colorado River forms the eastern boundary of the Moab Project site. The site is transected by the Moab Wash, an ephemeral stream which flows during significant storm events. Approximately one-third of the site lies within the 100-year floodplain of either the Colorado River or Moab Wash. The Moab site is susceptible to flooding from the Colorado River and/or Moab Wash during runoff of spring snowmelt in the Rocky Mountains, generally reaching a maximum flow between late May and early June. Thunderstorms in the drainage basin of the Moab Wash can also have an impact on the floodplain at the Moab site. Groundwater underlying the site moves from northwest to the southeast, discharging to the Colorado River.

The climate of the Moab site is semi-arid with average annual temperature approximately 60°F. January is the coldest month, with low temperatures averaging 21°F, and July is the warmest month, with high temperatures averaging 100°F. The total rainfall is approximately 8.6 inches

with half of the precipitation falling from July through September. Most of the rainfall occurs as high-intensity, convective thunderstorms in late summer. Light snow falls in winter, but usually does not remain on the ground very long.

The primary hydrogeologic unit at the Moab site consists of unconsolidated alluvium on the valley floor flanked by consolidated sandstones and shale on the canyon walls beyond the site boundary. Soil at the site is highly disturbed due to the removal of 12-72 inches of topsoil during previous remediation efforts. Soils at the site are variable, but generally are alkaline, saline, and fine grained, which further complicates vegetation establishment. Flooding can impact portions of the revegetation area. A berm located along the Colorado River north of the Moab Wash and several off-pile areas of the site were remediated in the winter of 2010/2011. As part of this remediation, the berm previously installed along the riverbank north of Moab Wash and more than 158,000 cubic yards of contaminated soil were removed, creating areas of lower elevation. As a result of the soil remediation activities, this eastern off-pile area has been more susceptible to flooding at lower river stages.

Historically, the southern side of a site dirt road and Moab Wash crossing (where Moab Wash leaves the eastern CA boundary) has been an entry point for higher flood waters to enter the southern end of the site (i.e., the well field). In spring 2021, a berm was constructed at this location. It has successfully demonstrated preventing storm water from late summer monsoons from entering the well field and shows promising results for keeping higher flood waters out.

At higher river stages, the natural downward slope in topography along the site also allows flood waters to enter from the southern end, inundating the general southern part of the site (i.e., the well field). Due to the bottomland morphology of much of the well field, high-water floods can result in standing water several feet deep. Poor drainage is an issue, leading to high salt concentrations and poor soil quality in this area (Parent 2010). Refer to *Moab UMTRA Flood and Drought Mitigation Plan* (DOE-EM-GJ1640) and *Moab UMTRA 2019 Flood Response Summary* (DOE-EM/GJTAC3035) for more details on flooding.

The Moab site consists of upland and riparian vegetation characteristic of the Colorado Plateau. Plant communities are comprised of a mixture of salt desert shrub, mixed desert shrub, and lowland riparian. Predominant native vegetation includes cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*), Gooding's willow (*Salix gooddingii*), rabbit brush (*Ericameria nauseosa*), four-wing salt bush (*Atriplex canescens*), sand sagebrush (*Artemisia filifolia*); native grasses such as alkali sacaton (*Sporobolus airoides*), inland salt grass (*Distichlis spicata*), and native forbs including scarlet globemallow (*Sphaeralcea coccinea*), Rocky Mountain bee plant (*Cleome serrulata*), firecracker penstemon (*Penstemon eatonii*), and annual sunflowers (*Helianthus annuus*).

Due, in large part, to the removal of topsoil during remediation efforts, much of the off-pile area at the site has been populated with non-desirable weeds. Many undesirable flora species have spread and most of these species thrive in soils that are alkaline, highly saline, and lacking in organic material. Prominent non-native species include tamarisk (*Tamarix ramosissima*), kochia (*Bassia scoparia*), Russian knapweed (*Acroptilon repens*), Russian olive (*Elaeagnus angustifolia*), cheatgrass (*Bromus tectorum*), tumbleweed (*Salsola tragus*), perennial pepperweed (*Lepidium latifolium*), and halogeton (*Halogeton glomeratus*).

Crescent Junction

The disturbed areas at the Crescent Junction site outside of the CA and the disposal cell are the main areas for revegetation, including The Wedge spoils embankment (Figure 4) for storm water requirements. Refer to the *Moab UMTRA Project Crescent Junction Storm Water Pollution Prevention Plan* (DOE-EM/GJ1238) for more details regarding SWPPP requirements.

The climate of the Crescent Junction site, similar to the Moab site, is also semi-arid. The average annual temperature at the Crescent Junction site is approximately 57°F. January is the coldest month with low temperatures averaging 27°F, and July is the warmest month, with high temperatures averaging 86°F. The total annual average rainfall is approximately 7.5 inches. Most of the rainfall occurs as high-intensity, convective thunderstorms in late summer. Light snow falls in winter, but usually does not remain on the ground very long.

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. Run off occurs mostly as sheet washes and can also collect in converging gullies.

Soils consist primarily of silt and clayey silt alluvium, that represent successive sheet wash deposits from erosion of Quaternary deposits and Mancos Shale along the lower slopes of the Bookcliffs. Two native soil types exist for Crescent Junction:

1. Toddler-Ravola-Glenton families' association soils were deposited at elevations ranging from 4,000 to 5,000 ft above mean sea level (AMSL) in flood plains and drainages. The parent material for this soil class is alluvium, derived from sandstone and shale. The soils are well drained, slightly to strongly saline, with moderate water storage capacities, and moderate runoff potential. These soils are prone to gully formation in areas where runoff is concentrated.
2. The Chipeta complex soils were deposited at elevations ranging from 4,200 to 6,100 ft AMSL in cuestas or mesas. The parent material for this soil class is colluvium derived from shale and/or residuum weathered from shale. The soils are well drained, non-saline to very slightly saline, with low storage capacities and high runoff potential.

There are no streams, lakes, or wetlands located within proximity of the Crescent Junction site. Groundwater underlying the Crescent Junction site occurs intermittently in sand lenses in the alluvium and in fractures in the Mancos Shale (depth to water table is 80 inches). No groundwater was found in the any of the bedrock swales or surface washes.

The Wedge was constructed to divert storm water runoff from the Bookcliffs and downslope alluvial fan around the disposal cell. Surface water run-on from the area is split to flow eastward and westward around the Wedge. The top of the Wedge has been revegetated in the past with native grasses and dryland pasture mix to stabilize the soils and sediment. Water that collects directly atop of the Wedge is captured by containment berms which prevent concentrated surface flows down the side slopes of the structure.

The Crescent Junction site vegetation type consists predominantly of low-growing desert grass and shrub communities. Low density populations of desert grasses, shrubs, and forbs occur on the upland soils. Grasses include the dominant exotic and invasive cheatgrass (*Bromus*

tectorum) along with native species of galleta grass (*Hilaria jamesii*), alkali sacaton (*Sporobolus airoides*), and blue grama (*Bouteloua gracilis*). Forbs include tansyaster (*Machaeranthera canescens*), globemallow (*Sphaeralcea* sp.), and Segó lily (*Calochortus nuttallii*). Shrubs include broom snakeweed (*Gutierrezia sarothrae*), four-wing saltbush (*Atriplex canescens*), bud sage (*Artemisia spinescens*), Gardner's saltbush (*Atriplex gardneri*), and shadscale (*Atriplex confertifolia*). Mat saltbush (*Atriplex corrugata*) is also common, particularly in areas disturbed by prairie dog burrows.

In areas that receive extensive amounts of overland sheet flow and sediment deposition, nearly pure stands of annual wheatgrass (*Eremopyrum triticeum*) are found, with occasional rabbitbrush (*Ericameria nauseosa*) and bur buttercup (*Ceratocephala testiculata*). Sandier soils along the far western portion of the site support a shrub community dominated by greasewood (*Sarcobatus vermiculatus*) and spiny hop sage (*Grayia spinosa*), with an understory of native and exotic annuals and perennials. Non-native exotic species are prolific throughout the Crescent Junction site and include halogeton (*Halogeton glomeratus*), Russian thistle (tumble weed; *Salsola tragus*) and heron's-bill (*Erodium cicutarium*).

1.3 Purpose and Scope

DOE's vision of the Moab UMTRA Project site is a self-sustaining native landscape that will require little to no maintenance in 5 years (2023-2027). The scope of this document focuses on revegetation and weed control for the Moab and Crescent Junction sites of the Moab UMTRA Project. Revegetation areas include disturbed areas outside the Contamination Areas (Figures 3 and 4). This document will focus on revegetation objectives, address weed control and propose treatments for noxious and non-noxious weed species. The Crescent Junction site was formerly not included in this plan however, it will now be included going forward. Revegetation will be dynamic as the Project changes over time. The following goals are for revegetation efforts and weed control at both sites:

MOAB SITE:

- Revegetation personnel will await the results of the Radiological Verification (Final Status Surveys (FSS)) before proceeding with new revegetation projects.
- Maintain current revegetation projects.
- Continue the noxious weed program.
- In disturbed post-construction areas, establish vegetative cover (storm water pollution prevention plan (SWPPP), fugitive dust, etc.)
- Maintain SWPPP vegetative buffers (50 ft surrounding surface waters).
- Assist Closure Team with vegetation needs for Final Status Surveys (i.e., vegetation to 6-8" in height).

CRESCENT JUNCTION SITE:

- Determine revegetation zones.
- Conduct vegetation inventory.
- Post-construction stabilization of the Wedge for SWPPP requirements (i.e., reseeding).
- Assist engineer with potential experimental vegetation plots related to the evapotranspiration (ET) cover for the disposal cell.
- In disturbed post-construction areas, establish vegetative cover (SWPPP, fugitive dust, etc.).
- Start noxious weed program.

2.0 Revegetation Priorities and Planning

The second step in the workflow is determining the priorities and planning for revegetation projects.

2.1 Revegetation Management Zones

For management purposes at the Moab site, revegetation zones in the revegetation area are categorized by similar current vegetative composition and cover, and/or ecological potential. Most are delineated by road boundaries or washes, but a few are demarcated by discernable differences in vegetation and/or soil (Figure5).

