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June 30, 2025

Jacob Mulinex and Christy Luciani, McKinley Mine Team Leaders
USDI- Office of Surface Mining Reclamation and Enforcement
P.O. Box 25065
Denver, CO 80225-0065

via email:
jmulinex@osmre.gov
cluciani@osmre.gov

Re: McKinley Mine
Permit No. NM-0001K
Vegetation Management Unit 4 Final Bond Release and
Liability Release & Termination of Jurisdiction Application

Dear Mr. Mulinex and Ms. Luciani:

Enclosed for OSMRE review is an application for final bond release on Permanent Program lands and full reclamation liability release and termination of jurisdiction on Initial Program lands in Vegetation Management Unit 4. There are approximately 1,141 acres associated with this application. CMI requests OSMRE's review and comment on the completeness and content of this application package to ensure that all necessary information is contained in the application document.

The submittal of the document on this date will be transmitted via the OSMRE SharePoint transfer to download the documents referred to above. If you have any questions regarding this submittal, please contact me at 575-585-7639 or Kyle Kutter at (314) 984-8800.

Sincerely,

Armando Martinez
McKinley Mine – Remediation Ops Specialist
CEMREC

Kyle Kutter, P.E.
Assistant Vice President
WSP USA, Inc

Encl

McKinley Mine Permit No. NM-0001K
Vegetation Management Unit 4
Application for a Permanent Program Final Bond Release and Initial Program Reclamation Liability Release & Termination of Jurisdiction

Submitted to: The Office of Surface Mining Reclamation and Enforcement
Western Region Office
P.O. Box 25065
Denver, Colorado 80225-0065

Submitted by: Chevron Environmental Management Company
On behalf of Chevron Mining Inc.
6001 Bollinger Canyon Road, C-2144
San Ramon, CA 94583-2324

Prepared by: WSP USA, Inc.
701 Emerson Road, Suite 250
Creve Coeur, Missouri, 63141

Date: June 30, 2025

Table of Contents

1.0 OVERVIEW 2

2.0 APPLICATION CERTIFICATION 4

3.0 VMU 4 LOCATION AND REGULATORY ACREAGES 4

4.0 BRIEF HISTORY 4

5.0 ACCESS ROADS 5

6.0 SURFACE AND SUBSURFACE WATER 5

7.0 EROSION CONTROL AND MAINTENANCE 6

8.0 POSTMINING WATER-CONTAINMENT STRUCTURES 6

9.0 POSTMINING LAND USE 8

10.0 REVEGETATION 8

11.0 WILDCLIFE HABITAT ENHANCEMENTS 14

12.0 PERFORMANCE BOND 17

13.0 LANDONWER NOTIFICATION 18

14.0 NEWSPAPER ADVERTISEMENT 18

15.0 SUPPLEMENTAL INFORMATION FOR INIITIAL PROGRAM LANDS 19

16.0 BIBILOGRAPHY 20

EXHIBITS

E1: General Location

E2: McKinley Mine OSMRE Vegetation Management Units

E3: USGS 7.5 Minute (24k) Topographic Map Tse Bonita School Quadrange

E4: VMU 4 And Approved Phase I And II Bond Release Areas

E5: Primary Roads

E6: Hydrologic Features

E7: Permanent Program Lands Seeding

E8: Wildlife Enhancements

E9: IPL Topography and Cross Section Locations

E10: IPL Cross Section Profiles

E11: IPL Slope Gradient Analysis

E12: IPL Topsoil Depth - Verification Location

APPENDICES

Appendix A1: Application Certification

Appendix A2: Groundwater and Surface Water Evaluation (Trihydro)

Appendix A3: Environmental Monitoring and Outfalls Map

Appendix A4: Initial Program Lands Seeding

Appendix A5: Revegetation Monitoring Reports

Appendix A6: Wildlife Enhancements

Appendix A7: Performance Bond

Appendix A8: Landowner Notification

Appendix A9: Newspaper Advertisement

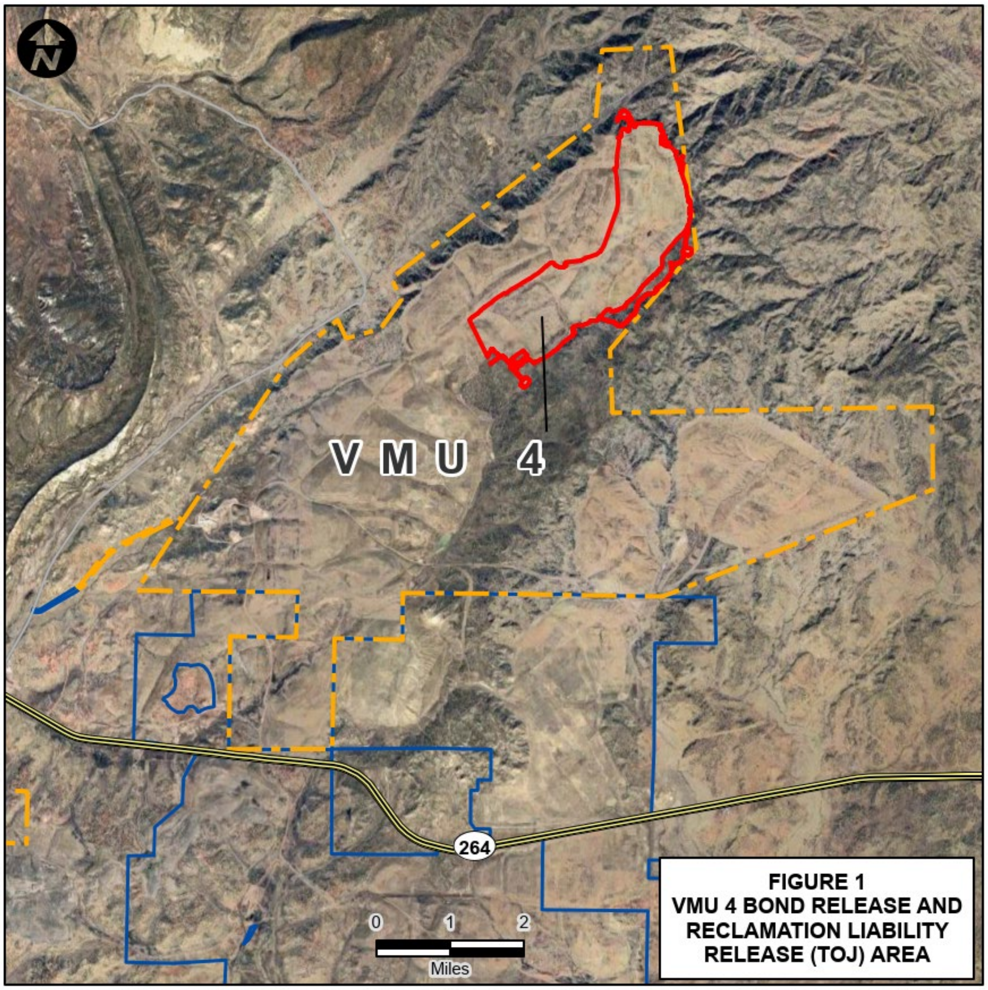
Appendix A10: Riparian PATFM Evaluation

1.0 Overview

On behalf of Chevron Mining Inc. (CMI), the Chevron Environmental Management Company (CEMC) hereby submits this application for a Phase III bond release of Permanent Program Lands (PPL) and a reclamation liability release and termination of jurisdiction (TOJ) of Initial Program Lands (IPL) for reclaimed lands in Vegetation Management Unit 4 (VMU 4). The application includes a request for 7.1 acres of Phase I, II and III bond release on three Permanent Impoundments, and Phase II and III bond release on 53 acres in Area 6 along the reclaimed highwall slope. The associated performance bond reduction requested in this application is $2,705.000, as discussed in Section 12 of this document.

The lands are generally located in former mining Areas 3, 5 and 6 of the McKinley Mine. Figure 1 shows the location and configuration of VMU 4.

Figure 1: General Location of VMU 4



The McKinley Mine is permitted under Permit NM-0001K (the Permit). The McKinley Mine permittee is CMI (formerly the Pittsburg and Midway Coal Mining Co. [P&M]).

This application addresses bond release requirements under 30 CFR 800.40 (c) (3) and the Office of Surface Mining, Reclamation, and Enforcement's (OSMRE's) Permanent Program Phase III bond release guidance provided in the following document:

> Guideline to Bond Release Procedures for Permanent Program Lands, Indian Programs Branch, Western Region (OSMRE Bond Release Guideline) (OSMRE 2017).

The application demonstrates that the plant community is moving toward a desired successional trajectory to meet the intended postmining land use per 30 CFR 816.111 and the currently approved Permit. Reclamation was completed in conformance with the performance standards in 30 CFR 715 for IPL and 30 CFR 816 and the PP permit for PPL. The PPL reclamation also meets all applicable requirements of the performance standards in 30 CFR Part 810 through 828.

VMU 4 combines IPL and PPL in accordance with Section 6.5.1.2 of the Permit, and together as one logical unit must meet the Permit revegetation success standards, which they do, as discussed in this application. The lands constitute a bond release block as described in the OSMRE Bond Release Guideline. The period of extended responsibility of ten years for the PP lands has been met in accordance with 30 CFR 816.116. Furthermore, this application contains information that demonstrates revegetation success has been met on PPL in any two years following Year 6 of the responsibility period, which is 2023 and 2024, as required by the OSMRE Bond Release Guidance. The IPL has been revegetated for decades well beyond the minimum two growing seasons for cover called for in 30 CFR 715.20 (f).

The application has been organized to address both PPL and IPL application requirements as much as possible. The application follows this order of information: 2.0 Application Certification, 3.0 VMU 4 Location and Regulatory Acreages, 4.0 Brief History, 5.0 Access Roads, 6.0 Surface and Subsurface Water, 7.0 Erosion and Sediment Control, 8.0 Postmining Water-Containment Structures, 9.0 Postmining Land Use, 10. Revegetation, 11.0 Wildlife Habitat Enhancements, 12.0 Performance Bond, 13.0 Landowner Notification, 14.0 Newspaper Advertisement. Section 15.0 Supplemental Information for Initial Program Lands; this section includes information to make the reclamation liability release and TOJ IPL application complete.

2.0 Application Certification

An executed Application Certification is contained in Appendix A1, which certifies that all applicable reclamation activities have been completed in VMU 4 that are necessary for a Phase I, II and III for the impoundments, Phase II and III for 53 acres on the Area 6 reclaimed highwall slope, a Phase III bond release of the rest of the PPL, and a full reclamation liability release and TOJ of IPL. The document also states that these activities were done in accordance with applicable mine permits, reclamation requirements, and regulations, and consistent with the intent of the Act.

The Application certification includes a statement that there are no outstanding violations or cessation orders for the lands contained in this application.

3.0 VMU 4 Location and Regulatory Acreages

VMU 4 consists of 1,141 acres of land, all within the Navajo Reservation Boundary. The approximate center of VMU 4 is Latitude - 35.7065 N, Longitude -108.928764 W.
VMU 4, which consists of PPL and IPL is shown on Exhibit E1. Minor adjustments were made to the initial VMU 4 configuration for a polygon with a logical release boundary defined by the disturbance limits. Exhibit E2 shows the location of VMU 4 relative to the other McKinley Mine VMUs. Table T1 shows the VMU 4 acreage by regulatory category.

Table T1: VMU 4 by Regulatory Category (in acres).

Initial Program Lands	22.5
Permanent Program Lands	1118.5
VMU 4 Total Acres	1141.0
Three Permanent Impoundments (Included in Permanent Program Lands acreage above)	7.1
Area 6 Reclaimed Highwall Slope (included in the Permanent Program Lands acreage above)	53.0

A USGS 7.5 Minute Quadrangle map (from the Window Rock Quadrangle) with the boundaries of VMU 4 depicted on it is provided on Exhibit E3.

4.0 Brief History

This VMU 4 configuration overlaps parts of two previous Phase I and II bond release applications on the PPL. The first application was the Areas 3 and 5 Phase I and Phase II Bond Release Application, which was initially submitted on August 22, 2019. The second application was the Area 6 Phase I and Phase II Bond Release Application, which was initially submitted on May 28, 2019. Both applications were approved through OSMRE correspondence dated January 29, 2020. There have been no previous applications for reclamation liability release and TOJ on the IPL.

Exhibit E4 shows the VMU 4 boundary superimposed over the previous Phase I and II bond release applications. Exhibit E4 shows the three impoundments included in this application for Phase I, II and III, and the 53 Acres of land on the Area 6 reclaimed highwall included in this application for Phase II and III (see area identified as “Area 6 Phase I Bond Release Area Approved by OSMRE” in the legend).

VMU 4 consists of lands in both Mining Area 3 and Mining Area 6, with a small contribution from Area 5. The general locations of the mining areas are labeled on Exhibit E4. Primary mining was done by dragline in Area 3, which proceeded from west to east. In Area 6, primary mining was also dragline proceeding from a westerly direction to the east.

The various reclamation phases through seeding were conducted contemporaneously with mining activities. Seeding began in the IPL in 1987 and in the PPL in 1992. More details on seeding may be found in the revegetation section below.

5.0 Access Roads

The Navajo Nation requested that two-track trails be the primary access for the postmining land users. Section 5.1.5 and 5.6.3.7 in the Permit contain details regarding configurations for the postmining road system in accordance with the Navajo Nation request. Annual updates to the currently active road system shown on Exhibit 5.1-4 are submitted to OSMRE for incorporation into the Permit. Exhibit 5.1-4 dated March 27, 2024, was used as the source of the road locations for the final postmining primary road system provided in this application. Exhibit E5 shows the final postmining primary road network in and around VMU 4. The location of the primary road network within VMU 4 has been certified by a professional engineer.

6.0 Surface and Subsurface Water

This section provides information regarding impacts to surface and subsurface water by lands in VMU 4. The VMU 4 lands are reclaimed and revegetated such that they are not contributing total suspended solids to streamflow or runoff outside the permit area. A detailed analysis is provided in Appendix A2 entitled, Vegetation Management Unit 4 Final Bond Release and Liability Release & Termination of Jurisdiction Application

(Trihydro 2025), which also includes information on ground water. The data will also show that there is no alkaline or acid drainage coming from the reclaimed land.

Sedimentology and NPDES Outfalls

As stated in Section 5.7.4.3 of the Permit, extensive sediment-yield analyses have been done throughout the mine through paired watershed sampling and modelling that all demonstrated acceptable sediment yields for various reclaimed-land scenarios.

All outfalls at McKinley Mine are categorized under the EPA NPDES Western Alkaline Coal Mining (reclamation areas) standards, which focus on a sediment control plan (SCP) supported by modeling built around attaining sediment discharge levels that do not exceed pre-mining conditions. The primary attainment mechanism is monitoring of and compliance with Best Management Practices (BMPs). The BMPs for the reclaimed areas include the reconstructed landforms, the hydrologic structures (including terraces and downdrains, and armored channels), seeding and mulching, and revegetation. These BMPs are further augmented by the application of rock mulch in zones prone to higher levels of sheet erosion. Compliance is verified through collection of water monitoring data from outfall discharges and field inspections of the BMPs.

There are three NPDES outfalls associated with VMU 4: 010/DC 1, 012 CB 6-7, and 013 SP 3-6. The locations are shown on Exhibit 6.1-1 in Appendix A3 and on Figure 2-1 In Appendix A2.

7.0 Erosion Control and Maintenance

Maintenance of structures and erosion has been conducted regularly during the liability period. Disturbance associated with the maintenance work was seeded and mulched.

8.0 Postmining Water-Containment Structures

This section contains support information for the design and function of Permanent Impoundments and small depressions (SDs). Information regarding wildlife enhancements for these structures is provided in the Wildlife Habitat Enhancements section of this application.

Permanent Impoundments

The Navajo Nation requested that as many impoundments as possible be retained for the postmining land use (See Permit Appendix 5.6-B). To that end, VMU 4 has three

Permanent Impoundments (PI) in this application: 3-7, 6-7 and 6-8. The impoundments have been approved for retention by OSMRE and meet the requirements of 30 CFR 816.49 and the Permit. The impoundments were not included in Phase I or II applications since they were still temporary impoundments at the time. They are included in this application for Phase I, II and III bond release. The locations of these impoundments may be found in Exhibit E6.

Impoundment Design and Construction

The Permanent Impoundments were designed to be adequate for their intended use, and the water level will be sufficiently stable and capable of supporting grazing and wildlife, as discussed in Permit Section 5.7.3.4. Professional Engineer certified as-built drawings of the impoundments were submitted to OSMRE for incorporation into Permit Appendix 5.7-B. The spillway of Impoundment 6-8 was recently reconstructed in 2025 as detailed in the permanent impoundment design. Sediment is scheduled to be removed in 2025.

The impoundments were last inspected on May 16, 2025, and an impoundment report for each structure was certified on June 20, 2025. The volumes measured on May 16, 2025, are provided in Table T2, which includes the annual capacity loss from sedimentation and the expected life of the impoundments. Sediment is being removed from Impoundment 6-8 in 2025 to increase the lifespan of the impoundment to at least a 10-year capacity. An as-built drawing of Impoundment 6-8 will be submitted showing the updated spillway and impoundment configuration, after sediment removal is completed.

Table T2: Permanent Impoundment Summary

Impoundment	Volume (Ac-Ft)	Annual Capacity Loss (Ac-Ft)	Expected Life (Years)
3-7	9.44	0.90	11
6-7	4.83	0.17	>20
6-8*	4.06	0.90	5

* Impoundment 6-8 is scheduled for an upcoming sediment clean-out to be completed as part of this Bond Release. This effort will bring the expected life to at least 10 years.

Impoundment Water Quality

The requirements for impoundment water quality may be found under 30 CFR 816.49 (b)(2). As discussed in Permit Section 5.6.3.4.3 Permanent Impoundment Water Quality, it was demonstrated that the water quality in these impoundments met the applicable water-quality standards for livestock watering.

Impoundment Riparian PATFM

Permit section 5.3.5.12 requires that Permanent Impoundments built on spoil have the spoil tested to confirm the soil materials are not detrimental to riparian plant establishment. Permit Modification 25-02 was submitted to OSMRE (currently pending approval) making that demonstration that the spoil material was suitable for planting, which includes Permanent Impoundments 3-7 and 6-8. Permanent impoundment 6-7 is not located on spoil material. The permit modification included a technical report with the demonstration entitled Riparian PATFM Assessment dated 6/4/25. The narrative from that report in support of this demonstration has been included in Appendix A10.

Small Depressions

VMU 4 has two small depressions (SD) (3-SD4 and 6-SD1); the locations are shown on Exhibit E8. Some additional minor small depressions exist but were not necessary to identify on the exhibit. In accordance with 30 CFR 816.102 (h), the small depressions are compatible with the postmining land use, do not restrict normal access or constitute a hazard, conserve soil moisture, and promote revegetation and landscape diversity.

9.0 Postmining Land Use

The IPL were reclaimed to rangeland for grazing, and the PPL have been reclaimed to a grazing and wildlife habitat postmining land use. As discussed below, both IPL and PPL together meet the revegetation success standards and are suitable for grazing and wildlife habitat.

10.0 Revegetation

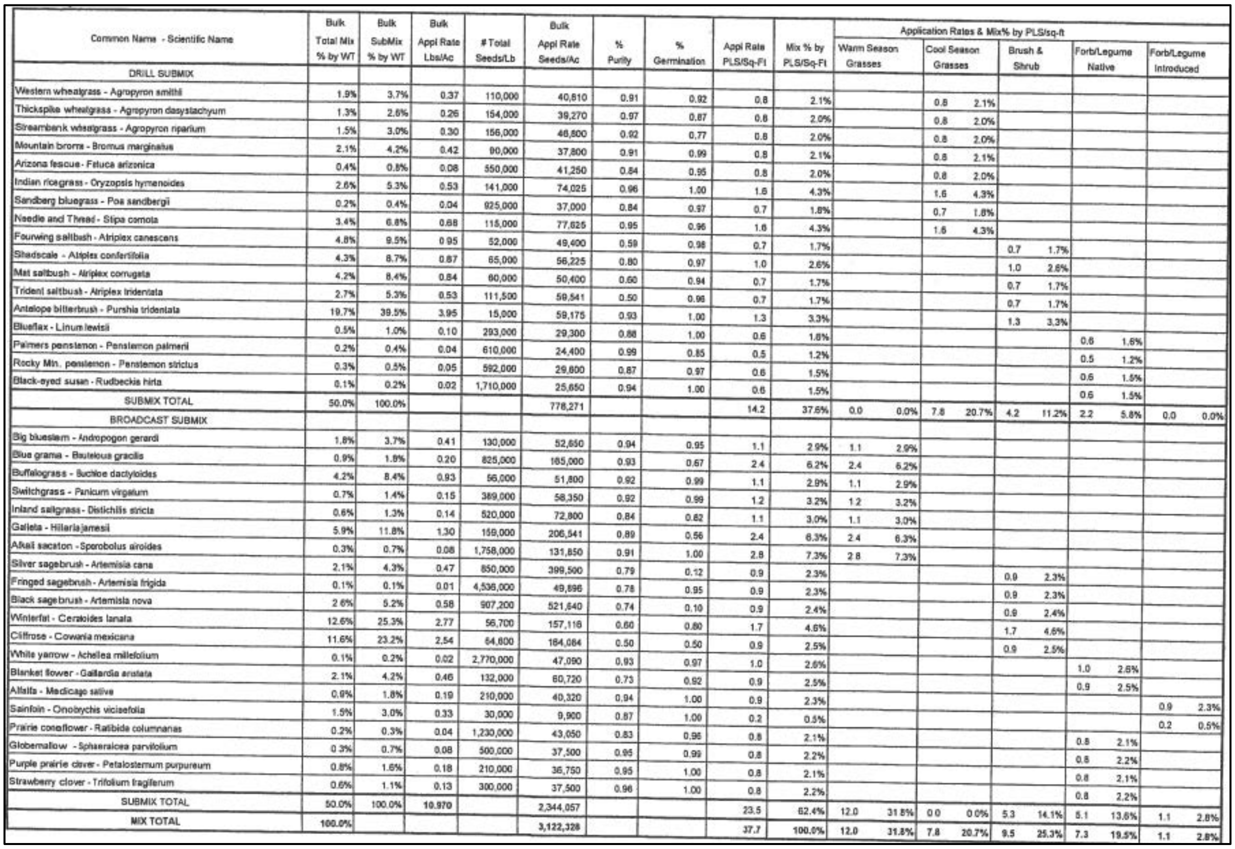
After topdressing placement, the seedbed was scarified or ripped on the contour to a depth of about 8 to 12 inches. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, certified weed-free, long-stem, hay mulch, or straw was applied at a rate of about two tons per acre. The mulch was anchored 3 to 4 inches into the cover with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which tends to favor the establishment of cool-season grasses and shrubs. The approved seed mixes used at McKinley have varied over time but included both introduced and native warm-season grasses, cool-season grasses, forbs, and shrubs. More detail by regulatory category (IPL or PPL) follows in the next two subsections.

PPL Revegetation

Final seeding was conducted after topdressing was applied. Most of the PPL lands were initially seeded from 1992-2012, with some small parcels done after that period. In 2014, there were 183.3 acres of interseeding to strengthen vegetation on land that had been previously seeded. There was other reseeding or interseeding activities for areas that required erosion repair or to support vegetation establishment. Seeding, reseeding, and interseeding activities are shown on Exhibit E7.

The permanent seed mix shown in Table T3 below was the primary seed mix used based on the availability of the species listed. CMI worked with the seed supplier to substitute comparable species for unavailable seeds.

Table T3: Permanent Program Seed Mix



Common Name - Scientific Name	Bulk Total Mix % by WT	Bulk SubMix % by WT	Bulk Appl Rate Lbs/Ac	# Total Seeds/Lb	Bulk Appl Rate Seeds/Ac	% Purity	% Germination	Appl Rate PLS/Sq-Ft	Mix % by PLS/Sq-Ft	Application Rates & Mix% by PLS/sq-ft									
										Warm Season Grasses		Cool Season Grasses		Brush & Shrub		Forb/Legume Native		Forb/Legume Introduced	
DRILL SUBMIX																			
Western wheatgrass - Agropyron smithii	1.9%	3.7%	0.37	110,000	40,810	0.91	0.92	0.8	2.1%			0.8	2.1%						
Thickspike wheatgrass - Agropyron dasystachyum	1.3%	2.6%	0.26	154,000	39,270	0.97	0.87	0.8	2.0%			0.8	2.0%						
Streambank wheatgrass - Agropyron riparium	1.5%	3.0%	0.30	156,000	46,800	0.92	0.77	0.8	2.0%			0.8	2.0%						
Mountain brome - Bromus marginatus	2.1%	4.2%	0.42	90,000	37,800	0.91	0.99	0.8	2.1%			0.8	2.1%						
Arizona fescue - Fetuca arizonica	0.4%	0.8%	0.08	550,000	41,250	0.84	0.95	0.8	2.0%			0.8	2.0%						
Indian ricegrass - Oryzopsis hymenoides	2.6%	5.3%	0.53	141,000	74,025	0.96	1.00	1.6	4.3%			1.6	4.3%						
Sandberg bluegrass - Poa sandbergii	0.2%	0.4%	0.04	925,000	37,000	0.84	0.97	0.7	1.8%			0.7	1.8%						
Needle and Thread - Stipa comota	3.4%	6.8%	0.68	115,000	77,625	0.95	0.96	1.6	4.3%			1.6	4.3%						
Fourwing saltbush - Atriplex canescens	4.8%	9.5%	0.95	52,000	49,400	0.59	0.98	0.7	1.7%					0.7	1.7%				
Shadscale - Atriplex confertifolia	4.3%	8.7%	0.87	65,000	56,225	0.80	0.97	1.0	2.6%					1.0	2.6%				
Mat saltbush - Atriplex corrugata	4.2%	8.4%	0.84	60,000	50,400	0.60	0.94	0.7	1.7%					0.7	1.7%				
Trident saltbush - Atriplex tridentata	2.7%	5.3%	0.53	111,500	59,541	0.50	0.96	0.7	1.7%					0.7	1.7%				
Antelope bitterbrush - Purshia tridentata	19.7%	39.5%	3.95	15,000	59,175	0.93	1.00	1.3	3.3%					1.3	3.3%				
Blueflax - Linum lewisii	0.5%	1.0%	0.10	293,000	29,300	0.88	1.00	0.6	1.6%							0.6	1.6%		
Palmers penstemon - Penstemon palmerii	0.2%	0.4%	0.04	610,000	24,400	0.99	0.85	0.5	1.2%							0.5	1.2%		
Rocky Mtn. penstemon - Penstemon strictus	0.3%	0.5%	0.05	592,000	29,600	0.87	0.97	0.6	1.5%							0.6	1.5%		
Black-eyed susan - Rudbeckia hirta	0.1%	0.2%	0.02	1,710,000	25,650	0.94	1.00	0.6	1.5%							0.6	1.5%		
SUBMIX TOTAL	50.0%	100.0%			778,271			14.2	37.6%	0.0	0.0%	7.8	20.7%	4.2	11.2%	2.2	5.8%	0.0	0.0%
BROADCAST SUBMIX																			
Big bluestem - Andropogon gerardi	1.8%	3.7%	0.41	130,000	52,650	0.94	0.95	1.1	2.9%	1.1	2.9%								
Blue grama - Bouteloua gracilis	0.9%	1.8%	0.20	825,000	165,000	0.93	0.67	2.4	6.2%	2.4	6.2%								
Buffalograss - Buchloe dactyloides	4.2%	8.4%	0.93	56,000	51,800	0.92	0.99	1.1	2.9%	1.1	2.9%								
Switchgrass - Panicum virgatum	0.7%	1.4%	0.15	389,000	58,350	0.92	0.99	1.2	3.2%	1.2	3.2%								
Inland saltgrass - Distichlis stricta	0.6%	1.3%	0.14	520,000	72,800	0.84	0.82	1.1	3.0%	1.1	3.0%								
Galleta - Hilaria jamesii	5.9%	11.8%	1.30	159,000	206,541	0.89	0.56	2.4	6.3%	2.4	6.3%								
Alkali sacaton - Sporobolus airoides	0.3%	0.7%	0.08	1,758,000	131,850	0.91	1.00	2.8	7.3%	2.8	7.3%								
Silver sagebrush - Artemisia cana	2.1%	4.3%	0.47	850,000	399,500	0.79	0.12	0.9	2.3%					0.9	2.3%				
Fringed sagebrush - Artemisia frigida	0.1%	0.1%	0.01	4,536,000	49,896	0.78	0.95	0.9	2.3%					0.9	2.3%				
Black sagebrush - Artemisia nova	2.6%	5.2%	0.58	907,200	521,640	0.74	0.10	0.9	2.4%					0.9	2.4%				
Winterfat - Ceratoides lanata	12.6%	25.3%	2.77	56,700	157,116	0.60	0.80	1.7	4.6%					1.7	4.6%				
Cliffrose - Cowania mexicana	11.6%	23.2%	2.54	64,800	164,084	0.50	0.50	0.9	2.5%					0.9	2.5%				
White yarrow - Achellea millefolium	0.1%	0.2%	0.02	2,770,000	47,090	0.93	0.97	1.0	2.6%							1.0	2.6%		
Blanket flower - Gaillardia aristata	2.1%	4.2%	0.46	132,000	60,720	0.73	0.92	0.9	2.5%							0.9	2.5%		
Alfalfa - Medicago sativa	0.9%	1.8%	0.19	210,000	40,320	0.94	1.00	0.9	2.3%									0.9	2.3%
Sainfoin - Onobrychis viciaefolia	1.5%	3.0%	0.33	30,000	9,900	0.87	1.00	0.2	0.5%									0.2	0.5%
Prairie coneflower - Ratibida columnaris	0.2%	0.3%	0.04	1,230,000	43,050	0.83	0.96	0.8	2.1%							0.8	2.1%		
Globemallow - Sphaeralcea parvifolium	0.3%	0.7%	0.08	500,000	37,500	0.95	0.99	0.8	2.2%							0.8	2.2%		
Purple prairie clover - Petalostemum purpureum	0.8%	1.6%	0.18	210,000	36,750	0.95	1.00	0.8	2.1%							0.8	2.1%		
Strawberry clover - Trifolium fragiferum	0.6%	1.1%	0.13	300,000	37,500	0.96	1.00	0.8	2.2%							0.8	2.2%		
SUBMIX TOTAL	50.0%	100.0%	10.970		2,344,057			23.5	62.4%	12.0	31.8%	0.0	0.0%	5.3	14.1%	5.1	13.6%	1.1	2.8%
MIX TOTAL	100.0%				3,122,328			37.7	100.0%	12.0	31.8%	7.8	20.7%	9.5	25.3%	7.3	19.5%	1.1	2.8%

IPL Revegetation

Seeding and mulching followed topdressing. IPL lands were mostly seeded between 1987 and 1995. Appendix A4 and Exhibit E7 contain drawings showing where and when these seedings occurred.

The seed mixes used varied over the years. While definitive records are not available for what was planted where, the Settlement Agreement B.8 Report-Volume I Revegetation report developed by the Pittsburg & Midway Coal Mining Co. (P&M (now CMI)) (SA B.8 Report) (P&M 1994) contained in Appendix 5.5-A of the Permit No. NM-0001K, has a table that summarizes the mixes that were used during the IP time period, which is provided in Table T4 below. Most of the IPIL would have been initially seeded with the mixes shown during the late1980s and early 1990s. Interseedings and seeding of repaired areas in the more recent years were planted with mixes similar to those shown for the early 1990s. More recent interseeding and seeding of repair areas would have been done with the permanent seed mix in Table T3.

Table T4: Expected Seed Mixtures for IPL

	SPECIES Common Name - *Scientific Name*	MIX APPROVED BY YEAR			MIX PLANTED BY YEAR								
		spoil 73 75	topsoil 73 75	80	75	77	79	80-84	85	86-87	88 & 90	91	92
GRASSES	Alkali sacaton - *Sporobolus airoides*								●	●	●	●	●
	Sandberg bluegrass - *Poa sandbergii*								●	●	●	●	●
	Mountain brome - *Bromus marginatus*								●	●	●	●	●
	Smooth brome - *Bromus inermis*				●	●							
	Arizona fescue - *Festuca arizonica*								●	●	●		●
	Sheeps fescue - *Festuca ovina*											●	
	Galleta - *Hilaria jamesii*		●	●				●		●	●	●	●
	Blue grama - *Bouteloua gracilis*										●	●	●
	Sideoats grama - *Bouteloua curtipendula*			●			●	●	●	●	●	●	●
	Indian ricegrass - *Oryzopsis hymenoides*			●			●	●	●	●	●	●	●
	Mountain muhly - *Muhlenbergia montana*					●							
	Spike muhly - *Muhlenbergia wrightii*					●			●	●	●	●	●
	Sand dropseed - *Sporobolus cryptandrus*					●	●					●	●
	Crested wheatgrass - *Agropyron cristatum*	●	●		●	●							
	Intermediate wheatgrass - *Agropyron intermedium*			●				●					
	Pubescent wheatgrass - *Agropyron trichophorum*	●	●	●		●		●					
	Siberian wheatgrass - *Agropyron sibericum*	●	●		●	●							
	Slender wheatgrass - *Agropyron trichycautum*				●	●						●	
	Streambank wheatgrass - *Agropyron riparium*					●	●						
	Tall wheatgrass - *Agropyron elongatum*			●	●	●		●					
	Thickspike wheatgrass - *Agropyron dasystachyum*						●		●	●			
	Western wheatgrass - *Agropyron smithii*		●	●	●	●	●	●	●	●	●	●	●
SHRUBS	Fourwing saltbush - *Atriplex canescens*		●	●			●	●	●	●	●	●	●
	Shadscale - *Atriplex confertifolia*								●	●	●	●	●
	Winterfat - *Ceratoides lanata*			●				●	●	●	●	●	●
	Cliffrose - *Cowania mexicana*											●	●
	Utah serviceberry - *Amelanchier alnifolia*											●	●
	Skunkbush sumac - *Rhus trilobata*											●	●
FORBS	Alfalfa - *Medicago sativa*								●	●	●	●	●
	Black-eyed Susan - *Rudbecka hirta*									●	●	●	●
	Blanket flower - *Gaillardia aristata*									●	●	●	●
	Blueflax - *Linum Lewisii*									●	●	●	●
	Purple prairie clover - *Petalostemum purpureum*											●	
	Red prairie coneflower - *Ratibida columnaris*											●	●
	Globemallow - *Sphaeralcea coccinea*								●	●	●		●
	Globemallow - *Sphaeralcea parvifolia*											●	
	Rocky Mtn. penstemon - *Penstemon strictus*								●	●	●	●	●
	Hooker evening primrose - *Oenothera hookeri*											●	
	Sainfoin - *Onobrychis viciaefolia*								●				
	Sulphur Flower - *Eriogonum umbellatum*									●			
	Yellow sweet clover - *Melilotus officinalis*				●	●							
	White yarrow - *Achillea millefolium*									●	●	●	●

Source: Settlement Agreement B.8 Report – Volume I: Revegetation

Revegetation Success Standards

Revegetation success standards are those provided in Table T5 (Table 5.5-1 of the Permit). The standards are applicable to both PPL and IPL, which are sampled as one unit in the VMU. There was a change to the revegetation success standards in 2023 through OSMRE-approved Permit Modification 23-03. The change in standards allowed for an improved and more accurate assessment of revegetation success. More information regarding and supporting this modification may be found in the Permit. Table T5 shows the revegetation success criteria applicable for the 2023 and 2024 sample results.

Table T5: Permanent Program Revegetation Success Standards

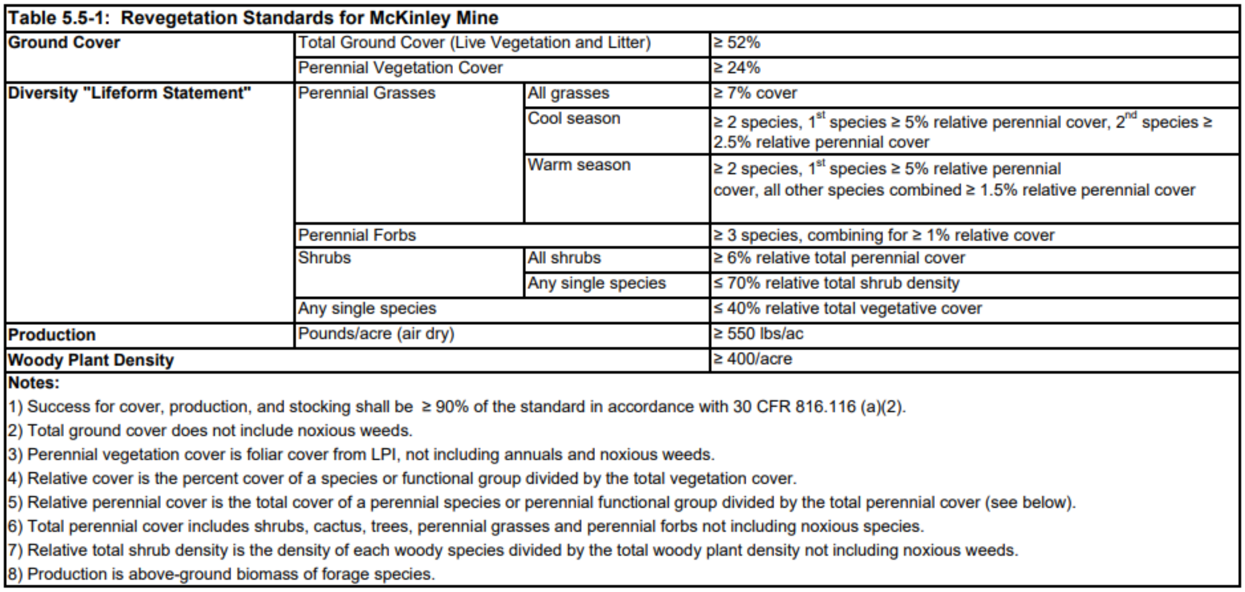


Table 5.5-1: Revegetation Standards for McKinley Mine

Ground Cover	Total Ground Cover (Live Vegetation and Litter)		≥ 52%
	Perennial Vegetation Cover		≥ 24%
Diversity "Lifeform Statement"	Perennial Grasses	All grasses	≥ 7% cover
		Cool season	≥ 2 species, 1st species ≥ 5% relative perennial cover, 2nd species ≥ 2.5% relative perennial cover
		Warm season	≥ 2 species, 1st species ≥ 5% relative perennial cover, all other species combined ≥ 1.5% relative perennial cover
	Perennial Forbs		≥ 3 species, combining for ≥ 1% relative cover
	Shrubs	All shrubs	≥ 6% relative total perennial cover
		Any single species	≤ 70% relative total shrub density
	Any single species		≤ 40% relative total vegetative cover
Production	Pounds/acre (air dry)		≥ 550 lbs/ac
Woody Plant Density			≥ 400/acre

Notes:
1) Success for cover, production, and stocking shall be ≥ 90% of the standard in accordance with 30 CFR 816.116 (a)(2).
2) Total ground cover does not include noxious weeds.
3) Perennial vegetation cover is foliar cover from LPI, not including annuals and noxious weeds.
4) Relative cover is the percent cover of a species or functional group divided by the total vegetation cover.
5) Relative perennial cover is the total cover of a perennial species or perennial functional group divided by the total perennial cover (see below).
6) Total perennial cover includes shrubs, cactus, trees, perennial grasses and perennial forbs not including noxious species.
7) Relative total shrub density is the density of each woody species divided by the total woody plant density not including noxious weeds.
8) Production is above-ground biomass of forage species.

Revegetation Sampling

Sampling methodologies were also updated in 2023, which were approved by OSMRE as part of Permit Modification 23-03. The change in methodology allowed for better capture of data more representative of the revegetation conditions on the reclaimed land. More information regarding this change may be found in the Permit in Section 5.5 and 6.5. The revegetation success sampling reports in Appendix A5 detail what methodologies were used for the respective years of sampling.

Vegetation sampling for bond release was conducted on the IPL and PPL in VMU 4 from 2021 through 2024. All the revegetation success standards were met in 2023 and 2024, which addresses the requirement that the revegetation success standards have been met in two growing seasons. The longevity of the revegetation on the IPL that goes back 40 years shows the long-term resiliency of the vegetation. Vegetation sampling sites were selected that included both PPL and IPL lands as called for in the Permit. The locations sampled, methodologies, and results may be found in the report entitled Vegetation Management Unit 4 (also referred to as O-VMU-4), Vegetation Success Monitoring, 2023 (WSP 2024) & 2024 (WSP 2025) in Appendix A5.

Carrying Capacity

While there has been no formal grazing for carrying capacity demonstrations, this section contains information on the livestock carrying capacity for VMU 4. The calculations were based on an average of 30 days per month with a 50% utilization of the vegetation production values. Carrying capacity is in terms of the animal-unit-month (AUM), which is the amount of dry forage required by one animal unit for one month based on a forage allowance of twenty-six (26) pounds per day for a 1,000-pound cow either dry or with calf up to 6 months of age, or four (4) sheep or goats (MMD 2000).

Table T6 summarizes the carrying capacities calculated from VMU 4 forage production data collected in 2023 and 2024. The calculations were performed on both mean and median forage production values. The utility of these calculations can be assessed by comparing them to an acceptable range condition. To that end, the mine reclaimed soils best fit the NRCS range site description (RSD) for Shallow Savannah, and the carrying capacity for this RSD for a good range condition is 0.20 AUM/Ac (See SA B.8 Report in the Permit Appendix 5.5-A). The 2023 and 2024 forage production data for VMU 4 significantly exceed 0.20 AUM/AC, which supports that the intended postmining land use of grazing is met by the level of vegetation on the reclamation.

Table T6: VMU 4 Carrying Capacity Calculations for 2023 and 2024 Forage Production

	Forage Production	Utilization		1 Cow Usage	Forage	Days / Month	Months / Ac	Animal Unit Months / ac
	lb / ac	%	lb / ac	lb / day	days / ac		% of month	AUM / Ac
2023 VMU 4 Mean Forage	750	50	375	26	14.4	30	0.48	0.48
2023 VMU 4 Median Forage	632	50	316	26	12.2	30	0.41	0.41
2024 VMU 4 Mean Forage	791	50	396	26	15.2	30	0.51	0.51
2024 VMU 4 Median Forage	755	50	378	26	14.5	30	0.48	0.48

Weed Management

Because the proposed Phase III bond release area plant community is moving toward a desired successional trajectory as per 30 CFR 816.111 and the currently approved Permit to meet the intended post-mine land use, continued ecologically based invasive plant management practices have been employed. Various options for weed control are contained in the McKinley Mine Integrated Weed Management Plan (HMI 2018). The most effective tools from the weed management plan have been appropriately timed herbicides and mechanical treatments, complemented with interseeding. The revegetation monitoring reports have not indicated that weeds have been problematic towards revegetation meeting revegetation success or the postmining land uses. Weeds are not included in measurements for revegetation success.

11.0 Wildlife Habitat Enhancements

Wildlife enhancements were completed in VMU 4 that included: application of the permanent seed mix (which contains species important for wildlife), creation of rock piles, enhanced shrub plantings in wildlife corridors, planting of materials beneficial to mule deer, construction of water-retaining structures (Permanent Impoundments, small depressions (SDs)), riparian plantings, and wildlife fencing. Each of these categories is discussed below:

Permanent Seed Mix

The permanent seed mix contains species beneficial to wildlife for browse and cover. The mix includes important browse species, including shrubs such as Cliff rose or Antelope bitter brush, or a forb such as Sainfoin. Shrubs such as Fourwing saltbush are also utilized for cover by small mammals, and even mule deer have been observed using it as cover.

Rock Piles

Rock piles to support wildlife habitat were constructed on both PPL and IPL. Rock piles were created from stones and boulders that became available during grading operations. The availability of suitably sized materials partially determined the number and distribution of these features. The rock features were generally constructed in piles or in elliptical shapes along the contour to maximize the surface area of each pile and facilitate topsoil replacement and revegetation operations. In some areas, rock was placed along the top or base of the slopes to simulate escarpment outcrops or ledge features. Shrub and/or tree plantings were conducted at rock piles to compliment and augment the utility of the rock piles in some areas.

The rock piles range from about 20 to 400 square feet and from two to twelve feet high. The rock piles were constructed at an average density mine wide of about one per twenty acres of reclaimed land.

Permit Section 5.7.3.3 contains more details regarding rock piles. Exhibit E8 shows the rock pile locations.

<u>Enhanced Shrub Planting in Wildlife Corridor</u>

A wildlife corridor on permanent program lands was developed that extended from the north end of Area 6, south to Area 10 near State Highway 264; a part of that corridor extends through VMU 4. The corridor was established as a zone in which many of the supplemental plantings were done. Exhibit E8 shows the corridor.

The corridor has a permit requirement of 100 shrubs/acre comprising of at least four shrub species. The 100 shrubs/acre were to include plants established from the permanent seed mix, supplemental plantings, ad-mixes, and volunteer growth. As documented in Permit Section 5.7.3.2.1, this standard was met.

<u>Mule deer plantings</u>

Permit Section 5.7.3.2.3 contains a commitment to plant additional browse species beneficial to mule deer throughout the mine, which included sites in VMU 4. Table T7 (Table 5.5-1A from the Permit) shows the standard for the supplemental wildlife enhancement plantings.

This commitment was successfully completed and documented in the 2021 Annual Report. The report is entitled McKinley Mine: Mule Deer Additional Browse Species Planting Success (Golder 2022). Note that supplemental mule deer plantings also occurred as part of riparian plantings, as discussed in the next subsection.

Table T7: Permanent Program Requirements for Supplemental Wildlife and Pond/Riparian Plantings and Enhancements

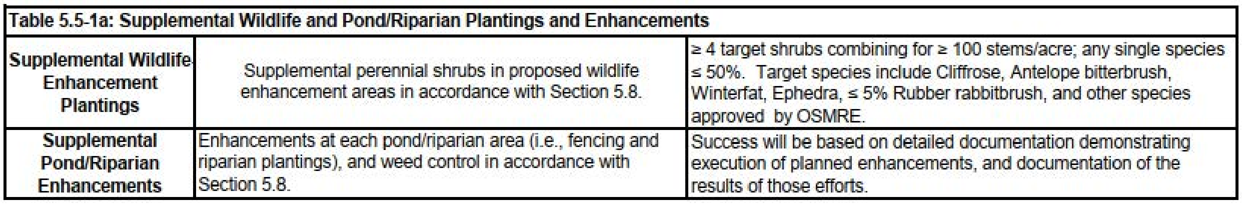


Table 5.5-1a: Supplemental Wildlife and Pond/Riparian Plantings and Enhancements		
Supplemental Wildlife Enhancement Plantings	Supplemental perennial shrubs in proposed wildlife enhancement areas in accordance with Section 5.8.	≥ 4 target shrubs combining for ≥ 100 stems/acre; any single species ≤ 50%. Target species include Cliffrose, Antelope bitterbrush, Winterfat, Ephedra, ≤ 5% Rubber rabbitbrush, and other species approved by OSMRE.
Supplemental Pond/Riparian Enhancements	Enhancements at each pond/riparian area (i.e., fencing and riparian plantings), and weed control in accordance with Section 5.8.	Success will be based on detailed documentation demonstrating execution of planned enhancements, and documentation of the results of those efforts.

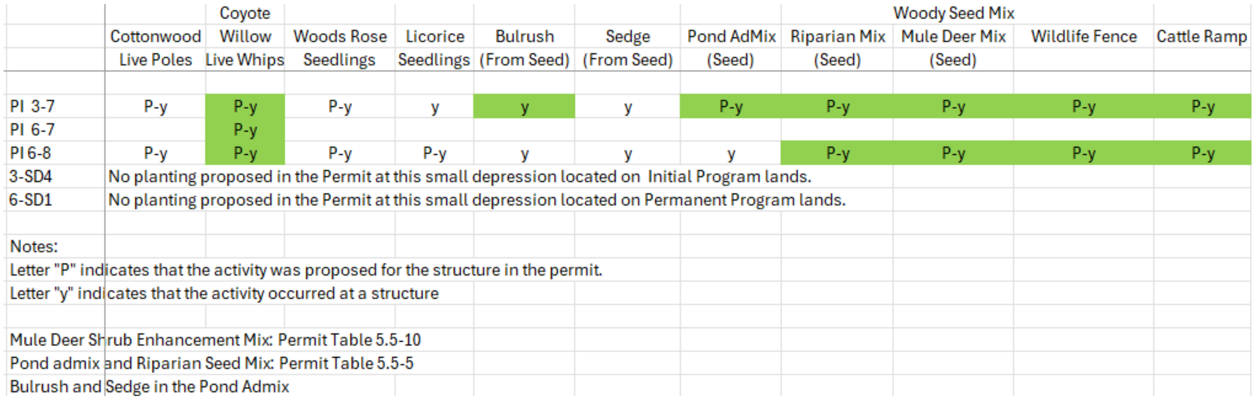
<u>Water-Retaining Structures and Riparian Plantings</u>

This section provides information on postmining water resources and associated riparian habitat enhancements. The term ponds is used in this subsection to broadly reference the Permanent Impoundments (PI), and Small Depressions (SDs). As stated earlier, VMU 4 contains 3 Permanent Impoundments (PI 3-7, PI 6-7 and PI 6-8) and 2 SDs (3-SD4 and 6-SD1). Exhibit E8 Wildlife Enhancements shows the locations of these ponds. These ponds are also part of a greater mine-wide network for access to water by wildlife (See Permit Section 5.8.3.4).

Ponds not only promote reclaimed-land diversity but also have conditions for riparian habitat establishment. To that end, a combination of riparian plantings was done that included live plantings and special seeding. The Permit (Appendix 5.8-B, Table 5.8-B1) lists the riparian species proposed for the plantings and the locations to be planted. Plantings were also done at other locations when there was an opportunity to do so. Table T7 lists the expectations around supplemental pond/riparian enhancements.

Table T8 in this application lists the kinds of plantings that were done at the ponds to demonstrate execution of the plan. This information was extrapolated from the 2019 through 2023 annual reports, which contain more details. This table was augmented with information from field inspections conducted in 2024.

Table T8: Permanent Program Wildlife Enhancements Plan and Results Summary



	Cottonwood Live Poles	Coyote Willow Live Whips	Woods Rose Seedlings	Licorice Seedlings	Bulrush (From Seed)	Sedge (From Seed)	Pond AdMix (Seed)	Riparian Mix (Seed)	Woody Seed Mix Mule Deer Mix (Seed)	Wildlife Fence	Cattle Ramp
PI 3-7	P-y	P-y	P-y	y	y	y	P-y	P-y	P-y	P-y	P-y
PI 6-7		P-y									
PI 6-8	P-y	P-y	P-y	P-y	y	y	y	P-y	P-y	P-y	P-y
3-SD4	No planting proposed in the Permit at this small depression located on Initial Program lands.										
6-SD1	No planting proposed in the Permit at this small depression located on Permanent Program lands.										

Notes:

Letter "P" indicates that the activity was proposed for the structure in the permit.

Letter "y" indicates that the activity occurred at a structure

Mule Deer Shrub Enhancement Mix: Permit Table 5.5-10

Pond admix and Riparian Seed Mix: Permit Table 5.5-5

Bulrush and Sedge in the Pond Admix

The results of the planting efforts are also shown in Table T8. The table identifies in a green pattern where live plantings were observed that survived, where there was expression of species from the various special seed mixes, or where there were occurrences of more mature target species that came from the permanent seed mix. Additional documentation regarding riparian plantings is provided in Appendix A6 that includes a more-detailed table, a list of observed species, key planting information from the annual reports, and photographs from each of the ponds.

IPL Plantings

There were no specific IPL plantings in VMU 4 beyond those done as part of the enhanced shrub planting in the wildlife corridor discussed above.

Wildlife fencing

To promote the longevity of the riparian plantings and the utility of the ponds by wildlife, the Permit (Appendix 5.8-B, Table 5.8-B1) identified ponds to be fenced with wildlife-friendly fences (See Permit Section 5.8.3.4.2). In addition, to allow for controlled access to water by livestock, cattle ramps were installed in the PIs. Table T8 identifies which ponds had fences installed and which had cattle ramps constructed. Exhibit E8 shows these fenced structures and the acreage within the fenced areas.

12.0 Performance Bond

The current performance bond amount is shown on Table T9 for the remaining permanent program reclamation liability. There are two final costs to be deducted from the performance bond for VMU 4 at this last phase. The first bond deduction is for the cost to revegetate the reclaimed lands, which includes the acreage for the three impoundments. The other bond deduction is for the cost reserved in the bond to remove the impoundments. There was no bond necessary to remove for PII of the 53 acres on the reclaimed Area 6 highwall slope. There is no bond associated with the SDs.

The methodology for deducting the revegetation costs required factoring in that the performance bond is set up primarily by mining area. VMU 4 contains lands from different mining areas, and while prorating and tracking costs from each area could be done, it would be complex and difficult to follow in this application and in future applications for other Phase III bond releases.

Subsequently, the clearest and most supportable method to calculate the Phase III bond reduction is to multiply the number of PP acres in VMU 4 by the unit cost/acre to revegetate disturbed land from the bond assumptions. In a similar manner, the bond reduction for reclamation of the impoundments was calculated by multiplying the number of impoundments by the unit cost to remove each pond. The unit cost for impoundment reclamation included dewatering, backfilling, and grading.

The calculations for the bond reduction related to Phase III revegetation costs and ponds are provided in Appendix A7. The amount of bond to be released in this application and the remaining total bond are shown in Table T9. Approximately

$125,000 of the total bond reduction is associated with Phase I and II costs for the impoundment removals.

Table T9: Performance Bond Summary

Current Total Bond Amount	Reclamation Bond Reduction	Remaining Total Bond
$53,921,545	$2,705,000	$51,216,545

13.0 Landowner Notification

The list of property owners and entities adjacent to the reclamation liability release area affected by this application is provided in Appendix A8. The appendix includes a typical copy of the notification letter with a map to be sent along with a list of recipients.

A copy of this application will be available for public inspection at the following locations:

Mr. Jacob Mulinix and Ms. Christy Luciani
Western Region Office
Office of Surface Mining Reclamation and Enforcement
One Denver Federal Center, Building 41
Western Region Mine Plan Library
Lakewood, CO 80225-0065
Advance call required: WR Permitting Information Line 1-866-847-7362

The Navajo Nation Minerals Department – Office of Surface Mining Program
P.O. Box 9000
Window Rock, AZ 86515

County Clerk’s Office
McKinley County Courthouse
201 W. Hill Ave.
Gallup, NM 87301

14.0 Newspaper Advertisement

The reclamation liability release notice (and associated map) to be published in the local newspapers is provided in Appendix A9. The announcement will be published in both the Gallup Independent and Navajo Times for four consecutive weeks. Affidavits of publication from these newspapers will be sent to OSMRE.

15.0 Supplemental Information for Initial Program Lands

Backfilling and Grading

Backfilling and grading were conducted in a manner that promoted stability, eliminated spoil piles, and blended into unmined land. A proposed postmining topographical map was not available for this application. Spoil was graded to at least a 3H:1V slope in accordance with the IP regulations. A topographical map showing the final configuration may be found on Exhibit E9; the exhibit also shows cross section locations of the topography. Cross sections of the final topography are provided on Exhibit E10.

Exhibit E11 is an isogram with a gradient analysis for the slopes throughout the reclaimed area. Slopes showing as greater than 30 percent are typically affiliated with drainages.

Potentially Acid and Toxic Forming Materials (PATFM)

The level of PATFM monitoring on the IPL is unknown, although the reclaimed land today does not show evidence of poor soil conditions or vegetation that might not be growing because of poor spoil quality.

Topdressing

Topsoil replacement would have been done in conformance with 30 CFR 715.16 (b) Topsoil Redistribution. Regraded land would have been scarified prior to the placement of topdressing. Topsoil would have been redistributed in a uniform thickness (typically a minimum of six inches) and in a manner that minimized the potential for compaction.

To that end, topsoil depth checks were conducted at four locations on IPL. The locations included a diversity of locations representative of the IPLs. Topsoil was found to be at least six inches at the locations tested, which supports that at least a six-inch topdressing was applied at the time as required. Successful revegetation after 40 years, as discussed below, also supports that there is good soil medium for vegetation throughout the area. The locations where topsoil depth checks were conducted are shown on Exhibit E12.

Drainage Control

Drainage control technologies were instituted to create a stable landform and to safely route the design storm runoff through the reclaimed areas and into adjacent undisturbed lands. While terraces and downdrains were constructed on the PPL to promote controlled drainage of runoff from the reclaimed land, such structures were not built on the VMU 4 IPL since they were not needed at these locations in VMU 4. PPL structures, however, were integrated to route runoff safely along the peripheries of IPL.

Drainage channels that concentrate flow were armored with riprap to control runoff and to promote a smooth transition into undisturbed drainages. Exhibit E6 shows the locations of primary hydrologic structures installed to control runoff and minimize erosion near IPL.

Sedimentology and Surface Water

This section provides information regarding impacts to surface water by IPL in VMU 4. The section also covers sedimentology since that is directly related to surface water quality.

Sediment yields from VMU 4 IPL are expected to be below pre-mining levels based on the reclaimed landform, mine-wide sediment-yield analysis, and the EPA watershed status. Regarding the reclaimed landform, VMU 4 IPL were reconstructed in a manner consistent with stable landforms, hydrologic structures have been constructed in accordance with standard practice on the rest of the mine, and the land has been seeded, mulched, and revegetated.

As stated in Section 5.7.4.3 in PP Permit No. NM-0001K, extensive sediment-yield analyses have been done throughout the mine through paired watershed sampling and modelling that all demonstrated acceptable sediment yields for various reclaimed-land scenarios.

16.0 Bibliography

Habitat Management Inc. December 2018. McKinley Mine Integrated Weed Management Plan.

McKinley Mine Permit No. NM-0001K, 2016. OSMRE McKinley Mine SMCRA Mining and Reclamation Permanent Program Permit.

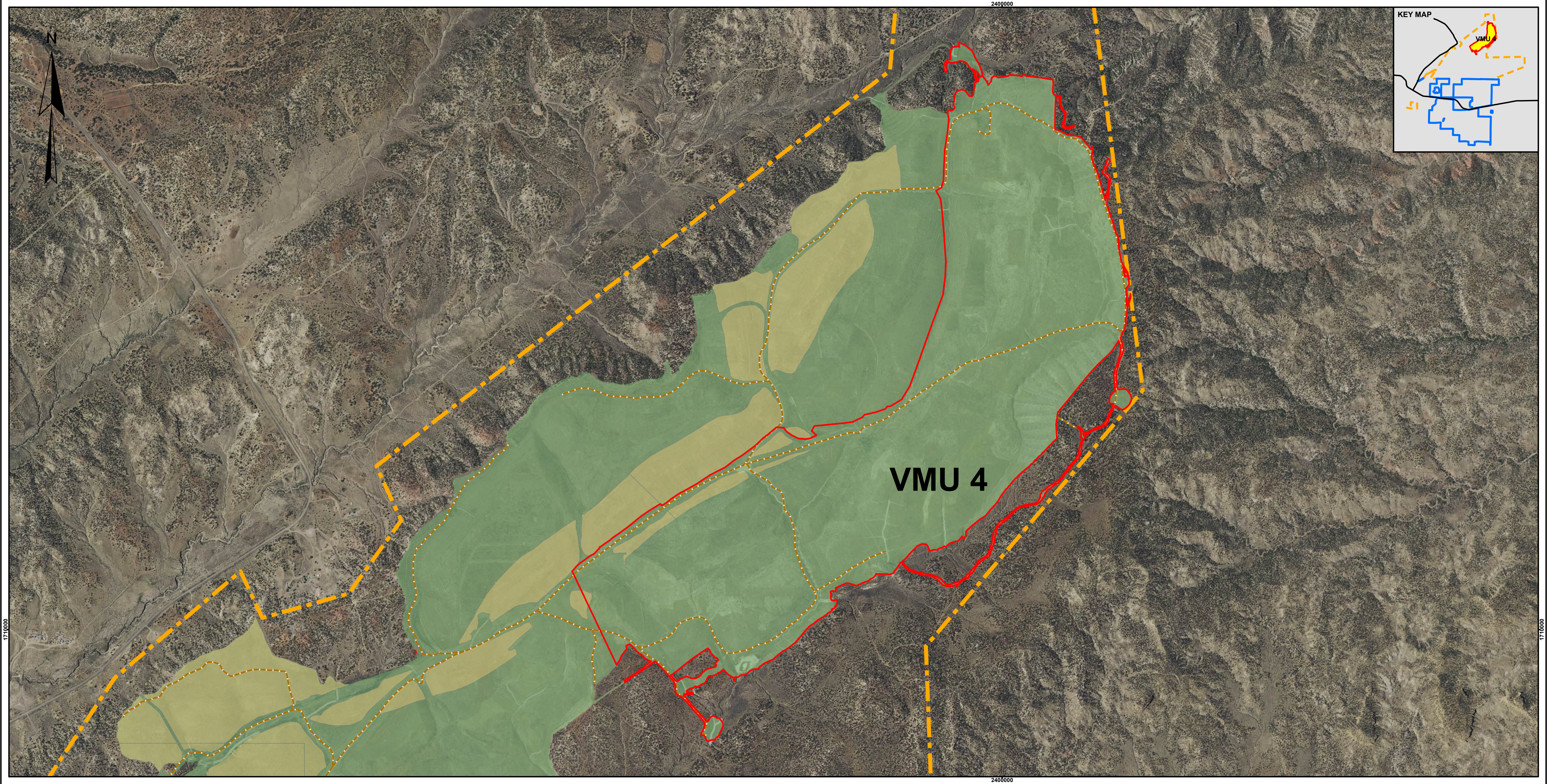
The Pittsburg & Midway Coal Mining Co (P&M). May 17,1994 Settlement Agreement B.8 Report-Volume I Revegetation Report.

WSP USA Inc. 2024. Vegetation Management Unit 4, Vegetation Success Monitoring, 2023.

WSP USA Inc. 2025. Vegetation Management Unit 4, Vegetation Success Monitoring, 2024.

Trihydro Associates. 2025. Vegetation Management Unit 4 Final Bond Release and Liability Release & Termination of Jurisdiction Application, Groundwater and Surface Water Evaluation.

Exhibits



LEGEND

- 🟥 Bond Release and Reclamation Liability Release (TOJ)
- 🟨 Initial Program Lands
- 🟩 Permanent Program Lands
- ▬ OSMRE Permit Boundary
- ∿ Post-Mining Two-Track Trails

0 2,000 4,000
Feet

NOTE(S)

1.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

CONSULTANT
wsp

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

TITLE
GENERAL LOCATION

PROJECT NO.	PHASE	REV.	FIGURE
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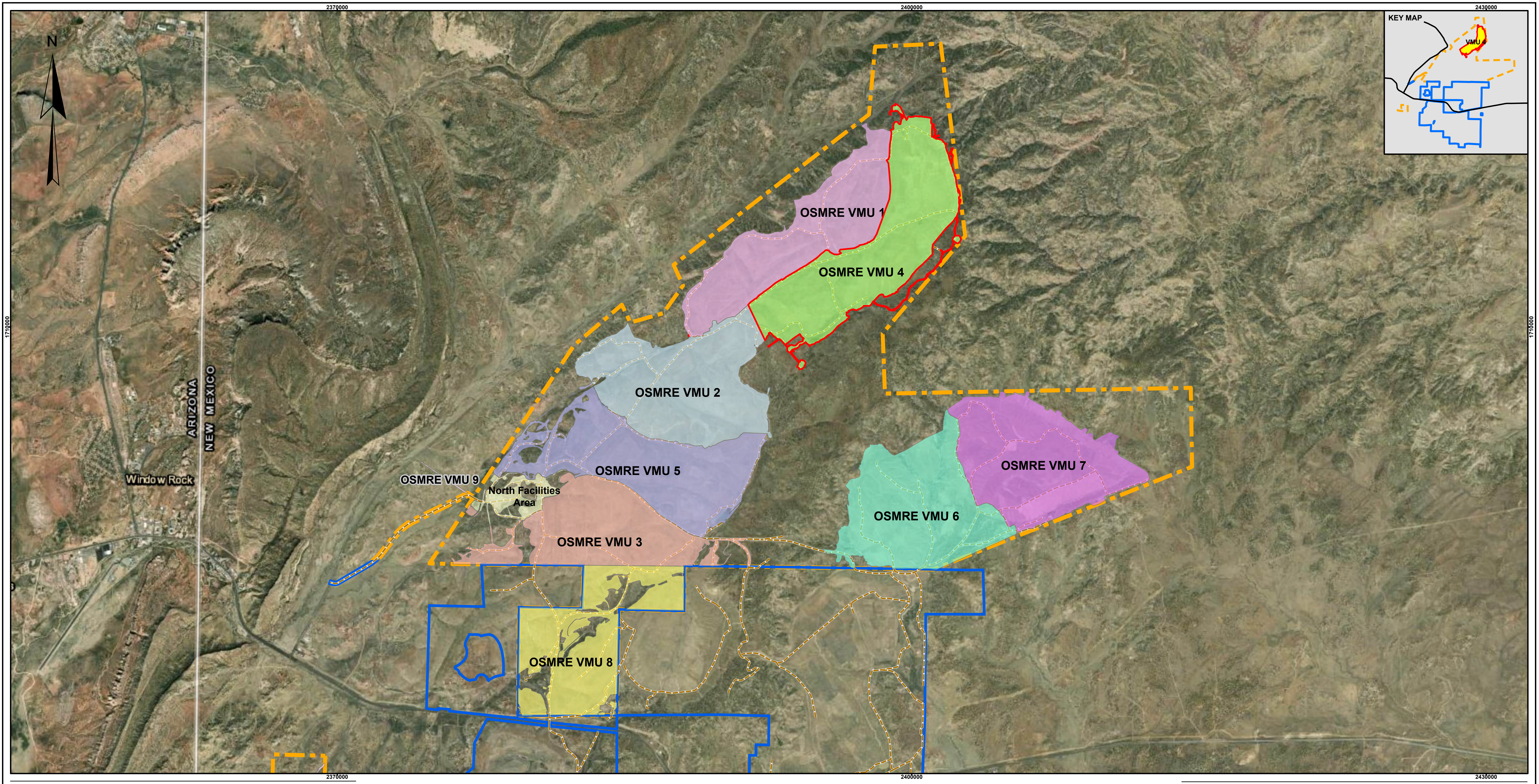

LEGEND

🟩 Bond Release and Reclamation Liability Release (TOJ)
🟧 OSMRE Permit Boundary
🟦 MMD Permit Boundary
∿ Post-Mining Two-Track Trails

Vegetation Management Unit
🟪 OSMRE VMU 1
🟦 OSMRE VMU 2
🟥 OSMRE VMU 3
🟩 OSMRE VMU 4
🟪 OSMRE VMU 5
🟦 OSMRE VMU 6
🟪 OSMRE VMU 7
🟨 OSMRE VMU 8
🟪 OSMRE VMU 9
⬜ OSMRE North Facilities Area

0 1 2
Miles

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
2. SERVICE LAYER CREDITS: WORLD IMAGERY: EARTHSTAR GEOGRAPHICS
WORLD BOUNDARIES AND PLACES: ESRI, HERE, GARMIN

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
MCKINLEY MINE OSMRE VEGETATION MANAGEMENT UNITS

PROJECT NO.	PHASE	REV.	FIGURE
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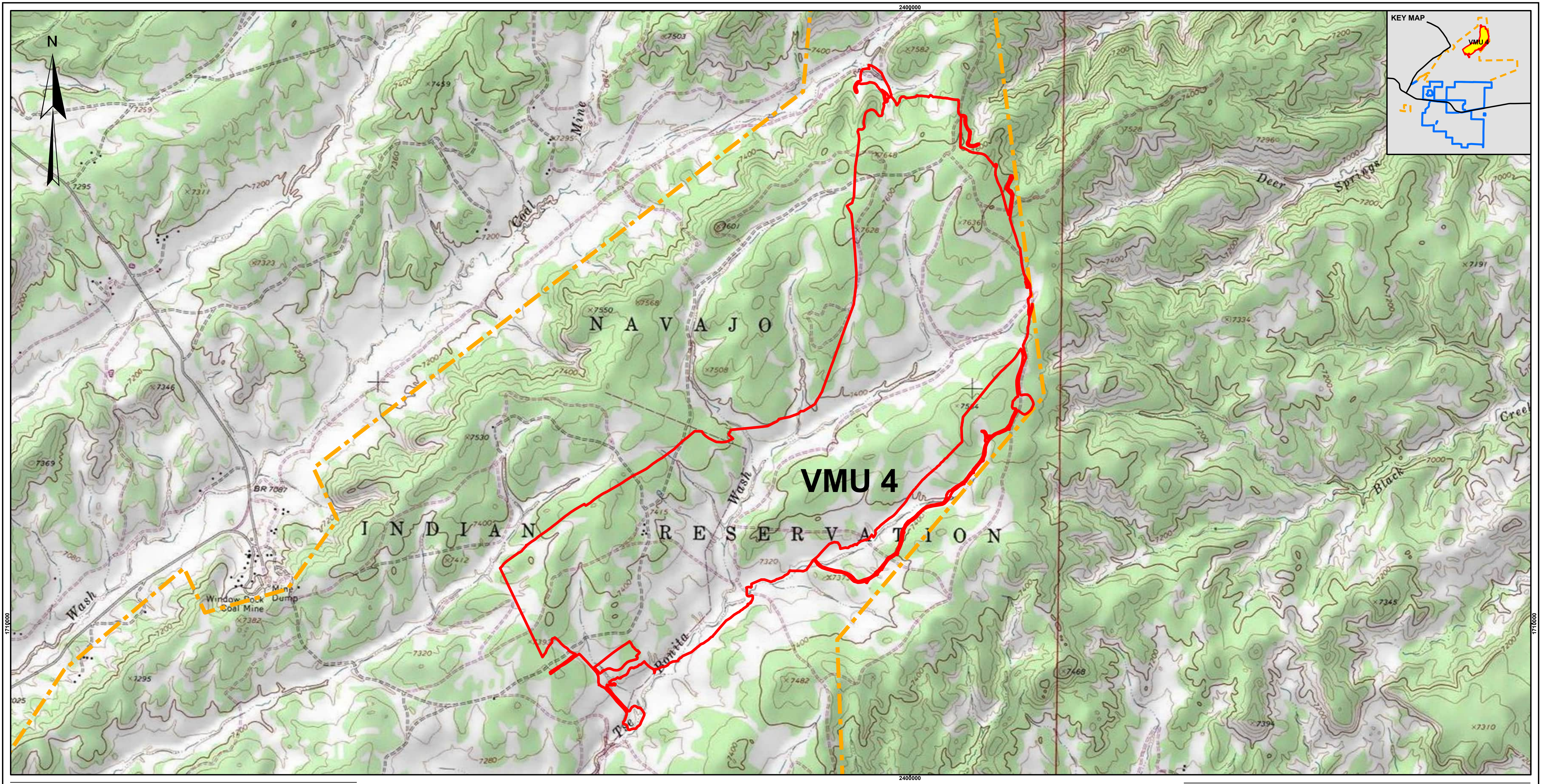

LEGEND

🟥 VMU 4 Bond Release and Reclamation Liability Release (TOJ)

🟧 OSMRE Permit Boundary

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Feet

NOTE(S)

1.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
2. SERVICE LAYER CREDITS: USGS TOPO MAPS (MAP SERVICE): COPYRIGHT:© 2013 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
USGS 7.5 MINUTE (24K) TOPOGRAPHIC MAP
TSE BONITA SCHOOL QUADRANGE

PROJECT NO.	PHASE	REV.	FIGURE
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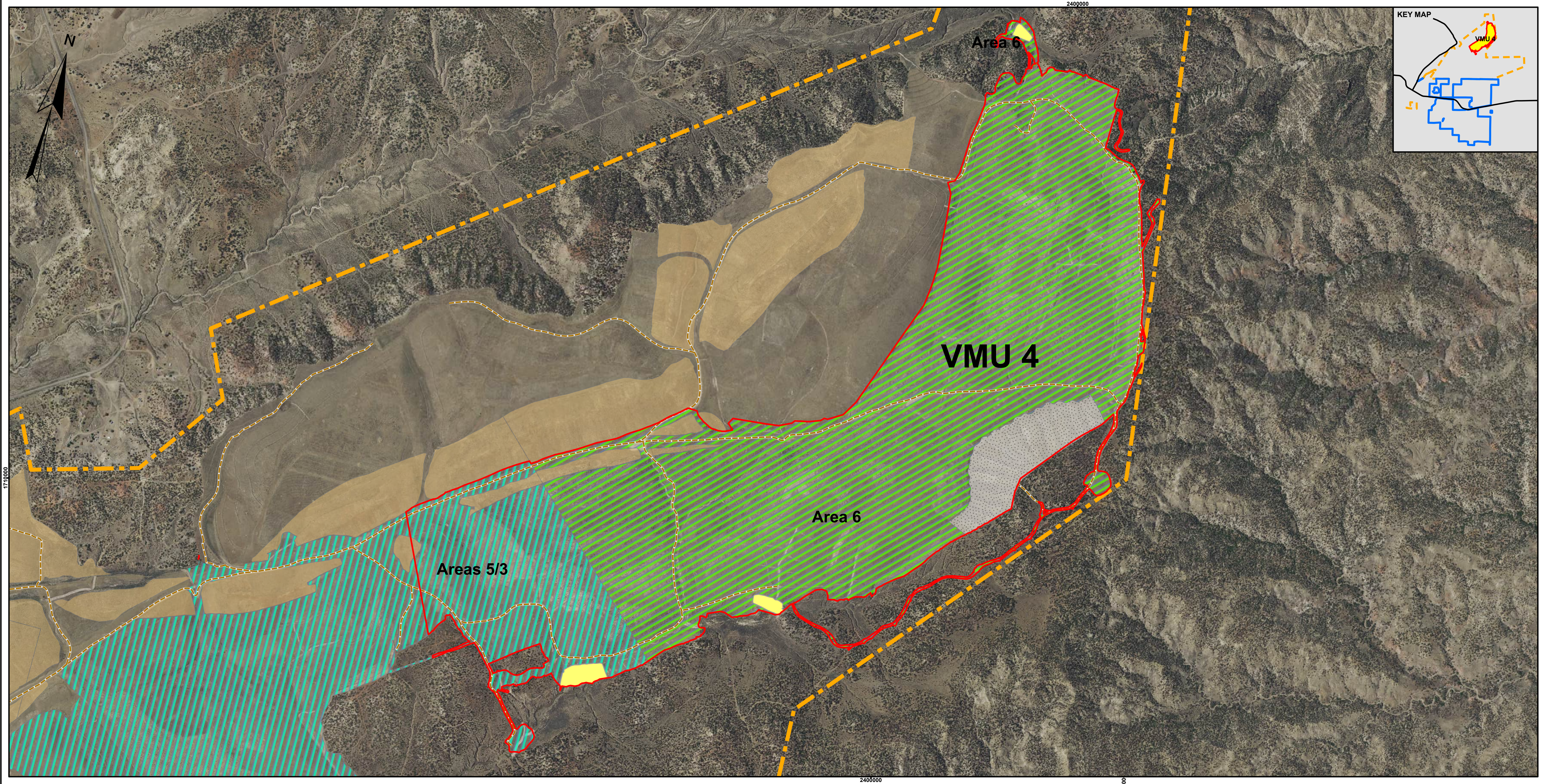

LEGEND

- 🟥 Bond Release and Reclamation Liability Release (TOJ)
- ▥ Areas 3 and 5 Phase I and II Bond Release Area Approved by OSMRE
- ▨ Area 6 Phase I and II Bond Release Area Approved by OSMRE
- ░ Area 6 Phase I Bond Release Area Approved by OSMRE
- 🟨 Impoundments Not In Past Phase I and Phase II Bond Release Applications
- 🟧 Initial Program Lands
- ▭ Prelaw Disturbance
- ∿ Post-Mining Two-Track Trails
- ▬ OSMRE Permit Boundary

0 2,000 4,000
Feet

NOTE(S)

1.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
VMU 4 AND APPROVED PHASE I AND II BOND RELEASE AREAS

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**E4**

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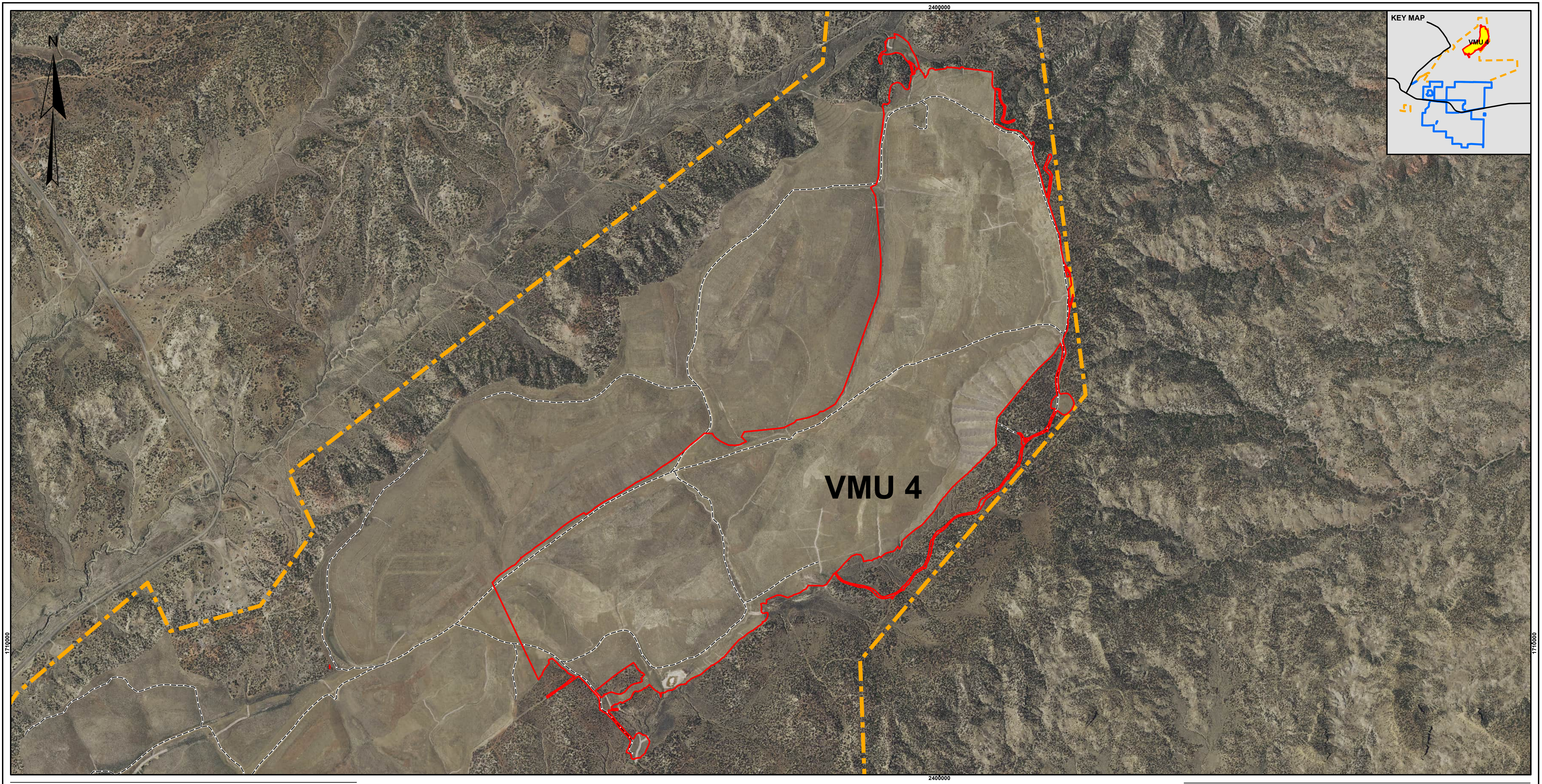

LEGEND

🟥	Bond Release and Reclamation Liability Release (TOJ)
∿	Primary Roads (Post-Mining Two Track Trails)
🟧	OSMRE Permit Boundary

SEAL

KYLE J KUTTER
NEW MEXICO
21519
PROFESSIONAL ENGINEER

06/30/25

I certify that the primary road locations shown within the VMU 4 boundary are correct to the best of my knowledge and belief.

0 2,000 4,000
Feet

CLIENT
Chevron
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT
wsp

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
PRIMARY ROADS

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**E5**

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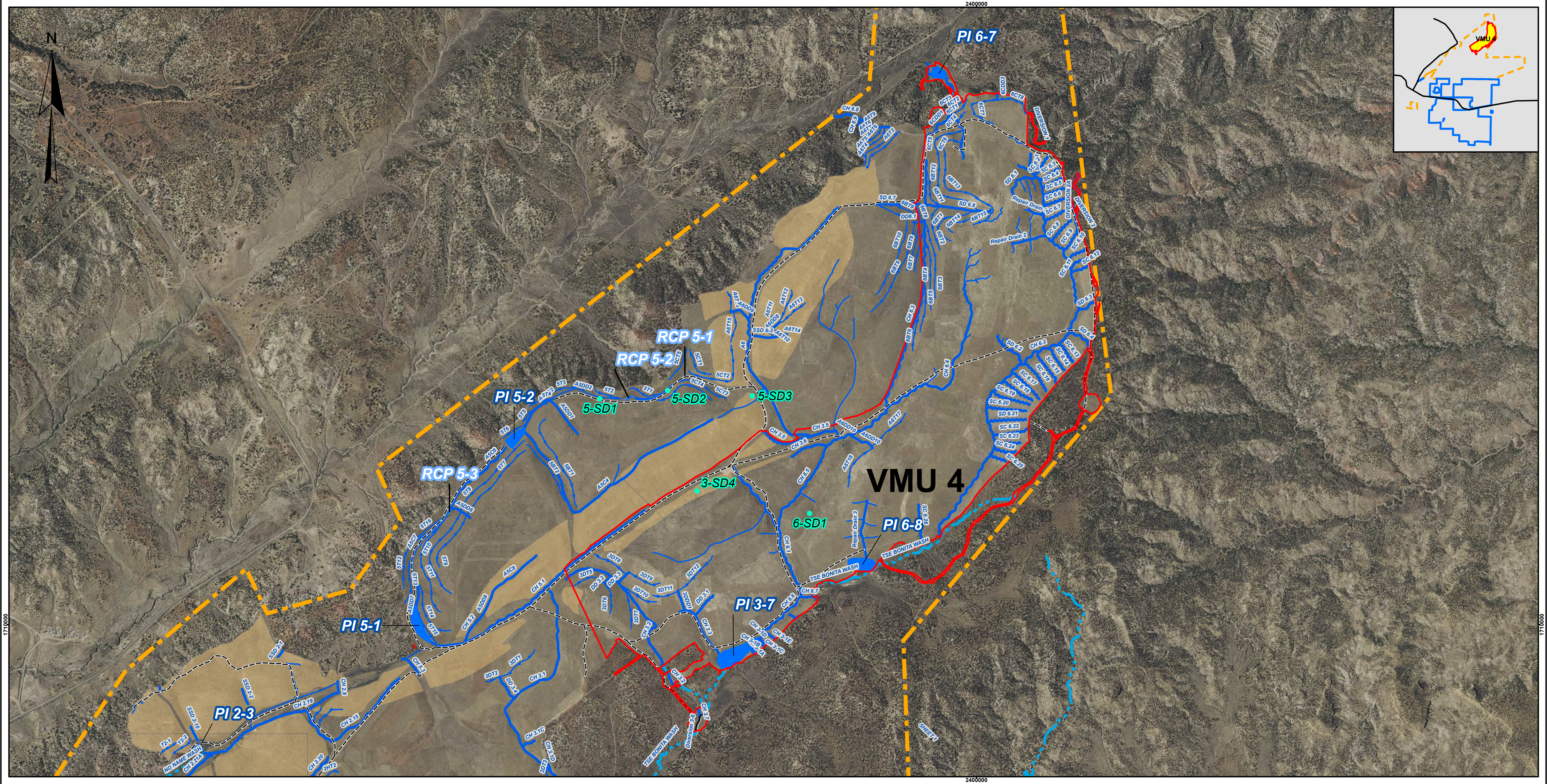

LEGEND

Undisturbed Stream	Permanent Impoundment (PI)
"CH" represents Channels "DD" represents Downdrains "SC" represents Scallops	Reclamation Channel Pool (RCP)
Concentrated Flow Path and Terrace	Small Depression (SD)
Diversion	Initial Program Lands
	Post-Mining Two-Track Trails

SEAL

KYLE J KUTTER
NEW MEXICO
21519
PROFESSIONAL ENGINEER

06/30/25

I certify that the hydrologic structures shown within the VMU 4 boundary are correct to the best of my knowledge and belief.

0 2,000 4,000
Feet

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT
wsp

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
HYDROLOGIC FEATURES

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	E6

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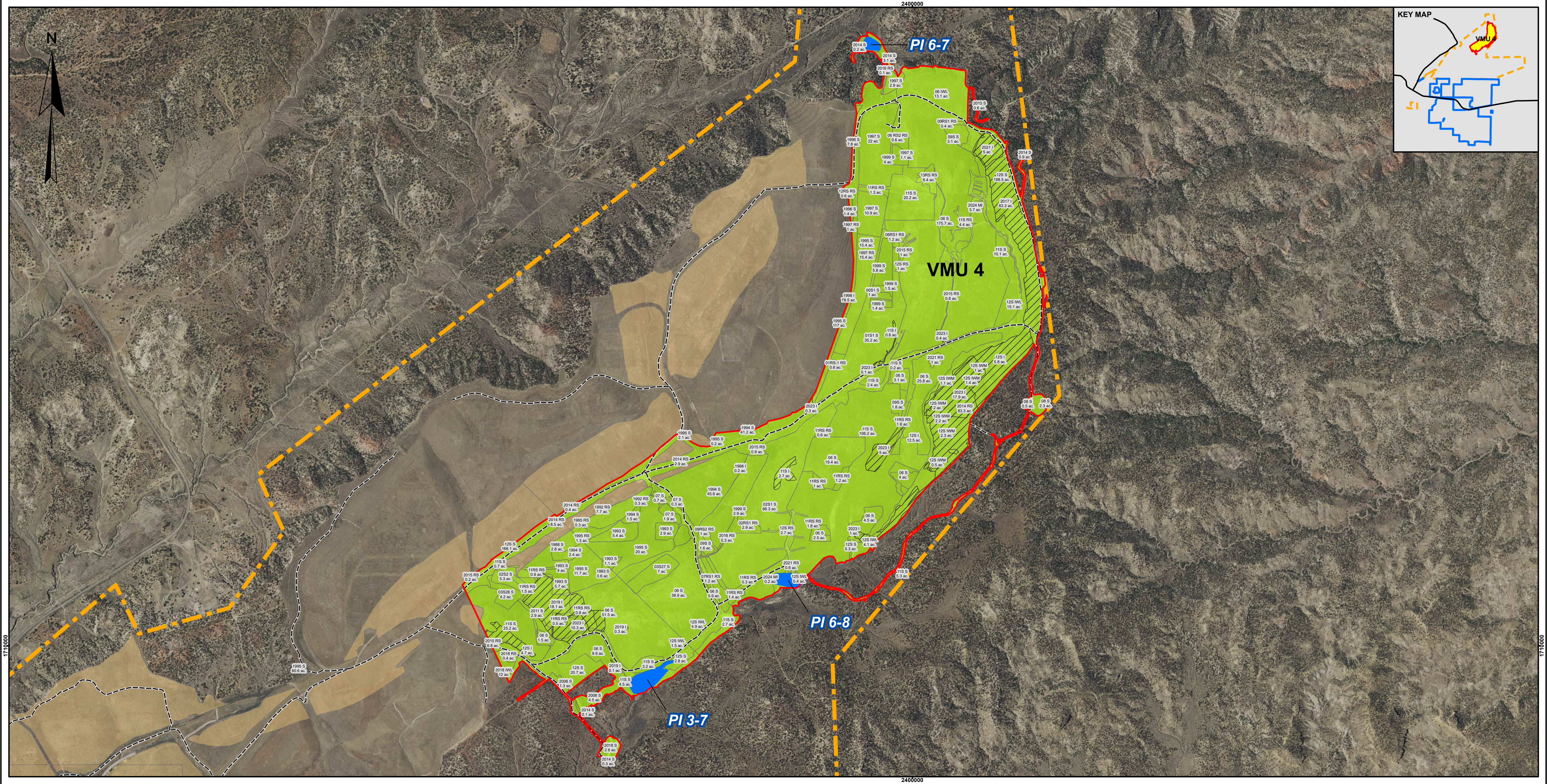


LEGEND

- ▭ Bond Release and Reclamation Liability Release (TOJ)
- 🟩 Seeding Year Seeded ("S") or Reseeded ("R") and Acreage
- ▨ Interseeded ("I")
- 🟨 Initial Program Lands
- ∿ Post-Mining Two-Track Trails
- ▬ OSMRE Permit Boundary

0 2,000 4,000
Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

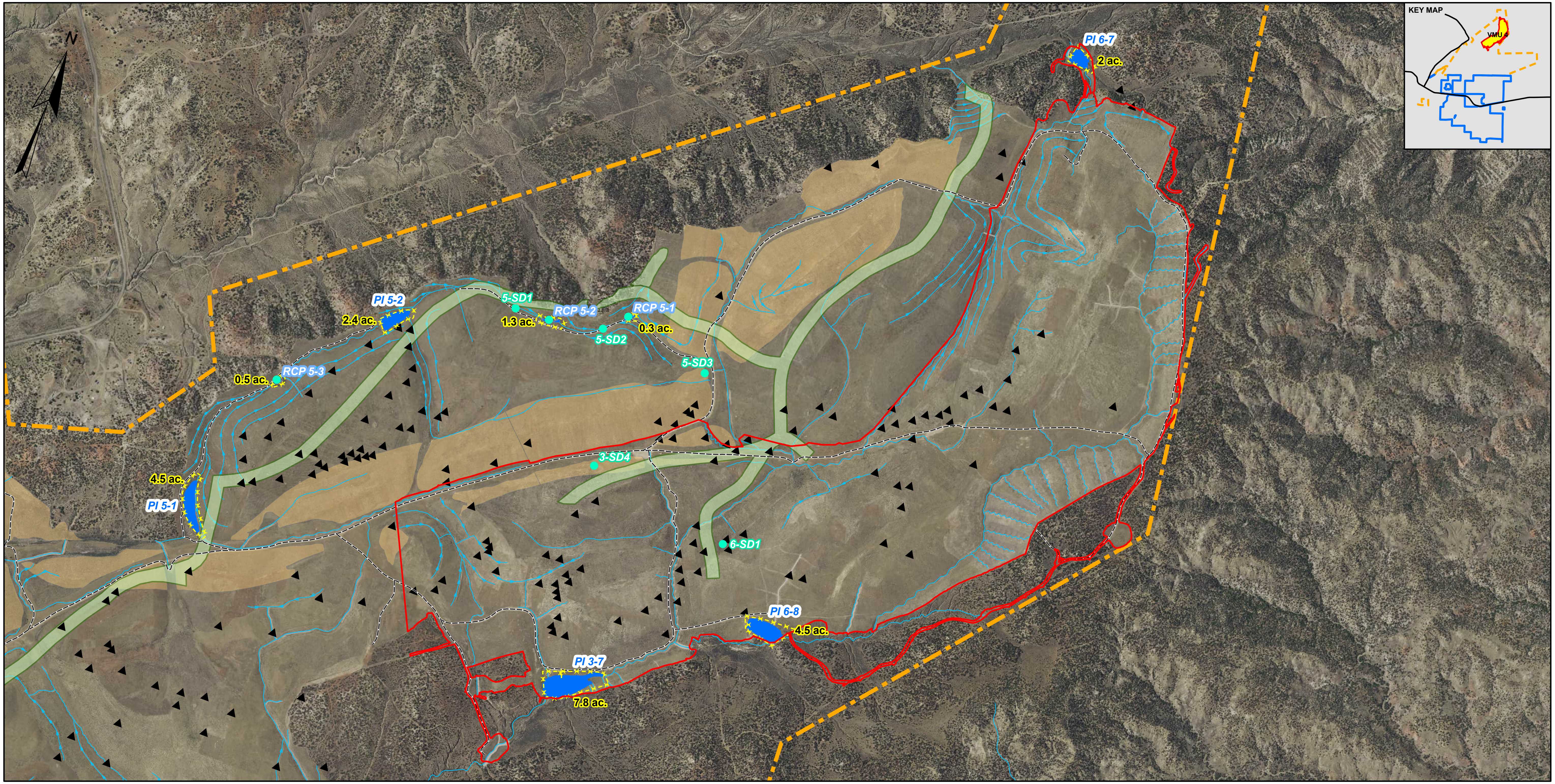
CONSULTANT

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
PERMANENT PROGRAM LANDS SEEDING

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**E7**



LEGEND

- 🟦 Permanent Impoundment (PI)
- ▨ Reclamation Channel Pool (RCP)
- 🟩 Small Depression (SD)
- ☐ VMU 4 Bond Release and Reclamation Liability Release (TOJ)
- ▲ Wildlife Rock Pile
- ☐ Pre-2018 Planted Wildlife Corridors
- ▨ Installed Wildlife Fence (with Acreages)
- ∼ Drainage Features
- ▭ Initial Program Lands
- ▬ OSMRE Permit Boundary
- ∿ Post-Mining Two-Track Trails

0 2,000 4,000
Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

CONSULTANT

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

TITLE
WILDLIFE ENHANCEMENTS

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**E8**

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LEGEND

🟥 VMU 4 Bond Release and Reclamation Liability Release (TOJ)

▨ Initial Program Lands

— Cross section

— Contour (ft)

— Channel

⬚ OSMRE Permit Boundary

∼ Post-Mining Two-Track Trails

0 500 1,000
Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

CONSULTANT

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

TITLE
IPL TOPOGRAPHY AND CROSS SECTION LOCATIONS

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**E9**

PATH: P:\Projects\Chevron\McKinley_Mine\99_PROJECTS\1338105207_McKinley_Mine\0016_BondRelease\VMU_4\OSM F09 Cross Sections.mxd PRINTED ON: 2025-06-30 AT: 10:19:29 PM

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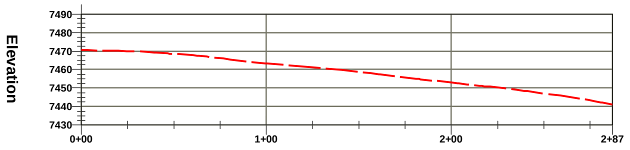

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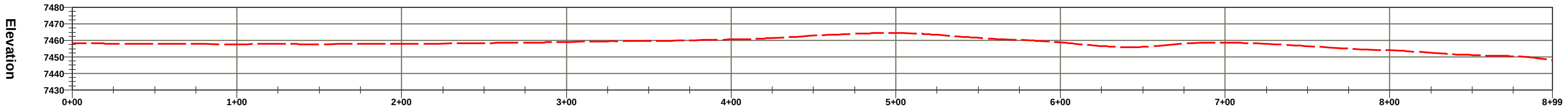

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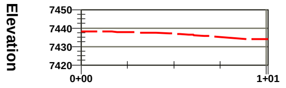

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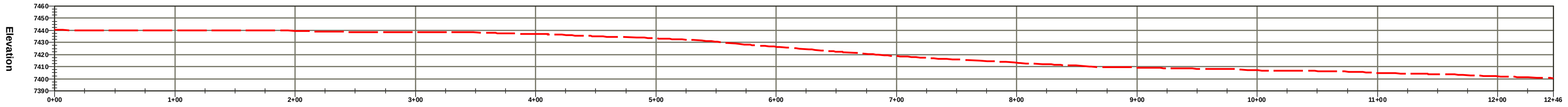

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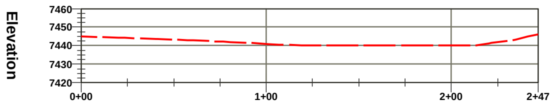

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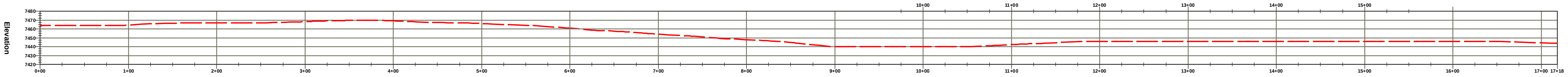

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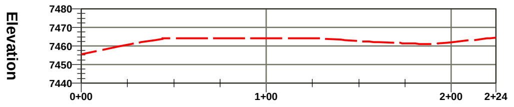
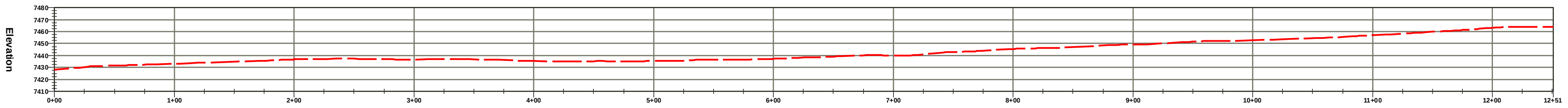
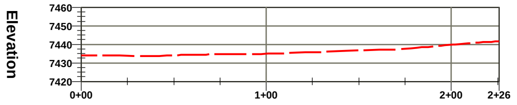


PROFILE I - I'



PROFILE F - F'



CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
IPL CROSS SECTION PROFILES

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**E10**

PATH: P:\Projects\Chevron\McKinley_Mine\99_PROJECTS\1338105207_McKinley_Mine\0016_BondRelease\VMU_4\OSM F10 Cross Section Profiles.mxd PRINTED ON: 2025-06-30 AT: 10:20:01 PM

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LEGEND

🟥 VMU 4 Bond Release and Reclamation Liability Release (TOJ)

Percent Slope

🟩 0 - 10%

🟩 11 - 20%

🟧 21 - 30%

🟥 > 30%

— Contour (ft)

— Channel

OSMRE Permit Boundary

Post-Mining Two-Track Trails

0 500 1,000
Feet

NOTE(S)

1.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
IPL SLOPE GRADIENT ANALYSIS

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**E11**

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0 1 in

LEGEND

⊗ Topsoil Depth Verification Location
🟥 VMU 4 Bond Release and Reclamation Liability Release (TOJ)
— Contour (ft)
— Channel
▨ Initial Program Lands
⌐┘ OSMRE Permit Boundary
∼ Post-Mining Two-Track Trails

0 500 1,000
Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT

YYYY-MM-DD	2025-06-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 4 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
IPL TOPSOIL DEPTH - VERIFICATION LOCATION

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**E12**

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Appendix A1: Application Certification

McKinley Mine
Vegetation Management Unit 4
Permanent Program Final Bond Release
and
Initial Program Reclamation Liability Release and Termination of Jurisdiction Application

CERTIFICATION

Chevron Mining Inc. (CMI) certifies that all applicable reclamation activities have been accomplished in this application that are necessary for final bond release of Permanent Program lands and for a reclamation liability release and termination of jurisdiction of Initial Program lands in McKinley Mine Vegetation Management Unit 4 in accordance with the requirements of the Surface Mining Control and Reclamation Act, the regulatory program, and the approved reclamation plans.

There are no outstanding violations, cessation orders, or other Office of Surface Mining, Reclamation and Enforcement (OSMRE) enforcement actions on the lands subject to this release application.

James Saynay
Manager Portfolio Operations, Central
Chevron Environmental Management Company (CEMC)

Date: June 24, 2025

State of New Mexico)
) SS
County of Taos)

Subscribed and sworn to before me, in my presence, this 24th day of June, 2025, a Notary Public in and for the State of New Mexico.

Anna C. Martinez

Notary Public

ANNA C. MARTINEZ
Notary Public - State of New Mexico
Commission # 1058122
My Comm. Expires Jul 24, 2026

My Commission expires: July 24, 2026

Appendix A2: Groundwater and Surface Water Evaluation (Trihydro)

VEGETATION MANAGEMENT UNIT 4

FINAL BOND RELEASE AND

LIABILITY RELEASE & TERMINATION OF JURISDICTION APPLICATION

GROUNDWATER AND SURFACE WATER EVALUATION

CHEVRON MINING INC. – MCKINLEY MINE, NEAR GALLUP, NEW MEXICO

June 30, 2025

Project #: CHEVR-025-0034

SUBMITTED BY: Trihydro Corporation

1252 Commerce Drive, Laramie, WY 82070

Table of Contents

1.0 INTRODUCTION....1-1

2.0 HYDROLOGIC SETTING AND PROTECTION....2-1
- 2.1 Geologic Setting and Climate....2-1
- 2.2 Historical Water Quality Data....2-2
- 2.3 Applicable Protection Standards....2-4
  - 2.3.1 Surface Water Comparison....2-4
  - 2.3.2 NPDES Requirements....2-4
  - 2.3.3 Groundwater Protection Standards....2-5
  - 2.3.4 Impoundment Water Quality....2-6
- 2.4 Protection of Hydrological Balance....2-6
  - 2.4.1 PHC Determination....2-6
  - 2.4.2 Cumulative Hydrologic Impact Assessment (CHIA)....2-7
  - 2.4.3 Surface and Groundwater Monitoring Plans....2-7

3.0 SURFACE WATER MONITORING....3-1
- 3.1 Surface Water Data....3-1
  - 3.1.1 Discharge Data....3-1
  - 3.1.2 Stream Water Quality Data....3-3
- 3.2 Assessment of Surface Water Data....3-6
  - 3.2.1 Comparison to Baseline Water Quality....3-6
  - 3.2.2 Comparison to Regulatory Standards....3-6
  - 3.2.3 Comparison to Probable Hydrologic Consequences....3-7

4.0 GROUNDWATER MONITORING....4-1
- 4.1 Alluvial Groundwater....4-1
- 4.2 Gallup Sandstone Aquifer....4-1
  - 4.2.1 Water Levels....4-2
  - 4.2.2 Water Quality....4-2
- 4.3 Bedrock Aquifer....4-3
  - 4.3.1 Water Levels....4-4
  - 4.3.2 Water Quality....4-4
- 4.4 Spoil Groundwater....4-6

Table of Contents (cont.)r (cont.)r5

4.5 Assessment of Groundwater Data 4-7

4.5.1 Comparison to Baseline Water Quality 4-7

4.5.2 Comparison to Regulatory Standards..4-7

4.5.3 Comparison to Probable Hydrologic Consequences 4-7

5.0 SURFACE AND GROUNDWATER ASSESSMENT SUMMARY 5-1

5.1 Surface Water Assessment Summary 5-1

5.2 Groundwater Assessment..5-1

6.0 REFERENCES 6-1

List of Tables

2-1. Precipitation Data – Rain 2, Rain 3, and Rain 6

2-2. McKinley Mine Water Analysis Parameters

3-1. Historical Discharge Data – Outfall 010

3-2. Historical Discharge Data – Outfall 013

3-3. Historical Surface Water Data – Coal Mine Wash Tributary (CMWT)

3-4. Historical Surface Water Data – TSE Bonita Wash (TBW)

4-1. Annual Water Level Summary

4-2. Well 3A Historical Groundwater Quality Data

4-3. Well MBR2 Historical Groundwater Quality Data

List of Figures

2-1. VMU 4 Proposed Bond Release Areas

List of Appendices

A. MCKINLEY MINE PERMIT SECTION 3.4, HYDROLOGY INFORMATION

B. OUTFALL SURFACE WATER QUALITY TEMPORAL PLOTS – OUTFALLS 010/DC1 AND 013/SP 3-6

C. ISCO STATION SURFACE WATER QUALITY TEMPORAL PLOTS – COAL MINE WASH TRIBUTARY (CMWT) AND TSE BONITA WASH (TBW)

D. GROUNDWATER QUALITY DATA

  D-1. HISTORICAL GROUNDWATER DATA - GALLUP SANDSTONE AQUIFER WELL 3A

  D-2. HISTORICAL GROUNDWATER DATA - BEDROCK MONITORING WELL MBR2

1.0 INTRODUCTION

This report contains a surface water and groundwater assessment in support of the Phase III bond release application for Vegetation Management Unit 4 (VMU 4). VMU 4 is located on reclaimed land near the northern tip of the McKinley Mine (Mine) permitted under Office of Surface Mining Reclamation and Enforcement (OSMRE) Permit No. NM-0001K. This report was prepared in accordance with the OSMRE Guideline to Bond Release Procedures for Permanent Program Lands as well as the 30 CFR 800.40 Requirement to Release Performance Bonds. Information regarding the Probable Hydrologic Consequences (PHC) and the Cumulative Hydrologic Impact Assessment (CHIA) are discussed in OSMRE Permit NM-0001K, Section 3.4, and included in Appendix A of this report.

The Mine is located approximately 24 miles northwest of Gallup, New Mexico. The Mine began operations in the early 1960s and ceased operations in 2009. Since that time, the Mine has been in various phases of reclamation including grading to post-mine topography, placement of topsoil, and revegetation. VMU 4 surface and groundwater sources have been monitored through a network of surface water monitoring stations and wells. Figure 2-1 shows the location of these monitoring facilities. The map also shows National Pollutant Discharge Elimination System (NPDES) Permit No. NN0029386 outfalls affiliated with the proposed bond-release area and other nearby areas within the larger watershed containing VMU 4 since information from the outfalls is discussed in this report.

Trihydro Corporation (Trihydro) began collecting water quality data in October 2012 and managing water quality in January 2013. This report provides an evaluation of water data from 2013 through 2024 because data during this time period are representative of post-mining conditions and are the most complete dataset available. The data analysis includes comparisons to baseline information, effluent standards, and the PHC.

A summary of the hydrologic setting and protection requirements for the Mine are included in this report in Section 2.0. Section 3.0 reviews the long-term chemical and physical characteristics of surface water associated with the NPDES outfalls 010 and 013 as well as surface water monitoring sites Tse Bonita Wash (TBW) and Coal Mine Wash Tributary (CMWT) that receive waters from the VMU 4 area. Section 4.0 provides a review of the long-term chemical and physical characteristics of the two groundwater wells (Well 3A and MBR-2) located nearest to VMU 4.

2.0 HYDROLOGIC SETTING AND PROTECTION

2.1 GEOLOGIC SETTING AND CLIMATE

The Mine is located in the southwest corner of the San Juan Basin in a structural sub-basin known as the Gallup Sag. The San Juan Basin, which is roughly circular in shape, occupies much of northwestern New Mexico, a narrow strip of northeastern Arizona, and a small portion of southwestern Colorado. The basin is bordered on the north by the San Juan Mountains, on the east by the Nacimiento Uplift, on the south by several uplifts including the Lucero Uplift and Zuni Uplift, and on the west by the Defiance Monocline, which separates it from the Black Mesa Basin.

The sedimentary rocks in the San Juan Basin are predominantly of Mesozoic age with some Tertiary rocks outcropping in the central basin and some Paleozoic and Pre-Cambrian rocks upturned along the basin margins. The sediments increase in thickness toward the basin's center. The geology in the vicinity of Gallup and McKinley County is comprised of Middle to Upper Jurassic (175-145 million years old) and Quaternary (less than 1-million years old) rocks. Older rocks, the Triassic River deposits of the Chinle Group, are exposed in the plains to the south and Cretaceous rocks form the high ridges. The rock formations include sandstone, shale, limestone, coal, and mudstone.

The San Juan Basin is characterized by low surface relief. Most of the basin is a relatively featureless plain with wide shallow valleys and some low mesas and cuestas. Elevations in the area range from 5,000 feet above mean sea level (ft amsl) in the north to 7,000 ft amsl in the south. A prominent north-south trending range, the Chuska Mountains, occurs along the western part of the basin with elevations exceeding 9,500 ft amsl. The Mt. Taylor volcanic area, with elevations up to 10,000 ft amsl, occurs within the southeast corner of the basin. The margins of the basin are characterized by hogback ridges, which are associated with the tectonic uplifts defining the basin boundaries.

The majority of the Mine is located in the Puerco River Drainage Basin with a small portion of the mine located in the San Juan River Drainage. The main drainages or watersheds in the mine are the headwaters of Defiance Draw (DD) and its tributary, Defiance Draw Tributary (DDT), Tse Bonita Wash (TBW), Coal Mine Wash (CMW) and its tributary, Coal Mine Wash Tributary (CMWT), and an unnamed tributary to Black Creek. A small portion of the mine lease area is in the headwaters of Deer Springs Wash and Black Springs Wash (both in the San Juan River Drainage Basin). Of the drainage basins listed above, DD is the largest drainage basin with an area of 27.5 square miles. TBW is the drainage basin that encompasses the highest percentage within the mine boundary at 35.0%. The watersheds encompassing VMU 4 discharge surface water run-off to TBW and CMWT; the sampling locations for those drainages are shown on Figure 2-1.

As presented in Mine Permit No. NM-0001K, Section 3.4, groundwater resources within the mine fall into three main types: alluvial, bedrock, and aquifer. Alluvial and bedrock groundwater resources are discontinuous, of poor physical and chemical quality, and of limited extent. The first major deep aquifer is the Gallup Sandstone Aquifer (GSA). The aquifer lies well below the zone of mining impact and is overlain by several impermeable shale members. Most recharge to the Gallup Sandstone comes from the Chuska Mountains to the northwest of the Mine. In addition to these three types, groundwater may also be found in spoil material above bedrock. The groundwater monitoring wells nearest VMU 4 are bed rock monitoring well MBR2 and GSA well 3A. The locations of these wells are shown on Figure 2-1.

The Mine climate is semi-arid with an average annual precipitation of approximately 11 inches (in.) per year. More than half the annual precipitation typically falls during the months of July through October. Precipitation often occurs as rainfall from intense, localized thunderstorms that occur sporadically in the region. This can result in high suspended solids levels in the runoff. In addition, soil chemistry and geomorphology contribute to the high levels of dissolved solids, salinity, and alkalinity. Within the general area of the mine, runoff due to precipitation events occurs in the form of surface runoff. Natural drainages or watersheds convey or temporarily store the runoff as it is routed to the Puerco River or San Juan River.

Precipitation data nearest to VMU 4 is reported from the precipitation monitoring stations at the mine, Rain 2, Rain 3, and Rain 6, as shown on Figure 2-1. These precipitation stations operate between mid-April and mid-November and are shut down annually during the winter months.

Table 2-1 provides the monthly and annual precipitation data from the three precipitation stations for the 2013-2024 period. Average monthly precipitation between April and November at the three precipitation stations ranged from 0.21 in. in November to 1.58 in. in August during the 12-year evaluation period. On average, most of the precipitation is received between July and September. The month with the highest 1-month precipitation total was August 2022 with 3.77 in. at Rain 2. Precipitation data are referenced throughout the report to help explain some of the observations presented for surface and groundwater stations.

2.2 HISTORICAL WATER QUALITY DATA

The Mine began operations in the early 1960s, before the passage of the Surface Mine Control and Reclamation Act and other regulations governing coal mining on Indian lands. At that time, baseline surface and groundwater quality and quantity data were not required before mining. As a result, comparisons cannot be made with pre-mining watershed conditions of the Mine as a single unit.

The original 1980 Geohydrology Associates Inc. (GAI) baseline groundwater report, incorporated into the Mine permits, provides surface and groundwater quality and quantity data that can be referenced for evaluating trends since that time. There are no baseline groundwater data applicable to the Mine site. Groundwater monitoring is reported annually as required by OSMRE Permit Number NM 0001K. The monitoring requirements were recently changed so all wells are sampled annually through Permit Modification Mod 23-04, which was approved by OSMRE on February 21, 2024. Groundwater resources within the Mine include alluvial, bedrock, Gallup Sandstone Aquifer, and spoil.

Alluvial groundwater is present in some fill and low-lying soils at the Mine. Wells penetrating the alluvial groundwater are designed to monitor the quality and quantity of shallow groundwater in alluvial valley-fill sediments. Valley-fill sediments in the Mine area serve as a reservoir for meteoric water to reside. Because the area is semi-arid and annual precipitation is limited, the presence of alluvial groundwater is generally dependent on rainfall and, to a lesser extent, snowfall quantities.