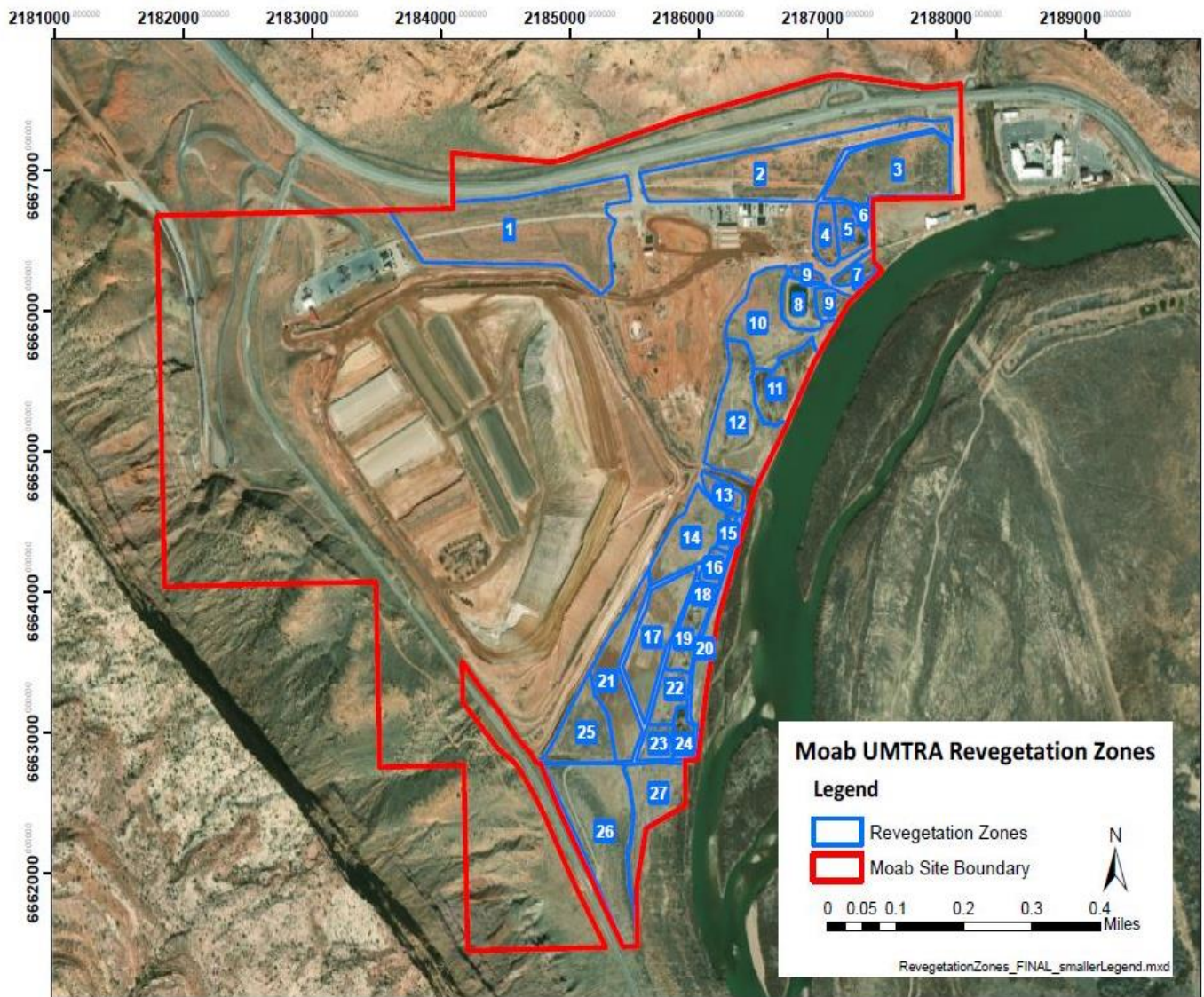


Figure 5. Revegetation Management Zones

Revegetation zones have not been determined for the Crescent Junction site and is a goal for this year.

2.2 Revegetation Management Priorities and One-, Three-, and Five-Year Plans

Revegetation priorities are based on short- and long-term goals outlined to achieve the vision of a self-sustaining native plant landscape. Based on the above goals, 1-, 3-, and 5-year plans are outlined for each site below.

Table 1. Revegetation One, Three, and Five-Year Plans for Moab and Crescent Junction Sites

Plan	Moab Site	Crescent Junction Site
1-Year Plan	Maintain current revegetation projects (e.g., watering, mowing, pruning, etc.).	Stabilize the Wedge after disposal cell excavation (i.e., reseeding with native seed; SWPPP requirement).
	Maintain SWPPP requirements and protect 50 ft vegetative buffers around surface waters.	Assist engineer with vegetation plots to test for the potential Evapotranspiration (ET) cell cover.
	Reseed post-construction disturbed areas outside CA with native seed, as needed.	Conduct vegetation inventory.
	Design and build irrigation system, as needed.	Focus on disturbed areas outside of CA.
	Continue noxious weed program.	Begin noxious weed program.
	Manage non-native species (e.g., mowing kochia)	
	Continue monitoring USGS plots in wellfield and collecting restoration/revegetation data.	
	Assist Closure Team with vegetation issues related to FSS (e.g., cutting down vegetation to 6-8" in height to accommodate field surveys and sampling).	
	Await FSS results and accommodate plan to results (e.g., start revegetation of disturbed areas in wellfield areas (i.e., Config. 5).	
	Protect underperforming areas for physical crust if vegetation cannot establish.	
Manage cottonwoods hedgerows, reducing water and replacing with pollinator plants		
3-Year Plan	Continue maintaining current revegetation projects (e.g., watering, mowing, pruning, etc.).	Monitor any SWPPP revegetation and Wedge seeding projects
	Continue maintaining SWPPP requirements and protecting 50 ft vegetative buffers around surface waters.	Continue maintaining revegetation projects (e.g., watering, mowing, etc.)
	Design and build irrigation system, as needed.	Continue assisting with ET cover as needed.
	Manage non-native species (e.g., mowing kochia)	Continue focusing on disturbed areas outside of CA.
	Continue with revegetation of wellfield (Config.5) revegetation projects.	Continue noxious weed program.
	Continue noxious weed program.	

Table 1. Revegetation One, Three, and Five-Year Plans for Moab and Crescent Junction Sites (continued)

Plan	Moab Site	Crescent Junction Site
3-Year Plan	Continue assisting Closure Team with vegetation issues related to FSS (e.g., cutting down vegetation to 6-8" in height to accommodate field surveys and sampling).	
	Begin revegetation of off-pile areas after FSS (e.g., Off-Pile Areas 1 and 2).	
	Apply lessons learned and conclusions from USGS experimental plots.	
	Begin revegetation of sub-pile areas after construction ceases and FSS is complete (e.g., Sub-Pile 1).	
	Continue awaiting FSS results and accommodate plan to results.	
	Continue protecting underperforming areas for physical crust if vegetation cannot establish.	
	Continue managing cottonwoods hedgerows, reducing water and replacing with pollinator plants.	
5-Year Plan	Continue maintaining current revegetation projects (e.g., watering, mowing, pruning, etc.).	Continue maintaining revegetation projects (e.g., watering, mowing, etc.)
	Continue maintaining SWPPP requirements and protecting 50 ft vegetative buffers around surface waters.	Continue assisting with ET cover as needed.
	Design and build irrigation system, as needed.	Continue noxious weed program.
	Manage non-native species (e.g., mowing kochia)	Continue focusing on disturbed areas outside of CA.
	Continue revegetation of off-pile and sub-pile areas as they pass FSS (e.g., Off-Pile Area 3, Sub-Pile Areas 2-4, etc.).	
	Revegetate other remediated areas as needed.	
	Continue noxious weed program	
	Continue to await FSS and accommodate plan to results.	
	Continue working with Closure Team to revegetate support areas as project progresses.	
	Continue applying lessons learned and conclusions from USGS experimental plots.	

2.3 Revegetation Planning Assumptions

This revegetation plan is intended as guidance for the Moab UMTRA Project site. It may be modified, altered, or departed from as specific locations warrant, as needs arise, and/or as priorities change.

2.4 Jurisdiction and Regulatory Compliance in Revegetation Areas

Revegetation areas may be subject to jurisdiction and regulations of another entity, which may impact revegetation activities (Table 2). Approximately 4.7 acres located at the Moab site along the Colorado River near the Moab Wash were identified in the *Moab UMTRA Project Floodplain and Wetlands Assessment for Additional Interim Actions at the Moab Project Site* (DOE-EM/GJ805-2005) as Jurisdictional Wetlands. Disturbance of jurisdictional wetland areas would require a U.S. Army Corps of Engineers 404 permit that may have additional requirements for reconstruction or mitigation.

Revegetation staff will ensure that compliance with rules and regulations are being met for revegetation activities. If there is any uncertainty regarding regulations associated with revegetation work, staff should bring these concerns to the attention of the RAC Environmental Compliance.

In regard to weed control, two more items are part of the regulatory framework:

1. Executive Order

Executive Order 13751, *Safeguarding the Nation from the Impacts of Invasive Species* (December 5, 2016), 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.

2. State of Utah

Utah noxious weed law is administered by the Utah Department of Agriculture and Food. Pursuant to Utah Noxious Weed Act (Utah Code 4-17-101 et seq.) and Utah Administrative Code R-68, it is the duty of every property owner to control and prevent spread of noxious weeds within their possession or control. As per authority vested in the Commissioner of Agriculture and Food under Section 4-17-3, a state noxious weed list has been designated and published (Appendix A).

Table 2. Environmental Compliance and Impacts on Revegetation Activities

Compliance Obligation (Issue Agency/Regulator)	Summary	Permit, Agreement, or Action	Impact(s) on Revegetation Activities
Grand County Conditional Use Permit (CUP) Resolution #2006-2741	Conditional Use Permits address criteria to determine if reasonably anticipated detrimental effects of proposed land use and whether reasonable conditions can be imposed to mitigate them.	Per requirements of the Grand County Conditional Use Permit Resolution #2006-2741, DOE submits Annual Statement of Continued Compliance, item #17 of the resolution (dated 2019).	Affects the Moab site U.S. Hwy 191 cottonwood hedgerow originally planted in 2006 for a visual barrier, which it has not been providing. In 2018, Grand County approved the Project to reduce watering, remove dying cottonwoods and replace with pollinator plants. In 2024, no more supplemental water will be applied to hedgerow.
Section 7 of the Endangered Species Act of 1973 (ESA) as amended (16 U.S.C. 1532 et seq.) and the Interagency Cooperation Regulations (50 CFR 402)	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. Critical fish habitat is protected by interception of contaminated groundwater and injection of fresh water in wells near the Colorado River. Biological Opinion and Incidental Take Statements for Moab and Green River.	Revegetation work completed near the Colorado River side channel habitats must be in compliance with the Biological Opinion of the Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah, Final Environmental Impact Statement (FEIS).
National Environmental Policy Act (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 are required periodically to ensure proposed Project activities are within the original bounds of the Final Environmental Impact Statement (FEIS).	An Environmental Aspects Checklist (Form 3000 on SharePoint) must be completed for any new non-routine activity to determine if a NEPA review is required.
Federal Insecticide, Fungicide, & Rodenticide Act (FIFRA)	FIFRA governs the distribution, sale, and use of pesticides. This Act categorizes pesticides as either restricted or general use.	General use pesticides applied at the Moab and Crescent Junction (CJ) sites.	Any revegetation activity which includes pesticides (which includes herbicides) must comply with FIFRA.
Clean Air Act (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 Moab and CJ sites.	Implementing control measures while doing revegetation activities that can produce dust or affect air quality (e.g., mowing, seeding, etc.).

Table 2. Environmental Compliance and Impacts on Revegetation Activities (continued)

Compliance Obligation (Issue Agency/Regulator)	Summary	Permit, Agreement, or Action	Impact(s) on Revegetation Activities
Utah Administrative Code (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.	Monitor fugitive dust emissions by individuals certified to EPA Method 9 and implement the controls outlined in the site fugitive dust control plans to the greatest extent practicable.	Implementing control measures while doing revegetation activities that can produce dust (e.g., mowing, seeding, etc.). Opacity will comply with program requirements.
33 USC 1251, Clean Water Act (CWA) / National Pollutant Discharge Elimination System (NPDES) Utah Administrative Code (UAC) Rule 317-8-3.9, "Storm Water Discharges"	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 the Utah Pollutant Discharge Elimination System (UPDES), an equivalent state system.	Utah Pollutant Discharge Elimination System (UPDES) Storm Water General Permits, Moab and CJ Annual Notice of Intent (NOIs) Implement site Storm Water Pollution Prevention Plans	Revegetation activities that disturb the land surface must be in compliance with the <i>Moab UMTRA Project Moab Site Storm Water Pollution Prevention Plan</i> (DOE-EM/GJRAC1475). Vegetative buffers (50 ft or more) must be maintained around surface waters (e.g., Colorado River).
Clean Water Act (CWA) Section 404	Restore and maintain the chemical, physical, and biological integrity of the Nation's waters. Prohibit the discharge of any pollutant into a navigable water, including wetlands, unless otherwise authorized by a permit.	Joint 404/Stream Channel Alteration Permit for Off-Pile Remediation; U.S. Army Corps of Engineers (USACE), Utah Division of Water Rights.	Notify the RAC Environmental Manager when planning work within 30 ft of the ordinary high-water mark of the Colorado River or Moab Wash. A 404 permit may be necessary.
National Historic Preservation Act (NHPA)	Memorandum of agreement (MOA) is in place among DOE, the Utah State Historic Preservation Office (SHPO), the Utah Department of Transportation (DOT), and the Bureau of Land Management (BLM) for protection of cultural and historic resources at the Project sites.	Annual cultural resource inventory performed at the Crescent Junction site for Native American art sites, and an annual report prepared and submitted in accordance with the applicable MOA. The conditions of the Moab site MOA have been previously met.	Any discovery of cultural resources must be reported to the RAC Environmental Manager and no further surface-disturbing activity will take place until DOE makes a decision concerning the disposition of the items.

Table 2. Environmental Compliance and Impacts on Revegetation Activities (continued)

Compliance Obligation (Issue Agency/Regulator)	Summary	Permit, Agreement, or Action	Impact(s) on Revegetation Activities
Migratory Bird Treaty Act (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.	Identify and/ or monitor endangered, threatened, or candidate species at Project sites. Evaluate Project activities that could impact endangered, threatened, or candidate species.	Walk down areas prior to mowing looking for ground nests and inspecting trees that are to be removed for active nests. If such nests are found, suspend activity until birds have migrated.
<p>DOE O 436.1, "Departmental Sustainability"</p> <p>Executive Order (EO) 13834 on Efficient Federal Operations EO 11988, "Floodplain Management"</p>	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 requirement for applicable environmental, public health, and resource protection laws, regulations, and DOE requirements. DOE's implementation of 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.	Develop annual Site Sustainability Plan and implement an Environmental Management Standard (EMS). Activities conducted in the floodplain require evaluation.	<p>Purchase items from the Bio-based list when feasible (www.biopreferred.gov) and report purchases to the RAC Sustainability Coordinator. Recycle or upcycle revegetation equipment, materials and supplies when possible.</p> <p>Revegetate with Utah native "Water Wise" plants and/or pollinators to the extent practical.</p> <p>Prior to implementation, discuss all floodplain revegetation activities with RAC Environmental Compliance Manager to ensure compliance.</p>

Table 2. Environmental Compliance and Impacts on Revegetation Activities (continued)

Compliance Obligation (Issue Agency/Regulator)	Summary	Permit, Agreement, or Action	Impact(s) on Revegetation Activities
EO 11988, "Floodplain Management EO 11990, "Protection of Wetlands"	DOE's implementation of 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. 10 CFR 1022 implements the requirements of EO 11990 for actions that may affect wetlands.	Activities conducted in the floodplain require evaluation. Evaluate Project activities that could impact jurisdictional wetlands.	Prior to implementation, discuss all floodplain revegetation activities with RAC Environmental Compliance Manager to ensure compliance. It was noted in the <i>Moab-Flood Plain and Wetlands Assessment for Additional Interim Actions</i> (2005) that 4.7 acres of jurisdictional wetlands exist on-site along the Colorado River. If any work is planned beyond the berm of the Colorado River, contact the RAC Environmental Compliance Manager.
EO 11990, "Protection of Wetlands"	10 CFR 1022 implements the requirements of EO 11990 for actions that may affect wetlands.	Evaluate Project activities that could impact jurisdictional wetlands.	It was noted in the <i>Moab-Flood Plain and Wetlands Assessment for Additional Interim Actions</i> (2005) that 4.7 acres of jurisdictional wetlands exist on-site along the Colorado River. If any work is planned beyond the berm of the Colorado River, contact the RAC Environmental Compliance Manager.

3.0 Revegetation Implementation

Sustainable revegetation needs to be accomplished within the confines of the existing ecosystem of the area (Anderson 2002). Advice from local Subject Matter Experts (SME) and collaborative research from strategic partnerships (e.g., U.S. Geological Survey, Rim to Rim Restoration) will help guide the decision-making process for best management practices, depending on the project. This will be important given some of the challenging conditions onsite.

A site assessment of the biological resources required for revegetation is a good practice. It may include a characterization of the vegetation, evaluation of the soils, history of disturbance, climatic data, or identification of possible “troubled areas” (Anderson 2002). Time is a critical factor for establishing a native revegetation planting, and it may take several years, or even decades, for the revegetation areas to begin to resemble native plant communities found on the undisturbed portions of the site. Other environmental conditions, such as drought or extreme heat, may factor into the establishment of vegetation.

Where feasible, begin with a small-scale pilot project before implementing a plan for an entire area. This helps in determining effectiveness of a particular approach, which can conserve funds and avoid wasted time (Sher 2010). To initiate this concept, a 2-year collaborative research project with the U.S. Geological Survey (USGS) began in fall 2020 investigating revegetation variables (e.g., soil amendments, seed mixes, fertilizers, etc.) in the wellfield (Zone 17). Experimental plots (336 total) were installed. Baseline data was collected in 2021 and further data collected in 2022. Research performed on site by USGS and UMTRA staff can be used as a tool for successful revegetation of the site. Continued data collection is currently being discussed between USGS and UMTRA.

One revegetation project to highlight from the Moab site is the successful seeding and native grass establishment in the wellfield (area that was formerly flood-irrigated forest plots). This project demonstrates the following steps that can lead to revegetation success.

3.1 Soil Characterization

Knowing your soil type is vital to revegetation (K. Dohrenwend, personal communication, Jan. 20, 2021). Soil sample data will support decisions regarding plant species and other necessary additional steps needed to affect successful revegetation (Sher 2010). Some soil conditions may require the use of amendments which can be time consuming and expensive.

However, many native species do not need soil amendments and adverse conditions can be addressed through the selection of appropriate plants, such as salt tolerant species (Dohrenwend 2013). Land managers in upper Colorado River basin have found that selection and use of halophytic (i.e., salt loving) species is the best management response to restoration situations exhibiting elevated soil salinity (Sher 2010).

In active flood areas, it is also important to note that soil conditions may be significantly altered during a flood. These dynamics may be a factor in the revegetation process and are considered in site management planning.

3.2 Seedbed Preparation

Proper seedbed preparation is essential for establishment of vegetation. Depending on soil type and conditions, certain areas may require various soil amendments and/or treatments before seeding. Addition of compost or mycorrhizal inoculants may help. The soil bed may receive further preparations such as disking or tilling to promote proper conditions for seedbeds. Soil compaction may also need to be addressed.

Addressing soil issues can greatly enhance establishment of species. However, it should be acknowledged that addressing some of these problems may be logistically or fiscally infeasible in some zones, and thus may be the reason to deprioritize them for revegetation (e.g., very little will establish in soil salinity levels over 15 dS/cm). The addition of clean fill dirt, when available, may aid in the establishment of these areas.

Compost is being created onsite and revegetation staff continue to explore best management practices. Composted materials and wood chips may be used to create a soil amendment for underperforming areas to improve soil chemistry and fertility.

3.3 Seeding, Seed Mixes & Planting

One of the most important aspects of the revegetation effort is species selection. Native species are often required because they are either adapted to the conditions that will exist at the site after revegetation, or they are disturbance-adapted and perform well during the first few years (Anderson 2002). Past performance of particular plant species in similar conditions and availability of seed or plant material should be considered in the species selection process. The source of the seed or plant materials should be as close as possible, geographically, to the area being revegetated (Anderson 2002), including collecting seeds from onsite plants when feasible. UMTRA staff collaborated with National Park Service biologists to learn techniques for collecting and processing seed and plan on using this knowledge in the future.

Seed mixes need to be carefully selected and targeted towards current soil conditions (i.e., salt-tolerant species). When seeding, mixes of native species (grasses, forbs, and shrubs) are used to encourage overall successful vegetation establishment. Because of the challenging conditions onsite, the final vegetation cover may not be biodiverse. It is noted that the revegetation subject matter expert (SME) has stated for certain areas onsite (i.e., bare ground due to poor soil conditions), it may take several years to establish native vegetation, if at all (K. Dohrenwend, personal communication, Jan. 20, 2021). This is not a result of lack of effort, but rather due to the ecological and environmental limitations.

Although, initially, the common native plant species that are being seeded have been carefully selected for the limiting conditions in some areas onsite, other native grasses, forbs, shrubs, or trees could be seeded and planted at a future time, if desired, to provide greater diversity to the revegetation locations. Succession is also a natural process, with some species performing better initially and being replaced by other species over time. This should be anticipated and planned for (Sher 2010). Another consideration is planting initial vegetation (e.g., grasses) that will still allow the use of an herbicide (e.g., broadleaf herbicide) without harming that species (Sher 2010).

Time is a critical factor for establishing a native revegetation planting. It may take several years, or even decades, for the revegetation areas to begin to resemble native plant communities found on the undisturbed portions of the site. Native plants often take longer to germinate and establish than non-native species. For the first year or two, many native species spend most of their energy developing a substantial root system before sending up much aboveground growth. It is also normal for revegetation efforts and plant succession to go through an initial stage of annual weeds followed by the establishment and dominance of the desired perennial species.

There are many aspects to seeding success, some of which we have no control (Mealor). Seeding may be done by broadcasting, drill seeding, or hand seeding. Depending on the location and purpose, planting may consist of seeding or planting poles or cuttings and, in some cases, may involve using containerized stock. Considerations, such as application rate, timing, warm vs cool season seeds, wind, and herbivory, will be evaluated at the time of planting (K. Dohrenwend, personal communication, Jan. 20, 2021).

Noxious weed species are prohibited species (Table 3) and use of non-native plants is to be avoided to the extent practical. Selected seed mixes shall be verified weed-free prior to purchasing.

Documentation of seeding and planting activities will be essential in the monitoring and evaluation process, especially since many seeds will not germinate for years after planting and some only after other species have established (Sher 2010).

3.4 Watering

Irrigation may be used to help establish vegetation growth in newly planted areas and to facilitate additional growth in areas that have been revegetated. A variety of irrigation methods are available including sprinklers, hose reels, drip systems, and flooding. The watering schedule will be designed to encourage permanent establishment of plants. After the first few years, the amount of irrigation water applied is reduced to encourage plant adaptation to the local water table/precipitation. The goal is to establish resilient native vegetation that does not require supplemental watering.

Past lessons learned show that improper watering has led to a host of problems. This includes a previous stand of planted cottonwoods in the wellfield that were constantly flood irrigated and when the watering regime changed (to encourage the roots to go deeper), trees experienced mortality, fell over, and created safety hazards.

SMEs and irrigation resources will be consulted to ensure proper water methods and timing. Irrigation type, design, and scheduling will be targeted for each zone. This is an on-going project which requires substantial maintenance and effort. Much of the historical irrigation layout is no longer relevant, and a large portion of the above ground system has been damaged beyond use by years of exposure in the desert environment.

Water application is recorded via irrigation log and will be updated to accurately track water use. A focus on reducing water use, as possible, throughout the life of the Project, is also important given the current and forecasted state of drought in this area.

3.5 Revegetation Activities & Vegetative Debris

Revegetation activities are important to the maintenance of revegetation areas along with specific project objectives. These activities include mowing, pruning, thinning, chipping/shredding, and mulching. Periodic thinning of mature cottonwood and willow trees is performed to improve overall growth and avoid creating a safety hazard. Tree trimmings from pruning/thinning may be shredded in a chipper and spread or composted. These activities may create large quantities of vegetative debris, in particular woody debris.

Vegetative debris will be evaluated on a case-by-case basis and may be dealt with in a variety of ways: chipping, mulching, composting, or taken to landfill.

This document will not go onto details about how to perform each these revegetation activities; more information is available in the *Moab UMTRA Project Revegetation Operations and Maintenance Manual* (DOE-EM/GJTAC2262).