In 1980, five bedrock wells (MBR1, MBR2, MBR3, MBR4, and MBR5) were installed approximately 50-feet (ft) below the Green Coal Seam to monitor groundwater below this unit. The Green Coal Seam was the lower-most recoverable coal seam at the Mine. These monitoring wells, referred to as McKinley bedrock wells, were located in and around the major drainage watersheds throughout the mine. Three of the original five wells (MBR1, MBR3, and MBR4) were mined through and not replaced. The active bedrock monitoring wells include MBR2 and MBR5, with MBR-2 being in the vicinity of VMU 4. Well MBR2 lies just outside of the watershed containing VMU 4, as shown on Figure 2-1.

The original 1980 GAI baseline groundwater report concluded that bedrock wells had little potential as a meaningful groundwater resource. The transmissivity of the bedrock deposits was less than 6 square feet per day (ft^2/day) and not capable of maintaining a sustained yield of 1 gallon per minute (gpm). Even though groundwater was present, none of the strata had sufficient continuity to be considered an aquifer.

Five water wells (1, 2, 3, 3A, and 4) have been completed in the Gallup Sandstone Aquifer throughout the Mine area. These wells were used as primary water sources for mine activities and reclamation. The wells now provide domestic water, dust-control water, and also used as monitoring wells. Because of the relatively low permeability of the shale units overlying the Gallup Sandstone Aquifer and the geologic structure in the area, the Gallup Sandstone Aquifer can be under artesian conditions. Moreover, due to the presence of the overlying shales, there is no hydraulic connection between the underlying Gallup Sandstone and the mined strata. Gallup Sandstone Aquifer Well 3A is located near the bond release area and within the same, larger watershed.

Five spoil recharge wells (2G2, 4A, 9A, 9S, and 11) were constructed in the Mine area. Two spoil wells 4A and 9A on New Mexico Mining and Minerals Division (MMD) regulated lands were installed in 1990; of these two wells, only 9A remains. Well 4A was not monitored after 2015 following approval by MMD to discontinue monitoring this well because the land at the well location had a full reclamation liability release. Well 4A was abandoned October 29, 2018.

In April 2013, three additional spoil recharge wells were constructed and designated as wells 2G2 (on OSMRE lands), 11 (on MMD lands), and 9S (on MMD lands). Spoil recharge wells were installed throughout the mine in reclaimed areas to determine chemical presence and groundwater properties. These wells were terminated at bedrock and their screens encompassed the spoil interval immediately above bedrock. Spoil Well 2G2 is the only spoil recharge well in the vicinity of VMU 4. Well 2G2 has had insufficient volume to sample since being installed in 2013 and has been dry since the third quarter of 2022.

Surface water has been monitored since the early 1980s through active and passive surface water monitoring stations, although the number and locations of stations have evolved over time. The currently monitored active, mine permit related surface water stations for large watersheds are located in and around the major drainage watersheds throughout the Mine and include the DD, TBW, DDT6, CMW, and CMWT stations. In the annual hydrology report, Station CMW is used to monitor flow and water quality from a relatively undisturbed large watershed drainage; the data from this station are used as background information and to contrast against other station data from large, disturbed watersheds.

2.3 APPLICABLE PROTECTION STANDARDS

2.3.1 SURFACE WATER COMPARISON

Stormwater runoff from the Mine drains through impoundments and/or hydraulic control structures (e.g., check dams, lined channels, etc.) before discharging into Defiance Draw, a tributary to the Puerco River segment from the Arizona border to the Gallup wastewater treatment plant in McKinley County. Data collected from the disturbed stations in the large watersheds are compared to data collected at the undisturbed CMW station, which are considered background data. The comparison is used to determine impacts from mining activities. This comparison is provided in the annual hydrology report, which is an appendix to the annual reclamation report that is submitted to OSMRE (Trihydro 2025).

2.3.2 NPDES REQUIREMENTS

The Mine operates under NPDES Permit No. NN0029386 which was last renewed July 1, 2017. A renewal application was submitted to the United States Environmental Protection Agency (USEPA) on December 27, 2021, and the Mine is currently operating under the current permit pending approval of the renewal application. As required under NPDES

Permit No. NN0029386, the Mine submitted an updated Sediment Control Plan on September 5, 2017, and is currently awaiting approval from USEPA. Until then, the Mine is operating under the current Sediment Control Plan dated March 15, 2013. All watersheds within the mine are classified as Western Alkaline, and in accordance with NPDES Permit No. NN0029386, reclamation inspections are conducted quarterly within the drainage basins associated with the Sediment Control Plan and inspection findings are summarized in quarterly reports.

Additionally, discharge sampling is conducted at NPDES outfalls per Table 1 of Permit No. NN0029386. All outfalls are subject to the Effluent Limitation Guidelines as specified in 40 CFR §434.80-81, water quality-based effluent limitations (WQBELs) in 40 CFR §122.44 (applicable to State NPDES programs), and Navajo Nation Water Quality Standards for outfalls located on Navajo Nation lands. There are three watersheds and NPDES outfalls located in the vicinity of VMU 4. Outfalls associated with VMU 4 and their associated watersheds are shown on Figure 2-1. The Mine will continue conducting quarterly reclamation inspections and sampling discharge through final bond release and subsequent removal of the outfalls from the NPDES permit.

2.3.3 GROUNDWATER PROTECTION STANDARDS

The Mine permit contains a list of parameters to analyze but there are no groundwater standards included with them since the intent of the permit is to monitor the change in water quality over time and to use that information to identify possible impacts to water quality during and after mining. While the permit has no standards, it may be useful to include in this report how the quality of the groundwater compares to known standards.

The Navajo Nation Environmental Protection Agency (NNEPA) exercises jurisdiction on Navajo Nation lands but does not have general groundwater protection standards. The New Mexico Administrative Code (NMAC), however, contains groundwater standards for the State of New Mexico, which will be reviewed in this report to provide a possible picture around utility of groundwater at the Mine. The table below contains a list of parameters with NMAC groundwater standards that would correlate to various parameters analyzed at the Mine.

Analyte	Upper Limit (unless otherwise indicated)
pH	6.0-9.0 s.u.
Fluoride	1.6 mg/L
Nitrate as N	10 mg/L
Selenium	0.05 mg/L
Chloride	250 mg/L
Dissolved Iron	1 mg/L
Dissolved Manganese	0.2 mg/L

Analyte	Upper Limit (unless otherwise indicated)
Sulfate	600 mg/L
TDS	1,000 mg/L
Zinc	10 mg/L

Criteria listed for chloride, iron, manganese, sulfate, TDS, zinc, and pH represent the maximum concentration for domestic water supply. The NMAC also has an existing total dissolved solids (TDS) concentration of 10,000 milligrams per liter (mg/l) or less (also the case for the NNEPA standards), for present and potential future use as domestic and agricultural water supply (NMAC 20. 6.2.3103).

2.3.4 IMPOUNDMENT WATER QUALITY

There are two permanent impoundments in VMU 4: 5-1 and 5-2. Both impoundments meet the required livestock watering standards as discussed in the McKinley Mine OSMRE Permit Section 5.7.3.4.3 Permanent Impoundment Water Quality. A water quality demonstration with data showing the Mine permanent impoundments met livestock watering standards is also provided in the McKinley Mine OSMRE Permit Section 5.7.3.4.3.

2.4 PROTECTION OF HYDROLOGICAL BALANCE

The Mine permit includes preventative and remedial measures for any potential adverse hydrologic consequences identified in the Probable Hydrologic Consequences (PHC) determination. The Permit includes sections on the PHC determination, groundwater and surface water monitoring plans, general plans to address possible hydrologic consequences, and a Cumulative Hydrologic Impact Assessment (CHIA), as provided by the MMD/OSMRE. These items can be found in Section 3.4 of the Mine permit. Related permit sections are summarized below. A copy of the active and approved Permit Section 3.4 is provided as Appendix A.

2.4.1 PHC DETERMINATION

The PHC first reviews the possible impacts of the impoundments on other surface waters, which are reviewed here for the purposes of a PHC update. Assumptions for and analysis of runoff to the impoundments and consumptive losses from the impoundments are provided. The impoundments have no negative impacts on regional water quantity and should enhance local property use for livestock and wildlife. The PHC also acknowledges and evaluates the possible impact from impoundment stormwater discharge on downstream water chemistry. Review of available data indicated identifiable impact as related to pre- and post-mine monitoring stations along Defiance Draw and its tributaries. Lastly, the PHC considers the possible impacts of the groundwater, located in the alluvial, bedrock, and Gallup Sandstone Aquifer. This last item will be further discussed in report Section 4.5.3.

2.4.2 CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT (CHIA)

A CHIA was prepared by Radian Corporation for OSMRE and MMD in 1995 for the Mine. The CHIA follows the PHC language in Appendix A. Sections 3.0 and 4.0 summarize possible surface and groundwater impacts/material damages concluded by the CHIA.

2.4.3 SURFACE AND GROUNDWATER MONITORING PLANS

Per Section 6.3.2.1 of the OSMRE Mine Permit, surface-water monitoring in large watersheds is conducted at five stations identified as DD, TBW, DDT6, CMW, and CMWT. Groundwater monitoring is conducted on the following sources: alluvial groundwater, bedrock groundwater, Gallup Sandstone Aquifer, and spoil recharge groundwater. McKinley Mine OSMRE Permit required analytes vary by water source, which are provided in Table 2-2.

3.0 SURFACE WATER MONITORING

VMU 4 is located in the Puerco River Drainage Basin, with possible influence on ephemeral and perennial streams. Surface water quality is monitored at five points downstream from VMU 4. Three stream discharge locations, Outfall 010 (DC 1), Outfall 012 (SP-CB 6-7), and Outfall 013 (SP 3-6), have been monitored since 2013. Additionally, two stream monitoring locations along Coal Mine Wash Tributary and Tse Bonita Wash have been monitored since 2013.

Temporal plots were developed for a graphical representation of surface water monitoring data. The surface water temporal plots are found in Appendices B and C. A statistical analysis was performed on the data as the temporal plots were developed. Outliers noted during the statistical analysis are depicted as a red dot on the temporal plots. As these are relatively small datasets (less than 30 observations for each given parameter), outliers are detected using Dixon's Test. The test focuses on the most extreme observation in a given data set and determines if the observation is an outlier by assessing the gap between the extreme values and its nearest neighbor relative to the overall range of the data. Dixon's Test is a standardized test and was used to identify outliers on both the discharge data sets and the stream water quality data sets.

3.1 SURFACE WATER DATA

3.1.1 DISCHARGE DATA

USEPA conducted a reasonable potential analysis based on comparisons with applicable water quality standards and found no basis for incorporating WQBELs in Permit No. NN0029386. If available data or other information showed that discharges have reasonable potential to contain levels of a pollutant in excess of a standard, this would demonstrate the reasonable potential to cause or contribute to future exceedances and a limit for that pollutant would be incorporated into Permit No. NN0029386. Limits for pH (Table 1, NN0029386) are established based on the Navajo Nation water quality standards and State of New Mexico water quality standards, based on the location of the outfall.

There are three stream discharge sampling locations affiliated with watersheds in VMU 4; Outfall 010, Outfall 012, and Outfall 013 (see Figure 2-1). Historical discharge data have been recorded since March 2019 at Outfall 010 and since September 2021 at Outfall 013. No discharge data have been recorded from Outfall 012 during the reporting period due to insufficient flow. Therefore, Outfall 012 is not represented on the discharge data tables or temporal plots. Sample data for Outfall 010 are presented in Table 3-1, and sample data for Outfall 013 are presented in Table 3-2. Appendix B presents select temporal plots for Outfall 010 and Outfall 013 based on available 2019 to 2024 data. A discussion concerning the data for each analyte follows.

- Aluminum concentrations fluctuate over time for Outfall 010, while concentrations are comparatively stable for Outfall 013. There are not enough data points for Outfall 010 between 2019 and 2022 to identify trends through this period, and the August 2021 aluminum concentration for Outfall 010 appears to be a potential outlier.
- From 2021 to 2024, calcium concentrations fluctuated in Outfall 010, while concentrations were comparatively stable in Outfall 013.
- Conductance is similar in both outfalls and fluctuates between approximately 200-400 microsiemens per centimeter (µS/cm).
- Cyanide at Outfall 013 was not detected above the laboratory limit of quantification from 2023 to 2024 but was detected at Outfall 010 in 2022 and 2024.
- Gross alpha is generally higher at Outfall 010 compared to Outfall 013, with maximum results being 266 picocuries per liter (pCi/L) and 66 pCi/L, respectively. There are no significant impacts to Puerco River because of the ephemeral storm response and small loads by extension.
- Related to concentrations of metals and biotoxicity is hardness. As shown in the tables and temporal plots, discharge hardness at Outfall 010 fluctuates between 100 mg/L and 400 mg/L (as $CaCO_3$), with anomalous maximums of 790 and 850 mg/L $CaCO_3$ in August 2021 and June 2023, respectively. Outfall 013 is steady around 120 mg/L $CaCO_3$. Even with elevated concentrations of iron and selenium, hardness will reduce toxicity for aquatic life.
- There are not enough data points for Outfall 010 between 2019 and 2022 to identify trends for iron concentrations through this period. Iron concentrations fluctuate over time for Outfall 010, reaching a maximum of 230 mg/L in August 2021, while concentrations are comparatively stable for Outfall 013, staying below 31 mg/L.
- Magnesium concentrations fluctuate over time for Outfall 010, reaching a maximum of 77 mg/L in 2021, while concentrations are comparatively stable for Outfall 013, staying below 10 mg/L.
- Oil & grease were not detected above the laboratory limit of quantification for Outfall 010 and Outfall 013 except for apparent outlier values detected in July 2022 and September 2022, respectively.
- pH at both outfalls fluctuates between 7.6 and 8.2.
- There are not enough data points for Outfall 010 between 2019 and 2022 to identify trends in selenium concentrations through this period, and August 2021 appears to be an outlier. Selenium concentrations increased in 2024 for Outfall 010 but have remained comparatively stable for Outfall 013.

- There are not enough data points for Outfall 010 between 2019 and 2022 to identify trends in total dissolved solids through this period, and August 2021 appears to be an outlier. Total dissolved solids are historically higher at Outfall 010 than Outfall 013.
- There are not enough data points for Outfall 010 between 2019 and 2022 to identify trends for total suspended solids through this period. Total suspended solids fluctuate over time at Outfall 010, reaching a maximum of 25,000 mg/L in June 2024, while concentrations are comparatively stable for Outfall 013, fluctuating around 270 mg/L.

Permanent impoundments are not suspected to significantly impact surface water quality or regional hydrology. Of the eleven impoundments located in the watersheds containing VMU 4, nine are upstream from Outfall 010, one upstream of Outfall 012, and two are upstream from Outfall 013. Small depressions do not pose any additional impacts to the PHC assessment in the Permit. These structures provide opportunistic water for livestock and wildlife and add diversity to the vegetation. Since they are small (less than one acre-ft), there would be minimal impact from small depressions to the water quantity leaving the mine.

Furthermore, examination of the previously discussed analytical trends suggests that discharge water quality outcomes have remained relatively consistent. Many analyte concentrations were anomalous in 2021 and 2024 for much of the surface water data available in the vicinity of VMU 4. As for unstable analytes, the data examined in Section 3.1.2 indicate significant attenuation within the Mine boundary or just downstream in the case of CMWT. Overall, these trends support the presumption that impacts from mining and reclamation operations on surface waters are limited.

3.1.2 STREAM WATER QUALITY DATA

There are two large watershed stream monitoring stations down-stream of VMU 4: CMWT along Coal Mine Wash Tributary and TBW along Tse Bonita Wash (Figure 2-1). Stream water quality data are available for both of these locations since July 2013. Water quality for CMWT and TBW may be further compared with the undisturbed watershed Coal Mine Wash (CMW) ISCO station as outlined in the McKinley Mine 2024 Annual Report - Hydrology Section (Trihydro 2025) Section 3.3. Required analyte data are presented in Tables 3-3 and 3-4. Appendix C presents temporal plots for stream monitoring data at CMWT and TBW from 2013 to 2024.

- Even though alkalinity is not a reportable analyte specified in the permit, it is a useful parameter when discussing bicarbonate and carbonate, which are the two most important compounds that determine alkalinity. Alkalinity has generally remained steady during the reporting period for CMWT and TBW. July 2018 appears to be an outlier for alkalinity in CMWT.

- Bicarbonate concentrations shown on the temporal plot mimic alkalinity trends for CMWT and TBW.
- Total calcium concentrations at CMWT have been variable for the reporting period while remaining comparatively stable at TBW from 2013 to 2022. Calcium concentrations have been similar in both streams since 2022. Concentrations for both sample locations were low in 2022, then increased significantly in the second quarter of 2024 before again decreasing in the third quarter of 2024. The high result in the second quarter of 2024 for TBW was identified as an outlier.
- Carbonate concentrations shown on the temporal plot are misleading as this analyte has historically been reported at or near the laboratory detection limit or the limit of quantification and is an insignificant component of total alkalinity at the historical pH levels. The carbonate concentrations were below detection limits during the reporting period except for an outlier value for CMWT detected in July 2018.
- The calculated cation-anion balance at both CMWT and TBW has been variable during the reporting period, and values for both streams have been similar during the reporting period.
- Chloride concentrations have been relatively stable at both streams during the reporting period.
- Field conductance is similar for both CMWT and TBW and has slightly increased from 2018 through 2019.
- Total hardness at CMWT has been variable for the reporting period while increasing slightly at TBW from 2015 to 2024. Concentrations for both sample locations were low in 2022, then increased significantly in the second quarter of 2024 before again decreasing in the third quarter of 2024.
- Dissolved iron concentrations have generally decreased for TBW and CMWT during the reporting period except for elevated values in CMWT during July and August of 2019 with one of those values noted as an outlier.
- Total iron concentrations at CMWT and TBW have been variable during the reporting period, with concentrations in TBW generally lower than those in CMWT. Concentrations for both sample locations were low in 2022, then increased significantly in the second quarter of 2024 before again decreasing in the third quarter of 2024.
- Total magnesium concentrations at CMWT and TBW have been variable during the reporting period, with concentrations in TBW generally lower than those in CMWT. Concentrations for both sample locations were low in 2022, then increased significantly in the second quarter of 2024 before again decreasing in the third quarter of 2024.
- Dissolved manganese concentrations have shown a relatively stable trend for TBW during the reporting period. Concentrations in CMWT were elevated from 2019 to 2021 but have since decreased to values similar to TBW.
- Total manganese concentrations at CMWT and TBW have been variable during the reporting period, with concentrations in TBW generally lower than those in CMWT. Concentrations for both sample locations were

lowest in 2022, then increased significantly in the second quarter of 2024 before again decreasing in the third quarter of 2024. Analytical results indicate that a greater concentration of suspended manganese was present than dissolved manganese for all of the sampling events in TBW and most of the sampling events for CMWT.

- Total mercury concentrations were below the limit of quantification for CMWT and TBW post-2019 with the exception of an increase in concentrations for CMWT in August 2022 and July 2024 and for TBW in July 2024.
- Nitrogen, expressed as nitrate, concentrations have remained relatively stable for CMWT during the reporting period. Concentrations in TBW have been relatively stable since an outlier value in July of 2017 with many samples below the laboratory limit of quantification.
- Field pH values have been variable during the reporting period but have ranged between 7.8 and 8.9 for both CMWT and TBW with the exception of elevated values around 9.5 for TBW in July 2015.
- Lab pH values have been variable during the reporting period with values at TBW ranging from 7.5 to 8.4 and those at CMWT ranging from 7.8 to 8.2.
- Phosphate levels have not been detected above the laboratory limit of quantification for both CMWT and TBW since 2021.
- Total phosphorous concentrations have shown an increasing trend in CMWT over the reporting period while concentrations have been comparatively stable in TBW. Concentrations for both sample locations were lowest in 2022, then increased significantly in the second quarter of 2024 before again decreasing in the third quarter of 2024. The high result in the second quarter of 2024 for TBW was identified as an outlier.
- Total potassium concentrations have been variable in CMWT over the reporting period while concentrations have been comparatively stable in TBW. Concentrations for both sample locations were lowest in 2022, then increased significantly in the second quarter of 2024 before again decreasing in the third quarter of 2024.
- Total selenium concentrations were generally below the laboratory limit of quantification for both CMWT and TBW prior to 2021. Concentrations for both sample locations were lowest in 2022, then increased significantly in the second quarter of 2024 before again decreasing in the third quarter of 2024.
- The sodium adsorption ratio for both CMWT and TBW has been relatively stable over the reporting period with the exception of an outlier value at TBW in September 2014.
- Total sodium concentrations at CMWT have been variable during the reporting period. Concentrations at TBW have been generally stable and lower than those of CMWT with the exception of elevated values reported in September 2014 and June 2024.

- Sulfate concentrations have been stable at CMWT over the reporting period with an outlier value reported in August 2013. Concentrations at TBW have generally decreased and remained stable since 2016 with an increased concentration reported in June 2024 before returning to levels consistent with prior concentrations.
- Settleable solids concentrations have fluctuated throughout the reporting period at CMWT and concentrations at TBW have been comparatively stable since the second half of 2019. Both streams had high outlier concentration values reported in July 2018.
- Total dissolved solids concentrations at CMWT have been variable over the reporting period. Concentrations at TBW have been comparatively stable during the reporting period. The second quarter of 2024 concentration was not detected due to an elevated detection limit as a result of a laboratory error.
- Total suspended solids concentrations at CMWT have been variable over the reporting period. Concentrations at TBW have been comparatively stable during the reporting period with a high outlier value in the second quarter of 2024. The majority of the cations found in surface water exist in the suspended phase relative to the dissolved phase.

Examination of the previously discussed analytical trends suggests that stream water quality has improved or remained consistent since 2013 in both Coal Mine Wash Tributary and Tse Bonita Wash. Lower constituent concentrations over time were expected as vegetation established in the area. Water quality is comparable between the two streams. There are anomalies within decreasing trends for samples taken in 2018 and 2021. Increased values for numerous analytes were reported in the second quarter of 2024 before decreasing in the third quarter of 2024. Overall, these trends support the presumption that impacts from mining and reclamation operations on surface water are limited or insignificant. Geochemical parameters such as pH, alkalinity, and hardness also indicate stream water is resistant to such impacts.

3.2 ASSESSMENT OF SURFACE WATER DATA

3.2.1 COMPARISON TO BASELINE WATER QUALITY

There are no actual surface water data from pre-mining conditions available for comparison to current discharge or stream water quality data. Therefore, this comparison is not included in this report.

3.2.2 COMPARISON TO REGULATORY STANDARDS

There are three NPDES outfalls affiliated with VMU 4: Outfall 010, Outfall 012 and Outfall 013. USEPA conducted a reasonable potential analysis based on comparisons with applicable water quality standards and found no basis for incorporating WQBELs in the site NPDES Permit other than pH. Therefore, there are no regulatory standards to compare the Outfall water quality results.

There are three stream monitoring stations downstream of the outfalls. CMWT is downstream of Outfall 010, CMW downstream of Outfall 012, and TBW downstream of Outfall 013 (Figure 2-1). There is no discharge data available from Outfall 012. Discharge water quality analysis from the outfalls was not conclusive, though analytical trend analysis of surface water quality of CMWT and TBW indicate attenuation of impacts observed at Outfalls 010 and 013. The overall findings of this report, as well as the trends outlined in the 2024 Hydrology Report (Trihydro 2025), for the surface water monitoring sites conclude there are limited or no impacts to surface waters after mining and reclamation operations and there are no impacts to the hydrologic balance.

3.2.3 COMPARISON TO PROBABLE HYDROLOGIC CONSEQUENCES

The PHC determination (Permit Section 3.4.4) acknowledges the possible consequence of stormwater on downstream water chemistry. Data show that there are no deleterious effects to watershed health of the Puerco River. Regional surface waters are also protected because of ephemeral flow patterns of the streams of interest and limited constituent loadings to downstream reaches as a result. Monitoring at NPDES outfalls and McKinley Mine surface water monitoring stations will cease upon final stages of bond release. NPDES outfalls will be removed from the stormwater permit subsequent to Phase III approval of permanent program lands and Termination of Jurisdiction on initial program lands. Full discussion of the surface water quality from each of the mine watersheds is included in the 2024 Annual Hydrology Report (Trihydro 2025) Section 3.0.

4.0 GROUNDWATER MONITORING

Groundwater at the Mine is monitored at four sources: alluvial, bedrock, Gallup Sandstone Aquifer, and spoil. A summary of data for the four groundwater sources is provided below followed by a comparison of results to baseline water quality, regulatory standards, and the PHC, as applicable. Depth to water data for the groundwater sources are presented in Table 4-1. Tabulated water quality data for the groundwater sources are presented in Tables 4-2 and 4-3 with temporal plots presented in Appendix D. Historical groundwater data tables include relevant groundwater protection standards for reference.

Temporal plots were developed for a graphical representation of the long-term groundwater monitoring. The surface water temporal plots are found in Appendices D1 and D2. A statistical analysis was performed on the data as the temporal plots were developed. Any outliers noted during the statistical analysis are depicted as a red dot on the temporal plots. As these are relatively small datasets (less than 30 observations for each given parameter), outliers are detected using Dixon’s Test. The test focuses on the most extreme observation in a given data set and determines if the observation is an outlier by assessing the gap between the extreme values and its nearest neighbor relative to the overall range of the data. Dixon’s Test is a standardized test and was used to identify outliers on both the GSA well data set and the bedrock well data set.

4.1 ALLUVIAL GROUNDWATER

Alluvial wells are located in and around major drainage watersheds throughout the Mine. Since water levels in these wells are dependent on direct precipitation, the depth to groundwater and the saturated thickness in wells vary to some degree based on rain and snowfall.

In 2016, OSMRE and MMD approved a permit modification to monitor only seven alluvial wells. Four of these wells have historically been considered recharging (DT2A, DT2B, TB2B2, and TB3D) whereas the remainder of the wells (CMC, D2C, and D3B2) have historically been dry. The alluvial wells being dry is consistent with the PHC. There are no alluvial wells in the vicinity of VMU 4.

4.2 GALLUP SANDSTONE AQUIFER

Five water wells (1, 2, 3, 3A, and 4) have been completed in the Gallup Sandstone Aquifer throughout the Mine area. These wells were used as primary water sources for mine activities and reclamation. The wells now provide domestic water, dust-control water, or are only monitored. Because of the relatively low permeability of the shale units overlying the Gallup Sandstone Aquifer and the geologic structure in the area, the Gallup Sandstone Aquifer can be under artesian conditions. Moreover, due to the presence of the overlying shales, there is no hydraulic connection between the underlying Gallup Sandstone and the mined strata. The nearest GSA Well to VMU 4, Well 3A, is located southwest of VMU 4 (Figure 2-1).

4.2.1 WATER LEVELS

Water level and saturated thickness are presented in Table 4-1 for Well 3A. Depth to groundwater in Well 3A has been variable since 2013 with corresponding increase/decrease in saturated thickness.

4.2.2 WATER QUALITY

Sampling of Well 3A has been conducted quarterly for multiple parameters since the second half of 2015. Significant chemical parameters are included in the Groundwater Quality Summary 2015-2024 (Table 4-2). Appendix D-1 presents temporal plots for Well 3A based on available 2015 to 2024 data.

Examination of the analytical data and temporal plots for the reporting period associated with Well 3A indicate the following.

- Alkalinity concentrations have been relatively stable at Well 3A over the reporting period except for a low outlier value reported in November 2024. Nearly all the alkalinity present in Gallup Sandstone groundwater is attributable to bicarbonate, as carbonate is a relatively minor component.
- Bicarbonate concentrations are identical to alkalinity trends for the reporting period.
- Dissolved calcium concentrations have been relatively stable at Well 3A over the reporting period except for a low outlier value reported in November 2024.
- Carbonate concentrations have consistently been reported below the laboratory limit of quantification over the reporting period.
- Chloride concentrations have remained relatively stable to slightly decreasing in Well 3A during the reporting period. High and low outliers have been reported throughout the reporting period.
- Fluoride concentrations in Well 3A have been mostly below laboratory limits of quantification for the reporting period.
- Total hardness concentrations, expressed as CaCO3, are generally stable in Well 3A with a normal range of 220-285 mg/L. A high outlier was reported in the first half of 2016 and the most recent measurement in November 2024 was reported as a low outlier.

- Total iron concentrations were relatively stable at Well 3A during the reporting period with normal concentrations below 1.4 mg/L. High outliers were reported in September 2015, August 2021, and January and November 2024.
- Dissolved magnesium concentrations for Well 3A have fluctuated between 11 and 13 mg/L during the reporting period.
- Total manganese concentrations have been relatively stable for Well 3A over the reporting period with outlier values in 2016, 2018, 2023, and 2024.
- Lab pH values have remained relatively stable over the reporting period with normal values falling within the 7.7 to 8.1 range.
- Phosphate was not detected above the laboratory limit of quantification at Well 3A during the reporting period.
- Potassium concentrations have slightly decreased in Well 3A over the reporting period.
- Dissolved sodium concentrations at Well 3A have remained relatively stable throughout the reporting period with values fluctuating between 36 mg/L to 47 mg/L.
- Sulfate concentrations have remained relatively stable throughout the reporting period for Well 3A, fluctuating around a concentration of 100 mg/L. The highest outlier of 270 mg/L was reported in September 2020, and the most recently reported concentration of 53 mg/L is the lowest outlier.
- Total dissolved solids concentrations have been relatively stable at Well 3A since 2017 except for a low outlier value reported in November 2024.
- Turbidity values were relatively stable at Well 3A during the reporting period with normal values below 12 mg/L. The highest outliers were reported in September 2015, August 2021, and November 2024.

Examination of the previously discussed analytical trends suggests that water-quality concentrations have remained relatively consistent since 2015 at Well 3A. Anomalous high and low outlier values were reported for many analytes in the second half of 2024. Additional water quality data comparison with other GSA wells located at the McKinley Mine can be found in Section 2.3 of the 2024 Annual Hydrology Report (Trihydro 2025). Overall, these trends support the presumption that impacts from mining and reclamation operations on groundwater in the Gallup Sandstone Aquifer have not occurred or are limited.

4.3 BEDROCK AQUIFER

In 1980, five bedrock wells (MBR1, MBR2, MBR3, MBR4, and MBR5) were installed approximately 50-feet (ft) below the Green Coal Seam to monitor groundwater below this unit. The Green Coal Seam was the lowermost recoverable coal seam at the mine. These monitoring wells, referred to as McKinley bedrock wells, were located in and around the major drainage watersheds throughout the mine. Three of the original five wells (MBR1, MBR3, and MBR4) were mined through and not replaced. The active bedrock monitoring wells include MBR2 and MBR5, with MBR2 being in the vicinity of VMU 4. Upon the ultimate stages of bond release, MBR2 will be plugged and abandoned in accordance with Permit Section 6.3.2.2.1 and NMAC 19.27.4.30.C.1.

4.3.1 WATER LEVELS

Water level and saturated thickness data are presented in Table 4-1 for MBR2. Depth to groundwater in MBR2 had been increasing since 2013 with slight recoveries in 2022 and 2024. However, 2022 and 2024 water level depths are still higher than pre-2020 levels.

4.3.2 WATER QUALITY

Sampling of MBR-2 has been conducted annually for multiple parameters. Significant chemical parameters are included in the Groundwater Quality Summary 2013-2024 (Table 4-3). Appendix D-2 presents temporal plots for MBR-2 based on available 2013 to 2024 data.

Examination of the analytical data and temporal plots for the reporting period associated with MBR2 indicate the following.

- Alkalinity is a useful parameter when discussing bicarbonate and carbonate trends below. Alkalinity concentrations have been relatively stable at MBR2 and fluctuate around 550 mg/L $CaCO_3$. Nearly all the alkalinity present in bedrock groundwater is attributable to bicarbonate as carbonate, and is a relatively minor component
- Bicarbonate concentrations are identical to alkalinity trends for the reporting period.
- Total boron levels have fluctuated from 0.15 to 0.20 mg/L at MBR2, with the exception of an outlier of 0.27 mg/L reported in October 2024. Overall, boron levels show a slight increasing trend during the reporting period.
- Total calcium concentrations at MBR2 have been generally stable over the reporting period, staying below 7.1 mg/L. A high outlier concentration of 120 mg/L was reported in October 2024.
- Carbonate concentrations have consistently been reported below the laboratory limit of quantification over the reporting period.
- The calculated cation-anion balance percentages at MBR2 have been consistently less than 6%, other than an anomalous value in October 2014.

- Chloride concentrations at MBR2 have fluctuated since 2013 but indicate a generally neutral trend.
- Field conductance has been relatively stable at MBR2 over the reporting period with the exception of an anomalous low outlier reported in October 2020.
- Fluoride concentrations at MBR2 have fluctuated since 2013 but indicate a generally neutral trend. Fluoride has consistently been above the water quality standard of 1.6 mg/L during the reporting period.
- Total hardness at MBR2 has been generally stable over the reporting period, fluctuating between 20 to 45 mg/L with a slightly decreasing trend prior to a high outlier concentration of 370 mg/L in October 2024.
- Dissolved iron has not been detected above the laboratory limit of quantification for the majority of samples. Dissolved iron concentrations exceeded the water quality standard (1 mg/L) in 2013.
- Total iron concentrations have fluctuated over the reporting period but have decreased since 2021. Most of the iron exists in the suspended phase since dissolved iron has often been non-detect.
- Total magnesium concentrations at MBR2 have been generally stable over the reporting period, fluctuating between 1.5 and 3.9 mg/L. A high outlier concentration of 18 mg/L was reported in October 2024.
- Dissolved manganese concentrations at MBR2 have fluctuated since 2013 but indicate a generally neutral trend with the exception of a high outlier concentration reported in October 2021. Dissolved manganese has not been detected above the water quality standard during the reporting period.
- Total manganese concentrations at MBR2 have fluctuated over the reporting period but show a slightly decreasing trend. A high outlier concentration was reported in October 2021 corresponding to the increased dissolved manganese reported during the same period.
- Nitrogen, expressed as nitrate, concentrations have been below the laboratory limit of quantification except during September 2016 and October 2020. The laboratory limit of quantification has varied as a result of matrix interference.
- Field pH values at MBR2 have varied over the reporting period ranging from 7.3 to 8.0.
- Lab pH values at MBR2 have varied over the reporting period ranging from 7.6 to 8.1.
- Phosphate has consistently been reported below the laboratory limit of quantification during the reporting period. The variability shown on the temporal plot is a result of varying limits of quantification through the reporting period.
- Total phosphorous concentrations at MBR2 that were above the laboratory limit of quantification have exhibited a slight increasing trend over the reporting period.

- Total potassium concentrations at MBR2 have been generally stable over the reporting period, fluctuating between 2.3 and 5.8 mg/L. A high outlier concentration of 25 mg/L was reported in October 2024.
- Total selenium concentrations were generally below the laboratory limit of quantification during the reporting period. The exceptions were detections reported in October 2014 and October 2024. The limit of quantification varies due to sample matrix interference.
- Total sodium concentrations been relatively stable at MBR2 over the reporting period with the exception of an anomalous low outlier reported in October 2024.
- Sulfate concentrations at MBR2 have fluctuated since 2013, ranging from 540 mg/L to 600 mg/L, but indicate a generally neutral trend.
- Total dissolved solids concentrations at MBR2 have fluctuated since 2013 but indicate a generally neutral trend over the reporting period. Total dissolved solids concentrations routinely exceed the water quality standard.
- Total zinc concentrations at MBR2 that were above the laboratory limit of quantification have exhibited a slight increasing trend over the reporting period, with the highest values reported in November 2015 and October 2024.

Examination of the previously discussed analytical trends suggests that water-quality concentrations have remained relatively consistent since 2013 at Well MBR2. Anomalous high and low outlier values were reported for several analytes in the second half of 2024. Overall, these trends support the presumption that impacts from mining and reclamation operations on groundwater have not occurred or are limited.

4.4 SPOIL GROUNDWATER

Five spoil recharge wells (2G2, 4A, 9A, 9S, and 11) were constructed in the Mine area. Two spoil wells (4A and 9A on MMD lands) were installed in 1990; of these two wells, only 9A remains. Well 4A was not monitored after 2015 following approval by MMD to discontinue monitoring this well because the land at the well location had a full bond and liability release. Well 4A was abandoned October 29, 2018. In April 2013, three additional spoil recharge wells were constructed and designated as wells 2G2 (on OSMRE lands in the vicinity of VMU 4), 11 (on MMD lands), and 9S (on MMD lands). Spoil recharge wells were installed throughout the mine in reclaimed areas to determine chemical presence and groundwater properties. These wells were terminated at bedrock and their screens encompassed the spoil interval immediately above bedrock. As shown on Table 4-1, water column thickness in Well 2G2 has been less than 1 ft since 2016. Due to lack of water column thickness, well 2G2 has not been sampled during the 2013-2024 reporting period.

4.5 ASSESSMENT OF GROUNDWATER DATA

4.5.1 COMPARISON TO BASELINE WATER QUALITY

There are no baseline groundwater data from pre-mining conditions available for comparison to current groundwater quality data. Therefore, this comparison is not included in this report.

4.5.2 COMPARISON TO REGULATORY STANDARDS

Water quality from the bedrock aquifer and Gallup Sandstone Aquifer were assessed against the regulatory standards established for the maximum allowable concentrations of groundwater of 10,000 mg/L TDS or less (NMAC 20.6.2.3103). Tables 4-2 and 4-3 include these standards at the bottom, allowing for easy comparison to groundwater quality data, with bolded values indicating exceedances. Only the following monitored constituents are regulated by the referenced standards: fluoride, nitrate as N, and selenium for human health standards and chloride, dissolved iron, dissolved manganese, sulfate, TDS, zinc, and pH for domestic water supply. As previously mentioned, Well 3A has fewer required analytes as a Gallup Sandstone Aquifer well. Well 3A had no observed exceedances (Table 4-2). Fluoride and TDS were observed in exceedance of 1,000 mg/L for every sampling event at MBR2 (Table 4-3). MBR2 also has reported exceedances for dissolved iron (Q4 2013). Please see the McKinley Annual Hydrology Report (Trihydro 2024) for comparison between other GSA and MBR wells.

4.5.3 COMPARISON TO PROBABLE HYDROLOGIC CONSEQUENCES

Data establish that bedrock groundwaters are of poor quality that cannot be used for beneficial purposes. Data also show, however, that they have had no deleterious effect on established surface or groundwater uses. Upon the final stages of bond release, wells will be abandoned or transitioned to the Navajo Nation.

5.0 SURFACE AND GROUNDWATER ASSESSMENT SUMMARY

As required for bond release of long-term surface and groundwater monitoring, water quality and quantity data are provided in this report. Evaluation of the data was presented in two separate sections to confirm that mining activities at the McKinley Mine have not adversely disturbed the hydrologic balance in or around the site. Findings from the 1980 GAI Report, comparison with the undisturbed Coal Mine Wash watershed, comparison with regulatory standards, and the PHC determination indicate that mining and reclamation have had minimal impact on the quality and quantity of this resource. The following provides a brief summary of those findings.

5.1 SURFACE WATER ASSESSMENT SUMMARY

There are three NPDES outfalls affiliated with VMU 4: Outfall 010, Outfall 012 and Outfall 013. There are three stream monitoring stations downstream of the outfalls. CMWT is downstream of Outfall 010, CMW downstream of Outfall 012, and TBW downstream of Outfall 013 (Figure 2-1). There is no discharge data available from Outfall 012. Discharge water quality analysis from the outfalls was not conclusive, though analytical trend analysis of surface water quality of CMWT and TBW indicate attenuation of impacts observed at Outfalls 010 and 013. The overall findings conclude there are limited or no impacts to surface waters after mining and reclamation operations and there are no impacts to the hydrologic balance.

The PHC determination (Permit Section 3.4.4) acknowledges the possible consequence of stormwater on downstream water chemistry. Data show that there are no deleterious effects to watershed health of the Puerco River. Regional surface waters are also protected because of ephemeral flow patterns of the streams of interest and limited constituent loadings to downstream reaches as a result.

5.2 GROUNDWATER ASSESSMENT

Near VMU 4 there is one bedrock well, MBR2, and the nearest Gallup Sandstone Aquifer well is 3A. Comparison of groundwater quality data to protection standards indicate exceedances of various analytes. Well 3A had no observed exceedances over the entire period of record. Meanwhile, MBR2 has one exceedance for dissolved iron over the period of record, as well as excess concentrations of fluoride and TDS. Anomalous high and low outlier values were reported for many analytes in the second half of 2024 for both Well 3A and MBR2. There are no impacts from mining on groundwater, which is consistent with the PHC.

6.0 REFERENCES

Geohydrology Associates, Inc. (GAI). 1980. Hydrology Study of the McKinley Mine.

McKinley Mine Permit No. NM-0001K, 2016.

30 CFR 800, Bond and Insurance Requirements for Surface Coal Mining and Reclamation Operations under Regulatory Programs, 1983 (as amended in 2017).

National Pollutant Discharge Elimination System (NPDES) Permit No. NN0029386. 2017. July 1.

New Mexico Administrative Code (NMAC). 2022. Title 20, Environmental Protection Chapter 6, Water Quality Part 4: Standards for Interstate and Intrastate Surface Waters. April 23.

New Mexico Administrative Code (NMAC). 2017. Title 19, Natural Resources and Wildlife Chapter 27, Underground Water Part 4: Well Driller Licensing; Construction, Repair, and Plugging of Wells. June 30.

New Mexico Administrative Code (NMAC). 2007. Title 20, Environmental Protection Chapter 6, Water Quality Part 2: Ground and Surface Water Protection. June 1.

Trihydro Corporation (Trihydro). 2025. McKinley Mine – 2024 Annual Report Hydrology Section. February 26.

TABLES

TABLE 2-1. PRECIPITATION DATA, RAIN 2, RAIN 3, AND RAIN 6
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Month	2013			2014			2015			2016			2017		
	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)
January	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
February	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
March	0.00	0.00	0.00	--	--	--	--	--	--	--	--	--	--	--	--
April	0.26	0.28	0.18	0.06	0.08	0.02	0.52	0.57	0.54	1.26	0.99	0.82	0.17	0.20	0.20
May	0.01	0.04	0.04	0.11	0.34	0.29	1.51	1.8	0.71	0.68	1.21	1.54	0.58	0.72	0.75
June	0.23	0.19	0.13	0.00	0	0	1.98	1.77	2.12	0.22	0.06	0.02	0.14	0.45	0.29
July	2.22	3.39	3.05	1.70	1.9	1.6	3.15	3.61	2.66	0.78	0.99	0.96	2.22	1.62	2
August	2.12	2.89	2.35	0.56	0.61	1.14	1.41	3.06	2.12	2.08	2.71	2.04	0.71	0.11	0.4
September	3.05	2.51	2.27	2.15	1.87	1.78	0.50	0.44	0	1.46	1.63	1.52	0.87	0.5	1.19
October	0.70	0.69	0.74	0.18	0.21	0.23	1.08	1.36	0.92	0.63	0.56	0.38	0.21	0.33	0.19
November	0.32	0.33	0.33	0.02	0.03	0.02	0.92	0.86	0.70	0.44	0.44	0.51	0.02	0.02	0.02
December	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Total Annual Precipitation

Year	2013			2014			2015			2016			2017		
Apr-Nov (inches)	8.91	10.32	9.09	4.78	5.04	5.08	11.07	13.47	9.77	7.55	8.59	7.79	4.92	3.95	5.04

Notes:

-- precipitation station not operating due to freezing temperatures

🟩 Partial operating month

in - inches

Apr - April

Nov - November

TABLE 2-1. PRECIPITATION DATA, RAIN 2, RAIN 3, AND RAIN 6
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Month	2018			2019			2020			2021			2022		
	Rain 2 (in)	**Rain 3 (in)**	**Rain 6 (in)**	**Rain 2 (in)**	**Rain 3 (in)**	**Rain 6 (in)**	**Rain 2 (in)**	**Rain 3 (in)**	**Rain 6 (in)**	**Rain 2 (in)**	**Rain 3 (in)**	**Rain 6 (in)**	**Rain 2 (in)**	**Rain 3 (in)**	**Rain 6 (in)**
January	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
February	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
March	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
April	0.06	0.04	0.03	0.22	0.39	0.36	0.26	0.00	0.05	0.00	0.03	0.02	0.00	0.00	0.01
May	0.26	0.3	0.21	1.41	1.5	1.2	0.09	0.01	0.02	0.03	0.09	0.06	0.00	0	0
June	0.30	0.35	0.46	0.15	0.32	0	0.05	0.05	0.02	0.16	0.05	0.03	1.03	1.03	0.66
July	1.10	0.92	0.97	0.35	0.7	0.01	1.65	1.06	0.82	0.99	0.69	0.83	3.00	2.99	2.55
August	0.90	0.91	0.56	0.73	0.11	0.34	0.20	0.62	0.55	1.09	1.04	0.19	3.77	3.07	3.05
September	1.40	1.27	1.02	1.35	1.72	1.82	0.17	0.16	0.14	1.03	1.63	0.46	1.22	1.18	0.69
October	1.48	1.69	1.45	0.04	0.06	0.04	0.31	0.27	0.08	0.94	1.17	1.06	1.14	1.19	0.28
November	0.00	0.00	0.00	0.05	0.06	0.03	0.16	0.19	0.16	0.00	0.00	0.00	0.39	0.54	0.47
December	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Total Annual Precipitation

Year	**2018**			**2019**			**2020**			**2021**			**2022**		
Apr-Nov (inches)	5.50	5.48	4.70	4.30	4.86	3.80	2.89	2.36	1.84	4.24	4.70	2.65	10.55	10.00	7.71

Notes:

-- precipitation station not operating due to freezing temperatures

🟩 Partial operating month

in - inches

Apr - April

Nov - November

TABLE 2-1. PRECIPITATION DATA, RAIN 2, RAIN 3, AND RAIN 6
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

	2023			2024		
Month	**Rain 2 (in)**	**Rain 3 (in)**	**Rain 6 (in)**	**Rain 2 (in)**	**Rain 3 (in)**	**Rain 6 (in)**
January	--	--	--	--	--	--
February	--	--	--	--	--	--
March	--	--	--	--	--	--
April	0.00	0.01	0.00	0.21	0.28	0.22
May	0.48	0.84	1.49	0.01	0.01	0.06
June	0.09	0.22	0.22	2.36	2.23	2.33
July	0.08	0.26	0.07	0.65	0.87	1.22
August	3.08	2.93	1.97	2.31	2.64	2.33
September	0.44	0.54	0.49	0.60	0.48	0.45
October	0.09	0.08	0.05	1.32	1.55	1.35
November	0.00	0.00	0.00	0.13	0.15	0.08
December	--	--	--	--	--	--

Average (2013-2024) (in)	**Maximum (2013-2024) (in)**
--	--
--	--
--	--
0.23	1.26
0.51	1.80
0.55	2.36
1.49	3.61
1.58	3.77
1.11	3.05
0.67	1.69
0.21	0.92
--	--

	Total Annual Precipitation			**Total Annual Precipitation**		
Year	**2023**			**2024**		
Apr-Nov (inches)	4.26	4.88	4.29	7.59	8.21	8.04

Average (2013-2024)	**Rain 2 Average (in)**
6.34	6.38
Rain 3 Average (in)	**Rain 6 Average (in)**
6.82	5.82

Notes:

--_ precipitation station not operating due to freezing temperatures

🟩 Partial operating month

in - inches

Apr - April

Nov - November

TABLE 2-2. McKINLEY MINE WATER ANALYSIS PARAMETERS
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Parameter	Sample Type		
	Surface	Alluvial	Bedrock/Spoil
Bicarbonate	*	*	*
Boron			*
Calcium, Total	*	*	*
Carbonate	*	*	*
Cation-Anion Balance	*	*	*
Chloride	*	*	*
Conductance, Field	*	*	*
Fluoride			*
Hardness	*	*	*
Iron, Dissolved	*@	*@	*@
Iron, Total	*	*	*
Magnesium, Total	*	*	*
Manganese, Dissolved	*@	*@	*@
Mercury, Total	*		
Manganese, Total	*	*	*
Nitrate	*	*	*
pH, Lab	*	*	*
pH, Field	*	*	*
Phosphate	*	*	*
Phosphorus, Total	*	*	*
Potassium, Total	*	*	*
SAR	*		
Selenium, Total	*	*	*
Settleable Solids	*		
Sodium, Total	*	*	*
Sulfate	*	*	*
Total Dissolved Solids	*	*	*
Total Suspended Solids	*		
Zinc, Total			*
Depth to water		*	*

Notes: * indicates that sample is analyzed for this parameter.
@ indicates a 0.45 micron filter is utilized.

TABLE 3-1. HISTORICAL DISCHARGE DATA - OUTFALL 010
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Location	Date Sampled	Aluminum, Total (mg/L)	Calcium, Total (mg/L)	Conductance (µS/cm)	Cyanide, Total (mg/L)	Gross Alpha (pCi/L)	Hardness (mg/L CaCO$_3$)	Iron, Total (mg/L)	Magnesium, Total (mg/L)	Oil & Grease (mg/L)	pH, Lab (s.u.)	Selenium, Total (mg/L)	Solids, Total Dissolved (mg/L)	Solids, Total Suspended (mg/L)
Outfall 010/DC 1	3/2/2019	6.35	NM	331	ND(0.01)	12.7	83.6	4.92	NM	ND(5)	7.9	0.00073	264	158
Outfall 010/DC 1	8/2/2021	210	190	230	ND(0.005)	266	790	230	77	ND(9.84)	8	0.045	3,800	12,000
Outfall 010/DC 1	7/30/2022	87	39	273	ND(0.005)	30.9	150	35	12	31.3	7.97	0.0071	785	240
Outfall 010/DC 1	8/16/2022	19	36	317	ND(0.005)	11.5	130	8.3	8.5	ND(9.73)	8.2	0.0016	290	19
Outfall 010/DC 1	9/22/2022	17	39	304	ND(0.005)	ND(86)	140	17	11	ND(9.61)	7.98	0.0024	535	270
Outfall 010/DC 1	10/17/2022	5.5	38	332	ND(0.005)	ND(75.6)	130	5.7	9.3	ND(10)	8.1	ND(0.005)	274	38
Outfall 010/DC 1	2/21/2023	3.2	22	227	ND(0.01)	ND(84)	79	1.7	5.7	ND(9.83)	7.59	ND(0.001)	345	100
Outfall 010/DC 1	3/22/2023	15	29	451	ND(0.005)	ND(95.2)	110	10	9.3	ND(9.95)	8.06	0.0048	705	180
Outfall 010/DC 1	8/15/2023	36	44	291	ND(0.005)	61	170	35	14	ND(9.78)	7.74	0.0022	1,180	1,000
Outfall 010/DC 1	8/24/2023	99	73	153.6	ND(0.005)	249	320	100	35	NM	7.83	0.0066	ND(500)	6,600
Outfall 010/DC 1	10/18/2023	20	54	436	ND(0.005)	38.9	200	20	15	ND(9.76)	7.69	0.0017	460	970
Outfall 010/DC 1	6/27/2024	160	220	372	ND(0.005)	243	850	170	74	ND(5.5)	8.1	0.023	2,800	25,000
Outfall 010/DC 1	7/25/2024	92	88	246	0.0055	31	370	110	36	ND(10)	7.7	0.012	970	4,500
Outfall 010/DC 1	8/7/2024	41	110	243	0.0077	67.8	400	48	29	ND(4.9)	7.8	0.0073	750	12,000
Outfall 010/DC 1	8/14/2024	120	86	174.1	ND(0.005)	128	360	92	35	ND(5.1)	7.9	0.015	1,100	4,500
Outfall 010/DC 1	8/26/2024	33	48	291	ND(0.005)	52.8	190	34	16	ND(5.1)	7.9	0.0048	790	790
Outfall 010/DC 1	10/20/2024	8.3	29	283	ND(0.005)	8.23	100	6.9	7.7	ND(5.2)	8	0.0017	490	160

Abbreviations:
mg/L - milligrams per liter
mg/L CaCO$_3$ - milligrams per liter as calcium carbonate
µS/cm - microSiemens per centimeter
ND - non-detect (detection limit in parentheses)
NM - not measured
pCi/L - picocuries per liter, measure of radioactivity
s.u. - standard units

TABLE 3-2. HISTORICAL DISCHARGE DATA - OUTFALL 013
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Location	Date Sampled	Aluminum, Total (mg/L)	Calcium, Total (mg/L)	Conductance (µS/cm)	Cyanide, Total (mg/L)	Gross Alpha (pCi/L)	Hardness (mg/L $CaCO_3$)	Iron, Total (mg/L)	Magnesium, Total (mg/L)	Oil & Grease (mg/L)	pH, Lab (s.u.)	Selenium, Total (mg/L)	Solids, Total Dissolved (mg/L)	Solids, Total Suspended (mg/L)
Outfall 013/SP 3-6	9/27/2021	17	29	180	ND(0.005)	16.4	100	18	7.2	ND(9.87)	7.83	**0.0067**	600	190
Outfall 013/SP 3-6	7/27/2022	16	37	354	0.00621	8.18	120	6.4	7.7	ND(9.93)	7.93	0.0014	446	50
Outfall 013/SP 3-6	8/16/2022	32	32	251	ND(0.005)	13.8	110	15	6.7	ND(10.2)	8.03	0.0017	368	360
Outfall 013/SP 3-6	9/22/2022	29	33	158	ND(0.005)	65.9	120	31	10	504	7.85	0.0028	600	430
Outfall 013/SP 3-6	10/4/2022	12	33	235	ND(0.005)	ND(133)	110	12	7.2	ND(9.59)	8.04	0.0017	282	98
Outfall 013/SP 3-6	10/18/2022	9.1	32	194	ND(0.005)	13.9	110	9.8	7.2	ND(9.7)	7.83	0.0024	284	100
Outfall 013/SP 3-6	2/21/2023	1.6	22	150	ND(0.01)	3.89	74	1.1	4.4	ND(10.5)	7.62	0.0016	390	160
Outfall 013/SP 3-6	3/23/2023	0.57	40	385	ND(0.005)	ND(94.1)	130	0.52	8.3	ND(9.8)	8.09	ND(0.001)	164	14
Outfall 013/SP 3-6	8/13/2023	15	33	267	ND(0.005)	46.9	120	20	8.4	ND(10.1)	7.78	0.0011	252	630
Outfall 013/SP 3-6	8/24/2023	19	34	218	ND(0.005)	32.2	120	24	9.1	ND(9.92)	7.79	0.0015	740	450
Outfall 013/SP 3-6	8/25/2024	2.7	45	356	ND(0.005)	6.44	150	3	8.8	ND(5.4)	7.8	0.0013	310	50
Outfall 013/SP 3-6	9/17/2024	17	41	283	ND(0.005)	19.6	140	18	9.6	ND(5.2)	7.9	ND(0.005)	820	720

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
µS/cm - microSiemens per centimeter
ND - non-detect (detection limit in parentheses)
NM - not measured
pCi/L - picocuries per liter, measure of radioactivity
s.u. - standard units

TABLE 3-3. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Alkalinity (mg/L $CaCO_3$)	Bicarbonate (mg/L $CaCO_3$)	Calcium, Total (mg/L)	Carbonate (mg/L $CaCO_3$)	Chloride (mg/L)	Hardness (mg/L $CaCO_3$)	Iron, Dissolved (mg/L)	Iron, Total (mg/L)	Magnesium, Total (mg/L)	Manganese, Dissolved (mg/L)	Manganese, Total (mg/L)	Mercury (mg/L)	Nitrogen Nitrate (mg/L)	pH, Lab s.u.
7/26/2013	129	129	169	ND(2)	3.8	NM	25.5	128	55.5	1.91	3.5	NM	0.75	8
8/7/2013	82.5	82.5	62.6	ND(2)	11.6	NM	0.0445	42.2	21.4	0.007	0.694	NM	1.9	7.8
9/23/2014	99.3	99.3	119	ND(2)	4.9	449	53.7	118	47.5	0.768	2.32	0.00092	1.2	8
9/29/2014	84.2	84.2	131	ND(2)	5.7	422	20.3	110	47.1	1.03	3.1	ND(0.0002)	1.3	8.2
6/13/2015	118	118	331	ND(2)	5.7	1,690	0.711	67.7	61.9	0.0074	6.66	0.0006	2.1	8
7/14/2018	276	236	247	40.2	5.8	1,490	51.3	155	91.3	1.11	5.53	0.0019	1.5	8.1
9/2/2018	128	122	65	ND(25)	4.5	154	34.4	52.7	23.5	0.858	1.11	ND(0.002)	1.8	8
7/30/2019	174	174	503	ND(8)	8.4	1,670	190	295	173	5.29	9.22	0.0028	0.87	8
8/6/2019	135	135	205	ND(8)	7.5	ND(2,000)	102	159	75	2.24	4.7	0.00021	1.6	8.1
7/12/2021	118.8	118.8	390	ND(2)	5.9	1,500	2.1	370	140	5.4	9	ND(0.0008)	2	7.99
8/2/2021	90.44	90.44	280	ND(2)	6.4	1,200	5.5	340	110	2.7	8.8	ND(0.0008)	1.9	8.08
7/30/2022	96.68	96.68	31	ND(2)	5.7	110	0.93	26	8.7	0.03	0.16	ND(0.0002)	1	7.98
8/17/2022	67.96	67.96	52	ND(2)	6.3	210	3.3	75	20	0.074	0.95	0.00021	1.4	8
9/22/2022	81.16	81.16	33	ND(2)	5	120	0.87	22	9.4	0.023	0.15	ND(0.0002)	0.76	7.9
10/17/2022	87.24	87.24	30	ND(2)	5.8	100	0.7	6	7.1	0.018	0.055	ND(0.0002)	ND(1)	7.97
6/27/2024	94	94	320	ND(2)	4.1	1,200	0.03	220	98	0.0021	5.8	ND(0.0002)	1.3	8
7/25/2024	79	79	240	ND(2)	3.6	920	ND(0.02)	190	79	0.0028	5.1	0.0014	ND(1)	8
8/14/2024	92	92	83	ND(2)	6.6	350	0.04	97	35	0.0027	2.1	ND(0.0008)	ND(1)	7.9
8/24/2024	100	100	39	ND(2)	7.9	140	0.039	14	11	0.005	0.19	ND(0.0002)	ND(1)	8.1

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
ND - non-detect (detection limit in parentheses)
NM - not measured
NTU - Nephelometric Turbidity Units
s.u. - standard units

TABLE 3-3. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Phosphate (mg/L)	Phosphorus, Total (mg/L)	Potassium, Total (mg/L)	Selenium, Total (mg/L)	Sodium, Total (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Sulfate (mg/L)
7/26/2013	NM	4.1	38.3	ND(0.02)	26.5	NM	NM	13.5
8/7/2013	NM	0.877	17.1	ND(0.02)	52.3	2,760	1,770	151
9/23/2014	6.6	2.87	45.4	0.0309	28	254	8,550	11.7
9/29/2014	7.8	2.98	26.8	0.0061	29	682	6,640	20.9
6/13/2015	32.2	4.3	29.9	0.0077	29.5	254	30,000	70.3
7/14/2018	20.8	5.3	55.8	ND(0.05)	30.9	699	9,350	12.4
9/2/2018	5	1.25	20.2	ND(0.05)	15.2	408	2,700	18.5
7/30/2019	25.2	8.7	82.7	ND(0.05)	32.3	268	2,680	17.5
8/6/2019	14.5	4.45	36.4	ND(0.05)	33.1	1,030	6,780	35.5
7/12/2021	ND(2.5)	22	63	0.035	48	980	38,000	35
8/2/2021	ND(2.5)	12	51	0.054	33	4,750	16,000	34
7/30/2022	ND(2.5)	0.42	13	0.0025	23	494	150	40
8/17/2022	ND(2.5)	1.6	16	0.012	22	1,060	2,200	53
9/22/2022	ND(2.5)	0.46	11	0.0032	24	280	190	48
10/17/2022	ND(2.5)	0.17	8.3	0.0038	28	390	50	48
6/27/2024	ND(2.5)	14	48	0.026	48	3,300	21,000	35
7/25/2024	ND(0.5)	10	45	0.02	20	1,400	16,000	13
8/14/2024	ND(0.5)	1.5	25	0.013	19	1,200	4,400	26
8/24/2024	ND(2.5)	0.37	12	0.0029	33	400	310	60

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
ND - non-detect (detection limit in parentheses)
NM - not measured
NTU - Nephelometric Turbidity Units
s.u. - standard units

TABLE 3-4. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Alkalinity (mg/L $CaCO_3$)	Bicarbonate (mg/L $CaCO_3$)	Calcium, Total (mg/L)	Carbonate (mg/L $CaCO_3$)	Chloride (mg/L)	Hardness (mg/L $CaCO_3$)	Iron, Dissolved (mg/L)	Iron, Total (mg/L)	Magnesium, Total (mg/L)	Manganese, Dissolved (mg/L)	Manganese, Total (mg/L)	Mercury (mg/L)	Nitrogen Nitrate (mg/L)	pH, Lab (s.u.)
7/20/2013	76.4	76.4	176	ND(2)	3.5	NM	38.1	197	59.5	0.65	3.58	NM	0.66	7.8
7/29/2013	92.7	92.7	33.7	ND(2)	11.9	NM	0.0604	19.8	9.02	0.0194	0.222	NM	0.72	7.8
8/6/2013	79.6	79.6	85	ND(2)	3.7	NM	8.44	76.8	25.6	0.136	1.76	NM	0.42	7.7
9/29/2014	87.3	87.3	55.1	ND(2)	8	200	ND(0.2)	19.4	16.5	0.0014	0.348	ND(0.0002)	0.32	8
7/13/2015	76.1	76.1	48.1	ND(2)	4.4	201	0.0546	25.3	14.6	0.0056	0.342	0.000054	0.39	7.9
7/15/2015	79.4	79.4	44.3	ND(2)	3.2	179	0.311	28.3	13.5	0.004	0.485	0.00011	0.38	7.9
8/31/2015	127	127	60.6	ND(200)	3.2	225	0.137	41.7	18.8	0.0107	0.689	0.00028	0.37	8.4
7/24/2017	75.9	75.9	40.3	ND(5)	5	162	ND(0.2)	41.6	14.9	0.0033	0.514	0.00014	2.8	7.6
7/18/2018	127	116	169	ND(50)	3.6	554	53.1	97.9	45.2	1.44	3.85	0.00052	0.94	7.9
9/2/2018	103	103	58.1	ND(25)	4.1	151	10.4	64.3	19.5	0.139	0.951	ND(0.002)	1.3	7.7
7/12/2021	85.52	85.52	87	ND(2)	6	360	3.4	130	36	0.8	1.7	ND(0.0008)	ND(1)	7.9
7/24/2021	72.76	72.76	34	ND(2)	4.7	130	0.41	34	11	0.0084	0.33	ND(0.0008)	1.4	7.49
8/3/2021	87.64	87.64	41	ND(2)	ND(5)	160	0.78	38	13	0.04	0.33	ND(0.0008)	1.4	7.9
8/11/2021	67.76	67.76	180	ND(2)	ND(5)	690	5.8	230	61	1	4.9	ND(0.0008)	ND(1)	8
10/6/2021	89.68	89.68	35	ND(2)	4.7	120	0.35	10	7.7	0.014	0.1	ND(0.0002)	ND(0.5)	8.1
8/17/2022	86.04	86.04	40	ND(2)	2.5	150	4.3	49	13	0.16	0.52	ND(0.0002)	ND(0.5)	7.8
9/22/2022	86.6	86.6	42	ND(2)	ND(2.5)	160	2.1	63	14	0.14	0.51	ND(0.0002)	ND(0.5)	7.8
10/17/2022	101.4	101.4	36	ND(2)	2.6	130	1.4	15	8.9	0.056	0.19	ND(0.0002)	ND(1)	8
6/27/2024	100	100	350	ND(2)	3.5	1200	0.068	230	82	0.0035	4.1	ND(0.0002)	1.4	8
7/25/2024	95	95	160	ND(2)	3.2	620	0.02	130	53	0.006	3.2	0.00093	ND(1)	8
8/24/2024	120	120	62	ND(2)	4.3	230	0.038	46	18	0.0024	0.58	ND(0.0002)	ND(1)	8

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
ND - non-detect (detection limit in parentheses)
NM - not measured
NTU - Nephelometric Turbidity Units
s.u. - standard units

TABLE 3-4. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Phosphate (mg/L)	Phosphorus, Total (mg/L)	Potassium, Total (mg/L)	Selenium, Total (mg/L)	Sodium, Total (mg/L)	Solids, Total Dissolved (mg/L)	Solids, Total Suspended (mg/L)	Sulfate (mg/L)
7/20/2013	1.5	3.71	36.6	0.0096	37.8	574	13,700	142
7/29/2013	3.6	0.408	9.69	ND(0.02)	18	1,050	8,300	70.4
8/6/2013	0.77	1.52	16.7	ND(0.02)	19.5	1,650	4,200	62.5
9/29/2014	ND(0.31)	0.371	9.96	ND(0.02)	70.2	697	860	213
7/13/2015	1.2	0.454	10.1	ND(0.02)	33.6	370	663	111
7/15/2015	1.7	0.519	10.1	ND(0.02)	21.1	322	950	68.6
8/31/2015	2.4	0.725	12.8	ND(0.02)	17.9	470	2,770	71.2
7/24/2017	2.6	0.769	16.5	ND(0.02)	17.5	424	1,360	18.7
7/18/2018	7.9	2.54	27.7	ND(0.05)	14	1,770	6,700	9.8
9/2/2018	4.6	1.09	13.9	ND(0.05)	14.6	536	1,590	28.8
7/12/2021	ND(2.5)	3.4	28	0.011	14	700	5,900	17
7/24/2021	ND(2.5)	0.7	14	0.0059	16	920	250	26
8/3/2021	ND(2.5)	0.71	13	0.0062	18	1,160	520	32
8/11/2021	ND(5)	6.6	35	0.029	8.3	1,600	6,300	7.2
10/6/2021	ND(2.5)	ND(0.5)	7.8	0.0031	15	335	170	39
8/17/2022	ND(2.5)	0.87	13	0.0048	9	810	920	23
9/22/2022	ND(2.5)	0.67	13	0.0051	9.1	590	980	23
10/17/2022	ND(2.5)	0.27	8.5	0.0032	9.3	530	230	22
6/27/2024	ND(2.5)	16	38	0.022	56	ND(2500)	62000	100
7/25/2024	ND(0.5)	5	35	0.017	26	1600	9200	15
8/24/2024	ND(2.5)	1.2	15	0.0045	14	510	1600	37

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as
ND - non-detect (detection limit in pa
NM - not measured
NTU - Nephelometric Turbidity Units
s.u. - standard units

TABLE 4-1. ANNUAL WATER LEVEL SUMMARY
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

YEAR	**WELL 3A, TD = 882 ft bmp**		**WELL MBR2, TD = 179.8 ft bmp**		**WELL 2G2, TD = 56.85 ft bmp**	
	DTW ft bmp	**Saturated Thickness ft**	**DTW ft bmp**	**Saturated Thickness ft**	**DTW ft bmp**	**Saturated Thickness ft**
2013	NM	NM	132.84	47.63	54.59	2.26
2014	NM	NM	132.17	47.57	**54.68**	2.17
2015	NM	NM	132.23	46.57	**54.73**	2.12
2016	**702.98**	179.02	133.23	46.17	**55.79**	1.06
2017	**697.20**	184.80	133.63	46.12	**56.69**	0.16
2018	**719.15**	162.85	133.68	45.98	**56.73**	0.12
2019	**706.44**	175.56	133.82	45.98	**56.77**	0.08
2020	**697.20**	184.80	133.86	45.94	56.82	0.03
2021	**694.89**	187.11	138.62	41.18	**56.77**	0.08
2022	**700.67**	181.33	134.05	45.75	ND	0
2023	**711.06**	170.94	135.18	44.62	ND	0
2024	706.44	175.56	134.40	45.40	ND	0

Note:

1. Values in bold represent arithmetic means calculated from at least two measurements from the same year.

Abbreviations:

bmp - below measuring point
DTW - depth to water
ft - feet
ND - non-detect/dry well
NM - not measured

TABLE 4-2. WELL 3A HISTORICAL GROUNDWATER QUALITY DATA
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Alkalinity mg/L CaCO3	Bicarbonate mg/L CaCO3	Calcium, Dissolved mg/L	Carbonate mg/L CaCO3	Chloride mg/L	Fluoride mg/L	Hardness mg/L CaCO3	Iron, Total mg/L	Magnesium, Dissolved mg/L	Manganese, Total mg/L	pH, Lab (s.u.)	Phosphate mg/L	Potassium, Dissolved mg/L	Sodium, Dissolved mg/L	Solids, Total Dissolved mg/L	Sulfate mg/L	Turbidity NTU
9/2/2015	207	207	73.9	ND(2)	4.6	ND(0.5)	264	4.45	12	0.101	8.3	ND(0.31)	2.8	43.1	402	102	28.4
11/3/2015	213	213	79.9	ND(2)	3.3	ND(0.5)	274	0.498	12.9	0.101	7.8	ND(0.31)	2.88	42.2	460	98.3	2.3
2/24/2016	215	215	77.9	ND(2)	3.9	ND(0.5)	295	1.35	12.5	0.116	8.1	ND(0.31)	2.76	40.1	423	86.8	8.5
5/24/2016	217	217	75.7	ND(2)	3.6	ND(0.5)	338	0.915	12.2	0.0984	8	ND(0.31)	2.7	39.1	408	96.5	3.7
9/14/2016	217	217	72	ND(5)	3.9	ND(0.5)	227	0.463	11.7	0.087	8	ND(0.31)	2.66	41.3	421	102	2.5
11/9/2016	221	221	70.8	ND(5)	4.1	ND(0.5)	246	0.318	11.4	0.0849	7.7	ND(0.31)	2.68	38.5	379	114	1.4
3/3/2017	221	221	75.6	ND(5)	4.4	ND(0.5)	267	0.841	12.6	0.0973	7.9	ND(0.31)	3.37	43.9	397	70.5	3.7
6/7/2017	215	215	77.5	ND(5)	3.4	ND(0.5)	251	0.499	12.5	0.0918	8	ND(0.31)	2.99	39.9	384	106	3.4
9/13/2017	211	211	70.2	ND(5)	4.3	0.3	232	0.528	11.9	0.0978	7.7	ND(0.31)	2.72	36.4	389	98	4
11/16/2017	218	218	69.9	ND(5)	4.3	ND(0.5)	234	0.503	11.5	0.0889	7.9	ND(0.31)	2.62	36.2	392	93.2	3.6
2/21/2018	212	212	75.7	ND(5)	4.1	ND(0.5)	240	0.433	12	0.0925	8	ND(0.31)	2.75	39.3	406	105	1.7
5/16/2018	207	207	76.8	ND(5)	4.4	0.45	219	0.309	12.5	0.0836	8	ND(0.31)	2.67	40.2	388	96.1	3.5
9/12/2018	220	220	72.1	ND(5)	3.4	ND(0.5)	231	1.14	11.6	0.123	8	ND(0.31)	2.84	44.2	384	73.5	12
11/15/2018	224	224	72.3	ND(5)	3.7	0.37	276	0.525	11.9	0.13	8.2	ND(0.31)	2.8	40.7	388	74.8	7.8
2/28/2019	220	220	79.2	ND(5)	3.9	ND(0.5)	232	0.337	12.7	0.0927	8.1	ND(0.31)	3.1	40.7	376	105	2.6
5/14/2019	217	217	77.4	ND(5)	3.9	ND(0.5)	235	0.336	12.1	0.0916	8	ND(0.31)	2.6	38.5	391	120	3.2
8/20/2019	222	222	77.7	ND(8)	4.4	ND(0.5)	266	0.368	12.7	0.0964	8	ND(0.31)	2.63	39.9	392	140	4.1
11/13/2019	219	219	71.3	ND(8)	3.9	ND(0.5)	285	0.593	11.8	0.0924	8.1	ND(0.31)	2.57	36.3	388	104	8.9
2/19/2020	215	215	74.8	ND(8)	4	ND(0.5)	277	1.22	12	0.0931	7.9	ND(0.31)	2.72	38	399	93.4	16
4/29/2020	217	217	74.7	ND(8)	3.9	ND(0.5)	268	0.754	12	0.09	8	ND(0.31)	2.63	42.1	398	133	10
9/9/2020	220	220	74	ND(8)	4.1	0.32	270	1.1	12	0.092	7.8	ND(0.31)	2.7	45	420	270	18
10/22/2020	220	220	73	ND(8)	3.6	ND(0.5)	290	0.55	11	0.093	7.9	ND(0.31)	2.9	38	390	93	9.3
1/26/2021	210	210	75	ND(8)	5.6	0.29	260	1	13	0.09	8	ND(0.31)	2.8	45	370	130	11
5/12/2021	219.6	219.6	76	ND(2)	3.4	ND(0.5)	240	0.91	12	0.095	7.73	ND(2.5)	2.7	45	401	97	8.1
8/10/2021	218.3	218.3	81	ND(2)	3	ND(0.5)	240	3.7	13	0.11	7.7	ND(2.5)	2.9	41	378	98	88
10/27/2021	218.1	218.1	75	ND(2)	3.6	ND(0.5)	240	0.6	12	0.085	7.93	ND(2.5)	2.5	37	387	100	5.4
2/10/2022	217.6	217.6	73	ND(2)	3.7	ND(0.5)	220	0.82	12	0.091	7.76	ND(2.5)	2.6	41	405	100	10
4/26/2022	219.1	219.1	77	ND(2)	3.4	0.23	230	0.96	12	0.09	7.81	ND(0.5)	2.5	47	409	100	8.5
12/7/2022	215.4	215.4	73	ND(2)	3.2	ND(0.5)	250	0.96	12	0.095	7.54	ND(2.5)	2.5	39	388	90	7.8
3/15/2023	222.4	222.4	73	ND(2)	3.3	ND(0.5)	240	1.9	12	0.1	7.83	ND(2.5)	2.6	37	404	93	16
5/24/2023	222.6	222.6	71	ND(2)	3.6	ND(0.5)	230	0.95	12	0.081	8.08	ND(2.5)	2.5	47	403	100	11
7/12/2023	221.6	221.6	76	ND(2)	3.4	ND(0.5)	240	0.7	12	0.096	7.78	ND(2.5)	2.6	44	378	97	6
10/18/2023	220.6	220.6	76	ND(2)	ND(5)	ND(1)	240	1.4	13	0.12	7.92	ND(5)	2.6	41	387	92	13
1/30/2024	217.1	217.1	75	ND(2)	3.4	ND(0.5)	230	4.3	12	0.14	7.74	ND(2.5)	2.4	38	384	92	50
11/21/2024	180	180	44	ND(2)	3	0.14	150	7.4	12	0.093	8	ND(0.5)	2.7	39	270	53	450
Standard	-	-	-	-	250	1.6	-	-	-	-	6 - 9	-	-	-	1,000	600	-

Bold values indicate concentration or detection limit exceeds groundwater quality standard

Abbreviations:
CaCO3 - calcium carbonate, molecular weight of 100.06 g
mg/L - milligrams per liter
ND - non-detect (detection limit in parentheses)
NTU - Nephelometric Turbidity Units
s.u. - standard units

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TABLE 4-3. WELL MBR2 HISTORICAL GROUNDWATER QUALITY DATA
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Alkalinity mg/L CaCO3	Bicarbonate mg/L CaCO3	Boron, Total mg/L	Calcium, Total mg/L	Carbonate mg/L CaCO3	Cation-Anion Balance Percent	Chloride mg/L	Conductance, Field µS/cm	Fluoride mg/L	Hardness mg/L CaCO3	Iron, Dissolved mg/L	Iron, Total mg/L	Magnesium, Total mg/L	Manganese, Dissolved mg/L	Manganese, Total mg/L	Nitrogen Nitrate mg/L	pH, Field s.u.	pH, Lab s.u.	Phosphate mg/L	Phosphorus, Total mg/L	Potassium, Total mg/L	Selenium, Total mg/L	Sodium, Total mg/L	Solids, Total Dissolved	Sulfate mg/L	Zinc, Total mg/L
11/12/2013	590	590	0.154	5.32	ND(2)	0.89	6.9	2060	**5.4**	NM	**2.21**	2.59	1.8	0.0205	0.0214	ND(0.1)	7.5	7.9	ND(0.31)	0.0545	3.3	ND(0.02)	485	**1,520**	581	0.0108
10/22/2014	520	520	0.164	6.87	ND(2)	38.87	6.3	2340	**4.3**	44.6	ND(0.2)	0.353	1.54	0.0205	0.023	ND(0.1)	7.3	7.9	ND(0.31)	0.0196	2.48	0.0069	544	**1,400**	595	0.0043
11/19/2015	539	539	0.173	6.77	ND(2)	1.72	7.1	2150	**4.6**	36.6	ND(0.2)	10.5	3.93	0.0122	0.0606	ND(0.1)	7.8	7.6	ND(0.31)	0.135	5.77	ND(0.02)	490	**1,500**	562	0.0486
11/9/2016	564	564	0.159	5.14	ND(5)	0.12	7.7	2420	**5.9**	25.2	ND(0.2)	1.52	1.6	0.0074	0.0172	0.055	8.0	7.9	ND(0.31)	0.0456	2.79	ND(0.02)	490	**1,400**	569	0.0079
11/15/2017	519	519	0.159	6.43	ND(5)	3.55	7.3	2380	**4.7**	22.5	0.113	0.218	1.47	0.0322	0.0307	ND(0.1)	7.7	7.9	ND(0.31)	ND(0.1)	2.41	ND(0.02)	500	**1,660**	573	ND(0.02)
11/14/2018	519	519	0.161	7.06	ND(5)	1.68	6.9	2300	**6.8**	18.6	ND(0.2)	0.313	1.53	0.0244	0.0262	ND(0.1)	7.4	7.9	ND(0.31)	ND(0.1)	2.33	ND(0.05)	498	**1,310**	595	ND(0.02)
11/13/2019	568	568	0.151	6.1	ND(8)	3.88	7.6	2350	**5.2**	25.7	0.325	3.07	2.14	0.0129	0.0302	ND(0.1)	7.4	8.1	ND(0.31)	0.0809	3.84	ND(0.05)	511	**1,400**	542	0.0196
10/28/2020	510	510	0.17	6.7	ND(8)	2.84	7	2040	**4.7**	27	ND(0.21)	0.068	1.5	0.022	0.022	0.1	7.5	7.5	ND(0.31)	ND(0.1)	2.4	ND(0.05)	510	**1,200**	590	ND(0.02)
10/27/2021	568.5	568.5	0.2	9.5	ND(2)	5.27	7.1	2070	**4.9**	36	0.53	4.3	2.8	0.06	0.083	ND(0.5)	7.6	7.7	ND(2.5)	0.094	4.3	ND(0.005)	540	**1,600**	580	0.023
11/9/2022	576.6	576.6	0.17	5.4	ND(2)	4.37	6.7	2300	**4.9**	20	ND(0.02)	1.1	1.6	0.011	0.018	ND(0.5)	7.4	7.8	ND(2.5)	0.16	2.9	ND(0.001)	520	**1,460**	540	ND(0.01)
10/17/2023	530.1	530.1	0.18	6	ND(2)	2.33	6.8	2330	**4.6**	21	ND(0.02)	0.29	1.5	0.011	0.018	ND(0.5)	7.9	7.7	ND(2.5)	ND(0.05)	2.4	ND(0.001)	510	**1,510**	600	ND(0.01)
10/9/2024	580	580	0.27	120	ND(2)	5.64	7.2	2240	**5.4**	370	ND(0.02)	ND(0.05)	18	0.013	0.004	ND(1)	7.6	7.9	ND(2.5)	0.12	25	0.0014	250	**1,600**	540	0.044
Standard	-	-	-	-	-	-	250	-	1.6	-	1	-	-	0.2	-	10	6 - 9	6 - 9	-	-	-	0.05	-	1,000	600	10

Bold values indicate concentration or detection limit exceeds groundwater quality standard

Abbreviations:
CaCO3 - calcium carbonate, molecular weight of 100.06 g
mg/L - milligrams per liter
ND - non-detect (detection limit in parentheses)
NTU - Nephelometric Turbidity Units
s.u. - standard units

FIGURE

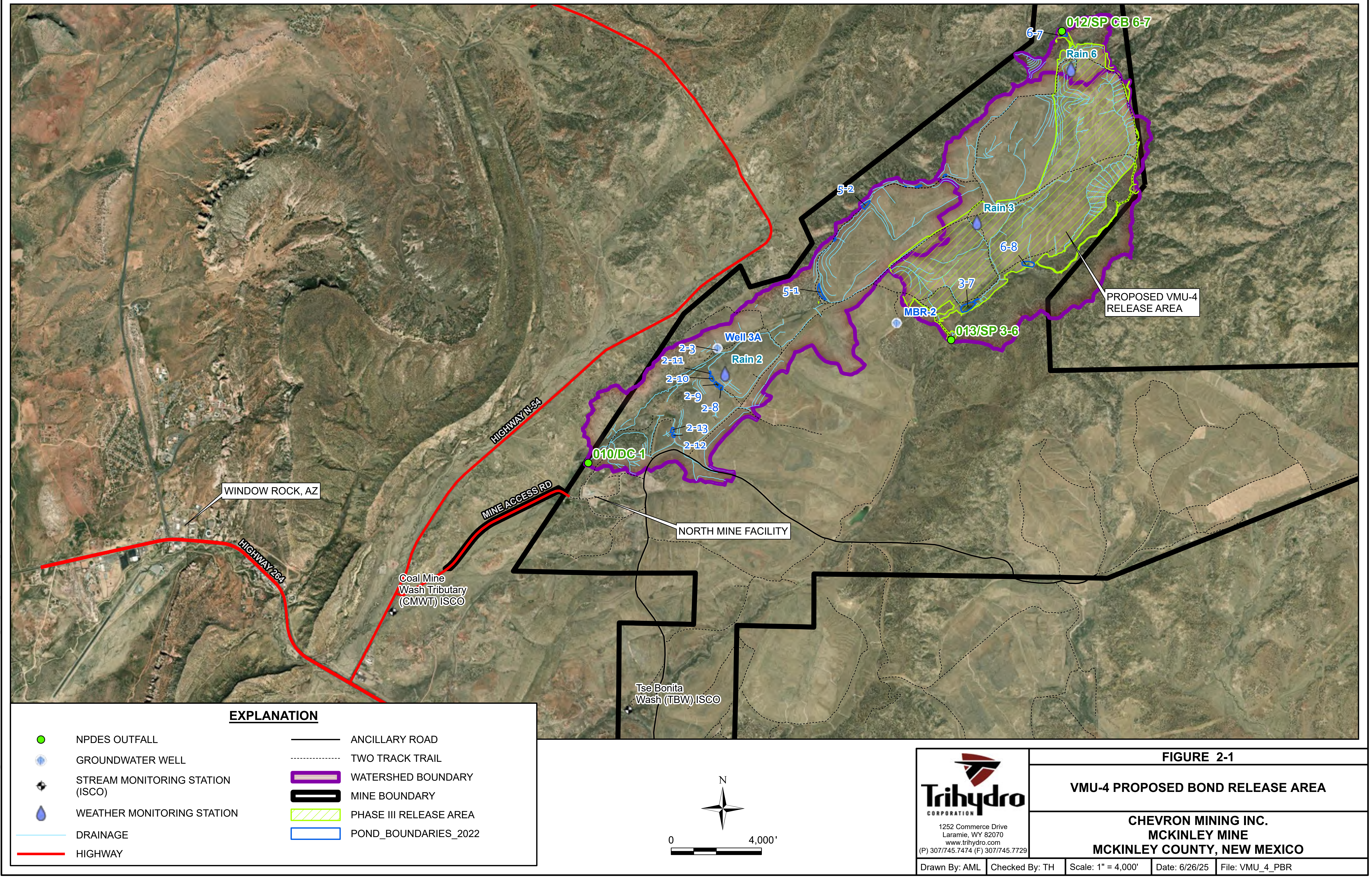


FIGURE 2-1

VMU-4 PROPOSED BOND RELEASE AREA

CHEVRON MINING INC.
MCKINLEY MINE
MCKINLEY COUNTY, NEW MEXICO

Trihydro
CORPORATION
1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

Drawn By: AML
Checked By: TH
Scale: 1" = 4,000'
Date: 6/26/25
File: VMU_4_PBR

\\TRIHYDRO.COM\CLIENTS\CHEVRON\CEMC MINING\MCKINLEYMINE\GIS\PROJECTS\MMD\PHASEIII HYDROLOGY VMU-4\PHASEIII HYDROLOGY VMU-4.APRX

APPENDIX A

MCKINLEY MINE PERMIT SECTION 3.4, HYDROLOGY INFORMATION

- (108°56'40"; 35°41'38") 16.1 ac-ft/annum (File No. G-93)
- (108°54'35"; 35°40'52") 16.1 ac-ft/annum (File No. G-94)
- (SW¼, NW¼, SE¼ Sec 14, T16N, R20W) 16.1 ac-ft/annum (File No. G-95)
- (NW¼, SE¼, NW¼ Sec 9, T16N, R20W) Domestic/Sanitary (File No. G-258)

A search of the Office Of The State (NM) Engineer records indicates the following additional groundwater rights holders in the vicinity of McKinley Mine (Appendix 3.4-A):

- (NW¼, NE¼ Sec 3, T16N, R21W) (File No. G-160, M. Abukhalil, Domestic)
- (NE¼, NW¼, Sec 1, T16N, R21W) (File No. G-28, W. Bald, Domestic)
- (SE¼, NE¼, SE¼ Sec 11, T16N, R20W) (File No. G-51, C. Wilhelm, Stock)
- (NW¼, SE¼, SE¼ Sec 9, T16N, R20W) (File No. G-390, N. Murphy, Domestic)
- (NW¼, NW¼ Sec 9, T16N, R20W) (File No. G-976, B. Nicholson, Domestic)
- (NE¼, NE¼ Sec 7, T16N, R20W) (File No. G-131, C. Harris, Domestic/Stock)
- (SW¼, NW¼, SE¼ Sec 1, T16N, R20W) (File No. G-677, N. Nation, Domestic)

3.4.3 HYDROLOGIC MODELING

Appendix 3.4-E contains modeling information which characterizes and contrasts surface water quality and quantity for medium sized watersheds in undisturbed, disturbed, and reclaimed surficial conditions.

3.4.4 PROBABLE HYDROLOGIC CONSEQUENCES (PHC)

The PHC addresses existing mining areas and the new mining area referred to as the "East Wing." The addition of 1870 acres in the East Wing Revision does not alter any of the surface or groundwater parameters addressed in the PHC. To address the addition of the East Wing, a separate and detailed update follows this general PHC analysis.

The validity of the PHC for the existing mining areas and the East Wing is supported by surface and ground water sampling programs conducted by P&M since 1980, which verify the original assumptions of runoff quantity and quality in the PHC. Surface and groundwater monitoring data is submitted to the OSM quarterly and as part of the Annual Report. A collection of studies, which analyze the data for both surface and groundwater, further verify the validity of the basis for the PHC and are included in this PAP at Appendix 3.4-G for surface water and Appendix 3.4-H for ground water.

Data collected from the surface water sampling program includes small (1.2 - 6.1 acres), medium (188 - 235 acres) and large (5.7 - 27.5 square miles) paired watersheds. Quarterly ground water sampling results show a slight reduction in the sparse alluvial and bedrock aquifers, and confirm the stagnant nature and poor quality of the aquifers. Sampling of the Gallup Aquifer shows no reduction in pumping quantity other than ordinary well usage drawdown and no change in quality.

In summary, more surface water will be retained on the reclaimed areas resulting in a slight reduction in runoff to the Puerco River drainage. The quality of surface runoff from the reclaimed areas has been shown to improve due to lower suspended solids and total settleable solids. PATFM management will improve effluent levels of dissolved solids, salinity, and alkalinity. The ground water quantity will be reduced slightly in the alluvial and bedrock aquifers. There will be negligible impact on ground water quality in the alluvial and bedrock aquifers, and none in the Gallup Sandstone.

SURFACE WATER QUANTITY

Surface water quantity may be increased on the reclaimed areas through the construction of small impoundments. These impoundments will be used to provide water for livestock and wildlife and to create small riparian habitats for small mammals, birds and reptiles. The amount of postmining runoff as compared to the premining runoff to the Puerco River drainage will be diminished by the harvesting of the water in the impoundments and other riparian areas. This reduction of runoff is supported by the hydrologic model included in Appendix 3.4-E of this application. However, the impact on the Puerco River drainage will be negligible due to the small percentage of the drainage area that the McKinley Mine comprises.

SURFACE WATER QUALITY

For a short term following reclamation of an area there may be a slight increase in the levels of total dissolved solids, sulfates, and other soluble elements in the overburden. This increase will eventually lessen as the runoff leaches the overburden. This potential slight increase will be documented by the collection and analysis of surface water runoff during the permit term as described in Section 6.3. The long term surface water PHC is described below.

Physical Quality

Surface water physical quality will be improved through stabilization of the reclamation areas and the creation of post mining impoundments. These actions will result in lower TSS and T-Set-S in the runoff from the disturbed areas. The PHC is evaluated using hydrologic models contained in Appendix 3.4-E of the permit application, and through the collection of TSS and T-Set-S samples during flow events. The modeling indicated that per acre sediment yields from the mining and post-mining areas will be less than from the pre-mining areas. The analytical results indicate that the TSS concentrations from the disturbed watershed are consistently lower than the undisturbed watershed concentrations since monitoring began as documented in the Annual Hydrology Reports submitted to OSM. The following section provides a summary of the sediment yield modeling provided in Appendix 3.4.E.

The Area 6 total sediment yield from the 10-year, 24-hour precipitation event was estimated to be 415.4 tons, 472.3 tons, and 189.1 tons for the pre-mining, mining and reclamation, and post-mining evaluations, respectively. On a per acre basis, sediment delivery equates to 0.45 tons/acre, 0.41 tons/acres, and 0.16 tons/acre for the pre-mining, mining and reclamation, and post-mining disturbance phases, respectively.

The average per acre sediment loading for the pre-mining condition is higher than for the mining and reclamation or post-mining conditions. For the mining and reclamation conditions, low sediment volumes are generated from reclaimed areas with BTCA sediment control practices, while somewhat higher sediment volumes are generated from the graded spoils where BTCA practices were not implemented. Nevertheless, the worst-case mining and reclamation condition does not exceed the pre-mining condition's average sediment loading values.

The volume of the sediment generated during the post-mining disturbance phase (when all disturbed areas have received a BTCA sediment control treatment) is significantly lower than either the pre-mining or mining and reclamation conditions. This leads to the conclusion that once BTCA practices are fully implemented, sediment transport is significantly reduced at the Mine compared to pre-mining conditions.

The times to peak sediment loading were estimated to occur at 12.4 hours, 12.0 hours and 12.2 hours for the pre-mining, mining and reclamation, and post-mining disturbance phases, respectively. These represent the period between commencement of the storm event and the time the peak sediment loading will be realized in runoff waters. The time to peak sediment loading for the pre-mining model corresponds to the time of peak runoff. The time to peak loading for the mining and reclamation and post-mining condition occurs approximately one hour before peak runoff occurs.

The predicted runoff volumes from the 10-year, 24-hour precipitation event for the three disturbance phase conditions are as follows: Pre-mining = 0.0389 acre-feet per acre of watershed, Mining and Reclamation = 0.0338 acre-feet per acre of watershed, and Post-mining = 0.023 acre-feet per acre of watershed. On a per acre basis, the largest volume of runoff occurs from lands in the pre-mining condition. The BTCA practices of land imprinting, mulching and revegetation utilized during the mining and reclamation, and post-mining disturbance phases reduce the overland flow velocity. As flow velocity is reduced, the runoff has increased opportunity to infiltrate into the soil and further reduce the volume of overland flow. Reduction in flow in turn reduces runoff, sediment carrying capacity and sediment delivery. Thus, the regulatory objective of preventing the contributions of additional suspended solids is met through the BTCA practices designed to harvest water and enhance soil moisture conditions in reclaimed areas. Also, water harvesting acts to stimulate plant growth and development. Increased vegetation cover in turn acts to improve the hydrologic characteristics of reclaimed lands.

Chemical Quality

Surface water chemical quality will be unaffected or could possibly improve by minimizing the potential of runoff coming into contact with potentially acid or toxic materials (PATFM). These materials consist of those uncovered during the mining operations, native soil materials that of are poor quality, and naturally occurring exposed coal seams. The PATFM Management program which is discussed in Section 5.2 of this permit, will identify graded spoil areas that have acid or toxic materials present in or near the rooting zone. Areas identified through this program will be mitigated prior to revegetation. These actions will prevent the degradation of the surface water quality within the mine and improve the effluent levels of dissolved solids, salinity, and alkalinity.

GROUNDWATER QUANTITY

Gallup Sandstone Aquifer

As discussed above, the Gallup Sandstone Aquifer is used as the primary source of water for the mine and for the McKinley County area. This aquifer occurs 400 to 1,000 feet below the lowest coal seam to be recovered and has no local recharge features. The recharge area for this aquifer is located to the north of McKinley Mine in the Chuska Mountains.

P&M drilled it's first large scale water supply well in 1975 and began measurement of withdrawals from their four supply wells in 1986. The average rate of groundwater withdrawal for the Mine between 1986 and 2002 is 275 ac-ft/yr. Under the imposed pumping stress, the potentiometric surface (as defined by the Mines production wells) has sustained a maximum rate of decline of 3.1 ft/yr in Wells #1 and #3, a 14-foot rise at Well #2, and has remained stable at Well #3A (Tetra Tech EM Inc. 2003).

The potentiometric surface defined by Wells #2 and #3A suggest that water levels in much of the Mine area are stable or rising. This condition has resulted from less water production or use of Wells #2 and 3A over the last five years.

Measured drawdown of the potentiometric surface within the Gallup Sandstone aquifer is between 700 to 1,000 feet in some of the older wells in the Yah-ta-hey well field located east of the Mine (NWCOG, 1998). This is the primary source of water for the City of Gallup. The dramatic decline in local water levels is the result of low storage within the Gallup Sandstone and large pumping interferences between closely spaced production wells.

Under the current Mine water production schedule, the probable hydrologic consequence of continued pumping is minimal to non-existent. Annual water withdrawals at the Mine represent less than 5% of total groundwater withdrawals from the Gallup Sandstone aquifer in the region.

To further substantiate this information and to show current information pertaining to the Gallup Sandstone formation, P&M developed a revised structure map of the Gallup Sandstone formation. This map has been included in this application as Exhibit 3.4-1. It should be noted that this map supplements or supersedes information provided in Appendix 3.4-C pertaining to the Gallup Sandstone formation. The changes made in the Gallup Sandstone Structure map are based on information collected from the drill logs for the four Gallup Sandstone Aquifer wells in use at McKinley Mine, therefore only the information in the immediate vicinity of the Mine has been modified.

In addition, P&M has developed a map showing the potentiometric surface of the Gallup Aquifer (Exhibit 3.4-2). Elevations of the potentiometric surface of the Gallup Sandstone Aquifer reflect an estimate of current static water levels for the four Gallup Sandstone Aquifer wells in use at McKinley Mine. As with Exhibit 3.4-1, only the information in the immediate vicinity of the Mine has been modified.

The potentiometric surface depicted on Exhibit 3.4-2 of the Mine permit application shows that groundwater flows in an east-northeast direction in the vicinity of the Mine. The potentiometric surface slopes from the hogback located immediately west of the Mine toward a pronounced trough defined by the 6600-, 6500-, and 6400-foot contours. The trough appears to drain groundwater toward the northeast or San Juan Basin. Geohydrology Associates, Inc (1980) were the first investigators to identify the trough feature, which appears to still exist.

Alluvial Aquifers

As discussed above, alluvial water is practically nonexistent, occurring generally in close proximity to arroyos, and in direct relation to the rate and amount of runoff in the arroyos. Water soaks into the sides and bottoms of the arroyos during runoff events. This type of recharge occurs principally during snowmelt and the summer runoff season. The only instance where this type of groundwater will be affected by the mining operations, is where alluvial areas are actually mined. The hydrologic impact on this groundwater source will be complete removal of the resource when encountered during mining. However, due to the limited areal extent of the resource, any impacts would be considered negligible.

Bedrock Aquifers

Bedrock water quantity is minimal in extent, consisting only as small pockets of perched water in the various stratums. The quantity and areal extent of these pockets of water are not of sufficient quantity or quality to be considered significant. This water is normally observed as seepage from the highwall or small amounts of water on the pit floor. The mining operation results in removal of this insignificant groundwater source.

GROUNDWATER QUALITY

Gallup Sandstone Aquifer

As noted above in the discussion on groundwater quantity, there will be no impact by mining on the recharge zones of the Gallup Sandstone Aquifer. Therefore, there will be no impact on the quality of the Gallup Sandstone Aquifer by the mining operations.

Alluvial Aquifers

Alluvial water quality, in undisturbed areas, will continue to be influenced primarily by the amount of runoff in the arroyos and characteristics of the soils in the area of infiltration. There will be minimal impacts on the quality of this resource by the mining operations.

Bedrock Aquifers

The bedrock water encountered during mining will be removed in the mining process. This removal will have no effect on the water present in areas not affected by mining. This is due to the low transmissivity of the formations associated with this type of water.

PROBABLE HYDROLOGIC CONSEQUENCES EAST-WING UPDATE

The section contains a detailed East Wing update regarding the Probable Hydrologic Consequences from this operation. The update also provides the necessary background information to show that there are no adverse impacts to the hydrologic regime from current mining and nor any expected from East Wing operations. This information also serves to show that surface and ground water monitoring mechanisms are in place to maintain an active watch over the hydrologic behavior of the East Wing and the rest of the mine. In order to accomplish this update, it was necessary to discuss information collected over the years mine wide from surface and ground water monitoring program.

Surface Water Monitoring

Major Drainage results and comparisons

Surface water from major drainages has been monitored since the early 1980's through active surface water monitoring stations. Four stations (TBW, CMWT, DDT6, DD) collect samples that have disturbed-area watersheds. One station (CMW) collects samples from a relatively undisturbed channel. The CMW station data is used as background information to contrast against the other four stations. One additional station has been constructed in the East Wing (EW1). EW1 went online in 2001 and provides baseline information concerning the East Wing area.

Data from the disturbed-watershed monitoring stations was contrasted with information from the undisturbed-drainage monitoring station in the 2000 Annual Report. That data has been included here under Appendix 3.4-I. The data ranges from the early 1980's through 2000. The following parameters are summarized in the report, as agreed upon with OSM, and include: pH, TDS, TSS, dissolved selenium, total iron, and dissolved boron. The data collected for a given year has been averaged and graphed. The original data for the entire list of parameters tested are submitted quarterly and are on file with OSM.

In general, the contrasted data shows a high level of agreement for nearly all the stations for most of the parameters over many years. That is, the background levels did not markedly differ from the disturbed watershed values. In very few instances, did the disturbed exceed the background levels significantly.

Various factors can affect the level of agreement between any of the watersheds. Perhaps of highest consideration is the effect localized thunderstorms can have on each watershed. For example, a high runoff event in one watershed could dilute TDS and raise total suspended solids (TSS). A low runoff event in another watershed could record a more concentrated TDS and lower TSS. Subsequently, the comparability of the two watersheds could be difficult at times. Therefore, to help evaluate the data, standards will be referenced where possible to see how the overall water quality measures up.

The CHIA for McKinley Mine (1984) established a value of 5000 mg/L of total dissolved solids (TDS) that could constitute material damage. The value represents the maximum TDS concentration recommended for livestock or irrigation. In the mid-1980's, a few high TDS averages are observed for some of the disturbed watersheds. While the counterpart TDS from CMW were generally less, the TDS were still below the 5000 mg/L reference.

The CHIA (1984) established that very high concentrations of TSS would be expected. The graphs show that most of the time TSS were higher for the undisturbed wash versus the other four disturbed watersheds. TBW had no data recorded in 1989, subsequently, no valid comparisons can be made that year.

As expected, average pH for both undisturbed and disturbed watersheds were alkaline. Generally, there was relatively good agreement in pH between the undisturbed and disturbed watersheds. The graphs show that pH averages were above 7.0 and below 9.0; quite often, the undisturbed watershed had the higher pH.

The other three parameters of interest are total iron, dissolved selenium, and dissolved boron. Initial data shows that the values for total iron and selenium were higher the first few years of sampling before leveling off. In those instances the undisturbed drainage had the higher values. The total iron for CMW and CMWT seems artificially high, but there is no information available at this point to confirm the data. Subsequent data, however, reflects constant parallel values between the undisturbed and disturbed watersheds that are low.

Boron comes into play around 1991. While disturbed and undisturbed watershed data for dissolved boron values agree at times, other times they vary by up to 0.2 mg/L. The highest averages do not go above 0.4 mg/L, which is below the New Mexico Administrative Code standard for irrigation of 0.75 mg/L, and 5.0 mg/L for livestock watering.

The EW1 major drainage surface water monitoring station was constructed in late 2000, and data is available for 2001. This data is contained in Appendix 3.4-I. The station captures runoff from an undisturbed watershed that will be affected by the East Wing mining operations. Subsequently, this data will serve as baseline data to contrast against information gathered from the disturbed watershed.

The initial EW1 data for various key parameters is summarized in the Table 3.4-1. The maximum values (pH includes minimum) recorded are shown.

Table 3.4-1
East Wing Surface Water Monitoring Station Data

Parameter	pH	TDS (mg/L)	TSS (mg/L)	SAR	Sulfate (mg/L)	Total Iron (mg/L)	Boron (mg/L)
	7.78-8.84	320	83000	3025	104	100	0.2

In summary, no additional major drainage watershed monitoring stations are necessary to construct. The EW1 surface water monitoring station will provide adequate representation of the East Wing mining areas, and to the overall hydrologic regime.

Medium Drainage results and comparisons

There are three medium watershed-monitoring stations at McKinley Mine (DDT9, DDT10, and A12). All three monitoring stations are in the Defiance Draw watershed (the Defiance Draw drainage also includes the East Wing mining area watersheds). DDT9 and DDT10 are downstream from areas affected by mining. The A12 monitoring station is in an undisturbed watershed in Area 12 just southeast of the East Wing mining areas.

The 2000 annual report data from the three stations is provided in Appendix 3.4-I. The data represent average values for the runoff season. Detailed data for parameters in the 2000 annual report, plus all the other parameters tested were submitted to OSM via quarterly reports.

The graphs show consistent ranges of values for most years for the parameters shown for the undisturbed versus the disturbed watersheds. DDT9 shows a spike in total iron in 1998; however, nearly all the runoff to this location came from alluvial areas ahead of mining. Subsequently, it is difficult to quantify the spike. Most other years, there was good agreement with iron.

No additional medium-drainage monitoring stations are needed for the East Wing since the A12 monitoring station is already near the East Wing. Since the East Wing is in the Defiance Draw drainage, the three medium-drainage monitoring stations are adequate to characterize surface water from medium drainages into Defiance Draw.

Ground Water Monitoring

Alluvial wells

Alluvial well transects are located in various locations throughout the mine. The intent of the transects was to monitor valley-fill water resources. The transects are located in five drainage locations that include Tse Bonita Wash, Coal Mine Wash, and Defiance Draw.

These drainages have one or more transects. The Tse Bonita Wash (TB) transect consists of 6 wells at two transects (TB2 and TB3). The Coal Mine wash (CM) transect consists of 6 wells. The Defiance Draw Drainage (the largest of the drainage systems) consists of three transect locations: DT2 (4 wells), D2 (5 wells), and D3 (4 wells).

Well information for key parameters agreed to between OSM and P&M from the 2000 annual report is provided in Appendix 3.4-I. Data is collected quarterly from some wells, and annually from others. Quarterly data was averaged by year for the 2000 annual report. Detailed data for 2000 annual report parameters, and all the other parameters tested were submitted to OSM via quarterly reports. The appendix also includes information regarding what alluvial wells have been historically dry.

The wells nearest to the East Wing are the four DT2 wells located to the southwest in Area 11. Over the past 15 years, water levels in three of the wells have not changed significantly (the 4th well is dry). An overview of the key chemical parameters shows that these values have remained fairly constant with the values originally recorded in the wells. Occasional spikes do appear, but have been short-lived and probably related to precipitation levels.

As reported in the original baseline report done by Geohydrology Associates, Inc., (1980), there were no existing wells which tap the valley-fill deposits of Defiance Draw. It was concluded in the report that Defiance Draw valley-fill material did not constitute an aquifer.
Geohydrology Associates, Inc. (1980) did a water quality evaluation of the well samples using the drinking water standards available at that time from the U.S. Public Health Service. None of the samples met these drinking-water recommendations for sulfate or dissolved solids.

Monitoring over the years has not shown any changes that would negate the original evaluation. Since the remaining alluvial fills in the East Wing are also tributary to Defiance Draw, it is apparent that drilling more transects in these upper reaches of Defiance Draw would not provide information that is not already captured in the existing wells. Given the proximity of the DT2 wells to the East Wing, and the fact that there already exist three sets of transects in the Defiance Draw watershed, no additional transects are needed in the East Wing.

Bedrock wells

Five bedrock wells were drilled to a depth of about 50 feet below the Green coal. The holes were referred to as McKinley bedrock (MBR) wells and distributed around the lease. The five wells are referred to as MBR1, MBR2, MBR3, MBR4, and MBR5. MBR4, located in Area 9 (south of Highway 264) was mined through and not replaced.

Well information for key parameters agreed to between OSM and P&M from the 2000 annual report is provided in Appendix 3.4-I. The wells are sampled annually. Detailed data for 2000 annual report parameters, and all the other parameters tested were submitted to OSM via quarterly reports.

The original baseline report by Geohydrology Associates, Inc. (1980) concluded that the wells had little potential as meaningful groundwater resources. The transmissivity of the bedrock deposits were low, less than 6 ft^2/day and not capable of maintaining a constant discharge of 1 gallon per minute sustained yield. Also, even though ground water was present, none of the strata had sufficient continuity to be considered an aquifer.

Quality-wise, Geohydrology Associates, Inc.'s (1980) baseline work showed that the ground water that was there did not meet the recommended maximum drinking-water standards set by the U.S. Public Health Service. The total mineralization was more than twice the recommended standard, fluoride was three times above the standard for MBR 2 and 3, and sulfate values were above the standard (250 mg/L) for MBR 2 (325 mg/L).

The wells that provide the most useful information in assessing the existing and expected bedrock-hydrology of the East Wing are MBR2 and MBR3. MBR2 will be reviewed to see how it has behaved since mining has occurred around that site and because it is the second nearest well to the East Wing. MBR3 will be evaluated since it is located in the middle of the East Wing. The period 1995 – 2000 has been averaged and listed below and contrasted against the 1980 values in the baseline report, and the standards contained in The Safe Drinking Water Act.

Table 3.4-2
MBR2 and MBR3 Quality Evaluation (mg/L)

	Sulfate	TDS	Nitrate	Chloride	Iron	Fluoride
MBR2						
(95-00)	527	1458	0.3	13.3	0.5	5.1
1980	325	1136	0.4	6.4		5.5
MBR3						
(95-00)	120	1537	0.16	82.5	0.6	6.9
1980	70	1368	0.5	86		5.7
Standard	250	500	10	250	0.3	2.0

The data contrast shows that little has changed in either well. TDS and fluoride still remain unacceptably high in both wells. In MBR2, sulfate that was already above the threshhold, still remains above the threshold. Chloride did increase for MBR2, but still below the standard.

MBR3 shows little change from what was originally reported in the baseline assessment. Given that little has changed from the original 1980 evaluation, the need to keep MBR3 does not seem necessary. The well was originally determined to be a poor resource for ground water from a quantitative and qualitative perspective—nothing has changed to negate that finding. In conclusion, the well will be mined through and not replaced.

Gallup Sandstone Aquifer

The potential effect of mining on the Gallup Sandstone Aquifer is monitored through the sampling of four wells: Well 1, Well 2, Well 3, and Well 3A. As stated in the Geohydrology Associates, Inc. report (1980), the Gallup aquifer is under artesian conditions because of the impermeable shales above it. Data from the wells also had shown that transmissivity was quite variable from well to well.

The data from the 2000 annual report is included in Appendix 3.4-I. The data collected quarterly was averaged for each year for the annual report. The information shows key parameters that P&M and OSM agreed to include in the Annual Report. Detailed data for the 2000 annual report parameters, and for all the other parameters tested were submitted to OSM via quarterly reports.

The McKinley Mine CHIA (1984) contained initial information on total dissolved solids (TDS) that will be useful to evaluate. The CHIA states that total dissolved solids for the Gallup Sandstone Aquifer averaged 1,121 milligrams per liter (presumably the overall aquifer).

Data from the four McKinley Mine wells show that total dissolved solids from these wells had a better quality initially than the average aquifer value of 1,121 mg/L. None of the wells started out with TDS above 700 milligrams per liter. Over the years, TDS for some wells has gone up and down; however, the quality has generally improved or stayed about the same. By 2000, TDS for three of the wells were below 400 mg/L; the fourth well was just below 500 mg/L.

The same trending and conclusions can be made about sulfate values, which also have gone up and down over time. By 2000, sulfate values have either decreased, or stayed close to the original 1983 values.

Iron values have stayed low and fairly constant over the past ten years. One spike, however, is noted in 1990 for Well 1; this anomaly is likely a sample contamination or lab error since the other values were very low (seven times less than the spike) and had not changed very much the other 17 years. Some other high iron values were recorded in the late 1980's for the other wells; since then, however, iron values have stayed consistently low. For the most part, iron values for two wells have been less than the original values (wells 3 and 3A); iron values for the other two wells (1 and 2) have generally stayed near the originally-tested values.

Static water levels have generally increased or stayed close to the initial recorded levels according to the data. Subsequently, no problem is noted with well recharge.

In summary, the well data show that the character of the aquifer has changed little and generally improved. Therefore, it is concluded that mining at the McKinley Mine is not adversely impacting the Gallup Sandstone aquifer. No future impact of the Gallup Sandstone Aquifer is likely; the recharge zone is not located in the McKinley Mine area, and the aquifer lies below impermeable shales.

3.4.5 CHIA (SYNOPSIS)

The Cumulative Hydrologic Impact Assessment (CHIA), completed by the Radian Corporation for the Office of Surface Mining as part of the Technical Analyses and Environmental Assessment by OSMRE on Permit No. NM-0001B/3-10P, covers all of the areas to be mined by this application and is still valid. Included below is a brief synopsis of the conclusions of the CHIA:

- Surface water use in the area is primarily stock watering with some irrigation. There are no permitted water rights holders downstream of the mining operation in the cumulative impact area. Indicator parameters related to hydrologic concerns in the basin are total dissolved solids and total suspended solids (TSS) concentrations.
- Cumulative impacts to the quantity of the flow in the Puerco River are

insignificant.

- Cumulative impacts to the quality (TDS and TSS) of flows in the Puerco River are minimal and should not cause significant changes in baseline conditions. No material damage to the hydrologic balance is expected.
- Ground water is an important source of water in the Gallup area. The major ground water pumping centers are at the Santa Fe and Yah-ta-hey well fields, both completed in the Gallup Sandstone and operated by the city of Gallup. Shallow ground water is not widely used owing to the relatively poor chemical quality and small well yields.
- Cumulative impacts related to ground-water quality are not expected: ground-water quality in terms of TDS and sulfate has not been demonstrated to change significantly and the poor physical properties of the near-surface zones are not greatly altered by mining.
- Ground-water quantity in the Gallup aquifer may be affected by the cumulative impacts of mining, particularly if declared water rights are fully used by P&M. Calculations of water-level drawdowns indicate that the Yah-ta-hey well field could experience up to 3 feet of drawdown attributable to mining activities; this does not constitute material damage. No material damage, based upon a criterion of a decline of 25% of available hydraulic head, is predicted as a result of surface coal mining.

Thus, based upon the report, P&M feels that any impacts which have or will occur on the hydrologic systems at the McKinley Mine are insignificant.

3.4.6 DEVELOPED WATER RESOURCES

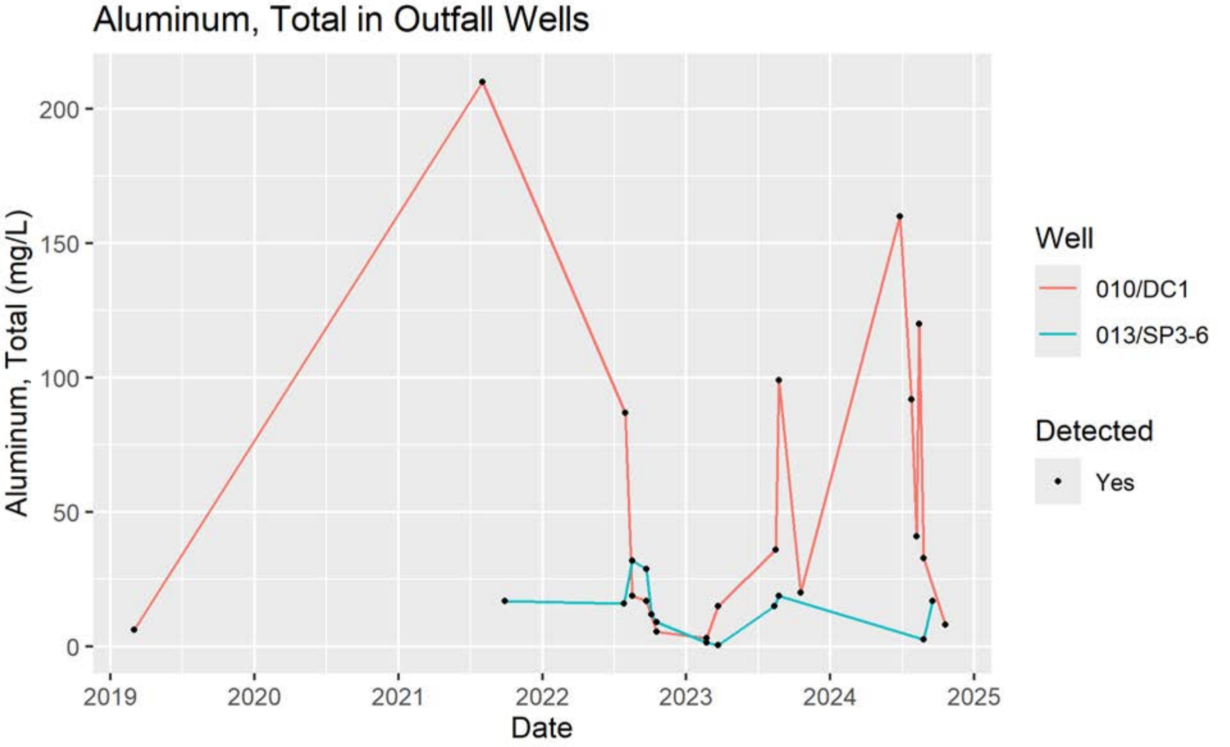
SURFACE WATER RESOURCES

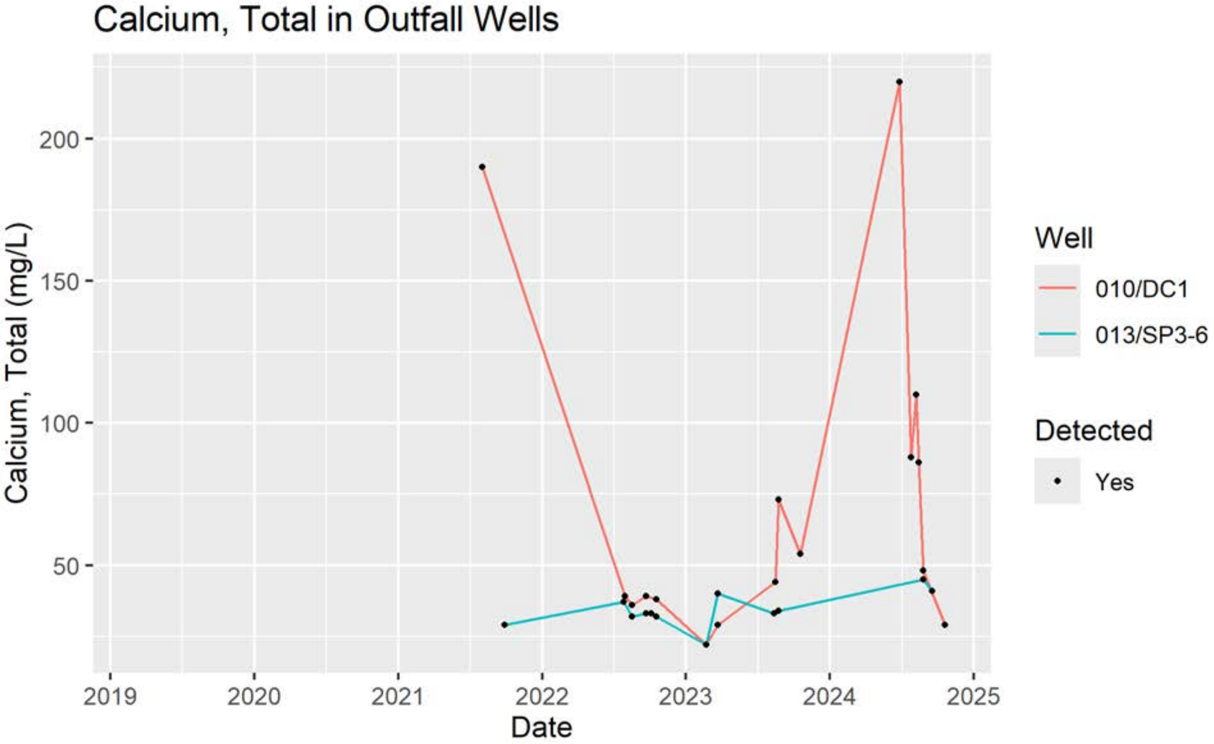
All identified developed surface water resources within the proposed permit area and within 1000 feet of the proposed permit boundary are shown on Exhibit 3.4-3. A total of 8 developed surface water resources were identified. All six of the resources are stockponds. Two of the resources will be disturbed by mining during this permit term; whereas, the other six resources will not be disturbed during this permit term. Replacement of the stockponds that will be disturbed during this permit term is discussed in Section 5.7.

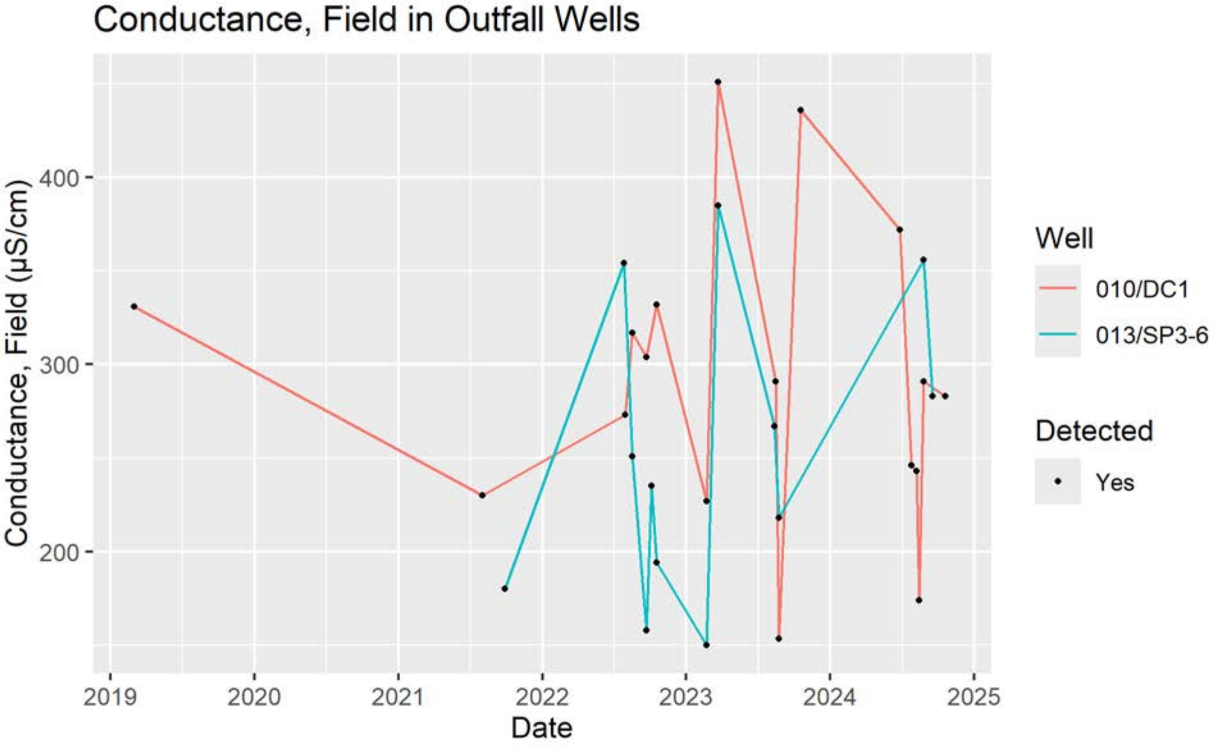
Permit NM-0001B Exhibit 2.9-1 depicted an impoundment located in the center of section 5. Subsequently, the impoundment was noted as a Stockpond in the original Developed Water Resource documentation. However, this impoundment was not a stockpond but a temporarily abandoned mining pit which was being temporarily used to impound water for dust control. This pit was covered by a surface water user permit which allowed for the diversion of the Tse Bonita Wash into it for water storage. Mining has since resumed in this pit and it no longer exists. At no time was this pit ever used for any other purpose but mining related storage.

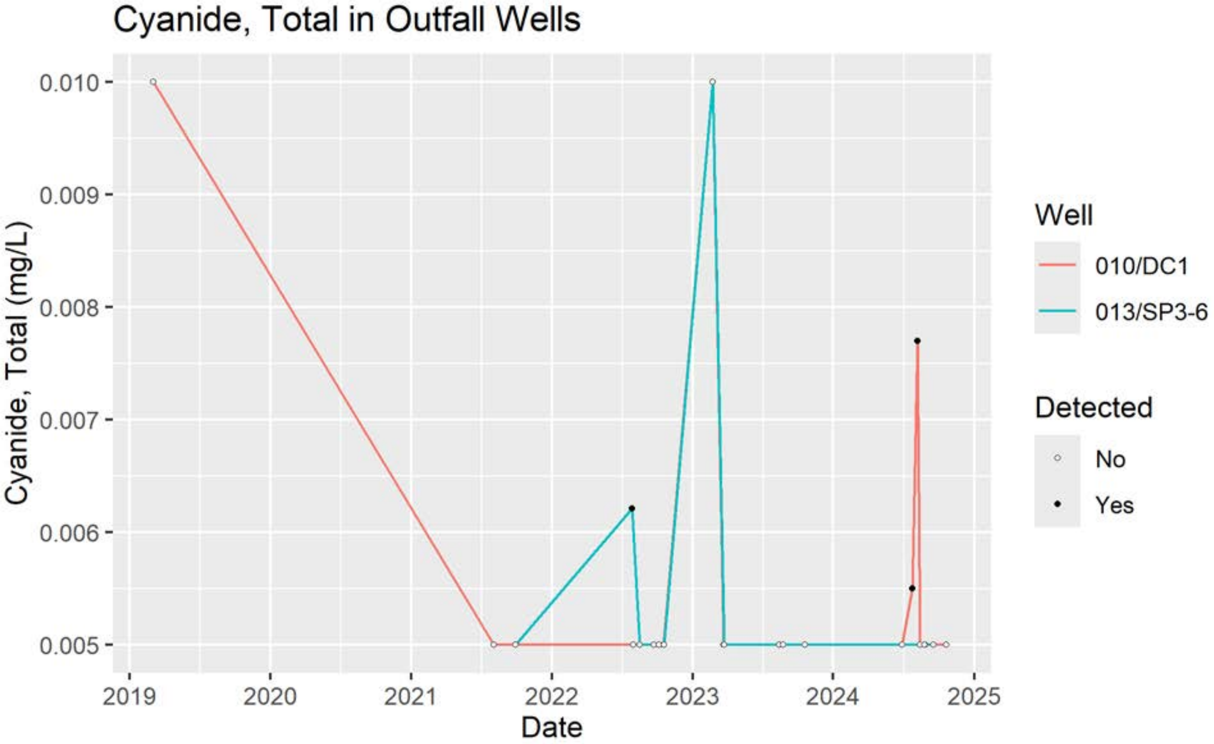
APPENDIX B

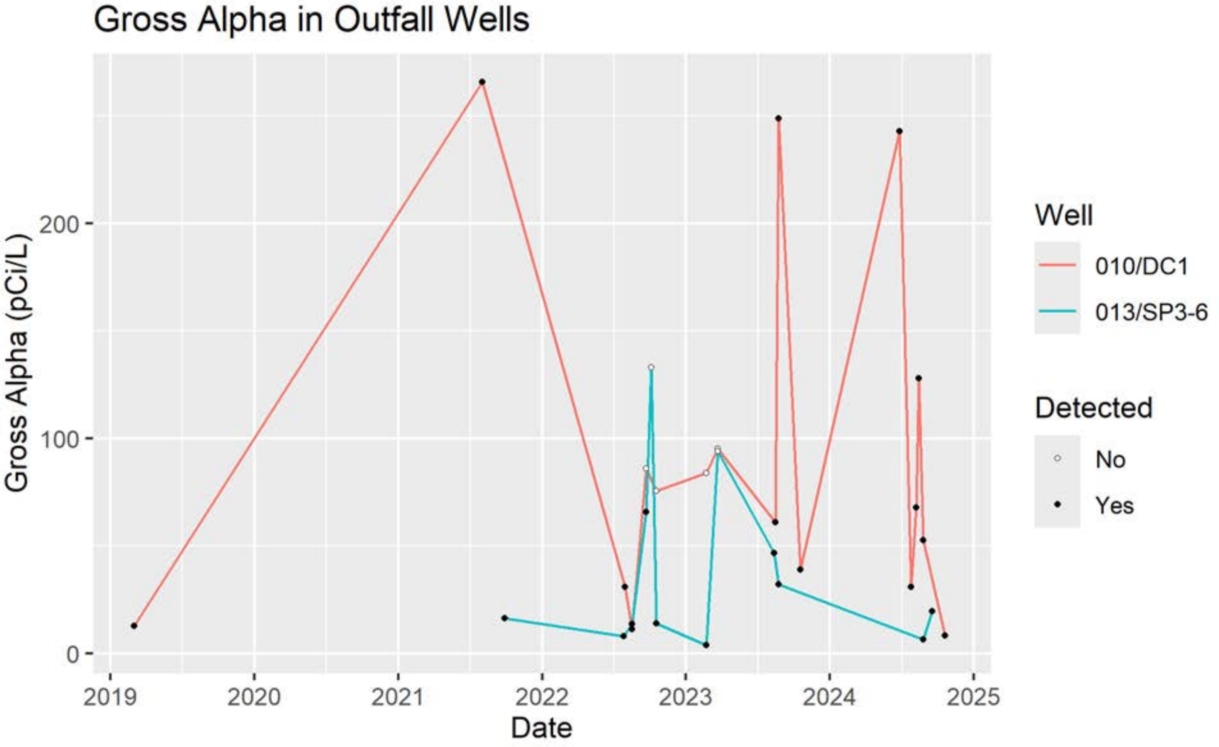
OUTFALL SURFACE WATER QUALITY TEMPORAL PLOTS – OUTFALLS 010/DC1 AND 013/SP 3-6

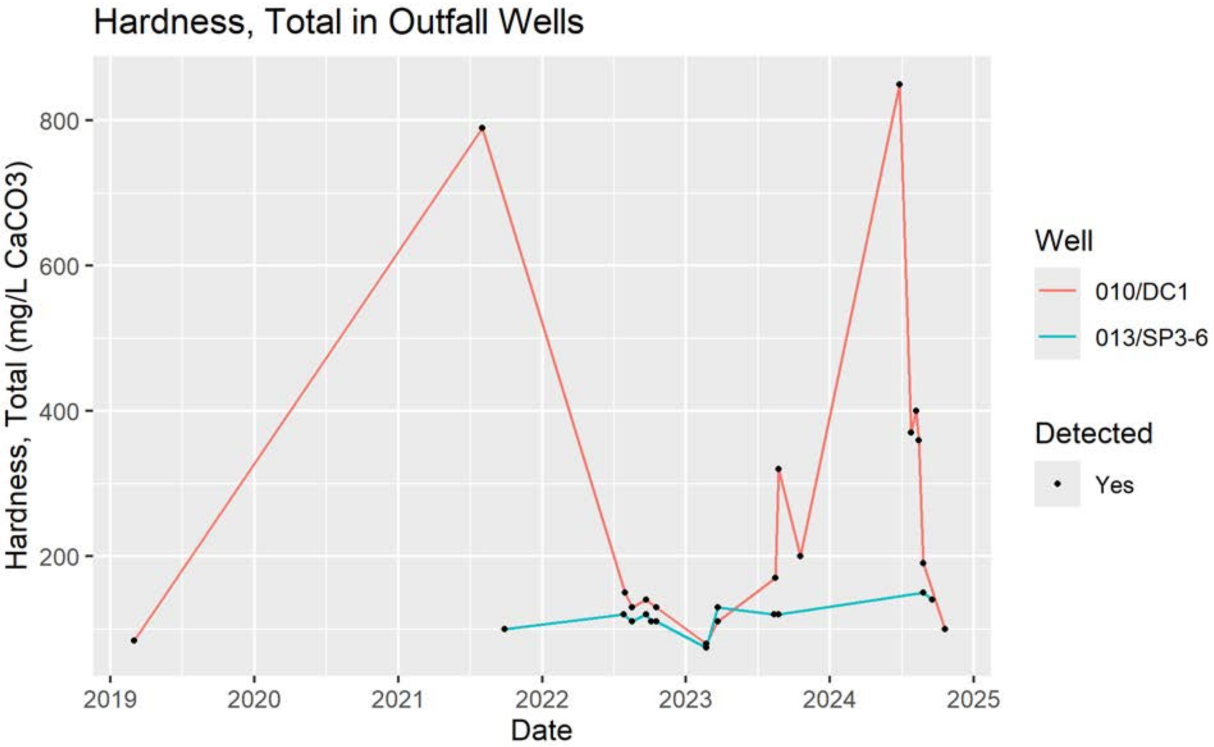

Aluminum, Total in Outfall Wells
Aluminum, Total (mg/L)
0
50
100
150
200
Date
2019
2020
2021
2022
2023
2024
2025
Well
010/DC1
013/SP3-6
Detected
Yes

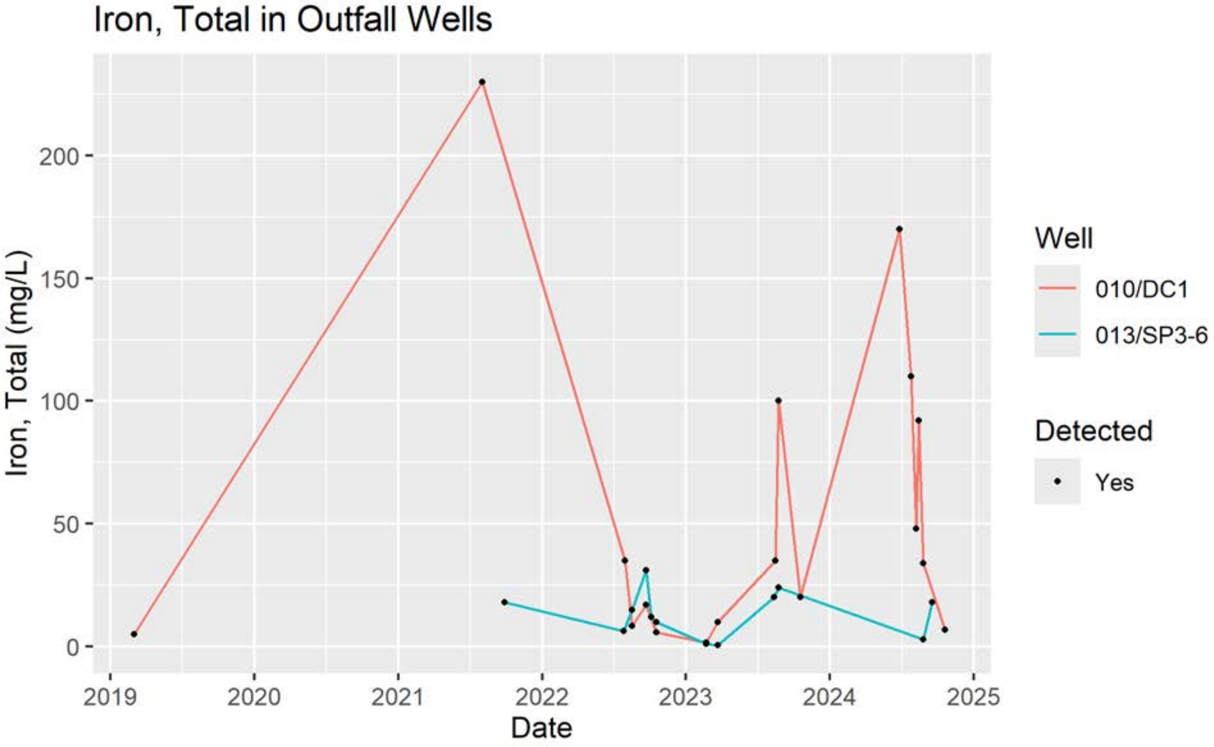

Calcium, Total in Outfall Wells
Calcium, Total (mg/L)
200
150
100
50
2019
2020
2021
2022
2023
2024
2025
Date
Well
010/DC1
013/SP3-6
Detected
Yes

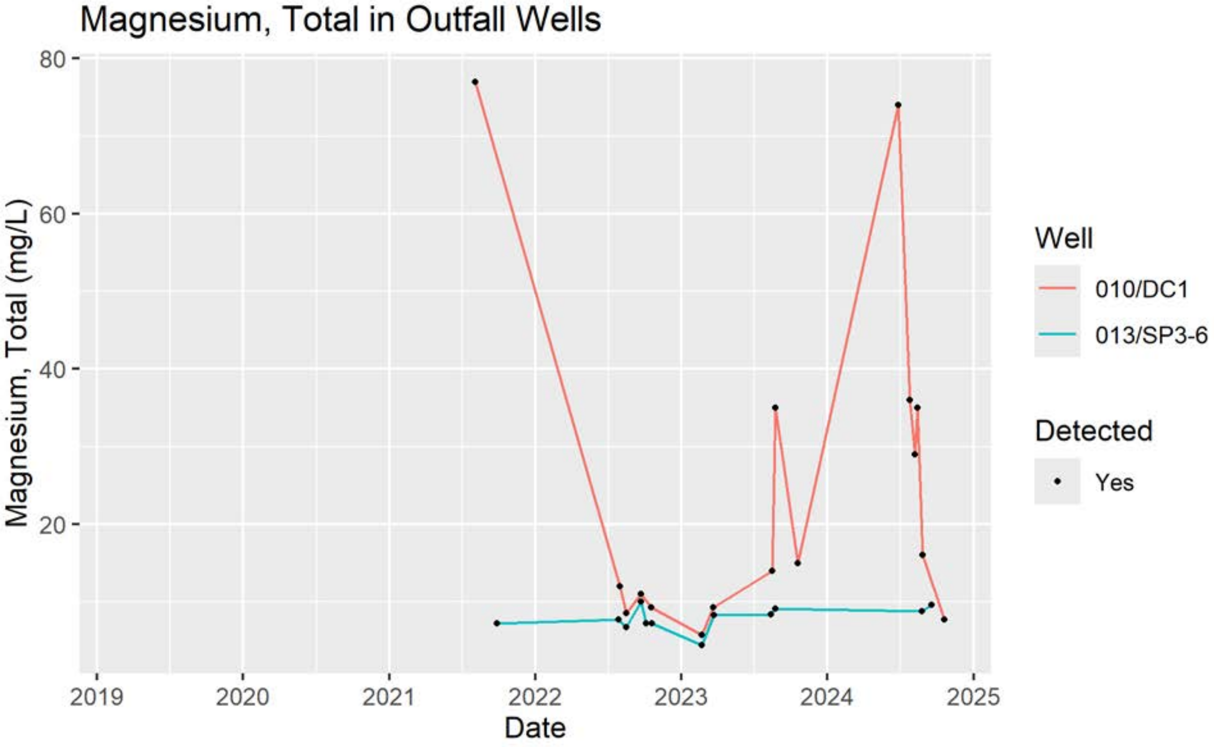

Conductance, Field in Outfall Wells
Conductance, Field (µS/cm)
400
300
200
2019
2020
2021
2022
2023
2024
2025
Date
Well
010/DC1
013/SP3-6
Detected
Yes

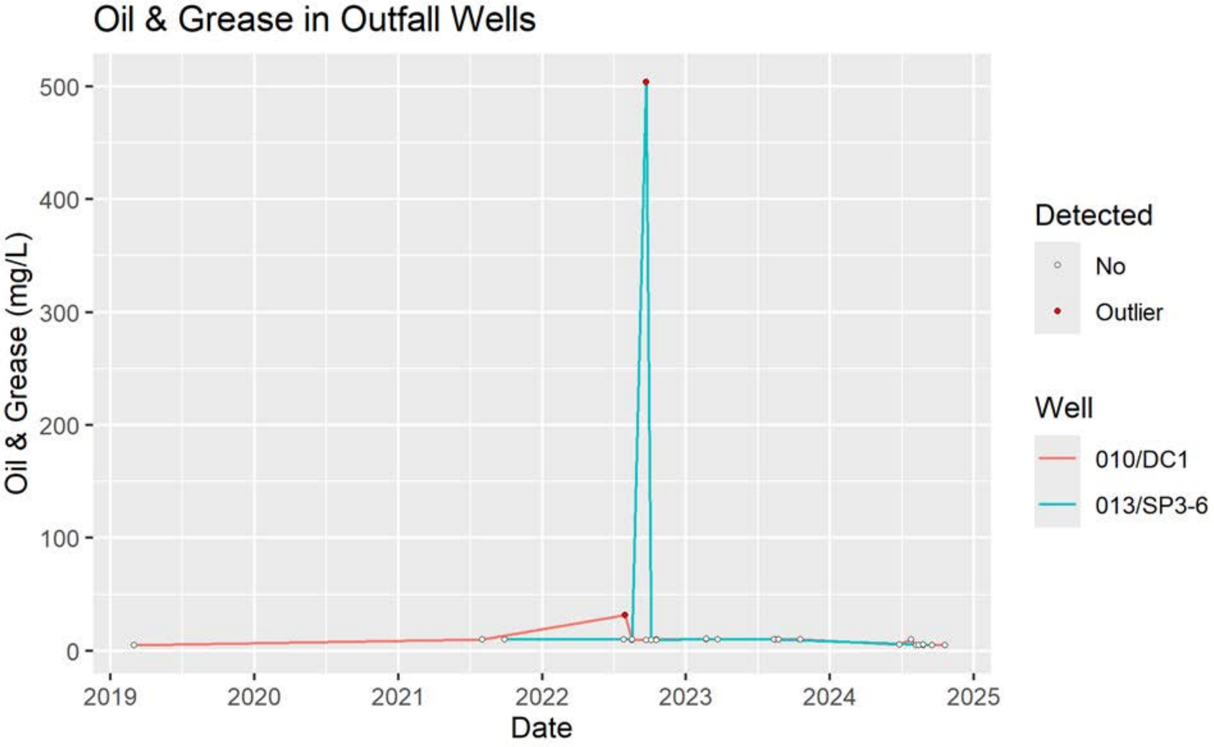

Cyanide, Total in Outfall Wells
Cyanide, Total (mg/L)
0.010
0.009
0.008
0.007
0.006
0.005
2019
2020
2021
2022
2023
2024
2025
Date
Well
010/DC1
013/SP3-6
Detected
No
Yes


Gross Alpha in Outfall Wells
Gross Alpha (pCi/L)
0
100
200
Date
2019
2020
2021
2022
2023
2024
2025
Well
010/DC1
013/SP3-6
Detected
No
Yes

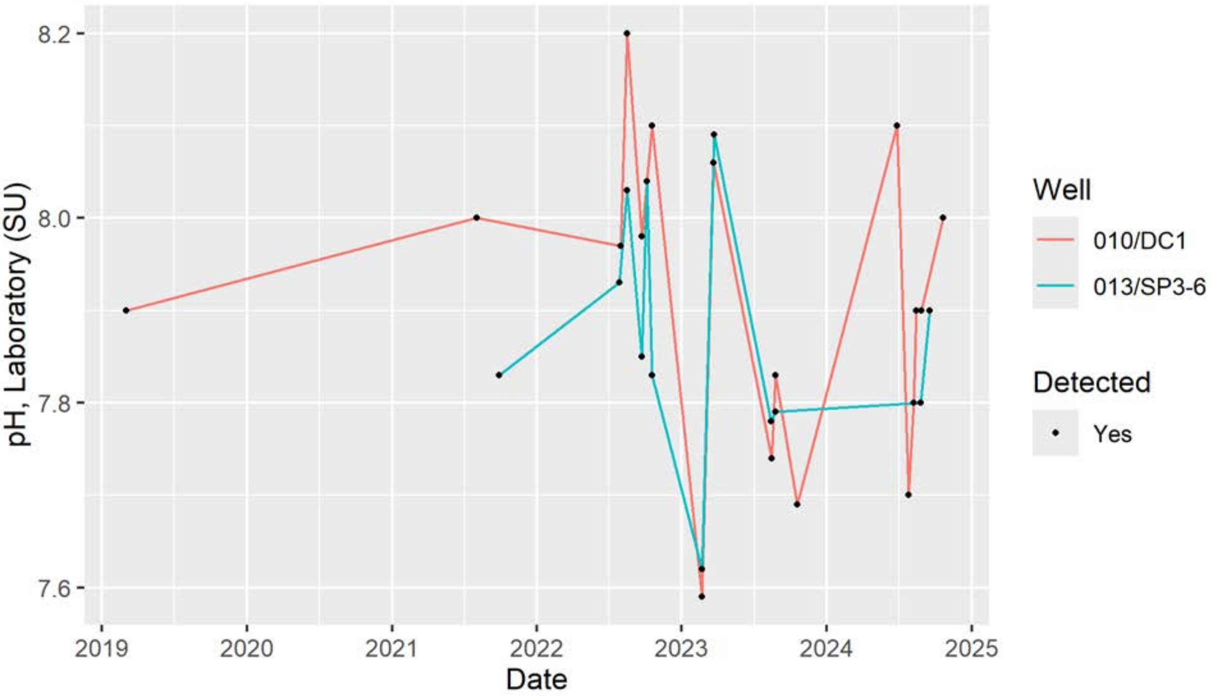

Hardness, Total in Outfall Wells
Hardness, Total (mg/L CaCO3)
800
600
400
200
2019
2020
2021
2022
2023
2024
2025
Date
Well
010/DC1
013/SP3-6
Detected
Yes

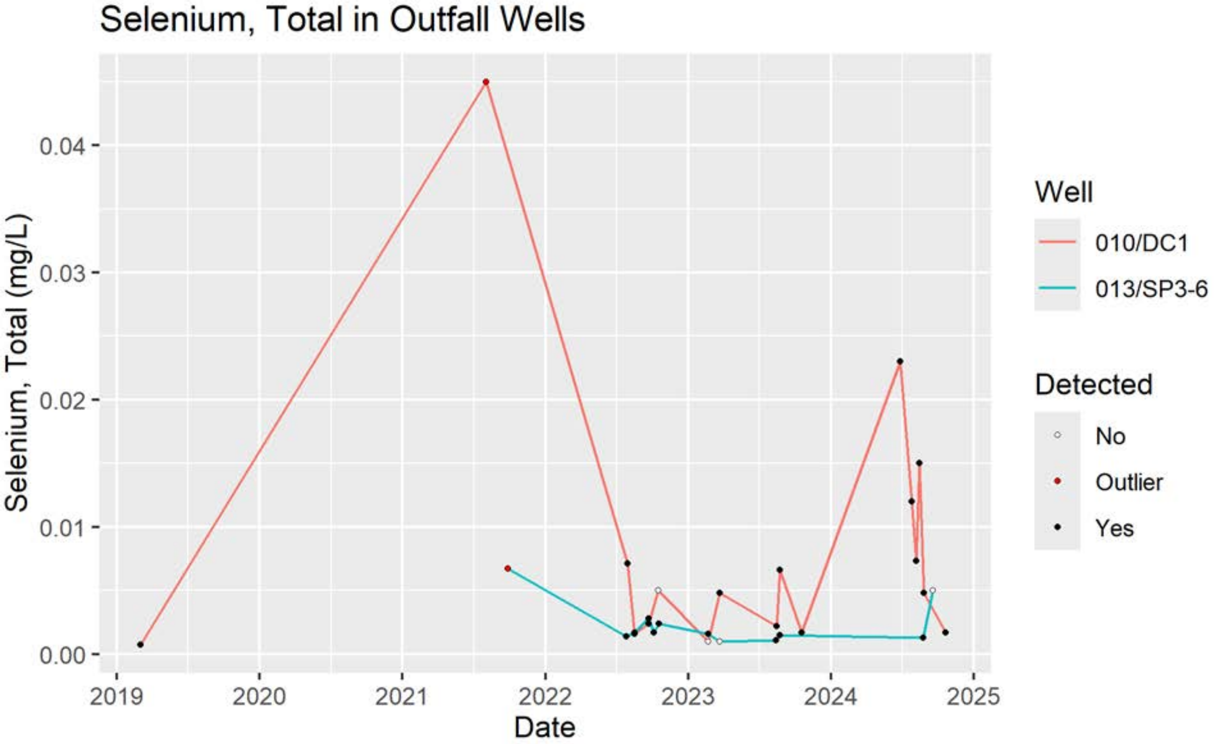

Iron, Total in Outfall Wells
Iron, Total (mg/L)
0
50
100
150
200
Date
2019
2020
2021
2022
2023
2024
2025
Well
010/DC1
013/SP3-6
Detected
Yes

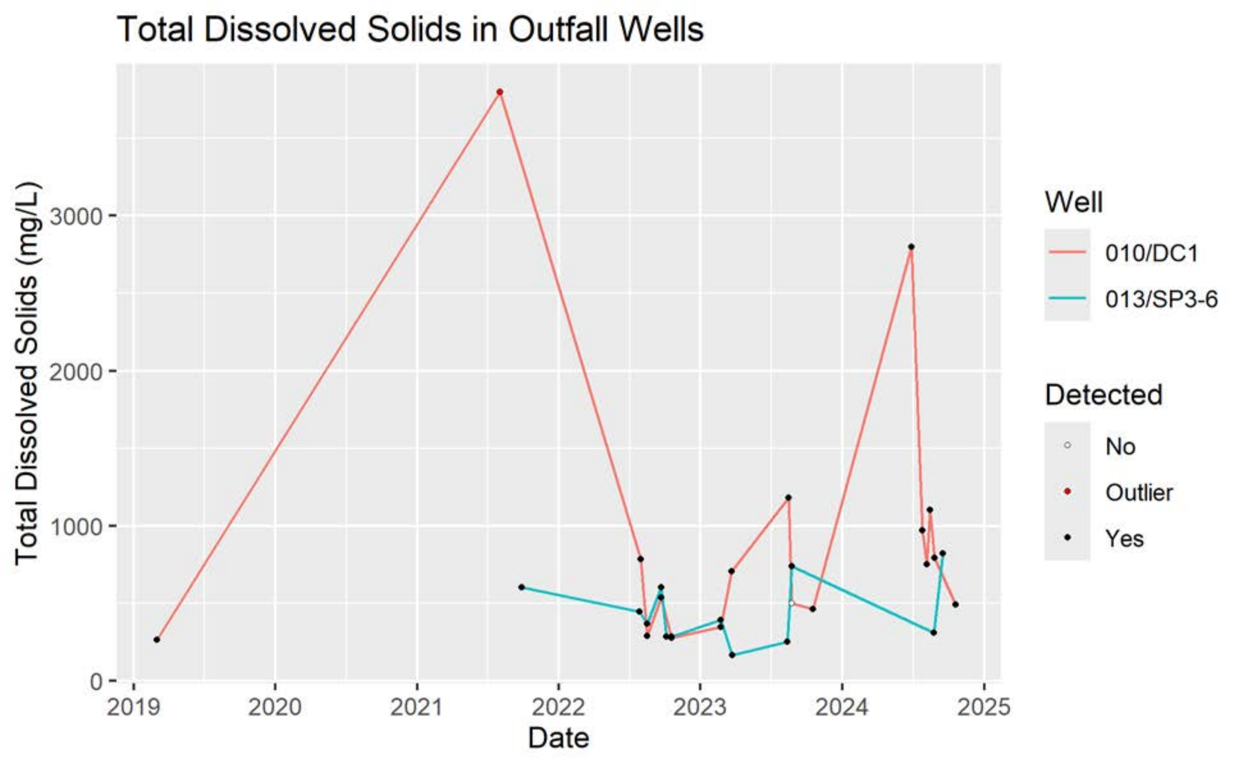

Magnesium, Total in Outfall Wells
Magnesium, Total (mg/L)
80
60
40
20
2019
2020
2021
2022
2023
2024
2025
Date
Well
010/DC1
013/SP3-6
Detected
Yes

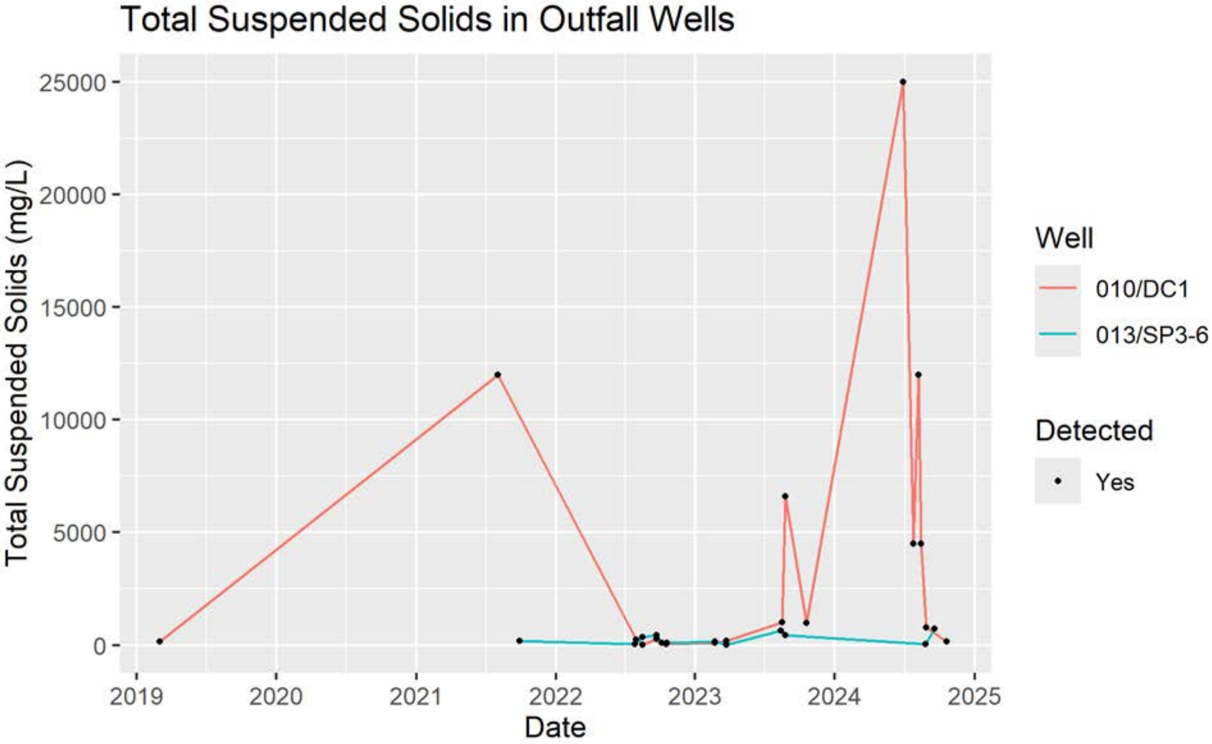

Oil & Grease in Outfall Wells
Oil & Grease (mg/L)
500
400
300
200
100
0
2019
2020
2021
2022
2023
2024
2025
Date
Detected
No
Outlier
Well
010/DC1
013/SP3-6

pH, Laboratory in Outfall Wells



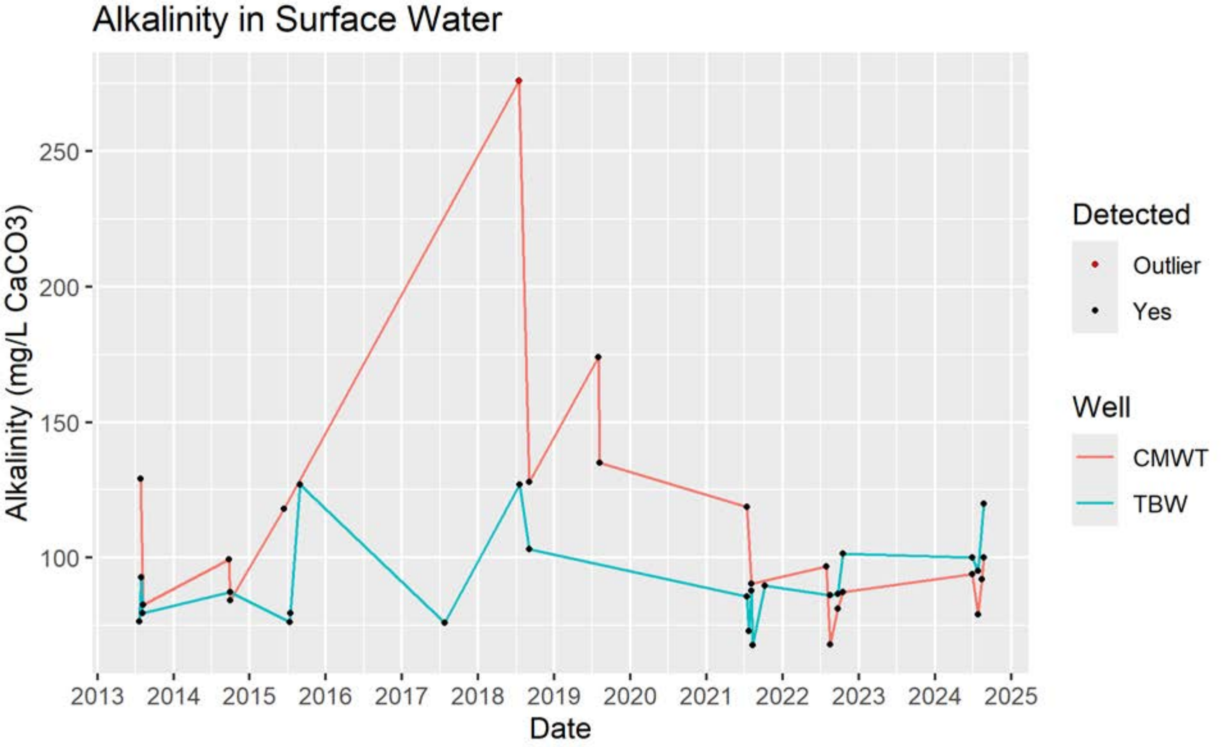

Selenium, Total in Outfall Wells
Selenium, Total (mg/L)
0.00
0.01
0.02
0.03
0.04
Date
2019
2020
2021
2022
2023
2024
2025
Well
010/DC1
013/SP3-6
Detected
No
Outlier
Yes

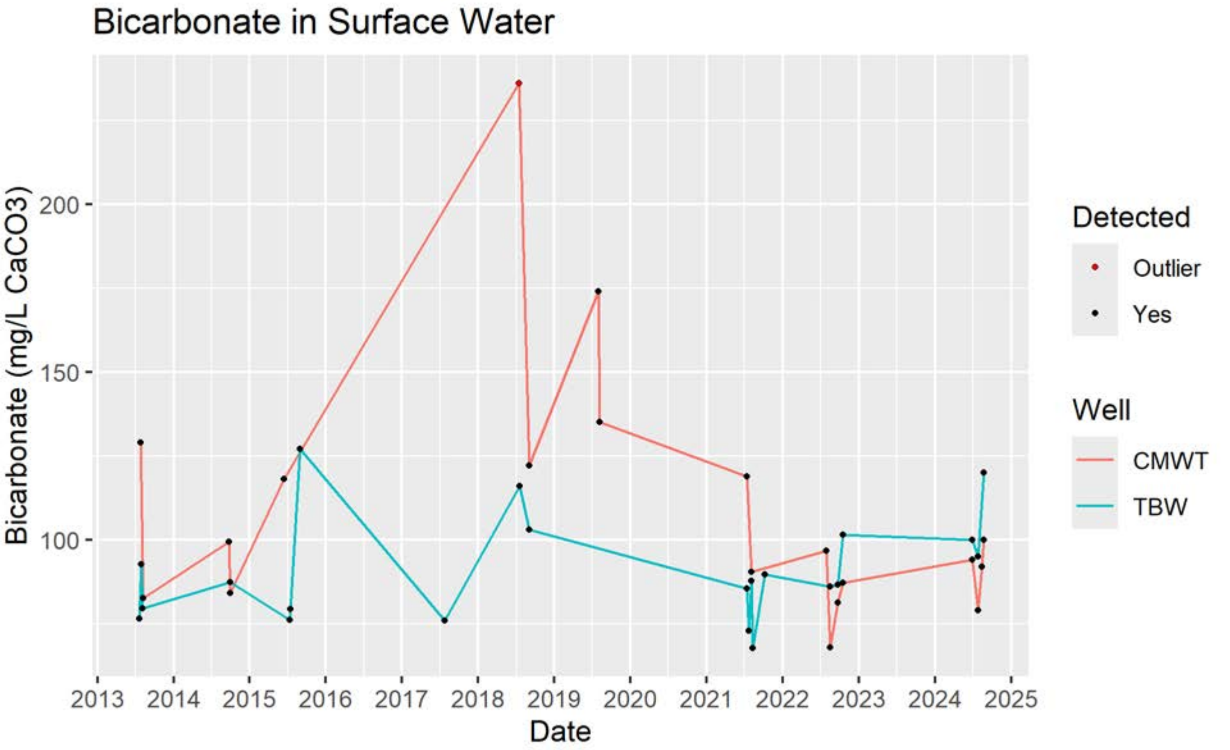

Total Dissolved Solids in Outfall Wells
Total Dissolved Solids (mg/L)
0
1000
2000
3000
Date
2019
2020
2021
2022
2023
2024
2025
Well
010/DC1
013/SP3-6
Detected
No
Outlier
Yes

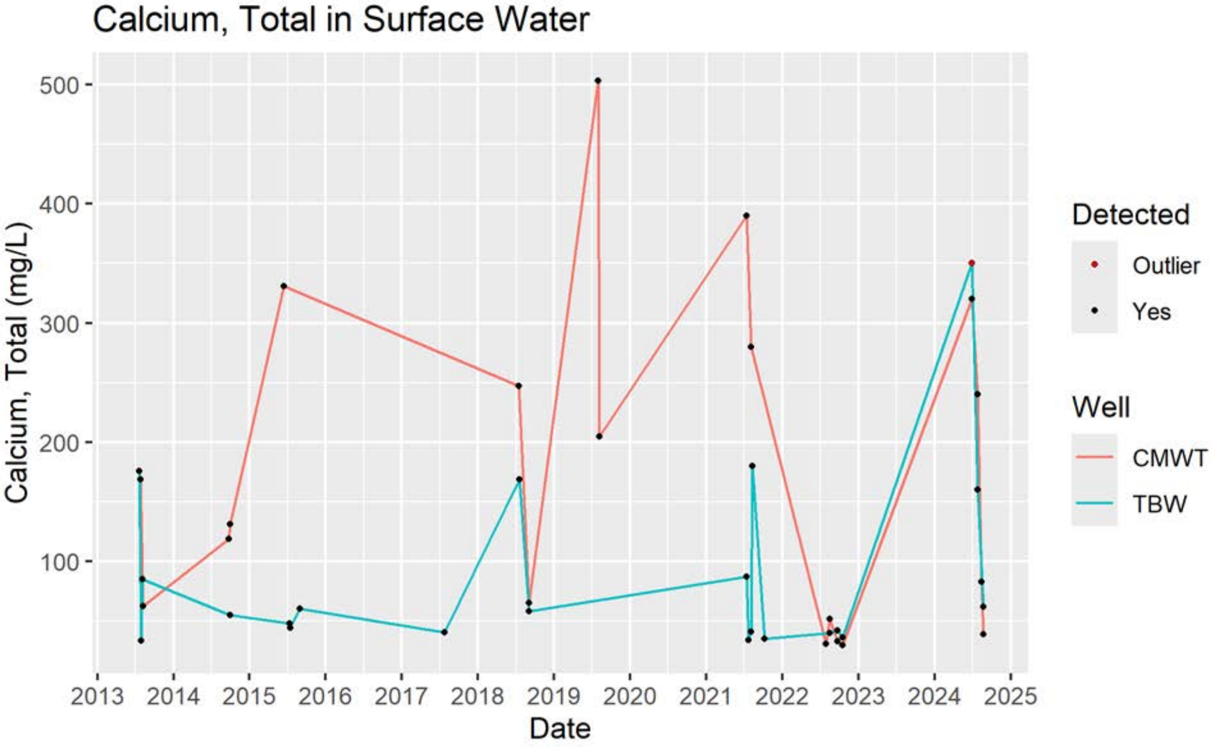

Total Suspended Solids in Outfall Wells
Total Suspended Solids (mg/L)
25000
20000
15000
10000
5000
0
2019
2020
2021
2022
2023
2024
2025
Date
Well
010/DC1
013/SP3-6
Detected
Yes

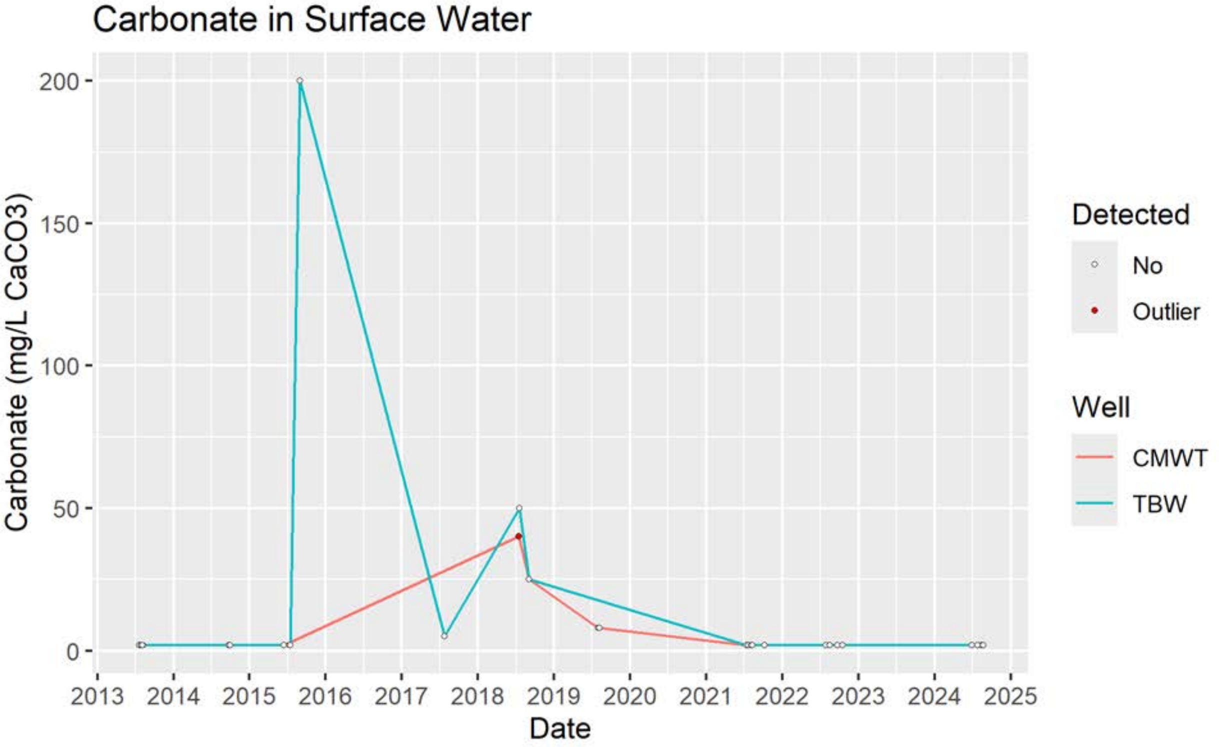
APPENDIX C

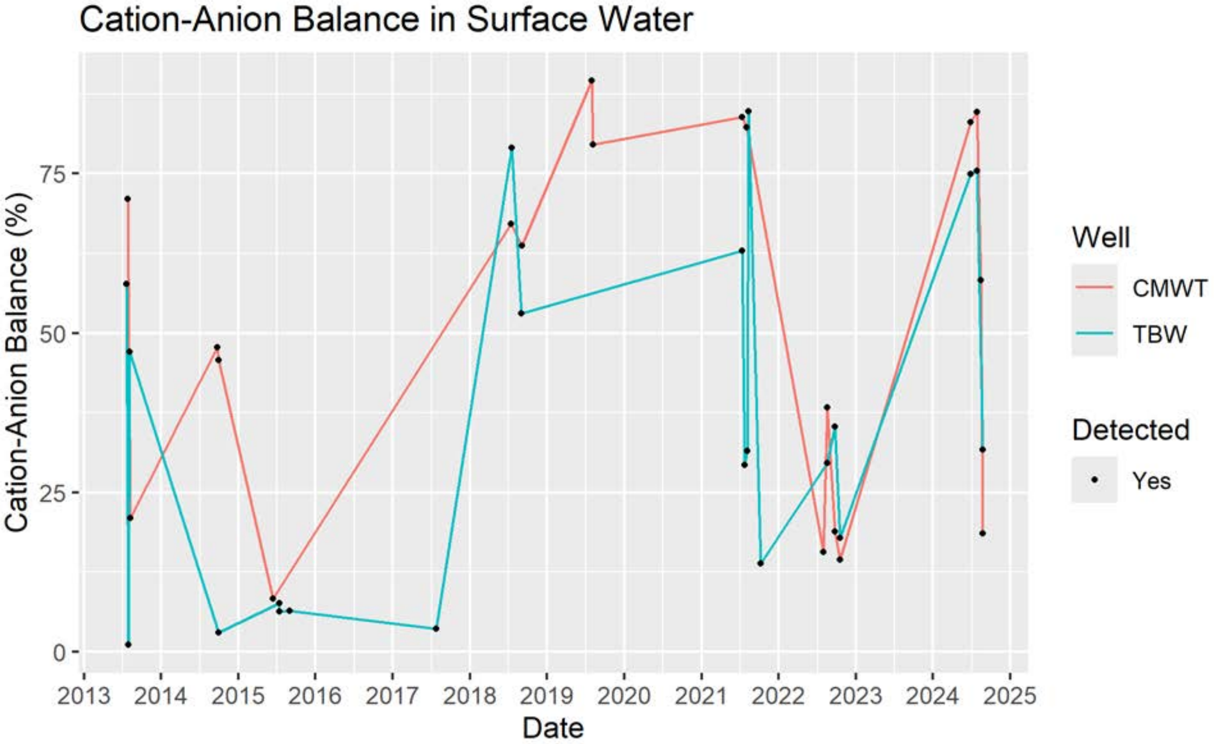
ISCO STATION SURFACE WATER QUALITY TEMPORAL PLOTS – COAL MINE WASH TRIBUTARY (CMWT) AND TSE BONITA WASH (TBW)

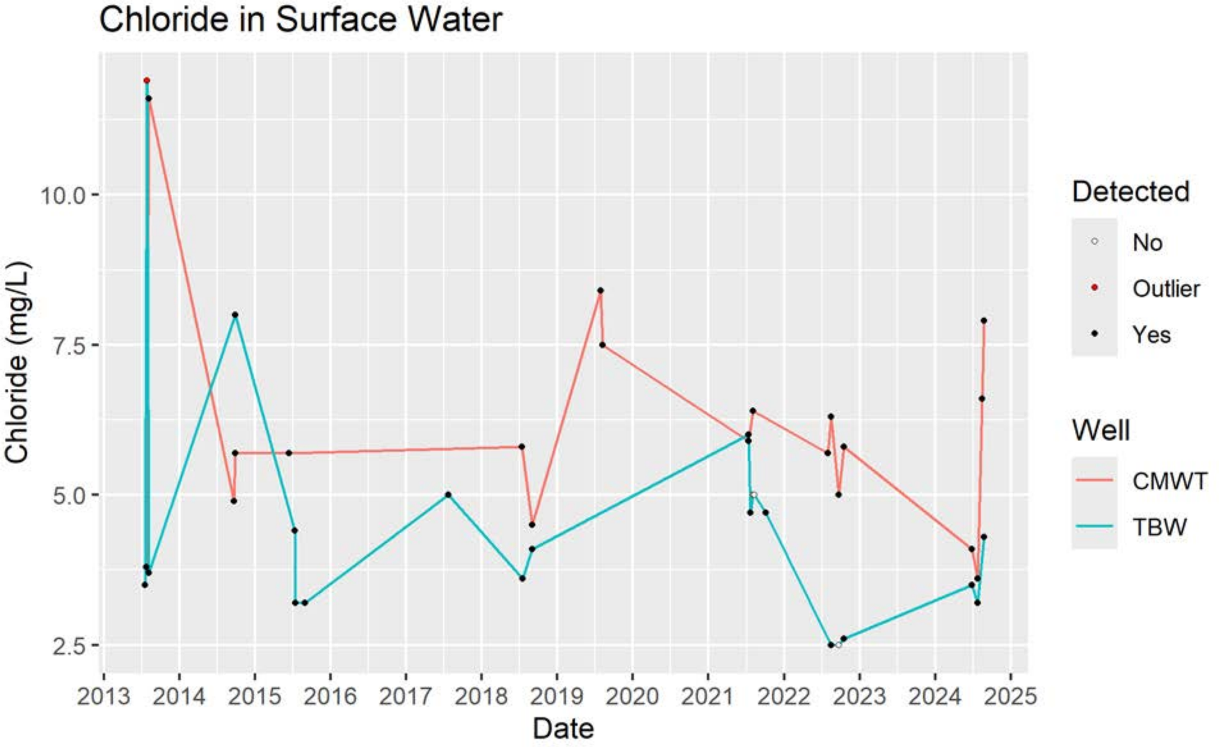

Alkalinity in Surface Water
Alkalinity (mg/L CaCO3)
250
200
150
100
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
CMWT
TBW

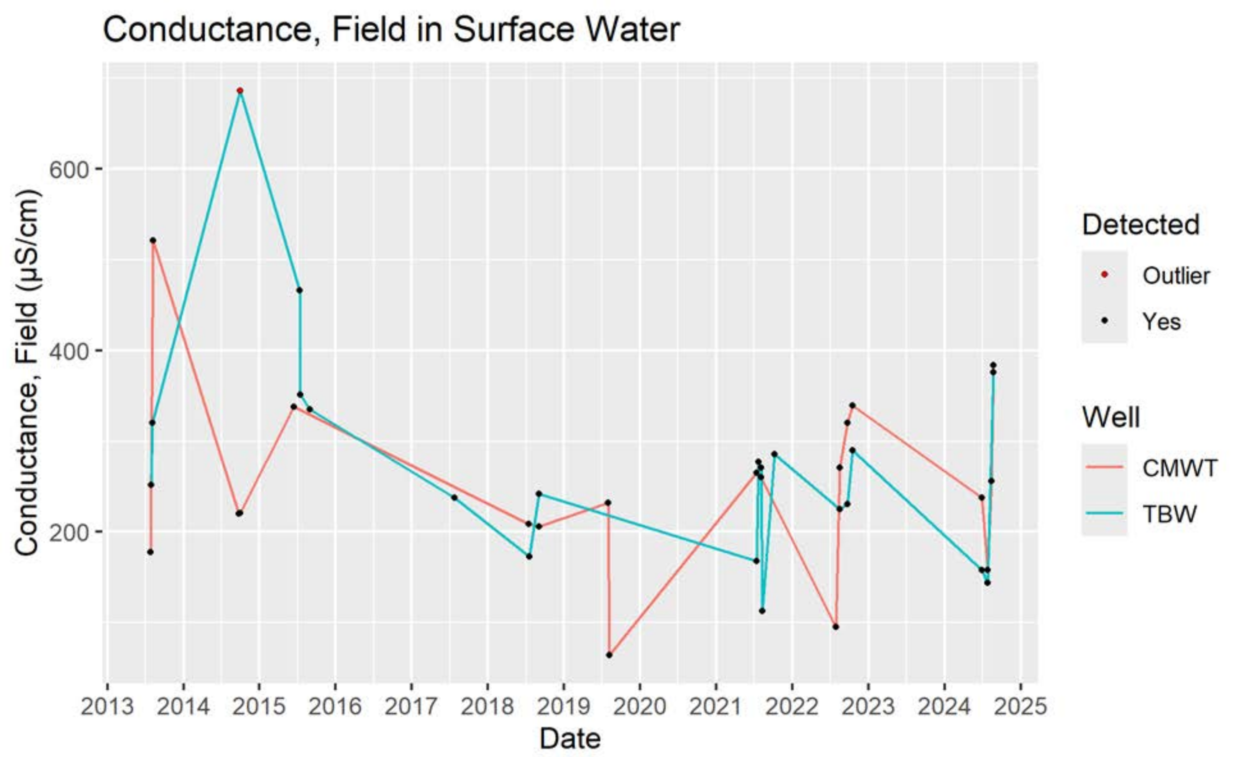

Bicarbonate in Surface Water
Bicarbonate (mg/L CaCO3)
200
150
100
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Detected
Outlier
Yes
Well
CMWT
TBW

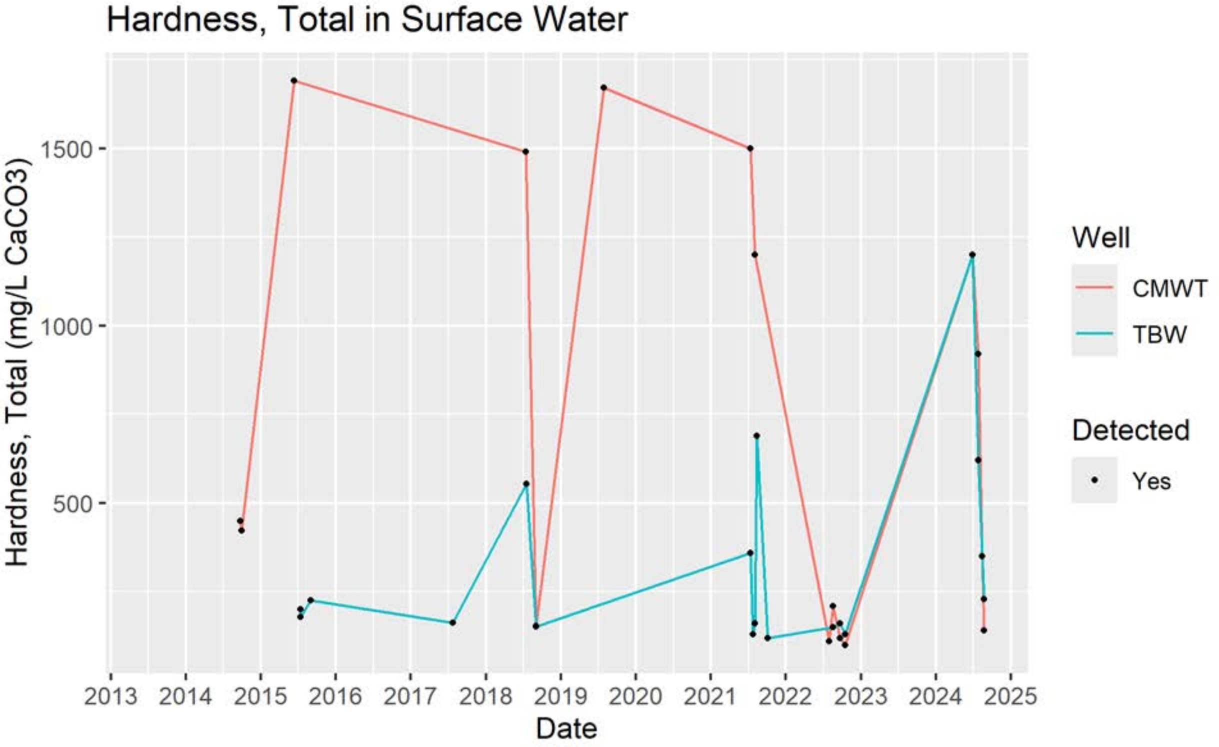

Calcium, Total in Surface Water
Calcium, Total (mg/L)
500
400
300
200
100
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Detected
Outlier
Yes
Well
CMWT
TBW

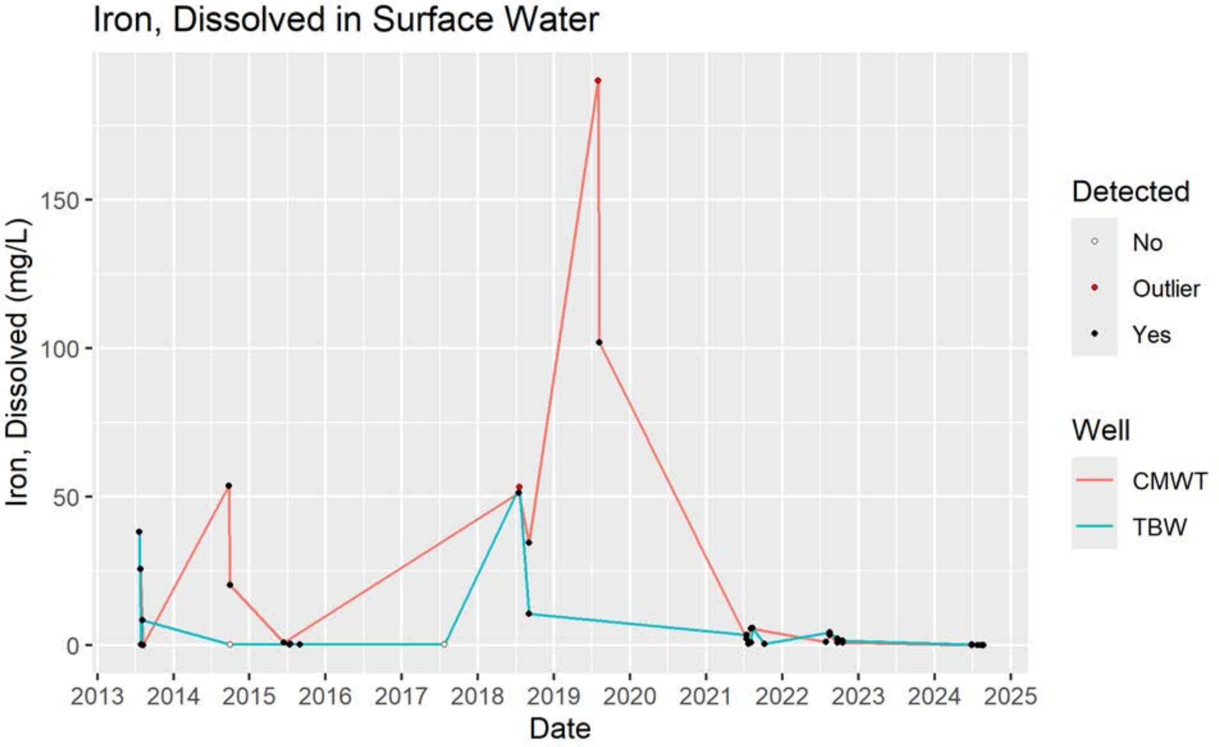

Carbonate in Surface Water
Carbonate (mg/L CaCO3)
200
150
100
50
0
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
No
Outlier
Well
CMWT
TBW

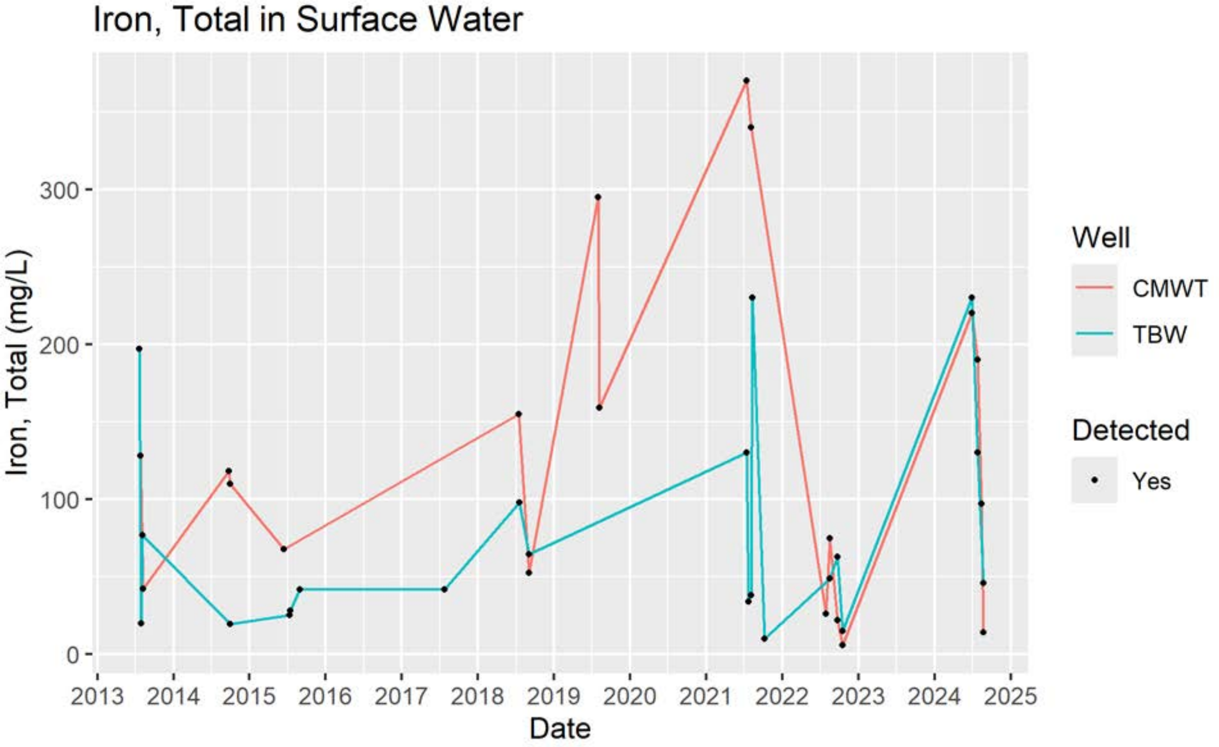

Cation-Anion Balance in Surface Water
Cation-Anion Balance (%)
0
25
50
75
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Well
CMWT
TBW
Detected
Yes

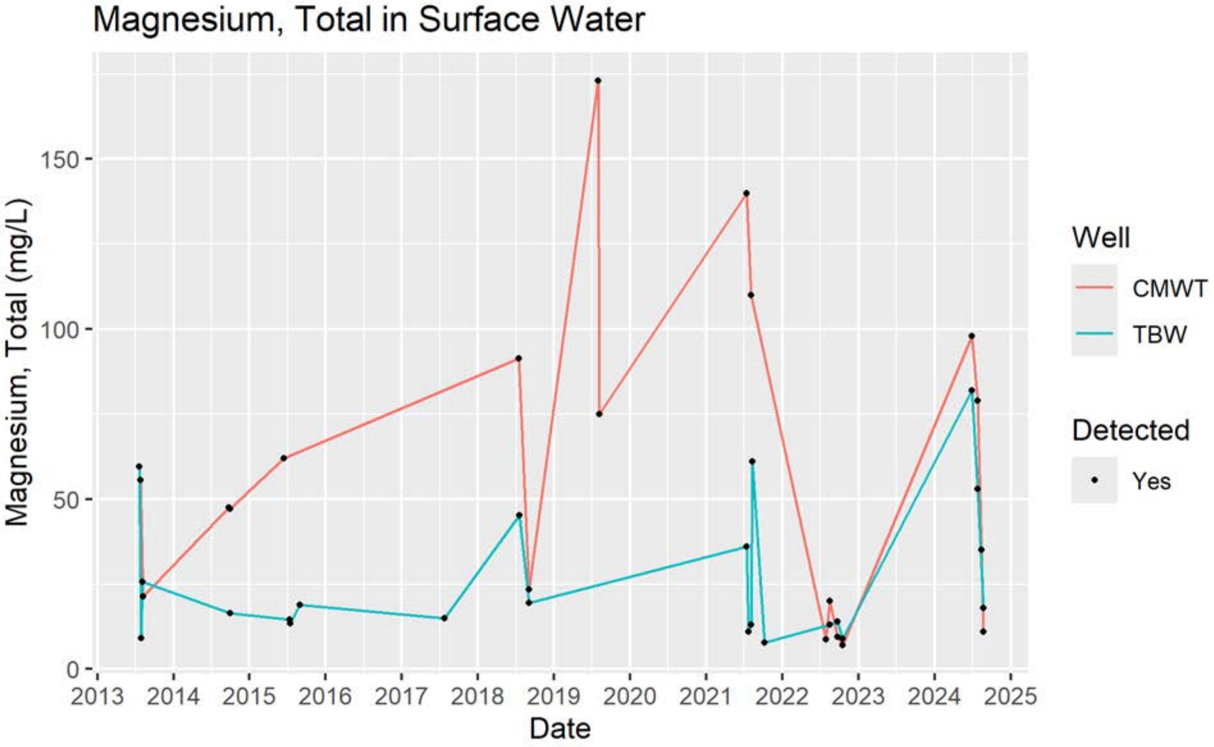

Chloride in Surface Water
Chloride (mg/L)
10.0
7.5
5.0
2.5
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
No
Outlier
Yes
Well
CMWT
TBW

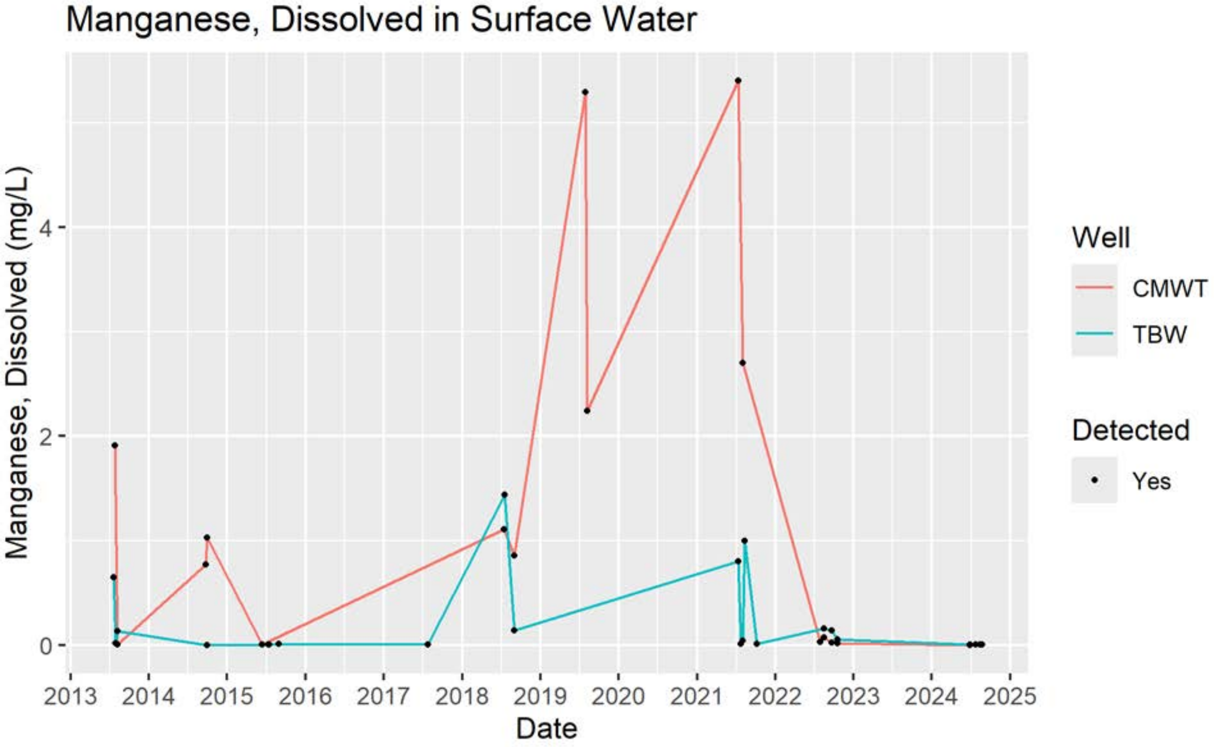

Conductance, Field in Surface Water
Conductance, Field (µS/cm)
600
400
200
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
CMWT
TBW

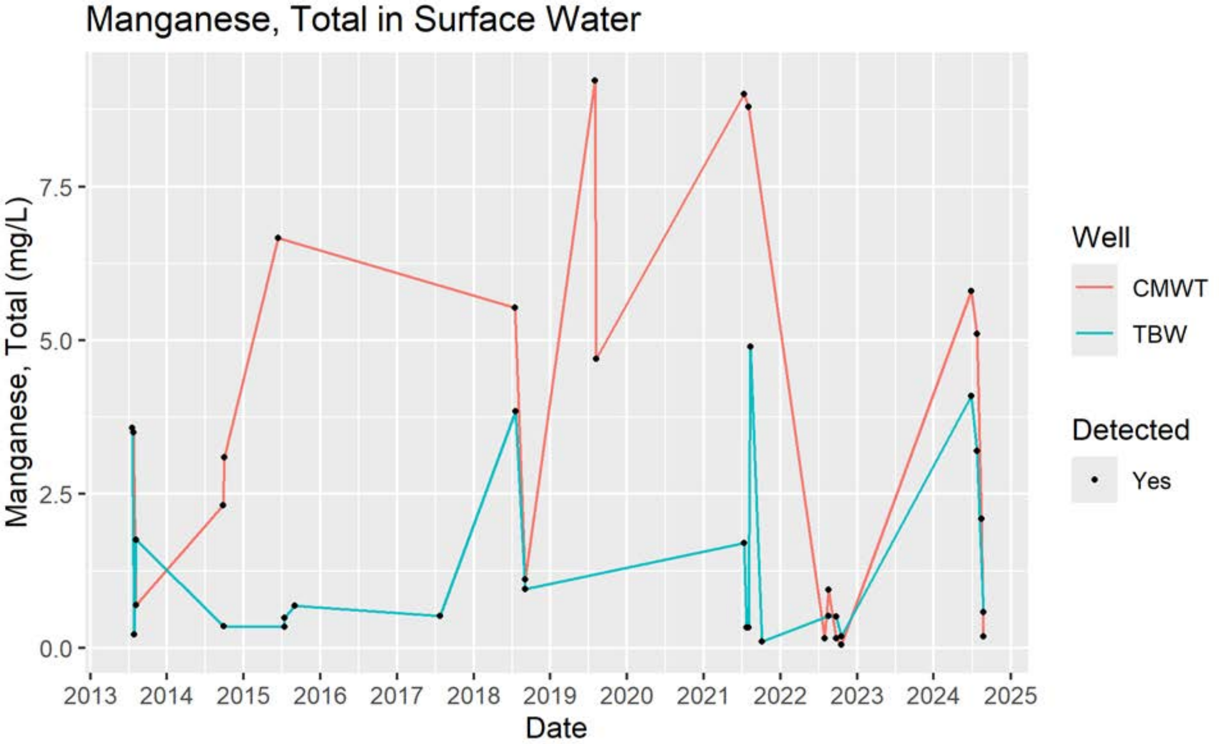

Hardness, Total in Surface Water
Hardness, Total (mg/L CaCO3)
1500
1000
500
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
CMWT
TBW
Detected
Yes

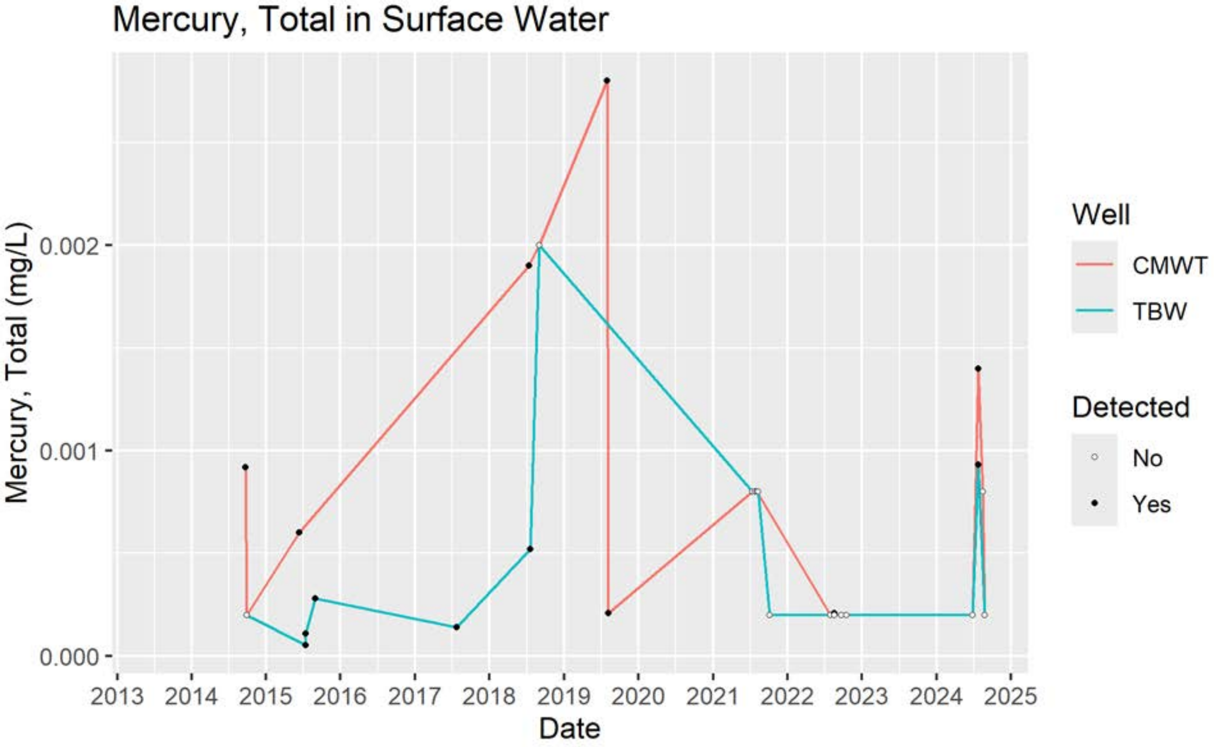

Iron, Dissolved in Surface Water
Iron, Dissolved (mg/L)
150
100
50
0
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
No
Outlier
Yes
Well
CMWT
TBW

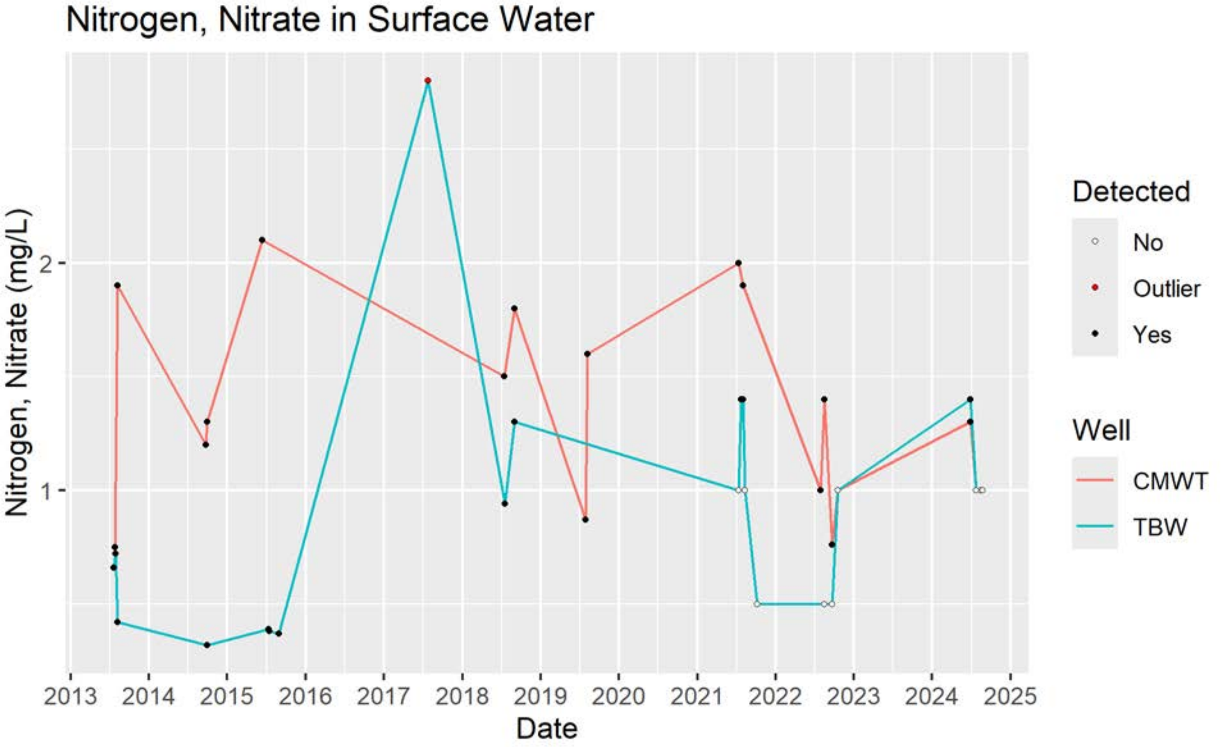

Iron, Total in Surface Water
Iron, Total (mg/L)
0
100
200
300
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
CMWT
TBW
Detected
● Yes

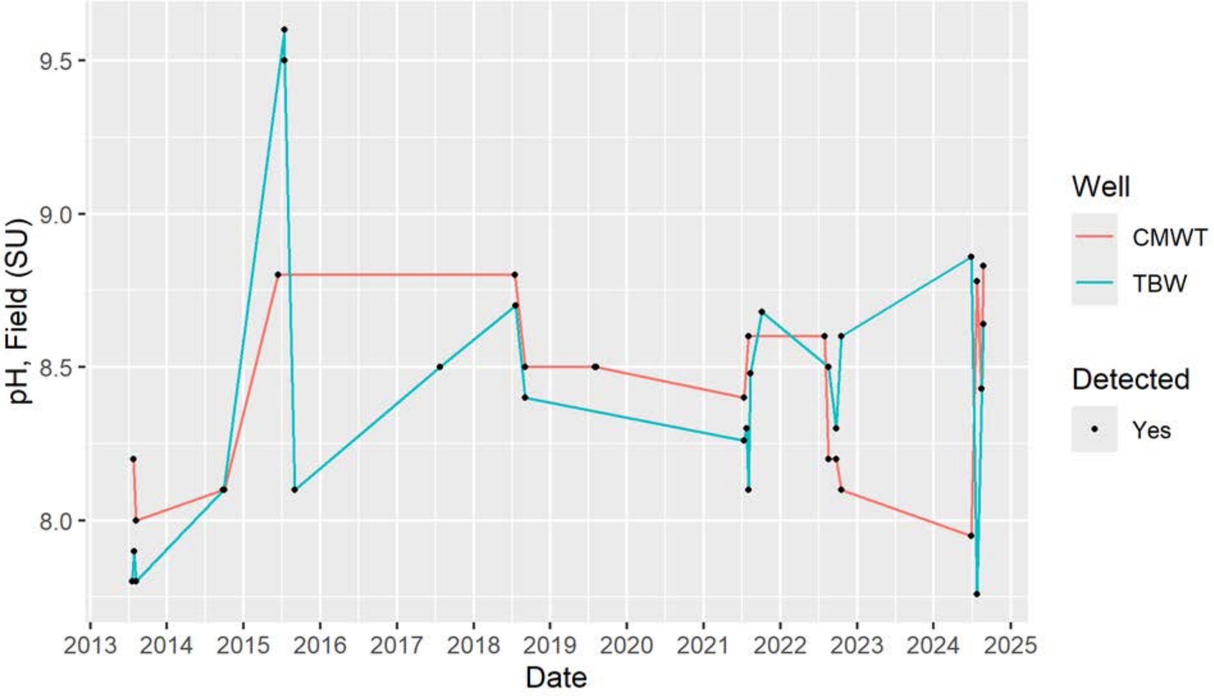

Magnesium, Total in Surface Water
Magnesium, Total (mg/L)
0
50
100
150
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Well
CMWT
TBW
Detected
Yes


Manganese, Dissolved in Surface Water
Manganese, Dissolved (mg/L)
0
2
4
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
CMWT
TBW
Detected
Yes


Manganese, Total in Surface Water
Manganese, Total (mg/L)
7.5
5.0
2.5
0.0
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
CMWT
TBW
Detected
Yes

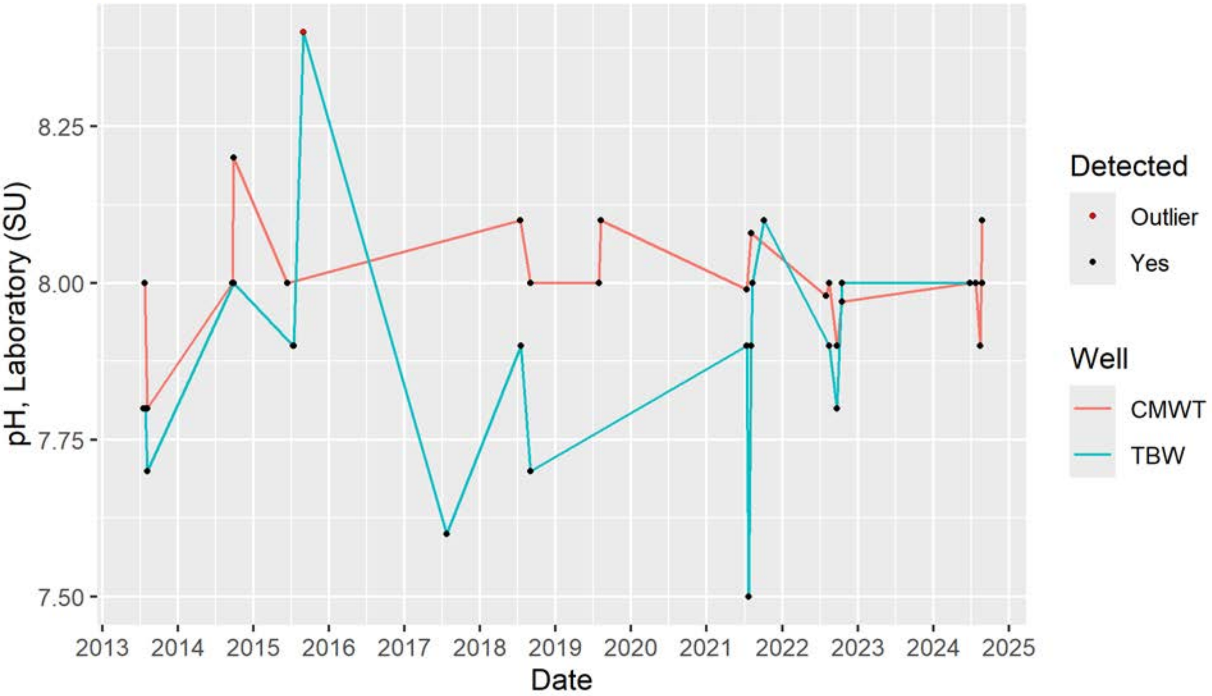

Mercury, Total in Surface Water
Mercury, Total (mg/L)
0.000
0.001
0.002
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Well
CMWT
TBW
Detected
No
Yes

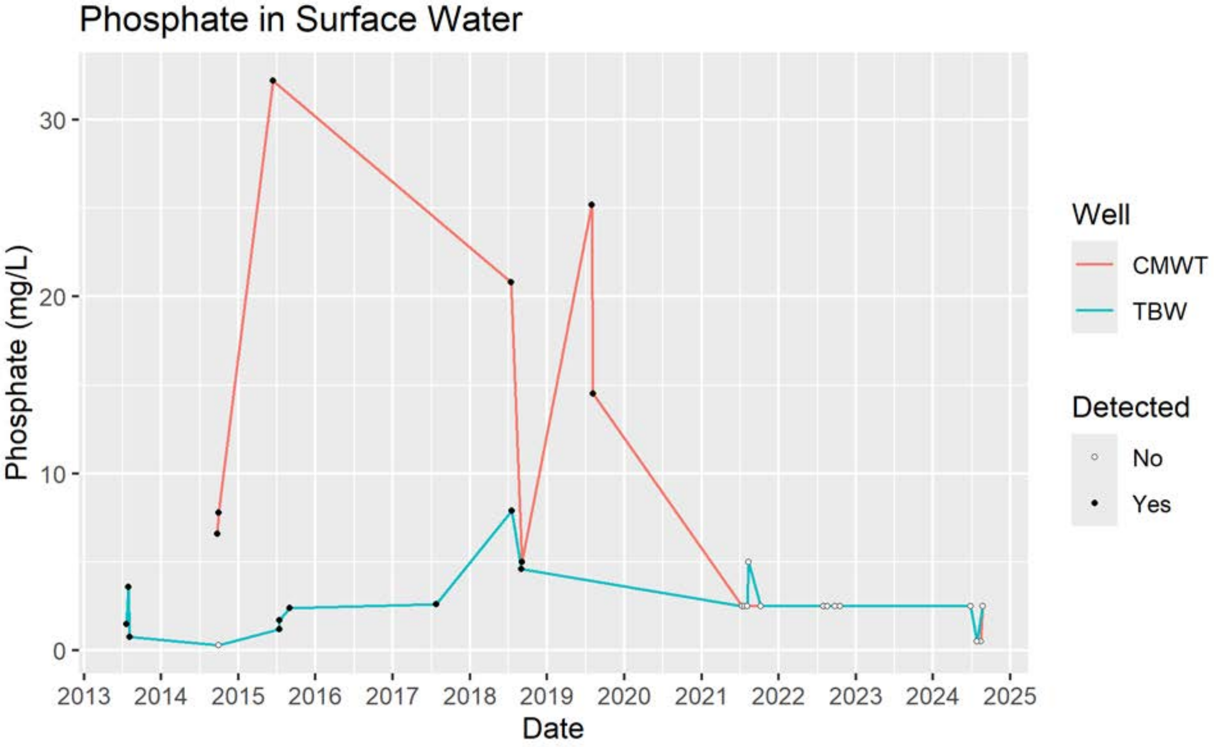

Nitrogen, Nitrate in Surface Water
Nitrogen, Nitrate (mg/L)
2
1
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
No
Outlier
Yes
Well
CMWT
TBW

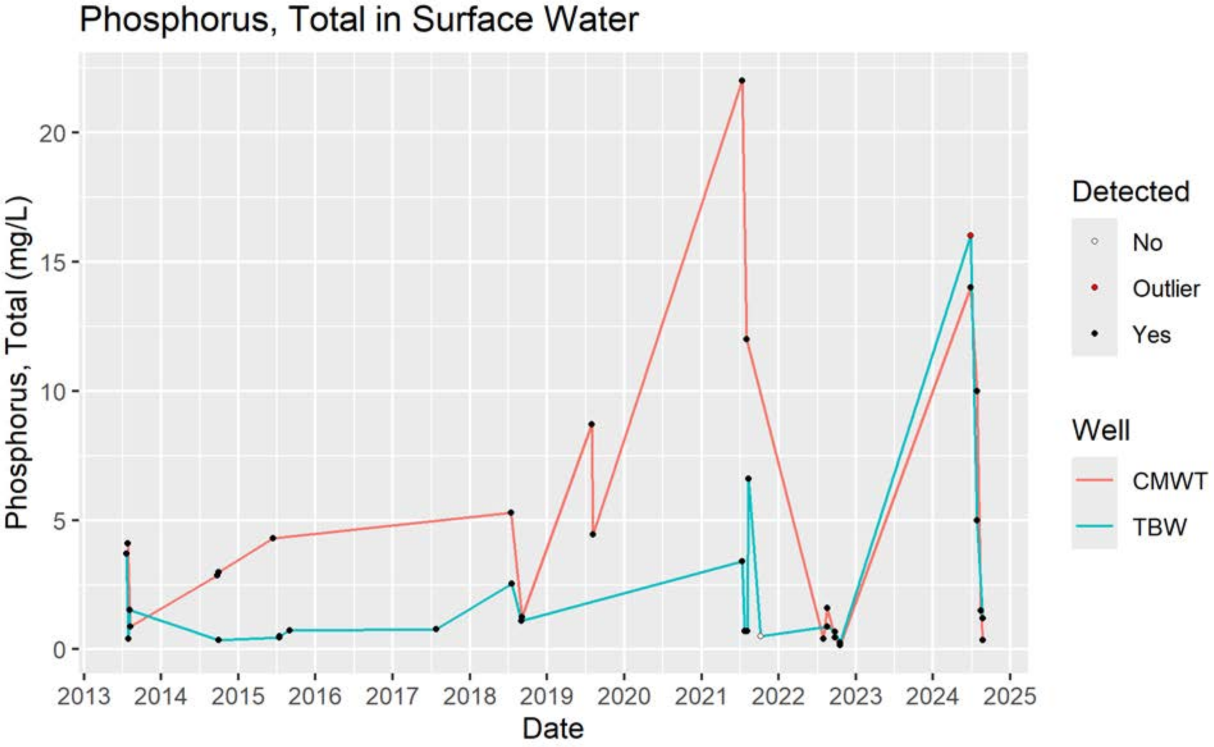


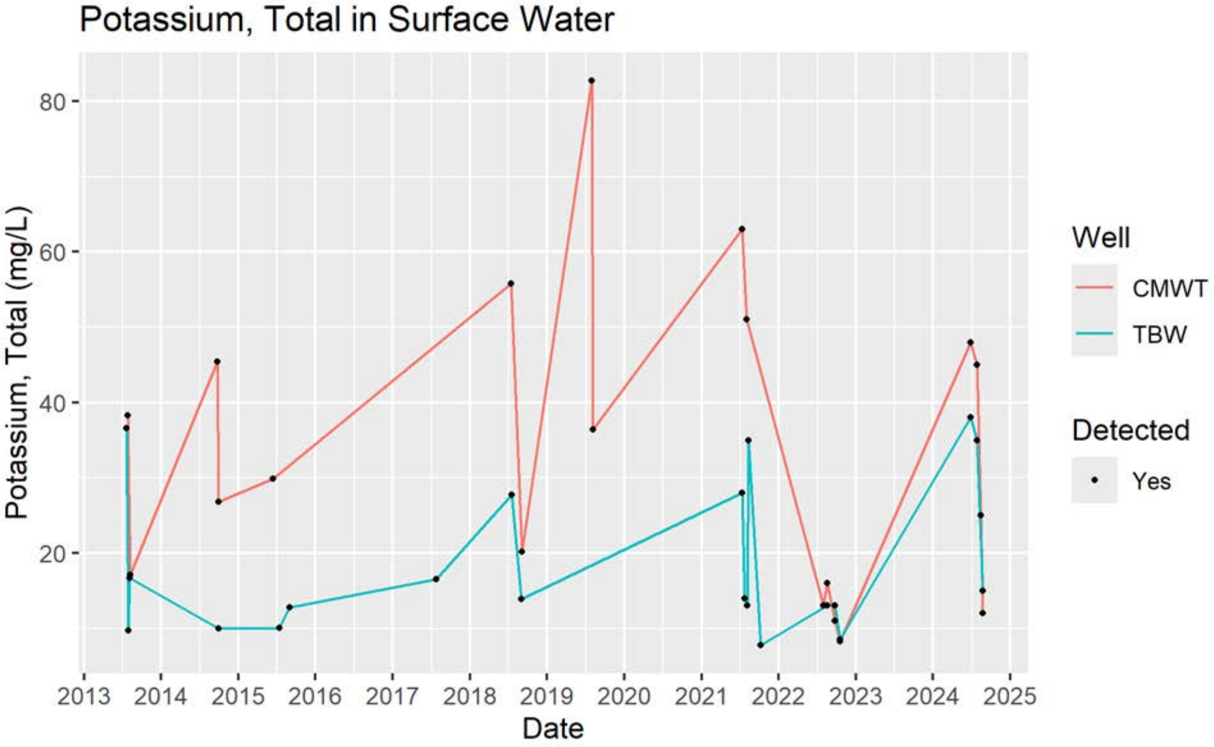
pH, Field in Surface Water

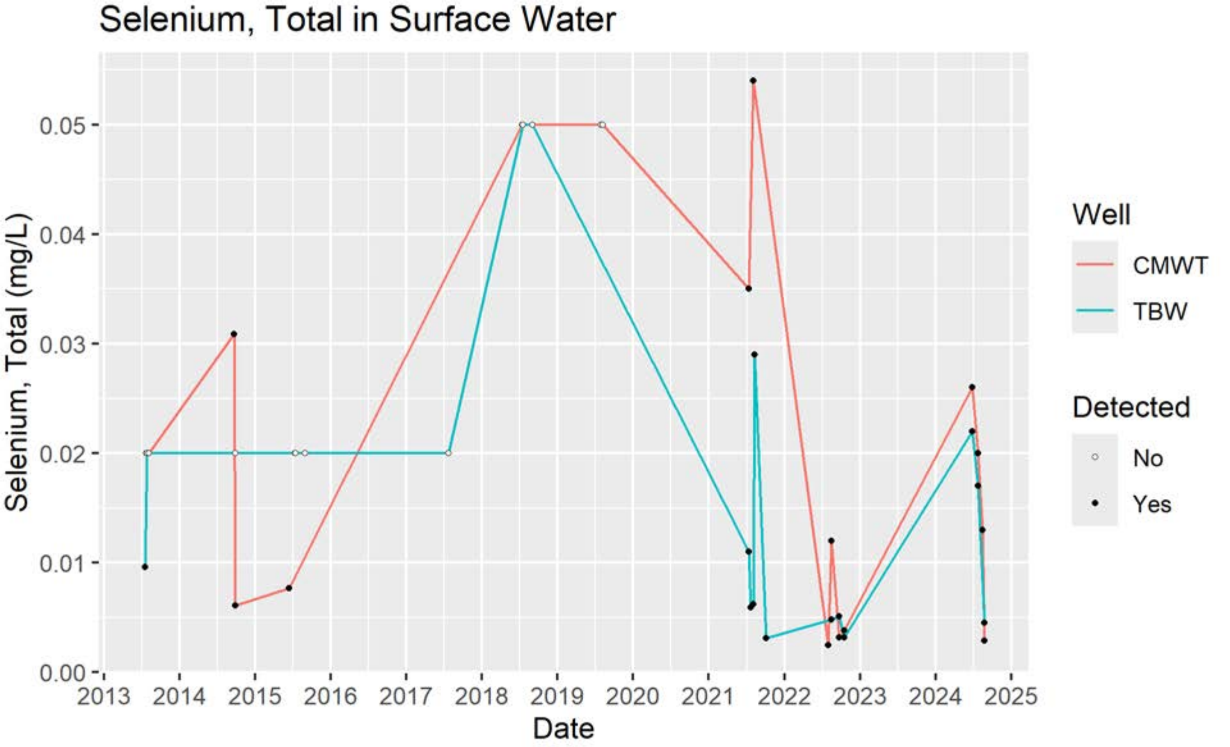
pH, Laboratory in Surface Water

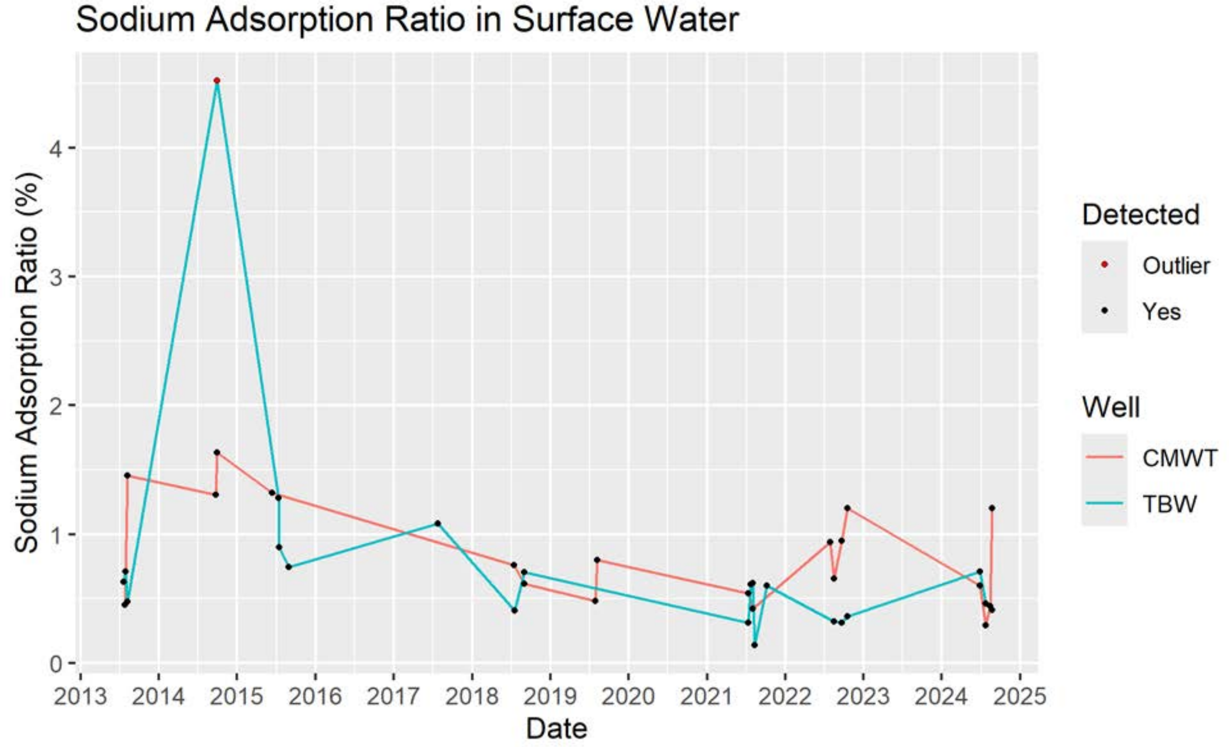


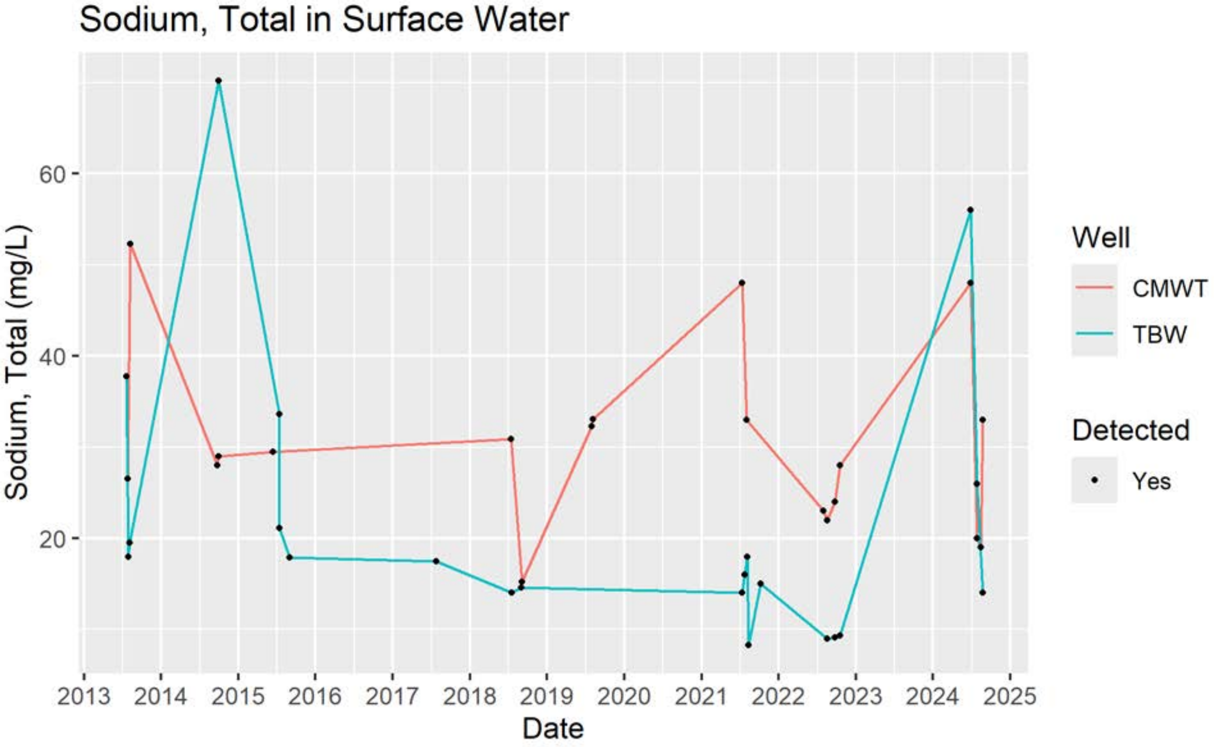

Phosphate in Surface Water
Phosphate (mg/L)
0
10
20
30
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Well
CMWT
TBW
Detected
No
Yes

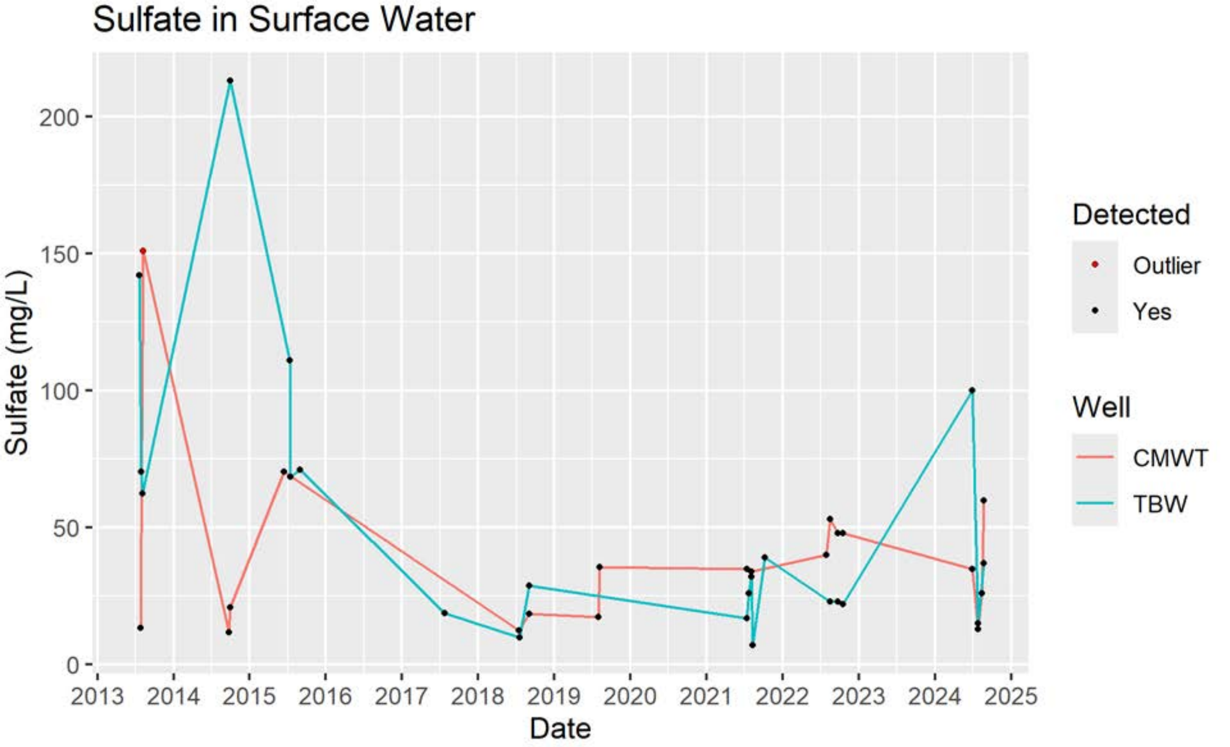

Phosphorus, Total in Surface Water
Phosphorus, Total (mg/L)
0
5
10
15
20
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Detected
No
Outlier
Yes
Well
CMWT
TBW