4.0 Weed Control

Managing noxious and invasive weeds is a critical component to achieve DOE's vision for a self-sustaining native plant landscape (Mattson et al. 2020). This Weed Control Plan uses an integrated framework of techniques to control present and prevent future infestations of noxious weeds, enhance the native plant communities, reduce wildfire hazards, and improve wildlife habitat.

Weed control, particularly noxious weed control, has been one of the top accomplishments of the Moab UMTRA Project revegetation program in recent years. Weed control efforts have made a significant difference at the Moab site since 2020, reducing the number of noxious weed species present and the overall size of infestations.

4.1 Weed Control Objectives

As appealing as it is to have a goal of being noxious-weed free onsite, the reality is that the Moab UMTRA Project site is located along the Colorado River, which is a major corridor for spreading invasive weed species. Without great expense, it is difficult, if not impossible in the long term, to maintain a weed-free island surrounded by weed-covered lands. This is a regional problem and one that other organizations are also tackling.

Collaborations and strategic partnerships with other land agencies are important to address shared weed problems. The Moab UMTRA site boundary is considered the berms closest to the river, thus the extent of onsite management. Any vegetation towards the river from the berms will be managed by Utah Division of Natural Resources. Collaboration will allow beneficial management for both agencies. In 2022, UMTRA revegetation staff successfully collaborated with Utah Department of Natural Resources to treat encroaching noxious weeds (tamarisk and Russian knapweed) along the shared eastern site boundary.

Given the location of the project site, weed control will most likely always be a management concern. However, it may be feasible to keep weed populations to a low maintenance level by

following the *Utah Strategic Plan for Managing Noxious Weeds* (Whitesides 2004) as a guideline. Objectives of the Moab UMTRA weed control plan, specifically for noxious weeds:

1. Prevention
 - a. Education and Personnel Training
2. Early Detection and Rapid Response
3. Management of Established Populations
 - a. Identify the perimeter
 - b. Eradicate satellite populations
 - c. Contain and suppress main population
 - d. Treatment methods
 - e. One, three, and five-year management plans
4. Revegetation or Restoration
5. Monitoring and Reporting

4.2 Weed Classifications and Weed Lists

Invasive plant species are non-native, aggressive plants with the potential to cause significant damage to native ecosystems and/or cause significant economic losses. Invasive plants are opportunistic plant species that readily flourish in disturbed areas, are difficult to control, and thereby, can compete with and/or prevent native plant species from re-establishing (Idaho Power 2020).

Invasive noxious weeds have been described as a raging biological wildfire—out of control, spreading rapidly, and causing enormous economic losses (Lowry et al. 2017). Noxious weeds are capable of spreading at rates of up to 60% annually (Smith et al. 1999). Devastation caused by noxious weeds is enormous. Economic losses from weeds exceed \$30 billion annually in the U.S. and the cost continues to grow (Pimentel et al. 2005).

Noxious weeds are a subset of invasive plants that are officially designated by a federal, state, or local agency as injurious to public health, agriculture, recreation, wildlife, or property (Sheley and Petroff 1999).

4.2.1 State of Utah

Under the Utah Noxious Weed Act, five classes of noxious weeds have been designated for the state of Utah based on preventive or management measures:

Class 1A. Early Detection Rapid Response / Watch List: Declared noxious and invasive weeds not native to the state of Utah and not known to exist in the State that pose a serious threat to the state and should be considered as a **very high priority**.

Class 1B. Early Detection Rapid Response: Declared noxious and invasive weeds not native to the State of Utah that are known to exist in the state in very limited populations and pose a serious threat to the state and should be considered as a **very high priority**.

Class 2. Control: Declared noxious and invasive weeds not native to the state of Utah, that pose a threat to the state and should be considered a **high priority** for control. Weeds listed in the control list are known to exist in varying populations throughout the state. The concentration of these weeds is at a level where control or eradication may be possible.

Class 3. Contain: Declared noxious and invasive weeds not native to the State of Utah that are widely spread. Weeds listed in the containment noxious weeds list are known to exist in various

populations throughout the state. Weed control efforts may be directed at **reducing or eliminating new or expanding weed populations**. Known and established weed populations, as determined by the weed control authority, may be managed by any approved weed control methodology, as determined by the weed control authority. These weeds pose a threat to the agricultural industry and agricultural products and should not enter commercial channels.

Class 4. Prohibited for sale or propagation: Declared noxious and invasive weeds, not native to the state of Utah, that pose a threat to the state through the retail sale or propagation in the nursery and greenhouse industry. Prohibited noxious weeds are annual, biennial, or perennial plants that the commissioner designates as having the potential or are known to be **detrimental to human or animal health, the environment, public roads, crops, or other property**.

See Appendix A for the current State of Utah noxious weed list.

4.2.2 Grand County

The Utah Noxious Weed Act states that “*Each county in Utah may have different priorities regarding specific State designated Noxious Weeds and is therefore able to reprioritize these weeds for their own needs.*”

See Appendix B for the current Grand County noxious weed list.

4.2.3 Moab UMTRA Project Site

A Moab UMTRA site-specific target weed list was created in 2020, which compiled noxious weeds lists from Grand County and State of Utah. Invasive (but technically not noxious) weed species of ecological impact and of management concern (e.g., kochia) were determined by revegetation personnel and also included on the Moab UMTRA site-specific target list. Because noxious weed lists are continually updated by the state and county to reflect new invasive species, the site-specific Moab UMTRA target list was updated in 2022 and is current for 2023 (Table 3).

A total of 65 (previously 60) weed species are on the Moab UMTRA target list: 56 noxious weed species (previously 51) and 9 invasive weed species of concern (Table 3). Noxious weeds will be of highest priority.

It is noted that *Phragmites (Phragmites australis subsp. americanus)* is present on site in two small patches (<200 sq ft), but is the native subspecies, not the noxious introduced variety (*Phragmites australis*). Project staff will continue to monitor for presence of any non-native *Phragmites*.

Cheatgrass (*Bromus tectorum*) was intentionally not included on the target weed list or in the previous weed mapping. It is pervasive and considered beyond management control throughout much of the West. However, new treatment strategies are promising. Future plans may consider these new options.

4.3 Current Noxious Weed Inventories, Surveys, and Results

Initial weed inventory and mapping were conducted by revegetation personnel in summer 2020 based on the site-specific target weed list. This established the baseline data for the weed control

program. See *Moab UMTRA Project Revegetation and Weed Control Plan Revision 7* (DOE–EM/GJTAC1655) for details and methodologies.

Table 3. Updated Moab UMTRA Site-specific Target Weed List 2023

GRAND & STATE NOXIOUS (Class 2-4)		UMTRA-SPECIFIC WEEDS OF CONCERN	
Bermudagrass	<i>Cynodon dactylon</i>	Bull thistle	<i>Cirsium vulgare</i>
Black Henbane	<i>Hyoscyamus niger</i>	Crested wheatgrass	<i>Agropyron cristatum</i>
Canada thistle	<i>Cirsium arvense</i>	Halogeton	<i>Halogeton glomeratus</i>
Cogongrass	<i>Imperata cylindrical</i>	Kochia	<i>Kochia scoparia</i>
Dalmatian toadflax	<i>Linaria dalmatica</i>	Tumbleweed	<i>Salsola tragus</i>
Dame's Rocket	<i>Hesperis matronalis</i>	Tumbling mustard	<i>Sisymbrium altissimum</i>
Diffuse knapweed	<i>Centaurea diffusa</i>	Woolly mullein	<i>Verbascum thapsus</i>
Dyers woad	<i>Isatis tinctoria</i>	Yellow salsify	<i>Tragopogon dubius</i>
Field bindweed	<i>Convolvulus arvensis</i>	Yellow sweet clover	<i>Melilotus officinalis</i>
Hoary cress	<i>Cardaria spp.</i>		
Houndstongue	<i>Cynoglossum officinale</i>		
Jointed Goatgrass	<i>Aegilops cylindrical</i>		
Leafy spurge	<i>Euphorbia esula</i>		
Medusahead	<i>Taeniatherum caput-medusae</i>		
Musk thistle	<i>Carduus nutans</i>		
Myrtle spurge	<i>Euphorbia myrsinites</i>		
Perennial pepperweed	<i>Lepidium latifolium</i>		
Perennial Sorghum spp. (Incl. but not limited to Johnson grass and Sorghum almum)	<i>Sorghum halepense</i> & <i>Sorghum almum</i> etc.		
Phragmites (Common reed, non-native variety)	<i>Phragmites australis</i>		
Poison hemlock	<i>Conium maculatum</i>		
Puncturevine (goathead)	<i>Tribulus terrestris</i>		
Purple loosestrife	<i>Lythrum salicaria</i>		
Quackgrass	<i>Agropyron repens</i>		
Ravenna grass	<i>Tripidum ravennae</i>		
Rush skeletonweed	<i>Chondrilla juncea</i>		
Russian knapweed	<i>Centaurea repens</i>		
Russian olive	<i>Elaeagnus angustifolia</i>		
Scotch broom	<i>Cytisus scoparius</i>		
Scotch thistle	<i>Onopordum acanthium</i>		
Spotted knapweed	<i>Centaurea maculosa</i>		
Squarrose knapweed	<i>Centaurea squarrosa</i>		
Tamarisk/Salt cedar	<i>Tamarix ramosissima</i>		
Yellow Starthistle	<i>Centaurea solstitialis</i>		
Scotch broom	<i>Cytisus scoparius</i>		
Yellow toadflax	<i>Linaria vulgaris</i>		

GRAND & STATE NOXIOUS (Class 1B & 1A)	
Class 1B: Early Detection Rapid Response (EDRR)	
African mustard	<i>Brassica tournefortii</i>
Blueweed (Vipers bugloss)	<i>Echium vulgare</i>
Camelthorn	<i>Alhagi maurorum</i>
Common St. Johnswort	<i>Hypericum perforatum</i>
Cutleaf vipergrass	<i>Scorzonera laciniata</i>
Elongated mustard	<i>Brassica elongata</i>
Garlic mustard	<i>Alliaria petiolata</i>
Giant reed	<i>Arundo donax</i>
Goatsrue	<i>Galega officinalis</i>
Japanese knotweed	<i>Polygon cuspidatum</i>
Oxeye daisy	<i>Chrysanthemum leucanthemum</i>
Purple starthistle	<i>Centaurea calcitrapa</i>
Class 1A: EDRR / Watch List	
African rue	<i>Peganum harmala</i>
Common crupina	<i>Crupina vulgaris</i>
Malta starthistle	<i>Centaurea melitensis</i>
Mediterranean sage	<i>Salvia aethiopsis</i>
North African grass	<i>Ventenata dubia</i>
Plumeless thistle	<i>Carduus acanthoides</i>
Small bugloss	<i>Anchusa arvensis</i>
Spring millet	<i>Milium vernale</i>
Syrian beancaper	<i>Zygophyllum fabago</i>

Results from the 2020 Moab UMTRA project site weed mapping showed 16 different weed species based on the target weed list, specifically 7 different noxious weed species (6 of which are Class 3, and 1 species is Class 4) and 9 different invasive weed species of concern.

In 2021 and 2022, no official inventory or mapping was conducted, however, revegetation personnel visually monitored for weeds throughout the site while doing other revegetation activities. It is noted that goatheads and field bindweed were observed to expand compared to previous years. Revegetation personnel are closely monitoring these species and conducting “early detection-rapid response”.

Summary of 2022 target species from weed list (Table 4) based on observational data:

- 8 different noxious weed species (7 of which are Class 3, and 1 species is Class 4)
- 9 different invasive weed species of concern

See Tables 4 and 5 for current status of noxious weed species onsite and summary of weed control activities conducted in 2021. Revegetation crews treated many of the noxious weed species, starting with the smaller infestations first.

Table 4. Current Status of Noxious Weed Species Onsite and Summary of Weed Control Activities Conducted at the Moab Site

	NOXIOUS WEED SPECIES ONSITE	CURRENT STATUS	NOTES
1	Tamarisk	Most wide-spread and extensive noxious weed onsite; all growth stages present	This is the most challenging noxious weed to treat. Treatments showing success.
2	Russian knapweed	Mostly large, sparsely covered patches throughout site	Treatments from 2020-2022 showing significant success.
3	Russian olive	A few seedlings scattered throughout site	Treatments in 2021 showing significant success. In 2021, over 95% of all Russian olive onsite were treated. With approval from the state, Russian olives along shared boundary (on river berm) were also treated. Monitoring areas.
4	Perennial pepperweed	Small infestations with moderate cover are interspersed throughout the site	This species, detected in 2020, invaded more zones in 2021. Revegetation crews successfully conducted early detection - rapid response and areas are being monitored.
5	Goathead (puncturevine)	Encroaching from seeds washing in along boundaries	New species detected onsite in 2021. Revegetation crews conducted early detection - rapid response. This species expanded into new areas; monitoring areas.
6	Bermuda grass	Small (<200 sq ft), contained patches	Treated; monitoring area.
7	Canada thistle	Small (<200 sq ft), contained patches	Treated; monitoring area.
8	Field bindweed	Small (<200 sq ft), contained patches	Treated; monitoring area. This species expanded into new areas; monitoring areas.

For management priorities, color-coded designations were assigned to each zone based on weed species presence and weed control treatment (Table 5). Colors were assigned for the number of different noxious weed species present and untreated in individual zones: green represents zero noxious weed species present; yellow-green is 1 noxious weed species, yellow is 2 different noxious weed species, orange is 3 different noxious weed species, and red is 4+ different species of noxious weeds present in that zone.

Results for all 27 revegetation zones can be seen in Table 5 and Figure 6. The purpose of this tool is to track progress and monitor success criteria for the noxious weed program. See Figure 7 for comparison of previous and current tracking tools of priorities for noxious weeds only, showing that weed control efforts are making a significant difference onsite.

Table 6 provides a summary and comparison of previous and current number of noxious weed species untreated at the Moab site. Overall, weed control efforts are reducing the number of

different noxious weed species in treated zones. All red zones (4+ different noxious weed species) and orange zones (3 different noxious weed species) were eliminated. Only one yellow zone (2 different noxious weed species) remains. Green zones (no noxious weed species present and untreated) increased significantly from 4 to 18, evidence of the diligence of weed control activities being conducted.

It is important to note that weed control is a dynamic situation. Due to adaptations and abilities of noxious weed species to rapidly invade and outcompete native vegetation, managing noxious weeds takes diligent effort over time and continual monitoring. Rarely does one treatment completely eliminate the species. Changes in environmental conditions (e.g., drought) can alter surroundings for favorable situations for certain noxious weed species. Eliminating seed banks in the soil may take a tremendously long time, depending on species and environmental factors. Revegetation personnel are prepared for this and continue to monitor the site, especially treated areas.

Currently, invasive weed species (non-noxious) of concern were not treated this year. Future plans may include this.

Table 5. Current Moab UMTRA Noxious Weed Presence, Treatment, and Priority Color-Coding Designations at the Moab Site

ZONE	Bermuda grass	Canada thistle	Field bindweed	Goathead	Perennial pepper-weed	Russian knapweed	Russian olive	Tamarisk	# of Diff. Noxious Weed Species *	Priority Color Code
1				Treated					0	Green
2			Monitoring	Monitoring		Treated	Monitoring	Monitoring	0	Green
3				Treated		Treated	Monitoring	Monitoring	0	Green
4						Treated	Monitoring	Partially treated	0	Green
5						Treated	Monitoring	Partially treated	0	Green
6				Treated					0	Green
7					Monitoring	Monitoring		X	1	Yellow-green
8							Treated	Partially treated	0	Green
9					Monitoring	Treated	Monitoring	X	1	Yellow-green
10					Partially treated	Partially treated	Monitoring	X	1	Yellow-green
11					Partially treated	Partially treated	Monitoring	Partially treated	0	Green
12					Partially treated	Partially treated	Monitoring	Partially treated	0	Green
13						Treated		Partially treated	0	Green
14					Monitoring	Treated		Partially treated	0	Green
15					Treated	Treated	Treated	Treated	0	Green
16					Monitoring		Treated	X	1	Yellow-green
17	Monitoring			Treated	Monitoring	Partially treated		X	1	Yellow-green
18						Monitoring			0	Green
19			Treated					X	1	Yellow-green
20		Monitoring				Partially treated	Monitoring	Partially treated	0	Green
21					Monitoring	Treated		Partially treated	0	Green
22			Treated			Monitoring	Treated	X	1	Yellow-green
23						Treated	Monitoring	X	1	Yellow-green
24					X	Partially treated	Partially treated	X	2	Yellow

Table 5. Current Moab UMTRA Noxious Weed Presence, Treatment, and Priority Color-Coding Designations at the Moab Site (continued)

ZONE	Bermud a grass	Canada thistle	Field bindweed	Goathead	Perennial pepper-weed	Russian knapweed	Russian olive	Tamarisk	# of Diff. Noxious Weed Species *	Priority Color Code
25								Partially treated	0	Green
26				Monitoring				Partially treated	0	Green
27						Treated		Partially treated	0	Green
Total Zones Treated (incl. partially)	0	0	2	4	4	17	5	13	---	---
Total Zones Monitored	1	1	1	2	6	3	10	2		
Total Zones Un-treated	0	0	0	0	1	0	0	9	---	---

"X" = weed species present and untreated, "Treated" = zone was treated in 2022. "Partially treated" = only part of the zone was treated in 2022. "Monitoring" = zone was treated in the past (2020 and/or 2021); was not treated this year and is currently being monitored.

* Color codes are based on number of different noxious weed species present and untreated: green = 0, yellow-green = 1, yellow = 2, orange = 3, red = 4+

Table 6. Comparison of Previous and Current Number of Noxious Weed Species Present and Untreated at the Moab Site

Number of Noxious Weed Species Present & Untreated	Corresponding Color Code	Number of Zones		
		As of February 2021	As of February 2022	As of December 2022
0	Green	3	4	18
1	Yellow-green	4	17	8
2	Yellow	6	4	1
3	Orange	7	2	0
4+	Red	7	0	0

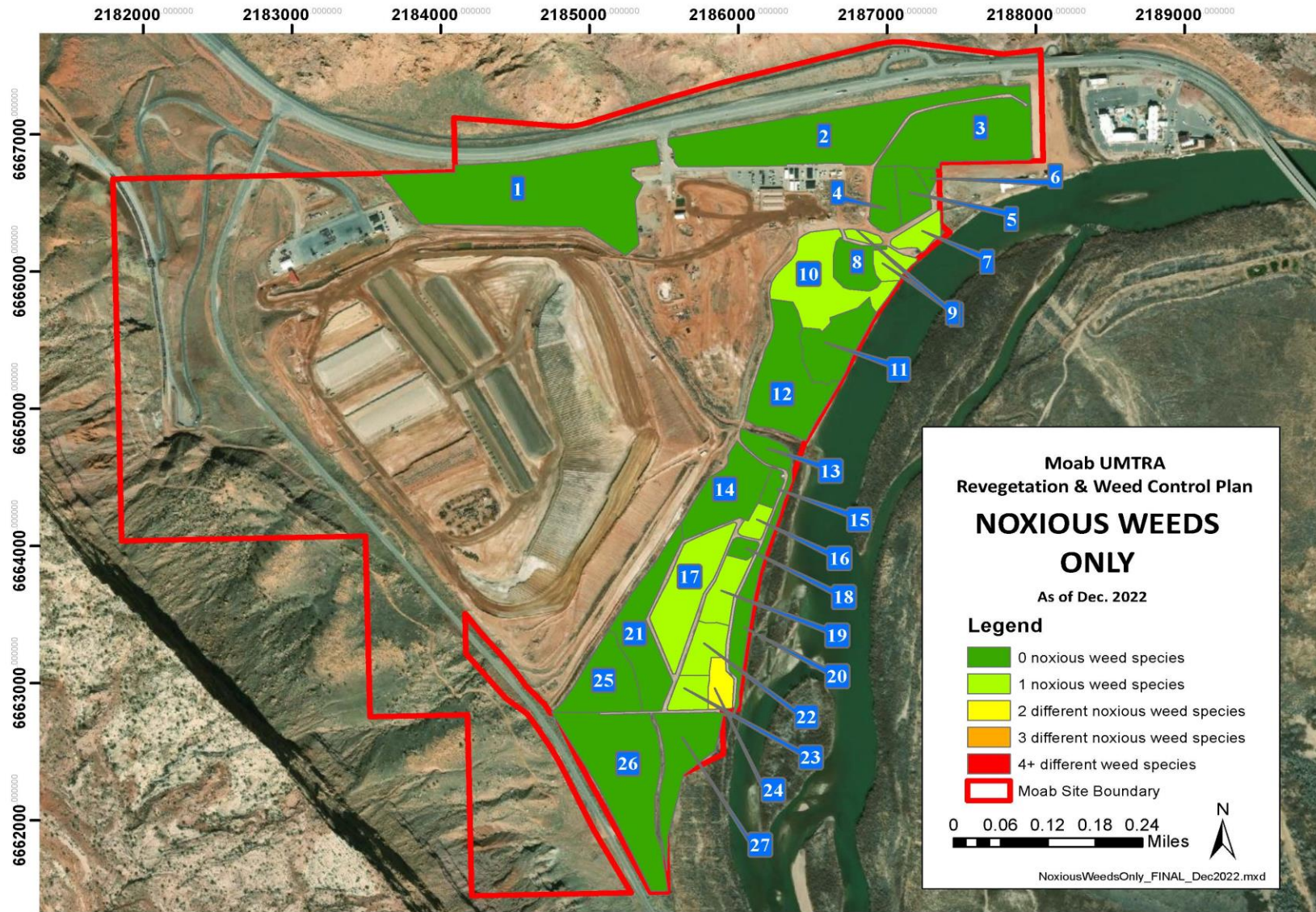


Figure 6. Tracking Tool for Priorities for Noxious Weeds Only, Color codes are based on number of different noxious weed species present and untreated: green = 0, yellow-green = 1, yellow = 2, orange = 3, red = 4+

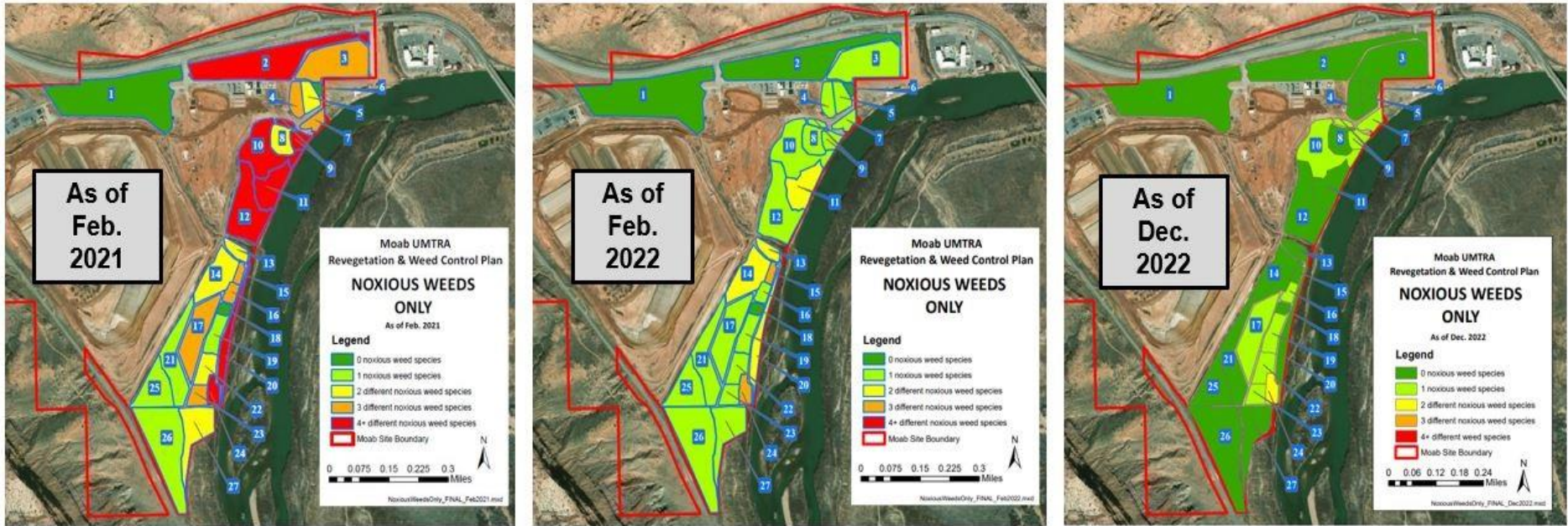


Figure 7. Comparison of Previous and Current Tracking Tool of Priorities for Noxious Weeds Only
 Color codes are based on number of different noxious weed species present and untreated:
 green = 0, yellow-green = 1, yellow = 2, orange = 3, red = 4+

4.4 Management of Noxious Weeds & Weeds Species of Concern

This section of the Plan describes the steps Moab UMTRA will take to prevent and control the establishment and spread of noxious weed species using the *Utah Strategic Plan for Managing Noxious Weeds* (Whitesides 2004) key elements.