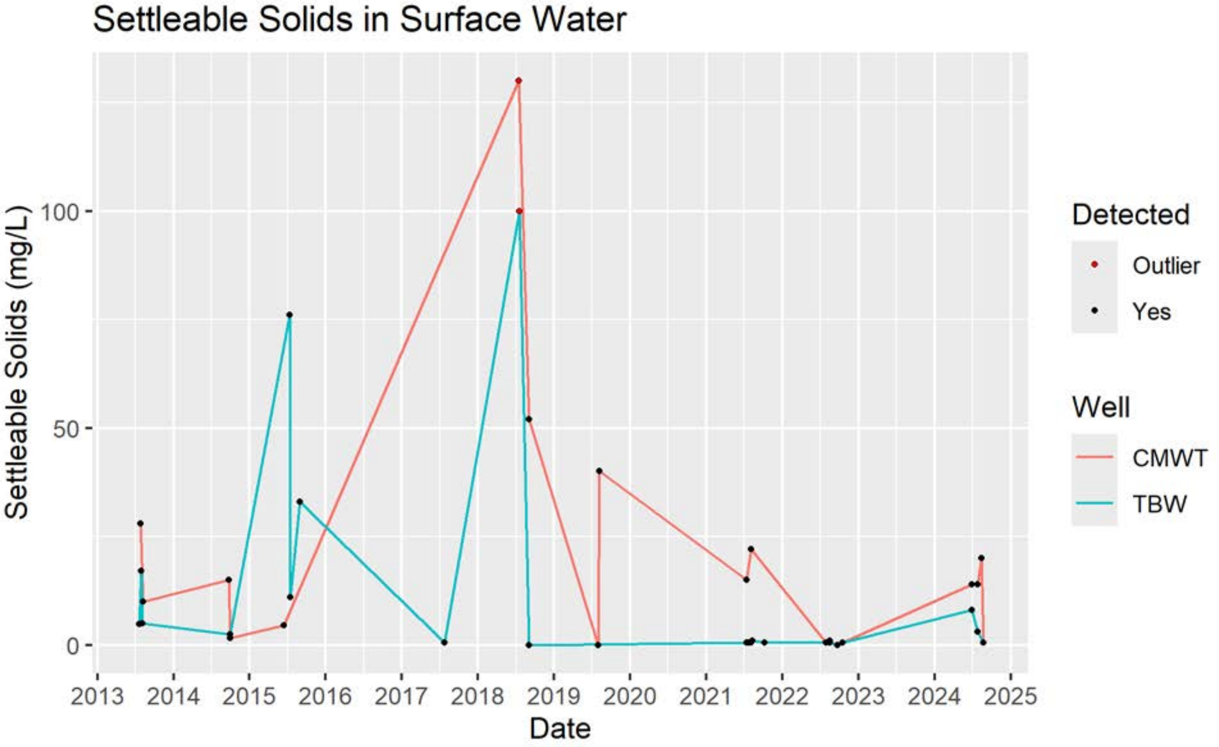

Potassium, Total in Surface Water
Potassium, Total (mg/L)
80
60
40
20
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
CMWT
TBW
Detected
Yes

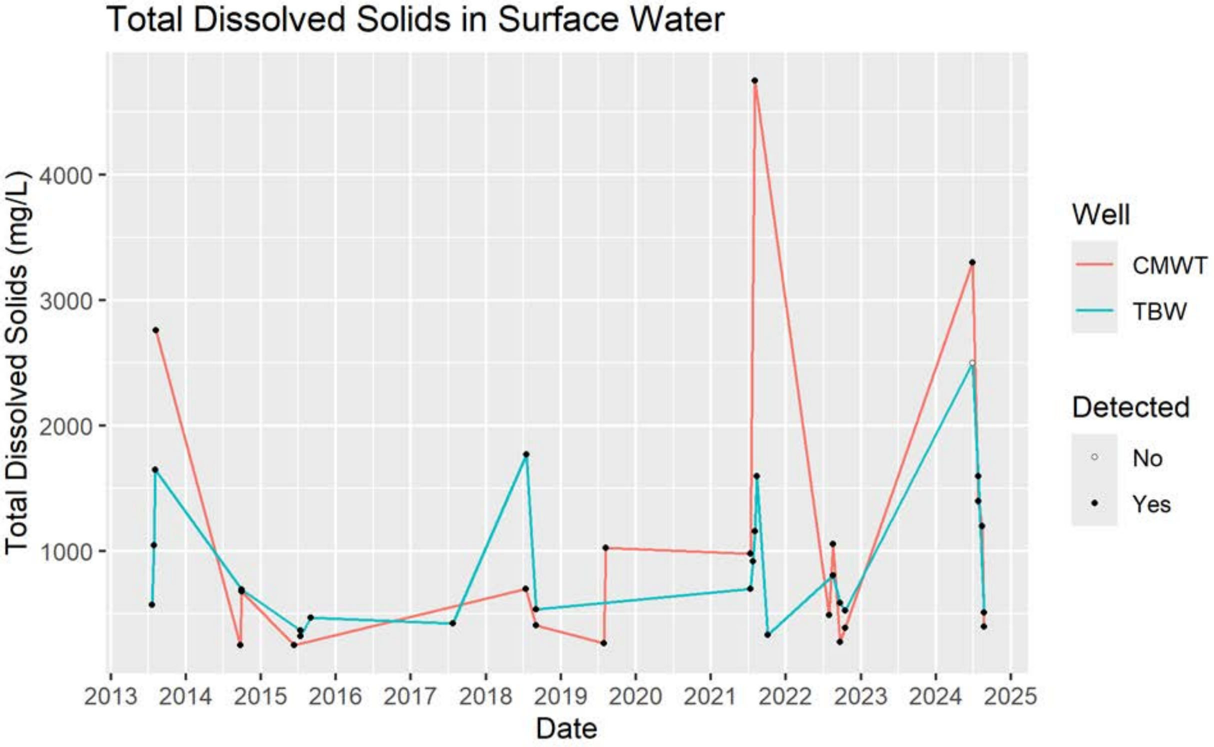

Selenium, Total in Surface Water
Selenium, Total (mg/L)
0.00
0.01
0.02
0.03
0.04
0.05
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Well
CMWT
TBW
Detected
No
Yes

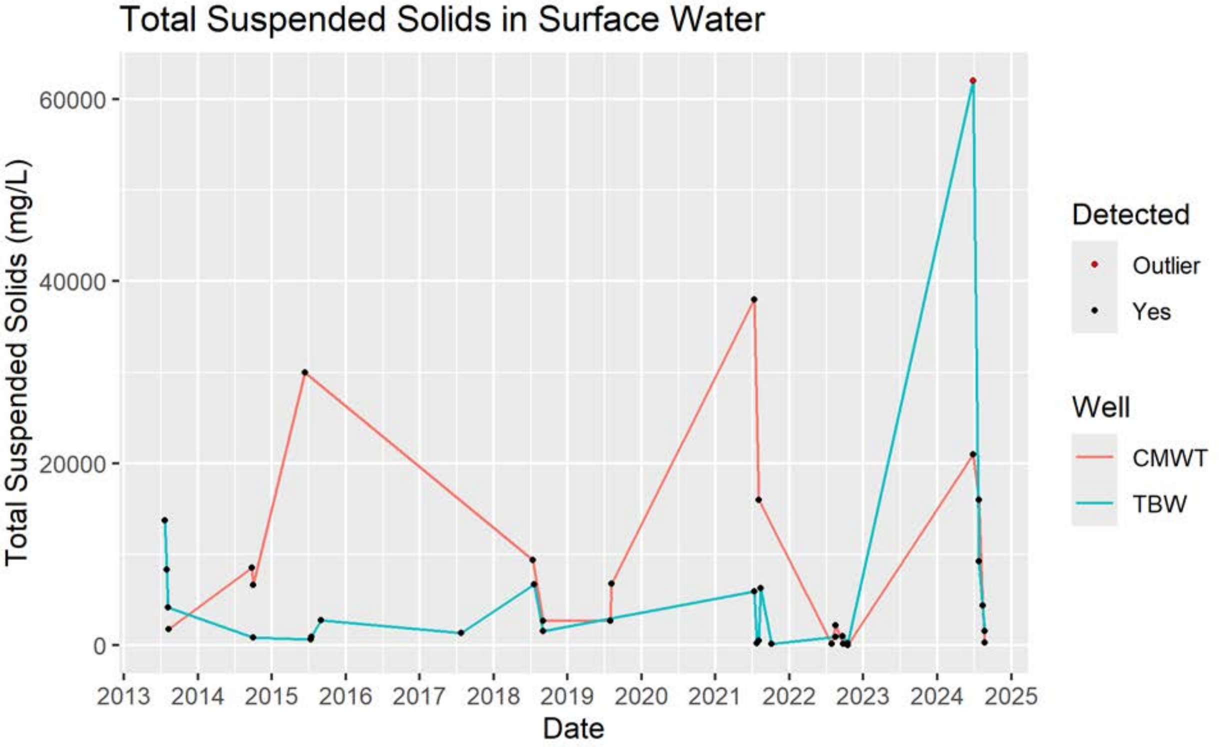

Sodium Adsorption Ratio in Surface Water
Sodium Adsorption Ratio (%)
0
1
2
3
4
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
CMWT
TBW


Sodium, Total in Surface Water
Sodium, Total (mg/L)
60
40
20
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Well
CMWT
TBW
Detected
Yes


Sulfate in Surface Water
Sulfate (mg/L)
0
50
100
150
200
Date
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Detected
Outlier
Yes
Well
CMWT
TBW


Settleable Solids in Surface Water
Settleable Solids (mg/L)
100
50
0
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
CMWT
TBW


Total Dissolved Solids in Surface Water
Total Dissolved Solids (mg/L)
4000
3000
2000
1000
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
CMWT
TBW
Detected
No
Yes


Total Suspended Solids in Surface Water
Total Suspended Solids (mg/L)
60000
40000
20000
0
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
CMWT
TBW

APPENDIX D

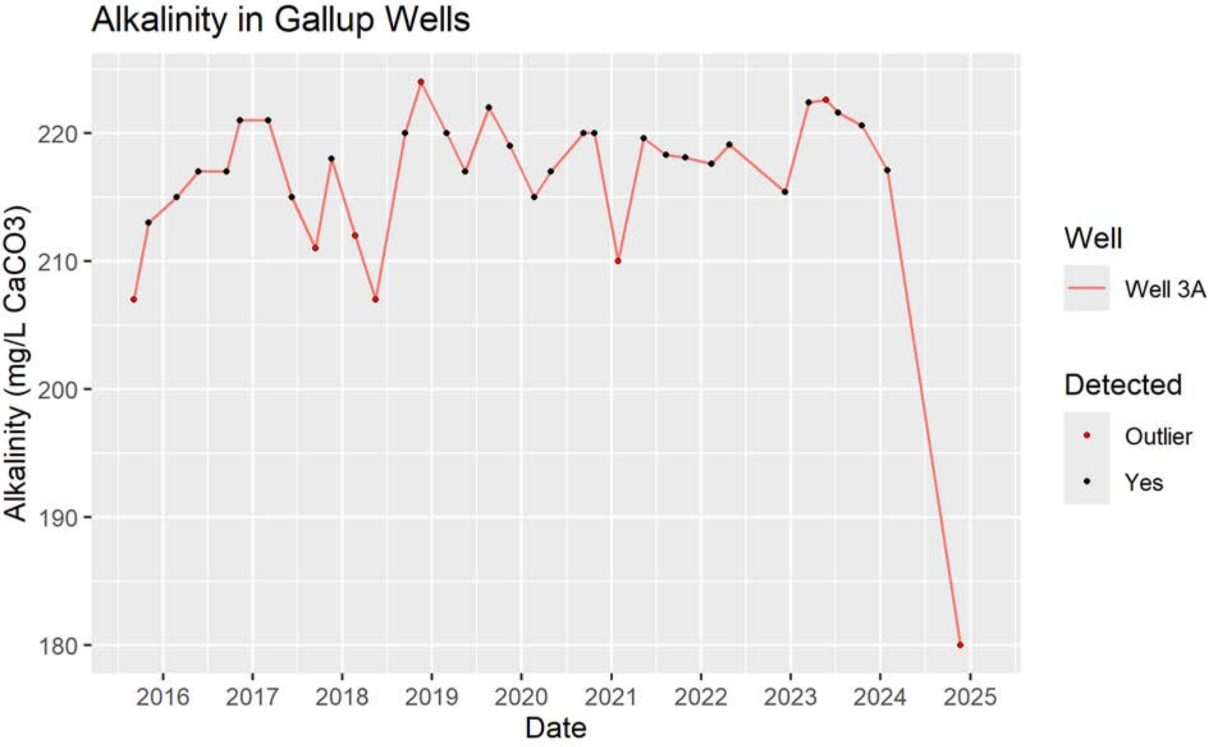
GROUNDWATER QUALITY DATA

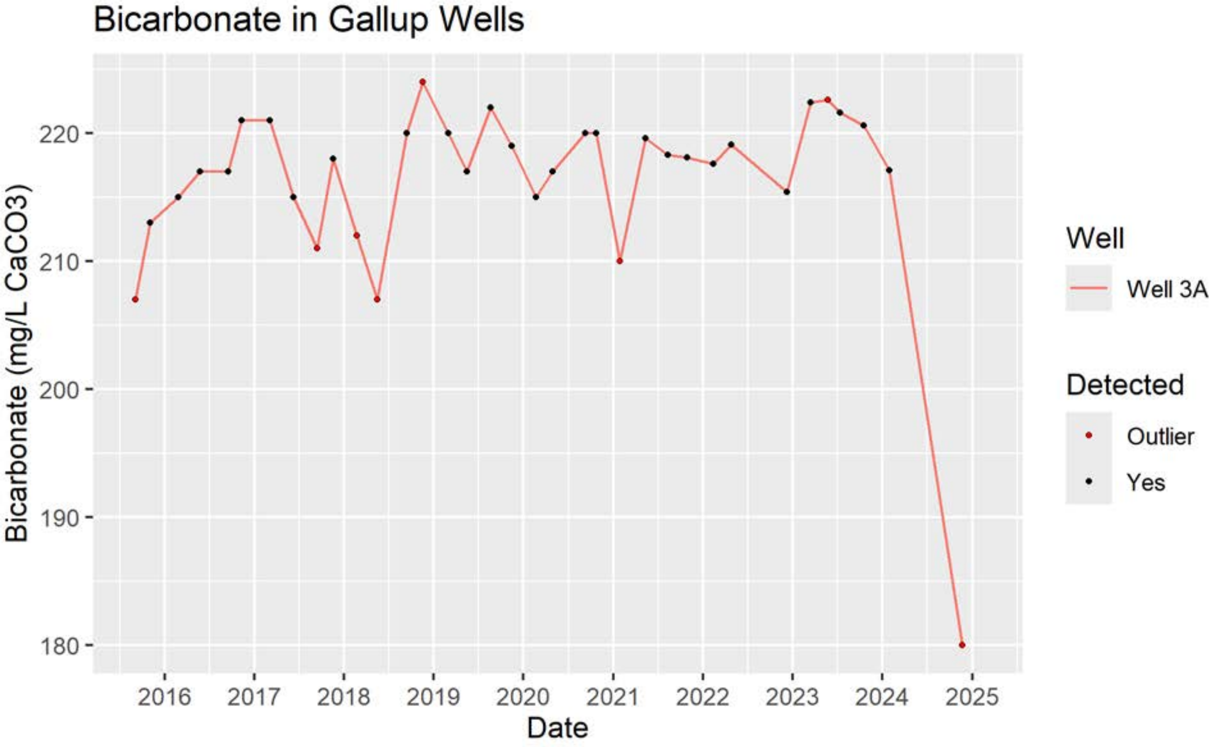
D-1. HISTORICAL GROUNDWATER DATA - GALLUP SANDSTONE AQUIFER WELL 3A

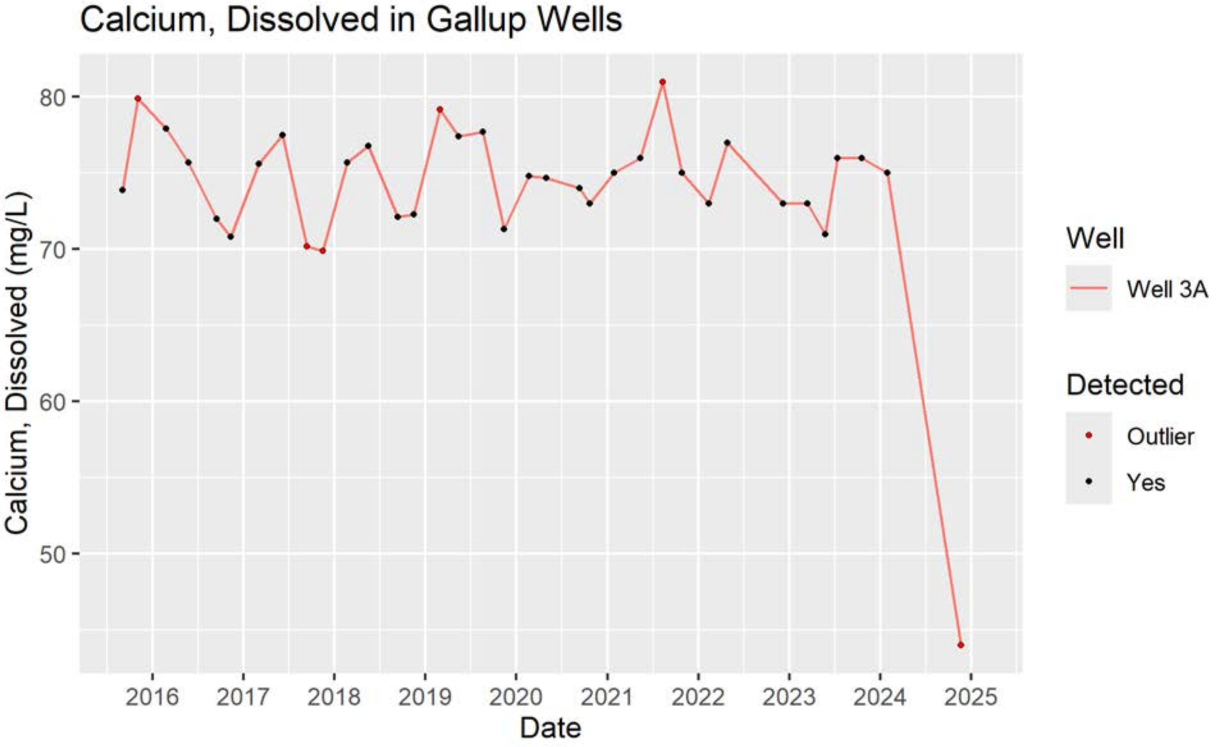
D-2. HISTORICAL GROUNDWATER DATA - BEDROCK MONITORING WELL MBR2

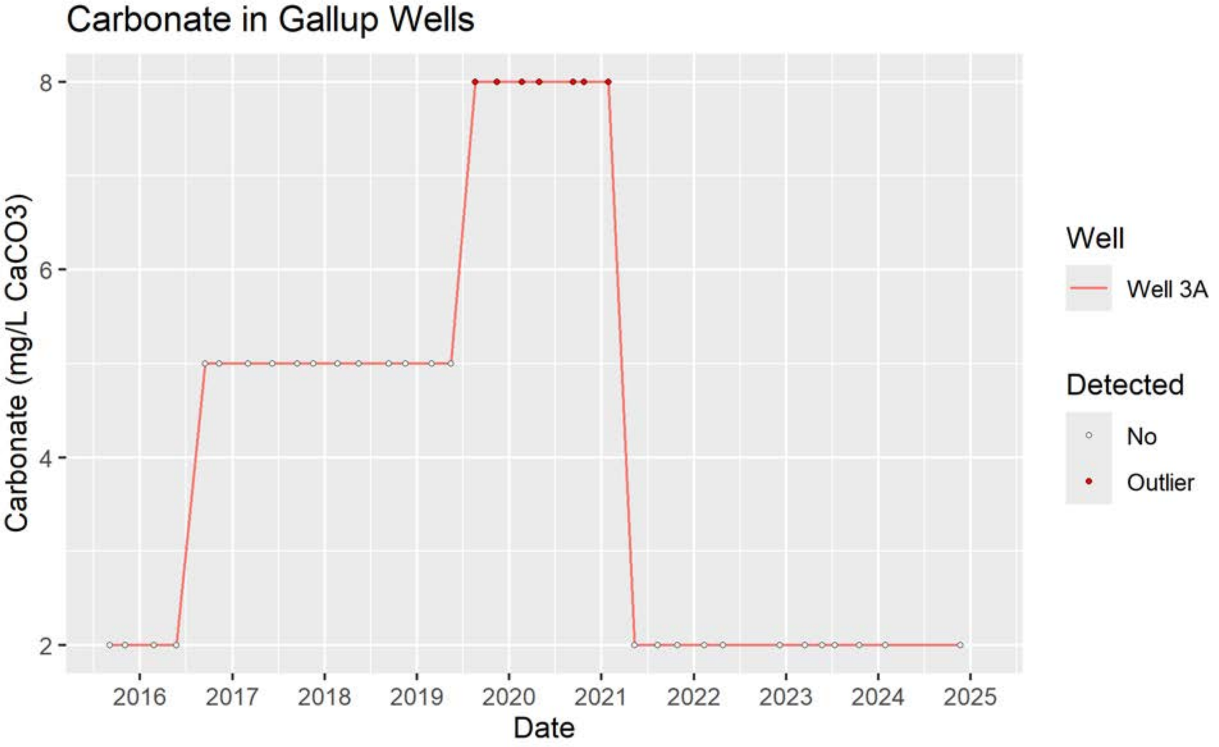
APPENDIX D-1

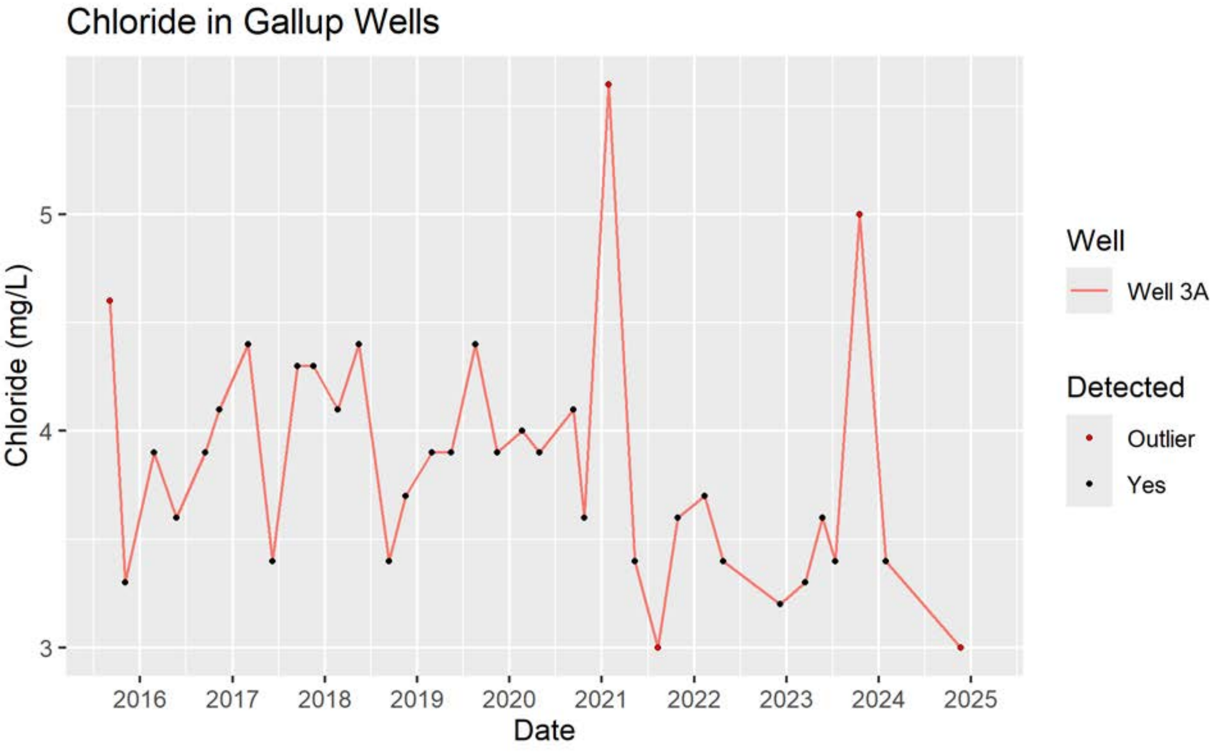
HISTORICAL GROUNDWATER DATA - GALLUP SANDSTONE AQUIFER WELL 3A

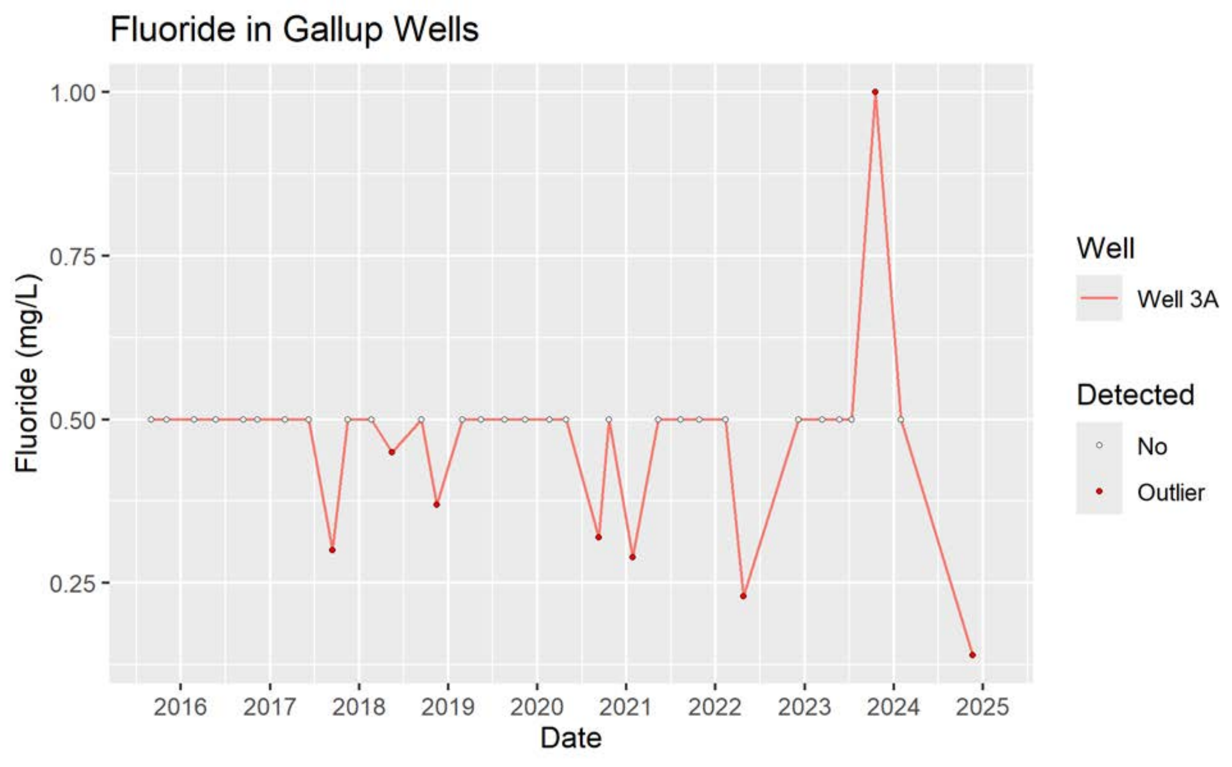

Alkalinity in Gallup Wells
Alkalinity (mg/L CaCO3)
220
210
200
190
180
Date
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Well
Well 3A
Detected
Outlier
Yes

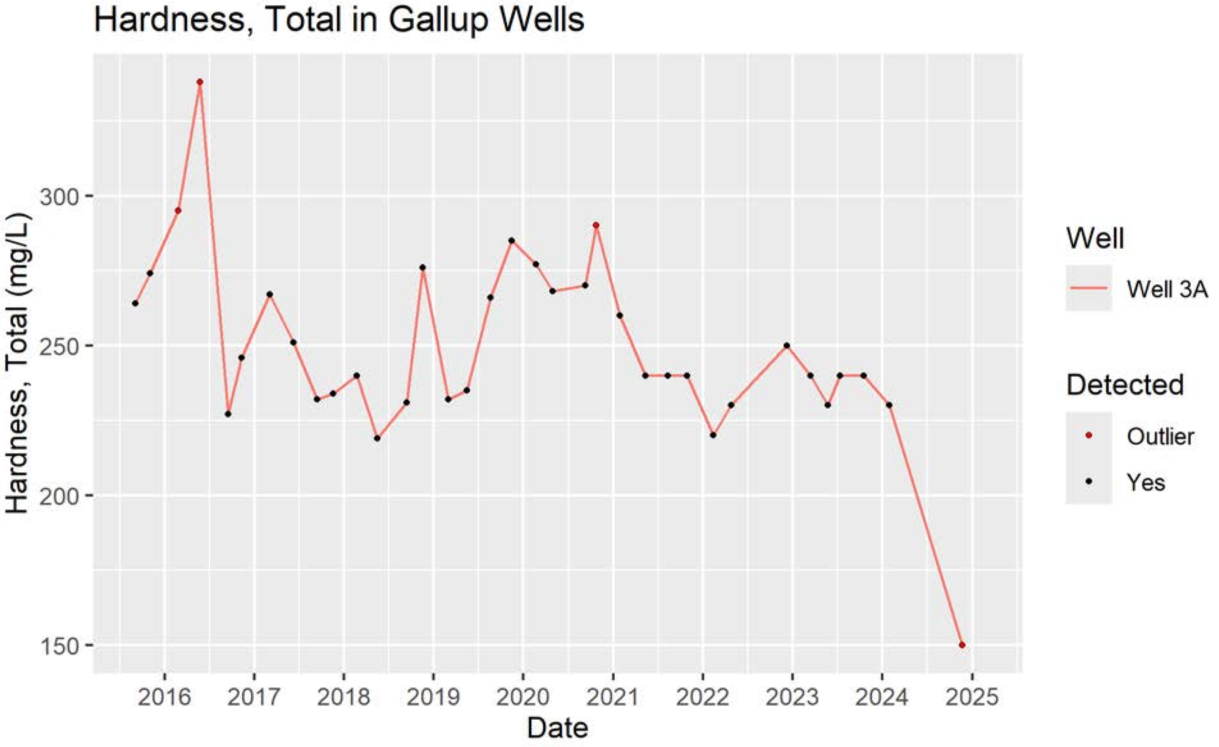

Bicarbonate in Gallup Wells
Bicarbonate (mg/L CaCO3)
220
210
200
190
180
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

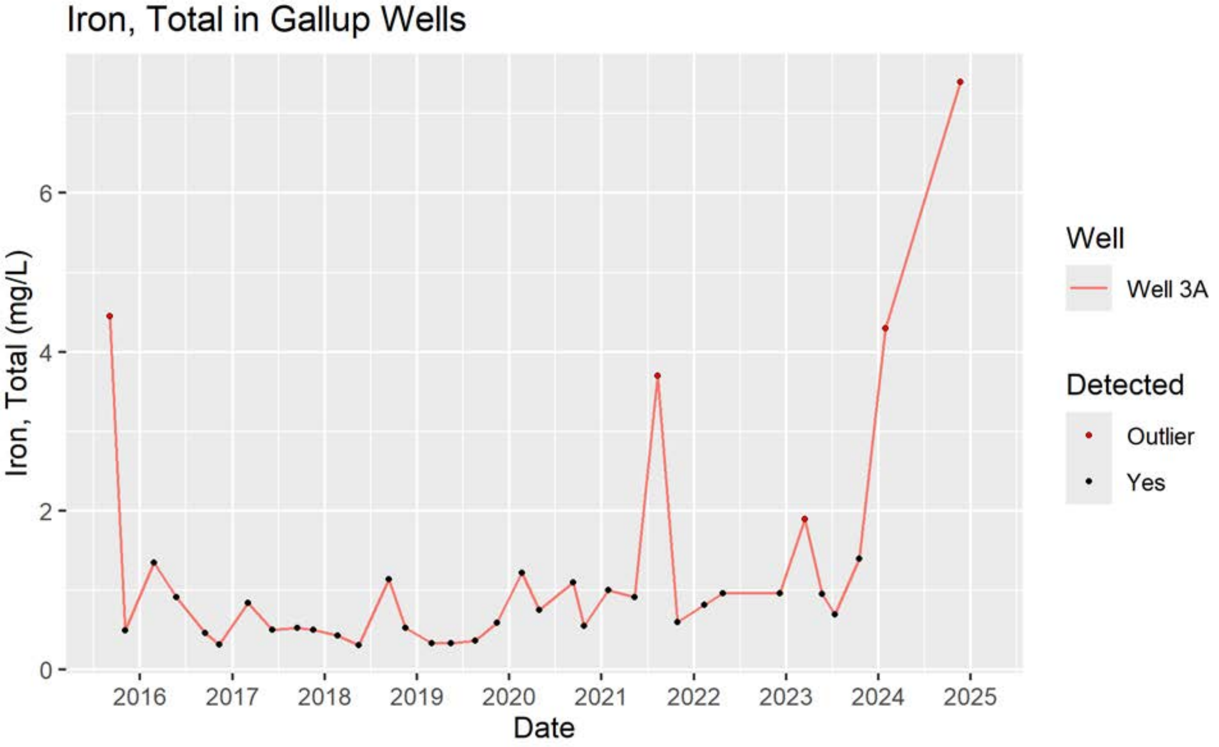

Calcium, Dissolved in Gallup Wells
Calcium, Dissolved (mg/L)
80
70
60
50
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes


Carbonate in Gallup Wells
Carbonate (mg/L CaCO3)
8
6
4
2
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
No
Outlier

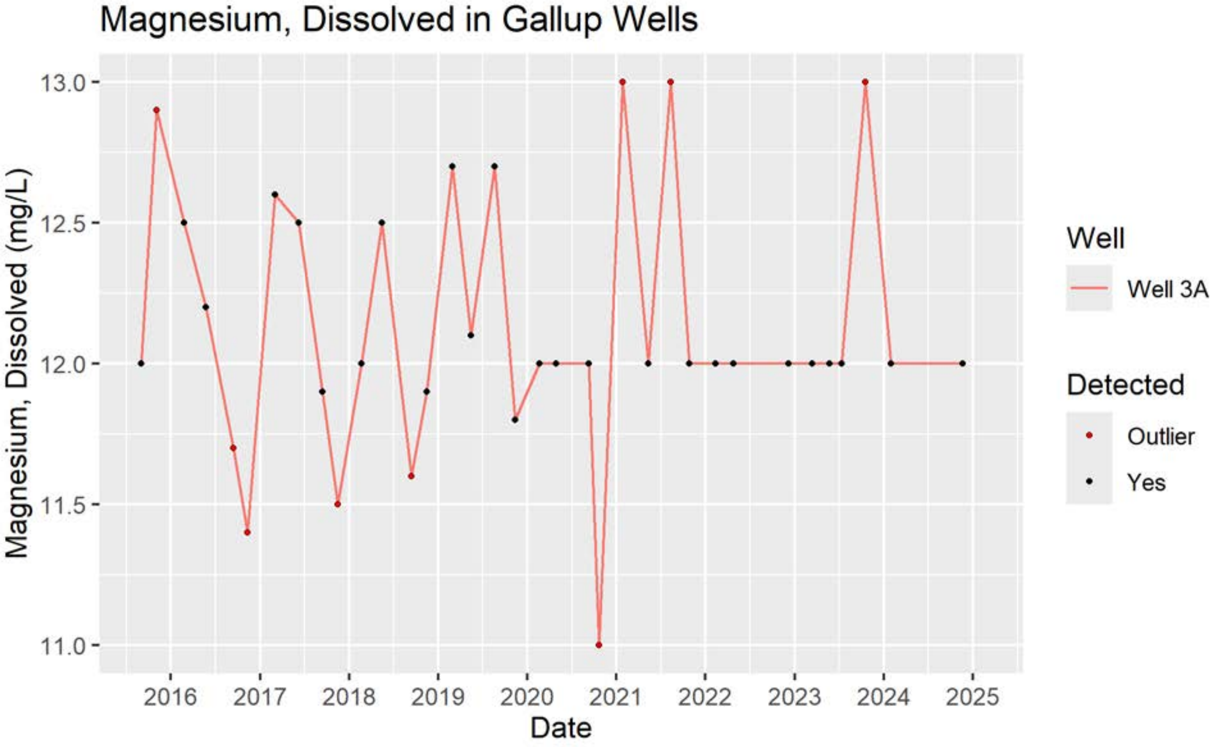

Chloride in Gallup Wells
Chloride (mg/L)
5
4
3
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

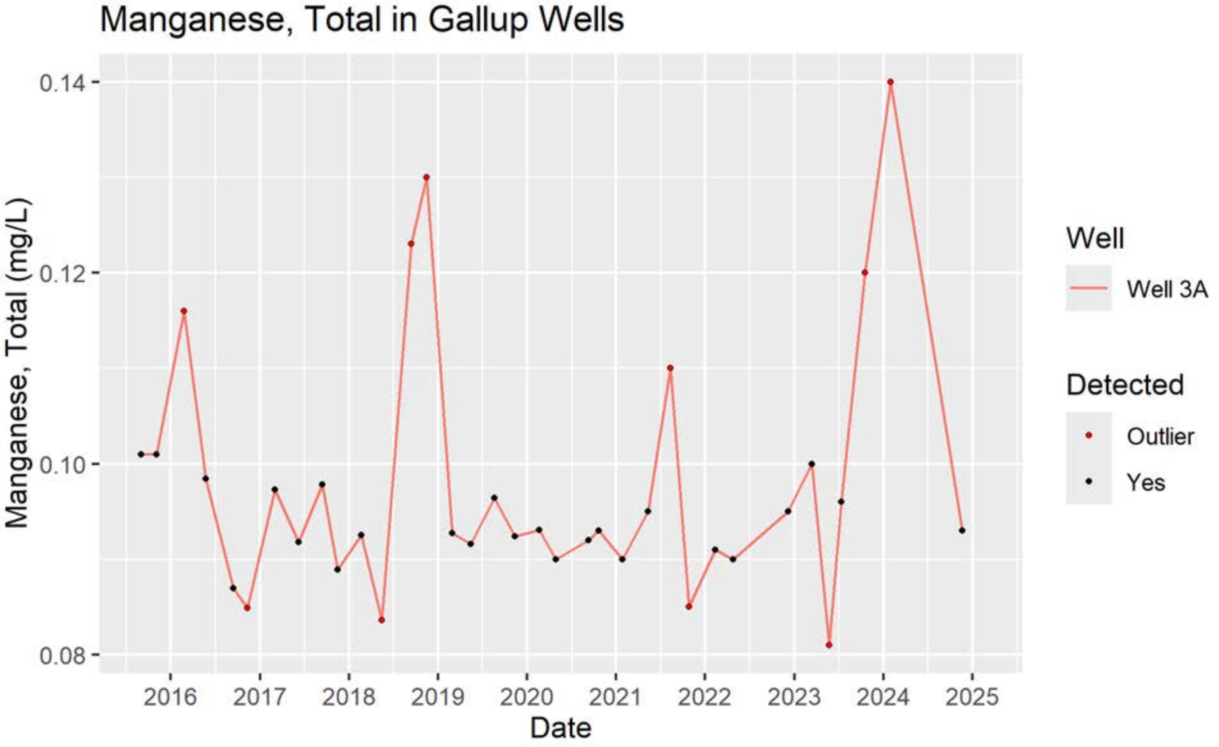

Fluoride in Gallup Wells
Fluoride (mg/L)
1.00
0.75
0.50
0.25
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
No
Outlier

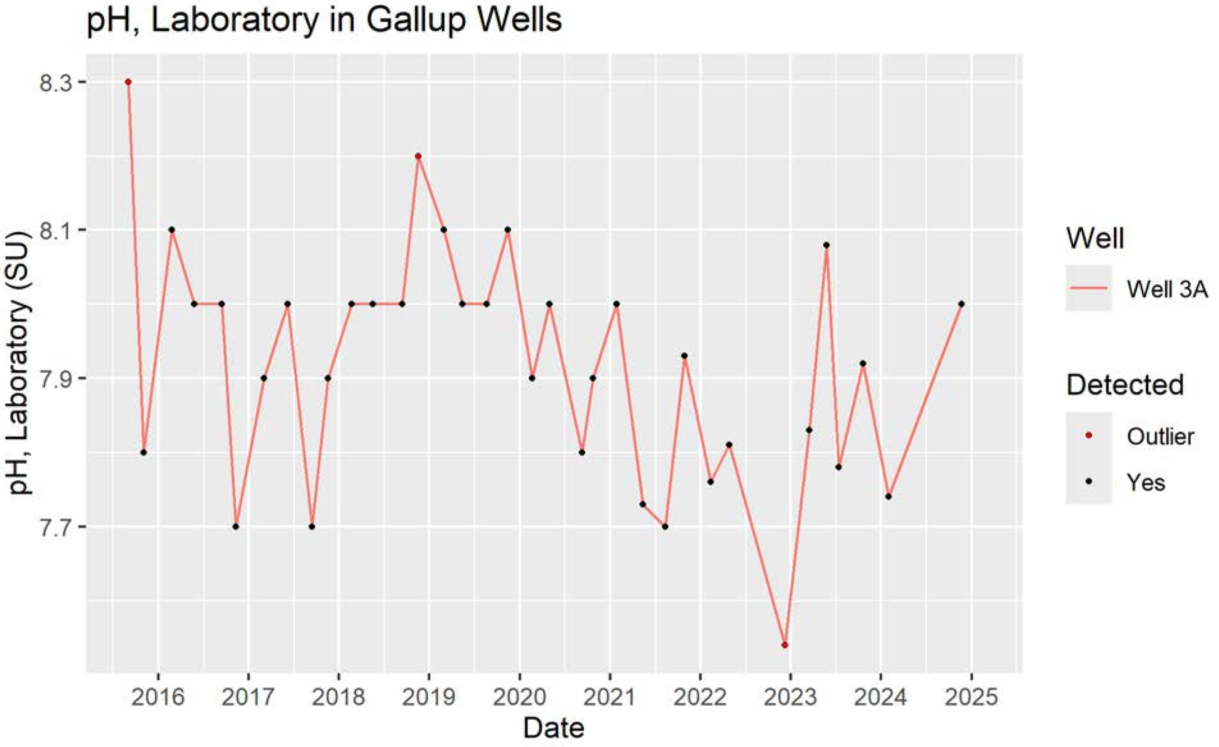

Hardness, Total in Gallup Wells
Hardness, Total (mg/L)
300
250
200
150
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

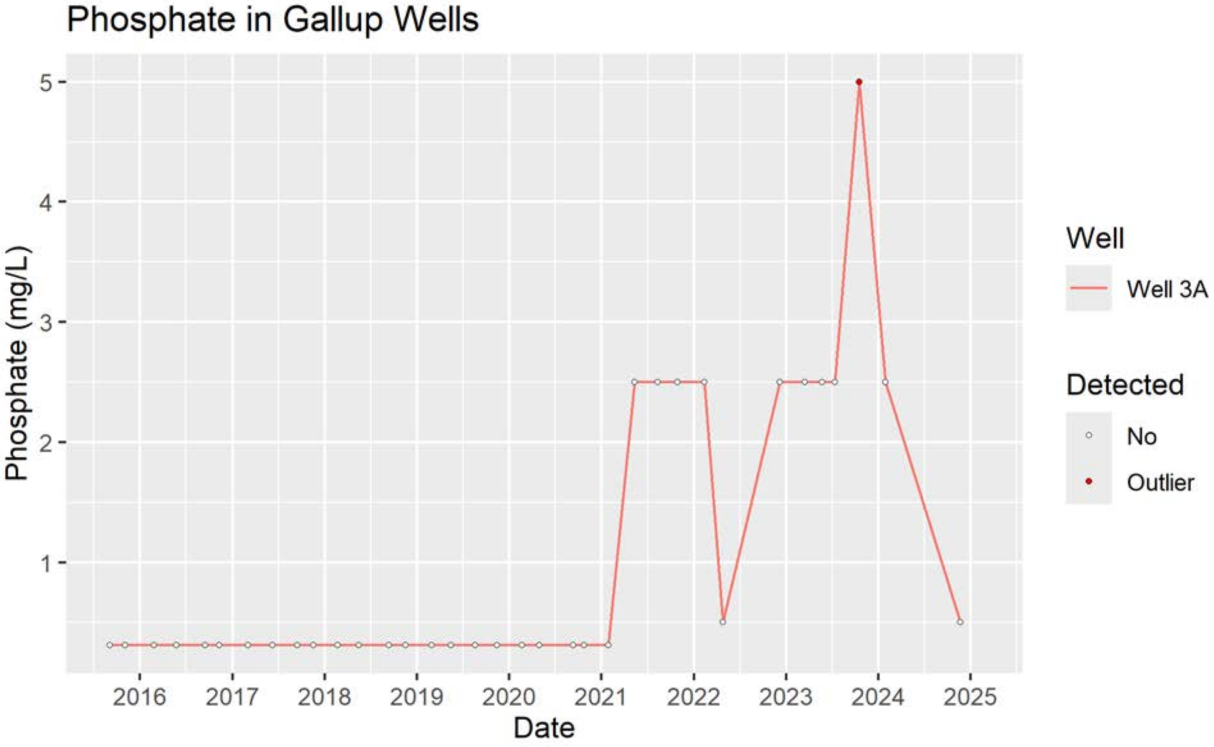


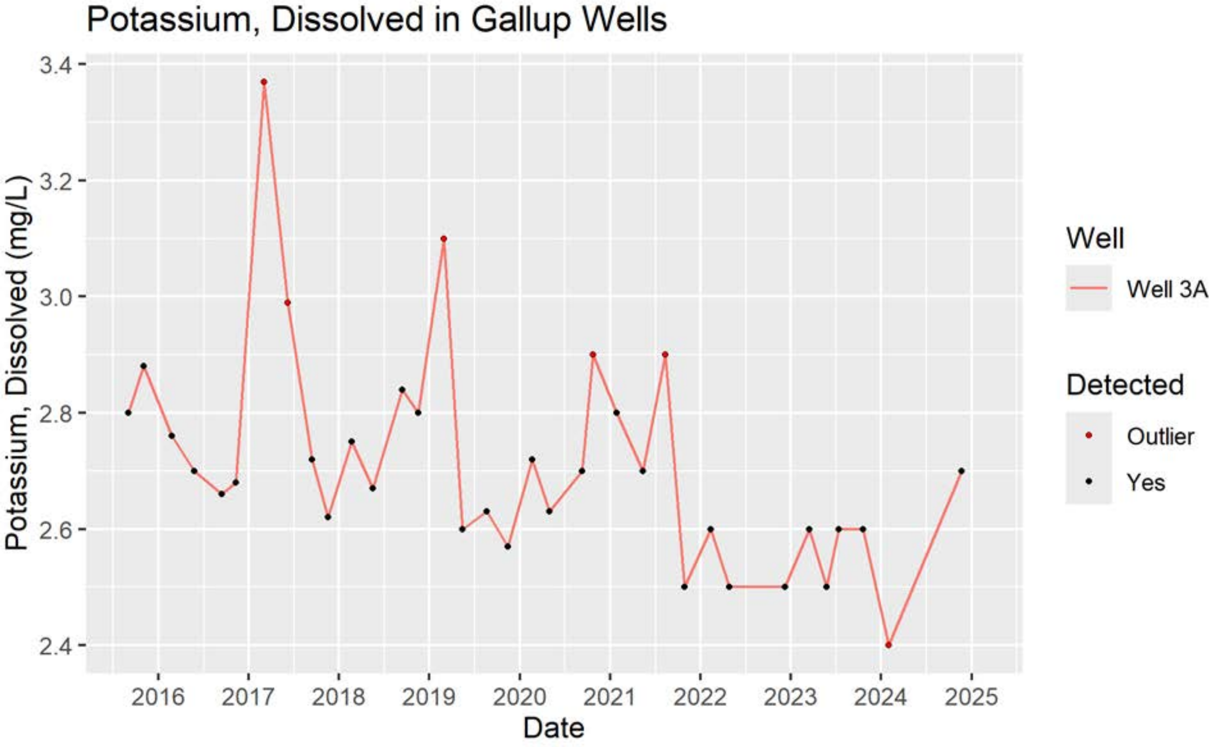
Iron, Total in Gallup Wells
Iron, Total (mg/L)
0
2
4
6
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

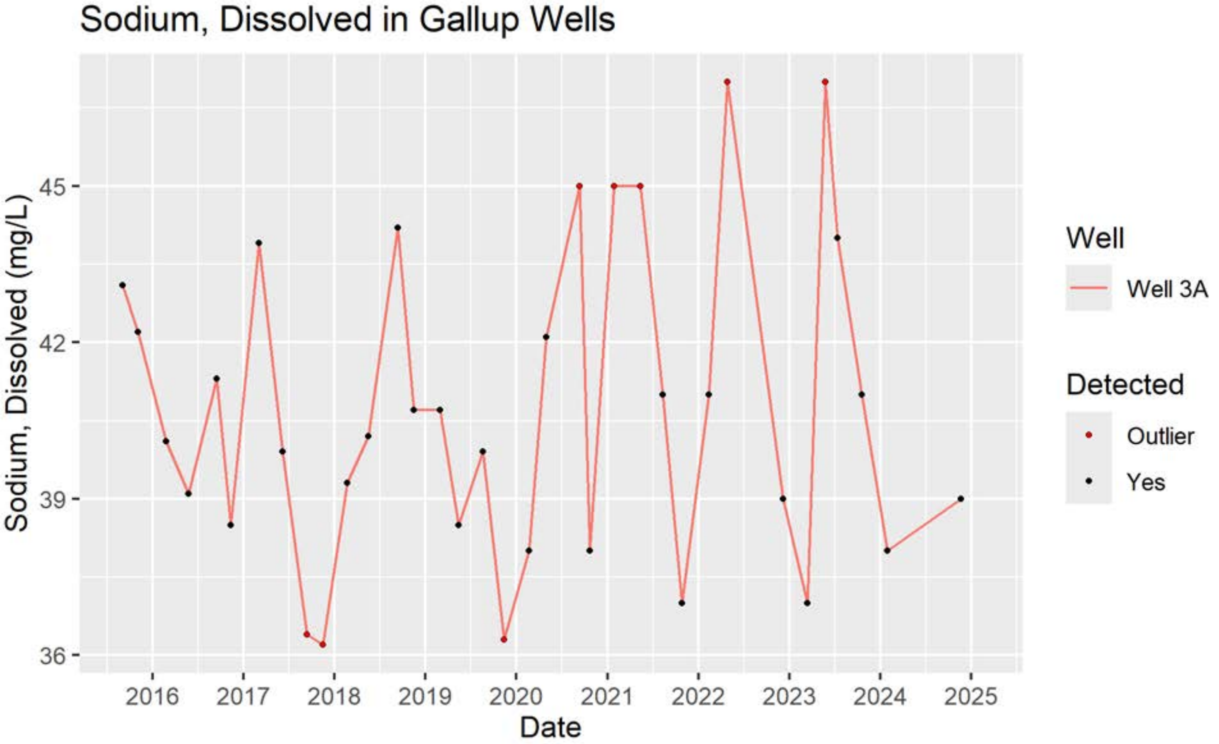

Magnesium, Dissolved in Gallup Wells
Magnesium, Dissolved (mg/L)
13.0
12.5
12.0
11.5
11.0
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

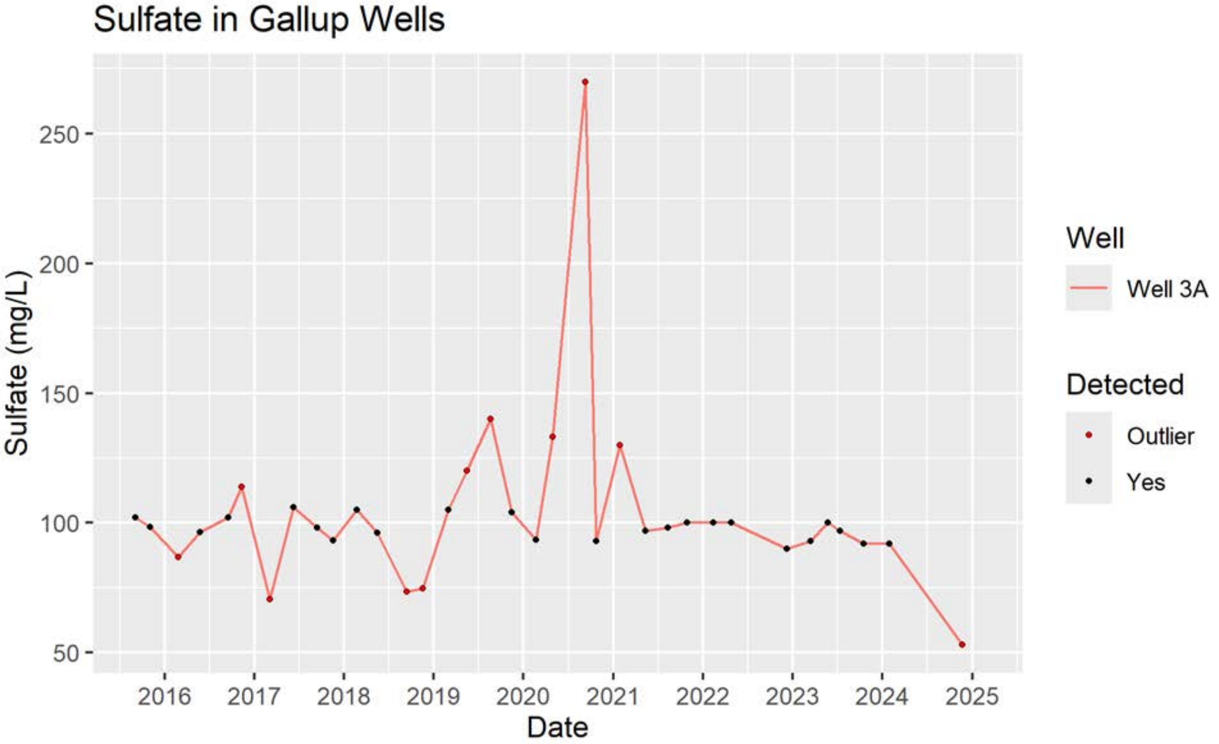

Manganese, Total in Gallup Wells
Manganese, Total (mg/L)
0.14
0.12
0.10
0.08
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

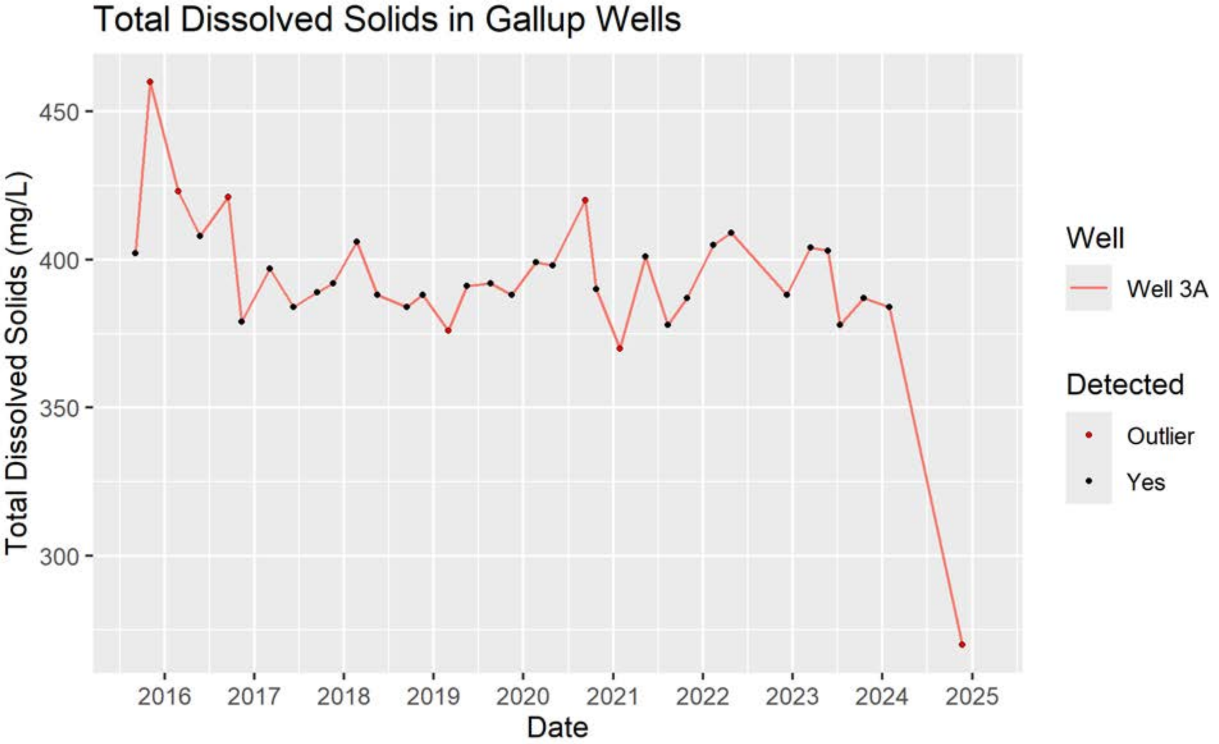

pH, Laboratory in Gallup Wells
pH, Laboratory (SU)
8.3
8.1
7.9
7.7
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

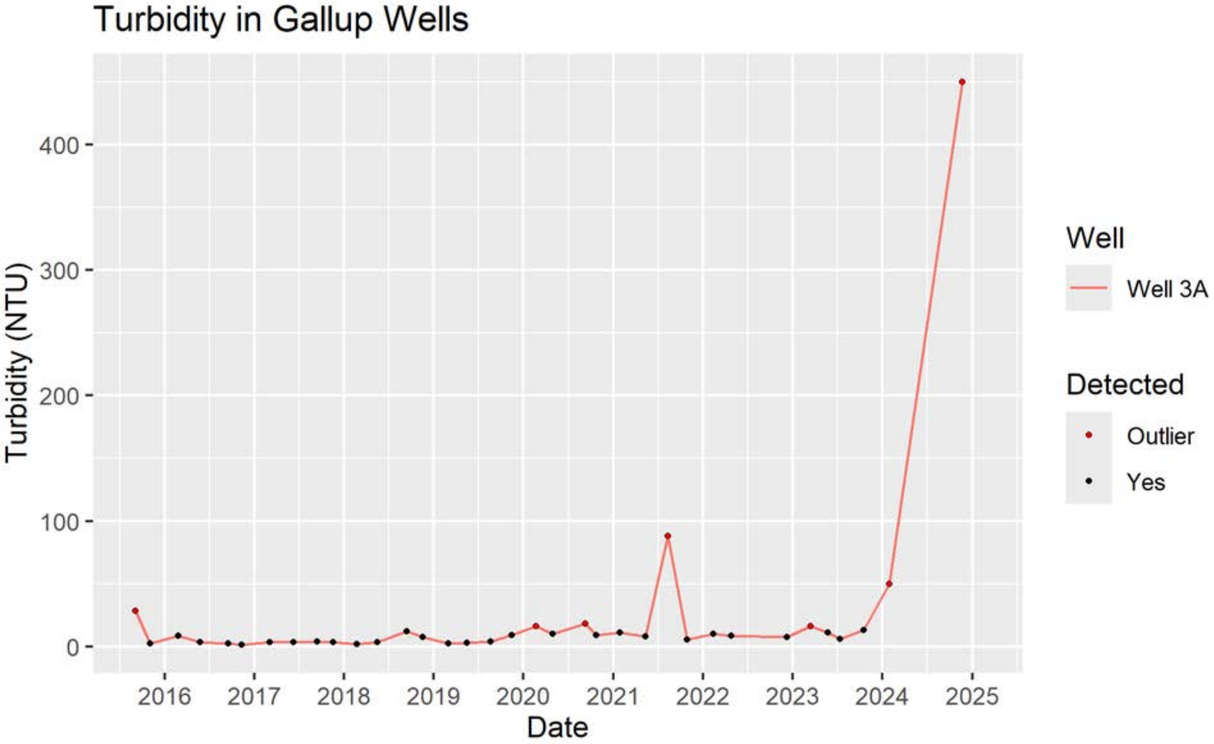

Phosphate in Gallup Wells
Phosphate (mg/L)
5
4
3
2
1
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
No
Outlier


Potassium, Dissolved in Gallup Wells
Potassium, Dissolved (mg/L)
3.4
3.2
3.0
2.8
2.6
2.4
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes


Sodium, Dissolved in Gallup Wells
Sodium, Dissolved (mg/L)
45
42
39
36
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

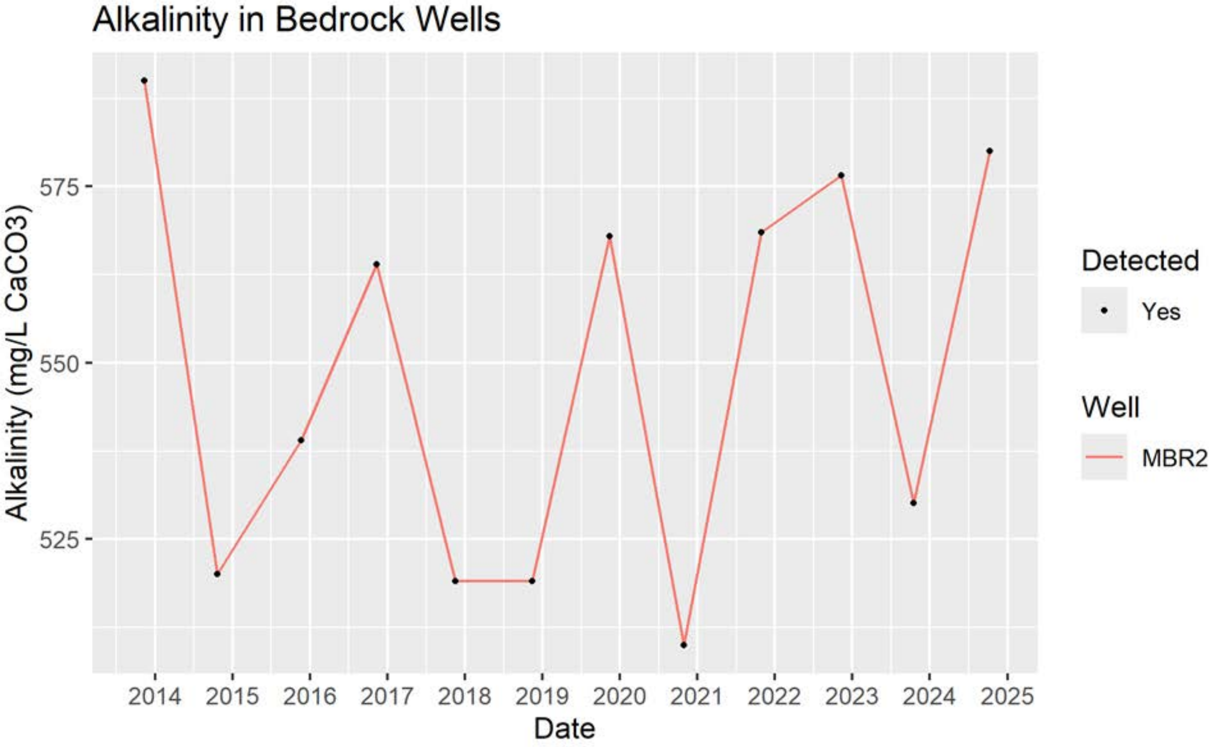

Sulfate in Gallup Wells
Sulfate (mg/L)
250
200
150
100
50
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

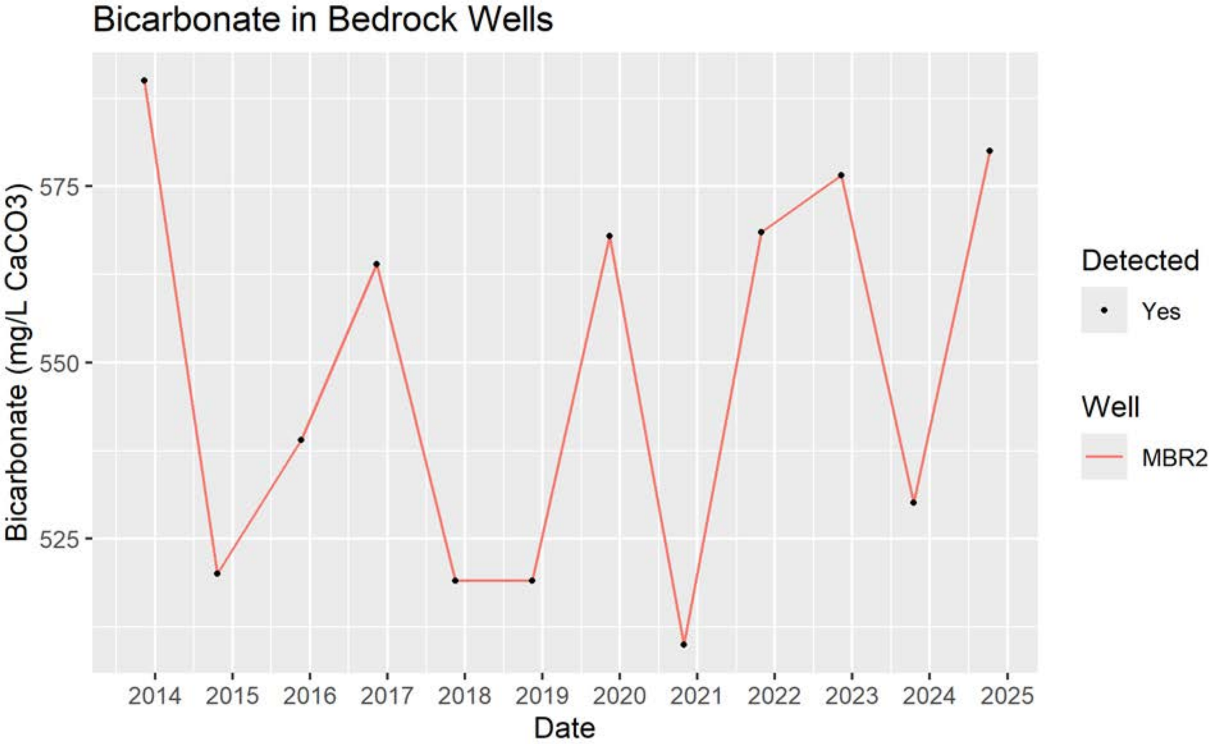

Total Dissolved Solids in Gallup Wells
Total Dissolved Solids (mg/L)
450
400
350
300
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

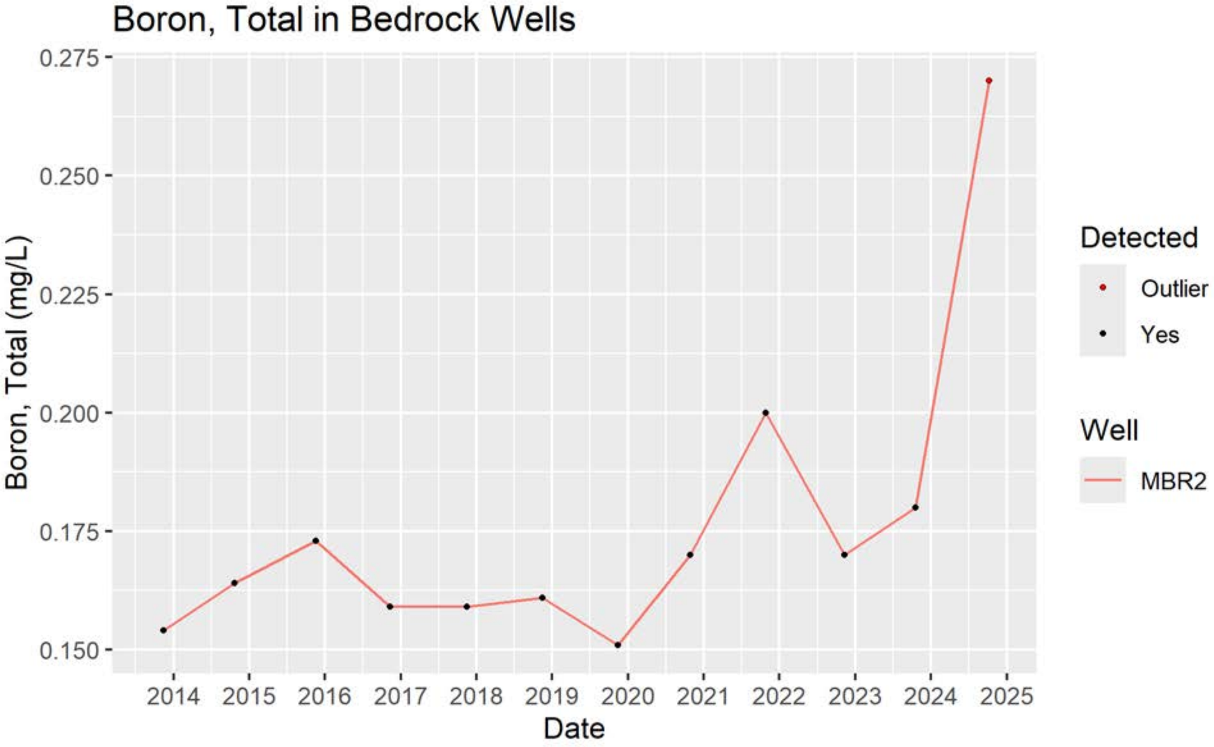

Turbidity in Gallup Wells
Turbidity (NTU)
400
300
200
100
0
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
Well 3A
Detected
Outlier
Yes

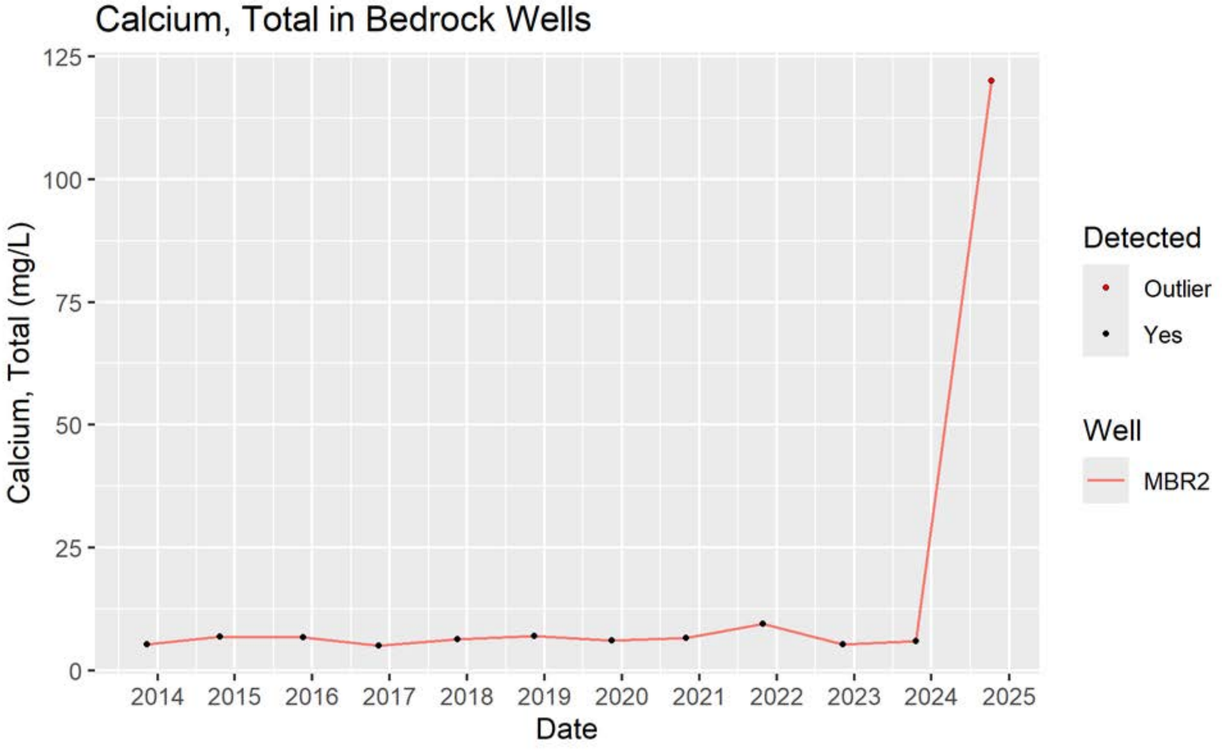
APPENDIX D-2

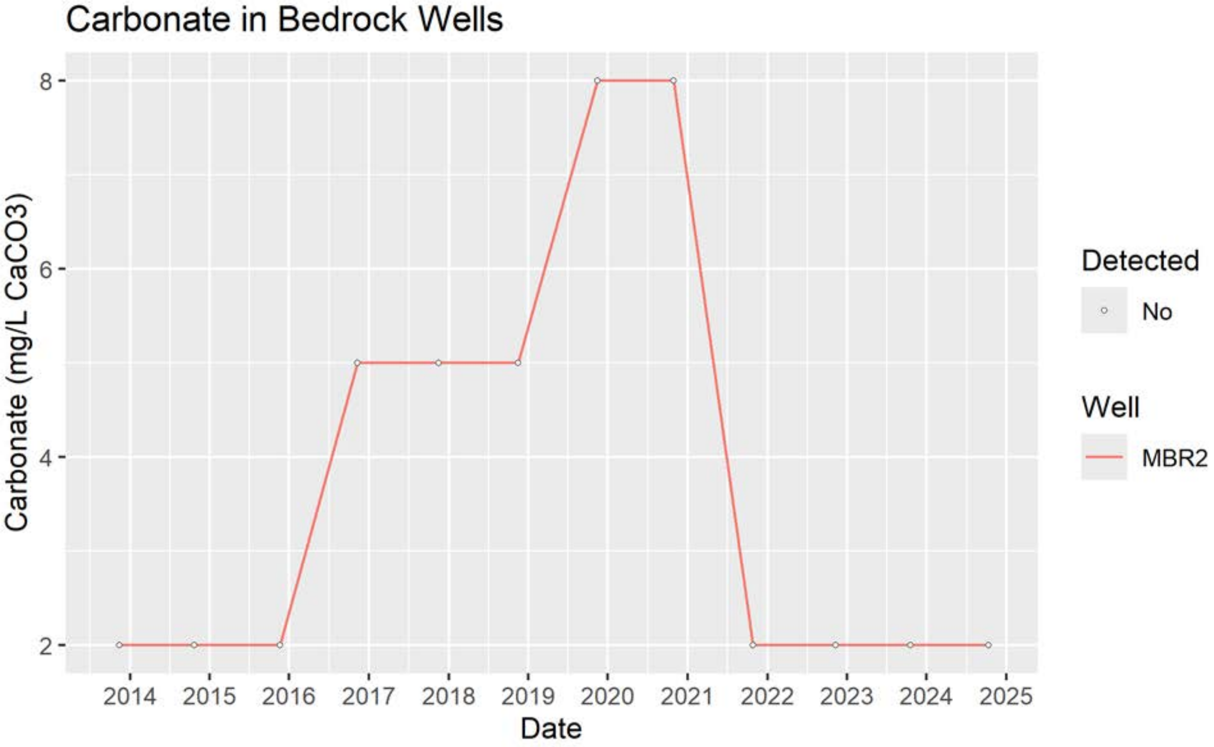
HISTORICAL GROUNDWATER DATA - BEDROCK MONITORING WELL MBR2

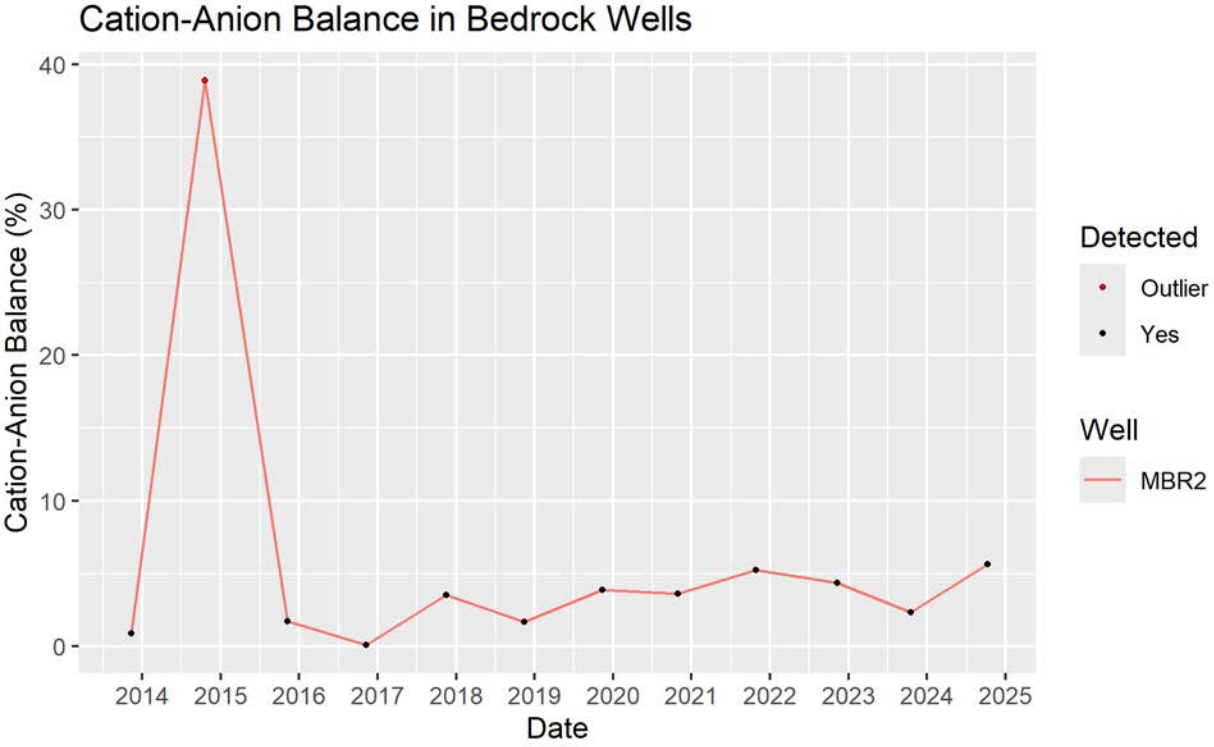

Alkalinity in Bedrock Wells
Alkalinity (mg/L CaCO3)
575
550
525
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Yes
Well
MBR2

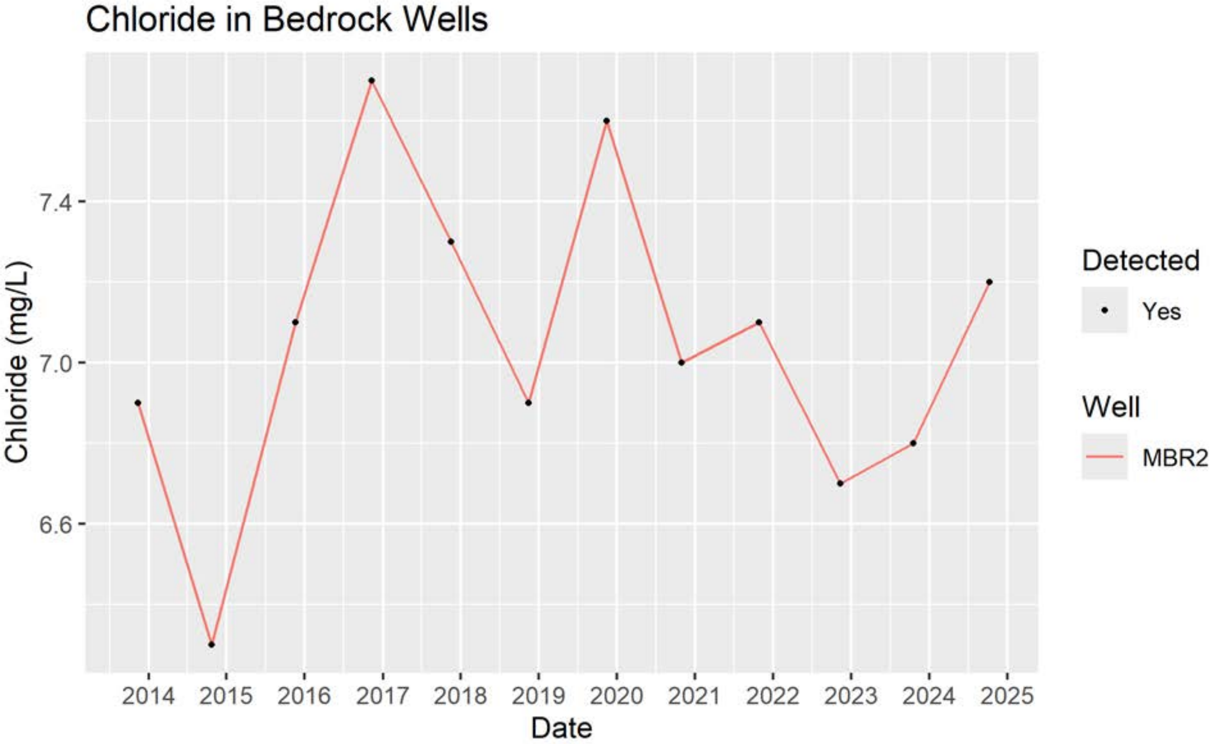

Bicarbonate in Bedrock Wells
Bicarbonate (mg/L CaCO3)
575
550
525
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Yes
Well
MBR2

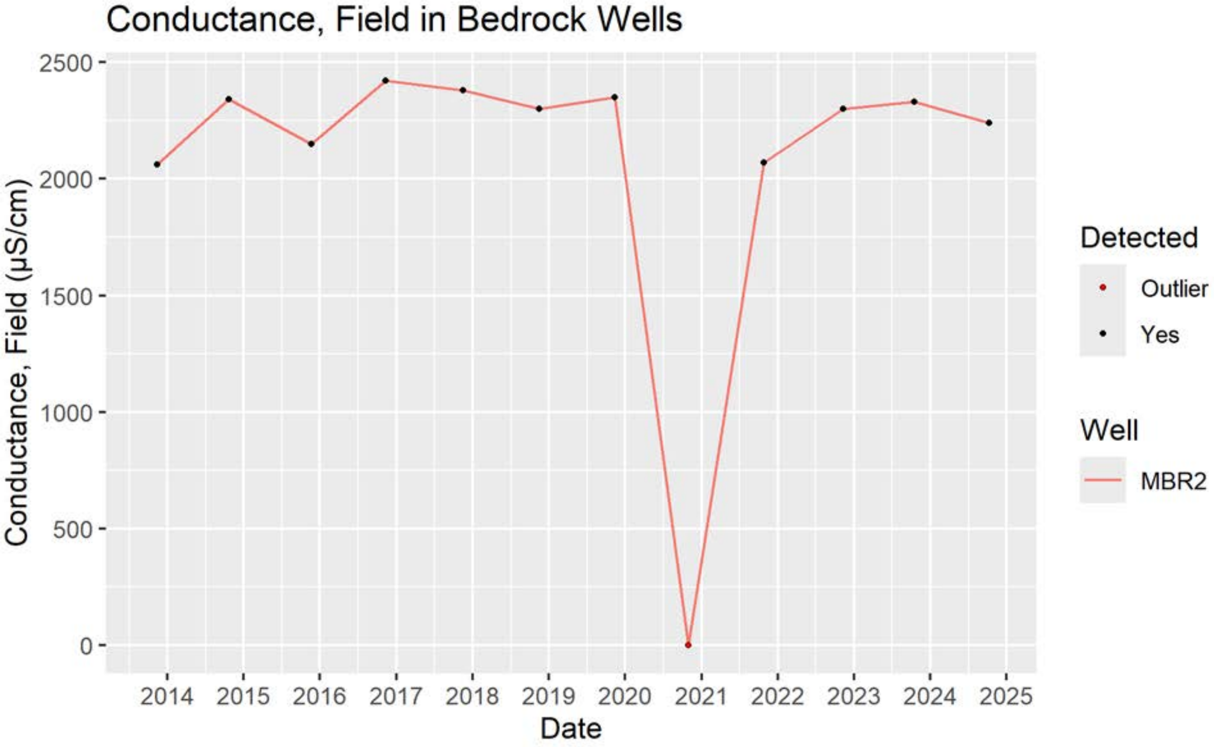

Boron, Total in Bedrock Wells
Boron, Total (mg/L)
0.275
0.250
0.225
0.200
0.175
0.150
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
MBR2

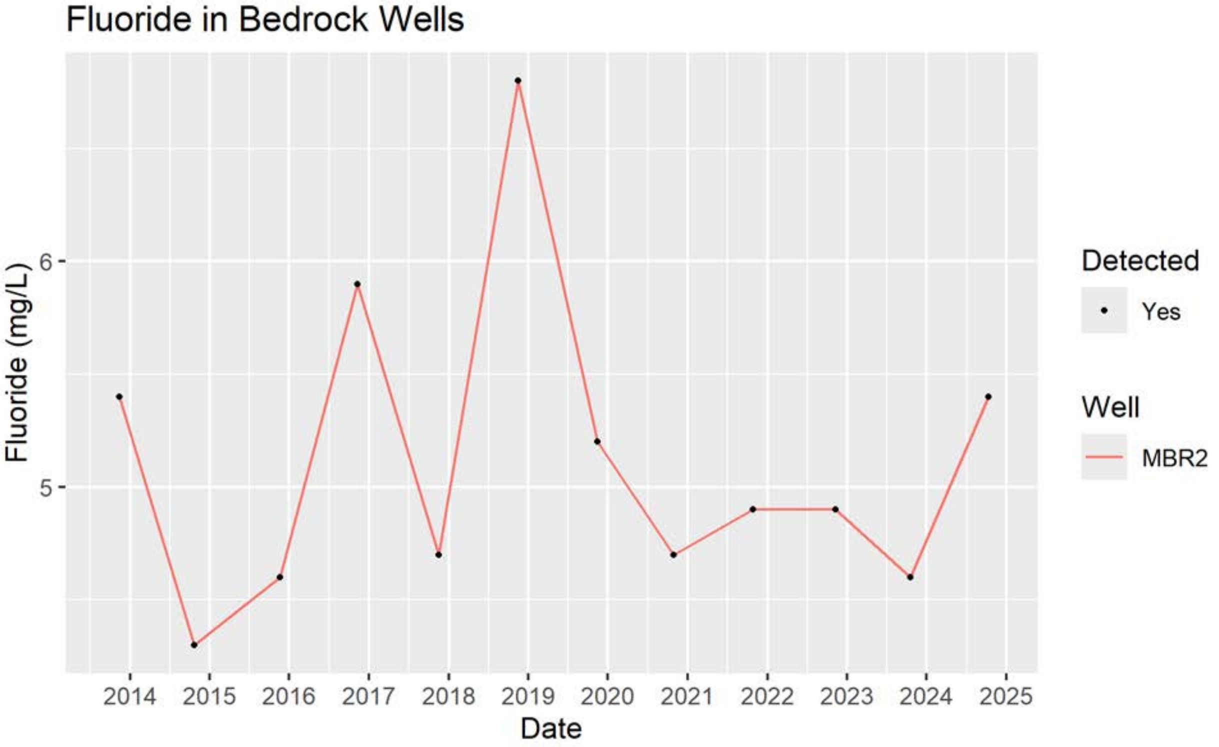

Calcium, Total in Bedrock Wells
Calcium, Total (mg/L)
125
100
75
50
25
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
MBR2

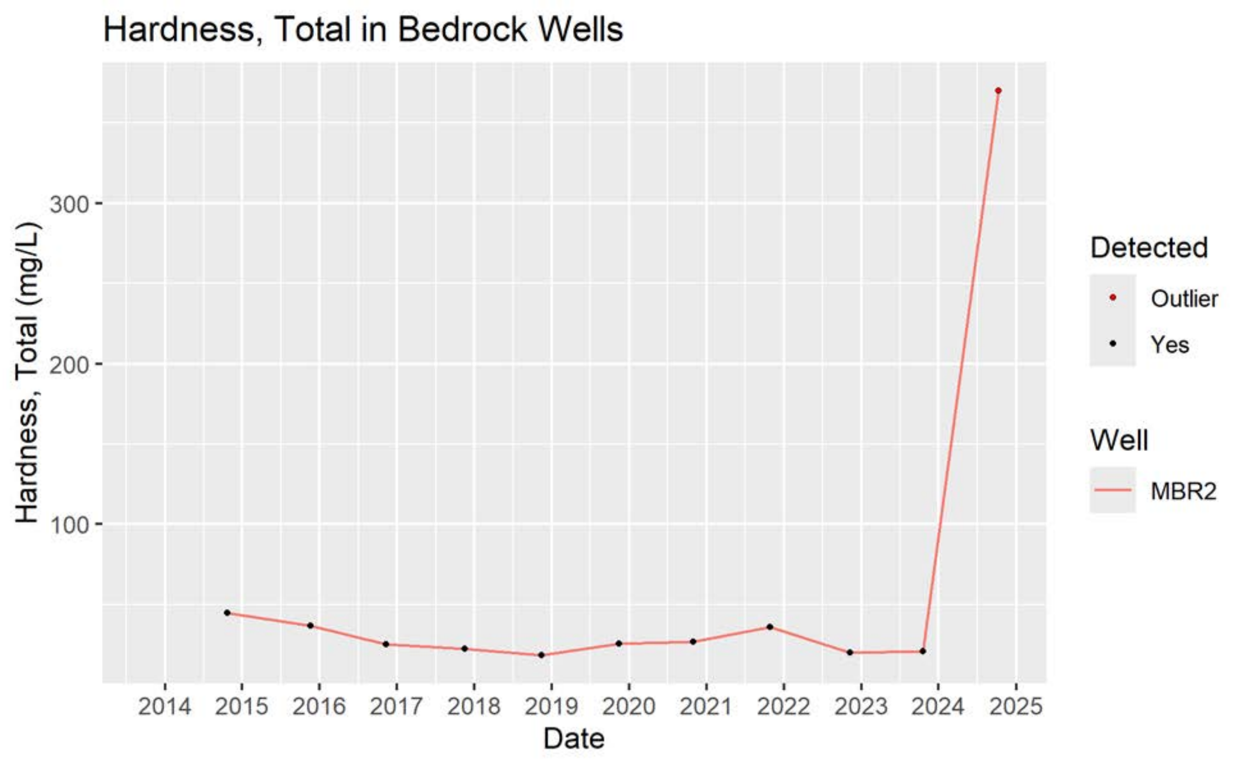

Carbonate in Bedrock Wells
Carbonate (mg/L CaCO3)
8
6
4
2
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
No
Well
MBR2

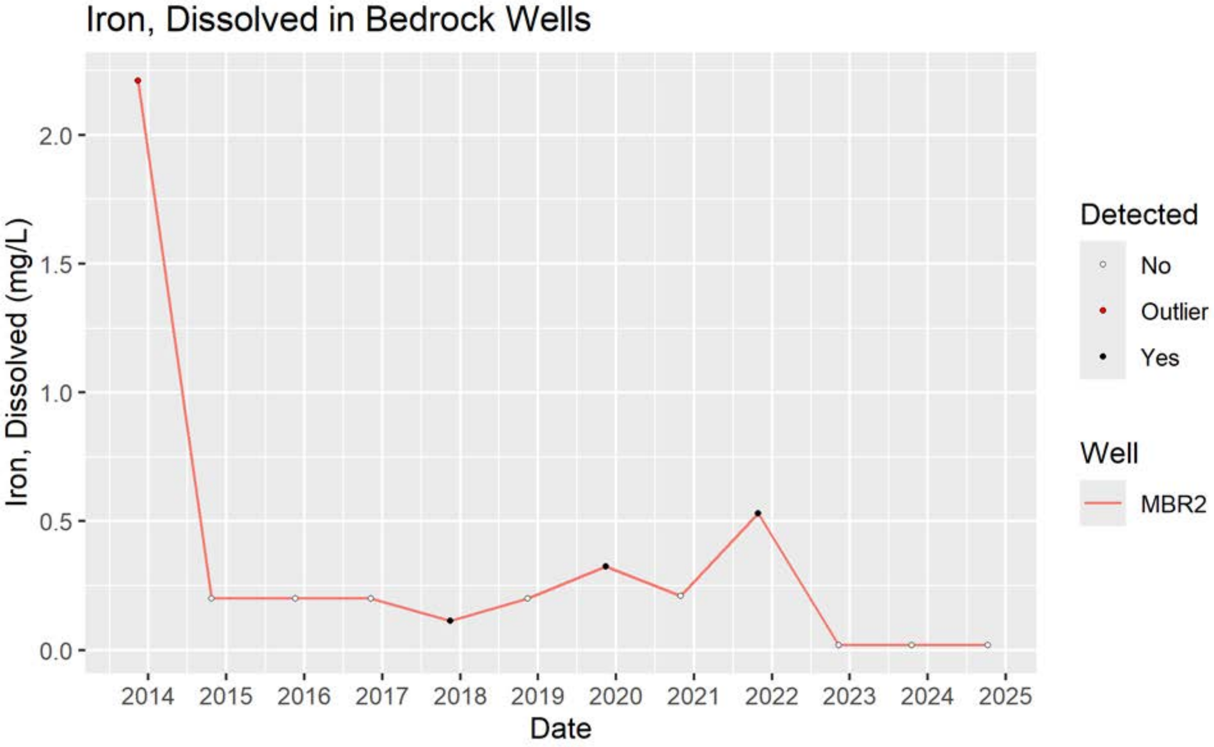

Cation-Anion Balance in Bedrock Wells
Cation-Anion Balance (%)
40
30
20
10
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
MBR2

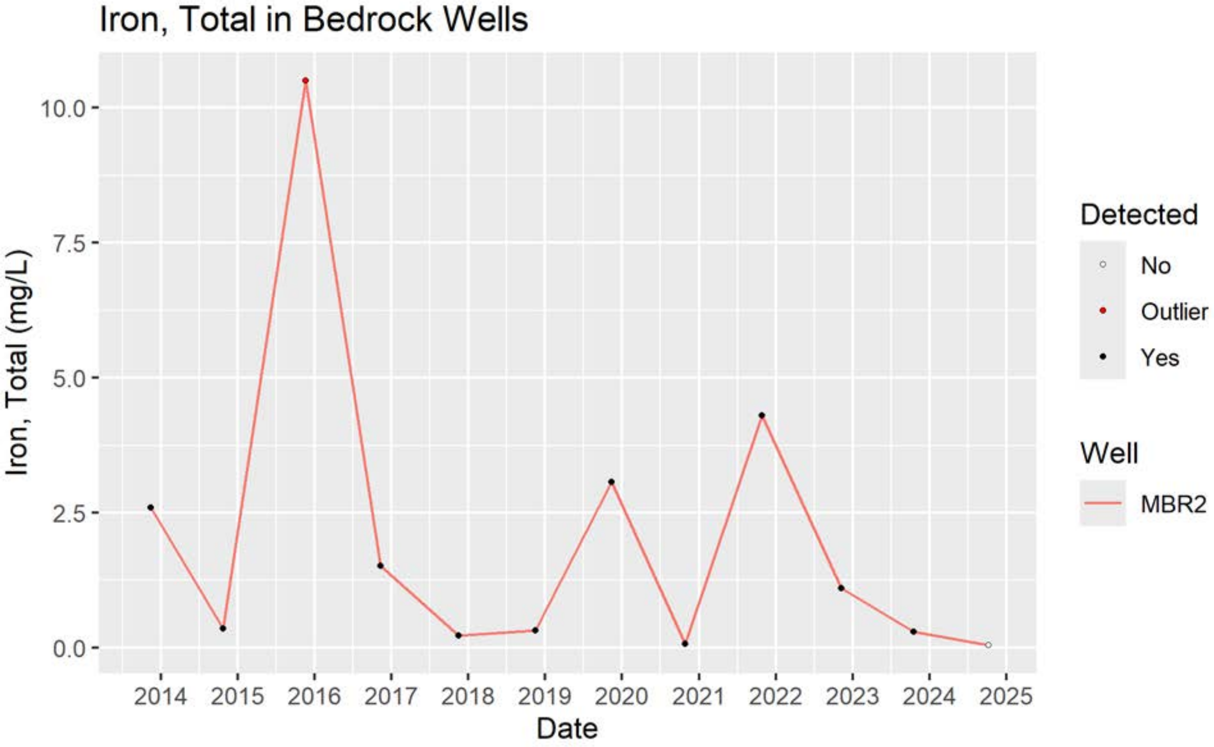

Chloride in Bedrock Wells
Chloride (mg/L)
7.4
7.0
6.6
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Yes
Well
MBR2

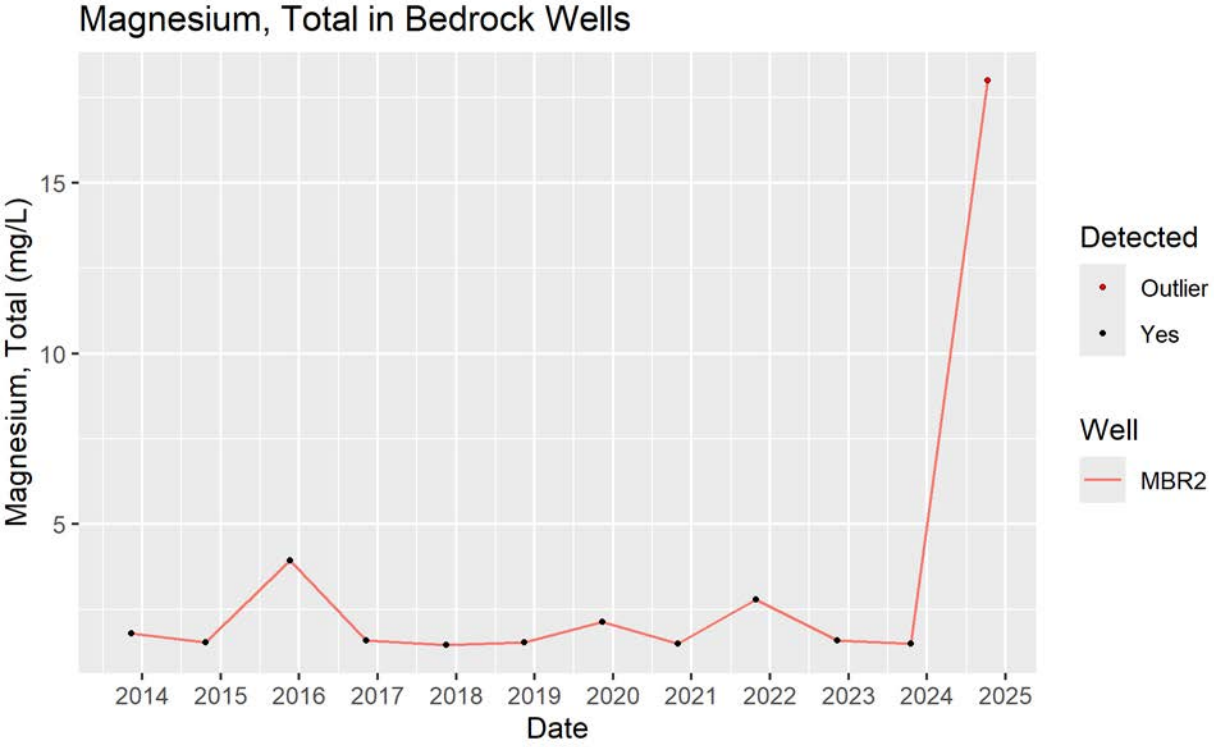

Conductance, Field in Bedrock Wells
Conductance, Field (µS/cm)
2500
2000
1500
1000
500
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
MBR2

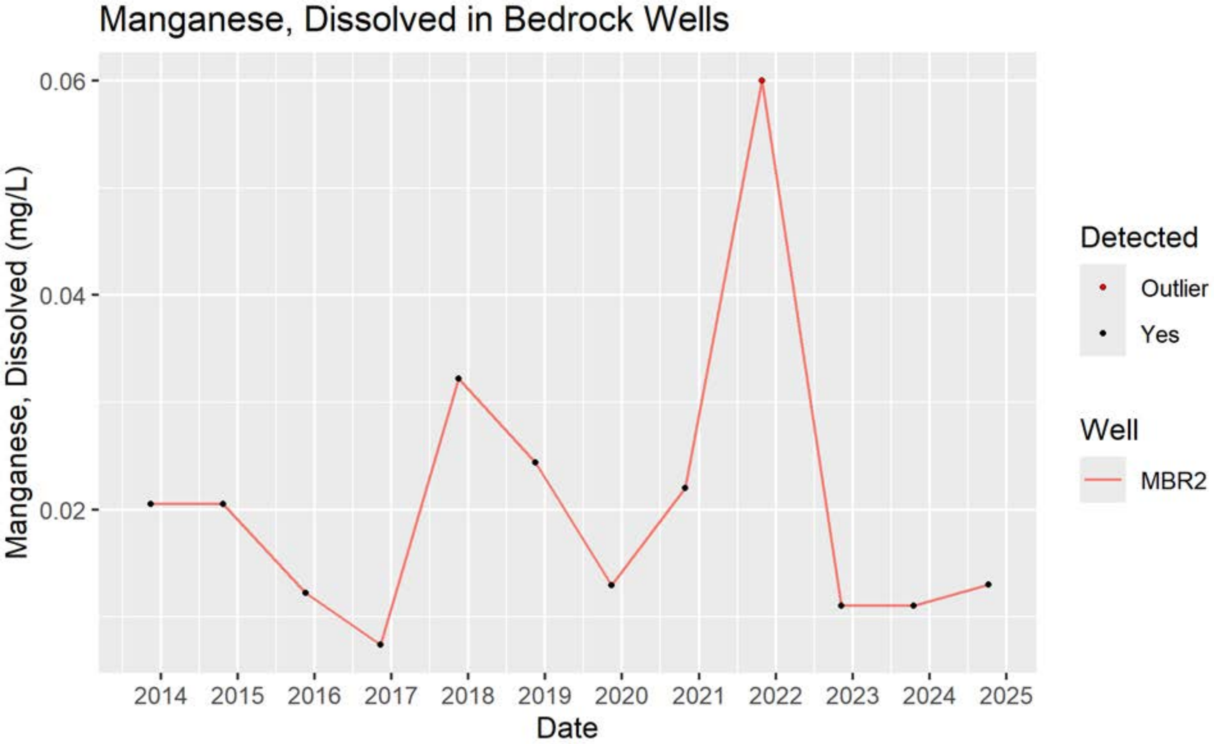

Fluoride in Bedrock Wells
Fluoride (mg/L)
6
5
Date
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Detected
Yes
Well
MBR2

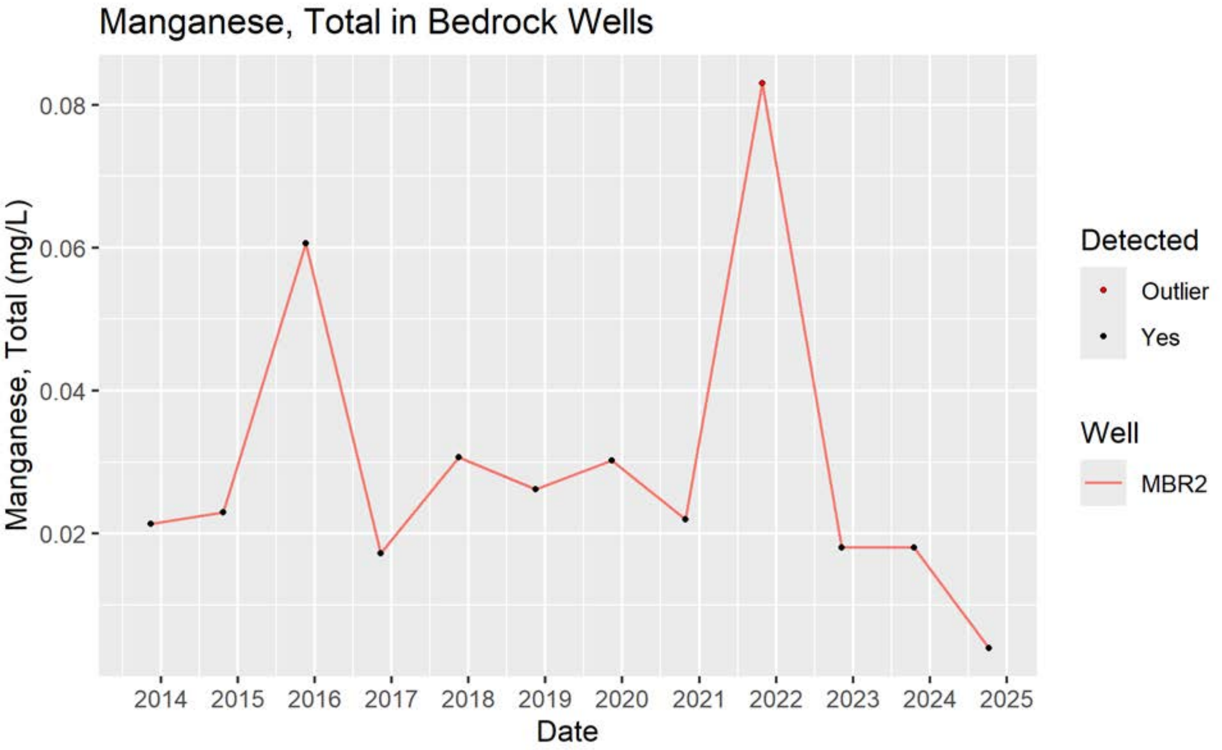

Hardness, Total in Bedrock Wells
Hardness, Total (mg/L)
300
200
100
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
MBR2

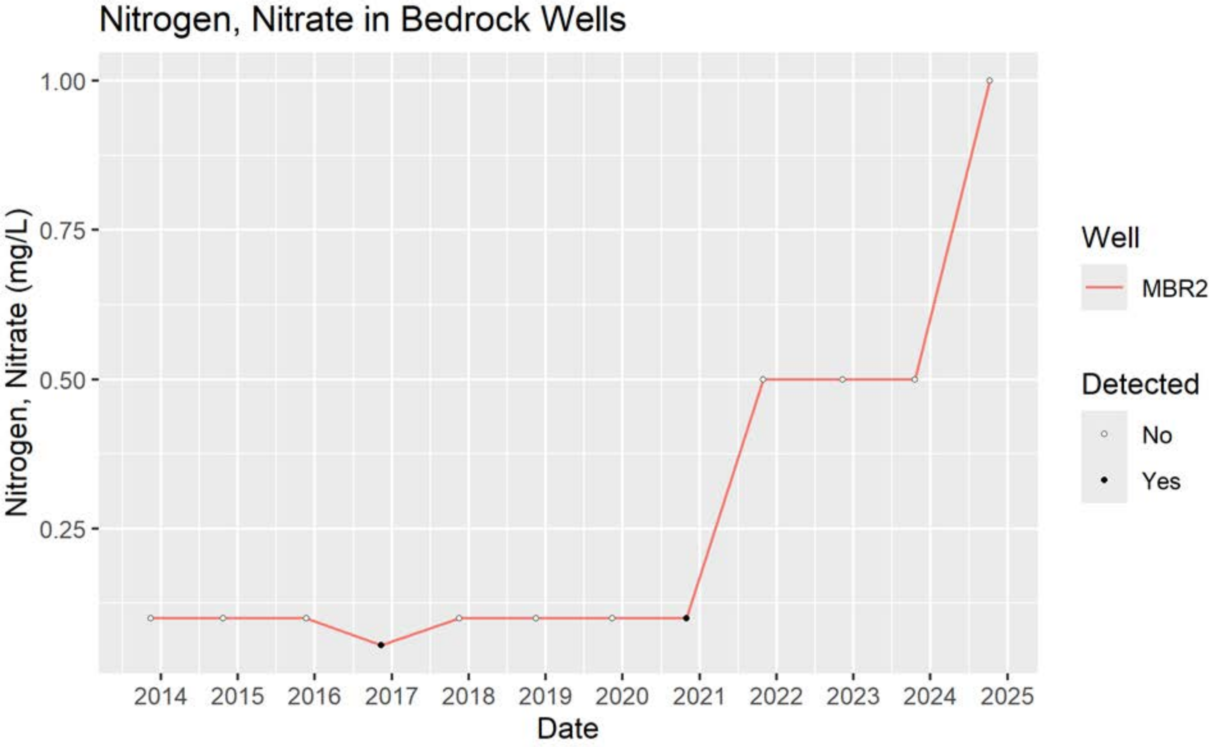

Iron, Dissolved in Bedrock Wells
Iron, Dissolved (mg/L)
2.0
1.5
1.0
0.5
0.0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
No
Outlier
Yes
Well
MBR2


Iron, Total in Bedrock Wells
Iron, Total (mg/L)
10.0
7.5
5.0
2.5
0.0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
No
Outlier
Yes
Well
MBR2

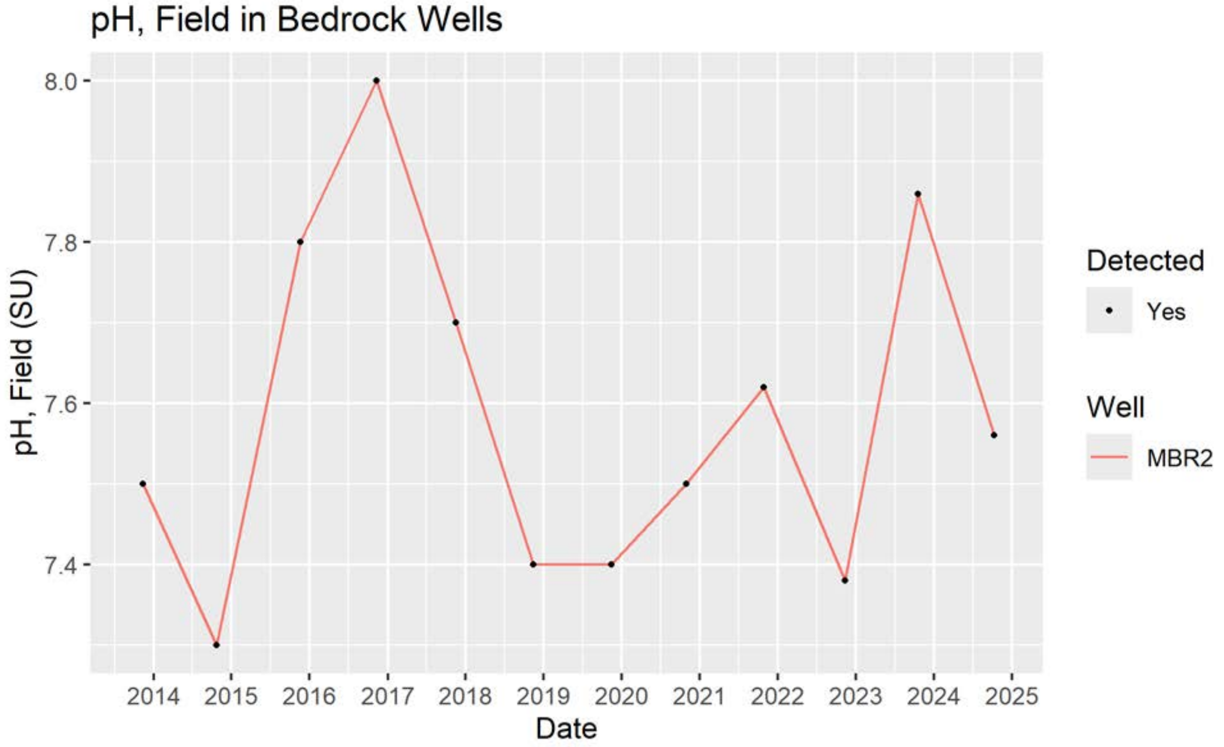

Magnesium, Total in Bedrock Wells
Magnesium, Total (mg/L)
15
10
5
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
MBR2