4.4.1 Prevention

Prevention is the best method of weed management (Dewey 1995). The most efficient and cost-effective way of dealing with noxious weeds is to prevent them in the first place.

4.4.2 Education and Personnel Training

All revegetation and other on-the-ground environmental personnel (i.e., groundwater, air monitoring, etc.) will be instructed on the importance of controlling noxious weeds and trained in weed identification. Moab UMTRA personnel detecting emerging noxious weed infestations will be key to prevention.

Revegetation personnel will be trained in weed mapping and inventory methods and be familiar with established populations of noxious weeds. Knowledge of weed ecology, reproduction, and known pathways for invasive species will help identify the most susceptible areas. Personnel will be trained in treatment strategies, equipment, and best management practices (BMPs). Those using herbicides are highly encouraged to acquire their herbicide/pesticide applicators license certification through the State of Utah.

Other preventative actions may include:

- Reseeding significantly disturbed areas with a native seed mix to help outcompete non-native species.
- Avoiding disturbance of soil in stable areas or places not actively being managed.
- Ensuring any imported materials (e.g., straw, hay, mulch, gravel, seed, compost, etc.) are weed-free.
- Using wattles in places where roads are draining into surrounding areas and weed species are spreading.
- Developing designated vehicle turn-out and/or turn-around spots along roads in revegetation areas to reduce disturbing soil.
- Avoiding use of noxious weed species in the compost
- Considering impact of noxious weeds when moving soil from one area to another.
- Choosing areas free of noxious weeds as the origin location to reduce seed dispersal onsite.
- Cleaning of equipment, boots, undercarriages, and tires to avoid seed dispersal.
- Personnel will inspect, remove, and appropriately dispose of weed seed and plant parts found on their clothing and equipment.
- Evaluating engineering controls to determine volume and occurrence of flood events in revegetation areas.

4.4.3 Early Detection and Rapid Response

Detecting new invaders early and taking urgent action before they become significant, ecosystem-altering or economically devastating issues is first line of defense (Whitesides 2004). The goal is to keep newly detected weed species from becoming established.

Early detection actions include:

- Revegetation and other personnel to be aware of potential invaders “watch list”. Train personnel in plant identifications and what to look out for.
- Develop routine and systematic surveys as part of weed management program.
- Know high risk areas and monitor frequently.
- Report new invasions to revegetation and/or weed management lead.
- Keep abreast of emerging county and state noxious weed species (e.g., African Rue recently discovered in Grand County).
- Share pertinent findings with Grand County Weed District and other surrounding landowners (e.g., Bureau of Land Management, private property) to educate others and promote partnerships.

Rapid response actions include:

- Act as soon as possible
- Follow the species-specific treatment (see *Moab UMTRA Project Revegetation Operations and Maintenance Manual for the Moab Site* (DOE-EM/GJTAC2262)), which outlines best management practices. Knowing proper treatment strategies is important before taking action. Some actions can produce negative results (i.e., tilling promoting root reproduction, etc.)
- Research treatment strategies, if uncertain
- Utilize resources, such as Utah State University (USU) Extension, Grand County Weed District or Rivers Edge West, for treatment methods and information.

4.4.4. Management of Established Populations

For established populations of noxious weeds, the goal is to identify the size of the infestation and work from the edges towards the central area of infestation. Weed mapping and inventories will be an important tool to identify established populations and track progress of treatment strategies.

The main objectives of controlling established weed populations are as follows:

- Identify the perimeter: during weed mapping, finding the outer perimeter of the infestation is important to know the size of the infestation.
- Eradicate satellite populations: eliminate smaller populations until one main infestation is left to control and manage, using species-specific treatment strategies and BMPs.
- Contain and suppress main population: once satellite populations have been controlled, direct all efforts on the main area of infestation to control and ultimately, eliminate.

4.4.5 Treatments

Control of noxious weeds will be implemented through mechanical, biological, and chemical control measures:

- Mechanical: removal of aboveground plants and/or roots with hand tools or heavy machinery (e.g., tractor with mowing attachment). Mechanical methods can be useful for smaller, isolated populations of noxious weeds in areas of sensitive habitats. Some rhizomatous plants can spread through mechanical means; therefore, implementation of this method will be species specific. Mechanical treatments that disturb the soil surface within native habitats will be avoided in favor of herbicide application. This will help prevent soil disturbance and establishment of new colonies of weeds.

- **Biological:** use of living organisms (insects, diseases, and livestock) to control noxious weeds (i.e., biocontrol). Many noxious weed species are from other continents (usually Eurasia) and recently introduced into North America. They have few natural enemies to control their population here. The biological control agent is typically adapted to a specific species and selected for their ability to attack critical areas of the plant that contribute to its persistence. Some biocontrol (e.g., gall wasps for Russian knapweeds) must be purchased in other states and a permit is required to cross state lines.
- **Chemical:** use of selective herbicides, specific to weed species. Herbicide treatment can be effective for large populations of noxious weeds where other means of control may not be feasible. Vehicle-mounted sprayers (i.e., Utility Terrain Vehicle - UTV) may be used in open areas readily accessible by vehicles. Hand sprayers and backpack sprayers will be used in small areas or areas hard to access by UTV. Impacts to non-target plant species and other environmental concerns will be addressed before applying herbicide. The DOE prefers that all herbicides used on-site are 2, 4-D-free and/or bio based.

Treatments will be carefully researched for best management practices— a wrong treatment for a species may exacerbate the infestation. Control measures will be based on species-specific and site-specific conditions (e.g., proximity to water or riparian areas, season of application, occurrence of special status plant species, etc.). Noxious weed control measures will be implemented in accordance with existing state and county regulations. Care must be exercised during treatment of weeds to prevent seed spread and dispersal.

Moab UMTRA species-specific control methodologies are documented in the *Moab UMTRA Project Revegetation Operations and Maintenance Manual for the Moab Site* (DOE-EM/GJTAC2262). The compilation was created based on recommendations from SMEs such as Navarro (previous DOE-Legacy Management contractor), Grand County weed department, Dinosaur National Monument, and other local weed managers. As of this writing, research into certain treatments for specific species is still being conducted.

Current treatment examples at Moab UMTRA project site include mechanical means (i.e., mowing) for kochia and tamarisk, herbicide application on Russian knapweed, and the tamarisk leaf beetle (*Diorhabda elongata*) which defoliates tamarisk. The tamarisk beetle is currently present onsite, having been released by Grand County in 2001.

Treatment results will be assessed, and methods re-evaluated, if necessary. Discussions with DOE Legacy Management (LM) or other local SMEs are also advisable.

4.4.6 Herbicide Application, Handling, Storage, Spills and Cleanup

Safety procedures for using chemical methods can be found in IWP/JSA Number: *MB-IWP/JSA-003, Facility and Ground Maintenance* and *MB-IWP/JSA-069 Vegetative Debris Management*.

The current list of Moab UMTRA approved herbicides is provided in the *Moab UMTRA Project Revegetation Operations and Maintenance Manual for the Moab Site* (DOE-EM/GJTAC2262). All manufacturer safety data sheets (SDS) for these herbicides can be located on site. Any new herbicide must be approved by Health & Safety before purchasing and application.

Herbicide application, handling, and storage actions include:

- Revegetation personnel using herbicide are strongly encouraged to acquire a Utah herbicide/pesticide applicator license certification
- Following all FIFRA regulations (Table 2)
- The herbicide applicator will have readily available copies of the appropriate SDSs for the herbicides used
- Herbicide applications will follow, by law, all label guidelines, as well as any federal, state, and/or county regulation. Application rates will be based on product label instructions
- Herbicide handling will include all personal protective equipment (PPE) stated on the label for mixing and applying, and also approved by Health & Safety
- All herbicide equipment and containers will have secondary containers and also be inspected for leaks. All herbicide equipment will be maintained and cleaned
- Calibration checks of equipment will be conducted prior to, and periodically during application to ensure proper rates are achieved
- Mixing will be done over a drip-catching device in an area devoid of sensitive vegetation and in an area that will limit human and wildlife exposure
- Disposal of spent containers will be in accordance with the herbicide label or local authorities
- Herbicides will be stored in a cabinet with secondary containers in the event of a leak
- Herbicides capable of freezing will be stored in a climate-controlled environment during the winter months

All reasonable precautions will be taken to avoid herbicide spills. Follow the SDS and MB-IWP/JSA-003 *Facility and Grounds Maintenance* for use/transfer/handling of chemicals.

4.4.7 Revegetation and Restoration

After invasion by an aggressive weed species and subsequent successful control/management activities, revegetation and restoration may be needed to return the site to a desirable species composition (Whitesides 2004). Refer to the *Revegetation Implementation* section for more details.

Revegetation and restoration actions related to this Noxious Weed Plan:

- Obtain knowledge of the system
- Collaborate with partners for research and experiments with restoring degraded lands (i.e., US Geological Survey, Rim to Rim Restoration) Take soil samples for nutrient analysis and amend, if necessary
- Develop a plan for each zone, including seeding and watering components
- Plant seeds with end result in mind
- Plant/seed native vegetation that is suitable for the local conditions
- Seed mixes will be determined by soil type and site-specific conditions
- Use of weed-free seed mixes
- If areas are expected to be disturbed due to future projects, develop a seed mixture and application plan to reduce weed establishment
- Re-evaluate annually

5.0 Monitoring and Evaluation

Monitoring and evaluation is the final step in the workflow of revegetation and weed control. It is a critical step in determining short- and long-term success towards achieving the vision of a self-sustaining native plant community. Restoration takes time and is an art form as much as it is a science (Sher 2010). Many factors can influence the success of revegetation. Some of these include variable climate (precipitation amounts, timing of precipitation events, temperatures), seedbed preparation, seed variability, soil fertility, undesirable species competition for resources, and herbivory.

Monitoring provides feedback on effectiveness of action steps taken and if goals, priorities, and/or implementation techniques need to be modified, altered, and/or maintained. Unknown challenges may be revealed, priorities may change, or efforts may need to be steered in a new direction as projects are implemented.

All revegetation projects should have appropriate monitoring and management to increase the probability that initial revegetation efforts will succeed. Initial success in all revegetation efforts is not a guarantee of long-term viability. Even if all these factors are favorable and conditions are conducive for revegetation success, a planting may still fail. Altering irrigation, fertilization, remedial planting, and invasive species control are examples of actions identified during monitoring as needed to improve restoration (Sher 2010).

When managing for weed control, monitoring invasive and noxious weed populations is a critical component at every stage of the weed plan. Prevention and early detection rely on monitoring to identify emerging weed species. Rapid response and treatment strategies need monitoring to assess results of actions taken. Comparing weed inventories over time is imperative to track populations over time, find any spread of new or known species, and report progress and success.

Monitoring can save significant time and money in the long term by addressing a wide range of problems before they become main factors in failure of the restoration effort. Post-planting monitoring, flexibility, and willingness to learn from mistakes are critical aspects of long-term success (Sher 2010).

Success criteria is outlined in the goals and one-, three-, and five-year plans for each Project site (Table 1). Success criteria are provided as initial guidance; however, common sense combined with scientific data must be applied to final evaluations to determine whether further management actions are required. Also, conditions at some locations may never reach specified success criteria simply because the physical, environmental, and climatic factors at a location are not conducive for substantial vegetation growth.

Monitoring can be qualitative (e.g., photo points, field notes; Figure 8) and/or quantitative (e.g., permanent transects, quadrats, digital mapping, data collection). Collection of baseline data is an important first step (Sher 2010). Larger projects should have more intensive monitoring programs included as part of the project plan and implementation to help inform maintenance actions and to help future project managers learn from success and failure of past projects. Specific data to be collected should be guided in part by the original restoration goal (Sher 2010). If possible, past research done onsite would be replicated.



Figure 8. Example of Repeat Photo Program (taken from wellfield revegetation project, 2022)

For long-term maintenance, monitoring on a regular basis is essential. Evaluations will be conducted annually at revegetation locations until success criteria have been achieved or until determined to be unnecessary. After locations have met success criteria, they will be incorporated into a rotation in which they will continue to be monitored every few years. The primary purpose of the continued monitoring is to demonstrate that the success criteria continue to be met and whether additional management actions are necessary. Regulatory requirements may have their own monitoring protocols and success criteria.

Reporting and documentation of monitoring and evaluation will be important for documentation purposes and also to track progress. Informing others of successful strategies, lessons learned, and any emerging weed species will be helpful not only to Moab UMTRA Project, but also to other local land managers, collaborators and partners.

6.0 Strategic Partnerships

Over the past four years revegetation staff have been working to build strategic partnerships with various public and private entities. These relationships are being established to share relevant and non-classified information between parties that will benefit the Moab UMTRA site as well as the greater community in ecological restoration efforts. These relationships were generally established through the participation of UMTRA staff in local and regional ecological working groups. As the project progresses, participation in these groups should be encouraged to continue building relationships that benefit the Project in both an objective aspect as well as good public relations.

The following is a list of entities with whom relationships have been established and a brief description of the purpose of each of them. Any formal partnerships will be detailed and recorded in an official memorandum of understanding (MOU) between all parties involved.

U.S. Geological Survey (USGS) – Southwest Biological Science Center:

USGS scientists with expertise in soil restoration and revegetation of highly disturbed landscapes were invited to collaborate with Moab UMTRA revegetation staff. A Memorandum of

Understanding (MOU) was drafted between the two agencies extending until 2025. In fall 2020, 336 experimental plots were installed in the well field (Zone 17) with the purpose of researching revegetation variables (e.g., soil amendments, seed mixes, fertilizers, biocrust inoculations, watering regimes, etc.). Baseline data was collected in summer 2021. Further data collection occurred in 2022.

Research performed on site by USGS and UMTRA staff can be used as a tool for successful revegetation of the site. Research should also be used to develop scientific literature that will be beneficial to the broader community of land managers and scientists involved in ecological restoration of disturbed landscapes. Discussions are currently happening with USGS regarding the future of the plots. Results from the study will be applied to revegetation goals and activities.

U.S. National Park Service (NPS):

UMTRA has participated in various salvage projects with the NPS over the past two years, benefitting both partners. In March 2020, ~105 native grasses were salvaged from an employee housing development in Canyonlands National Park and transplanted at the Moab site.

In summer 2021, biocrust was salvaged from a construction area inside of Arches National Park. Healthy biocrust was collected, brought onsite, and placed in various areas to test biocrust as a possible restoration technique. Fill dirt from another Arches National Park construction project was also brought onsite and placed in the wellfield.

In summer 2022, ~95 native plants were salvaged from another construction area in Canyonlands National Park begin developed for a parking lot and trailhead. Plants were brought back to the site and transplanted in the wellfield.

Moving forward UMTRA staff and NPS plan to coordinate on future projects including additional plant and biocrust salvaging and acquiring excess soil from park projects to use as amendments at site revegetation areas. Crews have also collaborated on seed collection efforts.

Rim to Rim Restoration (RRR):

Rim to Rim Restoration is a non-profit organization in Moab, Utah dedicated to the reestablishment of native vegetation for the benefit of wildlife, recreation opportunities and to support maintaining sustainable watersheds in the Upper Colorado Plateau. RRR helps build community and facilitate regeneration of native plants through collaboration with local land managers, government agencies, non-profit organizations and community members. RRR spearheads the Utah Watershed Restoration Initiative (WRI) proposal which encourages collaborations for riparian restoration work along the Colorado River corridor. Moab UMTRA became part of the greater WRI project and was awarded native seed and herbicide in 2021 and native seed in 2022. An MOU with RRR was developed in 2021.

Utah Division of Natural Resources/ Utah Forestry, Fire, and State Lands (DNR/FFSL):

This is an important partnership as the Moab UMTRA Project site shares boundaries with DNR/FFSL. Moab UMTRA and DNR successfully collaborated on a WRI proposal to address encroaching noxious weeds (tamarisk and Russian knapweed) from DNR lands onto Moab UMTRA lands along a shared boundary in spring 2022.

Staff have also acquired native seed from DNR through a previous WRI grant for vegetative restoration along the Colorado River corridor. Seed was applied to the area onsite referred to as “Former Policaro Property” (Zone 26 and 27, Figure 3) in late winter 2022.

Southeast Utah Riparian Partnership (SURP):

The Southeast Utah Riparian Partnership is a diverse public-private partnership of local, state and federal agencies; businesses; nonprofit organizations; and individuals. The group’s mission is to restore, protect and maintain a healthy riparian ecosystem in Utah’s Colorado River Watershed. All members of the partnership are committed to information sharing, networking, and collaborative interdisciplinary action in research, planning, monitoring and on the ground project implementation. Revegetation staff attended SURP annual meetings in 2019-2022. Many of the SURP partners are also involved in the WRI proposals and information shared with partners will also assist in specific revegetation implementation and monitoring techniques. Rim to Rim Restoration (RRR) leads the SURP. An updated MOU with all entities in the SURP was developed in 2022 and RRR will be collecting signatures in 2023.

RSI EnTech, LLC contractor for DOE Legacy Management (LM; previously Navarro):

Moab UMTRA connected with RSI EnTech, LLC, contractor for DOE LM, for guidance with weed control and overall revegetation goals. They spent time onsite in fall 2020 and again in 2021 teaching revegetation staff about weed control techniques and spraying knapweed, Russian olive, and tamarisk. This partnership will be invaluable with revegetation and weed control direction and implementation techniques.

7.0 Records

All documentation created as a result of compliance with this Plan 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. Documentation may include (but is not limited to):

- Inspection forms.
- Photographs.
- Corrective action logs.
- General correspondence related to storm water discharges or permitting.

Copies of inspection reports shall be retained for at least 3 years from the date of final site stabilization and termination of the UPDES Permit.

8.0 References

Anderson, D.C., and W.K. Ostler. 2002. *Revegetation of Degraded Lands at U.S. Department of Energy and U.S. Department of Defense Installations: Strategies and Successes*. Ecological Service, Bechtel, Nevada.

Dewey, S.A. 1995. *Noxious Weeds...A Biological Fire: Applying Fundamentals of Wildlife Management to Improve Noxious Weed Control*. Utah State University Cooperative Extension.

DOE (U.S. Department of Energy), *Moab UMTRA Project Crescent Junction Site Storm Water Pollution Prevention Plan* (DOE-EM/GJ1238).

DOE (U.S. Department of Energy), *Moab UMTRA Project Moab Storm Water Pollution Prevention Plan* (DOE-EM/GJ1475).

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

DOE (U.S. Department of Energy), *Moab UMTRA Project Revegetation Operations and Maintenance Manual* (DOE-EM/GJTAC2262).

DOE (U.S. Department of Energy), *Moab UMTRA 2019 Flood Response Summary* (DOE-EM/GJTAC3035).

DOE (U.S. Department of Energy), *Moab UMTRA Project Annual Site Environmental Report for Calendar Year 2021* (DOE-EM/GJ3082).

DOE (U.S. Department of Energy). July 2018. *Rocky Flats Site, Colorado, Revegetation Plan* (LMS/RFS/S04513-1.0).

DOE (U.S. Department of Energy). July 2018. *Rocky Flats Site, Colorado, Vegetation Management Plan* (LMS/RFS/S04512-3.0).

Dohrenwend, K. Personal Communication. January 20, 2021.

Dohrenwend, K., et al. 2013. *Restoring Native Vegetation in the Escalante River Watershed: Guidelines and Resources for Landowners and Land Managers*. Woody Invasives Committee for Escalante River Watershed Partnership.

Grand County Conditional Use Permit (CUP), Resolution #2006-2741, item #17. Grand County Annual Statement of Continued Compliance July 19, 2018 – July 18, 2019.

Idaho Power (modified by Oregon Department of Energy during ASC – PO Phase). July 2020. *Draft Noxious Weed Plan, Boardman to Hemingway Transmission Line Project*. Available online at: <https://www.oregon.gov/energy/facilities-safety/facilities/Facilities%20library/2020-07-01-B2H-PO-Attachment-P1-5.pdf>.

Lowry B.J., Ransom C.V., Whitesides R.E., and Olsen H. 2017. *Noxious Weed Field Guide for Utah*. 4th Edition. Utah State University Extension.

Mattson L., Atwater J.W., and Ritchey J.D. July 2020. *Moab UMTRA Project Revegetation and Weed-control Plan, Revision 6*. Available online at: Moab UMTRA Project (<https://www.gjem.energy.gov/>).

Mealor, R. *Revegetation: Seeding Essentials for Reclaiming Disturbed Lands*. University of Wyoming Cooperative Extension Service.

National Park Service Inventory & Monitoring. June 2016. *Early Detection of Invasive Exotic Plants in the Northern Colorado Plateau Network. Standard Operating Procedure #3. Monitoring Route Methods.* Available online at: <https://home.nps.gov/im/ncpn/invasive-plants.htm#22EA0C401DD8B71B0B0F96B4E6F9D76A>

Natural Resources Conservation Service (NRCS). *Major Land Resource Area (MLRA 35 Colorado and Green River Plateaus).* Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053624.

Parent, V. and R. Koenig. 2010. *Solutions to Soils Problems: High Salinity (Soluble Salts).* Utah State University Cooperative Extension.

Pimental, D., Zuniga, R. and Morrison, D. 2005. *Updates on the Environmental and Economic Costs Associated with Non-indigenous Species in the United States.* Ecol. Econ. 52:273-288.

Sheley, R.L., and J.K. Petroff. 1999. *Biology and Management of Noxious Rangeland Weeds.* Oregon State University. Corvallis, Oregon.

Sher, A., K. Lair, M. DePrenger-Levin, and K. Dohrenwend. 2010. *Best Management Practices for Revegetation after Tamarisk Removal in the Upper Colorado River Basin.* Denver Botanic Gardens.