Manganese, Dissolved in Bedrock Wells
Manganese, Dissolved (mg/L)
0.06
0.04
0.02
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
MBR2

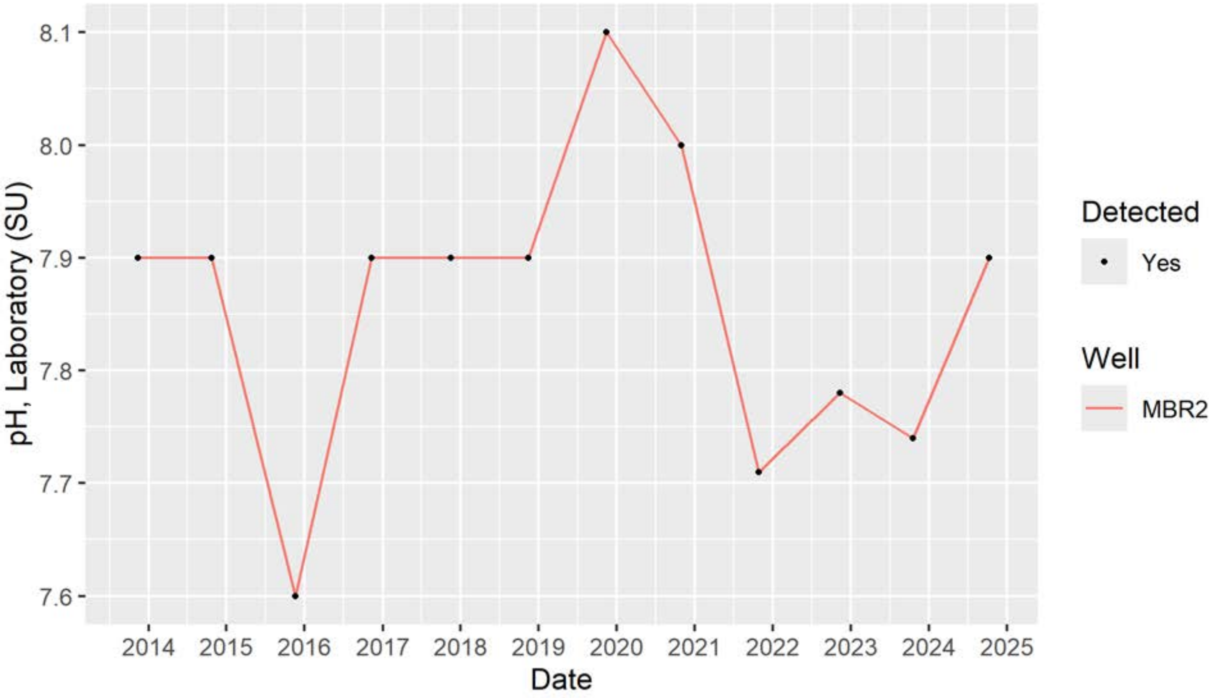

Manganese, Total in Bedrock Wells
Manganese, Total (mg/L)
0.08
0.06
0.04
0.02
Date
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Detected
Outlier
Yes
Well
MBR2

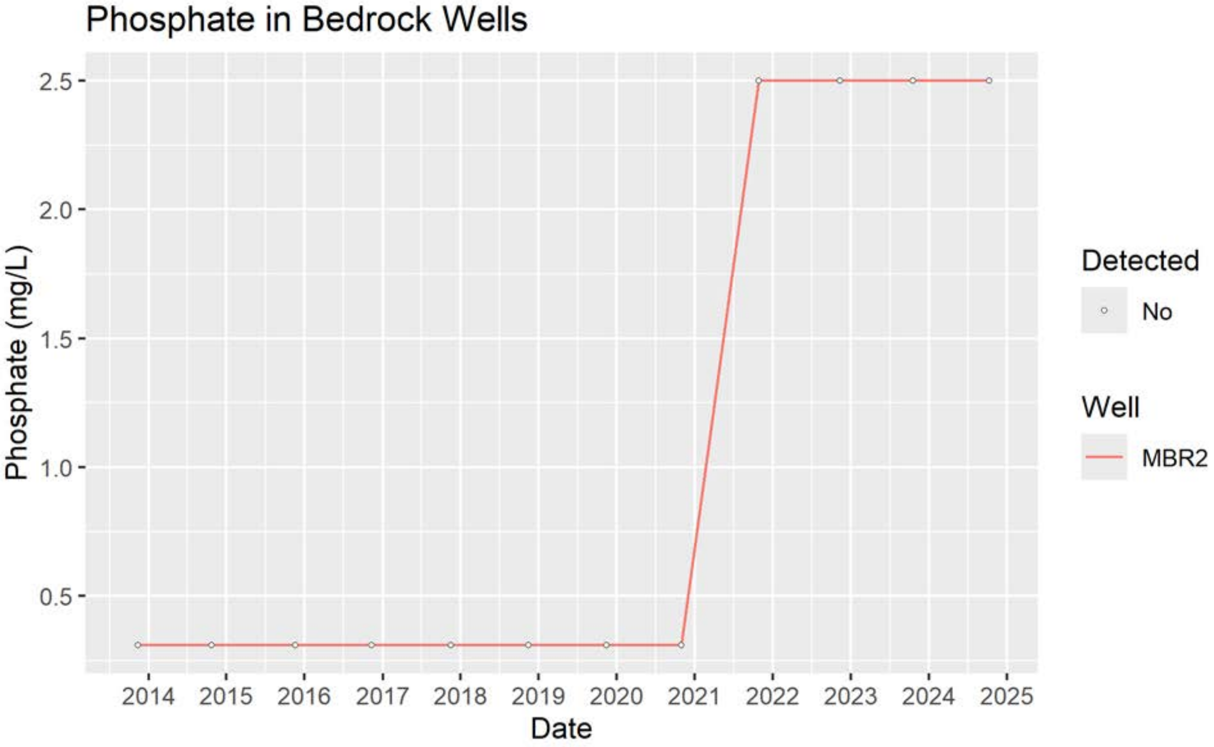


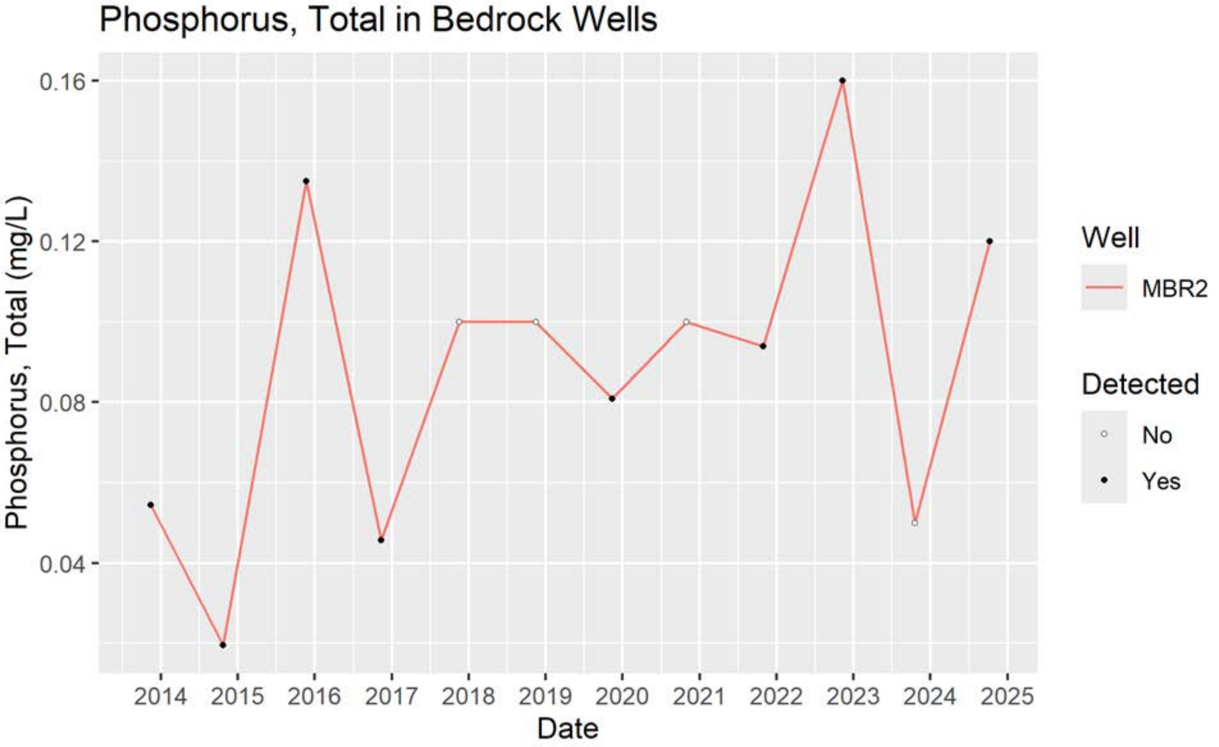
Nitrogen, Nitrate in Bedrock Wells

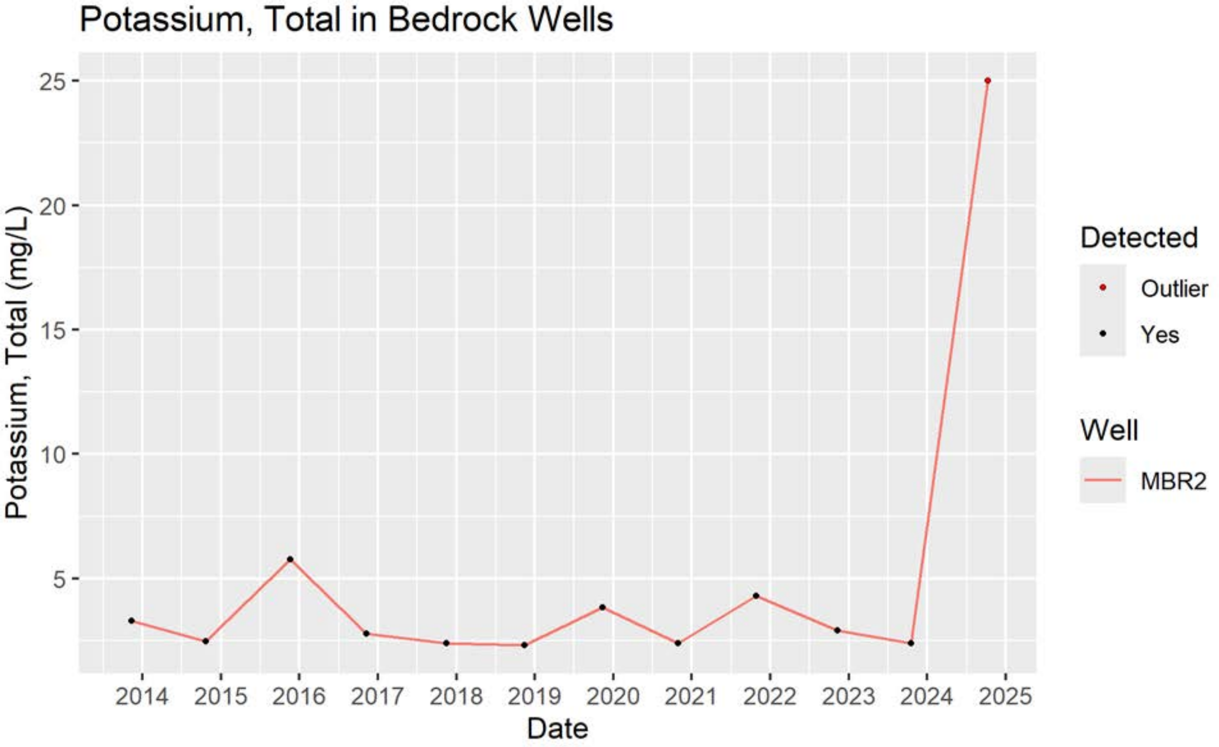

pH, Field in Bedrock Wells
pH, Field (SU)
8.0
7.8
7.6
7.4
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Yes
Well
MBR2

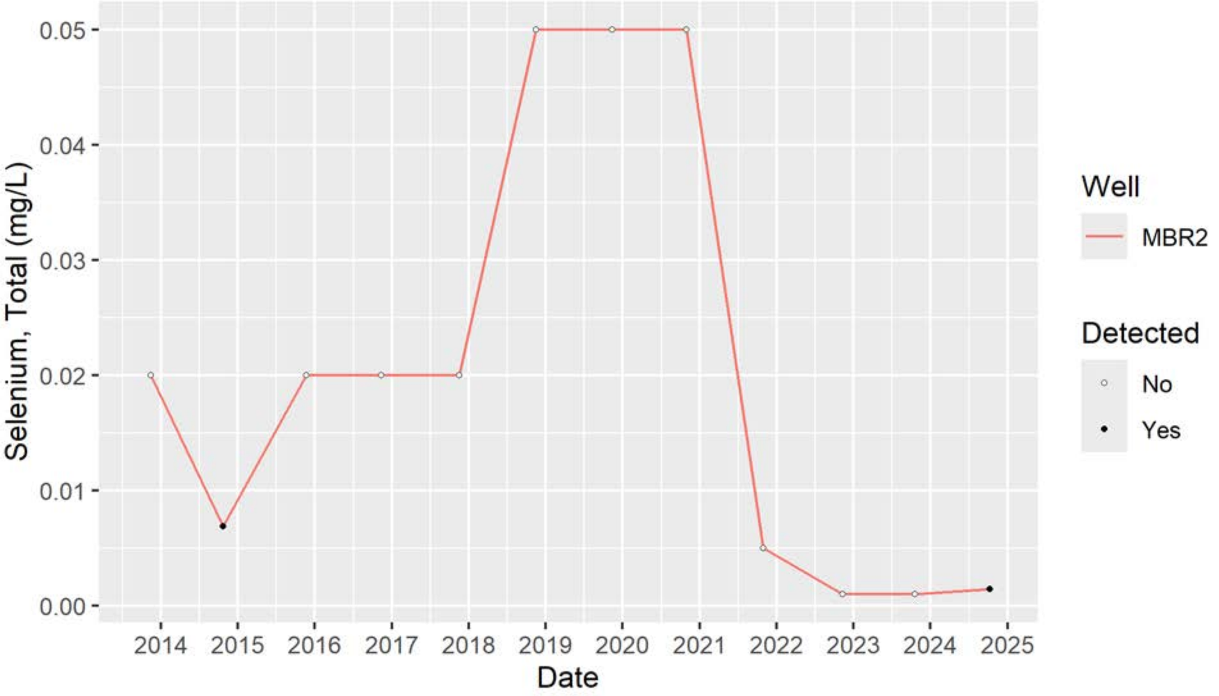
pH, Laboratory in Bedrock Wells



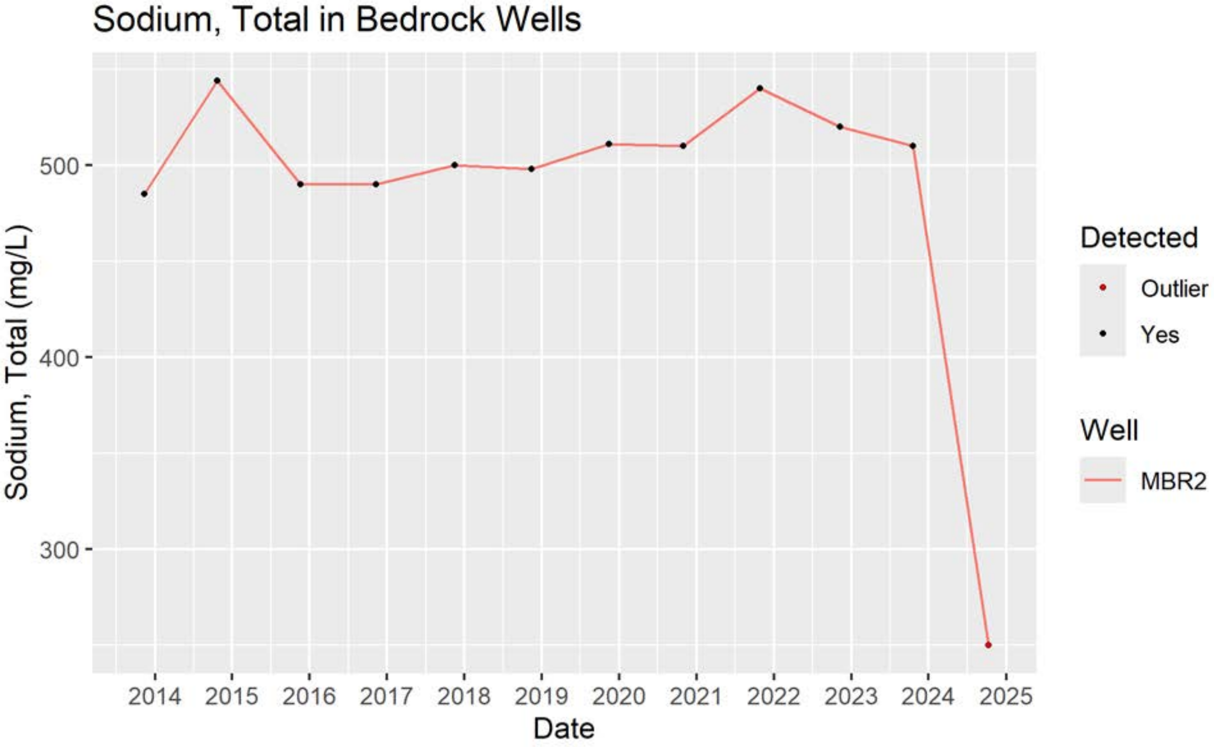

Phosphate in Bedrock Wells
Phosphate (mg/L)
2.5
2.0
1.5
1.0
0.5
Date
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Detected
No
Well
MBR2

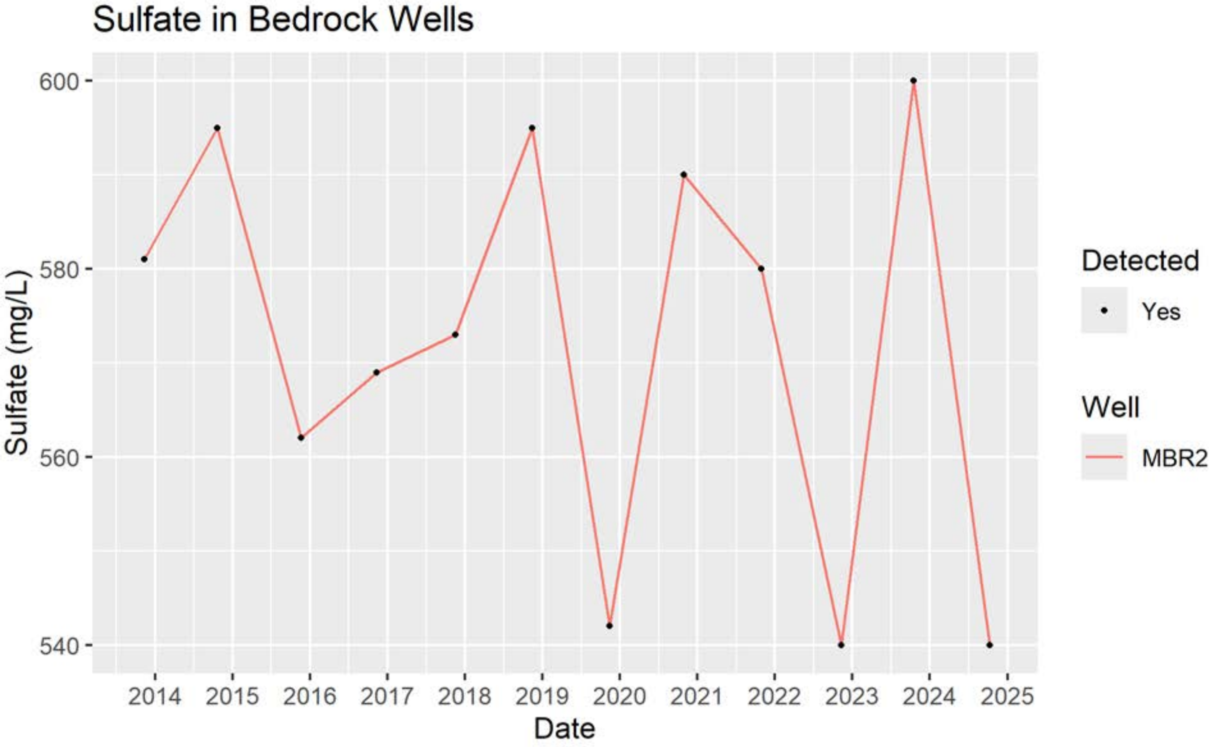

Phosphorus, Total in Bedrock Wells
Phosphorus, Total (mg/L)
0.16
0.12
0.08
0.04
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
MBR2
Detected
No
Yes

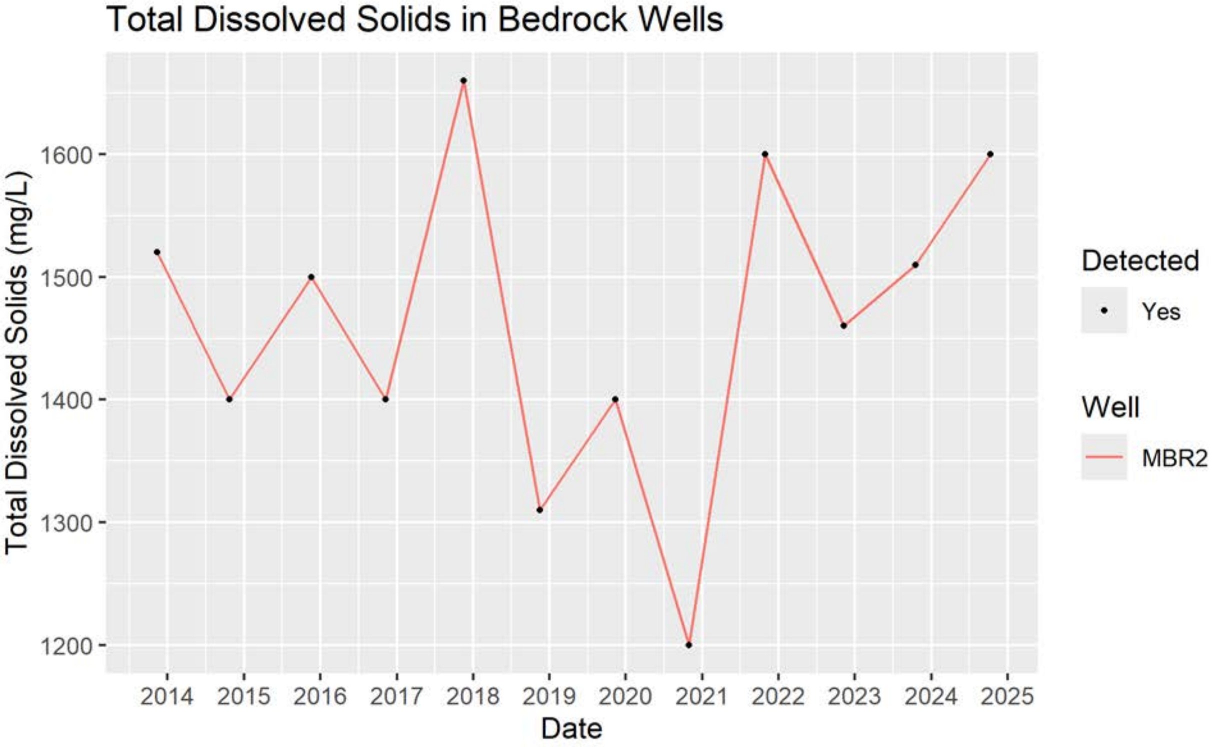

Potassium, Total in Bedrock Wells
Potassium, Total (mg/L)
25
20
15
10
5
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Outlier
Yes
Well
MBR2

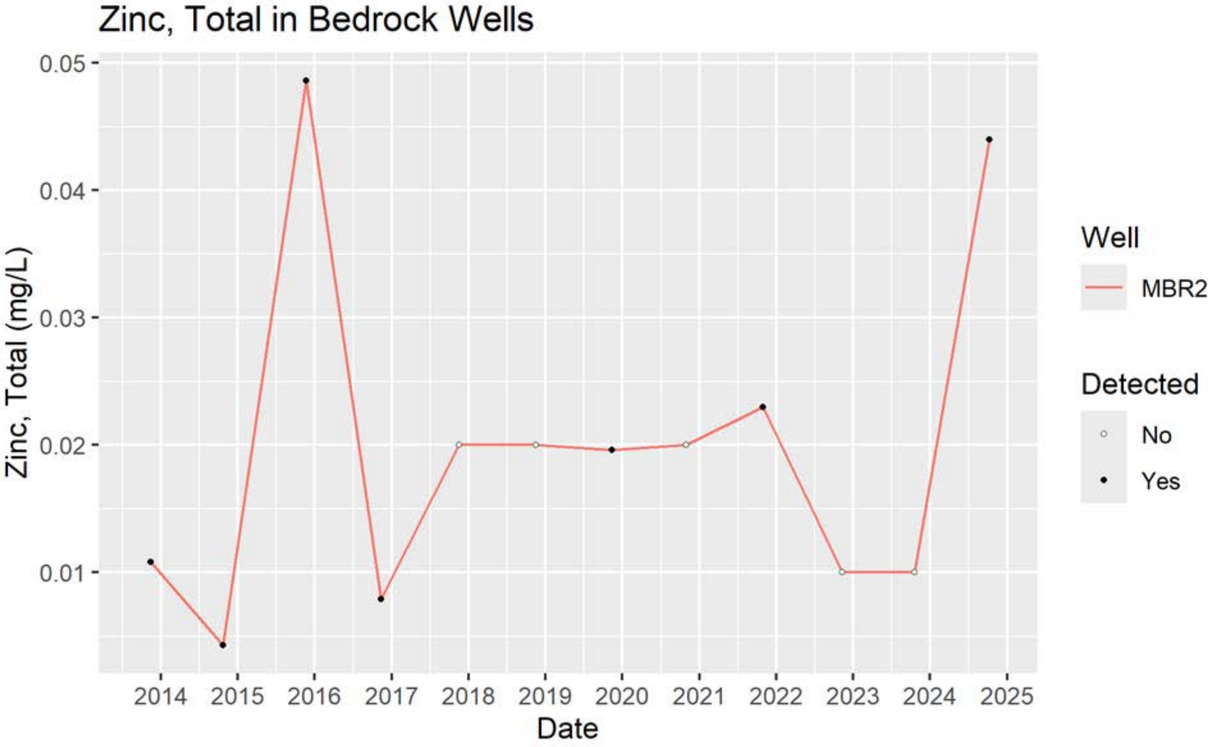


Selenium, Total in Bedrock Wells

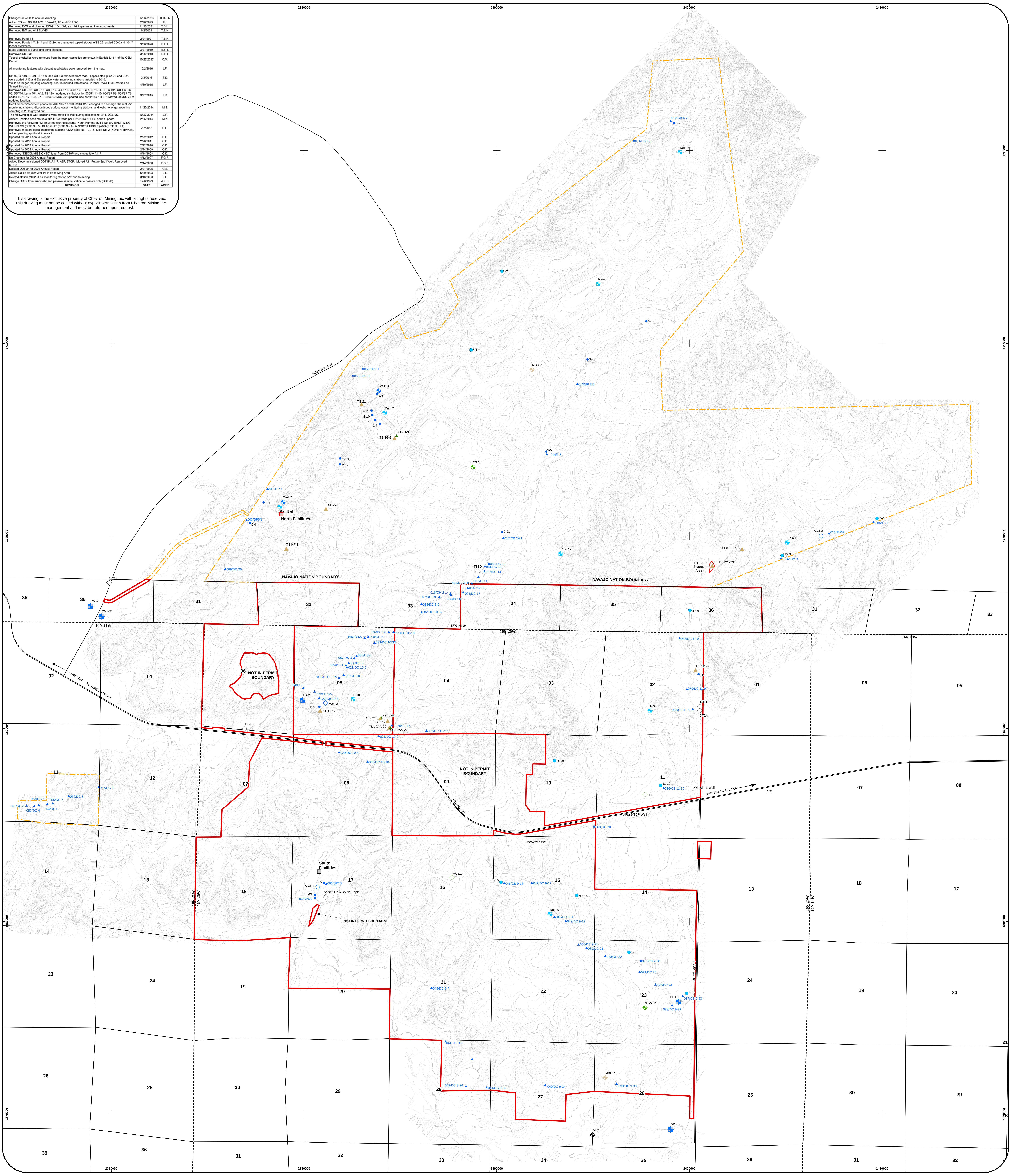

Sodium, Total in Bedrock Wells
Sodium, Total (mg/L)
500
400
300
Date
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Detected
Outlier
Yes
Well
MBR2


Sulfate in Bedrock Wells
Sulfate (mg/L)
600
580
560
540
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Yes
Well
MBR2


Total Dissolved Solids in Bedrock Wells
Total Dissolved Solids (mg/L)
1600
1500
1400
1300
1200
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Detected
Yes
Well
MBR2


Zinc, Total in Bedrock Wells
0.05
0.04
0.03
0.02
0.01
Zinc, Total (mg/L)
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
Well
MBR2
Detected
No
Yes

Appendix A3: Environmental Monitoring and Outfalls Map



Changed all wells to annual sampling	12/14/2023	TFB\F.R.
Added TS and SS 10AA-21, 10AA-22, TS and SS 2G-3	2/26/2023	H.J
Removed EW7 and changed EW-9, 15-1, 5-1, and 5-2 to permanent impoundments	11/18/2021	T.B.H.
Removed EW and A12 SWMS.	6/2/2021	T.B.H.
Removed Pond 1-5.	2/24/2021	T.B.H.
Removed Ponds 1-7, 2-14 and 12-2A, and removed topsoil stockpile TS 2B; added CDK and 10-17 topsoil stockpiles.	3/30/2020	E.F.T.
Made updates to outfall and pond statuses.	3/27/2019	E.F.T.
Removed CB 9-35.	3/26/2018	E.F.T.
Topsoil stockpiles were removed from the map; stockpiles are shown in Exhibit 3.14-1 of the OSM Permit.	10/27/2017	C.M.
All monitoring features with discontinued status were removed from the map.	12/2/2016	J.F.
SP 1N, SP 3N, SP4N, SP11-9, and CB 5-3 removed from map. Topsoil stockpiles 2B and CDK were added. A12 and EW passive water monitoring stations installed in 2015.	2/3/2016	S.K.
Wells no longer requiring sampling in 2015 marked with asterisk in label. Well TB3E marked as "Mined Through".	4/30/2015	J.F.
Removed CB 2-15, CB 2-16, CB 2-17, CB 2-18, CB 2-19, PI 3-4, SP 12-4, SPTS 104, CB 1-6, TS 96, DDT10, berm 104, A12, TS 12-4; updated symbology for 036/PI 11-10, 004/SP 6S, 005/SP 7S; added TS 10-17, TS CDK, TS 2C, 076/DC 26; updated label for 012/SP TI 6-7; Moved 009/DC 25 to updated location.	3/27/2015	J.K.
Certified berm/sediment ponds 032/DC 10-27 and 033/DC 12-8 changed to discharge channel; Air monitoring stations, discontinued surface water monitoring stations, and wells no longer requiring sampling in 2015 grayed out.	11/20/2014	M.S.
The following spoil well locations were moved to their surveyed locations: A11, 2G2, 9S.	10/27/2014	J.F.
Added: updated pond status & NPDES outfalls per EPA 2013 NPDES permit update.	2/25/2014	M.K.
Removed the following PM-10 air monitoring stations: North Remote (SITE No. 6A, EAST-WING, WILHELMS (SITE No. 5), BLACKHAT (SITE No. 9), & NORTH TIPPLE (A&B)(SITE No. 2A). Removed meteorological monitoring stations A12W (Site No. 10), & SITE No. 2 (NORTH TIPPLE). Added pending spoil well in Area 2.	2/7/2013	O.D.
Updated for 2011 Annual Report	2/22/2012	O.D.
Updated for 2010 Annual Report	2/26/2011	O.D.
Updated for 2009 Annual Report	2/22/2010	O.D.
Updated for 2008 Annual Report	2/24/2009	O.D.
Removed "DECOMMISSIONED" label from DDT9P and moved it to A11P	8/14/2008	O.D.
No Changes for 2006 Annual Report	4/12/2007	F.G.R.
Added Decommissioned DDT9P, A11P, A9P, 9TCP. Moved A11 Future Spoil Well, Removed MBR3.	2/14/2006	F.G.R.
Deleted DDT9P for 2004 Annual Report	2/21/2005	G.S.
Added Gallup Aquifer Well #4 in East Wing Area	6/20/2003	L.L.
Deleted station MBR1 & air monitoring station A12 due to mining	3/16/2003	L.L.
Change DDT9 from automatic and passive sample station to passive only (DDT9P).	12/6/1999	A.K.B.
REVISION	**DATE**	**APP'D**

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LEGEND

- MMD Permit Boundary
- OSM Permit Boundary
- Well - Alluvial, Annually Monitored
- Well - Bedrock, Annually Monitored
- Well - Spoil Wells, Annually Monitored
- Well - Gallup Aquifer, Annually Monitored
- Stream Monitor - Major Drainage
- Weather Monitor
- ▲ NPDES Outfall
- ● Sediment/Temporary Impoundment
- ● Permanent Impoundment
- ▲ Topsoil Stockpile
- ▲ Subsoil Storage
- ☐ North Facilities
- ▨ South Facilities

Township Number

- 001
- Section
- Public Road
- Major Surface Contour (25 ft. Interval)
- Minor Surface Contour (5 ft. Interval)

N

Chevron Mining Inc.

McKINLEY MINE

EXHIBIT 6.1-1
ENVIRONMENTAL MONITORING FACILITIES

Last Revision Date: 12/14/2023
Date Drawn: 02/12/2016

Drawn By: H.J./TFB
Checked By: K.J.K.
Approved By: M.S.

Scale: 1" = 1250'

0 750 1,500 3,000 Feet

Appendix A4: Initial Program Lands Seeding

REVISION	Date	App'd By

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Cooper Aerial Survey Co.
TUCSON, ARIZONA

LEGEND

Lease Boundary – Permitted	━━━
Lease Boundary – Not Permitted	━ ━
SEEDING YEAR BOUNDARY	───
YEAR SEEDED OR RESEEDED	85
SEEDED	S
RESEEDED	RS
INTERSEEDED	▨
CUSTOM PLANTING	▨
CUSTOM PLANTING IDENTIFICATION	2 G

NOTE: THIS MAP SHOWS THE LAST DATE SEEDING OR RESEEDING WAS DONE ON LANDS WITHIN THE SETTLEMENT AGREEMENT AREAS.

NOTE: INTERSEEDINGS SHOWN WERE DONE WITH 1992 PERMANENT SEED MIX UNLESS OTHERWISE NOTED ON MAP

Sheet Index

Photo Base Date: 7-28-92

P&M

The Pittsburg & Midway Coal Mining Co.
A Chevron Company

McKINLEY MINE
EXHIBIT 2

SETTLEMENT AGREEMENT
SEEDING DATES
(THROUGH 1992)

Drawn By: C.F.T.
Date Drawn: 7/29/93

Checked By: 7AR, CJB 08-05-93
Approved By: 7AR

Scale: 1" = 400'
Drawing Nº:

REVISION	Date	App'd By

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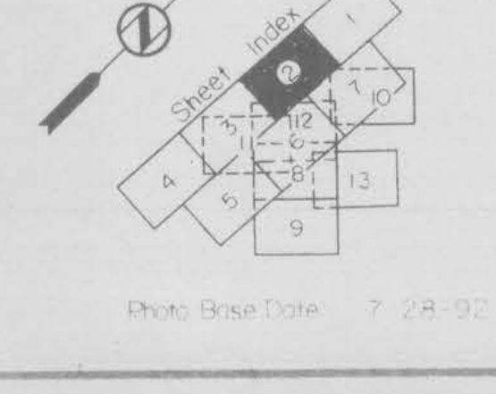
Cooper Aerial Survey Co.
TUCSON, ARIZONA

LEGEND

Lease Boundary – Permitted	▬▬
Lease Boundary – Not Permitted	▬ ▬
SEEDING YEAR BOUNDARY	—
YEAR SEEDED OR RESEEDED	85
SEEDED	S
RESEEDED	RS
INTERSEEDED	▨
CUSTOM PLANTING	▨
CUSTOM PLANTING IDENTIFICATION	2 G

NOTE THIS MAP SHOWS THE LAST DATE SEEDING OR RESEEDING WAS DONE ON LANDS WITHIN THE SETTLEMENT AGREEMENT AREAS

NOTE INTERSEEDINGS SHOWN WERE DONE WITH 1992 PERMANENT SEED MIX UNLESS OTHERWISE NOTED ON MAP



P&M

The Pittsburg & Midway Coal Mining Co.
A Chevron Company

McKINLEY MINE

EXHIBIT 2

SETTLEMENT AGREEMENT SEEDING DATES (THROUGH 1992)

Photo Base Date: 7-28-92
Drawn By: C.F.T.
Date Drawn: 7/29/93
Checked By: 7AR, jb 08-05-93
Approved By: 7AR
Scale: 1" = 400'
Drawing Nº

Appendix A5: Revegetation Monitoring Reports

REPORT

Vegetation Management Unit 4
Vegetation Success Monitoring, 2024

Submitted to:

Chevron Mining Inc. - McKinley Mine
24 Miles NW HWY 264
Mentmore, NM 87319

Submitted by:

WSP USA Inc.
2440 Louisiana Boulevard NE, Suite 400,
Albuquerque, New Mexico, USA 87110

+1 505 821-3043

31406184.000

March 2025

Table of Contents

1.0 INTRODUCTION 1

1.1 Vegetation Management Unit 4 1

1.2 Reclamation and Revegetation Procedures 1

1.3 Prevailing Climate Conditions 2

1.4 Livestock 3

2.0 VEGETATION STANDARDS AND MONITORING METHODS 3

2.1 Vegetation Success Standards 3

2.2 Sampling Design 4

2.3 Foliar, Canopy and Ground Cover 4

2.4 Annual Forage and Total Production 5

2.5 Shrub Density 5

2.6 Statistical Analysis 5

3.0 RESULTS 8

3.1 Total Ground Cover 8

3.2 Perennial Vegetation Cover 9

3.3 Production 9

3.4 Shrub Density 10

3.5 Composition and Diversity 10

3.6 Noxious Weeds 11

4.0 SUMMARY 11

5.0 REFERENCES 13

TABLE

Table 1: Revegetation Success Standards in the McKinley Mine OSM Permit

Table 2: North Mine Seasonal and Annual Precipitation, 2015-2024

Table 3: Summary Statistics, O-VMU-4, 2021-2024

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU-4, 2024

Table 5: Relative Shrub, Tree, and Cacti Density, O-VMU-4, 2024

Table 6: Results for Diversity, O-VMU-4, 2023-2024

Table 7: Results for Diversity, O-VMU-4, 2021-2022

FIGURES

Figure 1: General Overview of the McKinley OSMRE Permit Area Vegetation Management Units (VMU), 2024

Figure 2: Departure of Growing Season Precipitation from Long-Term Mean at Window Rock: Rain 3 and 6 Gauges

Figure 3: Vegetation Monitoring Transects 2024, Vegetation Management Unit 4

Figure 4: Vegetation Plot and Transect Layout

Figure 5: Typical Grass-Shrubland Vegetation in O-VMU-4, September 2024

Figure 6: Stabilization of the Mean for Annual Forage Production, O-VMU-4, 2024

Figure 7: Stabilization of the Mean for Shrub Density, O-VMU-4, 2024

APPENDICES

APPENDIX A
Vegetation Data Summary

APPENDIX B
Quadrat Photographs

APPENDIX C
Statistical Analysis

1.0 INTRODUCTION

Mining at the McKinley Mine ceased in 2009 and reclamation of remaining support facilities (e.g., impoundments, roads, etc.) is nearing completion. Reclamation practices have been applied at the McKinley Mine under various programs since at least the early 1970s. Chevron Mining Inc. (CMI) is assessing the vegetation in reclaimed areas in anticipation of future bond and liability release. CMI understands the importance of returning the mined lands to productive traditional uses in a timely manner. To qualify for release, the increment, or permit area as a whole, must meet the Permit No. NM-0001K (2016) (the Permit) permanent-program revegetation-success criteria as shown in Table 1 of this report. In general, the lands must be in a condition that is as good as or better than the pre-mine conditions, stable, and capable of supporting the designated postmining land uses of grazing and wildlife. WSP USA, Inc. (WSP) was retained to monitor and assess the vegetation relative to the established vegetation success standards.

This report documents the vegetation community attributes collected in 2024 in O-VMU-4 and compares them to the Permit's vegetation-success criteria. Section 1 includes the introduction and a general overview. Section 2 describes the vegetation monitoring methods that were used in 2024. Section 3 presents the results of the assessment with respect to total ground cover, perennial vegetation cover, forage production, woody plant density (shrub density), and composition and diversity. Section 4 is a summary of the results for O-VMU-4 with emphasis on vegetation success.

The 2024 sampling program was conducted and evaluated in accordance with the updated monitoring methods and revegetation success standards contained in Permit Modification Number 23-03. More details beyond what is already discussed throughout this report may be found in the Permit.

1.1 Vegetation Management Unit 4

This report presents results from 2024 quantitative vegetation monitoring conducted in Vegetation Management Unit 4 (O-VMU-4), which is in the eastern portion of Area 6 and northern portion of Area 3 (Figure 1). The configuration of the vegetation monitoring units within the U.S. Department of the Interior – Office of Surface Mining Reclamation and Enforcement (OSMRE) Permit Area, were developed in consultation with OSMRE. Undisturbed lands included within the VMU were not part of the sampling program. O-VMU-4 encompasses about 1,242 acres, comprised mostly of permanent program lands (PPL) and some initial program lands (IPL). Both PPL and IPL as one unit must meet the PPL success criteria as discussed in the Permit in Section 6.5.1.2. The 10 -year period of extended responsibility, however, only applies to PPL.

The elevation of O-VMU-4 ranges from about 7,200 to 7,600 feet above mean sea level. Reclamation started in 1986 with the vast majority seeded by 2014. Thus, the reclamation in the majority of O-VMU-4 ranges from 10 to 38 years old. This section provides a general description of the reclamation activities that were implemented. Additional details of the reclamation for specific areas can be obtained through review of the McKinley Mine annual reports.

1.2 Reclamation and Revegetation Procedures

Reclamation of permanent program lands included grading of the spoils to achieve a stable configuration, positive drainage, and approximate original contour. After grading, graded spoil monitoring was conducted to determine the suitability of the materials. A minimum of 6 inches of topdressing (topsoil or topsoil substitute) were then applied over suitable spoils.

After topdressing placement, the seedbed was scarified or ripped on the contour to a depth of about 8 to 12 inches. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, certified weed-free, long-stem, hay mulch, or straw was applied at a rate of about 2 tons per acre. The mulch was anchored 3 to 4 inches into the cover with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which tends to favor the establishment of cool-season grasses and shrubs. The approved seed mixes used at McKinley have varied over time but included both warm-season grasses, and introduced and native cool-season grasses, introduced and native forbs, and shrubs. The early seed mixes tended to emphasize the use the alfalfa and cool-season grasses. The majority of seed mixes planted on IPL consisted of native and introduced cool season grasses, limited warm-season grasses, some shrubs, but no forbs. Over time the seed mixes on PPL shifted to include more warm-season grasses, more shrub species, and a variety of forbs.

Initial program lands were typically graded so they were no steeper than 3:1 and topsoiled. Seeding practices were like those done on permanent program lands.

1.3 Prevailing Climate Conditions

The amount and distribution of precipitation are important determinants for vegetation establishment and performance. Once vegetation is established, the precipitation dynamics affect the amount of vegetation cover and biomass on a year-to-year basis with grasses and forbs showing the most immediate response. Long term precipitation has been monitored at the McKinley North Mine at the Bluff station (Figure 1). The mine added a system of 6 additional seasonal precipitation gauges to better capture more representative data from the various mining areas in 2011-2012 (gauges named by mining area). Data from the Rain 3 and 6 gauges were used to evaluate precipitation in O-VMU-4 (Figure 1).

Table 2 contains a summary of precipitation recorded at all the rain gauges in the North Mine Area. Total annual precipitation measured at the Bluff gauge near the mine entrance was 11.97 inches in 2024, slightly exceeding the regional average of 11.8 inches at Window Rock. Total annual precipitation for the season rain gauges is unavailable as they are taken offline due to freezing conditions from December through March.

Growing season precipitation provides additional context to evaluate vegetation performance in O-VMU-4. The departure of growing season precipitation (April through September) between the Rain 3 and Rain 6 and the Window Rock (1937-1999) long-term seasonal mean is illustrated in Figure 2. Growing season precipitation in O-VMU-4 has been below the long-term seasonal mean from 2018 to 2024 including a severe drought in 2020 when the site only received 27% of the normal growing season precipitation for the region. In 2022, O-VMU-4 growing season was about 115% above the long-term-average. In 2023, growing season precipitation measured at the Rain 3 and 6 gauges was 68% of the long-term average. Over the past ten years, growing season precipitation measured at Rain 3 was on average 15% below regional norms and 6 gauges was on average 28% below regional norms.

Precipitation in 2024 was near normal for the growing season with a wetter than average June accounting for nearly 35% of the total growing season precipitation. The Rain 3 gauge recorded 6.51 inches of precipitation and Rain 6 gauge recorded 6.61 inches of precipitation from April to September. This is essentially equivalent to what was recoded at the Bluff gauge (6.57 inches) for the same period. Rainfall in April, May, July, and September was below the monthly long-term average with a slightly wetter than normal August. Mine wide, the precipitation recorded in 2024 between April and November at the seven gauges indicate near normal regional rainfall, with average rainfall falling just 0.12 inches below the regional norm with variation both spatially and temporally (Table 2).

1.4 Livestock

CMI has aggressively managed trespass livestock (horses) the past several years, resulting in less evidence of overgrazing in the reclamation in 2024 in O-VMU-2. The combination of past grazing pressure with exceptional drought, however, may in some years adversely affected the ability to demonstrate that the vegetation is meeting or can meet the revegetation success standards.

2.0 VEGETATION STANDARDS AND MONITORING METHODS

Vegetation attributes in O-VMU-4 were quantified using the methods described in Section 6.5 of the Permit as modified in Permit Modification 23-03. Vegetation monitoring in O-VMU-4 was conducted from September 30 through October 13, 2024.

2.1 Vegetation Success Standards

The vegetation success standards for the Permit Area consist of five vegetative parameters: total cover, perennial cover, forage production, woody plant density, and diversity (Table 1). The total ground cover requirement, or the combined means for live vegetation cover and litter cover on the reclamation, is 52%. The perennial vegetation cover requirement is 24%. Both total ground and perennial vegetation cover use absolute cover. The annual forage production requirement is 550 air-dry pounds per acre (lbs/ac). The shrub density success standard is 400 live woody stems per acre. In accordance with 30 CFR 816.116 (a)(2), success for total cover, perennial cover, forage production, and shrub density shall be ≥ 90% of the standard.

Cover is defined in three ways for accurate evaluation of diversity according to Table 1.

1) Absolute cover utilizes first-hit line point intercept (LPI) data and is used to assess the perennial grass diversity standard.
2) Relative perennial cover, the metric used to assess grass, forb, and shrub diversity, compares the cover of perennial species relative to the sum of perennial plants calculated from all-hit LPI data (excluding noxious weeds) within the VMU.
3) Relative total cover, the metric used to assess the any-single-species diversity standard, is calculated by dividing the percent cover of each perennial/biennial species by the total live vegetative cover from all-hit LPI data (excluding noxious weeds) within a VMU.

Biennial forbs are included in the vegetation cover analyses and biennial forb diversity standards because they are important to the long-term ecological success of the reclamation. As monocarpic, or single flowering species, these forbs produce a high number of seeds, and as a result, persist long-term in the reclamation plant community. Future mention of “perennial” in this report thus includes biennial forb species. Plant duration was derived from the USDA Plants Database.

Relative shrub density, the metric used to assess the single shrub species standard, is calculated using belt-transect data by dividing the density of each species by the total density within a sampling unit. Relative calculations are valuable to determine whether a species or functional group is excessively dominant. The number of species required for the various diversity standard components (e.g., ≥ 2 species of cool-season grasses) is calculated by adding the total number of unique species captured in the LPI surveys.

Diversity is evaluated against numerical guidelines for different vegetation types. In summary, the diversity guideline is met if perennial grasses contribute 7% or more absolute vegetation cover; at least two cool-season perennial grasses have individual relative perennial vegetation covers of 5% and 1.5% or more; at least two warm-season perennial grasses species with the highest cover species 5% or more relative perennial vegetation cover and the remaining species combining to contribute 1.5% or more relative perennial vegetation cover, at least three non-annual non-noxious forbs combining to contribute 1% or more relative total vegetation cover; shrubs combining to 6% or more relative perennial vegetation cover and no single shrub species with greater than 70% relative shrub density, and no single species of any functional group with 40% or more relative total vegetation cover. Diversity is also demonstrated by evidence of colonization or recruitment of native (not-seeded) plants from adjacent undisturbed native areas.

2.2 Sampling Design

All lands (PPL, Prelaw and IPL) were included in the vegetation-sampling pool for unbiased random sampling. The transect locations were reviewed with OSMRE in advance of sampling. A 100-meter (m) by 100 m square grid was superimposed over the entire VMU to delineate vegetation sample plots. Random points were created in a geographic information system, and the locations, including the program land (IPL or PPL) designations, are shown in Figure 3. In the field, the randomly selected transect locations were assessed in numerical order with 40 primary transects accompanied by 10 alternate transects. If a transect location was determined to be unsuitable, the next alternative location was assessed for suitability. Transects that fell on or would intersect roads, drainage ways, wildlife rock piles, or prairie dog colonies were considered unsuitable.

Figure 4 shows the 100 m by 100 m vegetation plot with the cover transect orientation, and the location of the production quadrats and belt transect. The origin of the LPI transect is situated at the grid centroid and transect orientation (from 0° to 360°) is chosen randomly beginning from the transect origin, the point navigated to. LPI points are traversed on transect left with the laser pointed towards transect right, to limit disturbance from walking on the quad and belt survey areas located on transect right. Each LPI transect is 50 m long with three half square meter (½ m^2) production quadrats placed flush with the meter tape with the bottom left corner at the 10, 25, and 40 m mark to the right of the transect. The belt transect corridor is 2 m by 50 m along the transect's right side.

2.3 Foliar, Canopy and Ground Cover

The LPI method is used to collect cover measurements required by the Permit to evaluate total cover, perennial cover, and diversity. Prior to production clipping, a 50 m measuring tape is suspended between two metal pins to extend the tape fully. A tripod-mounted laser is then held along the edge of the tape, and readings are taken every meter for living plants, plant litter, rock fragments, and bare ground. When a live plant is encountered as a direct foliar hit, the species is recorded, and direct lower canopy live plant hits are also recorded that are observed down the profile. The LPI-derived data were evaluated against the permit vegetation success standards for vegetation cover and diversity provided in Table 1, with first hits used in absolute cover calculations and all hits (upper and lower canopy hits) used in relative cover calculations.

Additional cover measurements were estimated from each production quadrat, including relative cover for each species and total canopy cover, surface litter, rock fragments, and bare soil. Quadrat canopy cover data is not analyzed for success and is only briefly discussed in this report as additional support information (Table A-3). Canopy cover estimates include the foliage and foliage interspaces of all individual plant species rooted in the quadrat. Canopy cover is defined as the percentage of quadrat area included in the vertical projection of the canopy. The canopy cover estimates made on a species basis may exceed 100 percent in individual quadrats where the vegetation has multi-layered canopies. In contrast, the sum of the total canopy cover, surface litter, rock fragments, and bare soil does not exceed 100 percent. All cover estimates were made in 0.05 percent increments. Percent area cards were used to increase the accuracy and consistency of the cover estimates.

Not all plant species are expected to occur in the sampling transects and quadrats. Plants observed growing within the vegetation plots and across the reclaimed areas were inventoried while moving between transect locations and during formal sampling (Table A-6).

2.4 Annual Forage and Total Production

Forage production required by the Permit was determined by clipping and weighing all annual (current year's growth) above-ground forage biomass within the vertical confines of the three ½ m^2 quadrats placed systematically along the same 50 m transect used for LPI measurements. Biomass from all three quads from each transect are combined by species and the combined values for the transect (not the quads) are treated as a sampling unit. Production for vegetation success is assessed for above-ground annual forage production, excluding annuals and noxious weeds in air-dry lbs/ac. The Permit allows for excessively grazed production quadrats to be considered for exclusion from the sampling analysis in consultation with OSMRE, but no quadrats needed to be excluded in O-VMU-2 (the Permit, Section 6.5.2.2).

Grasses and forbs were clipped to within 5 centimeters (cm) of the soil surface, and the current year's growth was segregated from the previous year's growth (e.g., gray, weathered grass leaves, and dried culms). Production from shrubs was determined by clipping the current year's growth. Annuals and noxious weeds (e.g., Russian knapweed [*Acroptilon repens*]), when encountered, were not clipped. Photographs of the individual production quadrats are included in Appendix B.

The plant biomass samples of every species collected per transect were placed individually in labeled paper bags. The samples were air-dried (~ 90 days) until no weight changes were observed with repeated measurements on representative samples. The average tare weight of the empty paper bags was determined to correct the total sample weight to air-dry vegetation weights. The net weight of the air-dried vegetation was converted to lbs/ac.

2.5 Shrub Density

Shrub density (as required by the Permit), or the number of stems per square meter (stems/m^2), was determined using the belt transect method (Bonham 1989). The belt transect was located parallel to the 50 m transect used to determine cover. Shrubs rooted in the 2 m belt transect were counted on a species basis. A 2 m folding ruler was horizontally oriented perpendicular to the tape to ensure that observations were taken within the 2 m corridor. The number and species of woody plant stems within the belt transect were recorded.

2.6 Statistical Analysis

The procedures for liability release and the basis for statistical analysis applied in this report may be found in the Permit, and as referenced in the Permit: the Wyoming Department of Environmental Quality (WDEQ) handbook of sampling and statistical methods (WDEQ 2012), and the New Mexico Mining and Minerals Division (MMD) Coal Mine Reclamation Program guidelines (MMD 1999). Additional resources include *Evaluation and Comparison of Hypothesis Testing Techniques for Bond Release Applications* (McDonald et al. 2003), which was the basis of the WDEQ handbook, and other sources referenced herein. More specifically, Figure 6.5-1 and Appendix 6.5-B of the Permit guide the statistical approach in determining vegetation success for total ground cover, perennial vegetation cover, annual forage production, and shrub density. The statistical analyses applied to the O-VMU-2 vegetation data are presented in Appendix C, including equations for vegetation data analysis, vegetation attribute data with descriptive statistics, the statistical analyses comparing these attributes to the revegetation success standards, the statistical model, and descriptive statistics and normality for the vegetation attributes.

Descriptive statistics and statistical adequacy are presented for total ground cover, perennial vegetation cover, annual forage production, and shrub density in Tables 3 and C-2. Vegetation attribute data (Table C-2) was evaluated with the Shapiro-Wilk test to determine if data are normally distributed (Exhibits C-1 to C-4). For normally distributed data, statistical adequacy was assessed (Snedecor and Cochran 1967). Hypothesis testing for normal data that met sample adequacy was conducted using a one-sample, one-sided t-test under the classical null hypothesis. A one-sample, one-sided t-test using the reverse null hypothesis was applied for normally distributed data, which failed to meet statistical adequacy. A non-parametric one-sample, one-sided sign test using the reverse null hypothesis was applied to data that was not normally distributed and did not meet sample adequacy. While transformed data was not used in hypothesis testing for satisfying standards, as supplemental analyses, non-normal data were log-transformed. If the transformed data resulted in a normal distribution, a one-sample, one-sided t-test was used in accordance with the procedures described in Section 2.6.2. If a transformation is applied, the technical standard is also logarithmically transformed in congruence with the guidelines (MMD 1999, Appendix C, Section 6). This is done to be consistent with algebraic procedures where log(0.9x)=log(x)+log(0.9) and not 0.9*log(x). If transformed data were also non-normal, data were analyzed using the non-parametric one-sample, one-sided sign test using the reverse null hypothesis on the non-transformed data.

The following presents the statistical approach in more detail. Descriptive statistics and statistical tests were performed using both Microsoft® Excel and R-Studio (version 4.2.2).

2.6.1 Normality and Statistical Adequacy

The normality of each dataset was first assessed using the Shapiro-Wilk test to determine the appropriate hypothesis test method (i.e., parametric versus non-parametric). The Shapiro-Wilk null hypothesis is that the samples (of size n) come from a normal distribution. Data were considered normal when the test statistic had a p-value > 0.10 for alpha (α) = 0.10. If the data failed hypothesis testing and was not normal, a log transformation was performed, and if the transformation resulted in a normal distribution, the appropriate hypothesis test was chosen depending on sample adequacy (N_{min}) as outlined in Figure 6.5-1 of the Permit (2016).

The number of samples required to characterize a particular vegetation attribute depends on the uniformity of the vegetation and the desired degree of certainty required for the analysis. The number of samples necessary to meet N_{min} was calculated assuming the data were normally distributed using the Snedecor and Cochran (1967) equation below.

$$N_{min} = \frac{t^2 s^2}{(\overline{x}D)^2}$$

Where N_{min} equals the minimum number of samples required, t is the two-tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom, s is the standard deviation of the sample data, $\overline{x}$ is the mean, and D is the desired level of accuracy, which is 10 percent of the mean in this case.

In addition to N_{min}, the standard deviation and the 90% confidence interval (CI) about the sample means are reported in Table 3.

It is often impractical to achieve sample adequacy in vegetation monitoring studies based on Snedecor and Cochran's equation listed above. In such cases, the Permit allows a maximum sample number approach to compare the data regardless of the distribution (WDEQ 2012, MMD 1999). Where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples are considered adequate as stated in the

Permit. The 40-sample maximum is based on an estimate of the number of samples needed for a t-test under a normal distribution (Sokal and Rohlf 1981). Schulz et al. (1961) demonstrated that 30 to 40 samples provide a robust estimate for most cover and density measures, with increased numbers of samples only slightly improving the precision of the estimate.

The maximum 40 samples were collected at the outset of sampling based on the guidance discussed above. Each transect is considered a unique sampling unit. Sample adequacy was calculated to determine the number of samples that would have been required for adequacy by the Snedecor and Cochran equation. Further analysis for sample adequacy of cover, production, and density attributes was also demonstrated using a graphical stabilization of the mean method (Clark 2001) when sample adequacy was not met.

2.6.2 Hypothesis Testing

The emphasis on statistical adequacy assumes that parametric tests of normally distributed data will be conducted to demonstrate compliance with the vegetation success standards. Thus, if statistical adequacy is met for normally distributed data, the data would be analyzed with a one-sample, one-sided t-test using the classical null hypothesis. Non-parametric hypothesis tests have sufficient power to analyze data that are not normally distributed. Thus, if data is not normal then it is permissible based on the Permit and technically appropriate to use the one-sample, one-sided sign test using the reverse null approach as encouraged by OSMRE.

Hypothesis testing used to demonstrate compliance with the vegetation success standards for total ground cover, perennial vegetation cover, annual forage production, and shrub density were structured as follows (in accordance with Appendix 6.5-B of the Permit):

Classical Null Hypothesis:

H_0: Reclaim ≥ 90% of the Performance Standard

H_a: Reclaim < 90% of the Performance Standard

Where H_0 is the null hypothesis, and H_a is the alternative hypothesis.

The one-sample, one-sided t-test using the classical null hypothesis decision rules based on the test statistic are:

If $t^* \geq t_{(\alpha;\, n-1)}$, conclude that the performance standard was met.

If $t^* < t_{(\alpha;\, n-1)}$, conclude failure to meet the performance standard.

Test Statistic:

$$t^* = \frac{\bar{x} \; - 0.9\,(technical\ std)}{{}^{s}\!/\!\sqrt{n}}$$

Where t* is the calculated t-statistic, $\bar{x}$ is the sample mean, s is the standard deviation, n is the sample size, and α = 0.10. If this test is applied to the log transformed data, the log of the standard is added to the log of 0.9 rather than multiplying it.

Reverse Null Hypothesis:

H_0: Reclaim ≤ 90% of the Performance Standard

H_a: Reclaim > 90% of the Performance Standard

One-sample, one-sided sign test using the reverse null hypothesis decision rules are:

If P < 0.10 or $z < z_\alpha$ (for $\alpha = 0.10$, $z_\alpha = -1.282$), conclude that the performance standard was met (i.e., H_0 is rejected, the revegetation values tend to be statistically greater than 90% of the technical standard).

If P ≥ 0.10 or $z \geq z_\alpha$ ($\alpha = 0.10$, $z_\alpha = -1.282$), conclude failure to meet the performance standard (i.e., H_0 is NOT rejected, the revegetation values tend to be statistically less than or equal to 90% of the technical standard).

The z critical values of the normal distribution can be found in WDEQ, Table 1 (2012)

Sign Test Statistic:

$$\mathrm{z} = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$$

Where z is the sign test statistic (Daniel 1990), k is the test statistic resulting from the number of measurements that were less than 90% of the technical standard, and n is the sample size.

All hypothesis tests were performed with a 90% level of confidence. Hypothesis testing was not conducted for parameters where the mean or median did not exceed the minimum permit requirements. P-values, when reported, were calculated using R’s t distribution probability function with the appropriate t* and degrees of freedom. This function allows for calculating precise p-values given the relevant parameters of a distribution, without the need for a table (R Core Team 2023).

3.0 RESULTS

The vegetation in O-VMU-4 is well established and dominated by perennial plants and the vegetation community statistically met all vegetation success standards in 2024 as it did in 2023. Table 3 summarizes the results for total ground cover, perennial vegetation cover, annual forage production and woody plant density (shrub density) along with their corresponding technical standard.

Field data for LPI foliar cover, quadrat canopy cover, annual forage production, and shrub density by the belt transect are included in Appendix A (Tables A-1 through A-6). Photographs of the individual production quadrats are included in Appendix B and a representative photograph of the vegetation and topography is shown in Figure 5.

Table 4 summarizes the attributes for plants recorded in the LPI transects and production quadrats and Table A-6 summarizes all species observed within belt and quadrat surveys as well as those recorded opportunistically between transect locations during monitoring. Recruitment of additional native plant species is indicative of ecological succession and the capacity of the site to support a self-sustaining ecosystem.

Field data results and statistics for each vegetation parameter are discussed in the sections that follow.

3.1 Total Ground Cover

Total ground cover exceeded the revegetation success standard and met the required statistical demonstration. Total ground cover based on first hit LPI data in O VMU-4 in 2024 had a mean of 53.25 ± 2.7% (90% confidence interval [CI]) and a median of 53% (Table 3), exceeding the revegetation success standard. Total ground cover was not normally distributed on its own, nor with a logarithmic transformation (Exhibit C-1). Sample adequacy was 11 samples, which is less than the 40 samples taken indicating sample adequacy is met.

Given the attributes of the data, total ground cover was analyzed with a one-sided t- test under the classical null hypothesis. The resulting t*-statistic for total ground cover was 3.93, with a sample mean of 53.25%, a standard deviation of 10.4%, measured against a one-tail t (0.1, 39) value of -1.304. So, under the classical null hypothesis ($t^* \geq t(\alpha; n-1)$) and a p-value of 1, we conclude that the performance standard of 24% perennial vegetation cover was met (Exhibit C-1).

3.2 Perennial Vegetation Cover

Perennial vegetation cover, based on first hit LPI data, was calculated by summing the perennial and biennial species vegetation cover of the sampling unit excluding annuals and noxious weeds. The average perennial cover was 37.7 ± 2.4% and the median cover was 38% (Table 3), exceeding the revegetation success standard. Sample adequacy was met with 17 samples.

Perennial vegetation cover data were normally distributed and met sample adequacy (Exhibit C-2), data were statistically analyzed using a one-sample, one-sided t-test using the classical null hypothesis. The resulting t*-statistic for perennial vegetation cover was 11.10, with a sample mean of 37.7%, a standard deviation of 9.14%, measured against a one-tail t (0.1, 39) value of -1.304. So, under the classical null hypothesis ($t^* \geq t(\alpha; n-1)$) and a p-value of 1, we conclude that the performance standard of 24% perennial vegetation cover was met (Exhibit C-2).

3.3 Production

Forage production exceeded the revegetation success standard and met the required statistical demonstration. Annual forage production in O-VMU-4 in 2024 was 791 ± 96 lbs/ac (median of 755 lbs/ac, standard deviation was 369.3) (Table 3). The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for annual forage production was 62 samples (Table 3).

Annual forage production data for O-VMU-4 were not normally distributed (Figure C-3), though the log-transformed values were (Exhibit C-3). Given that N_{min} was larger than the number of samples taken, the use of the reverse null hypothesis is warranted as discussed in Section 2.6.2. T Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using the graphical stabilization of the mean (Clark 2001). Figure 6 illustrates the stabilization of the mean and 90% CI for production that begins to stabilize at 35 samples. This analysis suggests that 40 samples were more than adequate, and that the collection of additional data would not improve the precision of the estimate of annual forage production.

Annual production data were normally distributed with a log transformation but did not meet sample adequacy, thus, data were statistically analyzed using a one-sample, one-sided t-test using the reverse null hypothesis. The resulting t*-statistic for annual production was 4.31, with a sample mean of 2.85, a standard deviation of 0.22, measured against a one-tail t (0.9, 39) value of 1.304. So, under the reverse null hypothesis ($t^* \geq t(1-\alpha; n-1)$) and a p-value less than 0.001, we conclude that the performance standard of 550 lbs/ac production was met (Exhibit C-3).

3.4 Shrub Density

Shrub density exceeded the revegetation success standard and met the required statistical demonstration. In 2024 shrub density in O-VMU-4 substantially exceeded the vegetation success standard of 400 stems/ac from belt transect data with an average of 2,479 ± 456 stems/ac and a median of 2,206 stems/ac (Table 3). The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for shrub density was 76 samples (Table 3).

The shrub density data for O-VMU-4 were not normally distributed but was with a logarithmic transformation. (Exhibit C-4). Given that Nmin was larger than the number of samples taken, this underscores the use of the reverse null hypothesis having to significantly exceed the standard rather than meet or exceed it as outlined in MMD 1999. Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using the graphical stabilization of the mean (Clark 2001). Figure 7 illustrates the stabilization of the mean and 90% CI for shrub density that begins to stabilize at 28 samples. This analysis suggests that 40 samples were more than adequate, and that the collection of additional data would not improve the precision of the estimate of shrub density.

The shrub density log transformed data were normally distributed but did not meet sample adequacy, data were statistically analyzed using a one-sample, one-sided t-test using the reverse null hypothesis. The resulting t*-statistic for woody plant density was 16.70, with a sample mean of 3.30, a standard deviation of 0.28, measured against a one-tail t (0.9, 39) value of 1.304. So, under the reverse null hypothesis ($t^* \geq t\ (1\text{-}\alpha;\ n\text{-}1)$) and a p-value less than 0.001, we conclude that the performance standard of 400 stems/ac production was met (Exhibit C-4).

3.5 Composition and Diversity

In 2024, the standards were met for all the individual diversity standards in O-VMU-4 (Table 6). The revegetation diversity standards are based on a “lifeform statement” for grasses, forbs, and shrubs (Table 1) that consists of 12 individual parameters. The results for composition and diversity are discussed below by parameter. The results for composition and diversity are discussed below by parameter. Relative cover values of perennial and biennial species are calculated from all LPI data (first hit and understory: Table A-2). Relative perennial vegetation cover of individual species is listed in Table 4.

Grasses dominated the perennial vegetation cover with thickspike wheatgrass (*Elymus lanceolatus*) representing the highest cover (Table 4). Cool-season grasses dominated the vegetation reflecting the past seed mixes, season of seeding, and the site’s continued ability to support a diverse group of cool-season grasses. Western wheatgrass (*Pascopyrum smithii*), and Indian ricegrass (*Achnatherum hymenoides*) had the highest cover of the cool-season grasses, along with the dominant thickspike wheatgrass. Warm-season grasses were well represented with James’ galleta (*Pleuraphis jamesii*) and blue grama (*Bouteloua gracilis*) having high cover. Shrubs are important components of the reclamation due to their persistence and tolerance to harsh conditions. The woody plant component is dominated primarily by fourwing saltbush (*Atriplex canescens*), with rubber rabbitbrush (*Ericameria nauseosa*) and winterfat (*Krascheninnikovia lanata*) subdominant. Perennial forb species occurred on the LPI transects, though they are minor contributors to vegetation cover, cover with alfalfa (*Medicago sativa*) contributing the highest cover.

The perennial grass diversity standard requires a total absolute vegetation cover of at least 7%, which was achieved in 2024 with 27.7%. The diversity standard for cool-season perennial grasses was achieved with ten total species, and two species that represent at least 5 and 2.5% relative perennial vegetation cover (thickspike wheatgrass [18.2%] and western wheatgrass [14.8%]). The diversity standard for warm-season grasses is achieved with six total species, one species representing at least 5% (James' galleta [14.3%]) and all remaining species representing over 1.5% relative perennial vegetation cover at 4.7%.

The perennial forb diversity standard requires at least three perennial/biennial forbs (not including noxious weeds) combining to at least 1% relative perennial vegetation cover (calculated based on the percent foliar cover of perennial species excluding annuals and noxious weeds). This standard was achieved in 2023 with 11 species totaling 4.7% relative perennial vegetation cover with the greatest contributions from alfalfa (2.1%), hoary tansyaster (0.4%, *Machaeranthera canescens*), and sweetclover (0.8%, *Melilotus officinalis*).

The diversity standard for shrubs requires the relative perennial vegetation cover for all shrub species to total at least 6% with no single shrub exceeding or equal to 70% relative shrub density. Both standards were achieved with 28.1% relative perennial vegetation cover of all shrubs (Table 6) and 37.0% relative shrub density of fourwing saltbush – the most dominant shrub (Table 5).

Lastly, the diversity standards require that no single species of any functional group represent greater than 40% relative total vegetative cover. Relative total vegetative here is defined as the percent foliar cover of any recorded species divided by the total foliar cover for all live vegetation of the sampling unit, including annuals and noxious weeds. Thickspike wheatgrass represented the highest relative total vegetation cover at 17.6%, thus the reclamation achieved the single species diversity standard.

From 2021 through 2024, 125 plant species have been observed within reclaimed areas in O-VMU-4 including 24 grasses, 70 forbs, and 31 shrubs, trees, and cacti (Table A-7). Of the 24 grasses, 14 are cool-season perennials, two are cool-season annuals, six are warm-season perennials and two are warm-season annuals. Of the 66 forbs, 20 are annuals and the remaining 50 are perennials and/or biennials. Cacti (one species), succulents (one species), and trees (four species) were rare on the reclamation but provide diverse habitat or browse for wildlife. Shrubs and subshrubs were the most common woody plants observed (25 species). The recruitment of native plants and establishment of seeded species within is indicative of ecological succession and the capacity of the site to support a diverse and self-sustaining ecosystem.

3.6 Noxious Weeds

During the 2024 monitoring program, Class C noxious weeds (NMDA 2020) were rarely encountered in O-VMU-4. Class C noxious weeds are generally widespread in the state and managed at the local level based on feasibility of control and level of infestation. Cheatgrass was encountered infrequently in LPI surveys and production quadrats. Noxious weeds are not used in the assessment of revegetation success but are included in the single species cover standard (Table 1). Noxious trees and shrubs observed on O-VMU-4 in past years include Siberian elm (*Ulmus pumila*) and Russian olive (*Elaeagnus angustifolia*) but their presence in the reclaimed vegetation community is insignificant with densities much lower than native rangeland beyond the permit boundary. CMI continues to monitor for noxious weeds and actively controls them through husbandry practices that include annual services for weed management. Further, competition from desirable seeded and native species is expected to inhibit any substantial increase of noxious weeds in the reclamation.

4.0 SUMMARY

McKinley Mine's vegetation success standards for the post-mining land uses of grazing and wildlife are based on total ground cover, perennial vegetation cover, annual forage production, shrub density, and diversity. The technical standards (Table 1) were developed through negotiations with OSMRE based on the analysis of historical vegetation data, interpretation of the ecological site potential, and the anticipated post-mining land uses.

The vegetation monitoring results for the past four years indicate that the vegetation community in O-VMU-4 has progressed and now meets the revegetation success standards despite persistent drought conditions over the past several years. This progression is evident as the shrub density and total ground cover standards have been met every year and the perennial vegetation cover standard in all but one year (Table 3). A summary of the findings from the past four years are:

1. Vegetation Cover: The total ground cover standard has been met for the past four years. Perennial vegetation cover has met the performance standard in the past three years but not met in 2021 following two years of below normal growing season precipitation.
2. Forage Production: Average annual forage production met standards in both 2023 and 2024.
3. Shrub Density: O-VMU-4 has exceeded the success parameters for shrub density in very year since 2021 when monitoring was initiated.
4. Diversity: All plant diversity standards were met in all years except for the second warm season grass species standard in 2021 (Tables 6 and 7).

The reclamation in O-VMU-4 has demonstrated the capability of meeting and sustaining the post-mining land use by fully meeting the vegetation performance standard over the past two years. Long-term vegetation performance in the reclamation is encouraging considering below-average precipitation in 2 of the past 4 years including the exceptional drought in 2020 and 2021. The performance of vegetation in O-VMU-4 under these conditions show that the reclaimed plant communities are resilient and capable of sustaining themselves under the adverse conditions that are characteristic of this region.

5.0 REFERENCES

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Tables

Table 1: Revegetation Success Standards in the McKinley Mine OSMRE Permit

Vegetative Parameter	Components		Success Standards	
			2019-2022	
Cover	Total Ground Cover		≥ 52%	≥ 52%
	Perennial Vegetation Cover		≥ 24%	≥ 24%
Diversity "Lifeform Statement"	Perennial Grasses	All Grasses	≥ 7% absolute cover	≥ 7% absolute cover
		Cool-Season	≥ 2 species, each ≥ 1.5% cover	≥ 2 species, 1st species ≥ 5% relative perennial cover, 2nd species ≥ 2.5% relative perennial cove
		Warm-Season	≥ 2% contribution, ≥ 2 species, each ≥ 0.5% cover	≥ 2 species, 1st species ≥ 5% relative perennial cover, all other species combined≥ 1.5% relative perennial cove
	Perennial Forbs		≥ 3 species, combining for ≥ 1% relative	≥ 3 species, combining for ≥ 1% relative perennial cove
	Shrubs	All Shrubs	≥ 3% absolute cover	≥ 6% relative total perennial cove
		Any Single Species	≤ 70% relative total shrub cover	≤ 70% relative total shrub density
	Any Single Species (including weeds)		≤ 40% relative total vegetative cover	≤ 40% relative total vegetative cover
Production	Pounds/acre (air dry)		≥ 550 lbs/ac	≥ 550 lbs/ac
Woody Plant Density	Stems/acre		≥ 400/acre	≥ 400/acre

Notes:
Success for cover, production, and stocking shall be ≥ 90% of the standard in accordance with 30 CFR 816.116 (a)(2).
Total ground cover does not include noxious weeds.
Perennial vegetation cover is foliar cover from LPI, not including annuals and noxious weeds.
Relative cover is the percent cover of a species or functional group divided by the total vegetation cover including annuals and noxious weeds.
Relative perennial cover is the total cover of a perennial species or perennial functional group divided by the total perennial cover (see below).
Total perennial cover includes shrubs, cactus, trees, perennial grasses and perennial forbs not including noxious species.
Relative total shrub density is the density of each woody species divided by the total woody plant density not including noxious weeds.
Production includes above-ground biomass of forage species only.

Table 2: North Mine Seasonal and Annual Precipitation, 2015-2024

Year	Station	Area	Precipitation (inches)													
			January	February	March	April	May	June	July	August	September	October	November	December	Annual Total	Growing Season Total
2015	Rain Bluff	North Shop	1.39	1.21	0.11	0.35	1.54	1.15	2.81	1.91	0.51	1.18	1.16	0.74	14.06	8.27
	Rain 2	2	NA	NA	NA	0.52	1.51	1.98	3.17	1.39	0.50	1.08	0.92	NA	NA	9.07
	Rain 3	3	NA	NA	NA	0.57	1.80	1.77	3.61	3.06	0.44	1.36	0.86	NA	NA	11.25
	Rain 6	6	NA	NA	NA	0.54	0.71	2.12	2.66	2.12	0.00	0.92	0.70	NA	NA	8.15
	Rain 10	10	NA	NA	NA	0.42	1.32	1.11	2.59	1.39	0.30	1.10	0.78	NA	NA	7.13
	Rain 12	12	NA	NA	NA	0.49	1.59	1.39	2.88	2.14	0.47	1.17	1.29	NA	NA	8.96
	Rain 15	15	NA	NA	NA	0.46	1.90	1.62	3.17	2.88	0.32	0.94	0.69	NA	NA	10.35
2016	Rain Bluff	North Shop	0.39	0.25	0.03	1.28	0.70	0.19	1.15	1.85	1.79	0.69	1.18	1.98	11.48	6.96
	Rain 2	2	NA	NA	NA	0.17	0.58	0.14	2.22	0.71	0.87	0.21	0.02	NA	NA	4.69
	Rain 3	3	NA	NA	NA	0.20	0.72	0.45	1.62	0.11	0.50	0.33	0.02	NA	NA	3.60
	Rain 6	6	NA	NA	NA	0.20	0.75	0.29	2.00	0.40	1.19	0.19	0.02	NA	NA	4.83
	Rain 10	10	NA	NA	NA	0.13	0.55	0.20	2.75	0.38	0.99	0.14	0.02	NA	NA	5.00
	Rain 12	12	NA	NA	NA	0.30	0.78	0.36	1.34	0.49	1.16	0.18	0.05	NA	NA	4.43
	Rain 15	15	NA	NA	NA	0.31	0.85	0.04	1.95	0.35	1.31	0.18	0.05	NA	NA	4.81
2017	Rain Bluff	North Shop	0.81	0.04	0.70	0.32	0.41	0.16	3.71	0.37	0.62	0.54	0.05	0.02	7.75	5.59
	Rain 2	2	NA	NA	NA	1.28	0.66	0.22	0.78	2.08	1.46	0.63	0.44	NA	NA	6.48
	Rain 3	3	NA	NA	NA	1.04	1.16	0.06	0.99	2.71	1.63	0.56	0.44	NA	NA	7.59
	Rain 6	6	NA	NA	NA	0.86	1.50	0.02	0.96	2.04	1.52	0.38	0.51	NA	NA	6.90
	Rain 10	10	NA	NA	NA	1.00	0.67	0.08	0.94	1.63	1.36	0.34	0.81	NA	NA	5.68
	Rain 12	12	NA	NA	NA	1.17	0.91	0.05	0.88	1.89	1.77	0.47	0.46	NA	NA	6.67
	Rain 15	15	NA	NA	NA	1.15	1.36	0.02	0.68	1.91	1.56	0.40	0.41	NA	NA	6.68
2018	Rain Bluff	North Shop	0.23	0.48	0.44	0.08	0.22	0.28	2.17	0.00	1.00	1.51	0.14	0.43	6.98	3.75
	Rain 2	2	NA	NA	NA	0.06	0.26	0.30	1.10	0.90	1.40	1.48	0.00	NA	NA	4.02
	Rain 3	3	NA	NA	NA	0.04	0.30	0.35	0.92	0.91	1.27	1.69	0.00	NA	NA	3.79
	Rain 6	6	NA	NA	NA	0.03	0.21	0.46	0.97	0.56	1.02	1.45	0.00	NA	NA	3.25
	Rain 10	10	NA	NA	NA	0.08	0.20	0.27	3.05	1.15	0.92	1.51	0.00	NA	NA	5.67
	Rain 12	12	NA	NA	NA	0.06	0.37	0.26	1.08	1.36	1.09	1.54	0.00	NA	NA	4.22
	Rain 15	15	NA	NA	NA	0.05	0.32	0.28	1.16	0.63	1.31	1.31	0.00	NA	NA	3.75
2019	Rain Bluff	North Shop	0.95	0.98	1.10	0.24	0.17	0.03	0.03	1.14	0.10	0.04	1.15	0.97	6.90	1.71
	Rain 2	2	NA	NA	NA	0.22	1.41	0.15	0.35	0.73	1.35	0.04	0.05	NA	NA	4.21
	Rain 3	3	NA	NA	NA	0.39	1.50	0.32	0.70	0.11	1.72	0.06	0.06	NA	NA	4.74
	Rain 6	6	NA	NA	NA	0.36	1.20	0.00	0.01	0.34	1.82	0.04	0.03	NA	NA	3.73
	Rain 10	10	NA	NA	NA	0.20	1.49	0.37	0.19	0.27	1.34	0.03	0.05	NA	NA	3.86
	Rain 12	12	NA	NA	NA	0.20	1.59	0.28	0.35	0.14	1.38	0.07	0.04	NA	NA	3.94
	Rain 15	15	NA	NA	NA	0.22	1.17	0.14	0.78	0.15	1.60	0.05	0.05	NA	NA	4.06
2020	Rain Bluff	North Shop	1.00	1.35	1.15	0.26	0.02	0.14	0.89	0.26	0.21	0.33	0.28	0.32	6.21	1.78
	Rain 2	2	NA	NA	NA	0.26	0.09	0.05	1.65	0.20	0.17	0.31	0.16	NA	NA	2.42
	Rain 3	3	NA	NA	NA	0.00	0.01	0.05	1.06	0.62	0.16	0.27	0.19	NA	NA	1.90
	Rain 6	6	NA	NA	NA	0.05	0.02	0.02	0.82	0.55	0.14	0.08	0.16	NA	NA	1.60
	Rain 10	10	NA	NA	NA	0.11	0.02	0.13	0.79	0.14	0.14	0.16	0.09	NA	NA	1.33
	Rain 12	12	NA	NA	NA	0.25	0.08	0.06	0.97	0.47	0.35	0.29	0.28	NA	NA	2.18
	Rain 15	15	NA	NA	NA	0.32	0.01	0.05	0.65	0.87	0.28	0.09	0.44	NA	NA	2.18
2021	Rain Bluff	North Shop	1.13	0.21	0.46	0.04	0.04	0.20	2.17	1.31	1.13	0.86	0.20	0.92	8.67	4.89
	Rain 2	2	NA	NA	NA	0.00	0.03	0.16	0.99	1.09	1.04	0.93	0.00	NA	NA	3.31
	Rain 3	3	NA	NA	NA	0.03	0.09	0.05	0.69	1.04	1.64	1.16	0.00	NA	NA	3.54
	Rain 6	6	NA	NA	NA	0.02	0.06	0.03	0.83	0.19	0.47	1.05	0.00	NA	NA	1.60
	Rain 10	10	NA	NA	NA	0.01	0.06	0.24	2.48	1.80	0.96	0.80	0.00	NA	NA	5.55
	Rain 12	12	NA	NA	NA	0.00	0.08	0.22	1.58	2.08	1.24	1.01	0.00	NA	NA	5.20
	Rain 15	15	NA	NA	NA	0.00	0.07	0.05	1.04	2.58	1.47	1.00	0.00	NA	NA	5.21
2022	Rain Bluff	North Shop	--	--	0.59	0.03	0.00	1.24	3.13	4.66	1.27	1.40	0.48	0.58	13.38	10.33
	Rain 2	2	NA	NA	NA	0.00	0.00	1.03	3.00	3.77	1.22	1.14	0.39	NA	NA	9.02
	Rain 3	3	NA	NA	NA	0.00	0.00	1.03	2.99	3.07	1.18	1.19	0.54	NA	NA	8.27
	Rain 6	6	NA	NA	NA	0.01	0.00	0.66	2.55	3.05	0.69	0.28	0.47	NA	NA	6.96
	Rain 10	10	NA	NA	NA	0.00	0.00	0.69	3.57	4.27	1.02	1.83	0.33	NA	NA	9.55
	Rain 12	12	NA	NA	NA	0.00	0.00	0.91	3.76	4.07	1.08	1.57	0.52	NA	NA	9.82
	Rain 15	15	NA	NA	NA	0.00	0.01	0.91	4.06	3.84	1.12	1.68	0.50	NA	NA	9.94
2023	Rain Bluff	North Shop	1.21	0.50	1.64	0.05	0.55	0.13	0.03	3.16	0.33	0.57	0.42	--	8.59	4.25
	Rain 2	2	NA	NA	NA	0.00	0.48	0.09	0.08	3.08	0.44	0.09	0.09	NA	4.35	4.17
	Rain 3	3	NA	NA	NA	0.01	0.84	0.22	0.26	2.93	0.54	0.08	0.08	NA	4.96	4.80
	Rain 6	6	NA	NA	NA	0.00	1.49	0.22	0.07	1.97	0.49	0.05	0.00	NA	4.29	4.24
	Rain 10	10	NA	NA	NA	0.03	0.53	0.13	0.06	2.61	0.51	0.03	0.00	NA	3.90	3.87
	Rain 12	12	NA	NA	NA	0.00	0.74	0.21	0.10	2.47	0.41	0.05	0.00	NA	3.98	3.93
	Rain 15	15	NA	NA	NA	0.00	0.79	0.21	0.43	2.67	0.56	0.05	0.00	NA	4.71	4.66
2024	Rain Bluff	North Shop	1.06	0.58	2.22	0.45	0.03	2.27	1.17	2.33	0.32	1.18	0.36	0.00	11.97	6.57
	Rain 2	2	NA	NA	NA	0.21	0.01	2.36	0.65	2.31	0.60	1.32	0.13	NA	NA	6.14
	Rain 3	3	NA	NA	NA	0.28	0.01	2.23	0.87	2.64	0.48	1.55	0.15	NA	NA	6.51
	Rain 6	6	NA	NA	NA	0.22	0.06	2.33	1.22	2.33	0.45	1.35	0.08	NA	NA	6.61
	Rain 10	10	NA	NA	NA	0.16	0.05	2.65	0.38	1.92	0.37	0.98	0.12	NA	NA	5.53
	Rain 12	12	NA	NA	NA	0.15	0.10	2.58	0.54	2.58	0.87	1.24	0.20	NA	NA	6.82
	Rain 15	15	NA	NA	NA	0.18	0.05	3.36	0.48	2.41	0.72	1.21	0.29	NA	NA	7.20
Window Rock, Long Term normals			0.72	0.68	0.88	0.61	0.49	0.47	1.75	2.05	1.23	1.14	0.83	0.95	11.80	6.60

Notes:

Long-term averages are from Window Rock, Arizona Station (029410), 1937 to 1999 (Western Regional Climate Center, 2020).

Growing season total precipitation is between April and September

NA=rain gauges taken offline due to freezing conditions, data unavailable.

-- Rain gauge malfunction

In 2017 Rain Bluff experienced power issues in the summer that may have resulted in inaccurate precipitation readings.

data incomplete

Table 3: Summary Statistics, O-VMU-4, 2021-2024

	2021	2022	2023	2024	Technical Standard
Total Ground Cover (%)[1]					
Mean	51.5	46.2	59.6	53.3	≥ 52%
Standard Deviatior	13.3	10.9	13.3	10.4	
90% Confidence Interva	3.5	2.8	3.4	2.7	
Median	52	46	61	53	
Nmin[2]	19	16	14	11	
Live Vegetation Cover (%)[3]					
Mean	16.4	30.5	44.0	38.5	None
Standard Deviatior	7.6	10.3	11.9	9.3	
90% Confidence Interva	2	2.7	3.1	2.4	
Nmin[2]	62	33	21	17	
Perennial Vegetation Cover (%)[4]					
Mean	15.7	25.8	41.6	37.7	≥ 24%
Standard Deviatior	7.8	9	12.7	9.1	
90% Confidence Interva	2	2.3	3.3	2.4	
Median	14	26	42	38	
Nmin[2]	70	35	26	17	
Annual Forage Production (lbs/ac)[5]					
Mean	209	419	750	791	≥ 550 lbs/ac
Standard Deviatior	240	455	446	369	
90% Confidence Interva	63	118	116	96	
Median	130	241	632	755	
Nmin[2]	376	334	101	62	
Woody Plant Density (stems/acre) from Belt Transect					
Mean	2,578	2,206	2,566	2,479	≥ 400/ac
Standard Deviatior	2,512	2,238	2,397	1,755	
90% Confidence Interva	653	582	623	456	
Median	1,639	1,639	1,740	2,206	
Nmin[2]	270	292	248	76	

Notes:

[1] Mean foliar cover of live vegetation and litter

[2] Minimum number of samples to obtain 90% probability that the sample mean is within 10% of the population mean

[3] Mean vegetation foliar cover not including noxious weeds

[4] Mean foliar cover not including annuals and noxious weeds

[5] Annual forage production in air dry pounds per acre (lbs/ac) not including annuals or noxious weeds

Hypothesis testing found the success standard was not met

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU-4, 2023

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)				Mean Annual Production (lbs/ac)
			First Hit Foliar[1]	Understory [2]	Relative Perennial	Relative Total	
Cool-Season Grasses (11)							
Annuals (1)							
Bromus tectorum	Cheatgrass	BRTE	0.15	0.25	NA	0.9	--
Perennials (10)							
Achnatherum hymenoides	Indian ricegrass	ACHY	1.95	0.10	5.0	4.8	33.8
Agropyron cristatum	Crested wheatgrass	AGCR	0.05	--	0.1	0.1	--
Elymus elymoides	Bottlebrush squirreltail	ELEL5	0.40	0.40	1.9	1.9	12.7
Elymus lanceolatus	Thickspike wheatgrass	ELLA3	6.40	1.10	18.2	17.6	160.9
Elymus trachycaulus	Slender wheatgrass	ELTR7	0.80	--	1.9	1.9	25.3
Hesperostipa comata	Needle and thread	HECO26	1.50	0.10	3.9	3.8	20.1
Pascopyrum smithii	Western wheatgrass	PASM	5.20	0.90	14.8	14.3	160.1
Psathyrostachys juncea	Russian wildrye	PSJU3	0.25	--	0.6	0.6	3.7
Pseudoroegneria spicata	Bluebunch wheatgrass	PSSP6	0.55	0.05	1.5	1.4	7.9
Thinopyrum intermedium	Intermediate wheatgrass	THIN6	0.10	--	0.2	0.2	0.5
Warm-Season Grasses (8)							
Annuals (1)							
Bouteloua simplex	Matted grama	BOSI2	0.05	--	NA	0.1	--
Perennials (7)							
Bouteloua curtipendula	Sideoats grama	BOCU	0.10	0.05	0.4	0.4	1.2
Bouteloua dactyloides	Buffalograss	BODA2	--	--	--	--	0.7
Bouteloua gracilis	Blue grama	BOGR2	1.00	0.05	2.5	2.5	17.5
Heteropogon contortus	Tanglehead	HECO10	0.20	--	0.5	0.5	3.5
Pleuraphis jamesii	James' galleta	PLJA	5.60	0.30	14.3	13.9	82.6
Sporobolus airoides	Alkali sacaton	SPAI	0.50	--	1.2	1.2	--
Sporobolus cryptandrus	Sand dropseed	SPCR	0.05	--	0.1	0.1	1.0
Forbs (23)							
Annuals (4)							
Bassia scoparia	Burningbush	BASC5	0.05	--	NA	0.1	--
Portulaca oleracea	Little hogweed	POOL	0.05	--	NA	0.1	--
Salsola tragus	Prickly Russian thistle	SATR12	0.50	--	NA	1.2	--
Xanthium strumarium	Rough cocklebur	XAST	0.10	--	NA	0.2	--
Perennials/Biennials (19)							
Achillea millefolium	Common yarrow	ACMI2	--	0.05	0.1	0.1	0.1
Artemisia franserioides	Ragweed sagebrush	ARFR3	0.05	0.05	0.2	0.2	0.9
Bahia dissecta	Ragleaf bahia	BADI	--	--	--	--	0.8
Convolvulus arvensis	Field bindweed	COAR4	0.05	--	--	0.1	--
Descurainia pinnata	Western tansymustard	DEPI	--	--	--	--	0.1
Grindelia squarrosa	Curlycup gumweed	GRSQ	0.10	--	0.2	0.2	8.9
Heliomeris multiflora	Showy goldeneye	HEMU3	0.05	--	0.1	0.1	4.5
Lactuca serriola	Prickly lettuce	LASE	0.05	--	--	0.1	0.9
Linum lewisii	Lewis flax	LILE3	0.05	--	0.1	0.1	1.8
Machaeranthera canescens	Hoary tansyaster	MACA2	0.15	--	0.4	0.4	15.1
Medicago sativa	Alfalfa	MESA	0.80	0.10	2.2	2.1	19.7
Melilotus officinalis	Sweetclover	MEOF	0.25	0.10	0.8	0.8	15.7
Onobrychis viciifolia	Sainfoin	ONVI	--	--	--	--	0.2
Penstemon palmeri	Palmer's penstemon	PEPA8	--	--	--	--	2.8
Ratibida columnifera	Upright prairie coneflower	RACO3	--	0.05	0.1	0.1	0.0
Sphaeralcea coccinea	Scarlet globemallow	SPCO	0.05	--	0.1	0.1	5.3
Tragopogon dubius	Yellow salsify	TRDU	--	--	--	--	1.6
Tragopogon pratensis	Jack-go-to-bed-at-noon	TRPR	0.10	--	0.2	0.2	4.2
Unknown forb	Unknown Forb	UNKF	0.05	--	--	0.1	--
Shrubs, Trees, and Cacti (15)							
Artemisia frigida	Prairie sagewort	ARFR4	--	--	--	--	0.7
Artemisia ludoviciana	White sagebrush	ARLU	0.10	--	0.2	0.2	--
Artemisia nova	Black sagebrush	ARNO4	0.15	--	0.4	0.4	--
Artemisia tridentata	Big sagebrush	ARTR2	0.05	--	0.1	0.1	--
Atriplex canescens	Fourwing saltbush	ATCA2	5.75	0.05	14.1	13.6	72.0
Atriplex confertifolia	Shadscale saltbush	ATCO	0.40	--	1.0	0.9	15.1
Atriplex corrugata	Mat saltbush	ATCO4	0.05	--	0.1	0.1	2.2
Atriplex gardneri	Gardner's saltbush	ATGA	0.05	--	0.1	0.1	--
Ephedra viridis	Mormon tea	EPVI	0.05	--	0.1	0.1	--
Ericameria nauseosa	Rubber rabbitbrush	ERNA10	1.65	--	4.0	3.9	37.5
Gutierrezia sarothrae	Broom snakeweed	GUSA2	0.75	0.10	2.1	2.0	21.2
Krascheninnikovia lanata	Winterfat	KRLA2	1.05	--	2.5	2.5	19.8
Purshia mexicana	Mexican cliffrose	PUME	0.45	--	1.1	1.1	2.8
Purshia tridentata	Antelope bitterbrush	PUTR2	0.90	--	2.2	2.1	5.4
Senecio flaccidus	Threadleaf ragwort	SEFL3	0.05	--	0.1	0.1	--
Cover Components							
			53.5				
			38.8				
			37.9				
			3.1				
			14.8				
			43.5				

Notes:

[1] First hit foliar is calculated from first hits only

[2] Understory cover is calculated from second and lower hits

"--" = species captured in either LPI or quadrats but not both

NA = annuals not included in relative perennial cover calculations

Table 5: Relative Shrub, Tree, and Cacti Density, O-VMU-4, 2024

Scientific Name	Common Name	Code	Relative Density (%)
Artemisia frigida	Prairie sagewort	ARFR4	0.42
Artemisia ludoviciana	White sagebrush	ARLU	1.88
Artemisia nova	Black sagebrush	ARNO4	0.21
Artemisia tridentata	Big sagebrush	ARTR2	0.21
Atriplex canescens	Fourwing saltbush	ATCA2	37.00
Atriplex confertifolia	Shadscale saltbush	ATCO	7.91
Atriplex corrugata	Mat saltbush	ATCO4	1.21
Atriplex gardneri	Gardner's saltbush	ATGA	0.46
Chrysothamnus greenei	Greene's rabbitbrush	CHGR6	0.04
Ephedra trifurca	Longleaf jointfi	EPTR	0.08
Ephedra viridis	Mormon tea	EPVI	0.42
Ericameria nauseosa	Rubber rabbitbrush	ERNA10	10.51
Gutierrezia sarothrae	Broom snakeweed	GUSA2	10.84
Krascheninnikovia lanata	Winterfat	KRLA2	18.67
Purshia mexicana	Mexican cliffrose	PUME	4.44
Purshia tridentata	Antelope bitterbrush	PUTR2	4.27
Senecio flaccidus	Threadleaf ragwort	SEFL3	1.38
Ulmus pumila	Siberian elm	ULPU	0.04

Notes:

Relative density derived from belt method

Relative Density = (avg density per species per VMU ÷ avg total shrub density per VMU) * 100

Bolded species are newly observed on O-VMU-4 in 2023

Table 6: Results for Diversity, O-VMU-4, 2023-2024

Diversity Component	Metric[2]	Standard	2023		2024	
			Result	Species	Result	Species
Perennial Grasses	Absolute cover	≥ 7%	29.5	--	27.7%	--
Cool-season Grasses	# Species	≥	9	--	10	--
Grass 1	Relative perennial cover	≥ 5%	19.4	Thickspike wheatgrass	18.2%	Thickspike wheatgrass
Grass 2	Relative perennial cover	≥ 2.5%	13.0	Western wheatgrass	14.8%	Western wheatgrass
Warm-season Grasses	# Species	≥ 2	6	--	6	--
Grass 1	Relative perennial cover	≥ 5%	10.6	James' galleta	14.3%	James' galleta
All remaining species	Relative perennial cover	≥ 1.5%	2.7	--	4.7%	--
Perennial Forbs	# Species	≥3	12	--	11	--
	Relative perennial cover	≥ 1%	7.5	--	4.7%	--
Shrubs or Subshrubs	Relative perennial cover	≥ 6%	21.5	--	28.1%	--
Single Shrub Species	Relative shrub density	≤ 70%	27.7	Fourwing saltbush	37.0%	Fourwing saltbush
Any Single Species	Relative total cover	≤ 40%	18.2	Thickspike wheatgrass	17.6%	Thickspike wheatgrass

Table 7: Results for Diversity, O-VMU-4, 2021-2022

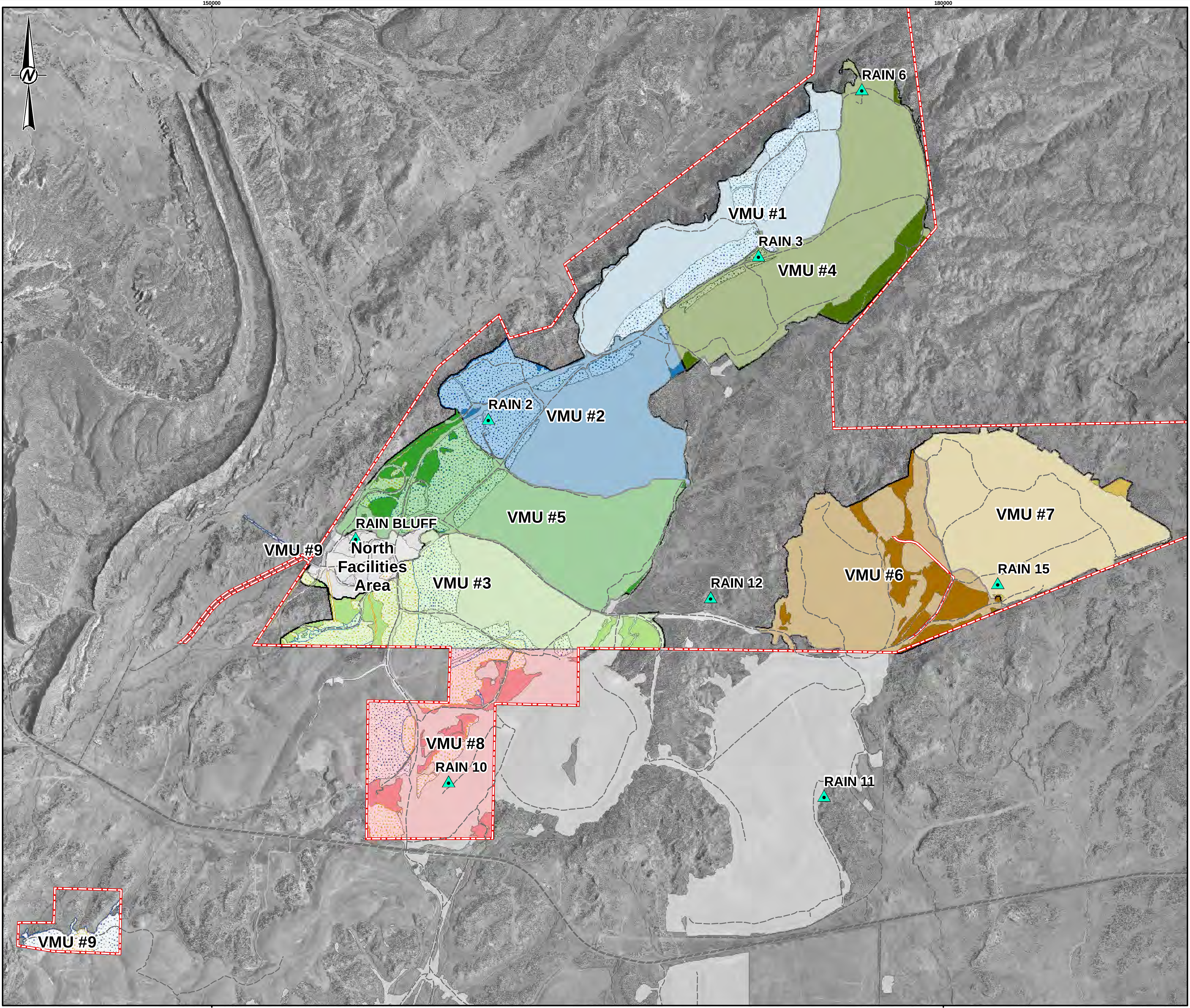
Diversity Component	Metric[2]	Standard	2021		2022	
			Result	Species	Result	Species
Perennial Grasses	Total absolute cover	≥ 7%	9.4%	--	16.6%	--
Cool-season Grasses	# Species[2]	≥	9	--	8	--
Grass 1	Absolute cover	≥ 1.5%	2.1%	Western wheatgrass	4.1%	Western wheatgrass
Grass 2	Absolute cover	≥ 1.5%	2.0%	Thickspike wheatgrass	3.2%	Thickspike wheatgrass
Warm-season Grasses	# Species	≥	3	--	5	--
	Total absolute cover[3]	≥ 2.0%	2.2%	--	4.4%	--
Grass 1	Absolute cover	≥ 0.5%	1.8%	James' galleta	3.1%	James' galleta
Grass 2	Absolute cover	≥ 0.5%	0.3%	Blue grama	0.8%	Blue grama
Perennial Forbs	# Species	≥	3	--	12	--
	Relative perennial cover	≥ 1%	2.9%	--	7.9%	--
Shrubs or Subshrubs	Total absolute cover	≥ 3%	5.8%	--	7.2%	--
Single Shrub Species	Relative shrub cover	≤ 70%	66.4%	Fourwing saltbush	56.3%	Fourwing saltbush
Any Single Species	Relative total cover	≤ 40%	23.5%	Fourwing saltbush	13.20%	Fourwing saltbush

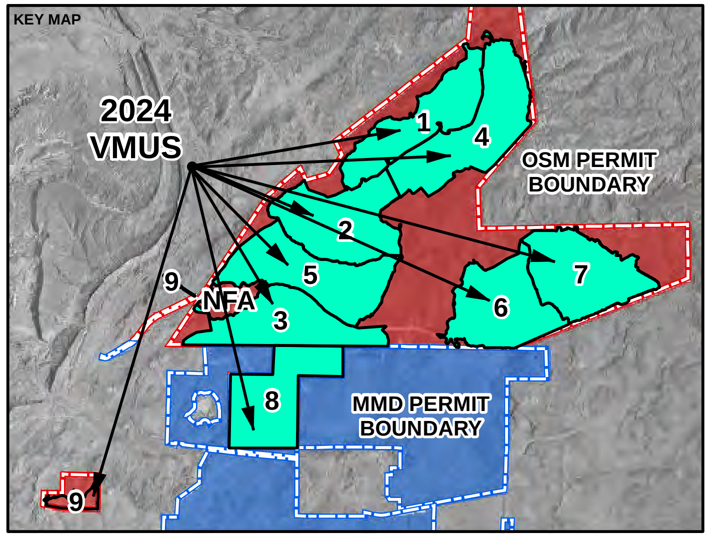
Notes:

Diversity calculated in accordance with Table 1 in either absolute or relative % cover

Success standard was not met

Figures





LEGEND

- ▲ Rain Gauges
- – – Mine Site Roads
- ▭ OSM Permit Boundary
- ▨ Prelaw (~ 387 acres)
- ▨ Initial Program (~ 1,248 acres)
- ⬜ Permanent Program (~ 11,327 acres)
- 🟦 OSM VMU 1 (~ 934 acres)
- 🟦 OSM VMU 2 (~ 1,085 acres)
- 🟩 OSM VMU 3 (~ 959 acres)
- 🟩 OSM VMU 4 (~ 1,242 acres)
- 🟩 OSM VMU 5 (~ 1,129 acres)
- 🟫 OSM VMU 6 (~ 1,024 acres)
- 🟨 OSM VMU 7 (~ 1,045 acres)
- 🟥 OSM VMU 8 (~ 953 acres)

NOTE(S)

1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN

REFERENCE(S)

1. ORTHOIMAGE: CHEVRON, 2013

COORDINATE SYSTEM: NAD 1927 STATEPLANE NEW MEXICO WEST FIPS 3003
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1927

CLIENT
CHEVRON ENVIRONMENTAL MANAGEMENT

PROJECT
MCKINLEY MINE - OSM PERMIT PHASE III BOND RELEASE,
2024 VEGETATION MONITORING

TITLE

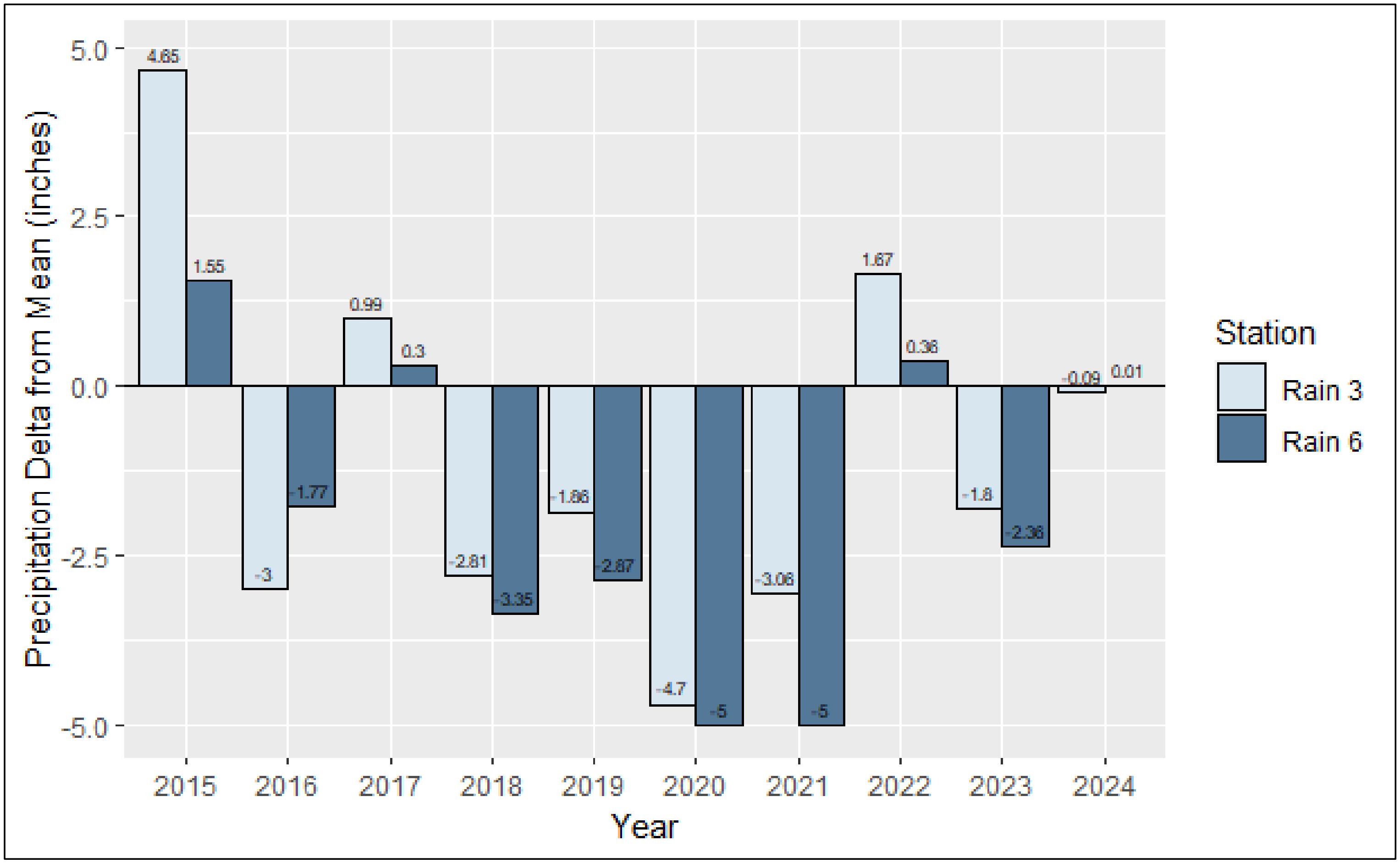
GENERAL OVERVIEW OF THE MCKINLEY OSMRE PERMIT AREA VEGETATION MANAGEMENT UNITS (VMU), 2024

CONSULTANT

YYYY-MM-DD	2025-02-14
DESIGNED	GFD
PREPARED	GFD
REVIEWED	MT
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
US-WSP-31406184.000	D003	0	1

Figure 2: Departure of Growing Season Precipitation from Long-Term Mean at Window Rock: Rain 3 and 6 Gauges

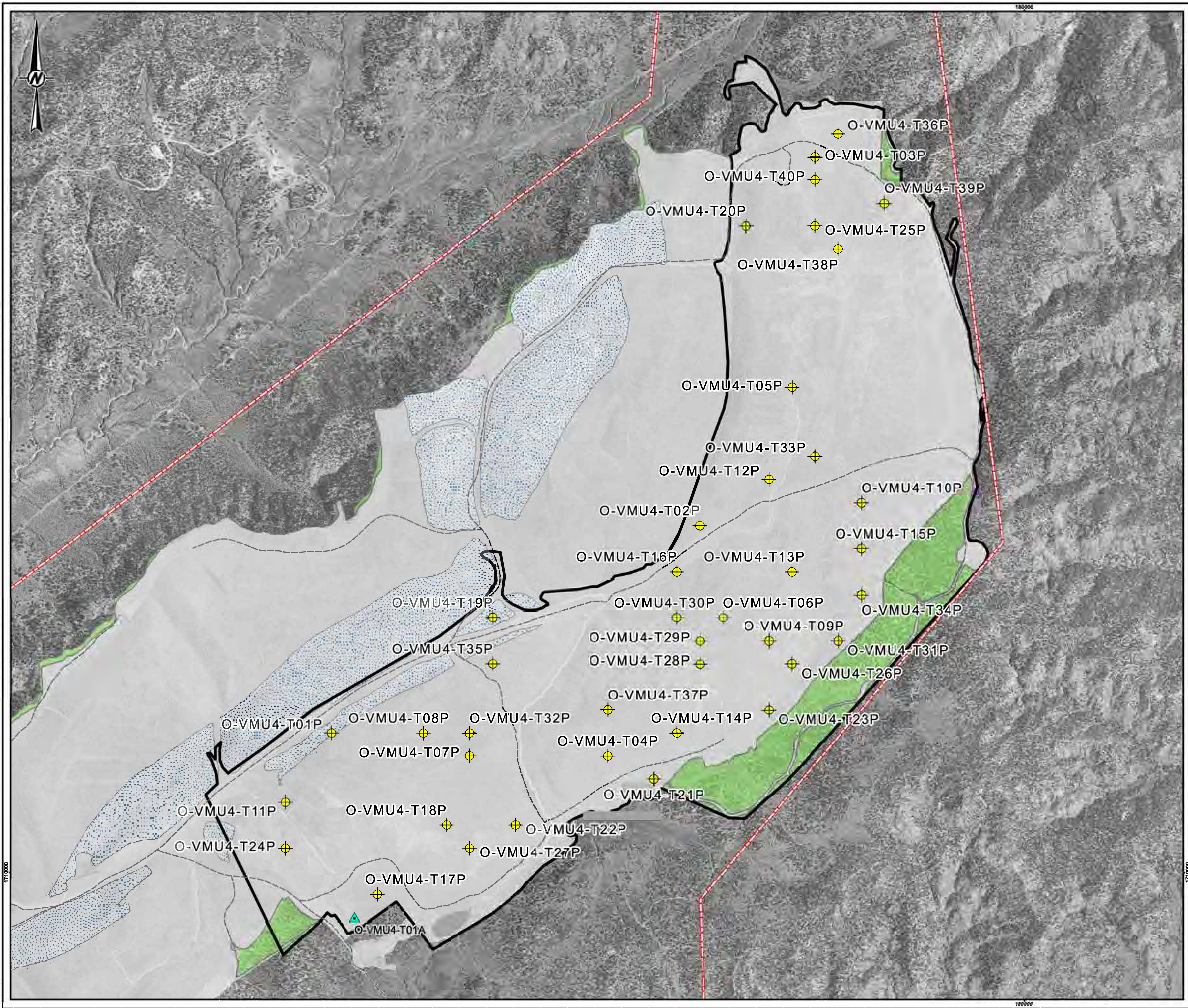


Notes:

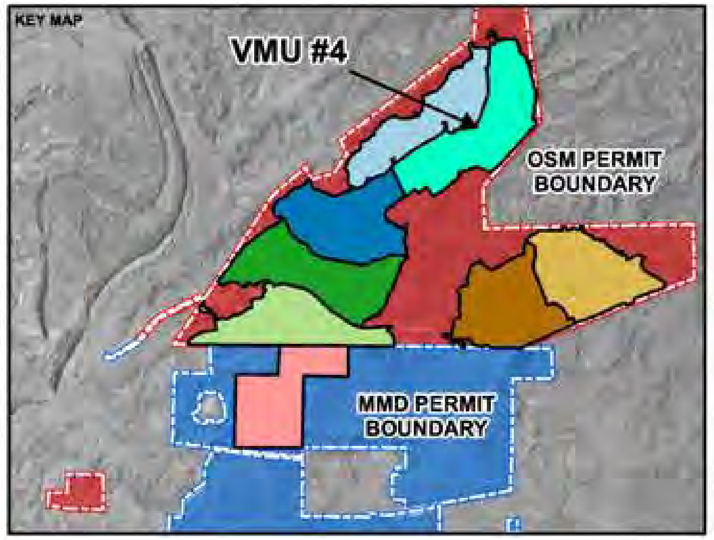
Long-term seasonal mean is from Window Rock, Arizona Station (029410) for 1937 to 1999 (Western Regional Climate Center, 2020).