Smith, H.A., Johnson, W.S., Shonkwiler, J.S. and Swanson, S.R. 1999. *The Implications of Variable or Constant Expansion Rates in Invasive Weed Infestations.* Weed Sci. 47: 62-66. United State Department of Agriculture Natural Resources Conservation Service Web Soil Survey Tool Website (<https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>)

Utah Department of Natural Resources. *Utah's Species of Greatest Conservation Need, October 2021.* Available at: <https://wildlife.utah.gov/pdf/WAP/2021-10-sgcn-list.pdf>.

Whitesides, R.E. 2004. *The Utah Strategic Plan for Managing Noxious and Invasive Weeds.* Utah Weed Advisory Council and the Utah Weed Control Association.

Appendix A:
State of Utah Noxious Weed List 2023

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Available online at: [Utah Noxious Weed Act \(R68-9\)](https://leg.utah.gov/legislation/bills_acts/acts/2018/0001/0009/0009_0001_0001_0001.html):

<https://ag.utah.gov/farmers/plants-industry/noxious-weed-control-resources/state-of-utah-noxious-weed-list/>

The following weeds are hereby officially designated and published as noxious for the State of Utah, as per the authority vested in the Commissioner of Agriculture and Food under Section 4-17-3.

There are hereby designated five classes of noxious weeds in the state: Class 1A (EDRR Watch List), Class 1 (EDRR), Class 2 (Control), Class 3 (Containment), and Class 4 (Prohibited for sale or propagation).

Class 1A: Early Detection Rapid Response (EDRR) Watch List Declared noxious and invasive weeds not native to the state of Utah and not known to exist in the State that pose a serious threat to the state and should be considered as a very high priority.

Common crupina – *Crupina vulgaris*
African rue – *Peganum harmala*
Small bugloss – *Anchusa arvensis*
Mediterranean sage – *Salvia aethiopsis*
Spring millet – *Milium vernale*
Syrian beancaper – *Zygophyllum fabago*
Ventenata (North Africa grass) – *Ventenata dubia*
Plumeless thistle – *Carduus acanthoides*
Malta starthistle – *Centaurea melitensis*

Class 1B: Early Detection Rapid Response (EDRR) Declared noxious and invasive weeds not native to the State of Utah that are known to exist in the state in very limited populations and pose a serious threat to the state and should be considered as a very high priority.

Camelthorn – *Alhagi maurorum*
Garlic mustard – *Alliaria petiolata*
Purple starthistle – *Centaurea calcitrapa*
Goats rue – *Galega officinalis*
African mustard – *Brassica tournefortii*
Giant reed – *Arundo donax*
Japanese knotweed – *Polygonum cuspidatum*
Blueweed (Vipers bugloss) – *Echium vulgare*
Elongated mustard – *Brassica elongata*
Common St. John’s Wort – *Hypericum perforatum*
Oxeye daisy – *Leucanthemum vulgare*
Cutleaf vipergrass – *Scorzonera laciniata*

Appendix A: State of Utah Noxious Weed List 2023 (*continued*)

Class 2: Control Declared noxious and invasive weeds not native to the state of Utah that pose a threat to the state and should be considered a high priority for control. Weeds listed in the control list are known to exist in varying populations throughout the state. The concentration of these weeds is at a level where control or eradication may be possible.

Leafy spurge – *Euphorbia esula*
Medusahead – *Taeniatherum caput-medusae*
Rush skeleton weed – *Chondrilla juncea*
Spotted knapweed – *Centaurea stoebe*
Purple loosestrife – *Lythrum salicaria*
Squarrose knapweed – *Centaurea virgata*
Dyer’s woad – *Isatis tinctoria*
Yellow starthistle – *Centaurea solstitialis*
Yellow toadflax – *Linaria vulgaris*
Diffuse knapweed – *Centaurea diffusa*
Black henbane – *Hyoscyamus niger*
Dalmatian toadflax – *Linaria dalmatica*

Class 3: Containment Declared noxious and invasive weeds not native to the State of Utah that are widely spread. Weeds listed in the containment noxious weeds list are known to exist in various populations throughout the state. Weed control efforts may be directed at reducing or eliminating new or expanding weed populations. Known and established weed populations, as determined by the weed control authority, may be managed by any approved weed control methodology, as determined by the weed control authority. These weeds pose a threat to the agricultural industry and agricultural products.

Russian knapweed – *Acroptilon repens*
Houndstongue – *Cynoglossum officinale*
Perennial pepperweed (Tall whitetop) – *Lepidium latifolium*
Phragmites (Common reed) – *Phragmites australis* ssp.
Tamarisk (Saltcedar) – *Tamarix ramosissima*
Hoary cress – *Cardaria* spp.
Canada thistle – *Cirsium arvense*
Poison hemlock – *Conium maculatum*
Musk thistle – *Carduus nutans*
Quackgrass – *Elymus repens*
Jointed goatgrass – *Aegilops cylindrica*
Bermudagrass* – *Cynodon dactylon*
Perennial Sorghum spp.: including but not limited to Johnson Grass (*Sorghum halepense*)
Sorghum alnum (*Sorghum alnum*)

Appendix A: State of Utah Noxious Weed List 2023 (*continued*)

Scotch thistle (Cotton thistle) – *Onopordum acanthium*

Field bindweed (Wild Morning-glory) – *Convolvulus* spp.

Puncturevine (Goathead) – *Tribulus terrestris*

*Bermudagrass (*Cynodon dactylon*) shall not be a noxious weed in Washington County and shall not be subject to provisions of the Utah Noxious Weed Law within the boundaries of that county. It shall be a noxious weed throughout all other areas of the State of Utah and shall be subject to the laws therein.

Class 4: Prohibited Declared noxious and invasive weeds, not native to the state of Utah, that pose a threat to the state through the retail sale or propagation in the nursery and greenhouse industry. Prohibited noxious weeds are annual, biennial, or perennial plants that the commissioner designates as having the potential or are known to be detrimental to human or animal health, the environment, public roads, crops, or other property.

Cogongrass (Japanese blood grass) – *Imperata cylindrica*

Myrtle spurge – *Euphorbia myrsinites*

Dames Rocket – *Hesperus matronalis*

Scotch broom – *Cytisus scoparius*

Russian olive – *Elaeagnus angustifolia*

Each county in Utah may have different priorities regarding specific State designated Noxious Weeds and is therefore able to reprioritize these weeds for their own needs.

The Weed Specialist coordinates weed control activities among the county weed organizations and the agricultural field representatives. Surveys of serious weed infestations are conducted, and control programs are developed through the county supervisors, county weed boards, and various landowning agencies. The weed specialist and the inspectors work continually with extension and research personnel in encouraging the use of the most effective methods to control the more serious weeds.

This entry was last updated on June 23, 2022.

Appendix B:
Grand County Noxious Weed List 2023

Appendix B: Grand County Noxious Weed List 2023

Available online at: <https://www.grandcountyutah.net/168/Noxious-Weeds>

Notice is hereby given this 1st day of May, 2020 Pursuant to the Utah Noxious Weed Act, Section 7, to every person who owns or controls lands in Grand County, Utah, that noxious weeds standing, being, or growing on such land shall be controlled and the spread of same prevented by effective cutting, tillage, cropping, pasturing, or treating with chemicals or other methods, or combination methods, or combination thereof, approved by the County Weed Supervisor, as often as may be required to prevent the weed from blooming and maturing seeds, or spreading by root, root stalks or other means.

Upon failure to comply with this notice, the owner or persons in possession of property upon which noxious weeds are present shall be deemed negligent and enforced control measures may be imposed at the discretion of county authorities. Expenses of control measures employed by the county shall be paid directly by the owner or person in possession of the property or shall constitute a lien on the property and become collectible by taxes.

The following are declared noxious weeds for the State of Utah and the County of Grand:

Class 1A EDRR – Early Detection Rapid Response Watch List:

Common Crupina	<i>Crupina vulgaris</i>
African rue	<i>Peganum harmala</i>
Small bugloss	<i>Anchusa arvensis</i>
Mediterranean sage	<i>Salvia aethiopis</i>
Spring millet	<i>Milium vernale</i>
Syrian beancaper	<i>Zygophyllum fabago</i>
North Africa grass	<i>Ventenata dubia</i>
Plumeless thistle	<i>Carduus acanthoides</i>
Malta thistle	<i>Centaurea melitensis</i>

Class 1B Early Detection:

Camelthorn	<i>Alhagi maurorum</i>
Garlic mustard	<i>Alliaria petiolate</i>
Purple starthistle	<i>Centaurea calcitrapa</i>
Goats rue	<i>Galega officinalis</i>
African mustard	<i>Brassica tournefortii</i>
Giant Reed	<i>Arundo donax</i>
Japanese Knotweed	<i>Polygonum cuspidatum</i>
Vipers' bugloss	<i>Echium vulgare</i>
Elongated mustard	<i>Brassica elongate</i>
Common St. John's Wort	<i>Hypericum perforatum L.</i>
Oxeye daisy	<i>Leucanthemum vulgare</i>
Cutleaf vipergrass	<i>Scorzonera laciniata</i>

Appendix B: Grand County Noxious Weed List 2023 (continued)

Class 2 Control:

Leafy spurge	<i>Euphorbia esula</i> L.
Medusahead	<i>Taeniatherum caput-medusae</i>
Rush skeletonweed	<i>Chondrilla juncea</i>
Spotted Knapweed	<i>Centaurea maculosa</i> Lam.
Purple Loosestrife	<i>Lythrum salicaria</i> L.
Squarrose Knapweed	<i>Centaurea Squarrosa</i> Gugler
Dyers Woad	<i>Isatis tinctoria</i> L.
Yellow Starthistle	<i>Centaurea solstitialis</i> L.
Yellow Toadflax	<i>Linaria vulgaris</i> Mill.
Diffuse Knapweed	<i>Centaurea diffusa</i> (Lam.)
Black henbane	<i>Hyoscyamus niger</i> (L.)
Dalmatian Toadflax	<i>Linaria dalmatica</i> (L.) Mill

Class 3 Contain:

Russian Knapweed	<i>Centaurea repens</i> L.
Houndstongue	<i>Cynoglossum officinale</i> L.
Perennial Pepperweed	<i>Lepidium latifolium</i> L.
Phragmites	<i>Phragmites australis</i> ssp
Tamarisk	<i>Tamarix ramosissima</i> Ledeb.
Hoary cress	<i>Cardaria</i> spp.
Canada thistle	<i>Cirsium arvense</i> (L.) Scop.
Poison Hemlock	<i>Conium maculatum</i> L.
Musk Thistle	<i>Carduus nutans</i> L.
Quackgrass	<i>Agropyron repens</i> (L.) Beauv.
Jointed goatgrass	<i>Aegilops cylindrical</i>
Bermudagrass*	<i>Cynodon dactylon</i> (L.) Pers
Scotch Thistle	<i>Onopordum acanthium</i> L.
Field bindweed	<i>Convolvulus</i> spp.
Puncturevine (Goathead)	<i>Tribulus terrestris</i> L.
Perennial Sorghum spp.	(including but not limited to Johnson grass) <i>Sorghum halepense</i> (L.) Pers. and <i>Sorghum Alnum</i> <i>Sorghum alnum</i> Parodi

Class 4 Prohibited:

Cogongrass	<i>Imperata cylindrical</i>
Myrtle spurge	<i>Euphorbia myrsinites</i>
Dame's Rocket	<i>Hesperis matronalis</i>
Scotch broom	<i>Cytisus scoparius</i>
Russian olive	<i>Elaeagnus angustifolia</i>
Ravenna grass**	<i>Tripidium ravennae</i> : previously <i>Tripidium saccharum</i>

* Bermudagrass shall not be a noxious weed in Washington County and shall not be subject to provisions of the Utah Noxious Weed Act within the boundaries of the county.

** Grand County noxious weed.