Growing season precipitation is April through September

Source data is in Table 2



KEY MAP



LEGEND

- ⊕ Primary Transect
- ▲ Alternate Transect
- - - Mine Site Roads
- ▭ OSM VMU 4 (~ 1,242 acres)
- ▨ Prelaw
- ▨ Initial Program
- ▭ Permanent Program
- 🟩 Native Areas
- 🟥 OSM Permit Boundary

TRANSECT LABEL EXPLANATION O-VMU-1-T1P

- OSM Permit Area
- Vegetation Management Unit (VMU-#)
- Transect Number
- Primary (P) or Alternate (A)

0 1,400 2,800

1 inch = 1,375 feet FEET

NOTE(S)

1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN
2. KEY MAP SCALE IS DIFFERENT FROM OVERVIEW OF VMUS
3. TRANSECT LOCATIONS WERE CREATED IN ACCORDANCE WITH THE METHODS OUTLINED IN THE PERMIT

REFERENCE(S)

1. ORTHOIMAGE: CHEVRON, 2013

COORDINATE SYSTEM: NAD 1927 STATEPLANE NEW MEXICO WEST FIPS 3003
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1927

CLIENT
CHEVRON ENVIRONMENTAL MANAGEMENT

PROJECT
MCKINLEY MINE - OSM PERMIT PHASE III BOND RELEASE, 2024 VEGETATION MONITORING

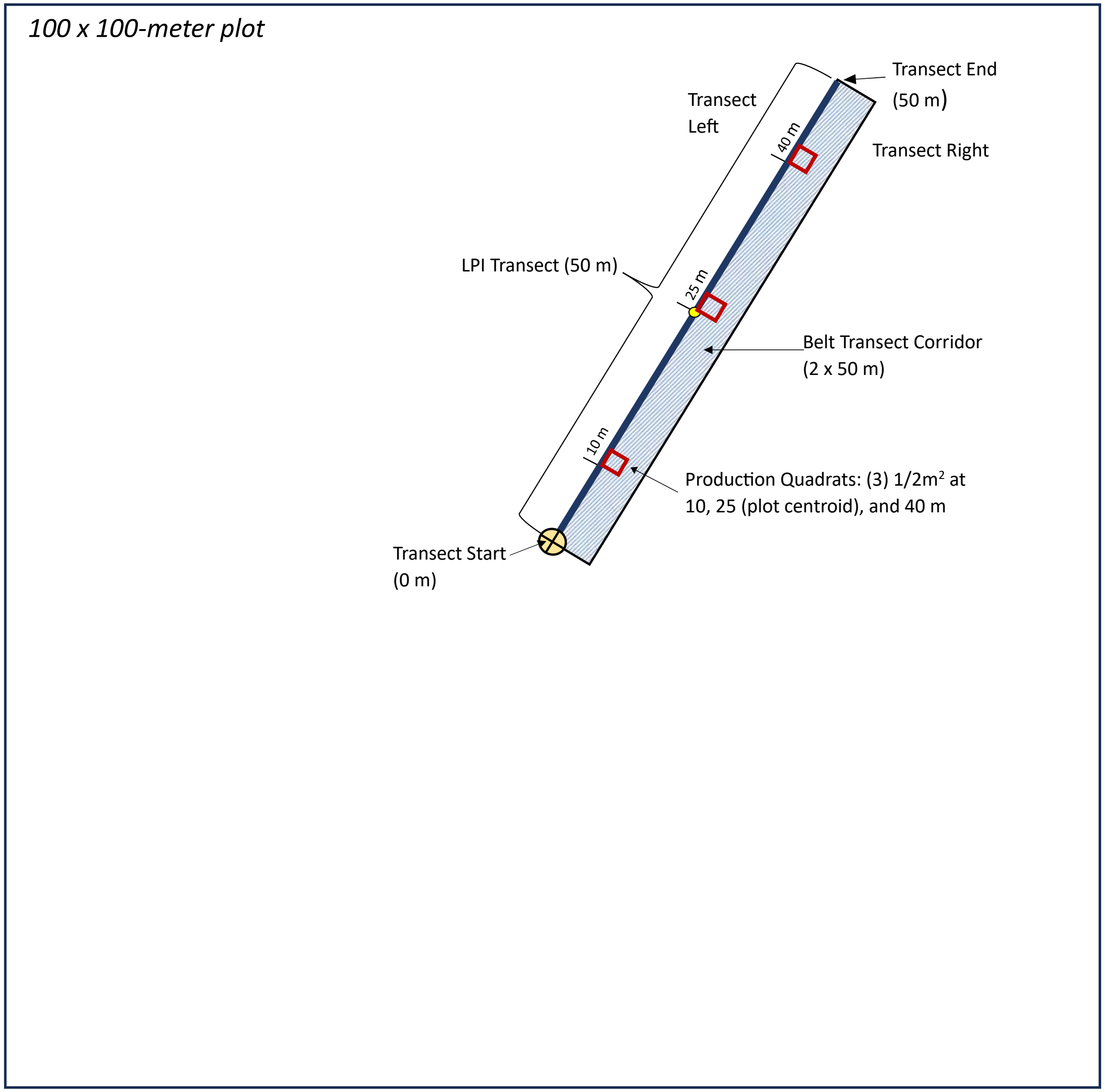
TITLE
SURVEYED VEGETATION MONITORING TRANSECTS, 2024 VEGETATION MANAGEMENT UNIT 4

CONSULTANT
wsp

YYYY-MM-DD	2025-02-14
DESIGNED	GFD
PREPARED	GFD
REVIEWED	MT
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
US-WSP-31406184.000	D002	0	3

Figure 4: Vegetation Plot and Transect Layout



Transect start placed on plot centroid and oriented randomly (0-360 degrees)* **Not to Scale

Figure 5: Typical Grass-Shrubland Vegetation in O-VMU-4, September 2024

Figure 6: Stabilization of the Annual Forage Production Mean and 90% Confidence Interval, O-VMU-4, 2024

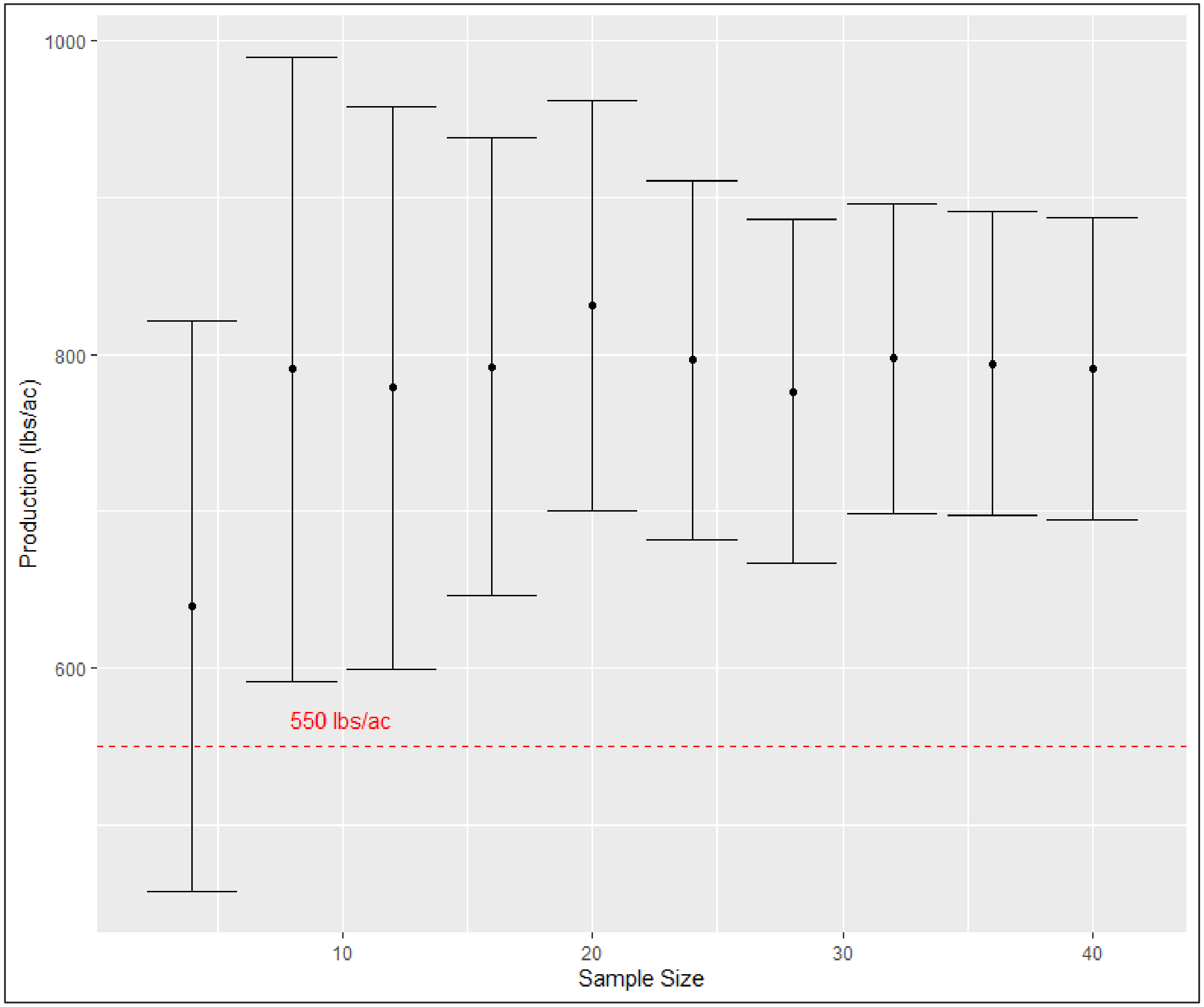
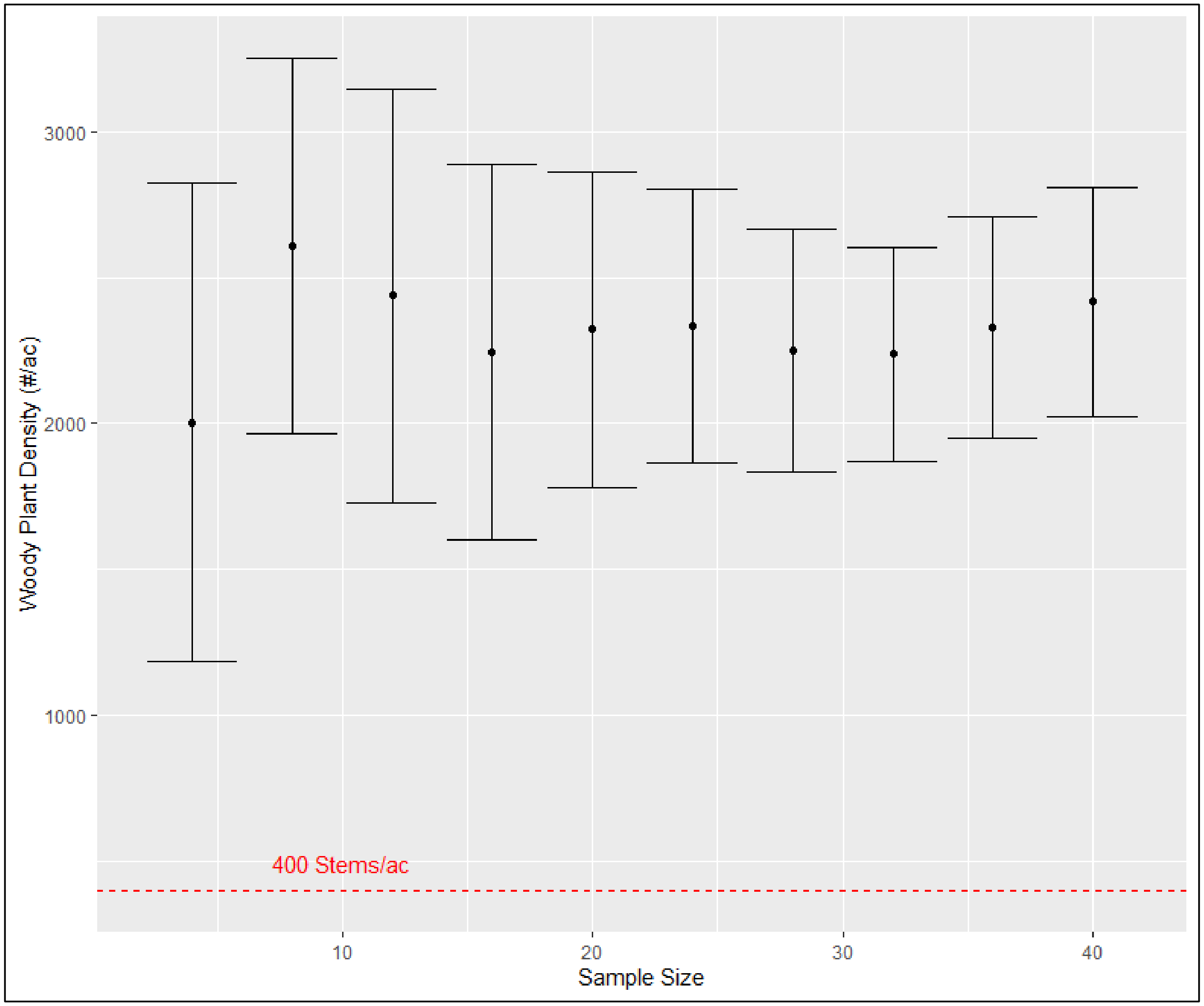


Figure 7: Stabilization of the Shrub Density Mean and 90% Confidence Interval, O-VMU-7, 2024



APPENDIX A

Vegetation Data Summary

Table A-1: O-VMU-4 Line Point Intercept Foliar Cover Data (first hits), 2024

Transect	T01A	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Grasses																																								
Cool-Season Annuals																																								
BOSI2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRTE	--	1	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cool-Season Perennials																																								
ACHY	--	--	--	--	--	--	2	1	3	--	1	1	1	--	--	1	1	--	1	--	6	5	--	--	--	--	--	2	--	--	--	1	1	3	2	3	--	1	3	--
AGCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
ELEL5	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	1	--	1	--	--	--	--	1	--	--	--	--	--	1	--	--	1	1	--	--	--	--	--
ELLA3	7	--	10	8	2	--	1	3	1	5	3	1	3	2	3	--	--	4	--	1	6	1	--	10	10	--	5	1	4	7	1	1	2	--	2	9	2	--	1	12
ELTR7	--	1	1	--	--	1	--	--	--	--	4	2	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	1	--	4	--	--	1	--	--	--	--	--	--	--
HECO10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	1	2	--	--	--	--	1	--	8	--	1	--	--	--	--	--	3	1	--	3	--	1	2	--	2	--	2	--	--	--	1	--	--	--	--	--	2	--
PASM	--	8	--	3	--	2	1	5	--	6	3	3	--	1	1	3	--	2	3	9	3	1	5	1	1	5	6	2	5	2	3	5	--	1	2	1	--	4	5	2
PSJU3	--	--	--	--	1	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PSSP6	1	2	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THIN6	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
Warm-Season Perennials																																								
BOCU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOGR2	2	--	1	--	3	--	--	--	--	--	--	1	1	--	1	--	--	1	3	3	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--
PLJA	13	1	5	--	8	3	--	2	12	2	1	1	4	5	11	1	1	4	1	3	--	1	--	11	1	7	1	--	2	2	4	--	--	--	--	--	--	1	4	--
SPAI	--	--	--	--	1	--	--	--	--	--	--	--	--	1	--	--	--	4	1	--	--	--	--	--	--	1	--	--	--	--	--	2	--	--	--	--	--	--	--	--
SPCR	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annuals																																								
BASC5	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
POOL	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR12	--	--	--	--	--	1	--	5	1	--	--	--	--	--	--	--	--	--	1	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
XAST	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennials/Biennials																																								
LASE	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GRSQ	--	--	--	--	--	1	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MACA2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MEOF	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MESA	--	--	--	1	--	--	--	--	--	--	--	--	--	3	--	--	4	--	--	--	--	--	1	--	2	--	--	--	--	--	--	--	--	--	--	2	--	--	1	2
TRPR	--	--	--	--	--	1	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARFR3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COAR4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
HEMU3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LILE3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Shrubs, Trees, and Cacti																																								
ARLU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARNO4	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--
ARTR2	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCA2	--	1	2	2	--	2	6	1	--	5	1	7	1	--	3	--	5	3	1	--	3	10	7	--	1	4	1	5	2	--	6	10	2	9	8	2	1	1	2	1
ATCO	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
ATGA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
ERNA10	1	--	--	--	--	1	--	1	--	--	--	--	1	--	--	2	2	--	--	4	--	--	--	--	--	--	2	--	4	7	--	--	--	1	1	--	2	1	3	--
GUSA2	--	--	--	--	--	--	--	4	4	--	--	--	--	--	--	--	--	--	1	--	--	--	2	--	--	--	1	1	--	--	2	--	--	--	--	--	--	--	--	--
KRLA2	--	2	--	1	4	--	1	--	2	2	--	3	--	--	3	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
PUME	--	--	--	2	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	4	--	--
PUTR2	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	2	2	--	--	2	--	--	--	--	3	--	--	--	1	1	--	--	--	6	--	--
SEFL3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																																								
UNK	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Cover Components																																								
Total Vegetation	24	19	20	20	22	17	12	22	24	22	21	25	14	12	27	11	17	19	15	32	23	21	19	25	18	20	24	16	22	22	17	19	8	16	18	19	13	18	24	18
Live Vegetation[1]	24	18	20	20	21	17	12	22	24	22	21	25	14	12	27	11	17	19	15	32	23	21	18	25	18	20	24	16	22	22	17	19	8	16	18	19	13	18	24	18
Perennial Vegetation[2]	24	16	20	20	21	14	12	17	23	22	21	25	14	12	26	11	17	19	14	31	22	21	18	25	18	20	24	16	22	22	17	19	8	16	18	19	13	18	23	18
Rock	0	3	0	2	1	0	1	0	4	0	0	7	2	2	2	3	3	2	3	2	0	0	0	0	0	1	1	3	2	0	0	2	1	2	4	0	3	0	0	5
Litter	6	5	2	9	4	2	6	4	4	11	7	7	3	13	5	22	7	8	7	4	6	9	10	6	4	8	11	7	4	12	9	7	5	18	4	6	8	6	6	13
Bare Soil	20	23	28	19	23	31	31	24	18	17	22	11	31	23	16	14	23	21	25	12	21	20	21	19	28	21	14	24	22	16	24	22	36	14	24	25	26	26	20	14

Notes:

Species codes defined in Table A-6

[1] Live vegetation is the total vegetation foliar hits for the transect, NOT including noxious weeds

[2] Perennial vegetation is the total vegetation foliar hits for the transect, NOT including annuals and noxious weeds

Table A-2: O-VMU-4 Line Point Intercept Foliar Cover Data (all hits), 2023

Transect	T01A	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Grasses																																								
Cool-Season Annuals																																								
BRTE	--	1	--	--	1	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--
Cool-Season Perennials																																								
ACHY	--	--	--	--	--	--	3	1	3	--	1	2	1	--	--	1	1	--	1	--	6	5	--	--	--	--	--	2	--	--	--	1	1	3	2	3	--	1	3	--
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ELEL5	--	--	1	--	--	--	--	2	--	--	--	2	--	--	--	--	--	3	--	1	--	--	--	--	1	--	--	--	--	--	2	--	1	1	2	--	--	--	--	--
ELLA3	8	--	10	9	2	--	1	3	3	5	3	1	4	2	3	--	--	4	--	1	6	1	--	10	10	--	5	3	7	9	1	1	2	--	4	13	2	3	1	13
ELTR7	--	1	1	--	--	1	--	--	--	--	4	2	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	1	--	4	--	--	1	--	--	--	--	--	--	--
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PASM	--	9	--	3	--	4	2	5	--	6	3	3	--	1	1	3	1	2	3	10	3	3	6	1	1	8	7	2	5	3	4	6	--	1	2	1	--	5	6	2
PSJU3	--	--	--	--	1	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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ATCA2	--	1	2	2	--	2	6	1	--	5	1	7	1	--	3	--	5	3	1	--	3	10	7	--	1	4	1	5	2	--	6	10	2	9	8	3	1	1	2	1
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Notes:
Species codes defined in Table A-5

Table A-3: O-VMU-4 Quadrat Canopy Cover Data (%), 2024

Transect	T01A			T01P			T02P			T03P			T04P			T05P			T06P			T07P			T08P			T09P			T10P			T11P			T12P			T13P			T14P			T15P			T16P			T17P			T18P			T19P		
Quadrat	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Grasses																																																												
Cool-Season Annuals																																																												
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0	--
BRAR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cool-Season Perennials																																																												
ACHY	--	--	--	--	--	--	--	--	4.0	--	3.0	--	--	--	4.0	--	--	--	--	29.0	--	--	--	--	--	--	5.0	--	--	--	--	--	--	--	--	3.0	--	--	6.0	--	--	--	--	--	--	7.0	--	--	--	--	--	--	--	--	--	9.0	0.2	--	--	--
ELEL5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0	0.1	--	--	0.9	--	6.0	--	--	--	--	--	--	--	--	10.0	--	--	0.1	--	--	--	--	--	--	--	--	--	1.0	--	--	--	--	14.0	--	--	9.0	--	--	--
ELLA3	2.0	38.0	10.0	--	--	--	24.0	18.0	5.0	12.0	5.0	35.0	17.0	20.0	17.0	--	--	--	--	--	--	10.0	47.0	34.0	--	--	--	--	--	--	31.0	5.0	4.0	--	--	--	--	8.0	1.0	3.0	31.0	14.0	--	--	0.5	--	--	--	--	27.0	1.0	58.0	--	--	--	2.5	--	--	--	--
ELTR7	--	--	--	--	3.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14.0	--	--	--	--	42.0	--	--	--	--	--	--
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PASM	20.0	--	1.0	35.0	10.0	20.0	--	--	--	--	--	7.0	--	--	41.0	50.0	24.0	12.0	--	--	20.0	--	--	--	--	--	--	0.5	22.0	62.0	--	--	--	--	--	--	11.0	4.0	--	--	--	--	--	--	--	12.0	--	2.0	--	--	--	--	0.5	--	33.0	5.5	4.0	10.0	25.0	--
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Warm-Season Perennials																																																												
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PLJA	18.0	--	--	--	--	--	--	4.0	1.0	--	--	--	--	27.0	--	--	--	0.1	--	--	--	--	--	--	--	37.0	--	0.3	--	--	--	--	--	--	--	--	14.0	--	--	--	--	--	59.0	42.0	25.0	--	10.0	1.0	--	--	--	--	--	--	--	--	--	--	--	12.0
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Total Vegetation Cover[1]	39.0	38.0	22.0	35.0	39.0	46.0	22.0	22.5	15.0	52.5	13.0	73.0	17.0	47.0	75.0	94.9	35.0	32.0	11.1	31.0	20.1	27.0	47.0	34.1	28.7	38.0	16.0	42.0	45.0	64.0	31.0	24.0	25.0	0.0	0.0	55.0	34.0	12.0	7.0	36.0	44.5	14.0	59.0	43.5	49.0	41.0	10.1	57.0	62.0	27.0	23.0	65.0	0.5	77.0	98.0	17.1	56.0	18.0	34.0	30.0
Rock	0.3	0.5	0.1	2.0	0.1	0.5	0.3	21.0	5.0	3.0	30.0	0.0	0.0	0.5	0.5	0.1	T	0.1	8.0	0.1	2.0	0.5	0.5	1.0	3.0	0.3	34.0	0.3	0.0	0.1	0.5	37.0	8.0	14.0	40.0	1.0	0.8	15.0	7.0	3.0	2.0	5.0	2.0	1.0	0.5	0.5	1.5	0.3	1.5	3.0	6.0	0.3	1.5	0.1	0.0	6.5	1.0	0.0	14.0	5.0
Litter	8.0	1.0	77.0	23.0	55.0	30.0	2.0	4.0	3.0	1.0	9.0	7.0	8.0	1.0	9.0	5.0	4.0	15.0	0.3	0.5	16.0	21.0	1.0	5.0	0.8	0.1	4.0	1.0	29.0	13.0	3.0	2.0	5.0	21.0	3.0	25.0	3.0	3.0	0.5	2.5	5.0	2.0	5.0	3.0	3.0	3.0	1.0	32.0	5.0	2.0	7.0	23.0	0.5	8.0	2.0	7.0	20.0	5.0	20.0	2.0
Bare Soil	52.8	60.5	1.0	40.0	5.9	23.5	75.8	52.5	77.0	43.5	48.0	20.0	75.0	51.5	15.5	0.1	61.0	53.0	80.7	68.5	62.0	51.5	51.5	60.0	67.6	61.7	46.0	56.8	26.0	23.0	65.5	37.0	62.0	65.0	57.0	19.0	62.3	70.0	85.5	58.5	48.5	79.0	34.0	52.5	47.5	55.5	87.5	11.8	31.5	68.0	64.0	11.8	97.5	15.9	0.0	69.4	23.0	77.0	32.0	63.0

Table A-3: O-VMU-4 Quadrat Canopy Cover Data (%), 2024 (cont'd)

Transect	T20P			T22P			T23P			T24P			T25P			T26P			T27P			T28P			T29P			T30P			T31P			T32P			T33P			T34P			T35P			T36P			T37P			T38P			T39P			T40P		
Quadrat	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
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Total Vegetation Cover[1]	13.0	31.0	15.0	28.0	3.1	35.0	38.0	54.0	22.0	32.0	97.0	15.0	25.0	3.0	48.5	0.4	88.5	13.0	49.0	5.2	36.0	14.0	25.0	18.5	35.1	58.0	72.2	86.0	15.0	26.1	48.0	30.0	45.3	45.0	17.5	54.0	17.0	22.0	34.0	29.5	34.0	32.1	31.0	11.1	43.0	13.0	27.0	66.5	33.3	0.3	31.6	5.0	3.0	10.0	28.8	21.0	83.0	41.9	64.0	34.0
Rock	2.0	0.5	1.0	2.8	3.0	4.0	0.1	0.1	0.1	0.3	0.0	0.1	3.0	4.0	2.0	2.0	0.1	0.5	0.1	1.5	3.0	3.0	52.0	10.0	0.0	0.3	0.1	0.0	0.1	0.1	0.0	10.0	0.5	1.0	21.0	0.1	10.0	0.3	4.0	T	0.1	3.0	0.3	2.0	0.1	3.0	3.0	4.0	0.1	6.5	2.0	16.0	4.0	2.0	15.0	5.0	0.3	2.0	8.0	0.0
Litter	6.0	7.0	3.0	5.0	6.0	4.0	4.0	3.0	28.0	15.0	1.0	14.0	15.0	5.0	8.0	4.0	3.0	3.0	11.0	15.0	15.0	2.0	4.0	3.0	6.0	5.0	10.0	9.0	2.0	2.0	51.0	11.0	7.0	4.5	1.0	44.0	0.5	0.5	5.0	55.0	40.0	2.0	2.0	70.0	6.0	5.0	16.0	8.0	2.5	0.0	8.0	0.0	1.0	7.0	2.5	15.0	5.0	1.0	9.5	13.0
Bare Soil	79.0	61.5	81.0	64.3	87.9	57.0	57.9	43.0	50.0	52.8	2.0	70.9	57.0	88.0	41.5	93.7	8.5	83.5	40.0	78.3	46.0	81.0	19.0	68.5	59.0	36.8	17.9	5.0	83.0	71.9	1.0	49.0	47.3	49.5	60.5	2.0	72.5	77.3	57.0	15.5	26.0	64.0	66.8	16.9	51.0	79.0	54.0	21.5	64.2	93.3	59.0	79.0	92.0	81.0	53.8	59.0	11.8	55.1	18.5	53.0

[1] Total vegetation canopy cover for the transect by the quadrat canopy cover estimate method

Table A-4: O-VMU-4 Air-dry Aboveground Annual Forage Production Data, 2024

Transect	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Perennial Grasses																																								
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ELEL5	--	--	--	--	--	--	6	5	6	--	--	15	5	--	--	--	6	2	8	--	--	--	--	--	--	--	--	--	--	--	14	9	--	8	--	--	1	--	--	--
ELLA3	74	--	43	41	51	--	--	96	--	--	46	--	8	39	>1	--	6	57	9	--	34	9	54	104	56	13	23	16	19	68	--	1	19	--	39	24	20	12	12	90
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BOGR2	--	--	12	--	--	--	--	--	9	--	--	--	--	--	16	9	7	18	28	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--
PLJA	33	--	11	--	21	1	--	--	29	4	--	--	9	--	107	10	--	--	--	21	--	--	--	10	--	163	19	--	--	8	--	--	--	--	--	--	--	5	106	--
Perennial/Biennial Forbs																																								
ACMI2	--	--	--	--	--	>1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BADI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--
DEPI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
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HEMU3	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	5	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LASE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--
LILE3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--
MACA2	--	--	--	--	--	7	--	--	--	5	--	25	--	--	--	5	15	--	--	--	--	--	--	--	5	25	--	--	>1	--	6	--	--	7	--	--	--	--	--	--
MEOF	--	--	9	--	--	23	--	--	--	--	--	--	5	--	--	11	41	--	--	--	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	7	--	--	--
MESA	11	--	--	37	--	--	--	--	--	15	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	37	--	--	5	8
ONVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEPA8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--
RACO3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	>1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	>1	--	--	--	--	--	--	--	--	17	7	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	>1	--	--	7	--	--	--	--	--	--	--	--
SPCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Shrubs, Trees, and Cacti																																								
ARFR3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARFR4	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCA2	--	9	6	--	--	48	7	9	--	--	--	--	--	8	9	--	--	2	119	--	--	--	--	--	--	--	--	--	--	--	36	89	--	125	5	--	7	--	6	--
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	43	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--
ERNA10	--	--	--	5	--	1	--	--	--	--	--	--	--	116	--	108	6	--	--	--	--	--	--	--	--	--	--	--	>1	9	--	--	--	--	--	7	--	--	--	--
GUSA2	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	12	--	4	--	--	--	--	--	--	--	--	--	120	--	--	--	--	--	--	--	--	--
KRLA2	--	--	--	--	37	--	6	--	47	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6	12	--	--	--	--	--	--	7	--	5	--
PUME	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--
PUTR2	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--
TRDU	>1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	>1	--	--	--	--	10	--	--	--	--	--	--
TRPR	--	--	--	--	--	--	>1	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	>1	--	--	7	--	--	--	--	5	5
Total Air-dry Aboveground Annual Forage Production																																								
Total (g)	141	63	91	135	205	227	91	110	108	245	106	49	62	181	143	173	186	146	236	96	85	61	128	144	89	221	75	58	147	134	212	140	70	256	93	97	99	30	258	126
Total (lbs/ac)	839	375	541	801	1,219	1,350	541	654	643	1,458	629	289	369	1,078	848	1,031	1,107	865	1,406	574	506	363	759	859	529	1,313	444	344	874	797	1,262	834	419	1,522	554	578	591	177	1,532	751

Notes:
Species codes defined in Table A-5
Total (g) is the total of all three .5 m^2 quads (1.5m^2 total) per transect
lbs/ac=total grams÷1.5*(4046.86 m^2/ac ÷ 453.59 g/lbs)
Forage plants are perennial and/or biennial duration excluding noxious weeds

Table A-5: O-VMU-4 Shrub Belt Transect Data (frequency), 2024

Transect	T01A	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Shrubs, Trees, and Cacti																																								
ARFR4	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	3	--	--	--	1	--	--	--	--	3	--	--	--	--	--	--	--	--	--	1	--	1	--	--
ARLU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	45	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARNO4	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--
ARTR2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCA2	18	26	36	11	12	23	62	5	7	20	14	7	1	16	28	4	25	31	23	19	3	51	47	5	16	12	7	38	21	2	15	62	76	29	41	11	12	12	15	21
ATCO	--	--	--	14	2	--	--	--	--	--	--	--	--	--	--	--	7	--	--	6	--	--	--	4	6	--	--	--	--	--	--	--	--	--	--	--	139	--	--	11
ATCO4	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	18	--	--	--	--	--	4	4
ATGA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	4	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--
CHGR6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--
EPTR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--
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ERNA10	3	--	--	7	--	12	1	9	1	--	2	8	3	2	--	21	36	1	4	3	1	3	--	--	--	--	15	1	17	43	8	--	3	5	7	18	3	7	5	2
GUSA2	5	--	--	--	1	--	--	47	50	3	--	1	2	--	1	--	5	--	24	--	34	--	21	--	--	2	23	6	--	--	11	1	--	--	21	--	--	--	--	1
KRLA2	--	21	3	--	75	--	39	--	77	8	--	--	--	--	80	2	5	--	--	49	--	--	2	--	8	3	--	19	12	4	3	--	10	2	1	--	13	2	2	6
PUME	--	--	2	52	--	--	--	--	--	--	1	--	4	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	18	2	--	--	--	16	--	8
PUTR2	--	--	--	--	--	--	3	--	--	--	2	4	--	--	--	--	1	--	--	--	5	--	1	6	--	--	--	7	4	9	--	--	28	2	--	2	--	23	--	5
SEFL3	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
ULPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
Total	26	47	41	84	93	59	105	61	135	31	21	20	10	18	110	27	92	32	55	81	89	54	71	23	31	20	51	71	54	58	37	63	153	42	75	32	170	63	26	58

Notes:

Species codes defined in Table A-6

The shrub belt transect area is 100m^2 (2mx50m); shrubs rooted in the belt transect were counted on an individual basis

Table A-6: Species Observed 2021-2024, O-VMU-4

Common Name	Scientific Name	Code
Cool-Season Grasses (16)		
Annuals (2)		
Field Brome	***Bromus arvenisis***	**BRAR**
Cheatgrass	*Bromus tectorum*	BRTE
Perennials (14)		
Indian ricegrass	*Achnatherum hymenoides*	ACHY
Crested wheatgrass	*Agropyron cristatum*	AGCR
Smooth brome	*Bromus inermis*	BRIN2
Bottlebrush squirreltail	*Elymus elymoides*	ELEL5
Thickspike wheatgrass	*Elymus lanceolatus*	ELLA3
Slender wheatgrass	*Elymus trachycaulus*	ELTR7
Tanglehead	***Heteropogon contortus***	**HECO10**
Needle and thread	*Hesperostipa comata*	HECO26
Colorado wildrye	*Leymus ambiguus*	LEAM
Western wheatgrass	*Pascopyrum smithii*	PASM
Russian wildrye	*Psathyrostachys juncea*	PSJU3
Bluebunch wheatgrass	*Pseudoroegneria spicata*	PSSP6
Intermediate wheatgrass	*Thinopyrum intermedium*	THIN6
Tall wheatgrass	*Thinopyrum ponticum*	THPO7
Warm-Season Grasses (8)		
Annuals (2)		
Matted grama	***Bouteloua simplex***	**BOSI2**
False buffalograss	*Munroa squarrosa*	MUSQ3
Perennials (6)		
Sideoats grama	*Bouteloua curtipendula*	BOCU
Buffalograss	*Bouteloua dactyloides*	BODA2
Blue grama	*Bouteloua gracilis*	BOGR2
James' galleta	*Pleuraphis jamesii*	PLJA
Alkali sacaton	*Sporobolus airoides*	SPAI
Sand dropseed	*Sporobolus cryptandrus*	SPCR
Forbs (70)		
Annuals (20)		
Desert madwort	*Alyssum desertorum*	ALDE
Alyssum	*Alyssum simplex*	ALSI8
Burningbush	*Bassia scoparia*	BASC5
Ribseed sandmat	*Chamaesyce glyptosperma*	CHGL13
Spotted sandmat	*Chamaesyce maculata*	CHMA15
Thymeleaf sandmat	*Chamaesyce serpyllifolia*	CHSE6
Mealy goosefoot	*Chenopodium incanum*	CHIN2
Fetid marigold	*Dyssodia papposa*	DYPA
Common sunflower	*Helianthus annuus*	HEAN3
Prairie sunflower	*Helianthus petiolaris*	HEPE
Longleaf false goldeneye	*Heliomeris longifolia*	HELO6
Shortstem lupine	***Lupinus brevicaulis***	**LUBR2**
Fendler's desertdandelion	*Malacothrix fendleri*	MAFE
Erect knotweed	*Polygonum erectum*	POER2
Bushy knotweed	*Polygonum ramosissimum*	PORA3
Little hogweed	*Portulaca oleracea*	POOL
Prickly Russian thistle	*Salsola tragus*	SATR12
Manyflower false threadleaf	***Schkuhria multiflora***	**SCMU6**
Golden crownbeard	*Verbesina encelioides*	VEEN
Rough cocklebur	*Xanthium strumarium*	XAST

Table A-6: Species Observed 2021-2024, O-VMU-4

Common Name	Scientific Name	Code
Perennials/Biennials (50)		
Common yarrow	*Achillea millefolium*	ACMI2
Russian knapweed	*Acroptilon repens*	ACRE3
Ragweed sagebrush	***Artemisia franserioides***	**ARFR3**
Fort Wingate milkvetch	*Astragalus wingatanus*	ASWI2
Ragleaf bahia	*Bahia dissecta*	BADI
Sego lily	*Calochortus nuttallii*	CANU3
Musk thistle	*Carduus nutans*	CANU4
Wyoming Indian paintbrush	*Castilleja linariifolia*	CALI4
Rose heath	*Chaetopappa ericoides*	CHER2
Whitemargin sandmat	*Chamaesyce albomarginata*	CHAL11
Field bindweed	*Convolvulus arvensis*	COAR4
Canadian horseweed	*Conyza canadensis*	COCA5
Western tansymustard	***Descurainia pinnata***	**DEPI**
Spreading fleabane	*Erigeron divergens*	ERDI4
Redstem stork's bill	*Erodium cicutarium*	ERCI6
Western wallflower	*Erysimum asperum*	ERAS2
Blanketflower	*Gaillardia aristata*	GAAR
Curlycup gumweed	*Grindelia squarrosa*	GRSQ
Showy goldeneye	*Heliomeris multiflora*	HEMU3
Flaxflowered ipomopsis	*Ipomopsis longiflora*	IPLO2
Manyflowered ipomopsis	*Ipomopsis multiflora*	IPMU3
Povertyweed	*Iva axillaris*	IVAX
Prickly lettuce	*Lactuca serriola*	LASE
Flatspine stickseed	*Lappula occidentalis*	LAOC3
Mesa pepperwort	*Lepidium alyssoides*	LEAL4
Lewis flax	*Linum lewisii*	LILE3
Hoary tansyaster	*Machaeranthera canescens*	MACA2
Tanseyleaf tansyaster	*Machaeranthera tanacetifolia*	MATA2
Alfalfa	*Medicago sativa*	MESA
Sweetclover	*Melilotus officinalis*	MEOF
Narrowleaf four-o’clock	*Mirabilis linearis*	MILI3
Colorado four o'clock	*Mirabilis multiflora*	MIMU
Sainfoin	*Onobrychis viciifolia*	ONVI
Beardlip penstemon	*Penstemon barbatus*	PEBA2
Palmer's penstemon	*Penstemon palmeri*	PEPA8
Prostrate knotweed	*Polygonum aviculare*	POAV
Upright prairie coneflower	*Ratibida columnifera*	RACO3
Curly dock	*Rumex crispus*	RUCR
Cutleaf vipergrass	*Scorzonera laciniata*	SCLA6
Broom-like ragwort	*Senecio spartioides*	SESP3
Tall tumblemustard	*Sisymbrium altissimum*	SIAL2
Scarlet globemallow	*Sphaeralcea coccinea*	SPCO
Fendler's globemallow	*Sphaeralcea fendleri*	SPFE
Gooseberryleaf globemallow	*Sphaeralcea grossulariifolia*	SPGR2
Spear globemallow	*Sphaeralcea hastulata*	SPHA
Gray globemallow	*Sphaeralcea incana*	SPIN2
Small-leaf globemallow	*Sphaeralcea parvifolia*	SPPA2
Yellow salsify	*Tragopogon dubius*	TRDU
Salsify	*Tragopogon porrifolius*	TRPO
Jack-go-to-bed-at-noon	*Tragopogon pratensis*	TRPR

Table A-6: Species Observed 2021-2024, O-VMU-4

Common Name	Scientific Name	Code
Shrubs, Trees, and Cacti (31)		
Silver sagebrush	*Artemisia cana*	ARCA13
Prairie sagewort	*Artemisia frigida*	ARFR4
White sagebrush	*Artemisia ludoviciana*	ARLU
Black sagebrush	*Artemisia nova*	ARNO4
Big sagebrush	*Artemisia tridentata*	ARTR2
Fourwing saltbush	*Atriplex canescens*	ATCA2
Shadscale saltbush	*Atriplex confertifolia*	ATCO
Mat saltbush	*Atriplex corrugata*	ATCO4
Gardner's saltbush	*Atriplex gardneri*	ATGA
Mound saltbush	*Atriplex obovata*	ATOB
Alderleaf mountain mahogany	*Cercocarpus montanus*	CEMO2
Greene's rabbitbrush	*Chrysothamnus greenei*	CHGR6
Russian olive	*Elaeagnus angustifolia*	ELAN
Mormon tea	*Ephedra viridis*	EPVI
Rubber rabbitbrush	*Ericameria nauseosa*	ERNA10
Broom snakeweed	*Gutierrezia sarothrae*	GUSA2
Hairy false goldenaster	*Heterotheca villosa*	HEVI4
Oneseed juniper	*Juniperus monosperma*	JUMO
Winterfat	*Krascheninnikovia lanata*	KRLA2
Pale desert-thorn	*Lycium pallidum*	LYPA
Plains pricklypear	*Opuntia polyacantha*	OPPO
Twoneedle pinyon	*Pinus edulis*	PIED
Ponderosa pine	*Pinus ponderosa*	PIPO
Mexican cliffrose	*Purshia mexicana*	PUME
Antelope bitterbrush	*Purshia tridentata*	PUTR2
Greasewood	*Sarcobatus vermiculatus*	SAVE4
Threadleaf ragwort	*Senecio flaccidus*	SEFL3
Riddell's ragwort	*Senecio riddellii*	SERI2
Spineless horsebrush	*Tetradymia canescens*	TECA2
Siberian elm	*Ulmus pumila*	ULPU
Banana yucca	*Yucca baccata*	YUBA

Notes:

Bold species are newly observed on O-VMU-4 in 2024

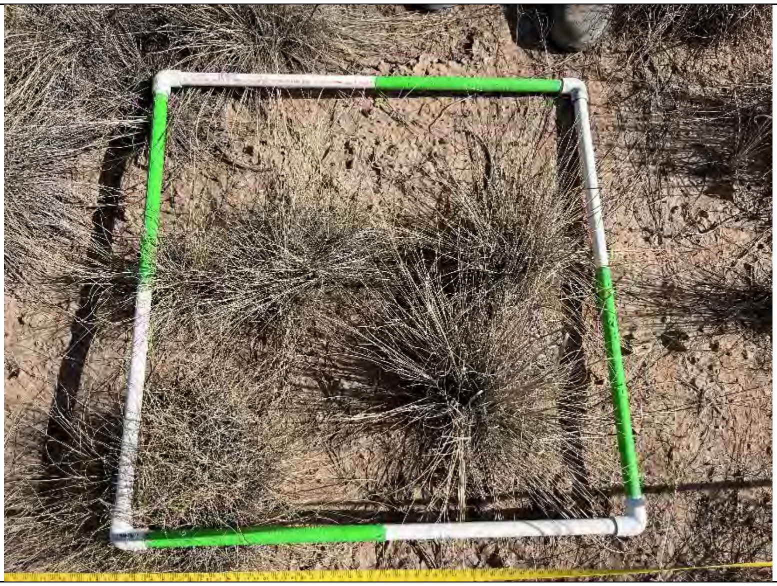
APPENDIX B

Quadrat Photographs

O-VMU4-T01A

Belt

Q1



Q2

Q3

O-VMU4-T01P

Belt

Q1

Q2

Q3

O-VMU4-T02P

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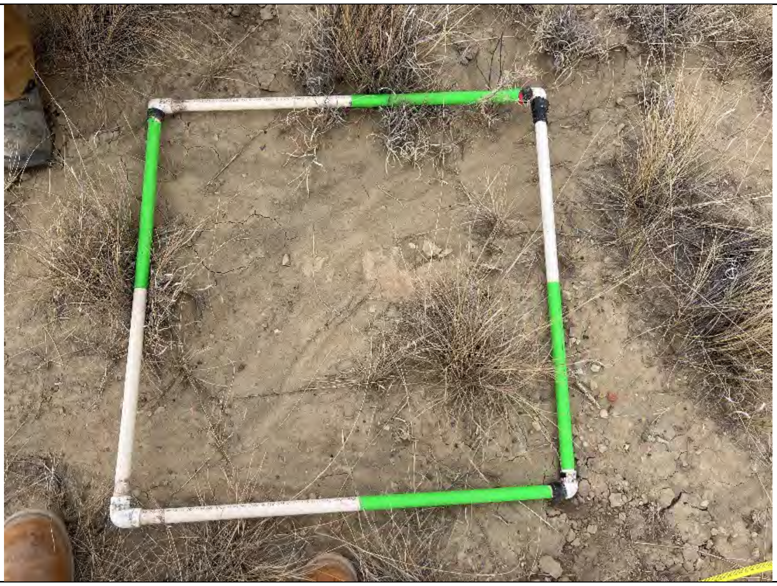
<tr><td></td><td></td></tr>
<tr><td>Q2</td><td>Q3</td></tr>
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O-VMU4-T03P

Belt

Q1

Q2

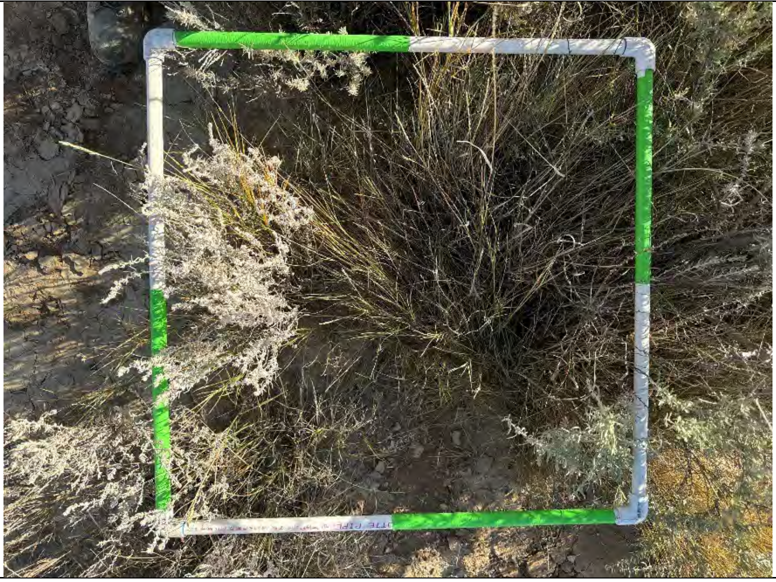
Q3

O-VMU4-T04P

Belt

Q1

Q2



Q3

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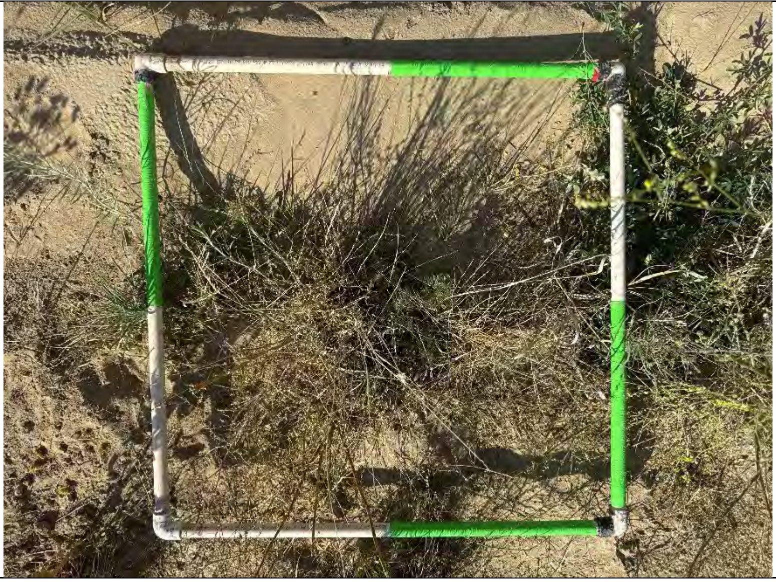
<tr><td></td><td></td></tr>
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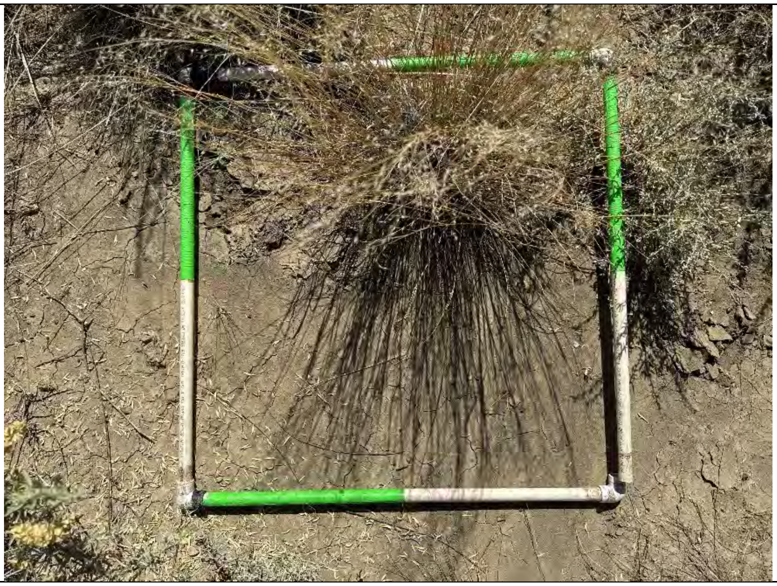
O-VMU4-T06P

Belt

Q1



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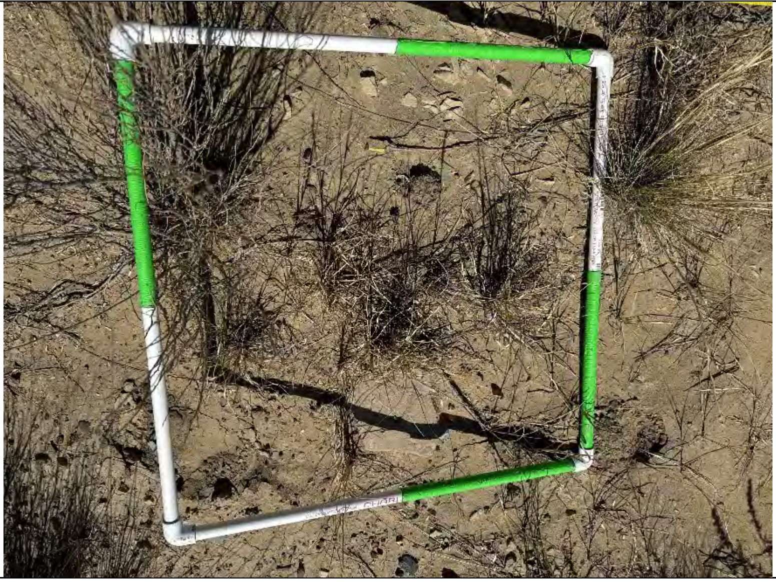
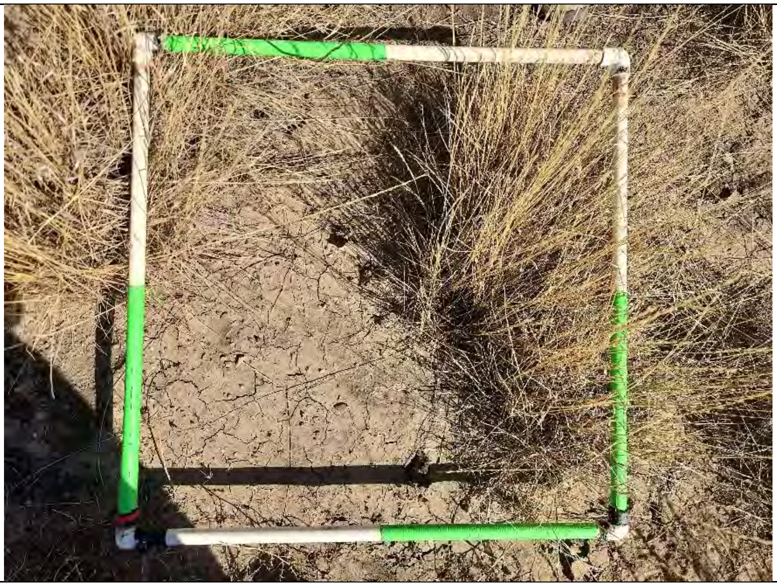


Q3

O-VMU4-T07P

Belt

Q1



Q2

Q3

O-VMU4-T08P

Belt

Q1

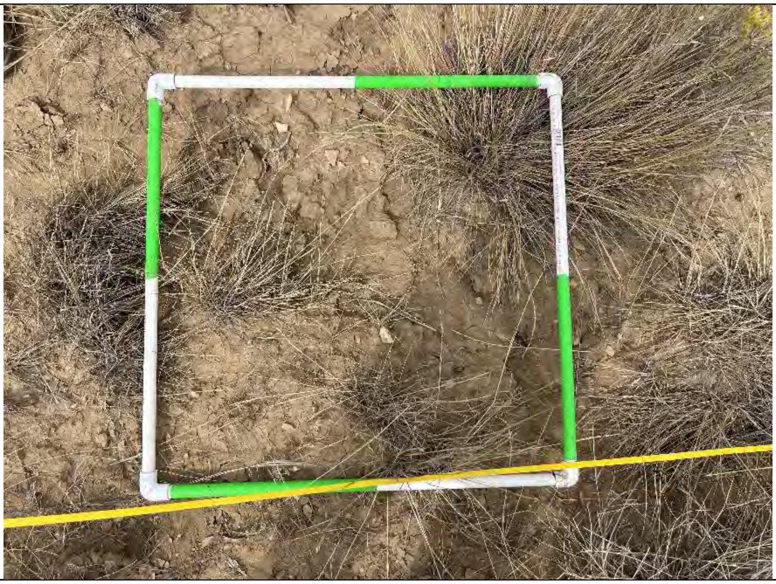
Q2

Q3

O-VMU4-T09P	
	
Belt	Q1
	
Q2	Q3

O-VMU4-T10P

Belt



Q1

Q2

Q3

O-VMU4-T11P

Belt

Q1

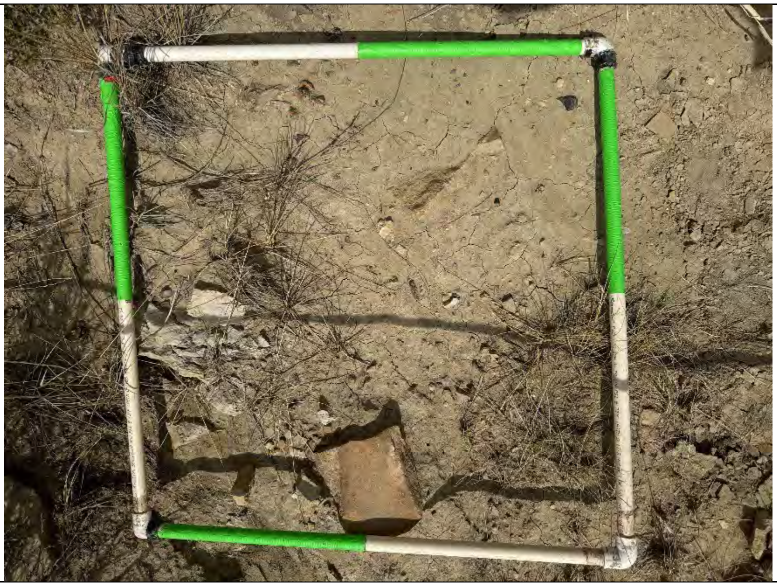
Q2

Q3

O-VMU4-T12P

Belt

Q1



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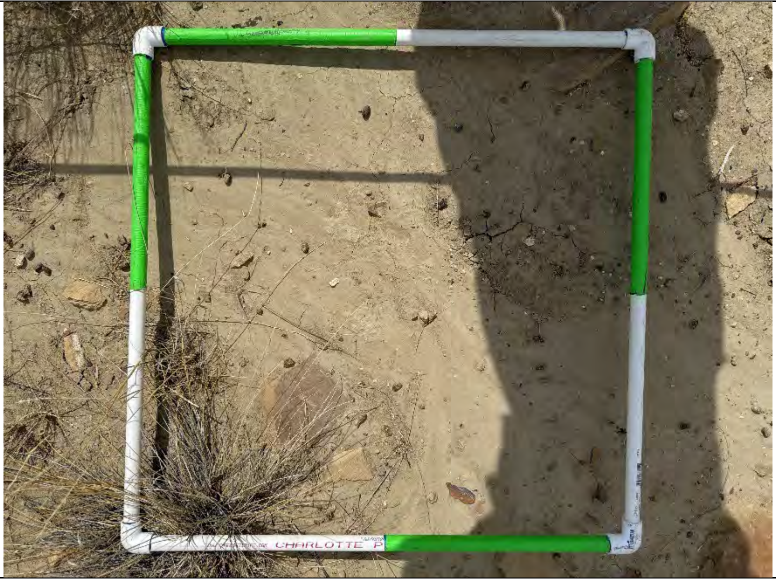

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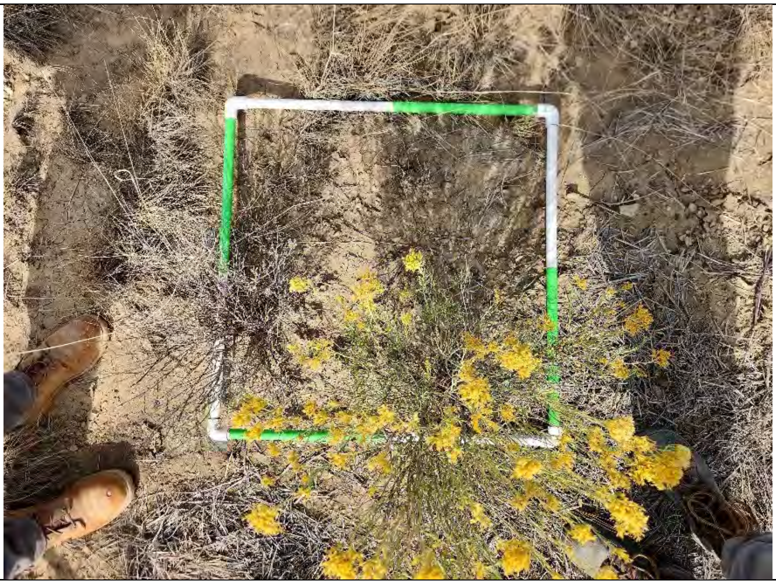
O-VMU4-T13P


Belt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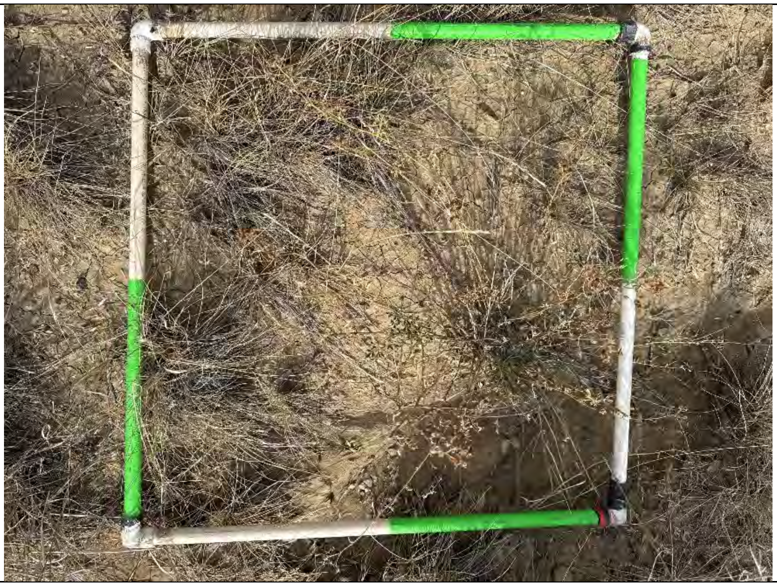
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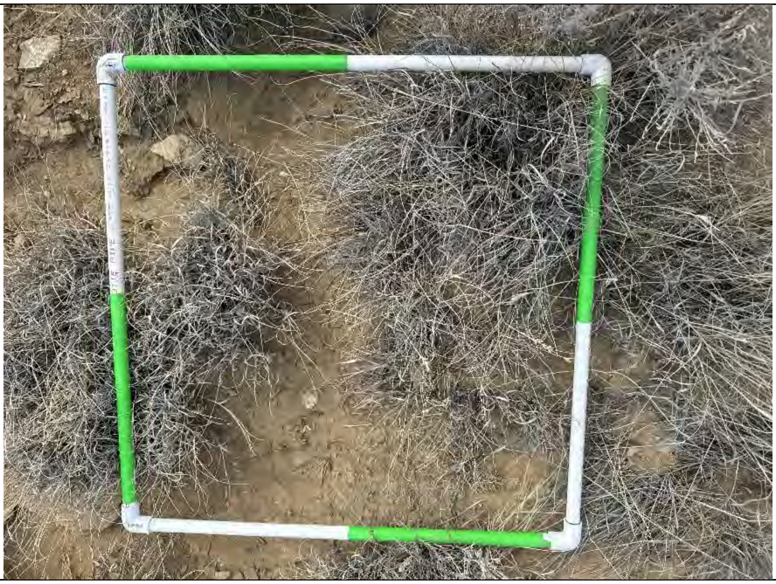
Q3

O-VMU4-T14P

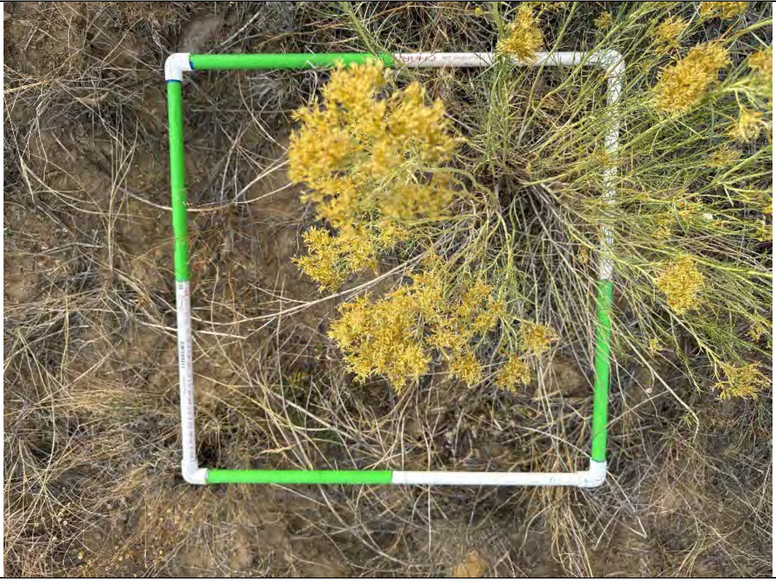
Belt



Q1

Q2

Q3

O-VMU4-T15P	
	
Belt	Q1
	
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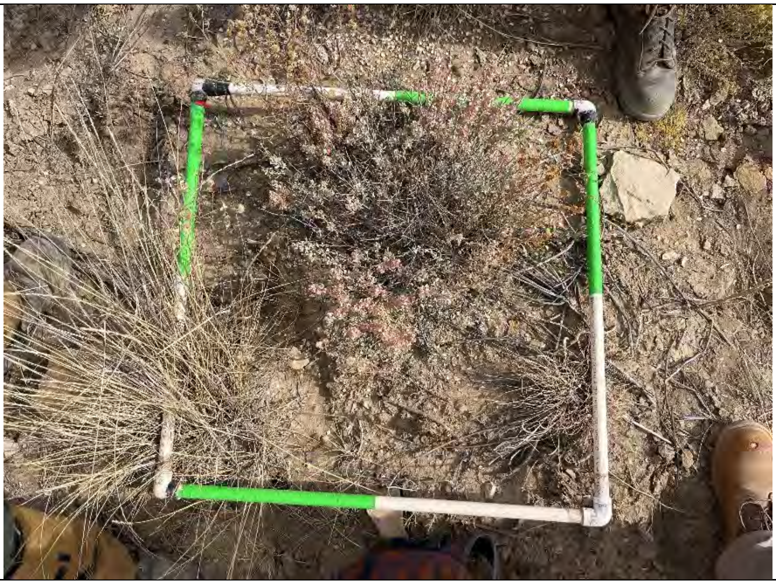
O-VMU4-T16P

Belt



Q1

Q2

Q3

O-VMU4-T17P	
	
Belt	Q1
	
Q2	Q3

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<tr><td></td><td></td></tr>
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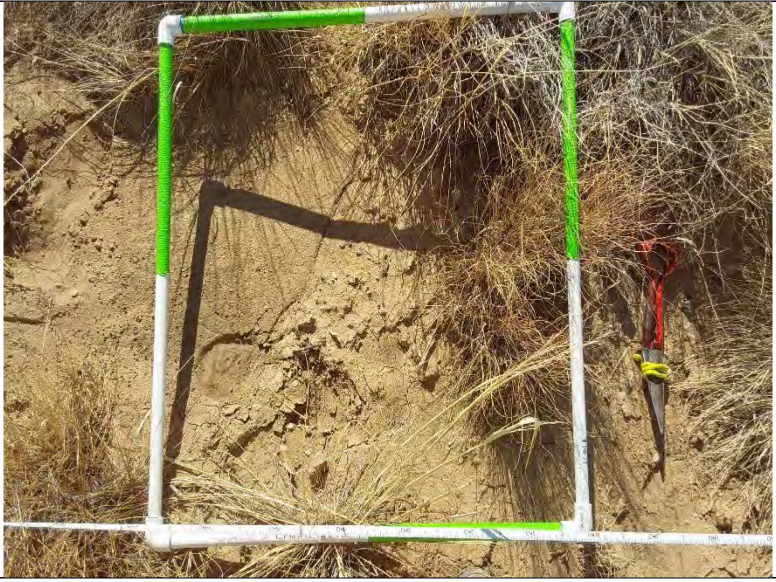
O-VMU4-T19P

Belt

Q1

Q2



Q3

O-VMU4-T20P

Belt

Q1

Q2

Q3

O-VMU4-T22P

Belt

Q1

Q2

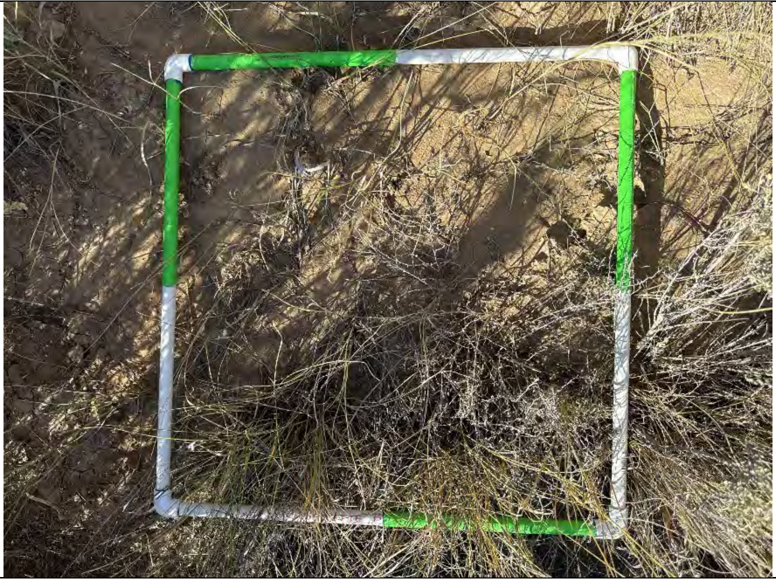
Q3

O-VMU4-T23P

Belt

Q1

Q2



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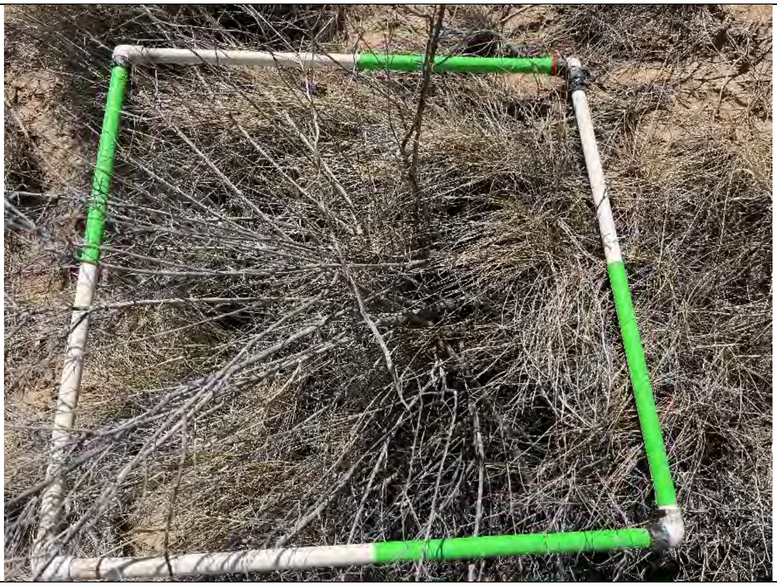
O-VMU4-T24P

Belt

Q1



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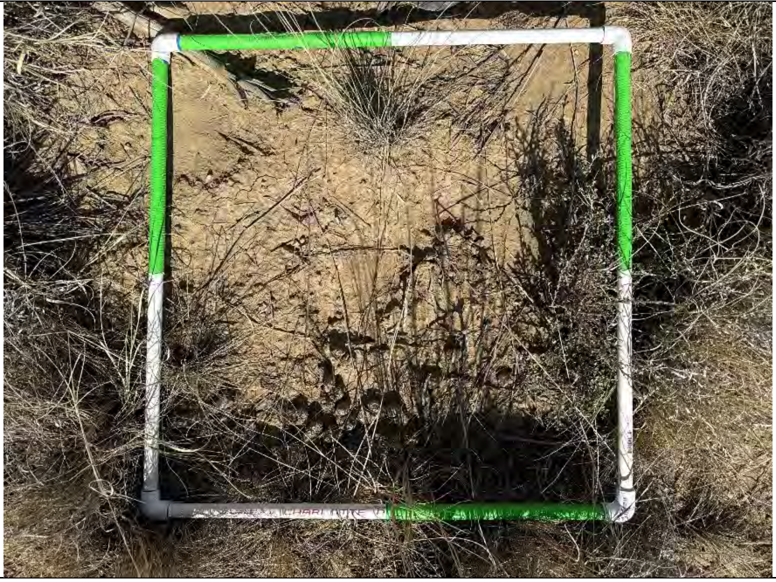

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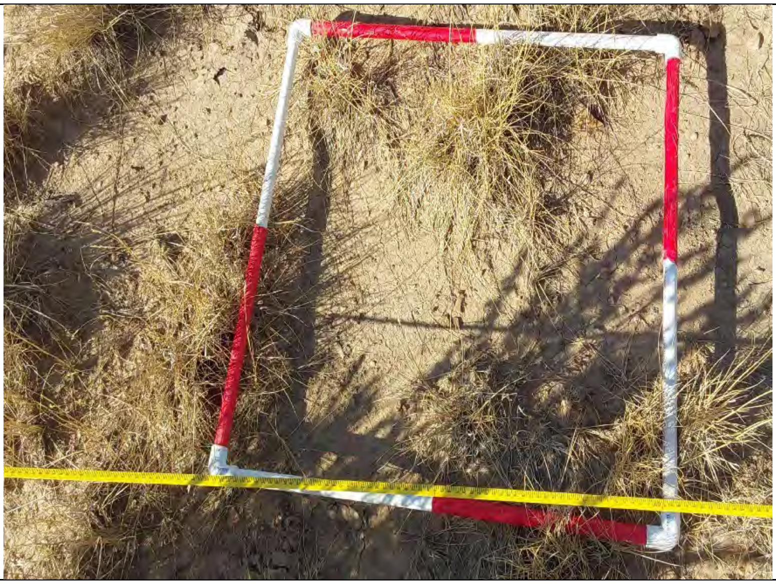
O-VMU4-T25P

Belt



Q1

Q2

Q3

O-VMU4-T26P

Belt

Q1

Q2

Q3

O-VMU4-T27P

Belt

Q1

Q2

Q3

O-VMU4-T28P

Belt

Q1

Q2

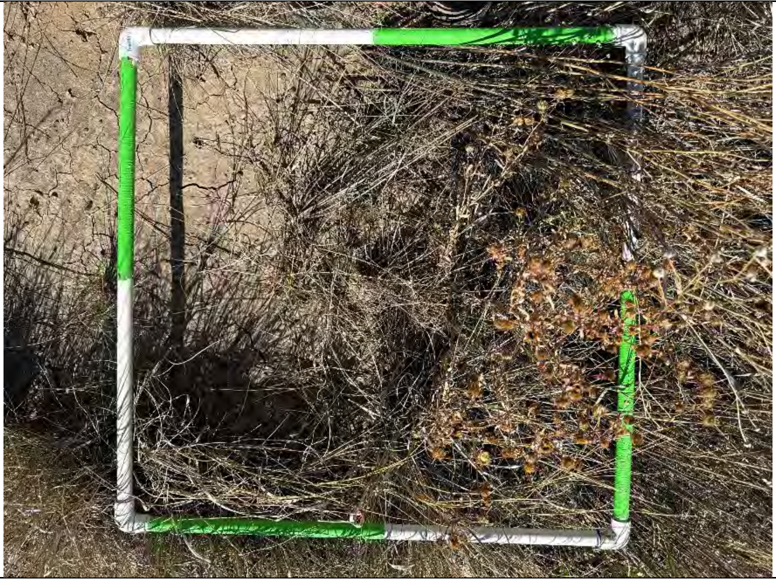
Q3

O-VMU4-T29P

Belt

Q1

Q2



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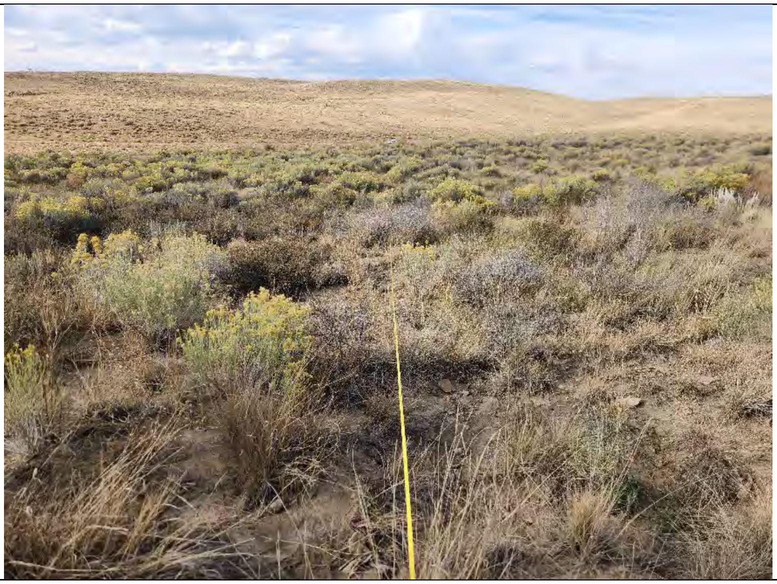
O-VMU4-T30P



Belt

Q1

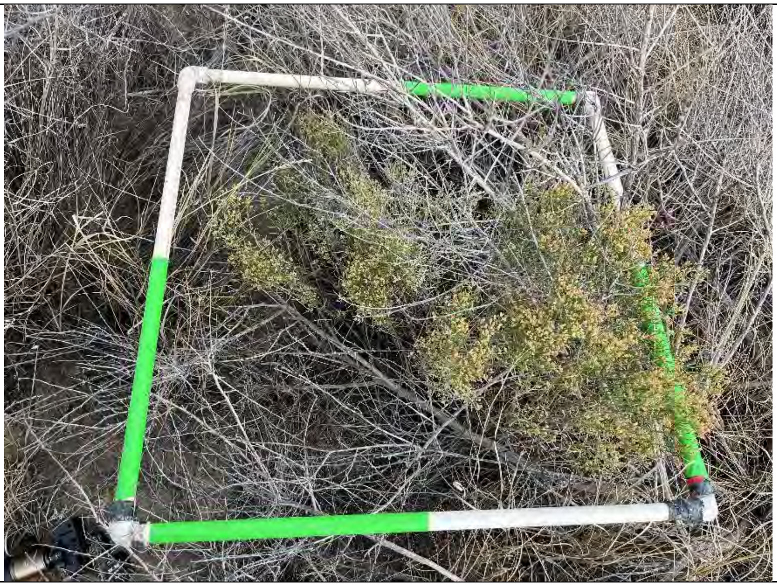
Q2

Q3

O-VMU4-T31P

Belt

Q1



Q2

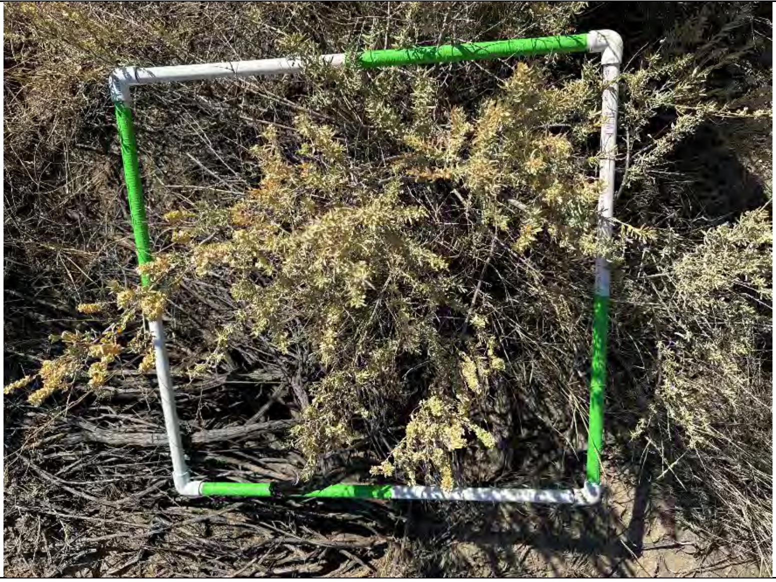
Q3

O-VMU4-T32P

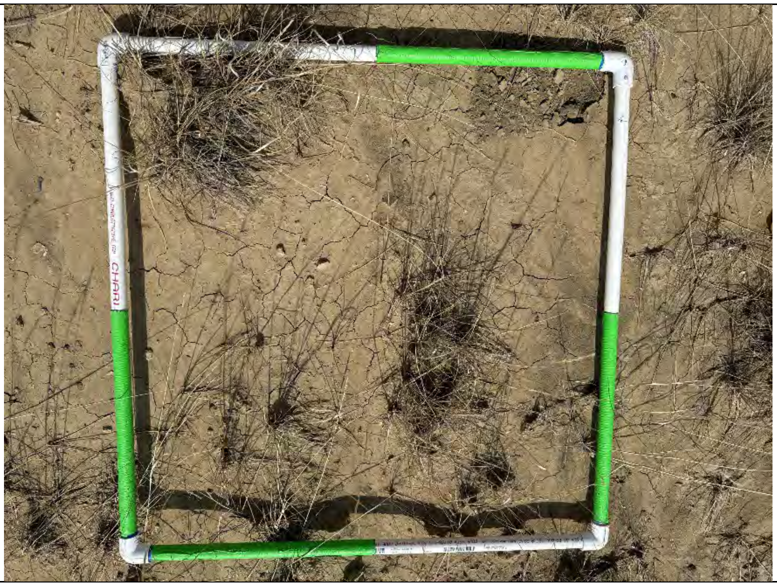
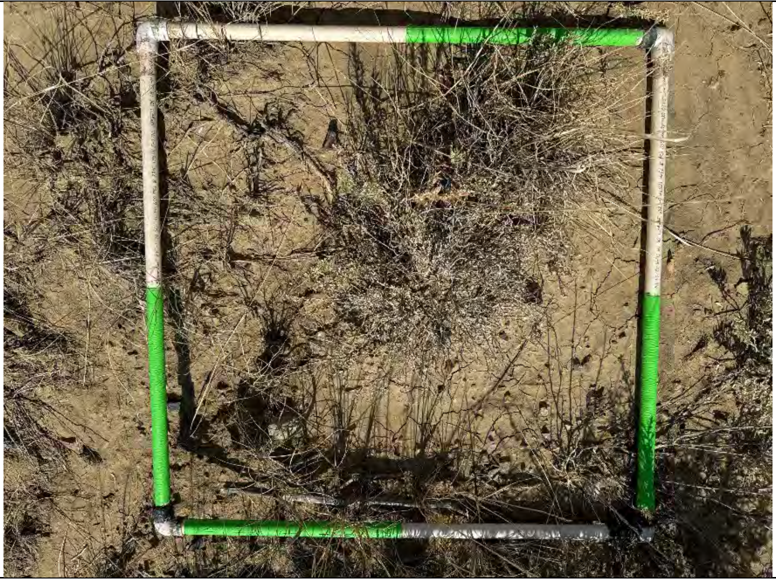
Belt

Q1

Q2



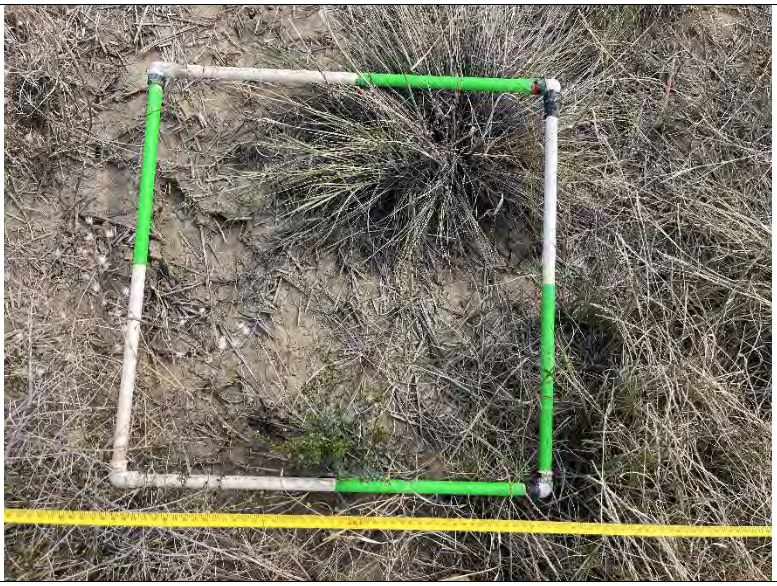
Q3

O-VMU4-T33P	
	
Belt	Q1
	
Q2	Q3

O-VMU4-T34P

Belt

Q1



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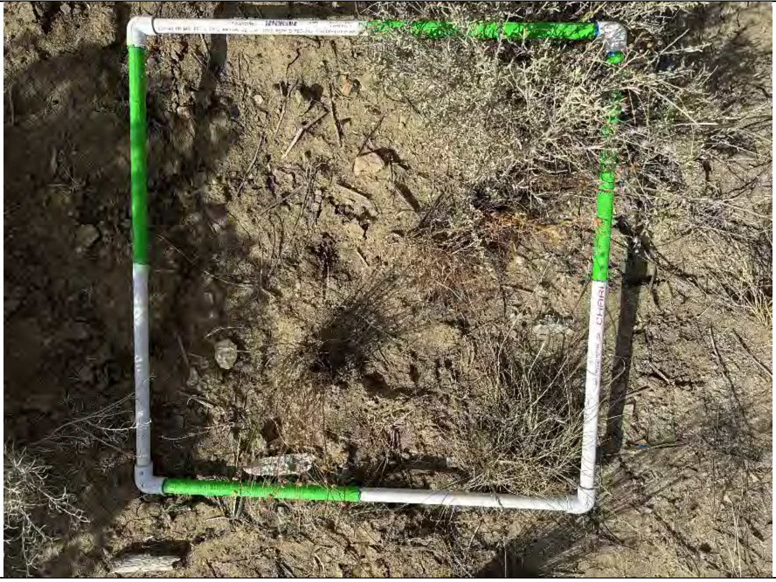


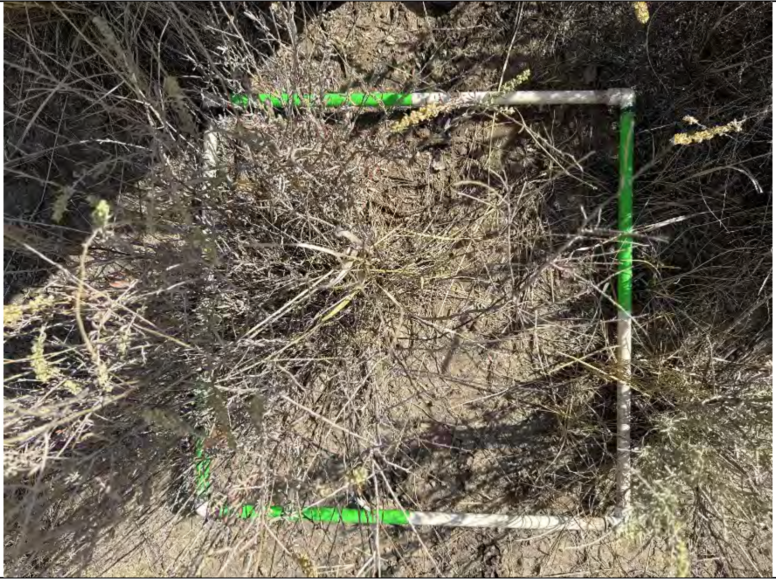
Q3

O-VMU4-T35P

Belt

Q1

Q2

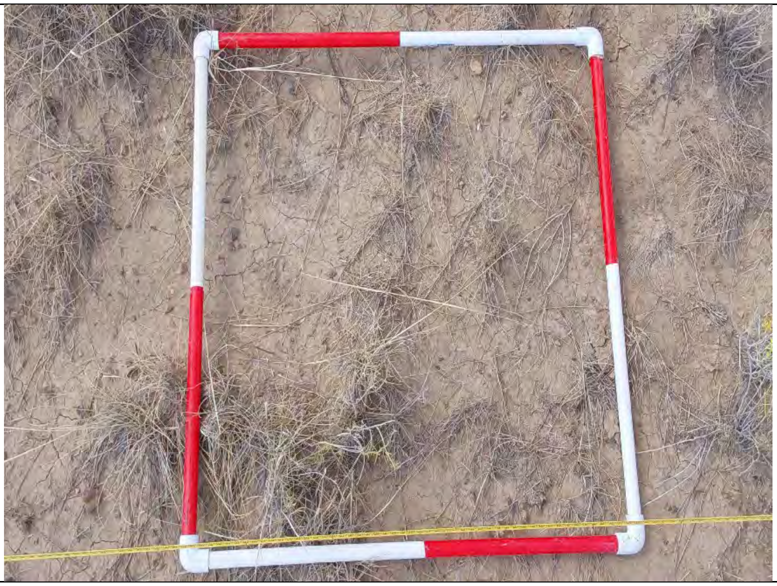


Q3

O-VMU4-T36P

Belt

Q1



Q2

Q3

O-VMU4-T37P

Belt

Q1

Q2

Q3

O-VMU4-T38P

Belt

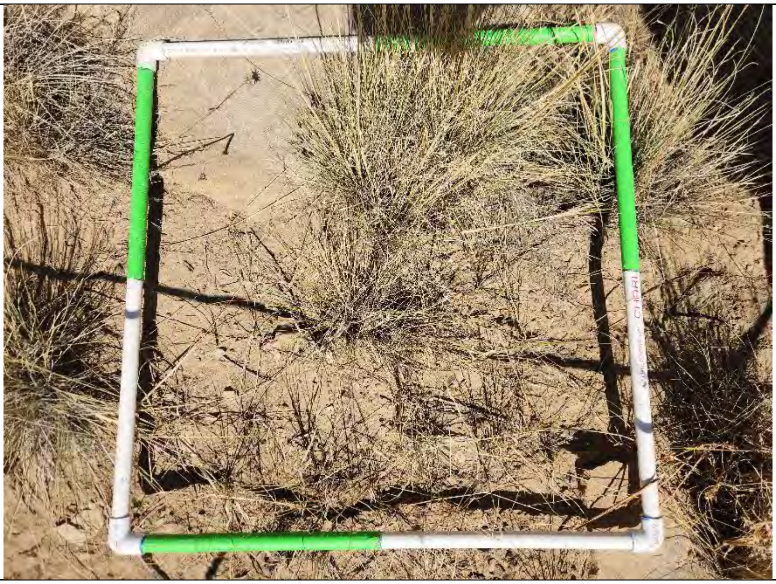
Q1

Q2

Q3

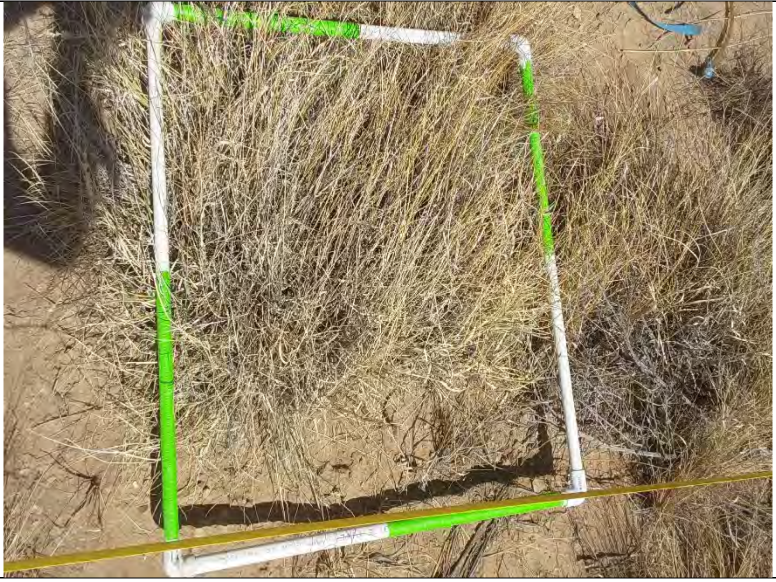
O-VMU4-T39P

Belt

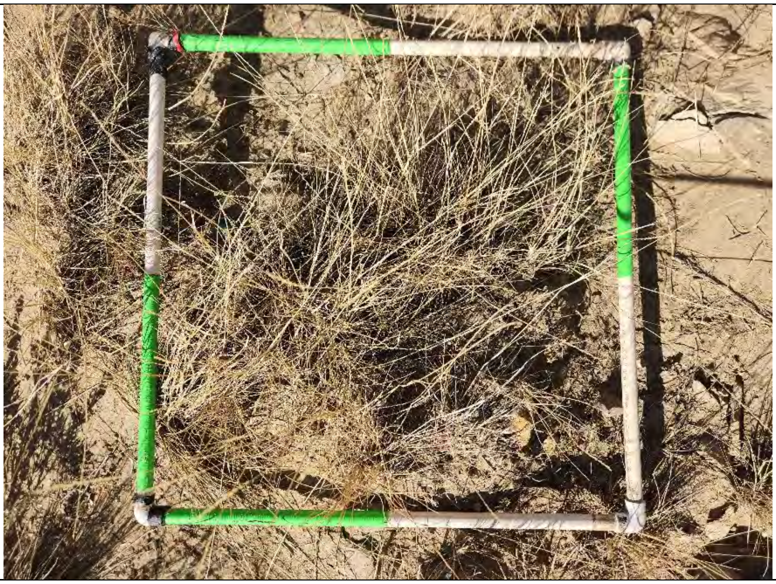
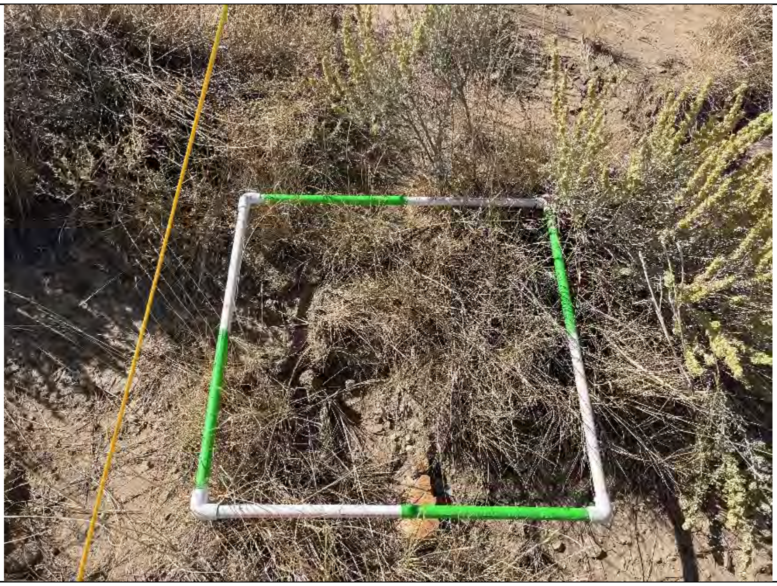


Q1

Q2



Q3

O-VMU4-T40P	
	
Belt	Q1
	
Q2	Q3

APPENDIX C

Vegetation Statistical Analysis

Table C1: Equations for Vegetation Data Analysis

Attribute	Equation	Where
Mean	$\bar{x} = \frac{\sum x}{n}$	$\bar{x}$ = sample mean $\sum$x = sum of values for variable n = number of samples
Standard Deviation	$s = \sqrt{\frac{\sum(\bar{x} - x)^2}{n - 1}}$	s = standard deviation $\sum$ = sum $\bar{x}$ = sample mean n = number of samples
Variance (sample)	$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$	s^2 = variance $\sum$ = sum x_i = Value of variable for sample *i* $\bar{x}$ = sample mean n = number of samples
90% Confidence Interval	$\bar{x} \pm z \frac{s}{\sqrt{n}}$	$\bar{x}$ = sample mean z = the critical value from the normal distribution with α/2 in each tail s = standard deviation n = number of samples
N_{min} (Sample Adequacy - Normal Data)	$N_{min} = \frac{t^2 s^2}{(\bar{x}D)^2}$	N_{min} = number of samples required t = two tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom s = standard deviation (s^2 = variance) $\bar{x}$ = sample mean D = the desired level of accuracy, which is 10 percent of the mean
Logarithmic Transformation	Y' = log(Y + k)	log = logarithmic function Y = attribute value k = constant, here we use 1
one-sample, one-sided t test	$t^* = \frac{\bar{x} - 0.9\ (technical\ std)}{s/\sqrt{n}}$	t* = calculated t-statistic $\bar{x}$ = sample mean s = standard deviation n = sample size
one-sample, one-sided sign test	$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$	z = sign test statistic k = test statistic resulting from the number of values falling below 90% of the technical standard n = sample size
Relative Cover (Perennial/Biennial Species)	Rp/b-cvr = Cvrp/b-sp. / Cvrp/b-abs.	$R_{p/b\text{-}cvr}$ = Calculated Relative Cover for a Perennial/Biennial Species $Cvr_{p/b\text{-}sp.}$ = Mean Absolute Cover of a Perennial/Biennial Species $Cvr_{p/b\text{-}abs.}$ = Mean Absolute Perennial/Biennial Cover
Relative Cover (All Species)	Rcvr = Cvrsp. / CvrAbs.	R_{cvr} = Calculated Relative Cover for a species $Cvr_{sp.}$ = Mean Absolute Cover of ANY species $Cvr_{abs.}$ = Mean Absolute Cover for All Species

Notes:
All Appendix C analysis, tables, and figures computed using R software: (R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/

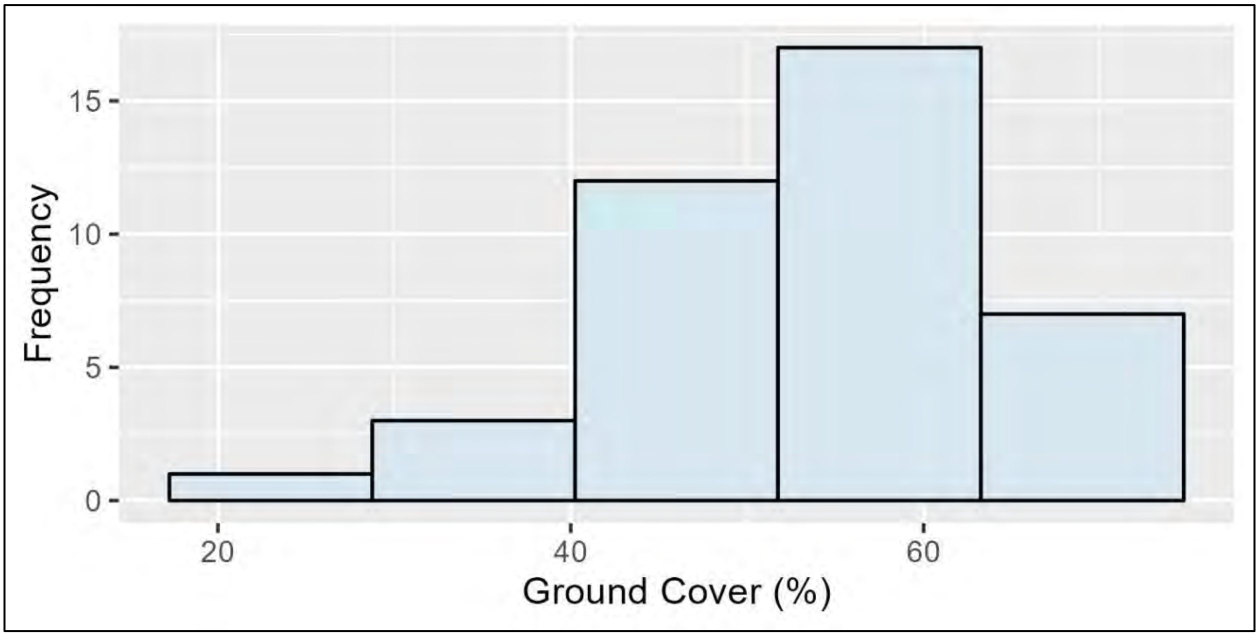
Table C-2: Data for Normal Distribution and Variance Analysis, O-VMU-4, 2024

Transect	Raw Data				Log-Transformed Data	
	Total Ground Cover (%)	Perennial Vegetation Cover (%)	Annual Forage Production (lbs/ac)	Woody Plant Density (#/ac)	Log - Total Ground Cover	Log - Perenial Vegetation CVover
O-VMU4-T01A	60	48	840	1,052	1.79	1.69
O-VMU4-T01P	46	32	375	1,902	1.67	1.52
O-VMU4-T02P	44	40	541	1,659	1.65	1.61
O-VMU4-T03P	58	40	801	3,399	1.77	1.61
O-VMU4-T04P	50	42	1,219	3,764	1.71	1.63
O-VMU4-T05P	38	28	1,352	2,388	1.59	1.46
O-VMU4-T06P	36	24	541	4,249	1.57	1.40
O-VMU4-T07P	52	34	654	2,469	1.72	1.54
O-VMU4-T08P	56	46	643	5,463	1.76	1.67
O-VMU4-T09P	66	44	1,458	1,255	1.83	1.65
O-VMU4-T10P	56	42	629	850	1.76	1.63
O-VMU4-T11P	62	48	289	809	1.80	1.69
O-VMU4-T12P	34	28	369	405	1.54	1.46
O-VMU4-T13P	50	24	1,078	728	1.71	1.40
O-VMU4-T14P	64	52	848	4,452	1.81	1.72
O-VMU4-T15P	66	22	1,032	1,093	1.83	1.36
O-VMU4-T16P	48	34	1,107	3,723	1.69	1.54
O-VMU4-T17P	54	38	865	1,295	1.74	1.59
O-VMU4-T18P	44	28	1,406	2,226	1.65	1.46
O-VMU4-T19P	72	62	574	3,278	1.86	1.80
O-VMU4-T20P	58	44	506	3,602	1.77	1.65
O-VMU4-T22P	60	42	363	2,185	1.79	1.63
O-VMU4-T23P	56	36	759	2,873	1.76	1.57
O-VMU4-T24P	62	50	859	931	1.80	1.71
O-VMU4-T25P	44	36	529	1,255	1.65	1.57
O-VMU4-T26P	56	40	1,313	809	1.76	1.61
O-VMU4-T27P	68	46	444	2,064	1.84	1.67
O-VMU4-T28P	46	32	344	2,873	1.67	1.52
O-VMU4-T29P	52	44	877	2,185	1.72	1.65
O-VMU4-T30P	68	44	797	2,347	1.84	1.65
O-VMU4-T31P	52	34	1,263	1,497	1.72	1.54
O-VMU4-T32P	52	38	834	2,550	1.72	1.59
O-VMU4-T33P	26	16	419	6,192	1.43	1.23
O-VMU4-T34P	68	32	1,522	1,700	1.84	1.52
O-VMU4-T35P	44	36	554	3,035	1.65	1.57
O-VMU4-T36P	50	38	578	1,295	1.71	1.59
O-VMU4-T37P	42	26	592	6,880	1.63	1.43
O-VMU4-T38P	48	36	177	2,550	1.69	1.57
O-VMU4-T39P	60	46	1,532	1,052	1.79	1.67
O-VMU4-T40P	62	36	751	2,347	1.80	1.57
Mean	53.3	37.7	790.8	2417.0	1.73	1.57
Standard Deviation	10.4	9.1	369.3	1504.8	0.1	0.1
Count	40	40	40	40	40	40
Variance	108	84	136364	2264571	0.01	0.01
90% Confidence Interval	2.70	2.38	96.04	391.37	0.02	0.03
Technical Standard	52%	24%	550	400	2.74	2.60
90% of Standard	46.8%	21.6%	495	360	2.70	2.56

Notes:

2024 Data are found in Appendix A

Appendix C: Statistics Exhibit 1: Total Ground Cover

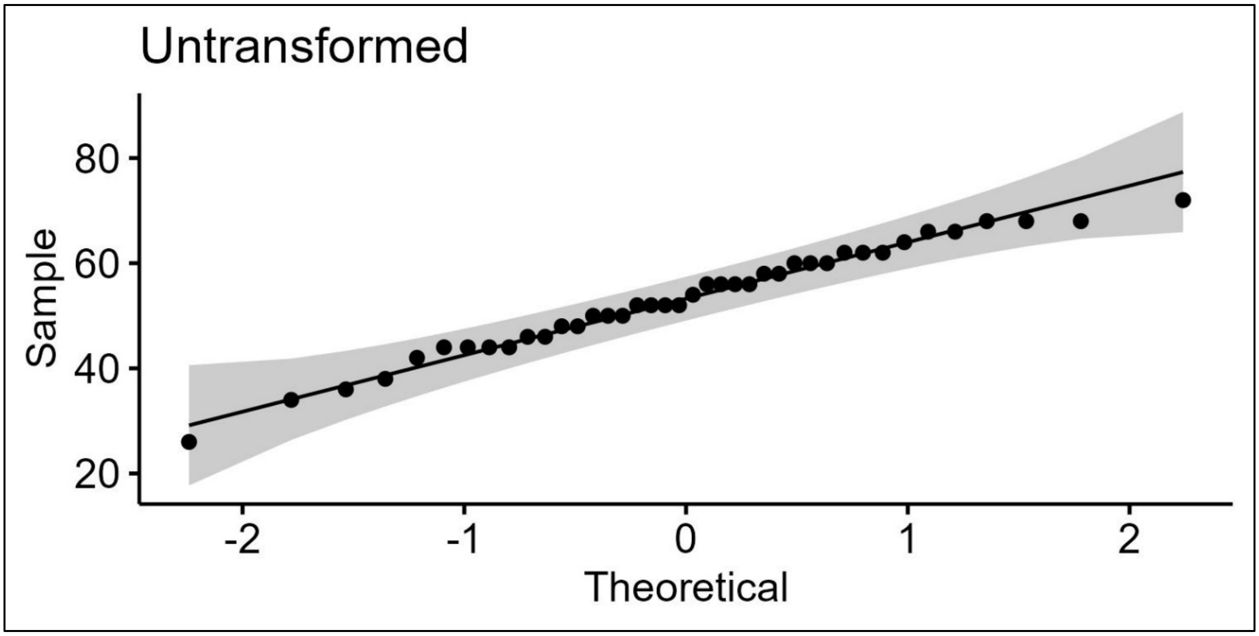


N	Mean	90% CI		SE	SD	Skew	Kurtosis	1st Quartile	Median	3rd Quartile
40	53.25	50.6	66.97	0.25	10.4	-0.39	2.82	46	53	60.5

Sample adequacy is 11 samples.

Normality

Q-Q Plot



Normality (cont.)

Shapiro-Wilk Test

W statistic	P value
0.979	0.66

H0: F(Y) = N(μ, σ)

The population is normally distributed.

H1: F(Y) ≠ N(μ, σ)

The population is not normally distributed

Statistical Analysis

The data are normally distributed, and sample adequacy has been met, therefore the statistical test was performed using a standard t-test under classic null hypothesis:

H_0: Reclaim ≥ 90% of the Performance Standard

H_a: Reclaim < 90% of the Performance Standard

Therefore,

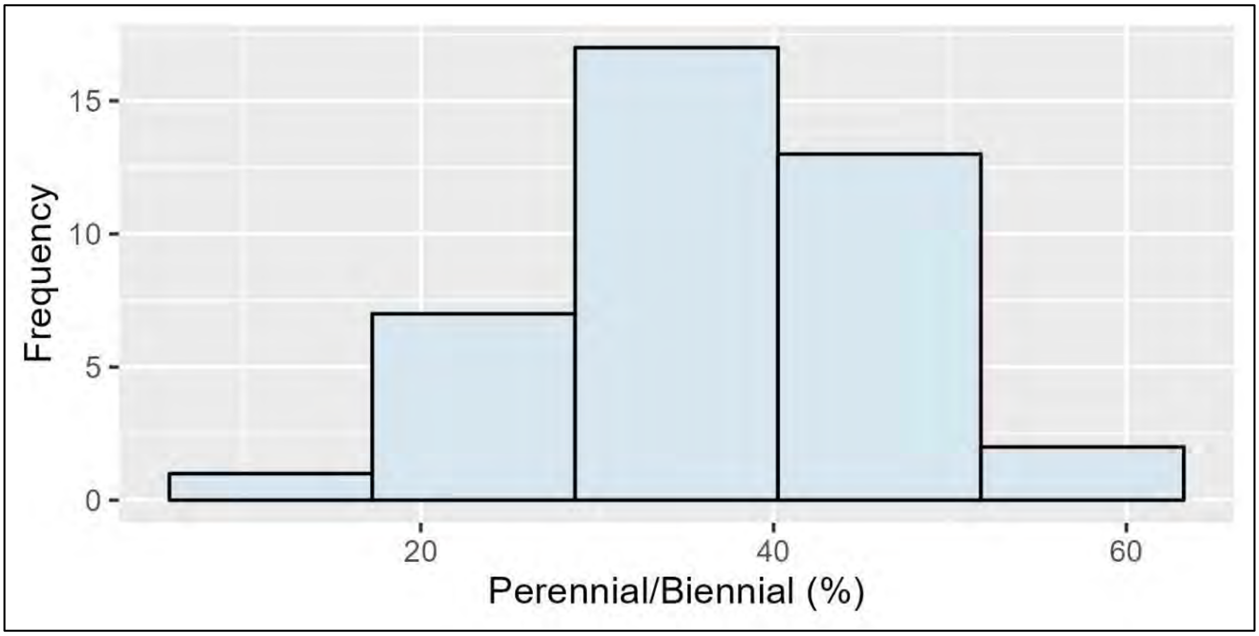
If $t^* \geq t_{(\alpha;\, n\text{-}1)}$, conclude that the performance standard was met.

If $t^* < t_{(\alpha;\, n\text{-}1)}$, conclude failure to meet the performance standard.

Total Ground Cover (%)	
Mean (%)	53.25
Standard Deviation (%)	10.4
Sample Size	40
Technical Standard (%)	52
t*	3.93
1-tail t (0.1, 39)	-1.304
p-value	1

t*(3.93) ≥ t(-1.304) and p>0.1, the performance standard is met

Appendix C: Statistics Exhibit 2: Perennial Ground Cover

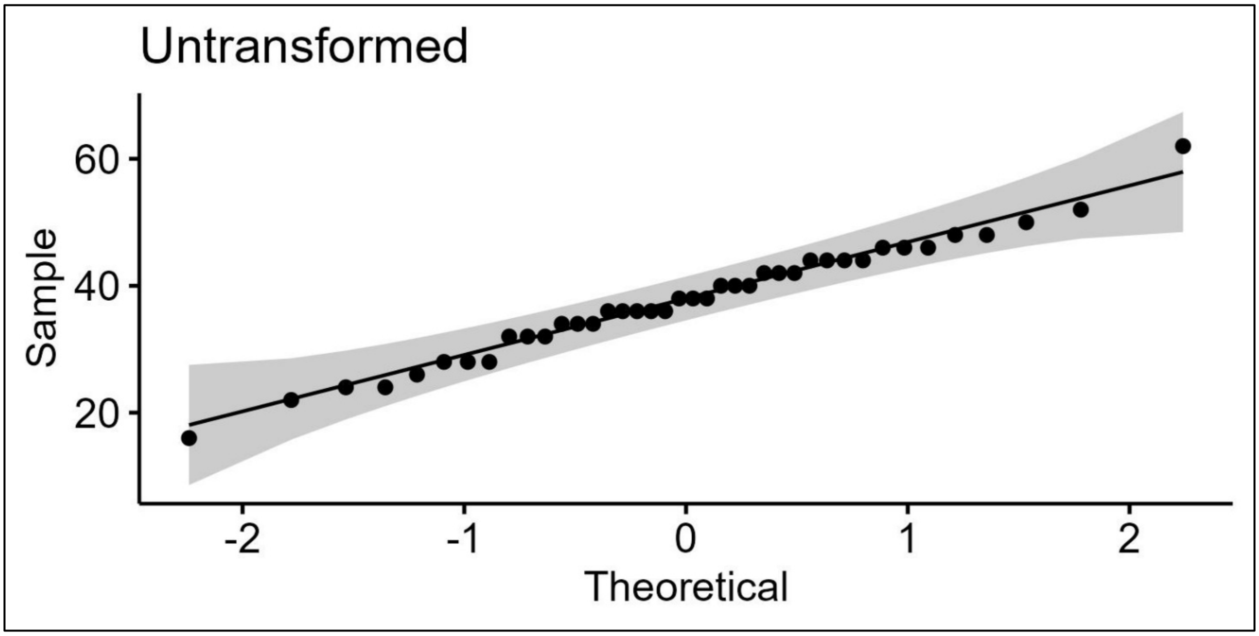


N	Mean	90% CI		SE	SD	Skew	Kurtosis	1st Quartile	Median	3rd Quartile
40	37.7	35.3	40.1	0.23	9.14	0.00	3.23	32	38	44

Sample adequacy is 17 samples.

Normality

Q-Q Plot



Normality (cont.)

Shapiro-Wilk Test

W statistic	P value
0.9876	0.933

H0: F(Y) = N(μ, σ)

The population is normally distributed.

H1: F(Y) ≠ N(μ, σ)

The population is not normally distributed

Statistical Analysis

The data are normally distributed, and sample adequacy has been met, therefore the statistical test was performed using a standard t-test under classic null hypothesis:

H_0: Reclaim ≥ 90% of the Performance Standard

H_a: Reclaim < 90% of the Performance Standard

Therefore,

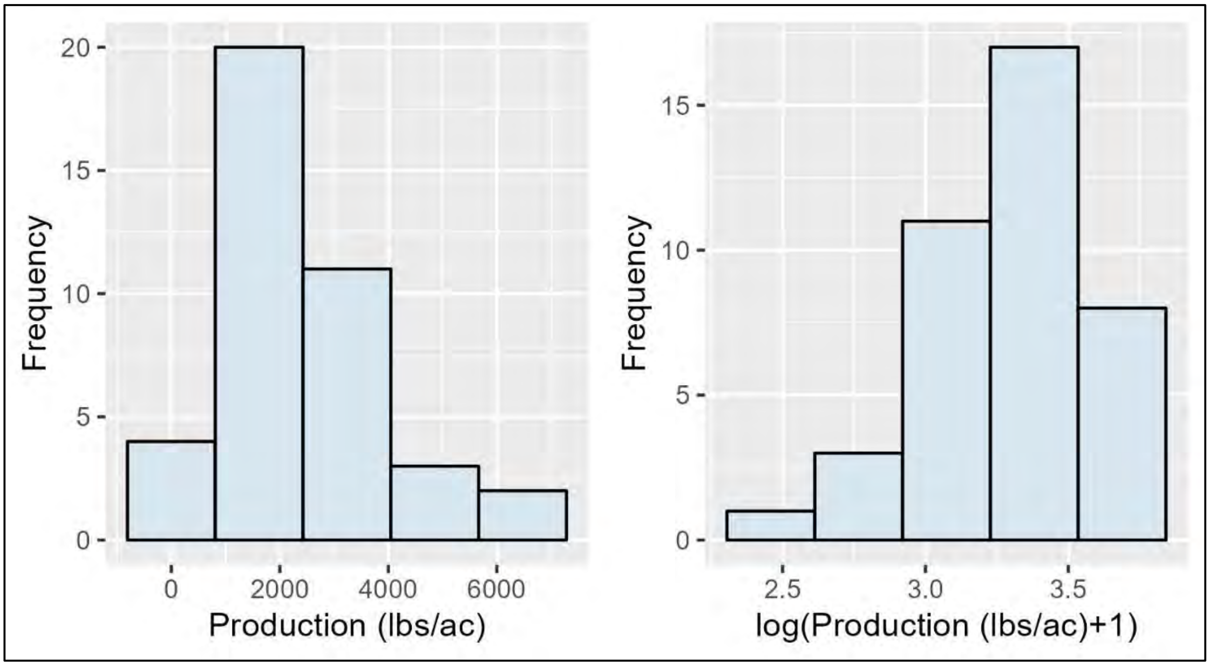
If $t^* \geq t_{(\alpha;\, n-1)}$, conclude that the performance standard was met.

If $t^* < t_{(\alpha;\, n-1)}$, conclude failure to meet the performance standard.

Perennial/Biennial Cover (%)	
Mean	37.7
Standard Deviation	9.14
Sample Size	40
Technical Standard	24
t*	11.10
1-tail t (0.1, 39)	-1.304
p-value	1

t*(11.10) ≥ t(-1.304) and p>0.1, the performance standard is met

Appendix C: Statistics Exhibit 3: Production

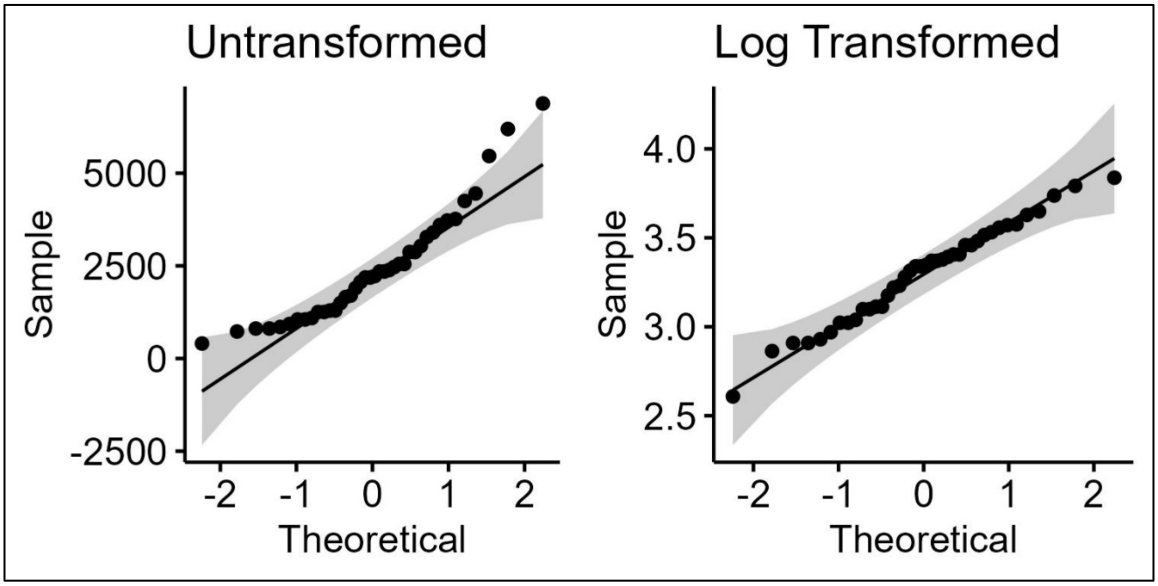


Data	N	Mean	90% CI		SE	SD	Skew	Kurtosis	1st Quartile	Median	3rd Quartile
Data	40	790.8	694.8	886.9	9.23	369.3	0.52	2.27	537.9	754.8	1043.7
log(X+1)	40	2.85	2.80	2.91	0.01	0.22	-0.42	2.86	2.73	2.88	3.02

Sample adequacy is 62 samples.

Normality

Q-Q Plot



Normality (cont.)

Shapiro-Wilk Test

Data	W statistic	P value
Data	0.942	0.0406
Log	0.968	0.313

H0: F(Y) = N(μ, σ)

The population is normally distributed.

H1: F(Y) ≠ N(μ, σ)

The population is not normally distributed

Statistical Analysis

The data are normally distributed with a logarithmic transformation, and sample adequacy has not been met, therefore the statistical test was performed using a standard t-test under reverse null hypothesis:

H_0: Reclaim ≤ 90% of the Performance Standard

H_a: Reclaim > 90% of the Performance Standard

Therefore,

If $t^* \geq t_{(1-\alpha;\, n-1)}$, conclude that the performance standard was met.

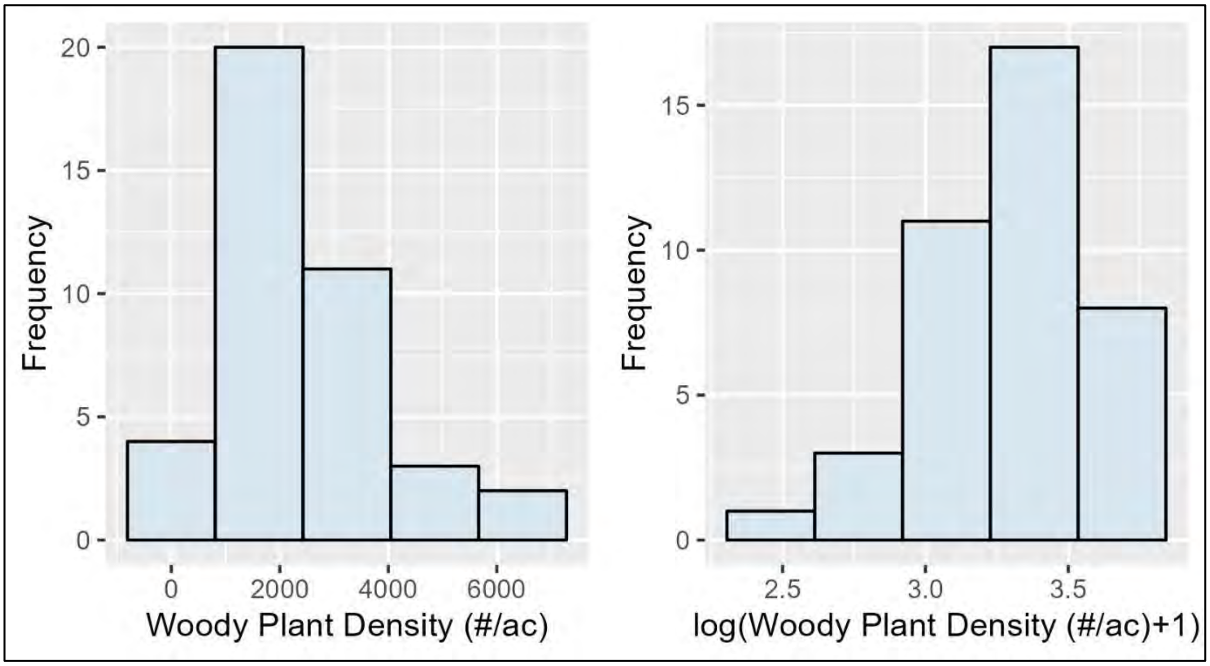
If $t^* < t_{(1-\alpha;\, n-1)}$, conclude failure to meet the performance standard.

Production (lbs/ac)	
Mean	2.85
Standard Deviation	0.22
Sample Size	40
Technical Standard[1]	2.70
t*	4.31
1-tail t (0.9, 39)	1.304
p-value	p < 0.001

t*(4.31) ≥ t(1.304) and p < 0.1, the performance standard is met

[1] Note the value reported is log(X)+log(0.9) not just the log(X)

Appendix C: Statistics Exhibit 4: Woody Plant Density

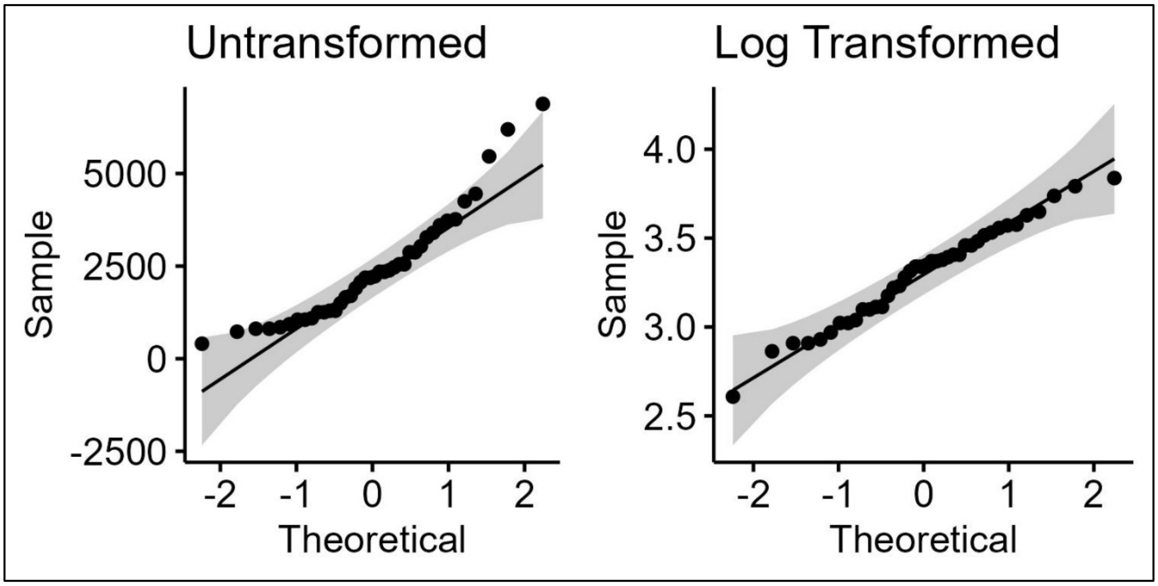


Data	N	Mean	90% CI		SE	SD	Skew	Kurtosis	1st Quartile	Median	3rd Quartile
Data	40	2417.0	2025.6	2808.4	37.6	1504.8	1.15	4.06	1254.5	2205.5	3095.8
log(X+1)	40	3.30	3.23	3.37	0.01	0.28	-0.23	2.60	3.10	3.34	3.49

Sample adequacy is 76 samples.

Normality

Q-Q Plot



Normality (cont.)

Shapiro-Wilk Test

Data	W statistic	P value
Data	0.904	0.0025
Log	0.983	0.8229

H0: F(Y) = N(μ, σ)

The population is normally distributed.

H1: F(Y) ≠ N(μ, σ)

The population is not normally distributed

Statistical Analysis

The data are normally distributed with a logarithmic transformation, and sample adequacy has not been met, therefore the statistical test was performed using a standard t-test under reverse null hypothesis:

H_0: Reclaim ≤ 90% of the Performance Standard

H_a: Reclaim > 90% of the Performance Standard

Therefore,

If $t^* \geq t_{(1-\alpha;\, n-1)}$, conclude that the performance standard was met.

If $t^* < t_{(1-\alpha;\, n-1)}$, conclude failure to meet the performance standard.

Woody Plant Density (#/ac)	
Mean	3.30
Standard Deviation	0.28
Sample Size	40
Technical Standard [1]	2.56
t*	16.70
1-tail t (0.9, 39)	1.304
p-value	p < 0.001

t*(16.70) ≥ t(1.304) and p < 0.1, the performance standard is met

[1] Note the value reported is log(X)+log(0.9) not just the log(X)

REPORT

Vegetation Management Unit 4
Vegetation Success Monitoring, 2023

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March 2024

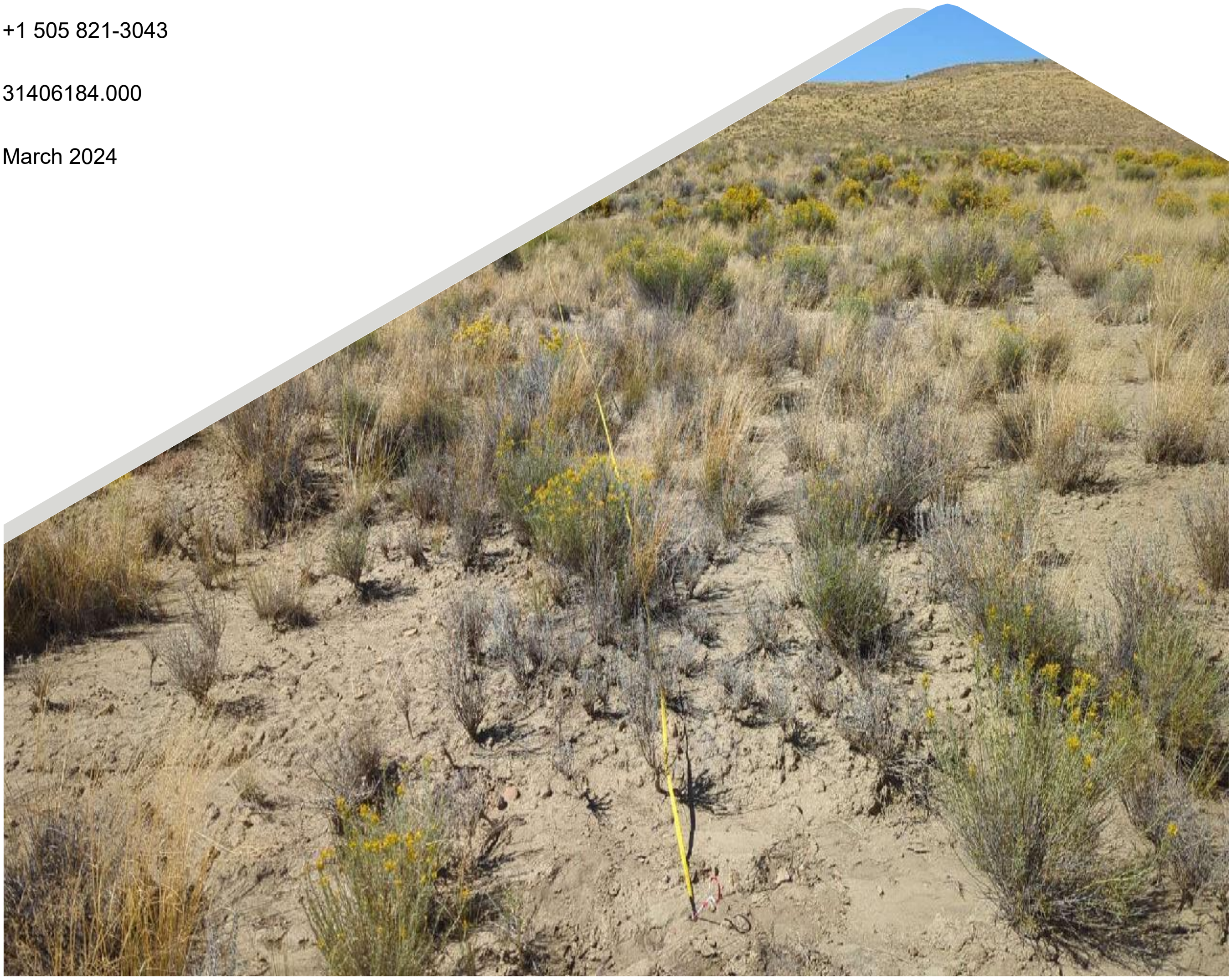

Table of Contents

1.0 INTRODUCTION 1

1.1 Vegetation Management Unit 4 1

1.2 Reclamation and Revegetation Procedures 1

1.3 Prevailing Climate Conditions 2

1.4 Livestock 2

2.0 VEGETATION STANDARDS AND MONITORING METHODS 3

2.1 Vegetation Success Standards 3

2.2 Sampling Design 4

2.3 Foliar, Canopy and Ground Cover 4

2.4 Annual Forage and Total Production 5

2.5 Shrub Density 5

2.6 Statistical Analysis 5

3.0 RESULTS 8

3.1 Total Ground and Perennial Vegetation Cover 8

3.2 Production 9

3.3 Shrub Density 9

3.4 Composition and Diversity 10

3.5 Noxious Weeds 11

4.0 SUMMARY 11

5.0 REFERENCES 13

TABLES

Table 1: Revegetation Success Standards in the McKinley Mine OSM Permit

Table 2: North Mine Seasonal and Annual Precipitation, 2015-2024

Table 3: Summary Statistics, O-VMU-4, 2021-2023

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU-4, 2023

Table 5: Relative Shrub, Tree, and Cacti Density, O-VMU-4, 2023

Table 6: Results for Diversity, O-VMU-4, 2023

Table 7: Results for Diversity, O-VMU-4, 2021-2022

FIGURES

Figure 1: General Overview of the McKinley OSMRE Permit Area Vegetation Management Units (VMU), 2023

Figure 2: Departure of Growing Season Precipitation from Long-Term Mean at Window Rock: Rain 3 and 6 Gauges

Figure 3: Vegetation Monitoring Transects 2023, Vegetation Management Unit 4

Figure 4: Vegetation Plot and Transect Layout

Figure 5: Typical Grass-Shrubland Vegetation in O-VMU-4, September 2023

Figure 6: Stabilization of the Mean for Annual Forage Production, O-VMU-4, 2023

Figure 7: Stabilization of the Mean for Shrub Density, O-VMU-4, 2023

APPENDICES

APPENDIX A
Vegetation Data Summary

APPENDIX B
Quadrat Photographs

APPENDIX C
Statistical Analysis

1.0 INTRODUCTION

Mining at the McKinley Mine ceased in 2009 and reclamation of remaining support facilities (e.g., impoundments, roads, etc.) is nearing completion. Reclamation practices have been applied at the McKinley Mine under various programs since at least the early 1970s. Chevron Mining Inc. (CMI) is assessing the vegetation in reclaimed areas in anticipation of future bond and liability release. CMI understands the importance of returning the mined lands to productive traditional uses in a timely manner. To qualify for release, the increment, or permit area as a whole, must meet the Permit No. NM-0001K (2016) (the Permit) permanent-program revegetation-success criteria as shown in Table 1 of this report. In general, the lands must be in a condition that is as good as or better than the pre-mine conditions, stable, and capable of supporting the designated postmining land uses of grazing and wildlife. WSP USA, Inc. (WSP) was retained to monitor and assess the vegetation relative to the established vegetation success standards.

This report documents the vegetation community attributes collected in 2023 in O-VMU-4 and compares them to the Permit's vegetation-success criteria. Section 1 includes the introduction and a general overview. Section 2 describes the vegetation monitoring methods that were used in 2023. Section 3 presents the results of the assessment with respect to total ground cover, perennial vegetation cover, forage production, woody plant density (shrub density), and composition and diversity. Section 4 is a summary of the results for O-VMU-4 with emphasis on vegetation success.

The 2023 sampling program was conducted and evaluated in accordance with the updated monitoring methods and revegetation success standards contained in Permit Modification Number 23-03. More details beyond what is already discussed throughout this report may be found in the Permit.

1.1 Vegetation Management Unit 4

This report presents results from 2023 quantitative vegetation monitoring conducted in Vegetation Management Unit 4 (O-VMU-4), which is in the eastern portion of Area 6 and northern portion of Area 3 (Figure 1). The configuration of the vegetation monitoring units within the U.S. Department of the Interior – Office of Surface Mining Reclamation and Enforcement (OSMRE) Permit Area, were developed in consultation with OSMRE. Undisturbed lands included within the VMU were not part of the sampling program. O-VMU-4 encompasses about 1,242 acres, comprised mostly of permanent program lands (PPL) and some initial program lands (IPL). Both PPL and IPL as one unit must meet the PPL success criteria as discussed in the Permit in Section 6.5.1.2. The 10-year period of extended responsibility, however, only applies to PPL.

The elevation of O-VMU-4 ranges from about 7,200 to 7,600 feet above mean sea level. Reclamation started in 1986 with the vast majority seeded by 2014. Thus, the reclamation in the majority of O-VMU-4 ranges from 10 to 38 years old. This section provides a general description of the reclamation activities that were implemented. Additional details of the reclamation for specific areas can be obtained through review of the McKinley Mine annual reports.

1.2 Reclamation and Revegetation Procedures

Reclamation of permanent program lands included grading of the spoils to achieve a stable configuration, positive drainage, and approximate original contour. After grading, graded spoil monitoring was conducted to determine the suitability of the materials. A minimum of 6 inches of topdressing (topsoil or topsoil substitute) were then applied over suitable spoils.

After topdressing placement, the seedbed was scarified or ripped on the contour to a depth of about 8 to 12 inches. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, certified weed-free, long-stem, hay mulch, or straw was applied at a rate of about 2 tons per acre. The mulch was anchored 3 to 4 inches into the cover with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which tends to favor the establishment of cool-season grasses and shrubs. The approved seed mixes used at McKinley have varied over time but included both warm-season grasses, and introduced and native cool-season grasses, introduced and native forbs, and shrubs. The early seed mixes tended to emphasize the use the alfalfa and cool-season grasses. The majority of seed mixes planted on IPL consisted of native and introduced cool season grasses, limited warm-season grasses, some shrubs, but no forbs. Over time the seed mixes on PPL shifted to include more warm-season grasses, more shrub species, and a variety of forbs.

Initial program lands were typically graded so they were no steeper than 3:1 and topsoiled. Seeding practices were like those done on permanent program lands.

1.3 Prevailing Climate Conditions

The amount and distribution of precipitation are important determinants for vegetation establishment and performance. Once vegetation is established, the precipitation dynamics affect the amount of vegetation cover and biomass on a year-to-year basis with grasses and forbs showing the most immediate response. Precipitation has been monitored at the McKinley Mine throughout most of its life at two primary precipitation stations (Bluff and South Tipple). The mine added a system of 8 additional seasonal precipitation gauges to better capture more representative data from the various mining areas in 2011-2012 (gauges named by area). Data from the Rain 3 and 6 gauges were used to evaluate precipitation in O-VMU-4 (Figure 2).

Table 2 contains a summary of precipitation recorded at all the rain gauges in the North Mine Area. Total annual precipitation measured at the Bluff gauge near the mine entrance was 8.59 inches, below the regional average of 11.8 inches at Window Rock. Rain 3 and 6 gauges recorded 4.96 and 4.29 inches of precipitation, respectively, from late April to mid-November (the period these stations operate), whereas the Bluff gauge recorded approximately 5.24 inches of rain for the same period with data throughout all of November. Mine wide, the precipitation recorded in 2023 between April and November at the other eight gauges indicate below average precipitation, on a scale of about 2-3 inches below average, with variation both spatially and temporally.

Growing season precipitation provides additional context to evaluate vegetation performance in O-VMU-4. The departure of growing season precipitation (April through September) between Rain 3 and 6 gauges and the Window Rock (1937-1999) long-term seasonal mean is illustrated in Figure 2. Growing season precipitation in O-VMU-4 was well below the long-term seasonal mean from 2018 to 2023, with the exception of the 2022 growing season wherein both the Rain 3 and 6 gauges were above the seasonal mean, measuring approximately 1.67 and 0.36 inches above the mean, respectively. Growing season precipitation from the Rain 3 and 6 gauges in 2023 were 1.8 and 2.36 inches below average, respectively.

1.4 Livestock

CMI has been aggressively managing trespass livestock and as a result evidence of trespass horses was less apparent in 2023 in O-VMU-4. The combination of past grazing pressure with exceptional drought, however, may in some years adversely affect the ability to demonstrate that the vegetation is meeting or can meet the revegetation success standards.

2.0 VEGETATION STANDARDS AND MONITORING METHODS

Vegetation attributes in O-VMU-4 were quantified using the methods described in Section 6.5 of the Permit as modified in Permit Modification 23-03. Vegetation monitoring in O-VMU-4 was conducted from September 23 through October 4, 2023.

2.1 Vegetation Success Standards

The vegetation success standards for the Permit Area consist of five vegetative parameters: total cover, perennial cover, forage production, woody plant density, and diversity (Table 1). The total ground cover requirement, or the combined means for live vegetation cover and litter cover on the reclamation is 52%. The perennial vegetation cover requirement is 24%. Both total ground and perennial vegetation cover use absolute cover. The annual forage production requirement is 550 air-dry pounds per acre (lbs/ac). The shrub density success standard is 400 live woody stems per acre. In accordance with 30 CFR 816.116 (a)(2), success for total cover, perennial cover, forage production, and shrub density shall be ≥ 90% of the standard.

Cover is defined in three ways for accurate evaluation of diversity according to Table 1.

1) Absolute cover utilizes first-hit line point intercept (LPI) data and is used to assess the perennial grass diversity standard.
2) Relative perennial cover, the metric used to assess some grass, forb, and shrub standards, compares the cover of perennial species relative to the sum of perennial plants calculated from all-hit LPI data (excluding noxious weeds) within the VMU.
3) Relative total cover, the metric used to assess the any-single-species diversity standard, is calculated by dividing the percent cover of each perennial/biennial species by the total live vegetative cover from all-hit LPI data (excluding noxious weeds) within a VMU.

Biennial forbs are included in the vegetation cover analyses and biennial forb diversity standards because they are important to long term ecological success of the reclamation. As monocarpic, or single flowering species, these forbs produce a high number of seeds, and as a result, persist long-term in the reclamation plant community. Future mention of “perennial” in this report thus includes biennial species.

Relative shrub density, the metric used to assess the single shrub species standard, is calculated using belt-transect data by dividing the density of each species by the total density within a sampling unit. Relative calculations are valuable to determine whether a species or functional group is excessively dominant. The number of species requirement for the various diversity standard components (e.g., ≥ 2 species cool-season grasses) is calculated by adding the total number of unique species captured in the LPI surveys.

Diversity is evaluated against numerical guidelines for different vegetation types. In summary, the diversity guideline is met if perennial grasses contribute 7% or more absolute vegetation cover; at least two cool-season perennial grasses have individual relative perennial vegetation covers of 5% and 1.5% or more; at least two warm-season perennial grasses species with the highest cover species 5% or more relative perennial vegetation cover and the remaining species combining to contribute 1.5% or more relative perennial vegetation cover, at least three non-annual non-noxious forbs combining to contribute 1% or more relative total vegetation cover; shrubs combining to 6% or more relative perennial vegetation cover and no single shrub species with greater than 70% relative shrub density, and no single species of any functional group with 40% or more relative total vegetation cover. Diversity is also demonstrated by evidence of colonization or recruitment of native (not-seeded) plants from adjacent undisturbed native areas.

2.2 Sampling Design

All lands (PPL and IPL) were included in the vegetation-sampling pool for unbiased random sampling. The transect locations were reviewed with OSMRE in advance of sampling. A 100-meter (m) by 100 m square grid was superimposed over the entire VMU to delineate vegetation sample plots. Random points were created in a geographic information system and the locations including the program land (IPL or PPL) designations are shown in Figure 3. In the field, the randomly selected transect locations were assessed in numerical order with 40 primary transects accompanied by 10 alternate transects. If a transect location was determined to be unsuitable, the next alternative location was assessed for suitability. Transects that fell on or would intersect roads, drainage ways, wildlife rock piles, or prairie dog colonies were considered unsuitable.

Figure 4 shows the 100 m by 100 m vegetation plot with the cover transect orientation, and the location of the production quadrats and belt transect. The origin of the LPI transect is situated at the grid centroid and transect orientation (from 0° to 360°) is chosen randomly beginning from the transect origin, the point navigated to. LPI points are traversed to on transect left with the laser pointed towards transect right, to limit disturbance from walking on the quad and belt survey areas located on transect right. Each LPI transect is 50 m long with three half square meter (½ m^2) production quadrats placed flush with the meter tape with the bottom left corner at the 10, 25, and 40 m mark to the right of the transect. The belt transect corridor is 2 m by 50 m along the transect's right side.

2.3 Foliar, Canopy and Ground Cover

The LPI method is used to collect cover measurements required by the Permit to evaluate total cover, perennial cover, and diversity. Prior to production clipping, a 50 m measuring tape is suspended between two metal pins to extend the tape fully. A tripod mounted laser is then held along the edge of the tape, and readings are taken every meter for living plants, plant litter, rock fragments, and bare ground. When a live plant is encountered as a direct foliar hit, the species is recorded, and direct lower canopy live plant hits are also recorded that are observed down the profile. The LPI-derived data were evaluated against the permit area vegetation success standards for vegetation cover and diversity provided in Table 1, with first hits used in absolute cover calculations and all hits (upper and lower canopy hits) used in relative cover calculations.

Additional cover measurements were estimated from each production quadrat including relative cover for each species and total canopy cover, surface litter, rock fragments, and bare soil. Quadrat canopy cover data is not analyzed for success and is only briefly discussed in this report as additional support information (Table A-4). Canopy cover estimates include the foliage and foliage interspaces of all individual plant species rooted in the quadrat. Canopy cover is defined as the percentage of quadrat area included in the vertical projection of the canopy. The canopy cover estimates made on a species basis may exceed 100 percent in individual quadrats where the vegetation has multi-layered canopies. In contrast, the sum of the total canopy cover, surface litter, rock fragments, and bare soil does not exceed 100 percent. All cover estimates were made in 0.05 percent increments. Percent area cards were used to increase the accuracy and consistency of the cover estimates.

Not all plant species are expected to occur in the sampling transects and quadrats. Plants observed growing within the vegetation plots and across the reclaimed facility were inventoried while moving between sample locations and during formal sampling (Table A-7).

2.4 Annual Forage and Total Production

Forage production required by the Permit was determined by clipping and weighing all annual (current year's growth) above-ground forage biomass within the vertical confines of the three ½ m^2 quadrats placed systematically along the same 50 m transect used for LPI measurements. Biomass from all three quads from each transect are combined by species and the combined values for the transect (not the quads) are treated as a sampling unit. Production for vegetation success is assessed for above-ground annual forage production, excluding annuals and noxious weeds in air-dry lbs/ac. The Permit allows for excessively grazed production quadrats to be considered for exclusion from the sampling analysis in consultation with OSMRE, but no quadrats needed to be excluded in O-VMU-4 (the Permit, Section 6.5.2.2).

Grasses and forbs were clipped to within 5 centimeters (cm) of the soil surface, and the current year's growth was segregated from the previous year's growth (e.g., gray, weathered grass leaves, and dried culms). Production from shrubs was determined by clipping the current year's growth. Annuals and noxious weeds (e.g., Russian knapweed [*Acroptilon repens*]), when encountered, were not clipped. Photographs of the individual production quadrats are included in Appendix B.

The plant biomass samples of every species collected per transect were placed individually in labeled paper bags. The samples were air-dried (~ 90 days) until no weight changes were observed with repeated measurements on representative samples. The average tare weight of the empty paper bags was determined to correct the total sample weight to air-dry vegetation weights. The net weight of the air-dried vegetation was converted to a lbs/ac.

2.5 Shrub Density

Shrub density (as required by the Permit), or the number of stems per square meter (stems/m^2), was determined using the belt transect method (Bonham 1989). The belt transect was located parallel to the 50 m transect used to determine cover. Shrubs rooted in the 2 m belt transect were counted on a species basis. A 2 m folding ruler was horizontally oriented perpendicular to the tape to ensure that observations were taken within the 2 m corridor. The number and species of woody plant stems within the belt transect were recorded.

2.6 Statistical Analysis

The procedures for liability release and the basis for statistical analysis applied in this report may be found in the Permit, and as referenced in the Permit: the Wyoming Department of Environmental Quality (WDEQ) handbook of sampling and statistical methods (WDEQ 2012), and the New Mexico Mining and Minerals Division (MMD) Coal Mine Reclamation Program guidelines (MMD 1999). Additional resources include Evaluation and Comparison of Hypothesis Testing Techniques for Bond Release Applications (McDonald et al. 2003), which was the basis of the WDEQ handbook, and other sources referenced herein. More specifically, Figure 6.5-1 and Appendix 6.5-B of the Permit guide the statistical approach in determining vegetation success for total ground cover, perennial vegetation cover, annual forage production, and shrub density. The statistical analyses applied to the O-VMU-4 vegetation data are presented in Appendix C including equations for vegetation data analysis, vegetation attribute data with descriptive statistics, the statistical analyses comparing these attributes to the revegetation success standards, the statistical model, and descriptive statistics and normality for the vegetation attributes.

Descriptive statistics and statistical adequacy are presented for total ground cover, perennial vegetation cover, annual forage production, and shrub density in Tables 3 and C-2. Vegetation attribute data (Table C-2) was evaluated with the Shapiro-Wilk test to determine if data are normally distributed (Figures C-2 to C-6). For normally distributed data, statistical adequacy was assessed (Snedecor and Cochran 1967). Hypothesis testing for normal data that met sample adequacy was conducted using a one-sample, one-sided t-test under the classical null hypothesis. A one-sample, one-sided t-test using the reverse null hypothesis was applied for normally distributed data which failed to meet statistical adequacy. A non-parametric one-sample, one-sided sign test using the reverse null hypothesis was applied to data that was not normally distributed and did not meet sample adequacy. While transformed data were not used in hypothesis testing for satisfying standards, as a supplemental analyses, non-normal data were log-transformed. If the transformed data resulted in a normal distribution, one of the t-tests previously described was performed depending on sample adequacy. If transformed data were also non-normal, data were analyzed using the non-parametric one-sample, one-sided sign test using the reverse null hypothesis on the non-transformed data.

The following presents the statistical approach in more detail. Descriptive statistics and statistical tests were performed using both Microsoft® Excel and R-Studio (version 4.2.2).

2.6.1 Normality and Statistical Adequacy

The normality of each dataset was first assessed using the Shapiro-Wilk test to determine the appropriate hypothesis test method (i.e., parametric versus non-parametric). The Shapiro-Wilk null hypothesis is that the samples (of size n) come from a normal distribution. Data were considered normal when the test statistic had a p-value > 0.10 for alpha (α) = 0.10.

The number of samples required to characterize a particular vegetation attribute depends on the uniformity of the vegetation and the desired degree of certainty required for the analysis. The number of samples necessary to meet sample adequacy (N_{min}) was calculated assuming the data were normally distributed using Snedecor and Cochran (1967) equation below.

$$N_{min} = \frac{t^2 s^2}{(\overline{x}D)^2}$$

Where N_{min} equals the minimum number of samples required, t is the two-tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom, s is the standard deviation of the sample data, $\overline{x}$ is the mean, and D is the desired level of accuracy, which is 10 percent of the mean in this case.

In addition to N_{min}, the standard deviation and the 90% confidence interval (CI) about the sample means are reported in Table 3.

It is often impractical to achieve sample adequacy in vegetation monitoring studies based on Snedecor and Cochran's equation listed above. In such cases, the Permit allows a maximum sample number approach to compare the data regardless of the distribution (WDEQ 2012, MMD 1999). Where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples is considered adequate as stated in the Permit. The 40-sample maximum is based on an estimate of the number of samples needed for a t-test under a normal distribution (Sokal and Rohlf 1981). Schulz et al. (1961) demonstrated that 30 to 40 samples provide a robust estimate for most cover and density measures with increased numbers of samples only slightly improving the precision of the estimate.

The maximum 40 samples were collected at the outset of sampling based on the guidance discussed above. Each transect is considered a unique sampling unit. Sample adequacy was calculated to determine the number of samples that would have been required for adequacy by the Snedecor and Cochran equation. Further analysis for sample adequacy of cover, production and density attributes was also demonstrated using a graphical stabilization of the mean method (Clark 2001).

2.6.2 Hypothesis Testing

The emphasis on statistical adequacy assumes that parametric tests of normally distributed data will be conducted to demonstrate compliance with the vegetation success standards. Thus, if statistical adequacy is met for normally distributed data, the data would be analyzed with a one-sample, one-sided t-test using the classical null hypothesis. Non-parametric hypothesis tests have sufficient power to analyze data that are not normally distributed. Thus, if data is not-normal then it is permissible based on the Permit and technically appropriate to use one-sample, one-sided sign test using the reverse null approach as encouraged by OSMRE.

Hypothesis testing used to demonstrate compliance with the vegetation success standards for total ground cover, perennial vegetation cover, annual forage production, and shrub density were structured as follows (in accordance with Appendix 6.5-B of the Permit):

Classical Null Hypothesis:

H_0: Reclaim ≥ 90% of the Performance Standard

H_a: Reclaim < 90% of the Performance Standard

Where H_0 is the null hypothesis, and H_a is the alternative hypothesis.

The one-sample, one-sided t-test using the classical null hypothesis decision rules based on the test statistic are:

If $t^* \geq t_{(\alpha;\ n-1)}$, conclude that the performance standard was met.

If $t^* < t_{(\alpha;\ n-1)}$, conclude failure to meet the performance standard.

Test Statistic:

$$t^* = \frac{\bar{x} \ - 0.9\ (technical\ std)}{{}^{s}/_{\sqrt{n}}}$$

Where t* is the calculated t-statistic, $\bar{x}$ is the sample mean, s is the standard deviation, n is the sample size, and $\alpha = 0.10$.

Reverse Null Hypothesis:

H_0: Reclaim ≤ 90% of the Performance Standard

H_a: Reclaim > 90% of the Performance Standard

One-sample, one-sided sign test using the reverse null hypothesis decision rules are:

If $P < 0.10$ or $z < z_\alpha$ (for $\alpha = 0.10$, $z_\alpha = -1.282$), conclude that the performance standard was met (i.e., H_o is rejected, the revegetation values tend to be statistically greater than 90% of the technical standard).

If P ≥ 0.10 or $z \geq z_\alpha$ ($\alpha = 0.10$, $z_\alpha = -1.282$), conclude failure to meet the performance standard (i.e., H_o is NOT rejected, the revegetation values tend to be statistically less than or equal to 90% of the technical standard).

The z critical values of the normal distribution can be found in WDEQ, Table 1 (2012)

Sign Test Statistic:

$$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$$

Where z is the sign test statistic (Daniel 1990), k is the test statistic resulting from the number of measurements that were less than 90% of the technical standard, and n is the sample size.

All hypothesis tests were performed with a 90% level of confidence. Hypothesis testing was not conducted for parameters where the mean or median did not exceed the minimum permit requirements.

3.0 RESULTS

The vegetation in O-VMU-4 is well established and dominated by perennial plants and the vegetation community achieved full compliance with the vegetation success standards in 2023. Table 3 summarizes the results for total ground cover, perennial vegetation cover, annual forage production and woody plant density (shrub density) along with their corresponding technical standard.

Field data for LPI foliar cover, quadrat canopy cover, annual forage production and shrub density by the belt transect are included in Appendix A (Tables A1-A7). Photographs of the individual production quadrats are included in Appendix B and a representative photograph of the vegetation and topography is shown in Figure 5.

Table 4 summarizes the attributes for plants recorded in the LPI transects and production quadrats and Table A-7 summarizes all species observed within belt and quadrat surveys as well as those recorded opportunistically between survey areas during monitoring. Recruitment of additional native plant species is indicative of ecological succession and the capacity of the site to support a self-sustaining ecosystem.

Field data results and statistics are discussed by parameter in the sections that follow.

3.1 Total Ground and Perennial Vegetation Cover

Total ground cover exceeded the revegetation success standard and met the required statistical demonstration. Total ground cover based on first hit LPI data, (mean total ground cover ± 90% CI) in O-VMU-4 in 2023 was 59.6 ± 3.4% and a median of 61% (Table 3), exceeding the revegetation success standard. This was composed of live vegetation cover (44.0 ± 3.1%) and litter cover (15.7 ± 2.1%). Live vegetation foliar cover in individual transects ranged from 10 to 31 hits (20 to 62% cover) and litter cover ranged from 1 to 18 hits (2 to 36% cover) calculated from first hit LPI data (Table A-1).

Perennial vegetation cover, based on first hit LPI data, was calculated by summing the perennial and biennial species vegetation cover of the sampling unit excluding annuals and noxious weeds. The average perennial cover was 41.6 ± 3.3% and the median cover was 42% (Table 3), exceeding the revegetation success standard. Perennial vegetation cover in the individual transects varied from 8 to 31 hits (16 to 62% cover) (Table A-1). For quadrat cover data (not used in evaluating standards), the mean total vegetation canopy cover was 24.4%, ranging from 0 to 92% among individual quadrats (Table A-4).

Total ground cover and perennial vegetation cover data for O-VMU-4 were normally distributed (Figures C-1 and C-2 respectively). Sample adequacy, estimated using the Snedecor and Cochran (1967) equation, was 14 samples for total ground cover and 26 samples for perennial vegetation cover, the minimum sample sizes needed to meet sample adequacy (N_{min}) at the 90% confidence level (Table 3). Both met sample adequacy with a sample size of 40.

Because total ground cover and perennial vegetation cover data were normally distributed and met sample adequacy, data were statistically analyzed using a one-sample, one-sided t-test using the classical null hypothesis. The resulting t*-statistic for total ground cover was 6.134, with a sample mean of 59.7%, a standard deviation of 13.3%, measured against a one-tail $t_{(0.1,\ 39)}$ value of -1.304. Therefore, testing under the classical null hypothesis ($t^* \geq t_{(\alpha;\ n\text{-}1)}$), we conclude that the performance standard of 52% total ground cover was met (Table C-3). The resulting t*-statistic for perennial vegetation cover was 10.013, with a sample mean of 41.7%, a standard deviation of 12.7%, measured against a one-tail $t_{(0.1,\ 39)}$ value of -1.304. So, under the classical null hypothesis ($t^* \geq t_{(\alpha;\ n\text{-}1)}$), we conclude that the performance standard of 24% perennial vegetation cover was met (Table C-4).

3.2 Production

Forage production exceeded the revegetation success standard and met the required statistical demonstration. Forage production for vegetation success is assessed for above-ground annual forage production, excluding annuals and noxious weeds in air-dry lbs/ac. Annual forage production in O-VMU-4 in 2023 was 750 ± 116 lbs/ac (median of 632 lbs/ac) (Table 3). Annual forage production in individual transects ranged from 86 to 1,902 pounds per acre (Table A-5). Perennial grasses (13 species) contributed the most forage with 510 lbs/ac, while shrubs (12 species) contributed 168 lbs/ac and 15 perennial forbs contributed 72 lbs/ac (Table 4).

Annual forage production data for O-VMU-4 were not normally distributed (Figure C-3), though the log-transformed values were (Figure C-5). The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for annual forage production was 101 samples (Table 3). Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using the graphical stabilization of the mean method (Clark 2001) with 90% CI (Figure 6). The mean begins to stabilize at 24 samples and the confidence levels show little change after that. The analysis suggests that improvements in variability around the mean would likely not have improved with additional samples beyond the 40 samples collected for annual forage production.

The one-sample, one-sided sign test with the reverse null hypothesis was used to test the mean against 90% of the technical standard of 550 lbs/ac. Of the 40 transects, 29 exceeded 90% of the technical standard (Table C-5) resulting in a probability (P) of 0.004 of observing a z-value less than -2.69. Therefore, under the reverse null hypothesis we conclude that the annual forage production performance standard is met in 2023.

3.3 Shrub Density

Shrub density exceeded the revegetation success standard and met the required statistical demonstration. In 2023 shrub density in O-VMU-4 substantially exceeded the vegetation success standard of 400 stems/ac from belt transect data with an average of 2,566± 623 stems/ac and a median of 1,740 stems/ac (Table 3). Twenty woody plant species were encountered in the belt and LPI transect sampling. Fourwing saltbush (*Atriplex canescens*) was the most common shrub encountered in both methods (Tables 5, A-1 and A-4).

The shrub density data for O-VMU-4 were not normally distributed (Figure C-4). The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for shrub density was 242 samples (Table 3). Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using the graphical stabilization of the mean method (Clark 2001) showing 90% CI (Figure 7). The mean begins to stabilize after 20 samples and the 90% CI shows very little change throughout. This analysis suggests that 40 samples were more than adequate, and that the collection of additional data would not improve the precision of the estimate of shrub density.

The one-sample, one-sided sign test with the reverse null hypothesis was used to test the mean against the 90% of the technical standard of 400 stems per acre. Of the 40 transects, 39 exceeded 90% of the technical standard (Table C-6) resulting in a probability (P) of <0.001 of observing a z-value less than -5.85. Therefore, under the reverse null hypothesis we conclude that the woody plant density performance standard is met in 2023.

3.4 Composition and Diversity

In 2023, the standards were met for all of the individual diversity standards in O-VMU-4 (Table 6). The revegetation diversity standards are based on a “lifeform statement” for grasses, forbs, and shrubs (Table 1) that consists of 12 individual parameters. The results for composition and diversity are discussed below by parameter. Relative perennial values of individual species and functional groups are calculated relative to the total perennial vegetation cover of 41.6% reported in Section 3.1. This data is calculated from all-hit LPI data (Table A-2). Relative perennial vegetation cover of individual species is listed in Table 4.

Grasses dominated the perennial vegetation cover with James’ galleta (*Pleuraphis jamesii*) representing the highest cover of the warm-season grasses (Table 4). Cool-season grasses also dominated the vegetation reflecting the past seed mixes, season of seeding, and the site’s continued ability to support a diverse group of cool-season grasses. Thickspike wheatgrass (*Elymus lanceolatus*), western wheatgrass (*Pascopyrum smithii*), and Indian ricegrass (*Achnatherum hymenoides*) represented the highest cover of the cool-season grasses. Shrubs are important components of the reclamation due to their persistence and tolerance to harsh conditions. The woody plant component is dominated primarily by fourwing saltbush, with winterfat (*Krascheninnikovia lanata*) and rubber rabbitbrush (*Ericameria nauseosa*) subdominant. Perennial forb species occurred on the LPI transects, though they are minor contributors to vegetation cover, accounting for 3.2% absolute vegetation cover with alfalfa (*Medicago sativa*) contributing the highest cover.

The perennial grass diversity standard requires a total absolute vegetation cover of at least 7%, which was achieved in 2023 with 29.5%. The diversity standard for cool-season perennial grasses was achieved with nine total species, and two species that represent at least 5 and 2.5% relative perennial vegetation cover (thickspike wheatgrass [19.4%] and western wheatgrass [13.0%]). The diversity standard for warm-season grasses is achieved with six total species, one species representing at least 5% (James’ galleta [10.6%]) and all remaining species representing over 1.5% relative perennial vegetation cover at 2.7%.

The perennial forb diversity standard requires at least three perennial/biennial forbs (not including noxious weeds) combining to at least 1% relative perennial vegetation cover (calculated based on the percent foliar cover of perennial species excluding annuals and noxious weeds). This standard was achieved in 2023 with 12 species totaling 7.5% relative perennial vegetation cover with the greatest contributions from alfalfa (2.1%), hoary tansyaster (1.6%, *Machaeranthera canescens*), and curlycup gumweed (1.1%, *Grindelia squarrosa*).

The diversity standard for shrubs requires the relative perennial vegetation cover for all shrub species to total at least 6% with no single shrub exceeding or equal to 70% relative shrub density. Both of these standards were achieved with 21.5% relative perennial vegetation cover of all shrubs and 27.7% relative shrub density of fourwing saltbush – the most dominant shrub.

Lastly, the diversity standards require that no single species of any functional group represent greater than 40% relative total vegetative cover. Relative total vegetative here is defined as the percent foliar cover of any recorded species divided by the total foliar cover for all live vegetation of the sampling unit, including annuals and noxious weeds. Thickspike wheatgrass represented the highest relative total vegetation cover at 18.2%, thus the reclamation achieved the single species diversity standard.

From 2021 through 2023, 118 plant species have been observed within reclaimed areas in O-VMU-4 including 21 grasses, 66 forbs, and 31 shrubs, trees, and cacti (Table A-7). Of the 21 grasses, 13 are cool-season perennials, one is a cool-season annual, six are warm-season perennials and one is a warm-season annual. Of the 66 forbs, 18 are annuals and the remaining 48 are perennials and/or biennials. Cacti (one species), succulents (one species), and trees (four species) were rare on the reclamation but provide diverse habitat or browse for wildlife. Shrubs and subshrubs were the most common woody plants observed (25 species). The recruitment of native plants and establishment of seeded species within is indicative of ecological succession and the capacity of the site to support a diverse and self-sustaining ecosystem.

Multi-hit LPI data provide an opportunity to investigate faciliatory relationships among plants (Table A-3). This summary suggests that fourwing saltbush is a common upper canopy species in O-VMU-4, most commonly harboring thickspike wheatgrass, which is also common outside of shrub canopies as well. Associations such as this may be informative in future management activities.

3.5 Noxious Weeds

During the 2023 monitoring program, Class C noxious weeds (NMDA 2020) were rarely encountered in O-VMU-4. Class C noxious weeds are generally widespread in the state and managed at the local level based on feasibility of control and level of infestation. Cheatgrass was encountered infrequently in LPI surveys and production quadrats. Noxious weeds are not used in the assessment of revegetation success but are included in the single species cover standard (Table 1). Noxious trees and shrubs observed on O-VMU-4 in past years include Siberian elm (*Ulmus pumila*) and Russian olive (*Elaeagnus angustifolia*) but their presence in the reclaimed vegetation community is insignificant with densities much lower than native rangeland beyond the permit boundary. CMI continues to monitor for noxious weeds and actively controls them through husbandry practices that include annual services for weed management. Further, competition from desirable seeded and native species is expected to inhibit any substantial increase of noxious weeds in the reclamation.

4.0 SUMMARY

McKinley Mine's vegetation success standards for the post-mining land uses of grazing and wildlife are based on total ground cover, perennial vegetation cover, annual forage production, shrub density, and diversity. The technical standards (Table 1) were developed through negotiations with OSMRE based on the analysis of historical vegetation data, interpretation of the ecological site potential, and the anticipated post-mining land uses. The vegetation monitoring results for the past three years indicate that the vegetation community in O-VMU-4 is progressing well having met the total ground cover and shrub density standards every year (Table 3). A summary of the findings from the past three years are:

1. Vegetation Cover: The total ground cover standard has been met for the past three years. Perennial vegetation cover has met the performance standard in the past two years, but not met in 2021 following two years of below normal growing season precipitation.
2. Forage Production: In 2020 and 2021, O-VMU-4 only received 32% of normal growing season precipitation that led to a significant decline in forage production. In 2022, with above normal precipitation,

average forage production recovered, and the average was well above the performance standard, but variability among samples was high. As such, hypothesis testing could not demonstrate the standard was met. In 2023, average annual forage production both exceeded the performance standard and passed hypothesis testing with reduced variability compared to 2022. Improved field methodology likely aided in reducing variability and enhanced the ability of the data to accurately capture the inherent variation in the landscape while achieving the performance standard.

3. Shrub Density: O-VMU-4 has exceeded the success parameters for shrub density in all three monitoring years.
4. Diversity: All plant diversity standards were met in all years except for the second warm season grass species standard in 2021.

Overall, vegetation performance in O-VMU-4 over the past three years is encouraging considering below-average precipitation for four of the past five years including the exceptional drought in 2020 and 2021. The performance of the vegetation under these conditions suggests that the reclaimed plant communities are resilient and capable of sustaining themselves under adverse conditions that are characteristic of this region. The reclamation in O-VMU-4 has demonstrated the capability of meeting and sustaining the post-mining land use.

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Tables

Table 1: Revegetation Success Standards in the McKinley Mine OSMRE Permit

Vegetative Parameter	Components		Success Standards	
			2019-2022	2023
Cover	Total Ground Cover		≥ 52%	≥ 52%
	Perennial Vegetation Cover		≥ 24%	≥ 24%
Diversity "Lifeform Statement"	Perennial Grasses	All Grasses	≥ 7% absolute cover	≥ 7% absolute cover
		Cool-Season	≥ 2 species, each ≥ 1.5% cover	≥ 2 species, **1st species ≥ 5% relative perennial cover, 2nd species ≥ 2.5% relative perennial cover**
		Warm-Season	≥ 2% contribution, ≥ 2 species, each ≥ 0.5% cover	≥ 2 species, **1st species ≥ 5% relative perennial cover, all other species combined ≥ 1.5% relative perennial cover**
	Perennial Forbs		≥ 3 species, combining for ≥ 1% relative	≥ 3 species, combining for ≥ 1% relative perennial cove
	Shrubs	All Shrubs	≥ 3% absolute cover	**≥ 6% relative total perennial cover**
		Any Single Species	≤ 70% relative total shrub cover	≤ 70% relative total **shrub density**
	Any Single Species (including weeds)		≤ 40% relative total vegetative cover	≤ 40% relative total vegetative cover
Production	Pounds/acre (air dry)		≥ 550 lbs/ac	≥ 550 lbs/ac
Woody Plant Density	Stems/acre		≥ 400/acre	≥ 400/acre

Notes:

Success for cover, production, and stocking shall be ≥ 90% of the standard in accordance with 30 CFR 816.116 (a)(2).

Total ground cover does not include noxious weeds.

Perennial vegetation cover is foliar cover from LPI, not including annuals and noxious weeds.

Relative cover is the percent cover of a species or functional group divided by the total vegetation cover including annuals and noxious weeds.

Relative perennial cover is the total cover of a perennial species or perennial functional group divided by the total perennial cover (see below).

Total perennial cover includes shrubs, cactus, trees, perennial grasses and perennial forbs not including noxious species.

Relative total shrub density is the density of each woody species divided by the total woody plant density not including noxious weeds.

Production includes above-ground biomass of forage species only.

Bolded standards are those that changed in 2023

Table 2: North Mine Seasonal and Annual Precipitation, 2015-2023

Year	Station	Area	Precipitation (inches)													
			January	February	March	April	May	June	July	August	September	October	November	December	Annual Total	Growing Season Total
2015	Rain Bluff	North Shop	1.39	1.21	0.11	0.35	1.54	1.15	2.81	1.91	0.51	1.18	1.16	0.74	14.06	*8.27*
	Rain 2	2	NA	NA	NA	0.52	1.51	1.98	3.17	1.39	0.50	1.08	0.92	NA	NA	*9.07*
	Rain 3	3	NA	NA	NA	0.57	1.80	1.77	3.61	3.06	0.44	1.36	0.86	NA	NA	*11.25*
	Rain 6	6	NA	NA	NA	0.54	0.71	2.12	2.66	2.12	0.00	0.92	0.70	NA	NA	*8.15*
	Rain 10	10	NA	NA	NA	0.42	1.32	1.11	2.59	1.39	0.30	1.10	0.78	NA	NA	*7.13*
	Rain 12	12	NA	NA	NA	0.49	1.59	1.39	2.88	2.14	0.47	1.17	1.29	NA	NA	*8.96*
	Rain 15	15	NA	NA	NA	0.46	1.90	1.62	3.17	2.88	0.32	0.94	0.69	NA	NA	*10.35*
2016	Rain Bluff	North Shop	0.39	0.25	0.03	1.28	0.70	0.19	1.15	1.85	1.79	0.69	1.18	1.98	11.48	*6.96*
	Rain 2	2	NA	NA	NA	0.17	0.58	0.14	2.22	0.71	0.87	0.21	0.02	NA	NA	*4.69*
	Rain 3	3	NA	NA	NA	0.20	0.72	0.45	1.62	0.11	0.50	0.33	0.02	NA	NA	*3.60*
	Rain 6	6	NA	NA	NA	0.20	0.75	0.29	2.00	0.40	1.19	0.19	0.02	NA	NA	*4.83*
	Rain 10	10	NA	NA	NA	0.13	0.55	0.20	2.75	0.38	0.99	0.14	0.02	NA	NA	*5.00*
	Rain 12	12	NA	NA	NA	0.30	0.78	0.36	1.34	0.49	1.16	0.18	0.05	NA	NA	*4.43*
	Rain 15	15	NA	NA	NA	0.31	0.85	0.04	1.95	0.35	1.31	0.18	0.05	NA	NA	*4.81*
2017	Rain Bluff	North Shop	0.81	0.04	0.70	0.32	0.41	0.16	3.71	0.37	0.62	0.54	0.05	0.02	7.75	*5.59*
	Rain 2	2	NA	NA	NA	1.28	0.66	0.22	0.78	2.08	1.46	0.63	0.44	NA	NA	*6.48*
	Rain 3	3	NA	NA	NA	1.04	1.16	0.06	0.99	2.71	1.63	0.56	0.44	NA	NA	*7.59*
	Rain 6	6	NA	NA	NA	0.86	1.50	0.02	0.96	2.04	1.52	0.38	0.51	NA	NA	*6.90*
	Rain 10	10	NA	NA	NA	1.00	0.67	0.08	0.94	1.63	1.36	0.34	0.81	NA	NA	*5.68*
	Rain 12	12	NA	NA	NA	1.17	0.91	0.05	0.88	1.89	1.77	0.47	0.46	NA	NA	*6.67*
	Rain 15	15	NA	NA	NA	1.15	1.36	0.02	0.68	1.91	1.56	0.40	0.41	NA	NA	*6.68*
2018	Rain Bluff	North Shop	0.23	0.48	0.44	0.08	0.22	0.28	2.17	0.00	1.00	1.51	0.14	0.43	6.98	*3.75*
	Rain 2	2	NA	NA	NA	0.06	0.26	0.30	1.10	0.90	1.40	1.48	0.00	NA	NA	*4.02*
	Rain 3	3	NA	NA	NA	0.04	0.30	0.35	0.92	0.91	1.27	1.69	0.00	NA	NA	*3.79*
	Rain 6	6	NA	NA	NA	0.03	0.21	0.46	0.97	0.56	1.02	1.45	0.00	NA	NA	*3.25*
	Rain 10	10	NA	NA	NA	0.08	0.20	0.27	3.05	1.15	0.92	1.51	0.00	NA	NA	*5.67*
	Rain 12	12	NA	NA	NA	0.06	0.37	0.26	1.08	1.36	1.09	1.54	0.00	NA	NA	*4.22*
	Rain 15	15	NA	NA	NA	0.05	0.32	0.28	1.16	0.63	1.31	1.31	0.00	NA	NA	*3.75*
2019	Rain Bluff	North Shop	0.95	0.98	1.10	0.24	0.17	0.03	0.03	1.14	0.10	0.04	1.15	0.97	6.90	*1.71*
	Rain 2	2	NA	NA	NA	0.22	1.41	0.15	0.35	0.73	1.35	0.04	0.05	NA	NA	*4.21*
	Rain 3	3	NA	NA	NA	0.39	1.50	0.32	0.70	0.11	1.72	0.06	0.06	NA	NA	*4.74*
	Rain 6	6	NA	NA	NA	0.36	1.20	0.00	0.01	0.34	1.82	0.04	0.03	NA	NA	*3.73*
	Rain 10	10	NA	NA	NA	0.20	1.49	0.37	0.19	0.27	1.34	0.03	0.05	NA	NA	*3.86*
	Rain 12	12	NA	NA	NA	0.20	1.59	0.28	0.35	0.14	1.38	0.07	0.04	NA	NA	*3.94*
	Rain 15	15	NA	NA	NA	0.22	1.17	0.14	0.78	0.15	1.60	0.05	0.05	NA	NA	*4.06*
2020	Rain Bluff	North Shop	1.00	1.35	1.15	0.26	0.02	0.14	0.89	0.26	0.21	0.33	0.28	0.32	6.21	*1.78*
	Rain 2	2	NA	NA	NA	0.26	0.09	0.05	1.65	0.20	0.17	0.31	0.16	NA	NA	*2.42*
	Rain 3	3	NA	NA	NA	0.00	0.01	0.05	1.06	0.62	0.16	0.27	0.19	NA	NA	*1.90*
	Rain 6	6	NA	NA	NA	0.05	0.02	0.02	0.82	0.55	0.14	0.08	0.16	NA	NA	*1.60*
	Rain 10	10	NA	NA	NA	0.11	0.02	0.13	0.79	0.14	0.14	0.16	0.09	NA	NA	*1.33*
	Rain 12	12	NA	NA	NA	0.25	0.08	0.06	0.97	0.47	0.35	0.29	0.28	NA	NA	*2.18*
	Rain 15	15	NA	NA	NA	0.32	0.01	0.05	0.65	0.87	0.28	0.09	0.44	NA	NA	*2.18*
2021	Rain Bluff	North Shop	1.13	0.21	0.46	0.04	0.04	0.20	2.17	1.31	1.13	0.86	0.20	0.92	8.67	*4.89*
	Rain 2	2	NA	NA	NA	0.00	0.03	0.16	0.99	1.09	1.04	0.93	0.00	NA	NA	*3.31*
	Rain 3	3	NA	NA	NA	0.03	0.09	0.05	0.69	1.04	1.64	1.16	0.00	NA	NA	*3.54*
	Rain 6	6	NA	NA	NA	0.02	0.06	0.03	0.83	0.19	0.47	1.05	0.00	NA	NA	*1.60*
	Rain 10	10	NA	NA	NA	0.01	0.06	0.24	2.48	1.80	0.96	0.80	0.00	NA	NA	*5.55*
	Rain 12	12	NA	NA	NA	0.00	0.08	0.22	1.58	2.08	1.24	1.01	0.00	NA	NA	*5.20*
	Rain 15	15	NA	NA	NA	0.00	0.07	0.05	1.04	2.58	1.47	1.00	0.00	NA	NA	*5.21*
2022	Rain Bluff	North Shop	--	--	0.59	0.03	0.00	1.24	3.13	4.66	1.27	1.40	0.48	0.58	13.38	*10.33*
	Rain 2	2	NA	NA	NA	0.00	0.00	1.03	3.00	3.77	1.22	1.14	0.39	NA	NA	*9.02*
	Rain 3	3	NA	NA	NA	0.00	0.00	1.03	2.99	3.07	1.18	1.19	0.54	NA	NA	*8.27*
	Rain 6	6	NA	NA	NA	0.01	0.00	0.66	2.55	3.05	0.69	0.28	0.47	NA	NA	*6.96*
	Rain 10	10	NA	NA	NA	0.00	0.00	0.69	3.57	4.27	1.02	1.83	0.33	NA	NA	*9.55*
	Rain 12	12	NA	NA	NA	0.00	0.00	0.91	3.76	4.07	1.08	1.57	0.52	NA	NA	*9.82*
	Rain 15	15	NA	NA	NA	0.00	0.01	0.91	4.06	3.84	1.12	1.68	0.50	NA	NA	*9.94*
2023	Rain Bluff	North Shop	1.21	0.50	1.64	0.05	0.55	0.13	0.03	3.16	0.33	0.57	0.42	NA	8.59	*4.25*
	Rain 2	2	NA	NA	NA	0.00	0.48	0.09	0.08	3.08	0.44	0.09	0.09	NA	4.35	*4.17*
	Rain 3	3	NA	NA	NA	0.01	0.84	0.22	0.26	2.93	0.54	0.08	0.08	NA	4.96	*4.80*
	Rain 6	6	NA	NA	NA	0.00	1.49	0.22	0.07	1.97	0.49	0.05	0.00	NA	4.29	*4.24*
	Rain 10	10	NA	NA	NA	0.03	0.53	0.13	0.06	2.61	0.51	0.03	0.00	NA	3.90	*3.87*
	Rain 12	12	NA	NA	NA	0.00	0.74	0.21	0.10	2.47	0.41	0.05	0.00	NA	3.98	*3.93*
	Rain 15	15	NA	NA	NA	0.00	0.79	0.21	0.43	2.67	0.56	0.05	0.00	NA	4.71	*4.66*
Window Rock, Long			0.72	0.68	0.88	0.61	0.49	0.47	1.75	2.05	1.23	1.14	0.83	0.95	11.80	*6.60*

Notes:
Long-term averages are from Window Rock, Arizona Station (029410), 1937 to 1999 (Western Regional Climate Center, 2020).
Growing season total precipitation is between April and September
NA=rain gauges taken offline due to freezing conditions, data unavailable.
-- Rain gauge malfunction
In 2017 Rain Bluff experienced power issues in the summer that may have resulted in inaccurate precipitation readings.
data incomplete

Table 3: Summary Statistics, O-VMU-4, 2021-2023

	2021	2022	2023	Technical Standard
Total Ground Cover (%)[1]				
Mean	51.5	46.2	59.6	≥ 52%
Standard Deviatior	13.3	10.9	13.3	
90% Confidence Interva	3.5	2.8	3.4	
Median	52	46	61	
Nmin[2]	19	16	14	
Live Vegetation Cover (%)[3]				
Mean	16.4	30.5	44.0	None
Standard Deviatior	7.6	10.3	11.9	
90% Confidence Interva	2	2.7	3.1	
Nmin[2]	62	33	21	
Litter Cover (%)				
Mean	35.1	15.7	15.7	None
Standard Deviatior	12.3	7.1	7.9	
90% Confidence Interva	3.2	1.8	2.1	
Nmin[2]	35	58	72	
Perennial Vegetation Cover (%)[4]				
Mean	15.7	25.8	41.6	≥ 24%
Standard Deviatior	7.8	9	12.7	
90% Confidence Interva	2	2.3	3.3	
Median	14	26	42	
Nmin[2]	70	35	26	
Annual Forage Production (lbs/ac)[5]				
Mean	209	419	750	≥ 550 lbs/ac
Standard Deviatior	240	455	446	
90% Confidence Interva	63	118	116	
Median	130	241	632	
Nmin[2]	376	334	101	
Woody Plant Density (stems/acre) from Belt Transec				
Mean	2,578	2,206	2,566	≥ 400/ac
Standard Deviatior	2,512	2,238	2,397	
90% Confidence Interva	653	582	623	
Median	1,639	1,639	1,740	
Nmin[2]	270	292	248	

Notes:

[1] Mean foliar cover of live vegetation and litter

[2] Minimum number of samples to obtain 90% probability that the sample mean is within 10% of the population mean

[3] Mean vegetation foliar cover not including noxious weeds

[4] Mean foliar cover not including annuals and noxious weeds

[5] Annual forage production in air dry pounds per acre (lbs/ac) not including annuals or noxious weeds

Hypothesis testing found the success standard was not met

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU-4, 2023

Scientific Name	Common Name	Code	Mean Vegetation Cover (%				Mean Annual Production (lbs/ac)
			All Hit Foliar	First Hit Foliar	Relative Perennial[1]	Relative Total[2]	
Cool-Season Grasses (11							
Annuals (1)							
Bromus tectorum	Cheatgrass	BRTE	0.35	0.25	--	0.8	NA
Perennials (10)							
Achnatherum hymenoides	Indian ricegrass	ACHY	4.60	4.50	10.5	9.9	42.8
Bromus inermis	**Smooth brome**	**BRIN2**	**NA**	**NA**	**NA**	**NA**	**0.3**
Elymus elymoides	Bottlebrush squirreltai	ELEL5	0.80	0.75	1.8	1.7	11.5
Elymus lanceolatus	Thickspike wheatgrass	ELLA3	8.50	8.05	19.4	18.2	91
Elymus trachycaulus	Slender wheatgrass	ELTR7	2.65	2.40	6.1	5.7	56.1
Hesperostipa comata	Needle and thread	HECO26	1.45	1.35	3.3	3.1	20.8
Pascopyrum smithii	Western wheatgrass	PASM	5.70	5.25	13.0	12.2	139
Psathyrostachys juncea	Russian wildrye	PSJU3	0.35	0.35	0.8	0.8	24.9
Pseudoroegneria spicata	Bluebunch wheatgrass	PSSP6	1.00	1.00	2.3	2.1	19.8
Thinopyrum intermedium	Intermediate wheatgrass	THIN6	0.15	0.15	0.3	0.3	NA
Warm-Season Grasses (6)							
Perennials (6)							
Bouteloua curtipendula	Sideoats grama	BOCU	0.10	0.05	0.2	0.2	NA
Bouteloua dactyloides	Buffalograss	BODA2	0.10	0.10	0.2	0.2	0.3
Bouteloua gracilis	Blue grama	BOGR2	0.75	0.75	1.7	1.6	13.7
Pleuraphis jamesii	James' galleta	PLJA	4.65	4.55	10.6	10.0	88.7
Sporobolus airoides	Alkali sacaton	SPAI	0.20	0.20	0.5	0.4	0.7
Sporobolus cryptandrus	Sand dropseed	SPCR	0.05	0.05	0.1	0.1	NA
Forbs (23)							
Annuals (4)							
Alyssum desertorum	**Desert madwort**	**ALDE**	**0.05**	**NA**	**--**	**0.1**	**NA**
Alyssum simplex	**Alyssum**	**ALSI8**	**0.05**	**0.05**	**--**	**0.1**	**NA**
Dyssodia papposa	Fetid marigold	DYPA	0.15	0.15	--	0.3	NA
Salsola tragus	Prickly Russian thistle	SATR12	2.25	2.15	--	4.8	NA
Perennials/Biennials (19)							
Bahia dissecta	Ragleaf bahia	BADI	NA	NA	NA	NA	<0.1
Chaetopappa ericoides	Rose heath	CHER2	NA	NA	NA	NA	2.2
Erigeron divergens	**Spreading fleabane**	**ERDI4**	**0.10**	**0.10**	**0.2**	**0.2**	**NA**
Erodium cicutarium	Redstem stork's bill	ERCI6	0.25	0.25	0.6	0.5	NA
Grindelia squarrosa	Curlycup gumweed	GRSQ	0.50	0.50	1.1	1.1	8.7
Lactuca serriola	Prickly lettuce	LASE	NA	NA	NA	NA	<0.1
Lappula occidentalis	Flatspine stickseed	LAOC3	0.15	0.15	0.3	0.3	0.4
Linum lewisii	Lewis flax	LILE3	0.05	0.05	0.1	0.1	<0.1
Machaeranthera canescens	Hoary tansyaste	MACA2	0.70	0.70	1.6	1.5	6.6
Machaeranthera tanacetifolia	Tanseyleaf tansyaste	MATA2	0.10	0.10	0.2	0.2	NA
Medicago sativa	Alfalfa	MESA	0.90	0.75	2.1	1.9	29.8
Melilotus officinalis	Sweetclover	MEOF	0.15	0.15	0.3	0.3	5.6
Mirabilis linearis	**Narrowleaf four-o'clock**	**MILI3**	**NA**	**NA**	**NA**	**NA**	**10.3**
Penstemon palmeri	Palmer's penstemon	PEPA8	0.10	0.10	0.2	0.2	NA
Ratibida columnifera	Upright prairie coneflower	RACO3	NA	NA	NA	NA	<0.1
Sphaeralcea coccinea	Scarlet globemallow	SPCO	0.20	0.20	0.5	0.4	3.7
Sphaeralcea incana	Gray globemallow	SPIN2	NA	NA	NA	NA	2.7
Tragopogon dubius	Yellow salsify	TRDU	0.10	0.10	0.2	0.2	0.8
Tragopogon pratensis	**Jack-go-to-bed-at-noon**	**TRPR**	**NA**	**NA**	**NA**	**NA**	**1.2**

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU-4, 2023

Scientific Name	Common Name	Code	Mean Vegetation Cover (%				Mean Annual Production (lbs/ac)
			All Hit Foliar	First Hit Foliar	Relative Perennial[1]	Relative Total[2]	
Shrubs, Trees, and Cacti (15)							
Artemisia frigida	Prairie sagewort	ARFR4	0.10	0.10	0.2	0.2	0.2
Artemisia nova	Black sagebrush	ARNO4	0.25	0.25	0.6	0.5	11.9
Atriplex canescens	Fourwing saltbush	ATCA2	4.30	4.20	9.8	9.2	75.8
Atriplex confertifolia	Shadscale saltbush	ATCO	0.20	0.20	0.5	0.4	0.3
Atriplex corrugata	Mat saltbush	ATCO4	0.15	0.10	0.3	0.3	6.3
Atriplex gardneri	Gardner's saltbush	ATGA	0.20	0.20	0.5	0.4	3.6
Chrysothamnus greenei	Greene's rabbitbrush	CHGR6	0.05	0.05	0.1	0.1	NA
Elaeagnus angustifolia	Russian olive	ELAN	0.05	0.05	0.1	0.1	NA
Ericameria nauseosa	Rubber rabbitbrush	ERNA10	1.00	1.00	2.3	2.1	6.6
Gutierrezia sarothrae	Broom snakeweed	GUSA2	0.75	0.60	1.7	1.6	26.2
Heterotheca villosa	**Hairy false goldenaster**	**HEVI4**	**NA**	**NA**	**NA**	**NA**	**<0.1**
Krascheninnikovia lanata	Winterfat	KRLA2	1.00	0.95	2.3	2.1	28.4
Purshia mexicana	Mexican cliffrose	PUME	0.40	0.40	0.9	0.9	NA
Purshia tridentata	Antelope bitterbrush	PUTR2	0.95	0.95	2.2	2.0	8.6
Senecio riddellii	**Riddell's ragwort**	**SERI2**	**NA**	**NA**	**NA**	**NA**	**0.5**
Cover Components							
Total Ground Cover[3]			59.6				
Live Vegetation Foliar Cover			44.0				
Perennial Vegetation Cover			41.6				
Rock			6.9				
Litter			15.7				
Bare Soil			33.2				

Notes:

[1] Relative % perennial/biennial foliar cover divided by mean foliar cover NOT including annuals and noxious weeds using all hits

[2] Relative % foliar cover for a species divided by the mean foliar cover for all live vegetation including noxious weeds using all hits

[3] % live vegetation foliar cover plus litter using first hits

Growing season for grasses from Allred (2005)

Plant duration from USDA Plants Database

NA = species captured in either LPI or quadrats but not both

"--" = annuals not included in relative perennial cover calculations

Bolded species are newly observed on O-VMU-4 in 2023

Table 5: Relative Shrub, Tree, and Cacti Density, O-VMU-4, 2023

Scientific Name	Common Name	Code	Relative Density (%)
Artemisia frigida	Prairie sagewort	ARFR4	1.33
Artemisia nova	Black sagebrush	ARNO4	0.89
Artemisia tridentata	Big sagebrush	ARTR2	0.08
Atriplex canescens	Fourwing saltbush	ATCA2	27.70
Atriplex confertifolia	Shadscale saltbush	ATCO	3.32
Atriplex corrugata	Mat saltbush	ATCO4	7.36
Atriplex gardneri	Gardner's saltbush	ATGA	0.69
Chrysothamnus greenei	Greene's rabbitbrush	CHGR6	0.24
Elaeagnus angustifolia	Russian olive	ELAN	0.04
Ephedra viridis	Mormon tea	EPVI	0.12
Ericameria nauseosa	Rubber rabbitbrush	ERNA10	8.17
Gutierrezia sarothrae	Broom snakeweed	GUSA2	16.82
Krascheninnikovia lanata	Winterfat	KRLA2	26.49
Opuntia polyacantha	Plains pricklypear	OPPO	0.04
Pinus edulis	Twoneedle pinyon	PIED	0.04
Purshia mexicana	Mexican cliffrose	PUME	3.52
Purshia tridentata	Antelope bitterbrush	PUTR2	2.95
Senecio flaccidus	Threadleaf ragwor	SEFL3	0.04
Senecio riddellii	Riddell's ragwort	SERI2	0.12
Ulmus pumila	Siberian elm	ULPU	0.04

Notes:

Relative density derived from belt method

Relative Density = (avg density per species per VMU ÷ avg total shrub density per VMU) * 100

Bolded species are newly observed on O-VMU-4 in 2023

Table 6: Results for Diversity, O-VMU-4, 2023

Diversity Component	Metric	Standard	2023	
			Result	Species
Perennial Grasses	Absolute cover	≥ 7%	29.5	--
Cool-season Grasses	# Species	≥ 2	9	--
Grass 1	Relative perennial cove	≥ 5%	19.4	Thickspike wheatgrass
Grass 2	Relative perennial cove	≥ 2.5%	13.0	Western wheatgrass
Warm-season Grasses	# Species	≥ 2	6	--
Grass 1	Relative perennial cove	≥ 5%	10.6	James' galleta
All remaining species	Relative perennial cover	≥ 1.5%	2.7	--
Perennial Forbs	# Species	≥3	12	--
	Relative perennial cover	≥ 1%	7.5	--
Shrubs or Subshrubs	Relative perennial cover	≥ 6%	21.5	--
Single Shrub Species	Relative shrub density	≤ 70%	27.7	Fourwing saltbush
Any Single Species	Relative total cover	≤ 40%	18.2	Thickspike wheatgrass

Table 7: Results for Diversity, O-VMU-4, 2021-2022

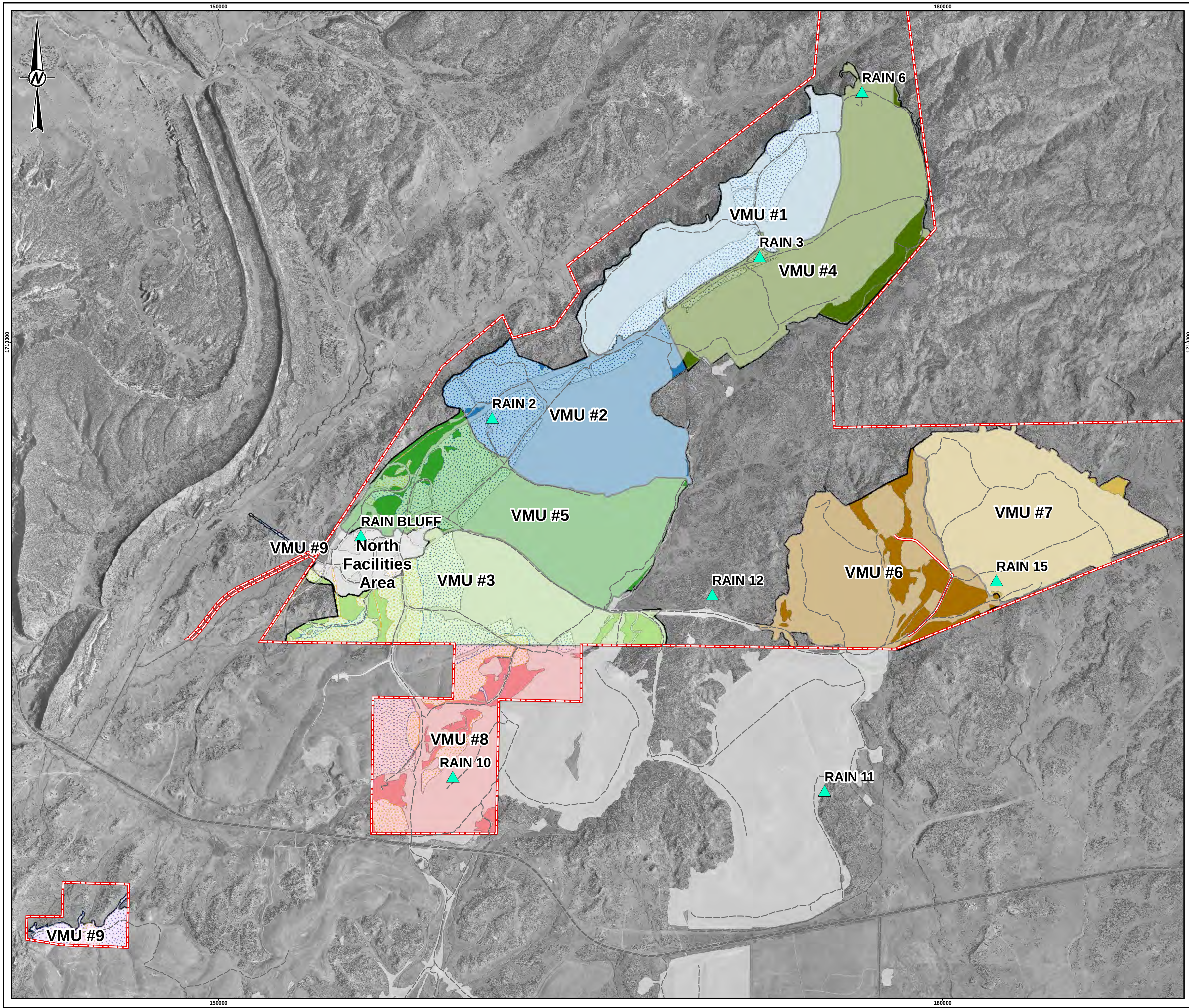
Diversity Component	Metric	Standard	2021		2022	
			Result	Species	Result	Species
Perennial Grasses	Total absolute cover	≥ 7%	9.4%	--	16.6%	--
Cool-season Grasses	# Species	≥ 2	9	--	8	--
Grass 1	Absolute cover	≥ 1.5%	2.1%	Western wheatgrass	4.1%	Western wheatgrass
Grass 2	Absolute cover	≥ 1.5%	2.0%	Thickspike wheatgrass	3.2%	Thickspike wheatgrass
Warm-season Grasses	# Species	≥ 2	3	--	5	--
	Total absolute cover	≥ 2.0%	2.2%	--	4.4%	--
Grass 1	Absolute cover	≥ 0.5%	1.8%	James' galleta	3.1%	James' galleta
Grass 2	Absolute cover	≥ 0.5%	0.3%	Blue grama	0.8%	Blue grama
Perennial Forbs	# Species	≥ 3	3	--	12	--
	Relative perennial cover	≥ 1%	2.9%	--	7.9%	--
Shrubs or Subshrubs	Total absolute cover	≥ 3%	5.8%	--	7.2%	--
Single Shrub Species	Relative shrub cover	≤ 70%	66.4%	Fourwing saltbush	56.3%	Fourwing saltbush
Any Single Species	Relative total cover	≤ 40%	23.5%	Fourwing saltbush	13.20%	Fourwing saltbush

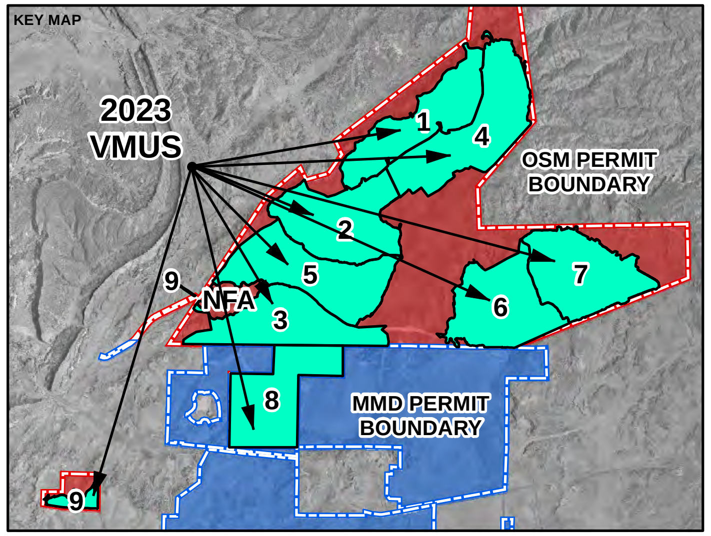
Notes:

Diversity calculated in accordance with Table 1 in either absolute or relative % cover

Success standard was not met

Figures





LEGEND

- ▲ Rain Gauges
- --- Mine Site Roads
- 🟥 OSM Permit Boundary
- ▨ Prelaw (~ 387 acres)
- ▨ Initial Program (~ 1,248 acres)
- ⬜ Permanent Program (~ 11,327 acres)
- 🟦 OSM VMU 1 (~ 934 acres)
- 🟦 OSM VMU 2 (~ 1,085 acres)
- 🟩 OSM VMU 3 (~ 959 acres)
- 🟩 OSM VMU 4 (~ 1,242 acres)
- 🟩 OSM VMU 5 (~ 1,129 acres)
- 🟫 OSM VMU 6 (~ 1,024 acres)
- 🟨 OSM VMU 7 (~ 1,045 acres)
- 🟥 OSM VMU 8 (~ 953 acres)
- 🟪 OSM VMU 9 (~ 96 acres)

0 4,000 8,000
1 inch = 4,000 feet FEET

NOTE(S)
1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN

REFERENCE(S)
1. ORTHOIMAGE: CHEVRON, 2013

COORDINATE SYSTEM: NAD 1927 STATEPLANE NEW MEXICO WEST FIPS 3003
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1927

CLIENT
CHEVRON ENVIRONMENTAL MANAGEMENT

PROJECT
MCKINLEY MINE - OSM PERMIT PHASE III BOND RELEASE,
2023 VEGETATION MONITORING

TITLE
GENERAL OVERVIEW OF THE MCKINLEY OSMRE PERMIT AREA VEGETATION MANAGEMENT UNITS (VMU), 2023

CONSULTANT

wsp

YYYY-MM-DD	2023-11-29
DESIGNED	GFD
PREPARED	GFD
REVIEWED	MR
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
31406184.000	B003	0	1

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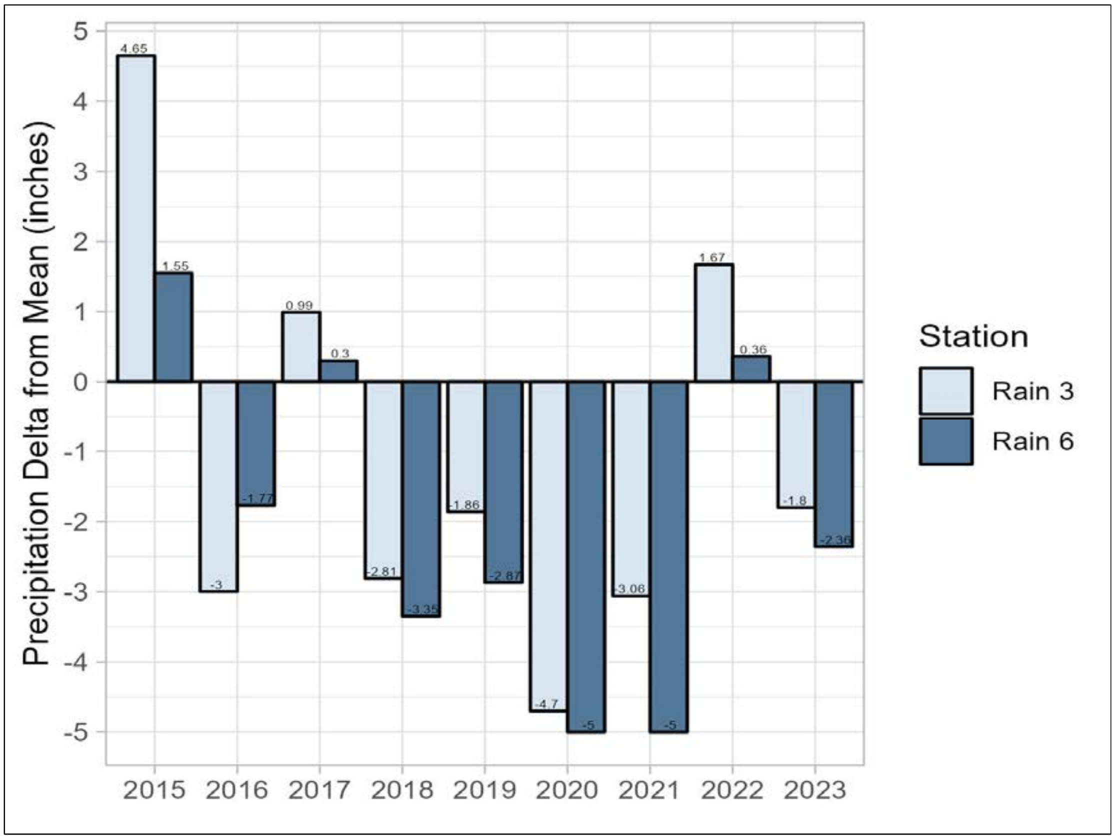
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Figure 2: Departure of Growing Season Precipitation from Long-Term Mean at Window Rock: Rain 3 and 6 Gauges

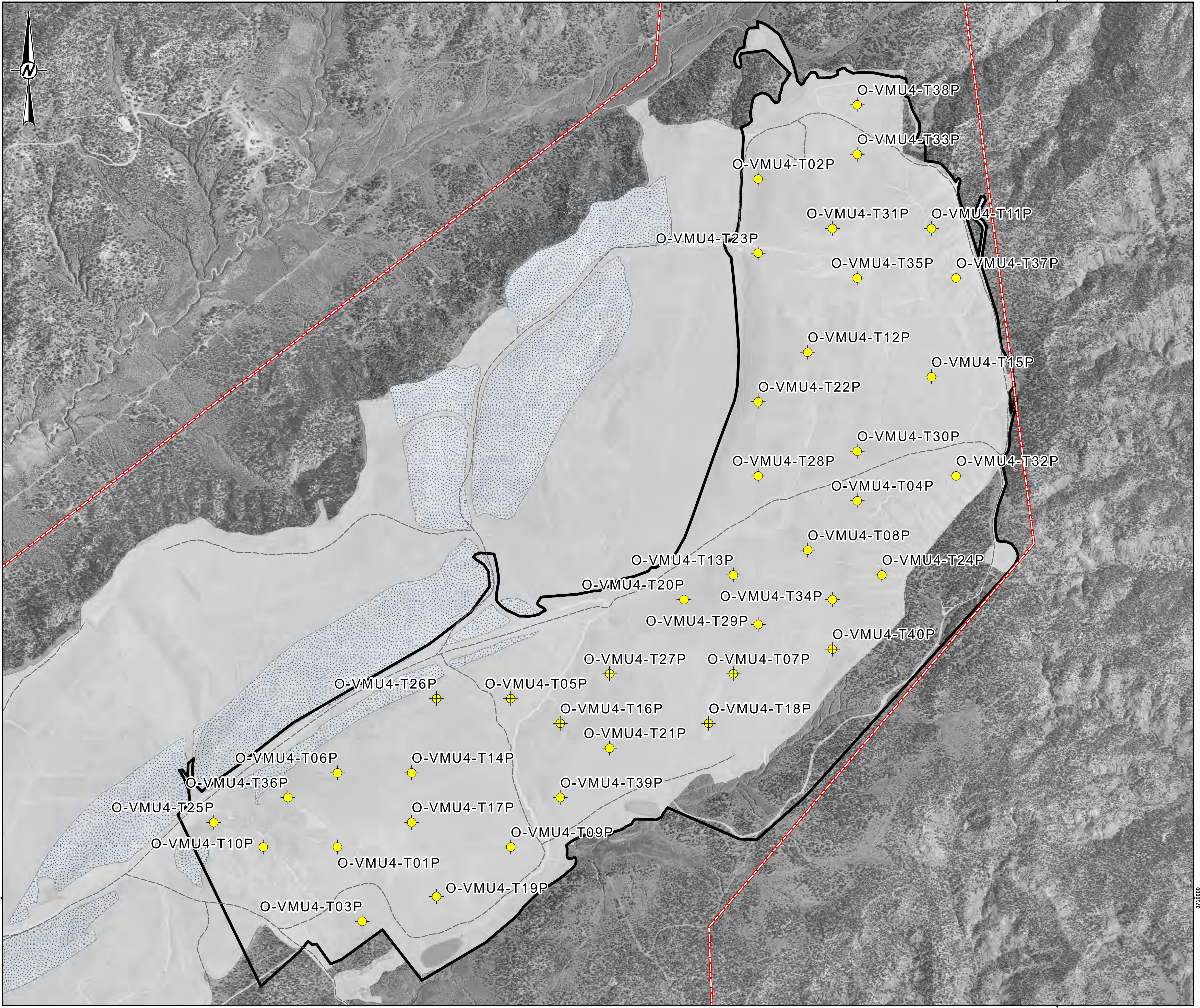


Notes:

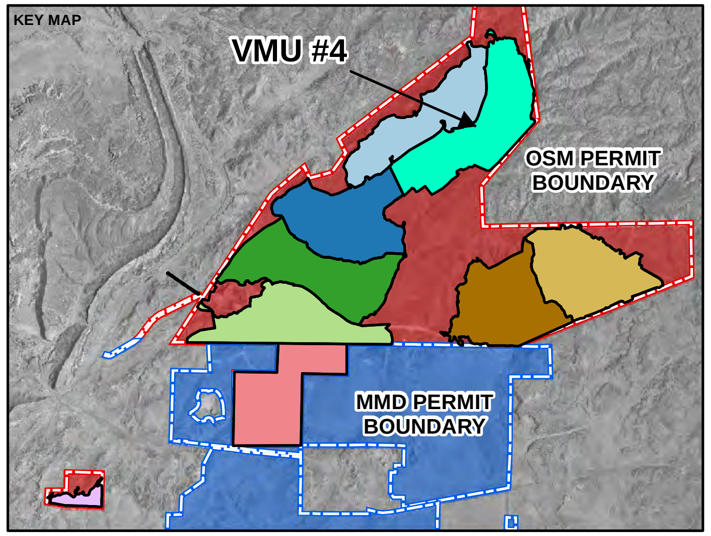
Long-term seasonal mean is from Window Rock, Arizona Station (029410) for 1937 to 1999 (Western Regional Climate Center, 2020).

Growing season precipitation is April through September

Source data is in Table 1



KEY MAP



LEGEND

- ✦ Primary Transect
- ▲ Alternate Transect
- --- Mine Site Roads
- ▭ OSM VMU 4 (~ 1,242 acres)
- ▨ Prelaw (~ 0 acres)
- ▨ Initial Program (~ 26 acres)
- ▭ Permanent Program (~ 1,108 acres)
- ▭ OSM Permit Boundary

TRANSECT LABEL EXPLANATION

O-VMU-1-T1P

OSM Permit Area
Vegetation Management Unit (VMU-#)
Transect Number
Primary (P) or Alternate (A)

0 1,300 2,600
1 inch = 1,300 feet FEET

NOTE(S)

1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN
2. KEY MAP SCALE IS DIFFERENT FROM OVERVIEW OF VMUS
3. TRANSECT LOCATIONS WERE CREATED IN ACCORDANCE WITH THE METHODS OUTLINED IN THE PERMIT

REFERENCE(S)

1. ORTHOIMAGE: CHEVRON, 2013

COORDINATE SYSTEM: NAD 1927 STATEPLANE NEW MEXICO WEST FIPS 3003
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1927

CLIENT
CHEVRON ENVIRONMENTAL MANAGEMENT

PROJECT
MCKINLEY MINE - OSM PERMIT PHASE III BOND RELEASE, 2023 VEGETATION MONITORING

TITLE
VEGETATION MONITORING TRANSECTS 2023, VEGETATION MANAGEMENT UNIT 4

CONSULTANT
wsp

YYYY-MM-DD	2023-11-29
DESIGNED	GFD
PREPARED	GFD
REVIEWED	MR
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
31406184.000	B007	0	3

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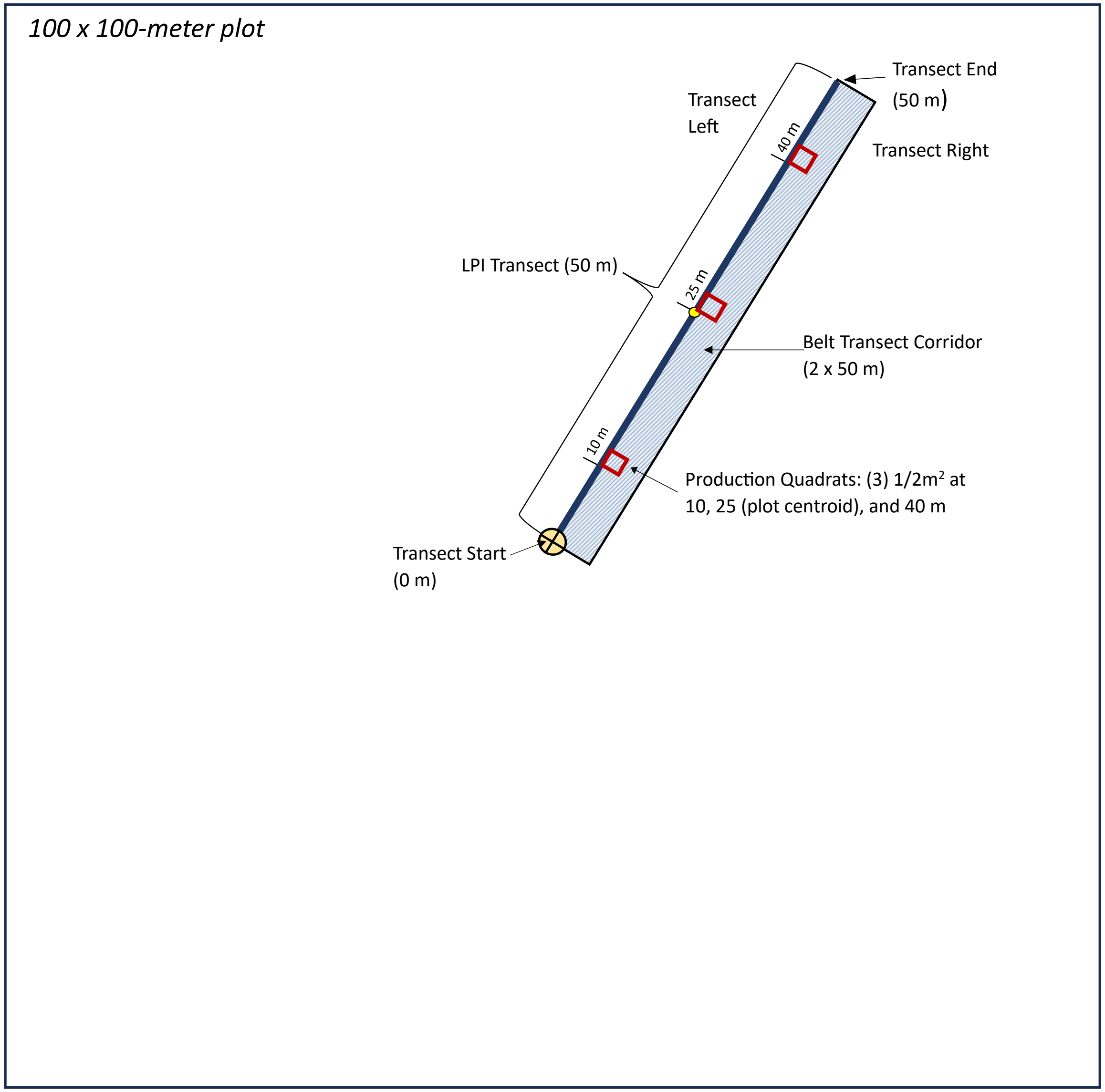
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

Figure 4: Vegetation Plot and Transect Layout



Transect start placed on plot centroid and oriented randomly (0-360 degrees)* **Not to Scale

Figure 5: Typical Grass-Shrubland Vegetation in O-VMU-4, September 2023

Figure 6: Stabilization of the Annual Forage Production, O-VMU-4, 2023

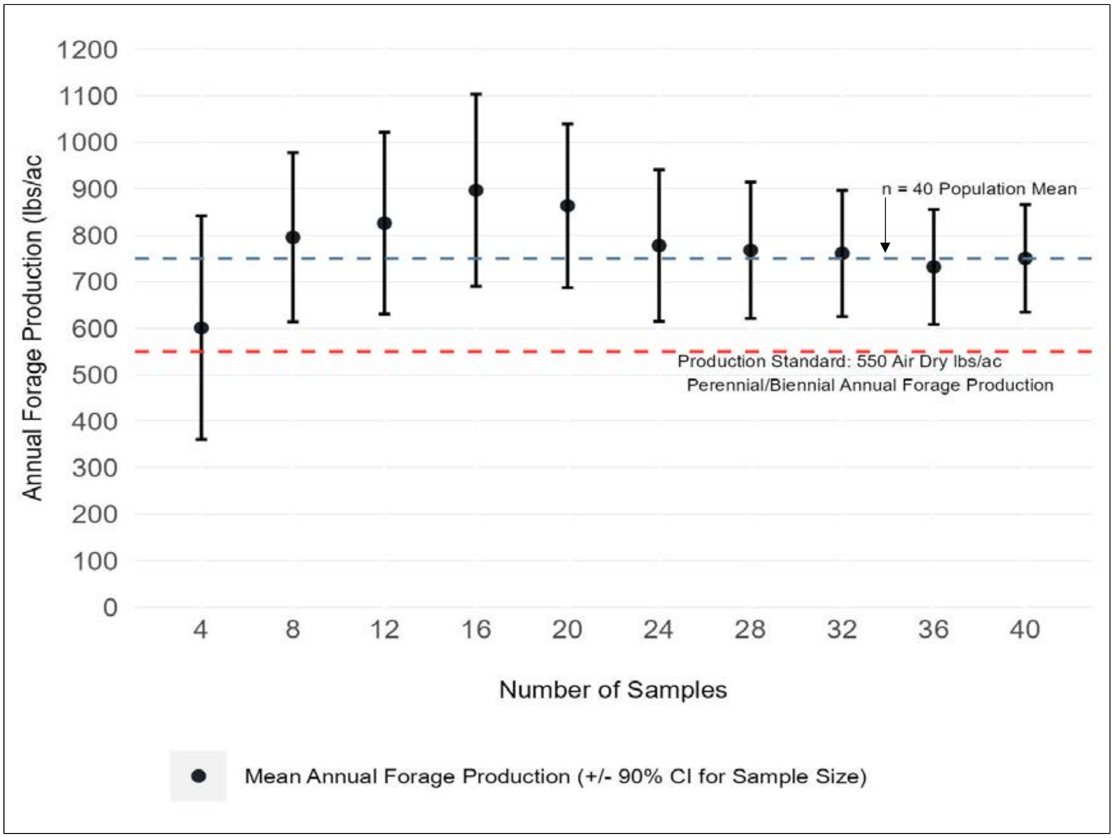
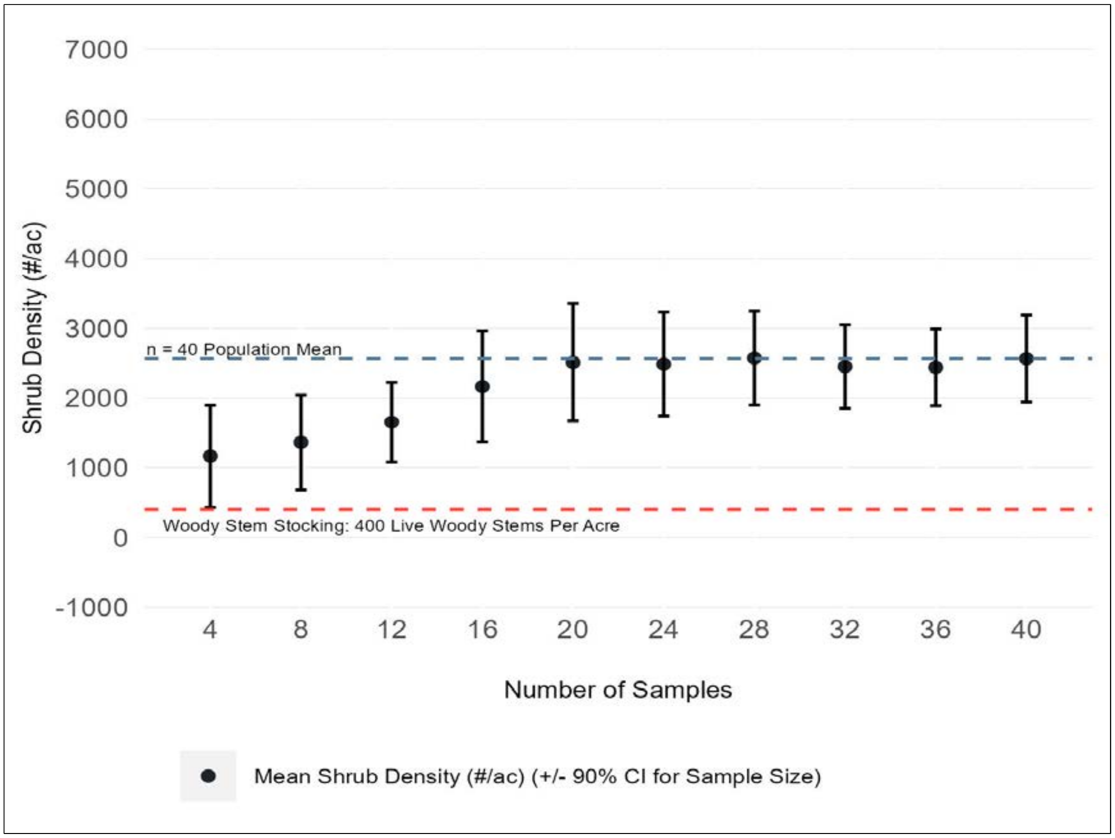


Figure 7: Stabilization of the Mean for Shrub Density, O-VMU-7, 2023



APPENDIX A

Vegetation Data Summary

Table A-1: O-VMU-4 Line Point Intercept Foliar Cover Data (first hits), 2023

Transect	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Grasses																																								
Cool-Season Annuals																																								
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--
Cool-Season Perennials																																								
ACHY	2	4	1	1	2	1	--	--	5	--	9	6	--	--	--	4	--	--	4	--	--	5	1	3	2	2	10	6	1	2	--	--	--	1	--	4	4	1	5	4
ELEL5	2	--	--	--	--	1	--	--	--	--	--	--	1	--	--	3	3	--	--	--	--	--	--	2	--	--	--	--	--	--	1	--	--	--	--	2	--	--	--	--
ELLA3	--	13	3	2	--	--	5	6	5	2	3	4	1	--	4	5	--	2	2	--	4	10	16	--	4	2	2	--	6	--	5	--	19	2	10	1	1	20	2	--
ELTR7	4	--	5	1	--	1	--	--	1	--	2	--	2	--	1	--	--	1	1	3	1	--	--	3	--	--	--	--	1	3	6	3	--	4	--	--	2	--	--	3
HECO26	--	--	2	1	--	--	1	--	2	--	--	--	--	--	1	--	4	--	3	--	1	--	--	--	1	--	--	--	2	1	1	--	--	2	1	--	--	1	2	1
PASM	4	1	1	1	1	3	5	8	2	--	1	--	5	8	2	--	5	--	2	4	--	3	--	3	6	9	4	1	4	4	2	3	--	8	--	1	1	--	--	3
PSJU3	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PSSP6	--	4	--	--	--	--	--	1	--	--	--	--	--	--	1	2	--	--	--	--	--	3	7	--	--	--	--	--	1	--	--	--	--	--	1	--	--	--	--	--
THIN6	--	2	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Warm-Season Perennials																																								
BOCU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
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Cover Components																																								
Total Vegetation	27	30	17	27	11	21	27	31	28	23	24	18	26	17	18	26	29	18	19	12	11	26	30	17	28	20	21	15	22	18	26	11	26	20	26	14	25	29	21	31
Live Vegetation[1]	27	30	17	27	11	21	27	31	28	23	24	18	23	17	18	26	29	18	19	12	11	26	30	17	28	20	21	15	22	18	24	10	26	20	26	14	25	29	21	31
Perennial Vegetation[2]	24	28	17	8	11	17	27	31	28	23	22	18	22	12	18	26	28	18	14	12	11	24	30	17	28	20	21	15	22	18	21	10	26	20	26	14	25	29	21	31
Rock	1	5	0	2	3	3	0	0	1	1	9	11	3	2	6	1	2	4	1	5	0	8	3	2	4	2	0	5	1	2	5	17	8	5	3	1	5	3	4	0
Litter	5	7	7	10	17	5	7	14	8	11	9	5	8	12	4	5	11	4	9	6	8	5	9	18	9	5	2	6	14	5	10	5	4	8	1	16	6	7	8	3
Bare Soil	17	8	26	11	19	21	16	5	13	15	8	16	13	19	22	18	8	24	21	27	31	11	8	13	9	23	27	24	13	25	9	17	12	17	20	19	14	11	17	16

Notes:
Species codes defined in Table A-5
[1] Live vegetation is the total vegetation foliar hits for the transect, NOT including noxious weeds
[2] Perennial vegetation is the total vegetation foliar hits for the transect, NOT including annuals and noxious weeds

Table A-2: O-VMU-4 Line Point Intercept Foliar Cover Data (all hits), 2023

Transect	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Grasses																																								
Cool-Season Annuals																																								
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	1	--	--	--	--
Cool-Season Perennials																																								
ACHY	2	4	1	1	2	1	--	--	6	--	9	6	--	--	--	4	--	--	4	--	--	5	1	3	2	2	11	6	1	2	--	--	--	1	--	4	4	1	5	4
ELEL5	2	--	--	--	--	1	--	--	--	--	--	--	1	--	--	3	3	--	--	--	--	--	--	2	--	--	--	--	--	1	2	--	--	--	--	2	--	--	--	--
ELLA3	--	14	3	2	--	--	6	6	6	2	3	6	1	--	4	6	--	2	2	1	5	10	16	--	4	2	2	--	7	--	5	--	19	2	11	1	2	20	2	--
ELTR7	4	--	6	1	--	1	--	--	2	--	3	--	2	--	1	--	--	1	1	3	1	--	--	3	--	--	--	--	1	4	6	4	--	4	--	--	2	--	--	4
HECO26	--	--	2	1	--	--	1	--	2	--	--	--	--	--	2	--	5	--	3	--	1	--	--	--	1	--	--	--	2	1	1	--	--	2	1	--	1	1	2	1
PASM	4	1	1	1	1	3	5	10	3	--	1	--	7	8	2	--	6	--	2	4	--	3	--	3	6	10	5	1	4	5	2	3	--	8	--	1	1	--	--	7
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Notes:
Species codes defined in Table A-5

Table A-3: O-VMU-4 Line Point Intercept Species Associations, 2023

		Upper Canopy Species														
		ACHY	ATCA2	ELAN	ERNA10	GRSQ	GUSA2	HECO26	LAOC3	MACA2	MEOF	PASM	PSSP6	PUME	PUTR2	**Total**
Lower Canopy Species	ACHY	--	2	--	--	--	--	--	--	--	--	--	--	--	--	2
	ALDE	1	--	--	--	--	--	--	--	--	--	--	--	--	--	1
	ATCA2	2	--	--	--	--	--	--	--	--	--	1	--	--	--	3
	ATCO4	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1
	BOCU	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1
	BRTE	--	2	--	--	--	--	--	--	--	--	--	--	--	--	2
	DESO	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1
	ELEL5	--	2	--	--	--	--	--	--	--	--	--	--	--	--	2
	ELLA3	--	6	--	--	--	1	--	--	1	--	--	--	2	1	11
	ELTR7	1	3	1	1	--	--	--	--	--	--	--	--	--	--	6
	ERCI6	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1
	GUSA2	3	--	--	--	--	--	--	--	--	--	--	--	--	--	3
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Notes:
Species codes defined in Table A-5

Table A-4: O-VMU-4 Quadrat Canopy Cover Data (%), 2023

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Total Vegetation Cove[1]	23.0	53.0	20.0	29.5	39.0	33.5	25.0	18.0	11.3	17.0	82.0	17.0	35.0	28.0	5.0	42.0	5.0	7.0	64.0	19.5	62.0	32.0	52.0	45.0	9.5	7.0	76.0	13.0	37.0	21.0	22.0	12.0	32.0	55.0	18.0	18.5	10.5	2.8	91.5	58.0	8.0	20.0	7.5	22.0	12.0	18.0	14.0	14.1	16.0	23.0	20.0	11.9	62.5	29.0	13.0	10.0	53.0	37.8	3.5	4.3
Rock	2.0	0.3	1.0	1.5	7.0	0.1	1.0	2.0	4.0	0.3	0.3	0.3	3.0	1.0	3.0	0.0	0.1	7.0	0.5	0.1	0.1	3.5	0.5	0.1	0.8	0.3	1.0	2.0	1.0	4.0	8.0	15.0	7.0	15.0	12.0	7.0	0.3	7.0	0.0	0.0	4.0	3.0	2.5	5.5	3.8	8.0	0.3	1.0	0.3	6.0	3.0	9.5	0.3	0.3	17.0	8.0	0.0	0.8	3.3	5.0
Litter	12.0	6.0	6.0	2.8	11.0	5.5	7.0	5.0	3.0	4.0	9.0	9.3	23.0	8.0	8.0	3.0	3.0	8.0	15.0	15.0	2.0	5.0	21.0	7.5	1.0	0.8	9.0	15.0	13.0	5.0	12.0	10.0	4.5	10.0	1.5	4.0	6.0	2.8	8.5	5.0	2.0	5.0	14.0	8.0	3.0	7.5	10.0	4.5	7.0	12.0	7.0	3.0	10.0	8.0	2.0	6.0	25.0	4.5	1.0	4.0
Bare Soil	63.0	40.8	73.0	66.3	43.0	61.0	67.0	75.0	81.8	78.8	8.8	73.5	39.0	63.0	84.0	55.0	91.9	78.0	20.5	65.5	36.0	59.5	26.5	47.5	88.7	92.0	14.0	70.0	49.0	70.0	58.0	63.0	56.5	20.0	68.5	70.5	83.2	87.5	0.0	37.0	86.0	72.0	76.0	64.5	81.3	66.5	75.7	80.5	76.8	59.0	70.0	75.6	27.3	62.8	68.0	76.0	32.0	57.0	92.3	86.8

Table A-4: O-VMU-4 Quadrat Canopy Cover Data (%), 2023 (cont'd)

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ATCA2	--	--	--	--	0.0	--	--	--	--	--	--	--	--	--	--	12.0	--	--	--	--	--	--	--	--	--	--	15.0	--	--	--	0.1	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0	--	--	--
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	1.5	--	--	--	--	--	21.5	9.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATGA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0	40.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0	--	--	--	--	--	--	--	--	--	--	--	--
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KRLA2	2.5	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	35.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21.0	--	--	--	--	--	--	22.0	8.5	20.0	--	--	--
PUTR2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25.0	--	--	--	--	--	--	27.0	--	--	--	--	--	--	--	--
SERI2	--	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																																																												
Total Vegetation Cove[1]	9.5	9.5	2.3	13.5	24.0	4.6	15.0	27.0	32.0	1.8	3.0	4.9	2.0	27.0	17.0	47.0	45.0	17.0	3.5	49.5	9.0	0.0	9.5	11.0	42.0	6.8	45.0	6.0	29.0	57.0	7.8	28.0	12.0	12.3	5.8	15.0	23.0	2.5	30.0	7.7	10.2	14.5	1.1	4.5	37.5	60.0	18.5	47.5	11.7	64.0	4.5	35.0	45.0	18.5	31.3	64.5	46.6	9.5	8.0	31.6
Rock	0.2	0.2	0.2	7.5	1.0	5.0	6.0	3.5	1.5	0.3	0.0	85.0	3.0	1.0	0.0	0.5	1.0	3.0	1.3	0.0	1.0	8.5	4.5	15.5	1.0	8.0	1.8	2.0	0.5	0.0	5.5	7.5	4.0	6.0	55.0	2.0	12.0	8.0	8.0	3.5	2.0	0.5	7.5	7.5	2.0	0.1	1.0	1.5	0.1	1.5	7.0	3.5	0.1	4.0	0.4	0.5	1.5	0.0	0.8	0.4
Litter	3.0	5.0	1.8	4.0	3.0	4.5	7.5	7.5	20.0	33.0	25.0	5.0	1.0	7.0	5.0	6.0	15.0	2.0	0.5	9.0	2.5	0.0	2.0	2.5	15.0	4.5	25.0	5.0	7.0	9.0	5.0	4.0	1.5	7.0	1.3	5.0	7.0	5.0	14.0	8.5	2.8	3.5	12.0	5.0	3.5	8.0	9.0	15.0	5.0	8.0	2.5	6.0	6.0	6.5	3.0	5.0	10.0	6.0	5.0	4.0
Bare Soil	87.3	85.3	95.8	75.0	72.0	85.9	71.5	62.0	46.5	65.0	72.0	5.2	94.0	65.0	78.0	46.5	39.0	78.0	94.8	41.5	87.5	91.5	84.0	71.0	42.0	80.8	28.3	87.0	63.5	34.0	81.7	60.5	82.5	74.7	38.0	78.0	58.0	84.5	48.0	80.3	85.1	81.5	79.4	83.0	57.0	31.9	71.5	36.0	83.3	26.5	86.0	55.5	49.0	71.0	65.4	30.0	41.9	84.5	86.3	64.0

Notes:

Species codes defined in Table A-5

[1] Total vegetation canopy cover for the transect by the quadrat canopy cover estimate method

Table A-5: O-VMU-4 Air-dry Aboveground Annual Forage Production Data, 2023

Transect	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Perennial Grasses																																								
Cool-Season																																								
ACHY	--	8	16	2	--	7	--	--	27	--	5	7	--	--	15	--	--	--	--	1	--	18	--	8	--	--	6	23	--	--	--	--	--	9	8	45	--	--	39	46
BRIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--
ELEL5	9	--	--	--	--	--	--	--	--	--	--	--	--	1	--	6	--	--	18	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	35	--	--	8	--
ELLA3	18	--	21	22	--	--	12	--	--	35	--	64	137	--	27	--	--	--	--	2	--	9	53	--	29	--	--	--	2	57	--	10	56	--	14	--	11	36	--	--
ELTR7	--	107	18	--	8	--	--	--	--	--	--	--	--	--	38	--	1	9	--	--	--	42	--	--	--	--	13	--	--	--	24	--	--	23	--	--	18	77	--	--
HECO26	11	--	1	10	--	--	--	--	19	6	6	--	--	--	--	--	10	--	--	4	--	--	--	--	4	--	--	--	34	25	5	--	--	--	--	--	--	--	6	--
PASM	17	2	2	4	--	46	10	63	80	0	--	--	37	84	--	17	80	--	31	13	23	28	--	3	1	75	72	--	3	66	18	42	--	32	--	10	--	--	25	54
PSJU3	--	--	--	--	158	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PSSP6	12	--	--	--	--	--	7	21	--	--	7	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	73	--	--	--	--	--	--	--	--	--	--	--
Warm-Season																																								
BODA2	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOGR2	22	9	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	--	23	13	--	--	6
PLJA	53	--	8	0	--	--	56	--	--	46	49	--	--	--	--	--	--	172	--	2	--	--	--	--	51	--	--	--	--	--	--	13	--	--	--	--	15	--	128	5
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Perennial/Biennial Forbs																																								
BADI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHER2	5	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GRSQ	--	--	0	--	--	--	15	16	--	--	24	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LAOC3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LASE	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LILE3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--
MACA2	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	2	--	--	--	--	--	3	--	1	--	--	--	2	--	--
MEOF	--	--	--	--	--	--	--	--	--	--	8	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--
MESA	--	--	--	--	--	--	47	68	--	--	--	--	38	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	48	--	--	--
MILI3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	69	--	--	--	--	--	--	--	--	--	--	--	--	--
RACO3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	20	2	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	0	--	--	--	--	--	--
SPIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--
TRDU	3	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
TRPR	--	0	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--	2	--	--	--	--	--	--	--	1	--	1	--	--	--	4
Shrubs, Trees, and Cacti																																								
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ARNO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCA2	--	--	1	--	--	--	--	--	180	--	--	--	52	233	--	--	--	--	--	--	--	0	--	--	--	24	--	--	19	--	2	--	--	--	--	--	--	--	1	--
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	3	--	37	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATGA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA10	--	--	1	--	--	--	--	35	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--
GUSA2	--	--	--	--	--	75	--	--	--	--	--	--	--	--	--	1	12	--	--	--	--	--	--	--	--	86	--	--	--	--	--	--	--	--	--	2	--	--	--	--
HEVI4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KRLA2	--	--	14	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	83	--	--	--	--	--	18	--	--	51	--
PUTR2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	34	--	--	24	--	--
SERI2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Air-dry Aboveground Annual Forage Production																																								
Total (g)	151	127	89	38	186	128	149	203	305	108	99	84	266	320	103	58	132	209	48	102	32	98	90	15	99	192	162	23	131	230	51	69	72	77	56	131	104	139	258	115
Total (lbs/ac)	897	755	527	226	1,109	763	886	1,205	1,814	645	587	501	1,578	1,902	613	343	785	1,242	287	608	193	585	535	86	588	1,143	961	137	777	1,370	303	409	427	455	331	782	619	824	1,534	683

Notes:

Species codes defined in Table A-5

Total (g) is the total of all three .5 m^2 quads (1.5m^2 total) per transect

Lbs/ac=total grams÷1.5*(4046.86/453.592)

Non-forage and forage determinations are based on the permit (e.g. plants of perennial and/or biennial duration are forage and plants of annual duration are non-forage; noxious weeds are non-forage)

Table A-6: O-VMU-4 Shrub Belt Transect Data (frequency), 2023

Transect	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Shrubs, Trees, and Cacti																																								
ARFR4	--	8	--	--	--	1	--	1	--	--	--	--	--	--	12	--	--	--	1	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARNO4	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	9	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--
ARTR2	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCA2	16	9	17	--	31	23	6	--	33	5	24	42	17	23	40	16	22	56	9	18	--	43	32	14	12	8	2	18	48	17	7	7	5	4	25	11	--	10	15	--
ATCO	--	--	--	--	--	--	--	--	8	--	--	--	--	6	--	--	--	--	--	38	--	--	--	--	--	1	--	--	--	--	--	11	--	1	--	--	--	17	--	41
ATCO4	4	--	1	--	--	--	--	--	1	--	2	--	--	31	--	3	--	--	--	--	--	87	--	--	--	--	--	--	--	--	--	--	2	51	--	--	--	--	--	--
ATGA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHGR6	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELAN	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA10	--	--	22	--	--	3	--	1	18	9	3	--	1	3	--	9	--	3	27	1	1	--	2	13	6	32	2	--	--	4	12	3	7	2	2	9	6	--	1	--
GUSA2	--	9	7	--	1	56	--	9	5	--	--	--	5	--	146	16	--	18	2	--	2	1	--	--	112	1	--	--	1	6	--	--	--	--	14	4	--	--	1	1
KRLA2	5	--	4	1	11	--	2	--	--	8	37	1	--	8	--	--	11	2	--	151	--	--	1	--	--	56	5	18	17	--	1	5	1	--	67	1	1	241	--	--
OPPO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PIED	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PUME	--	--	--	--	--	--	1	1	--	--	25	--	--	7	--	--	--	--	1	4	1	--	10	--	--	--	25	1	1	--	4	--	--	6	--	--	--	--	--	1
PUTR2	--	9	1	--	--	--	--	--	--	--	--	--	--	9	--	--	1	--	1	1	1	--	6	3	--	--	--	--	--	--	4	9	1	19	--	--	8	--	--	--
SEFL3	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SERI2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ULPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	25	35	54	1	43	90	9	12	65	22	91	43	24	88	198	56	34	84	50	217	16	131	53	34	136	99	34	37	67	27	29	35	16	83	108	25	15	269	18	43

Notes:

Species codes defined in Table A-5

The shrub belt transect area is 100m^2 (2mx50m); shrubs rooted in the belt transect were counted on an individual basis

Table A-7: Species Observed 2021-2023, O-VMU-4

Common Name	Scientific Name	Code
Cool-Season Grasses (14)		
Annuals (1)		
Cheatgrass	*Bromus tectorum*	BRTE
Perennials (13)		
Indian ricegrass	*Achnatherum hymenoides*	ACHY
Crested wheatgrass	***Agropyron cristatum***	**AGCR**
Smooth brome	***Bromus inermis***	**BRIN2**
Bottlebrush squirreltail	*Elymus elymoides*	ELEL5
Thickspike wheatgrass	*Elymus lanceolatus*	ELLA3
Slender wheatgrass	*Elymus trachycaulus*	ELTR7
Needle and thread	*Hesperostipa comata*	HECO26
Colorado wildrye	*Leymus ambiguus*	LEAM
Western wheatgrass	*Pascopyrum smithii*	PASM
Russian wildrye	*Psathyrostachys juncea*	PSJU3
Bluebunch wheatgrass	*Pseudoroegneria spicata*	PSSP6
Intermediate wheatgrass	*Thinopyrum intermedium*	THIN6
Tall wheatgrass	*Thinopyrum ponticum*	THPO7
Warm-Season Grasses (7)		
Annuals (1)		
False buffalograss	*Munroa squarrosa*	MUSQ3
Perennials (6)		
Sideoats grama	*Bouteloua curtipendula*	BOCU
Buffalograss	*Bouteloua dactyloides*	BODA2
Blue grama	*Bouteloua gracilis*	BOGR2
James' galleta	*Pleuraphis jamesii*	PLJA
Alkali sacaton	*Sporobolus airoides*	SPAI
Sand dropseed	*Sporobolus cryptandrus*	SPCR
Forbs (66)		
Annuals (18)		
Desert madwort	***Alyssum desertorum***	**ALDE**
Alyssum	***Alyssum simplex***	**ALSI8**
Burningbush	*Bassia scoparia*	BASC5
Ribseed sandmat	***Chamaesyce glyptosperma***	**CHGL13**
Spotted sandmat	***Chamaesyce maculata***	**CHMA15**
Thymeleaf sandmat	*Chamaesyce serpyllifolia*	CHSE6
Mealy goosefoot	*Chenopodium incanum*	CHIN2
Fetid marigold	*Dyssodia papposa*	DYPA
Common sunflower	*Helianthus annuus*	HEAN3
Prairie sunflower	*Helianthus petiolaris*	HEPE
Longleaf false goldeneye	*Heliomeris longifolia*	HELO6
Fendler's desertdandelion	*Malacothrix fendleri*	MAFE
Erect knotweed	*Polygonum erectum*	POER2
Bushy knotweed	***Polygonum ramosissimum***	**PORA3**
Little hogweed	*Portulaca oleracea*	POOL
Prickly Russian thistle	*Salsola tragus*	SATR12
Golden crownbeard	*Verbesina encelioides*	VEEN
Rough cocklebur	*Xanthium strumarium*	XAST

Table A-7: Species Observed 2021-2023, O-VMU-4

Common Name	Scientific Name	Code
Perennials/Biennials (48)		
Common yarrow	*Achillea millefolium*	ACMI2
Russian knapweed	***Acroptilon repens***	**ACRE3**
Fort Wingate milkvetch	***Astragalus wingatanus***	**ASWI2**
Ragleaf bahia	*Bahia dissecta*	BADI
Sego lily	*Calochortus nuttallii*	CANU3
Musk thistle	*Carduus nutans*	CANU4
Wyoming Indian paintbrush	*Castilleja linariifolia*	CALI4
Rose heath	*Chaetopappa ericoides*	CHER2
Whitemargin sandmat	*Chamaesyce albomarginata*	CHAL11
Field bindweed	*Convolvulus arvensis*	COAR4
Canadian horseweed	*Conyza canadensis*	COCA5
Spreading fleabane	***Erigeron divergens***	**ERDI4**
Redstem stork's bill	*Erodium cicutarium*	ERCI6
Western wallflower	*Erysimum asperum*	ERAS2
Blanketflower	*Gaillardia aristata*	GAAR
Curlycup gumweed	*Grindelia squarrosa*	GRSQ
Showy goldeneye	*Heliomeris multiflora*	HEMU3
Flaxflowered ipomopsis	*Ipomopsis longiflora*	IPLO2
Manyflowered ipomopsis	*Ipomopsis multiflora*	IPMU3
Povertyweed	*Iva axillaris*	IVAX
Prickly lettuce	*Lactuca serriola*	LASE
Flatspine stickseed	*Lappula occidentalis*	LAOC3
Mesa pepperwort	***Lepidium alyssoides***	**LEAL4**
Lewis flax	*Linum lewisii*	LILE3
Hoary tansyaster	*Machaeranthera canescens*	MACA2
Tanseyleaf tansyaster	*Machaeranthera tanacetifolia*	MATA2
Alfalfa	*Medicago sativa*	MESA
Sweetclover	*Melilotus officinalis*	MEOF
Narrowleaf four-o'clock	***Mirabilis linearis***	**MILI3**
Colorado four o'clock	*Mirabilis multiflora*	MIMU
Sainfoin	*Onobrychis viciifolia*	ONVI
Beardlip penstemon	*Penstemon barbatus*	PEBA2
Palmer's penstemon	*Penstemon palmeri*	PEPA8
Prostrate knotweed	***Polygonum aviculare***	**POAV**
Upright prairie coneflower	*Ratibida columnifera*	RACO3
Curly dock	*Rumex crispus*	RUCR
Cutleaf vipergrass	*Scorzonera laciniata*	SCLA6
Broom-like ragwort	*Senecio spartioides*	SESP3
Tall tumblemustard	*Sisymbrium altissimum*	SIAL2
Scarlet globemallow	*Sphaeralcea coccinea*	SPCO
Fendler's globemallow	*Sphaeralcea fendleri*	SPFE
Gooseberryleaf globemallow	*Sphaeralcea grossulariifolia*	SPGR2
Spear globemallow	*Sphaeralcea hastulata*	SPHA
Gray globemallow	*Sphaeralcea incana*	SPIN2
Small-leaf globemallow	*Sphaeralcea parvifolia*	SPPA2
Yellow salsify	*Tragopogon dubius*	TRDU
Salsify	*Tragopogon porrifolius*	TRPO
Jack-go-to-bed-at-noon	***Tragopogon pratensis***	**TRPR**

Table A-7: Species Observed 2021-2023, O-VMU-4

Common Name	Scientific Name	Code
Shrubs, Trees, and Cacti (31)		
Silver sagebrush	*Artemisia cana*	ARCA13
Prairie sagewort	*Artemisia frigida*	ARFR4
White sagebrush	*Artemisia ludoviciana*	ARLU
Black sagebrush	*Artemisia nova*	ARNO4
Big sagebrush	*Artemisia tridentata*	ARTR2
Fourwing saltbush	*Atriplex canescens*	ATCA2
Shadscale saltbush	*Atriplex confertifolia*	ATCO
Mat saltbush	*Atriplex corrugata*	ATCO4
Gardner's saltbush	*Atriplex gardneri*	ATGA
Mound saltbush	*Atriplex obovata*	ATOB
Alderleaf mountain mahogany	*Cercocarpus montanus*	CEMO2
Greene's rabbitbrush	*Chrysothamnus greenei*	CHGR6
Russian olive	*Elaeagnus angustifolia*	ELAN
Mormon tea	*Ephedra viridis*	EPVI
Rubber rabbitbrush	*Ericameria nauseosa*	ERNA10
Broom snakeweed	*Gutierrezia sarothrae*	GUSA2
Hairy false goldenaster	***Heterotheca villosa***	**HEVI4**
Oneseed juniper	*Juniperus monosperma*	JUMO
Winterfat	*Krascheninnikovia lanata*	KRLA2
Pale desert-thorn	*Lycium pallidum*	LYPA
Plains pricklypear	***Opuntia polyacantha***	**OPPO**
Twoneedle pinyon	*Pinus edulis*	PIED
Ponderosa pine	*Pinus ponderosa*	PIPO
Mexican cliffrose	*Purshia mexicana*	PUME
Antelope bitterbrush	*Purshia tridentata*	PUTR2
Greasewood	*Sarcobatus vermiculatus*	SAVE4
Threadleaf ragwort	*Senecio flaccidus*	SEFL3
Riddell's ragwort	***Senecio riddellii***	**SERI2**
Spineless horsebrush	*Tetradymia canescens*	TECA2
Siberian elm	***Ulmus pumila***	**ULPU**
Banana yucca	*Yucca baccata*	YUBA

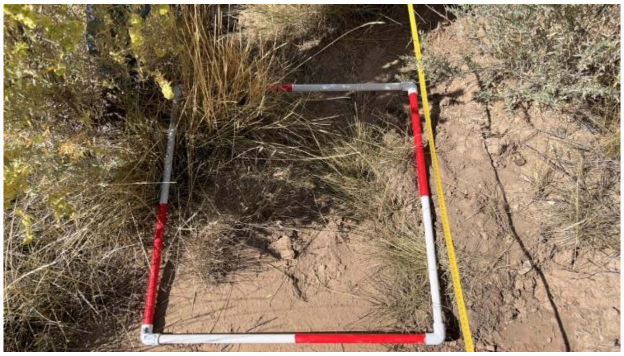
Notes:

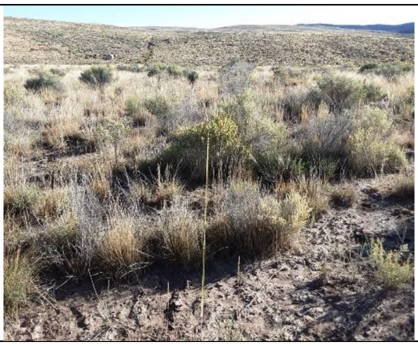
Bold species are newly observed on O-VMU-4 in 2023

APPENDIX B

Quadrat Photographs

	
O-VMU4-T01P	Q1
	
Q2	Q3

	
O-VMU4-T02P	Q1
	
Q2	Q3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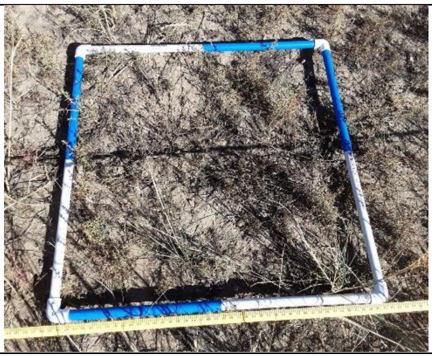
Q2	Q3

	
O-VMU4-T04P	Q1
	
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	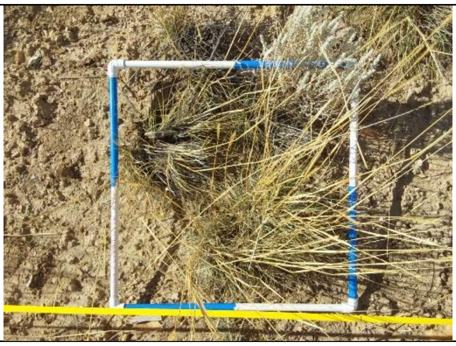
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Q2	Q3

	
O-VMU4-T06P	Q1
	
Q2	Q3

O-VMU4-T07P

Q1

Q2

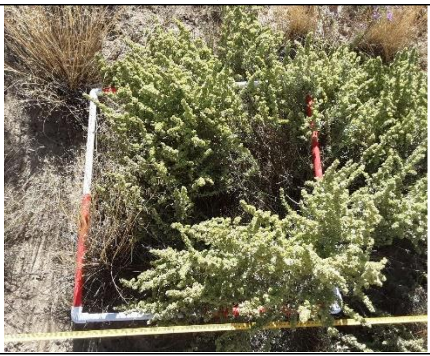
Q3

O-VMU4-T08P

Q1

Q2

Q3

	
O-VMU4-T09P	Q1
	
Q2	Q3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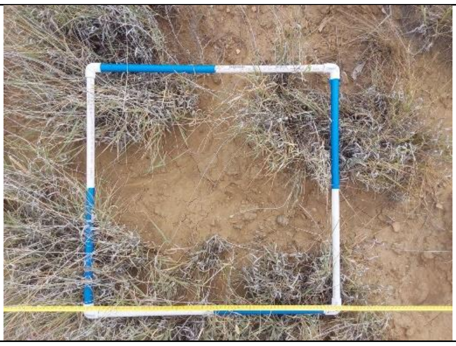
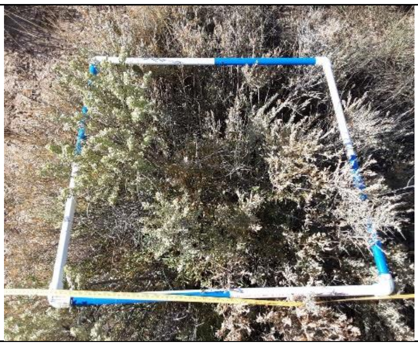
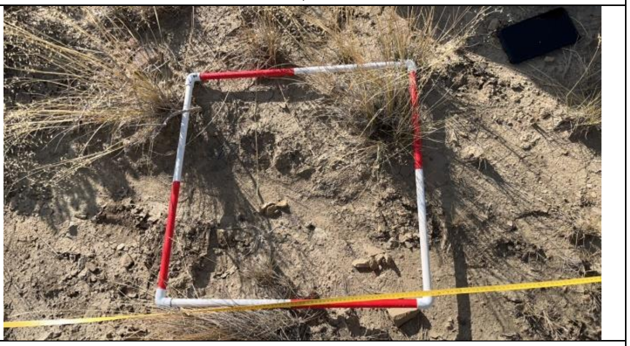
	
Q2	Q3

	
O-VMU4-T11P	Q1
	
Q2	Q3

	
O-VMU4-T12P	Q1
	
Q2	Q3

	
O-VMU4-T13P	Q1
	
Q2	Q3

	
O-VMU4-T14P	Q1
	
Q2	Q3

	
O-VMU4-T15P	Q1
	
Q2	Q3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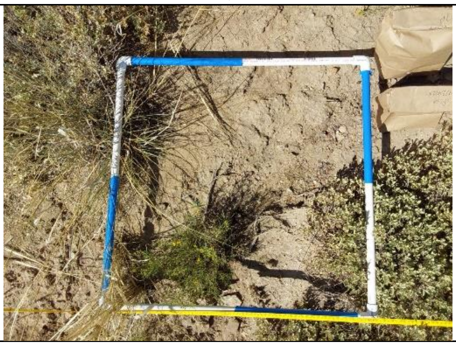
Q2	Q3


O-VMU4-T17P


Q1


Q2


Q3

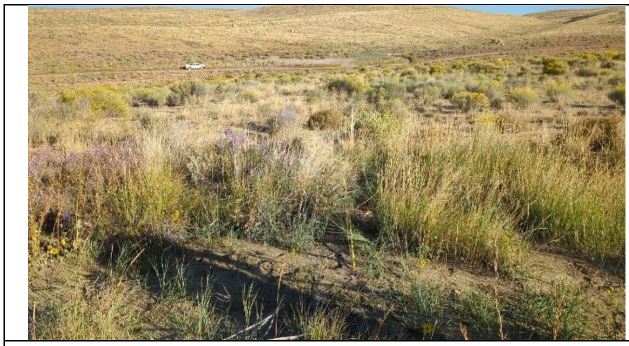
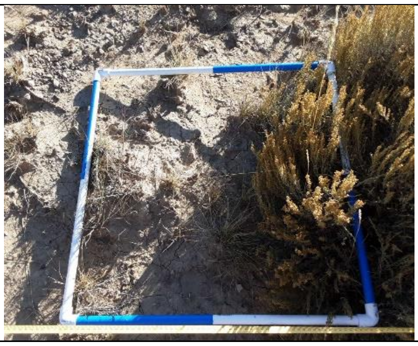

O-VMU4-T18P


Q1


Q2


Q3

	
O-VMU4-T19P	Q1
	
Q2	Q3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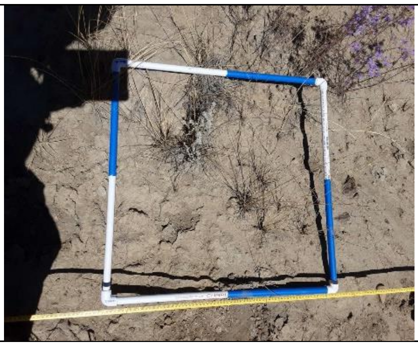
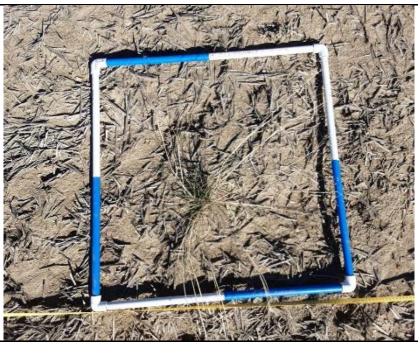
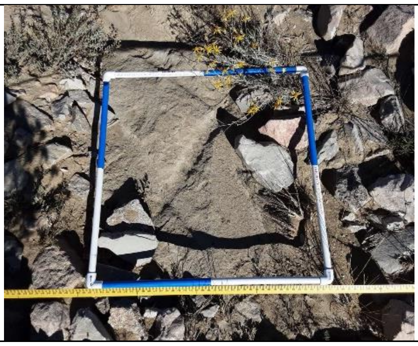
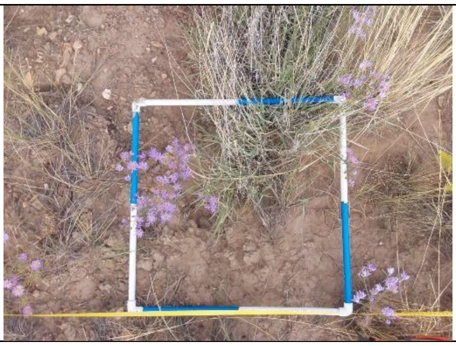
Q2	Q3

	
O-VMU4-T21P	Q1
	
Q2	Q3

	
O-VMU4-T22P	Q1
	
Q2	Q3

	
O-VMU4-T23P	Q1
	
Q2	Q3

	
O-VMU4-T24P	Q1
	
Q2	Q3

	
O-VMU4-T25P	Q1
	
Q2	Q3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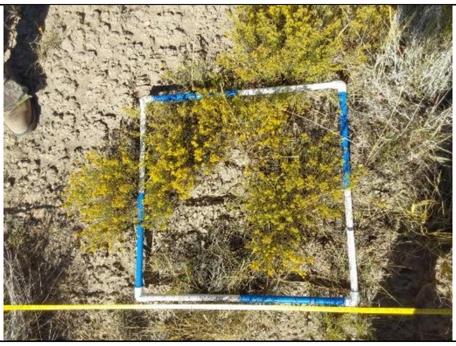
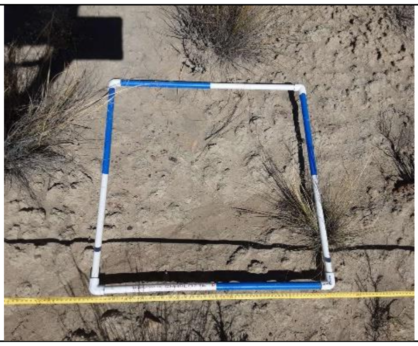
	
Q2	Q3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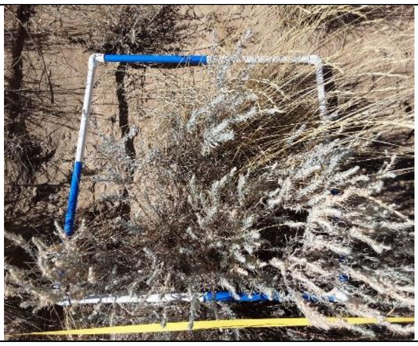
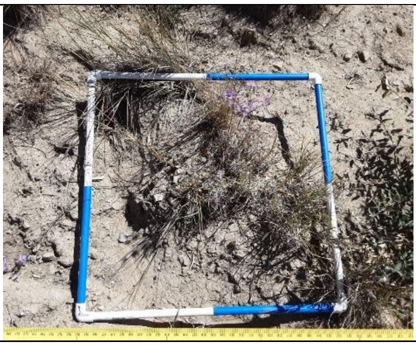
Q2	Q3

	
O-VMU4-T28P	Q1
	
Q2	Q3

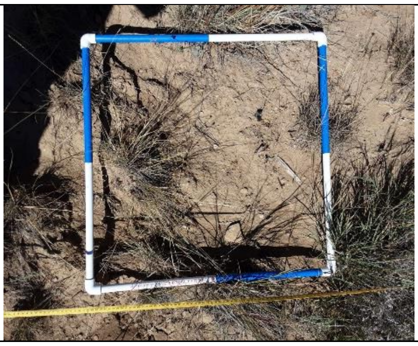
	
O-VMU4-T29P	Q1
	
Q2	Q3

	
O-VMU4-T30P	Q1
	
Q2	Q3

	
O-VMU4-T31P	Q1
	
Q2	Q3

	
O-VMU4-T32P	Q1
	
Q2	Q3

	
O-VMU4-T33P	Q1
	
Q2	Q3

	
O-VMU4-T34P	Q1
	
Q2	Q3

O-VMU4-T35P

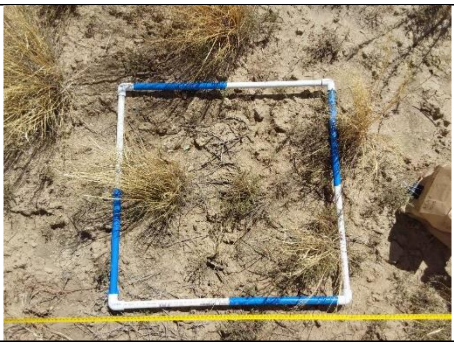
Q1

Q2

Q3

O-VMU4-T36P

Q1



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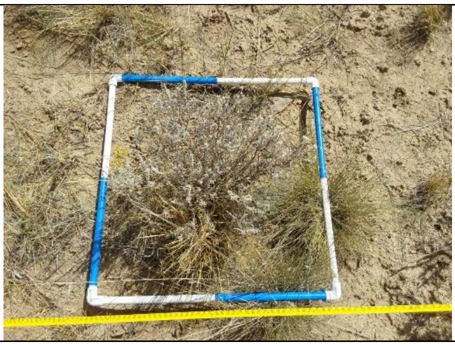

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O-VMU4-T37P

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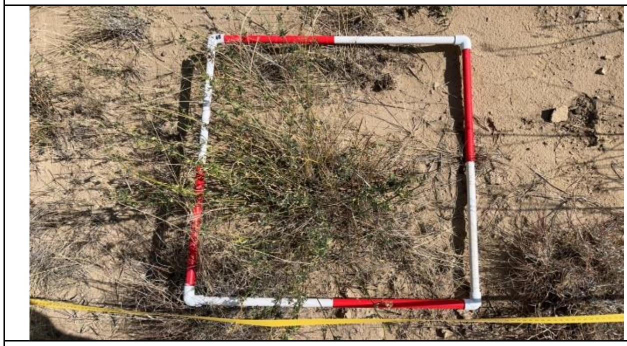

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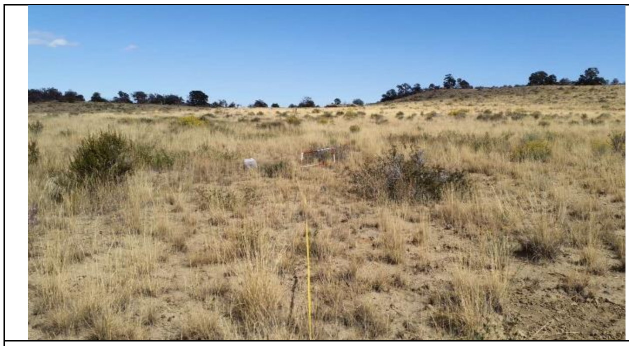

O-VMU4-T38P

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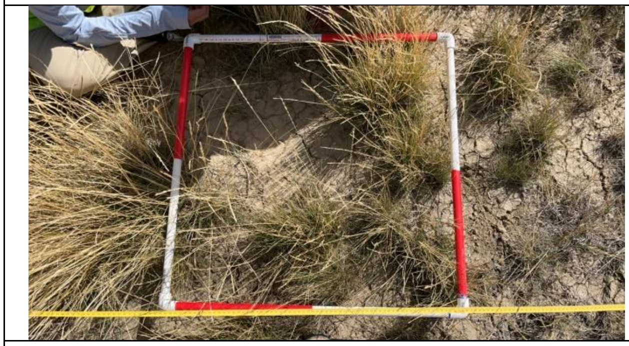
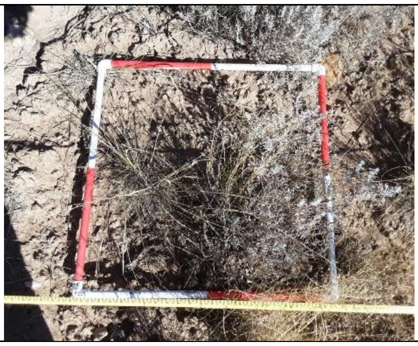


Q2

Q3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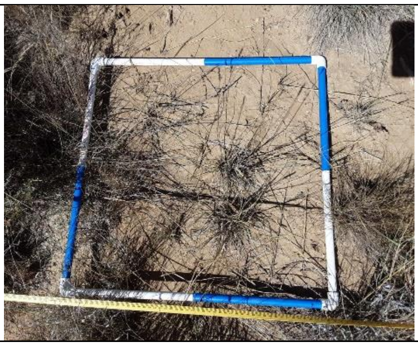
Q2	Q3

	
O-VMU4-T40P	Q1
	
Q2	Q3

APPENDIX C

Vegetation Statistical Analysis

Table C1: Equations for Vegetation Data Analysis

Attribute	Equation	Where
Sample Size / Count	$n = \sum samples$	n = number of samples $\sum$ = sum
Mean	$\bar{x} = \frac{\sum x}{n}$	$\bar{x}$ = sample mean $\sum$x = sum of values for variable n = number of samples
Standard Deviation	$s = \sqrt{\frac{\sum(\bar{x} - x)^2}{n - 1}}$	s = standard deviation $\sum$ = sum $\bar{x}$ = sample mean n = number of samples
Variance (population)	$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$	s^2 = variance $\sum$ = sum x_i = Value of variable for sample *i* $\bar{x}$ = sample mean n = number of samples
t-distribution	t = 1-α, v	t = two tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom α = significance level (0.10) v = degrees of freedom (n-1)
90% Confidence Interval	$\bar{x} \pm z \frac{s}{\sqrt{n}}$	$\bar{x}$ = sample mean z = the critical value from the normal distribution with α/2 in each tail s = standard deviation n = number of samples
N_{min} (Sample Adequacy - Normal Data)	$N_{min} = \frac{t^2 s^2}{(\bar{x}D)^2}$	N_{min} = number of samples required t = two tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom s = standard deviation (s^2 = variance) $\bar{x}$ = sample mean D = the desired level of accuracy, which is 10 percent of the mean
Logarithmic Transformation	Y' = log(Y + k)	log = logarithmic function Y = attribute value k = constant, here we use 1
one-sample, one-sided t test	$t^* = \frac{\bar{x} \; - 0.9\ (technical\ std)}{{}^{s}/_{\sqrt{n}}}$	t* = calculated t-statistic $\bar{x}$ = sample mean s = standard deviation n = sample size
one-sample, one-sided sign test	$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$	z = sign test statistic k = test statistic resulting from the number of values falling below 90% of the technical standard n = sample size
Relative Cover (Perennial/Biennial Species)	Rp/b-cvr = Cvrp/b-sp. / Cvrp/b-abs.	$R_{p/b\text{-}cvr}$ = Calculated Relative Cover for a Perennial/Biennial Species $Cvr_{p/b\text{-}sp.}$ = Mean Absolute Cover of a Perennial/Biennial Species $Cvr_{p/b\text{-}abs.}$ = Mean Absolute Perennial/Biennial Cover
Relative Cover (All Species)	Rcvr = Cvrsp. / CvrAbs.	R_{cvr} = Calculated Relative Cover for a species $Cvr_{sp.}$ = Mean Absolute Cover of ANY species $Cvr_{abs.}$ = Mean Absolute Cover for All Species

Notes:
All Appendix C analysis, tables, and figures computed using R software: (R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/

Table C-2: Data for Normal Distribution and Variance Analysis, O-VMU-4, 2023

Transect	Raw Data				Log-Transformed Data	
	Total Ground Cover (%)	Perennial Vegetation Cover (%)	Annual Forage Production (lbs/ac)	Woody Plant Density (#/ac)	Log - Annual Forage Production	Log - Woody Plant Density
O-VMU4-T01P	64	48	896	1,012	2.95	3.01
O-VMU4-T02P	74	56	755	1,416	2.88	3.15
O-VMU4-T03P	48	34	527	2,185	2.72	3.34
O-VMU4-T04P	74	16	225	40	2.35	1.62
O-VMU4-T05P	56	22	1,108	1,740	3.04	3.24
O-VMU4-T06P	52	34	762	3,642	2.88	3.56
O-VMU4-T07P	68	54	885	364	2.95	2.56
O-VMU4-T08P	90	62	1,205	486	3.08	2.69
O-VMU4-T09P	72	56	1,815	2,630	3.26	3.42
O-VMU4-T10P	68	46	644	364	2.81	2.56
O-VMU4-T11P	66	44	588	890	2.77	2.95
O-VMU4-T12P	46	36	501	3,683	2.70	3.57
O-VMU4-T13P	62	44	1,578	1,740	3.20	3.24
O-VMU4-T14P	58	24	1,902	971	3.28	2.99
O-VMU4-T15P	44	36	613	3,561	2.79	3.55
O-VMU4-T16P	62	52	343	8,013	2.54	3.90
O-VMU4-T17P	80	56	785	2,266	2.89	3.36
O-VMU4-T18P	44	36	1,241	1,376	3.09	3.14
O-VMU4-T19P	56	28	287	3,399	2.46	3.53
O-VMU4-T20P	36	24	608	2,023	2.78	3.31
O-VMU4-T21P	38	22	193	8,782	2.28	3.94
O-VMU4-T22P	62	48	585	647	2.77	2.81
O-VMU4-T23P	78	60	535	5,301	2.73	3.72
O-VMU4-T24P	70	34	86	2,145	1.94	3.33
O-VMU4-T25P	74	56	588	1,012	2.77	3.01
O-VMU4-T26P	50	40	1,144	5,504	3.06	3.74
O-VMU4-T27P	46	42	961	4,006	2.98	3.60
O-VMU4-T28P	42	30	137	1,376	2.14	3.14
O-VMU4-T29P	72	44	777	1,497	2.89	3.18
O-VMU4-T30P	46	36	1,370	2,711	3.14	3.43
O-VMU4-T31P	68	42	303	1,093	2.48	3.04
O-VMU4-T32P	30	20	409	1,174	2.61	3.07
O-VMU4-T33P	60	52	427	1,416	2.63	3.15
O-VMU4-T34P	56	40	456	647	2.66	2.81
O-VMU4-T35P	54	52	331	3,359	2.52	3.53
O-VMU4-T36P	60	28	781	4,371	2.89	3.64
O-VMU4-T37P	62	50	619	1,012	2.79	3.01
O-VMU4-T38P	72	58	824	607	2.92	2.78
O-VMU4-T39P	58	42	1,533	10,886	3.19	4.04
O-VMU4-T40P	68	62	683	728	2.83	2.86
Mean	59.65	41.7	750.3	2502.0	2.8	3.2
Standard Deviation	13.3	12.7	445.6	2396.2	0.3	0.4
Count	40	40	40	40	40	40
Variance	171	156	193,602	5,598,085	0.085	0.197
90% Confidence Interval	3	3	116	623	0.077	0.117
Technical Standard	52%	24%	550	400	2.74	2.60
90% of Standard	46.8%	21.6%	495	360	2.47	2.34

Notes:

2023 Data are found in Appendix A

Table C-3: Total Ground Cover, one-sample, one-sided t-test - classical null (left-sided), O-VMU-4, 2023

Total Ground Cover (%)	
Mean (%)	59.7
Standard Deviation (%)	13.3
Sample Size	40
Technical Standard (%)	52
t*	6.134
1-tail t (0.1, 39)	-1.304

Notes:

Data is from Table C-2

Decision Rules (the Permit - Appendix 6.5-B):

t* < t (α; n-1), failure to meet standard

t* ≥ t (α; n-1), performance standard met

t from Section 3, Table 1 (WDEQ, 2012)

Test Statistic:

$$t^* = \frac{\bar{x} \ - 0.9\ (technical\ std)}{s/\sqrt{n}}$$

t*(6.134) ≥ t (-1.304), **performance standard is met**

Table C-4: Perennial Vegetaion Foliar Cover, one-sample, one-sided t-test - classical null (left-sided), O-VMU-4, 2023

Total Perennial Cover (%)	
Mean (%)	41.7
Standard Deviation (%)	12.7
Sample Size	40
Technical Standard (%)	24
t*	10.013
1-tail t (0.1, 40)	-1.304

Notes:
Data is from Table C-2
Decision Rules (the Permit - Appendix 6.5-B):
t* < t (α; n-1), failure to meet standard
t* ≥ t (α; n-1), performance standard met
t from Section 3, Table 1 (WDEQ, 2012)
Test Statistic:

$$t^* = \frac{\bar{x} \; - 0.9 \; (technical\; std)}{{}^{s}/_{\sqrt{n}}}$$

t*(10.013) ≥ t (-1.304), **performance standard is met**

Table C-5: Annual Forage Production, one-sample, one-sided sign test- reverse null, O-VMU-4, 2023

Transect	Annual Forage Production	90% of Technical Standard	Difference
O-VMU-4-T01P	896	495	401
O-VMU-4-T02P	755	495	260
O-VMU-4-T03P	527	495	32
O-VMU-4-T04P	225	495	-270
O-VMU-4-T05P	1,108	495	613
O-VMU-4-T06P	762	495	267
O-VMU-4-T07P	885	495	390
O-VMU-4-T08P	1,205	495	710
O-VMU-4-T09P	1,815	495	1,320
O-VMU-4-T10P	644	495	149
O-VMU-4-T11P	588	495	93
O-VMU-4-T12P	501	495	6
O-VMU-4-T13P	1,578	495	1,083
O-VMU-4-T14P	1,902	495	1,407
O-VMU-4-T15P	613	495	118
O-VMU-4-T16P	343	495	-152
O-VMU-4-T17P	785	495	290
O-VMU-4-T18P	1,241	495	746
O-VMU-4-T19P	287	495	-208
O-VMU-4-T20P	608	495	113
O-VMU-4-T21P	193	495	-302
O-VMU-4-T22P	585	495	90
O-VMU-4-T23P	535	495	40
O-VMU-4-T24P	86	495	-409
O-VMU-4-T25P	588	495	93
O-VMU-4-T26P	1,144	495	649
O-VMU-4-T27P	961	495	466
O-VMU-4-T28P	137	495	-358
O-VMU-4-T29P	777	495	282
O-VMU-4-T30P	1,370	495	875
O-VMU-4-T31P	303	495	-192
O-VMU-4-T32P	409	495	-86
O-VMU-4-T33P	427	495	-68
O-VMU-4-T34P	456	495	-39
O-VMU-4-T35P	331	495	-164
O-VMU-4-T36P	781	495	286
O-VMU-4-T37P	619	495	124
O-VMU-4-T38P	824	495	329
O-VMU-4-T39P	1,533	495	1,038
O-VMU-4-T40P	683	495	188
		k	11
		n	40
		z	-2.69
Standard one-tailed normal curve area (Table C-3; MMD, 1999)			0.4964052
		P	0.004

Notes:

Data is from Table C-2

When k exceeds 50% of n-observations, the performance standard has not been met

P = 0.5-Area = prob of observing z; ≤0.1 performance standard met

z value calculation:

$$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$$

k (11) ≤ 20, P (0.004) ≤ 0.1, **performance standard is met**

Table C-6: Woody Plant Density, one-sample, one-sided sign test- reverse null, O-VMU-4, 2023

Transect	Annual Forage Production	90% of Technical Standard	Difference
O-VMU-4-T01P	1,012	360	652
O-VMU-4-T02P	1,416	360	1,056
O-VMU-4-T03P	2,185	360	1,825
O-VMU-4-T04P	40	360	-320
O-VMU-4-T05P	1,740	360	1,380
O-VMU-4-T06P	3,642	360	3,282
O-VMU-4-T07P	364	360	4
O-VMU-4-T08P	486	360	126
O-VMU-4-T09P	2,630	360	2,270
O-VMU-4-T10P	364	360	4
O-VMU-4-T11P	890	360	530
O-VMU-4-T12P	3,683	360	3,323
O-VMU-4-T13P	1,740	360	1,380
O-VMU-4-T14P	971	360	611
O-VMU-4-T15P	3,561	360	3,201
O-VMU-4-T16P	8,013	360	7,653
O-VMU-4-T17P	2,266	360	1,906
O-VMU-4-T18P	1,376	360	1,016
O-VMU-4-T19P	3,399	360	3,039
O-VMU-4-T20P	2,023	360	1,663
O-VMU-4-T21P	8,782	360	8,422
O-VMU-4-T22P	647	360	287
O-VMU-4-T23P	5,301	360	4,941
O-VMU-4-T24P	2,145	360	1,785
O-VMU-4-T25P	1,012	360	652
O-VMU-4-T26P	5,504	360	5,144
O-VMU-4-T27P	4,006	360	3,646
O-VMU-4-T28P	1,376	360	1,016
O-VMU-4-T29P	1,497	360	1,137
O-VMU-4-T30P	2,711	360	2,351
O-VMU-4-T31P	1,093	360	733
O-VMU-4-T32P	1,174	360	814
O-VMU-4-T33P	1,416	360	1,056
O-VMU-4-T34P	647	360	287
O-VMU-4-T35P	3,359	360	2,999
O-VMU-4-T36P	4,371	360	4,011
O-VMU-4-T37P	1,012	360	652
O-VMU-4-T38P	607	360	247
O-VMU-4-T39P	10,886	360	10,526
O-VMU-4-T40P	728	360	368
		k	1
		n	40
		z	-5.85
		Standard one-tailed normal curve area (Table C-3; MMD, 1999)	0.499999998
		P	0.000000002

Notes:

Data is from Table C-2

When k exceeds 50% of n-observations, the performance standard has not been met

P = 0.5-Area = prob of observing z; ≤0.1 performance standard met

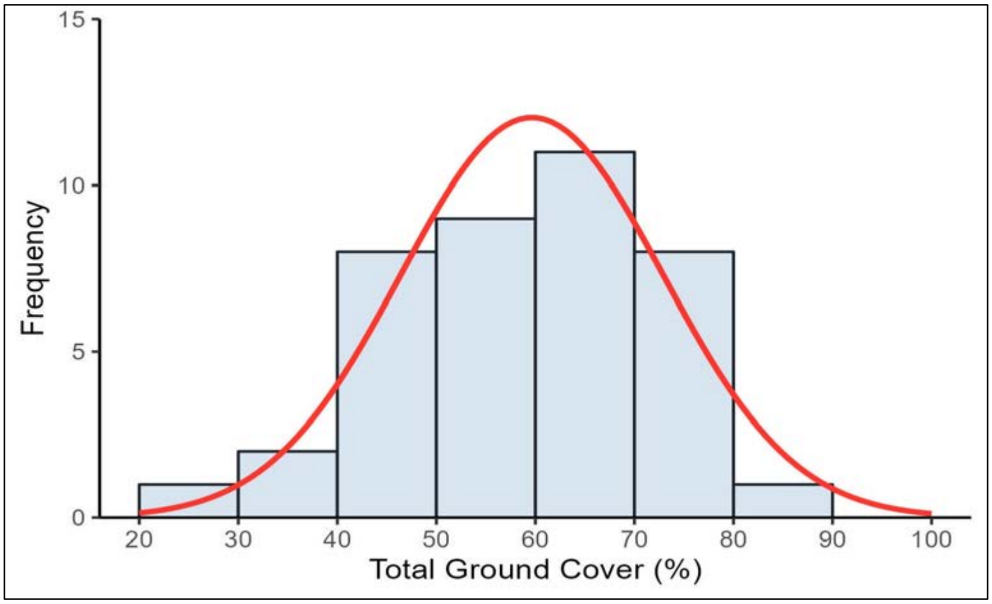
z value calculation:

$$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$$

k (1) ≤ 20, P (0.00000002) ≤ 0.1, **performance standard is met**

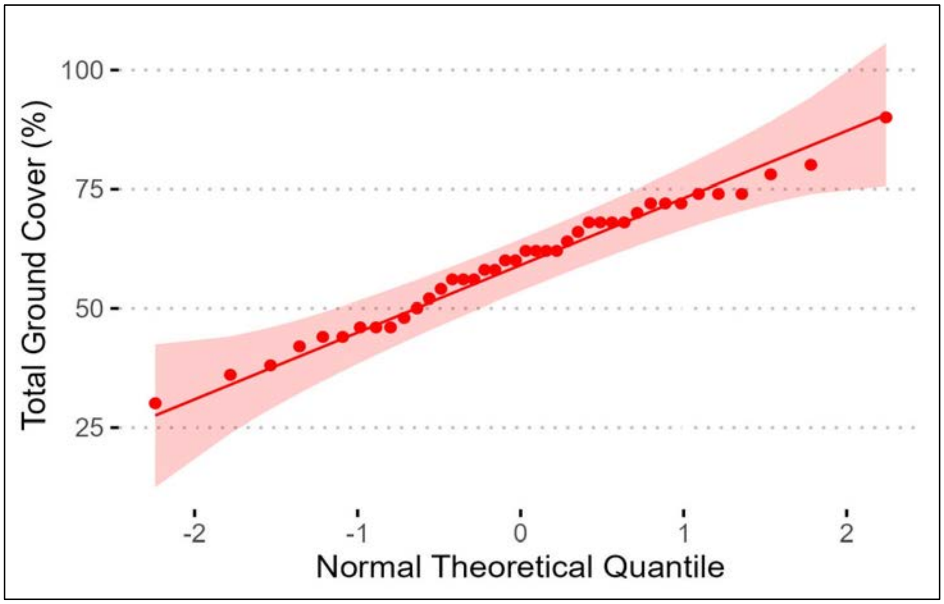
Figure C-1: Total Ground Cover (%), O-VMU-4, 2023

Descriptives



40	59.65	56.20	63.10	2	13	-0.14	-0.55	49.50	61.00	68.50

Normality



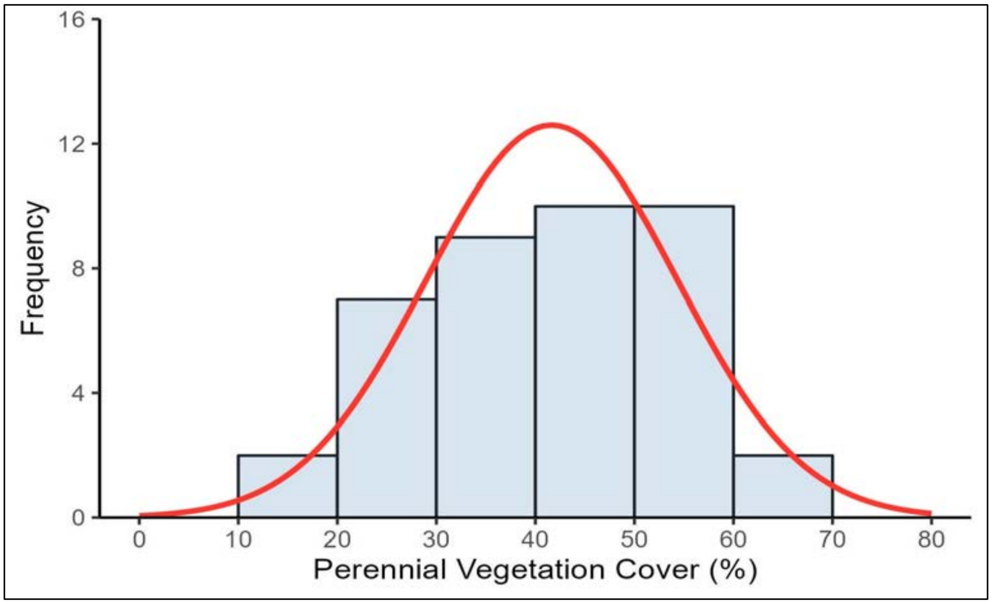
Shapiro-Wilk Test

W statistic	P-value
0.98649	0.906658

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Fail to reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P > 0.1)
(Data are normally distributed)

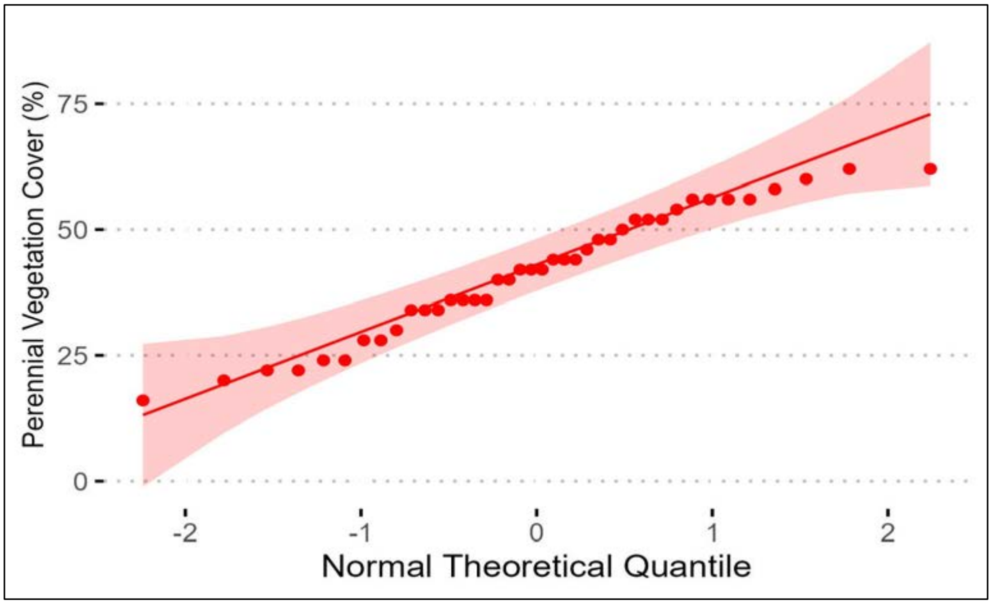
Figure C-2: Perennial Vegetation Foliar Cover (%), O-VMU-4, 2023

Descriptives



40	41.65	38.36	44.94	2	13	-0.20	-1.05	34.00	42.00	52.00

Normality



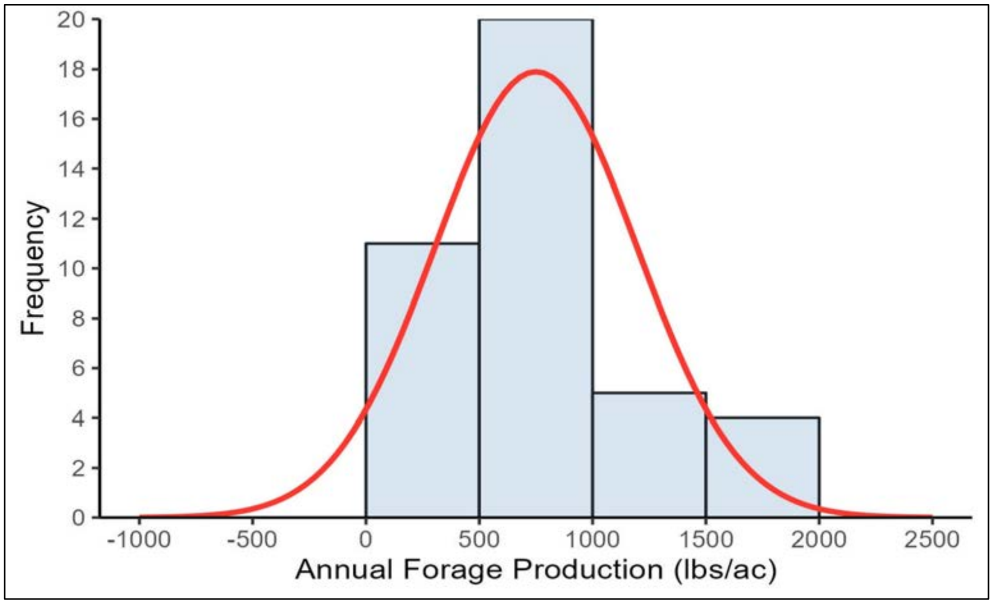
Shapiro-Wilk Test

W statistic	P-value
0.96460	0.239783

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Fail to reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P > 0.1)
(Data are normally distributed)

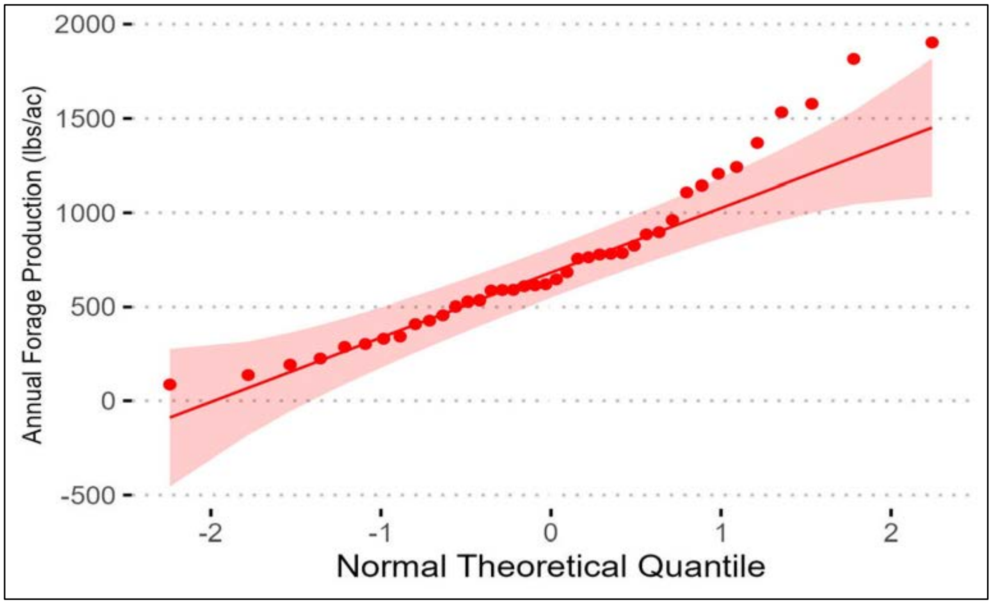
Figure C-3: Annual Forage Production (lbs/ac), O-VMU-4, 2023

Descriptives



40	750.3	634.36	866.16	70.46	445.61	0.85	0.09	448.77	631.50	912.50

Normality



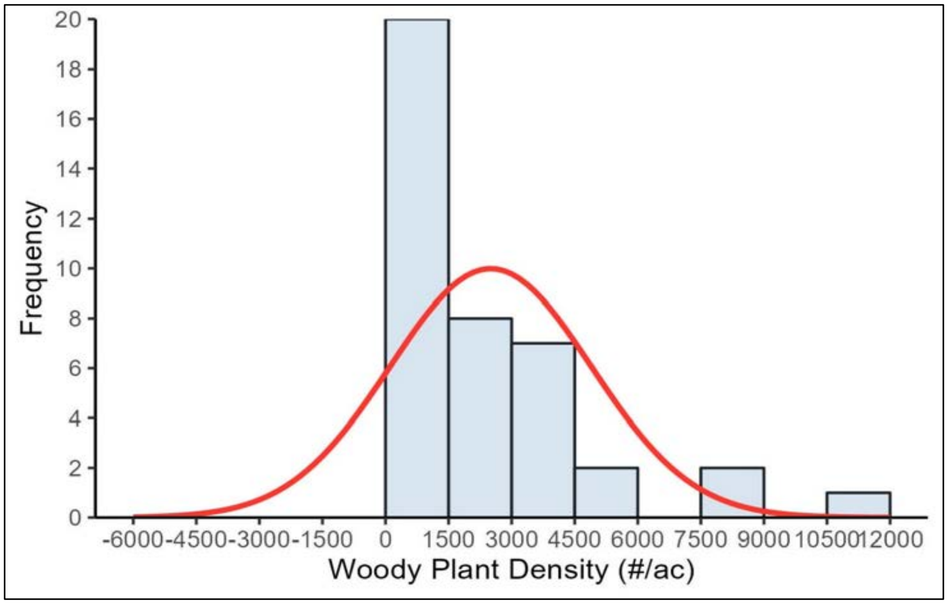
Shapiro-Wilk Test

W statistic	P-value
0.93103	0.017408

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P < 0.1)
(Data are not normally distributed)

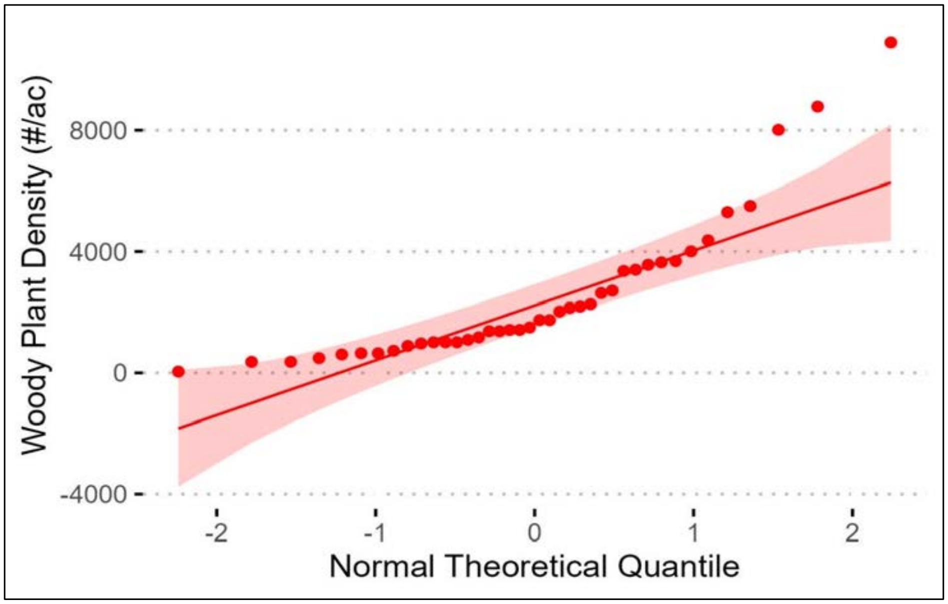
Figure C-4: Woody Plant Density (st/ac), O-VMU-4, 2023

Descriptives



40	2502	1878.73	3125.21	378.87	2396.17	1.76	2.89	1001.60	1618.74	3439.83

Normality



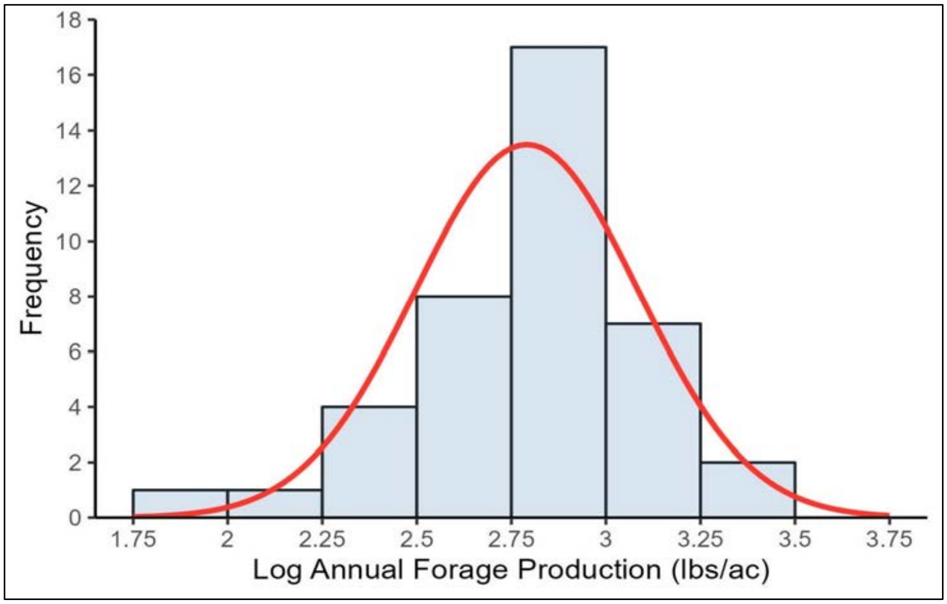
Shapiro-Wilk Test

W statistic	P-value
0.79301	0.000005

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P < 0.1)
(Data are not normally distributed)

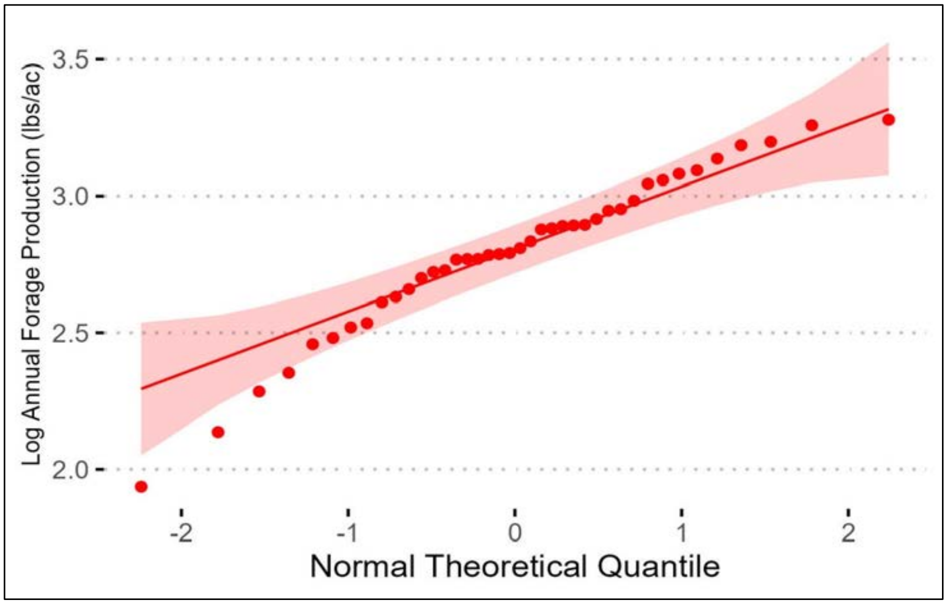
Figure C-5: Log Annual Forage Production (lbs/acre), O-VMU-4, 2023

Descriptives



40	2.791	2.71	2.87	0.05	0.30	-0.71	0.44	2.65	2.80	2.96

Normality



Shapiro-Wilk Test

W statistic	P-value
0.95966	0.163100

H0: F(Y) = N(μ, σ)

The population is normally distributed.

H1: F(Y) ≠ N(μ, σ)

The population is not normaly distributed

Fail to reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P > 0.1)

(Data are normally distributed)

Appendix A6: Wildlife Enhancements

Survey Date: 10/29-30/24

Structure	Cottonwood Live Poles	Coyote Willow Live Whips	Woods Rose Seedlings	Licorice Seedlings	Bulrush (From Seed)	Sedge (From Seed)	Pond AdMix (Seed)	Riparian Mix (Seed)	Woody Seed Mix Mule Deer Mix (Seed)	Mule Deer Mix Species Observed	Wildlife Fence	Cattle Ramp
PI 3-7	🟧 P-y	🟩 P-y	🟨 P-y	🟨 y	🟩 y	🟨 y	🟩 P-y	🟩 P-y	🟩 P-y	🟩 Rubber rabbitbrush	🟩 P-y	🟩 P-y
PI 6-7		🟩 P-y								🟩 Rubber rabbitbrush		
PI 6-8	🟧 P-y	🟩 P-y	🟨 P-y	🟨 P-y	🟨 y	🟨 y	🟨 y	🟩 P-y	🟩 P-y	🟩 Rubber rabbitbrush	🟩 P-y	🟩 P-y
3-SD4	No planting proposed in the Permit at this small depression located on Initial Program lands.											
6-SD1	No planting proposed in the Permit at this small depression located on Permanent Program lands.											

Notes:

Letter "P" indicates that the activity was proposed for the structure in the permit.

Letter "y" indicates that the activity occurred at a structure

🟩 Plant species observed alive in pond including mature species from prior plantings, seed mixes, or volunteer growth

🟧 Plant materials do not appear like they survived.

🟨 Plant species not observed.

Mule Deer Shrub Enhancement Mix: Permit Table 5.5-10

Pond admix and Riparian Seed Mix: Permit Table 5.5-5

Bulrush and Sedge in the Pond Admix

Species Observed at Permanent Impoundments (2024)

Dry	Common Name	Permanent Impoundment Name		
Scientific name		3-7	6-8	6-7
		Inspection Date		
		30-Oct	30-Oct	29-Oct
Salixa exigua	Coyote willow	X	X	X
Populus fremontii	Fremont's cottonwood	Did not appear alive	Did not appear alive	
Rosa woodsii	Wood's rose			
Glycerhiza lepidota	American licorice			
Ephedra viridis	Mormon Tea			
Purshia mexicana	Mexican cliffrose			
Purshia tridentata	Antelope bitterbrush			
Ericameria nauseosa	Rubber rabbitbrush	X	X	X
Typha domingensis	Cattail	X	X	
Scripus maratima	Bullrush	X		
Agropyron cristatum	Crested wheatgrass	X		X
Helinathus annuus	Common sunflower	X		
Hordeum jubatum	Foxtail barley	X	X	X
Sisymbrium altissimum	Tall tumblemustard	X		
Grindelia squarrosa	Curlycup gumweed	X	X	X
Psathyrostachys juncea	Russian wildrye	X		
Trifolium pratense	Red clover	X		
Bromus inermis	Smooth brome	X		X
Xanthium strumarium	Rough cocklebur	X	X	
Rumex crispus	Curly dock	X	X	
Cirsium arvense	Canada thistle		X	
Atriplex canescens	Four-wing saltbush	X	X	
Achnantherum hymenoides	Indian ricegrass		X	
Achillea millefolium	Yarrow		X	
Mellilotus officianalis	Yellow sweetclover		X	
Salsola tragus	Russian thistle			X
Conyza canadensis	Canadian horseweed		X	
Machaeranthera canescens	Hoary tansyaster			X
Pascopyrum smithii	Western wheatgrass			X
Ratibida columnifera	Prarie coneflower	X	X	
Phleum pratense	Timothy		X	
Notes:				
"X" means living plants that were observed during the inspection				
Blank spaces means the species was not observed				

PI 3-7 (Planting)

PI 6-8 (Willow and Cottonwood Plantings)

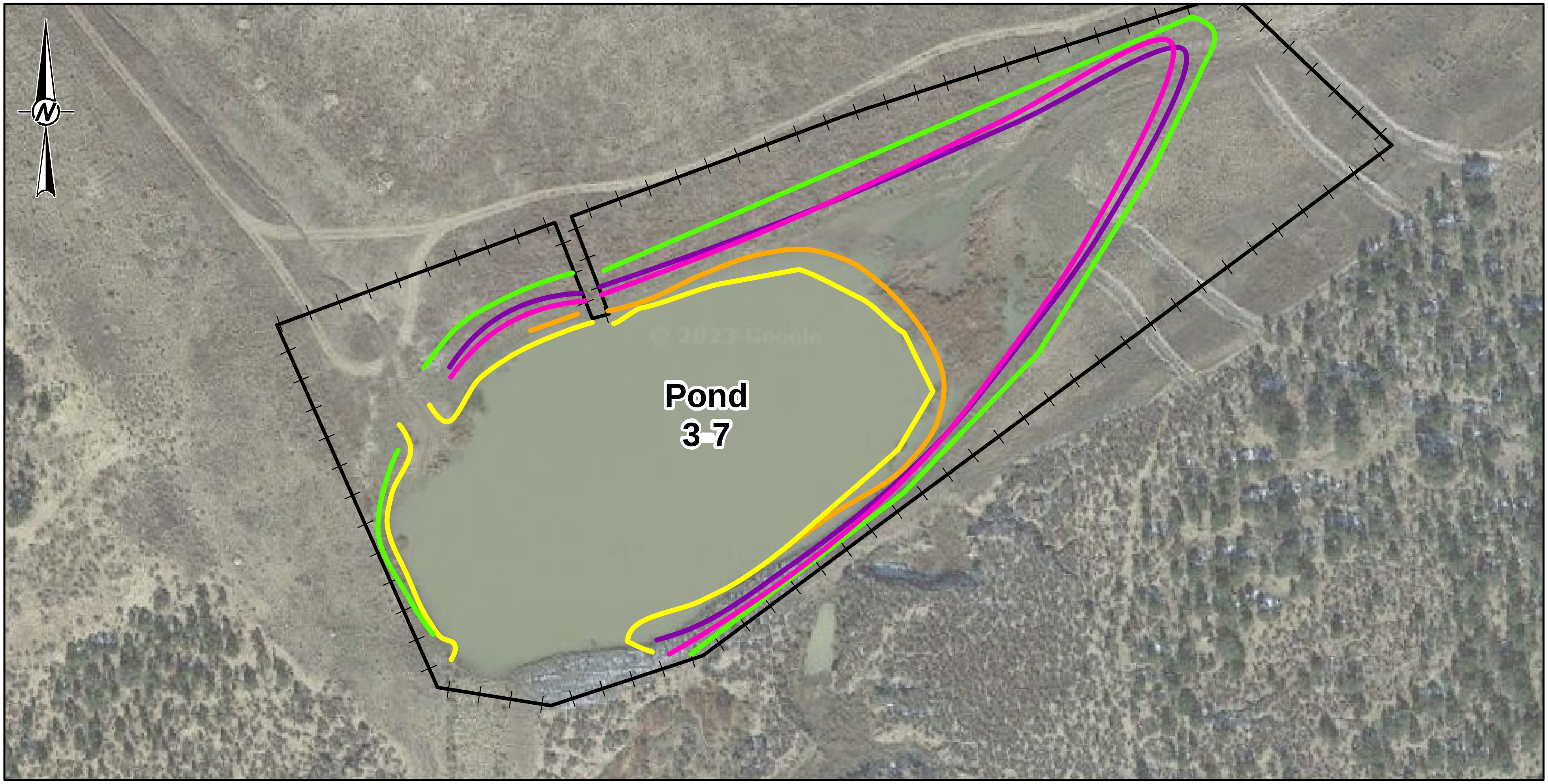
PI 6-8 (Cottonwood Plantings)

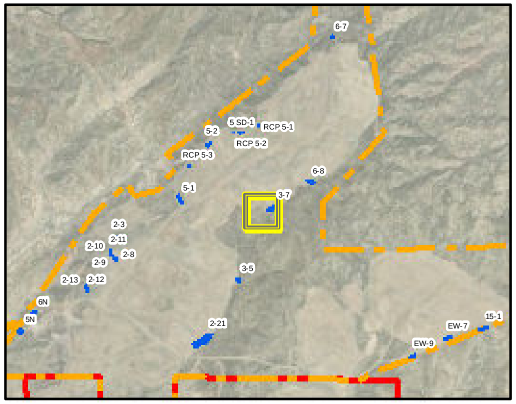
PI 6-8 (Willows Planted)

Licorice Planting

3-SD4 (No Planting Required)

6-SD1 (No Planting Required)





LEGEND

POND ENHANCEMENT TYPE

🟪	WOODS ROSE
🟪	LICORICE
🟩	COTTONWOOD
🟧	WILLOW
🟨	POND ADMIX
☐	WILDLIFE-FRIENDLY FENCING
🟧	OSM BOUNDARY
🟥	MMD BOUNDARY

0 130 260
Feet

REFERENCE(S)

1. SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

CLIENT

Chevron Mining Inc.
McKINLEY MINE

PROJECT
OSM 2022 ANNUAL REPORT

CONSULTANT

wsp

YYYY-MM-DD	3-30-2023
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	FR

TITLE

APPROXIMATE LOCATIONS OF RIPARIAN PLANTING 2022 (POND 3-7)

PROJECT NO.	CONTROL	REV.	FIGURE
31406184.000		A	1l

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

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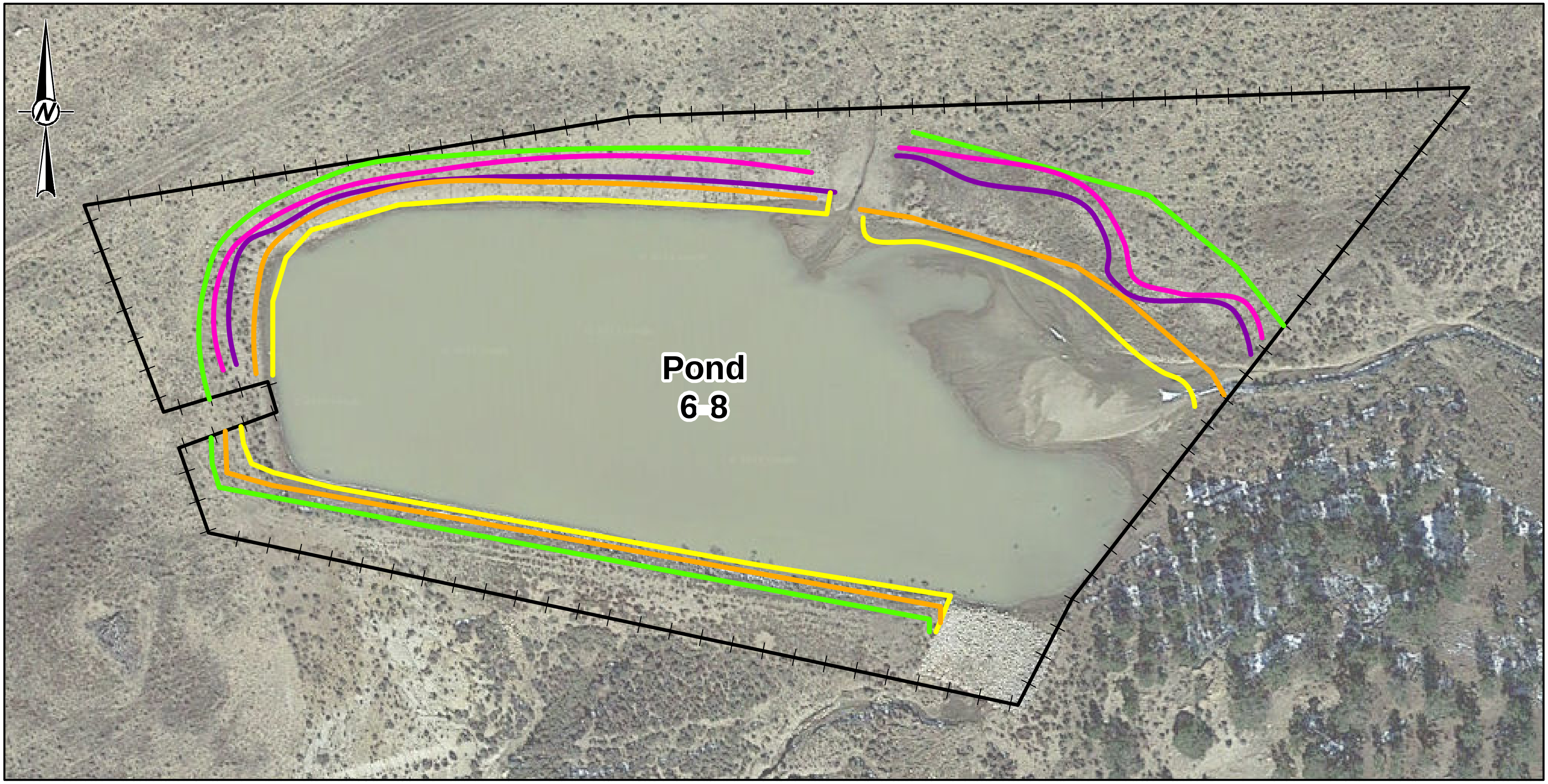
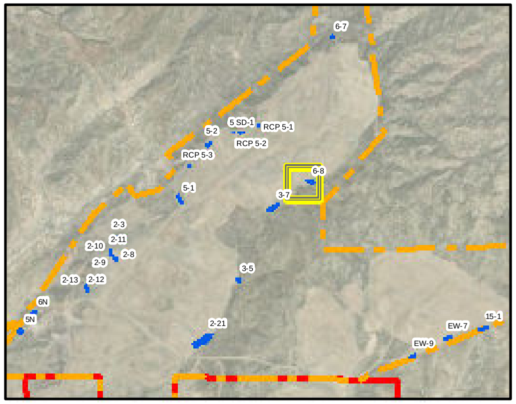




LEGEND

POND ENHANCEMENT TYPE

- 🟪 WOODS ROSE
- 🟪 LICORICE
- 🟩 COTTONWOOD
- 🟧 WILLOW
- 🟨 POND ADMIX

- ☐ WILDLIFE-FRIENDLY FENCING
- ☐ OSM BOUNDARY
- 🟥 MMD BOUNDARY

0 80 160

Feet

REFERENCE(S)

1. SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

CLIENT

Chevron Mining Inc.
McKINLEY MINE

PROJECT

OSM 2022 ANNUAL REPORT

CONSULTANT

wsp

YYYY-MM-DD	3-30-2023
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	FR

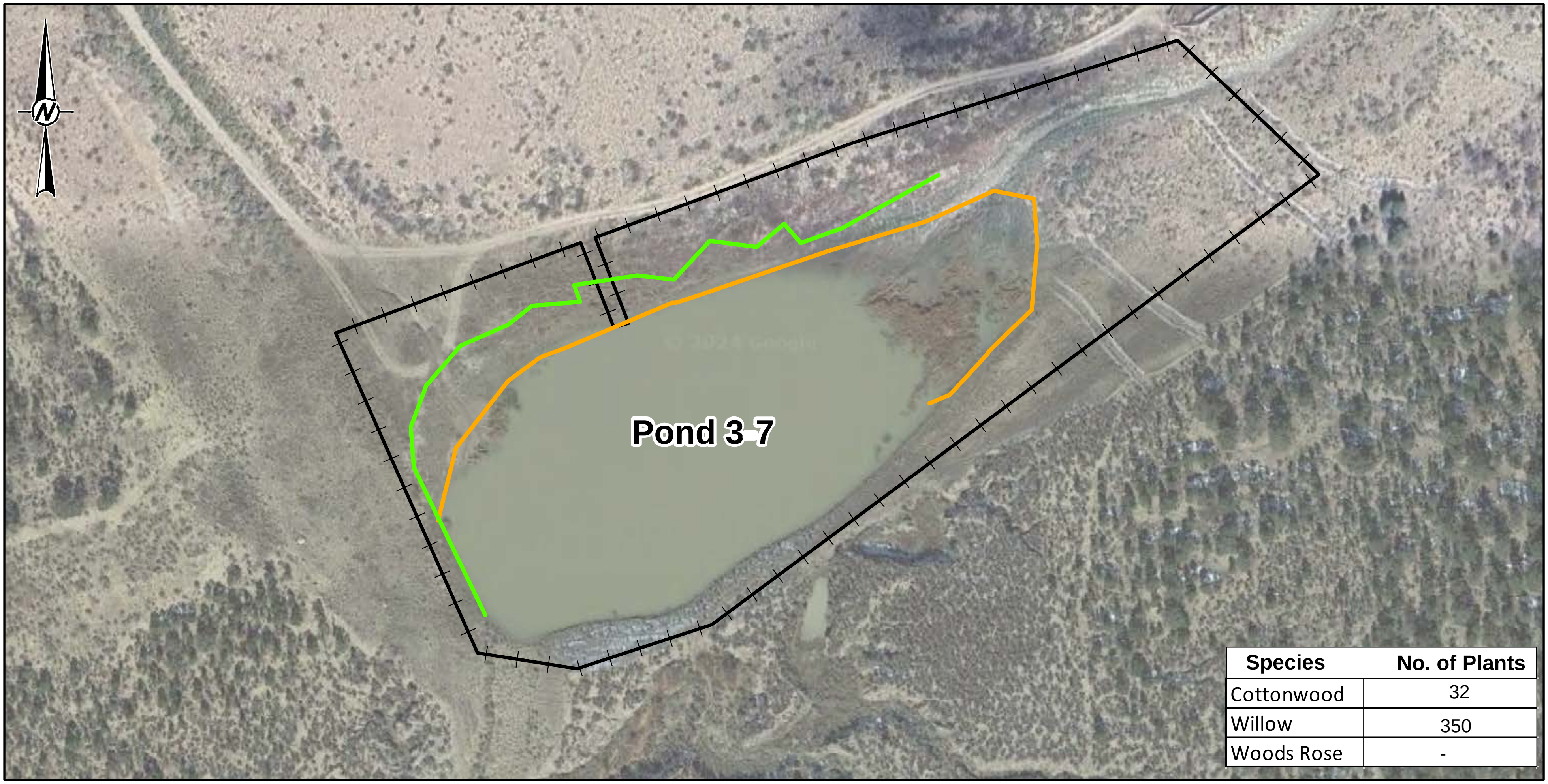
TITLE

APPROXIMATE LOCATIONS OF RIPARIAN PLANTING 2022 (POND 6-8)

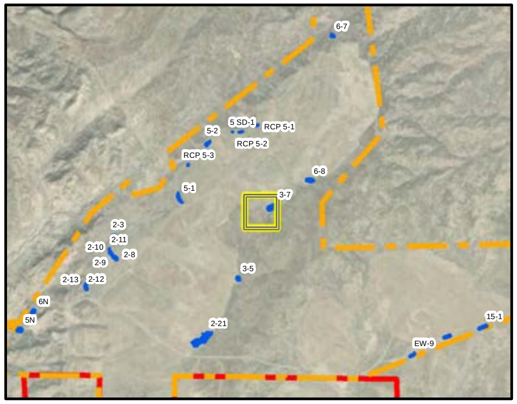
PROJECT NO.	CONTROL	REV.	FIGURE
31406184.000		A	1m

1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

PATH: P:\Projects\Chevron\McKinley_Mine\99_PROJECTS\1338105207_McKinley_Mine\0034_OSM_AnnualReport_2023\2023_OSM_RiparianPlanting_RevA_NAD83.mxd PRINTED ON: 2024-03-22 AT: 11:57:52 AM



Species	No. of Plants
Cottonwood	32
Willow	350
Woods Rose	-



LEGEND

Pond Enhancement Type

- 🟩 Cottonwood
- 🟧 Willow

- ▭ WILDLIFE-FRIENDLY FENCING
- ▭ OSM BOUNDARY
- 🟥 MMD BOUNDARY

0 150 300
Feet

REFERENCE(S)

1. SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

CLIENT

Chevron Mining Inc.
McKINLEY MINE

PROJECT
OSM 2023 ANNUAL REPORT

CONSULTANT

wsp

YYYY-MM-DD	12-28-2023
DESIGNED	-
PREPARED	HJ
REVIEWED	NB/OD
APPROVED	FR

TITLE

APPROXIMATE LOCATIONS OF RIPARIAN PLANTING 2023 (POND 3-7)

PROJECT NO.	CONTROL	REV.	FIGURE
31406184.000		A	1n

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
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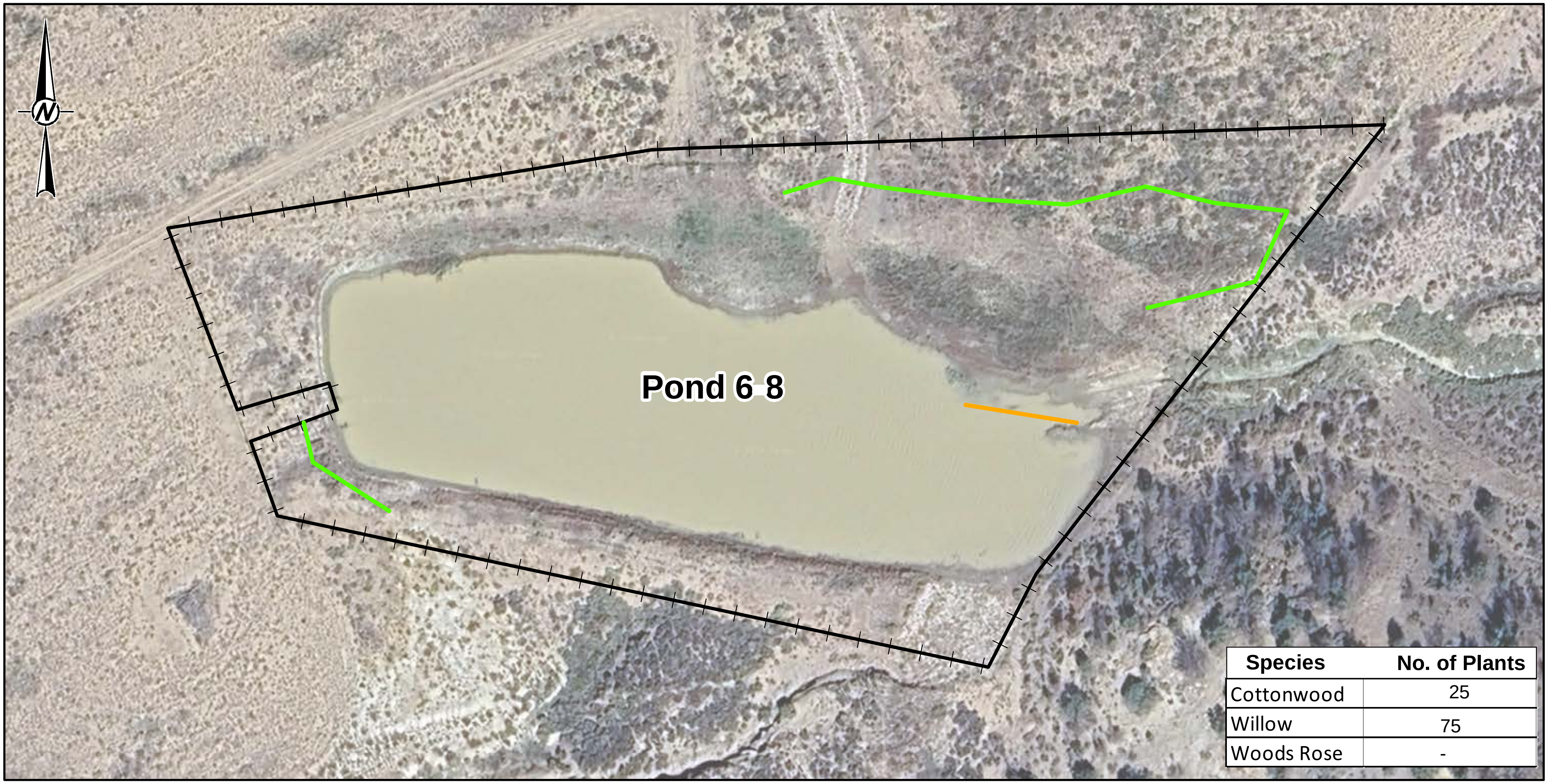
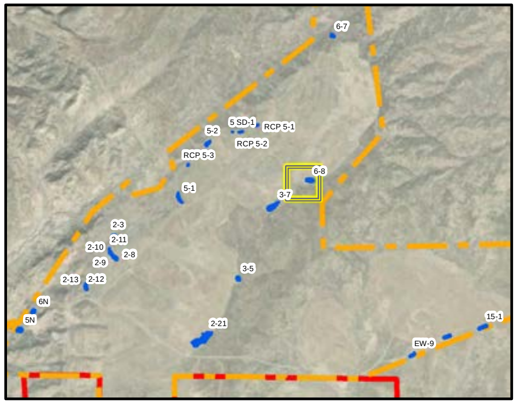


Species	No. of Plants
Cottonwood	25
Willow	75
Woods Rose	-



LEGEND

Pond Enhancement Type

- 🟩 Cottonwood
- 🟧 Willow

- ▭ WILDLIFE-FRIENDLY FENCING
- ▭ OSM BOUNDARY
- 🟥 MMD BOUNDARY

0 100 200

Feet

REFERENCE(S)

1. SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

CLIENT

Chevron Mining Inc.
McKINLEY MINE

PROJECT
OSM 2023 ANNUAL REPORT

CONSULTANT

wsp

YYYY-MM-DD	12-28-2023
DESIGNED	-
PREPARED	HJ
REVIEWED	NB/OD
APPROVED	FR

TITLE
APPROXIMATE LOCATIONS OF RIPARIAN PLANTING 2023 (POND 6-8)

PROJECT NO.	CONTROL	REV.	FIGURE
31406184.000		A	1r

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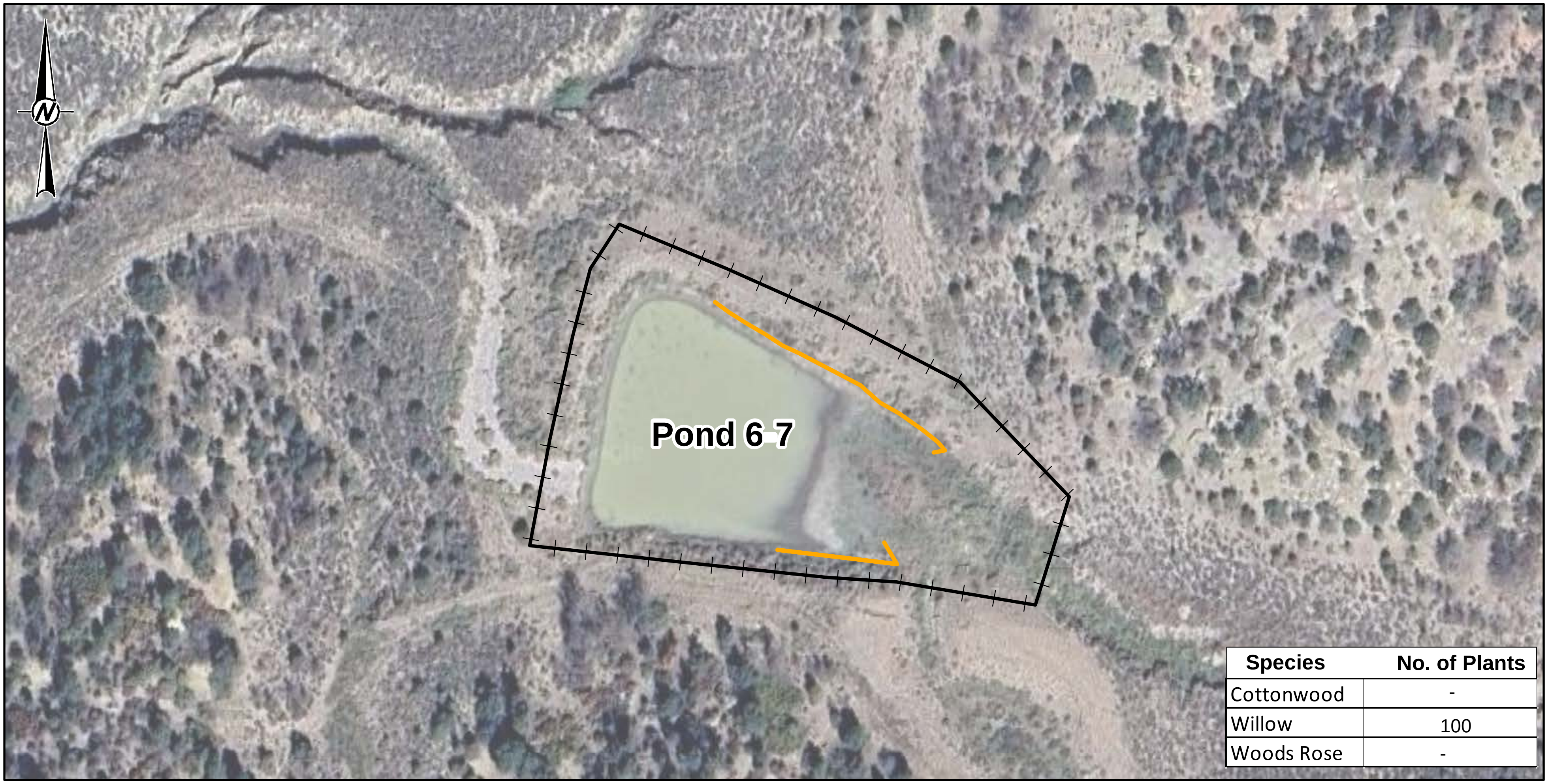
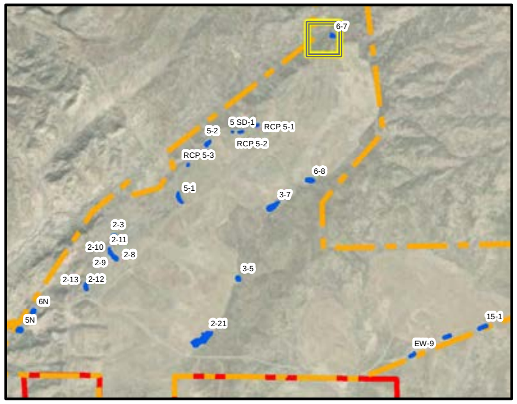
PATH: P:\Projects\Chevron\McKinley_Mine\99_PROJECTS\1338105207_McKinley_Mine\0034_OSM_AnnualReport_2023\2023_OSM_RiparianPlanting_RevA_NAD83.mxd PRINTED ON: 2024-03-22 AT: 12:00:12 PM



Species	No. of Plants
Cottonwood	-
Willow	100
Woods Rose	-



LEGEND

Pond Enhancement Type

— Willow

☐ WILDLIFE-FRIENDLY FENCING

☐ OSM BOUNDARY

☐ MMD BOUNDARY

0 120 240

Feet

REFERENCE(S)

1. SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

CLIENT

Chevron Mining Inc.

McKINLEY MINE

PROJECT

OSM 2023 ANNUAL REPORT

CONSULTANT

wsp

YYYY-MM-DD	12-28-2023
DESIGNED	-
PREPARED	HJ
REVIEWED	NB/OD
APPROVED	FR

TITLE

APPROXIMATE LOCATIONS OF RIPARIAN PLANTING 2023 (POND 6-7)

PROJECT NO.	CONTROL	REV.	FIGURE
31406184.000		A	1q

Appendix A7: Performance Bond

OSMRE Bond Cost Summary (2024 dollars as noted)			
Performance Bond After VMU 4 Phase IIII Deduction			
Red font indicates direct changes made to this spreadsheet			
Mining Areas			
2N (included below)			
2			$1,099,386
3, 3A Plug (A&T, TS, Reveg) and 5 (Reveg)			$933,444
3A Plug (A&T, TS, Reveg) (Included above)			
5 (reveg) (Included above)			
6			$1,231,952
10			$449,861
12			$1,997,973
12 Box-Cut			$643,577
14			$981,006
14 and 15 Box-Cut			$401,751
15			$1,278,805
A16 Ponds and Hydro			$92,750
16 + Box-cut (Not Mined)			$0
EW Mitigation pile			$0
	Orig. Total Ac.	Orig Total	
P. Roads (470 ac total) (Gr, A&T, TS & Reveg)	470	$7,714,481	$1,495,290
A. Roads (40.7 ac total) (TS & Reveg)	40.7	$96,378	$70,747
Facilities			$4,658,117
		Quantity	
Ponds (Cost/Pond included in Mining Areas): 3-7, 6-7, 6-8	$14,750	-3	-$44,250
Earthmoving Support Equip.			$2,046,664
Diversions (No Name and Tse Bonita [Area 2])			$0
		PP Acres	
Revegetation Cost/Ac VMU 4 Deduction	$822	-1118.5	-$919,407
Renewal Total Direct Costs (1999 Dollars)			$16,417,666
Inflation Factor (to Sept 06)	17.632%		
Renewal Total Direct Costs (2006 Dollars)			$19,312,489
Additional Current Dollar Direct Costs			
10B Truck Pod (in 06 Dollars)			$0
14A Truck Pod (in 06 Dollars)			
14A Truck Pod Expansion (in 06 Dollars)			$1,138,920
15E Additional 1000' Corridor (in 06 Dollars)			$487,185
2B Truck Pod (in 06 Dollars)			$0
Total Direct Costs (2006 Dollars)	$102,985,116		$20,938,594
	Orig Tot Above		
10 yr Inflation Factor (Based on 10 yrs.06-16)	36.660%		$28,614,683
Sep 16 to Mar 19 Inf Factor RSMeans (2.5 yrs)	4.649%		$29,944,980
Mar 19 to Sep 21 inf Factor RSMeans (2.5 yrs)	5.390%		$31,559,014
Sept 21 to Mar 24 inf Factor RSMeans (2.5 yrs)	16.65%		$36,813,590
Total Direct costs (2024 dollars)			$36,813,590
Indirect Costs			
Mob/Demobilization	1.0%		$368,136
Contingency Fund	3.0%		$1,104,408
Eng. Redesign Fee	2.5%		$920,340
Profit and Overhead	15.0%		$5,522,038
Project Management	2.5%		$920,340
Total Indirect Costs			**$8,835,262**
Total W/O Gross Receipts tax			**$45,648,851**
Gross Receipts Tax 6.4375%	6.43750%		$2,938,645
Navajo Nation Sales Tax 3.0 %	3.00%		$1,369,466
Navajo Fuel Excise Tax @ $0.18/gal	$1,747,486		$375,547
Fuel Tax Pro-rated on orig Tot direct costs & tax total	Orig Tot above		
Total Bond Amount			**$50,332,509**
Recommended Bond Amount (Rounded)			**$50,333,000**
Supplemental Contingency Bond Amount			$883,545
Updated Grand Total with Contingency			**$51,216,545**
Current Bond Amount			$53,921,545
Bond Reduction			$2,705,000
Note: Although mining in Area 16 is not bonded, the area has ponds, hydrologic structures and roads that are bonded.			

6/30/2025

Appendix A8: Landowner Notification

NOTIFICATION ADDRESS LIST

NAME	ADDRESS	CITY	ST	ZIP	OTHER
Navajo Nation Minerals Dept.	P.O. Box 1910	Window Rock	AZ	86515	Rowena Cheromiah, Departmen Manager
Navajo Nation Land Dept.	P.O. Box 9000	Window Rock	AZ	86515	Mike Halona, Dept. Manager
Public Service Co. Of NM	PNM Main Offices	Albuquerque	NM	87158	
Navajo Nation EPA Public Water Systems Supevisior Program	P.O. Box 339	Window Rock	AZ	86515	Yolanda Barney
Navajo Nation EPA Water Quality / NPDES Program	P.O. Box 339	Window Rock	AZ	86515	Patrick Antonio
Navajo Tribal Utility Authority	P.O. Box 170	Ft. Defiance	AZ	86504	Walter Haase, General Manager
Continental Divide Electric Corp.	P.O. Box 786	Gallup	NM	87305	
Kinder Morgan	P.O. Box 103	Rehoboth	NM	87322	Gallup District Office
Bureau of Land Management	6251 College Blvd.	Farmington	NM	87402	
BIA-Navajo Regional Office	P.O. Box 1060	Gallup	NM	87305	Bertha Spencer
New Mexico State Land Office	P.O. Box 1148	Santa Fe	NM	87504-1148	
Ft Defiance Chapter	P.O. Box 366	Ft. Defiance	AZ	86504	Wilson Stewart, Jr., Chapter President
Tsayatoh Chapter	P.O. Box 86	Mentmore	NM	87319	Walter Hudson, Chapter President
McKinley County Manager	P.O. Box 70	Gallup	NM	87305	Anthony Dimas, Jr., County Manager

Chevron

Armando Martinez
Remediation Ops
Specialist

Chevron Environmental
Management Company

P.O. Box 469
Questa, NM 87564
Tel (575) 585-7639
Cell (505) 690-5408
amarti@chevron.com

RE: McKinley Mine Permit No. NM-0001K
Vegetation Management Units 1 & 4
Application for Permanent Program Bond Release and
Initial Program Reclamation Liability Release and Termination of Jurisdiction

This notice is being provided to you since you or your organization may have an interest in the action described in this letter.

Chevron Mining Inc. (CMI) has filed an application for bond release of Permanent Program Lands and a reclamation liability release and termination of jurisdiction (TOJ) of Initial Program lands for reclaimed lands in Vegetation Management Units 1 and 4 (VMU 1 and VMU 4) contained in the McKinley Mine's mining and reclamation Permit No. NM-0001K (Permit NM-0001K) approved 09-07-2016, located in McKinley County, New Mexico.

VMU 1: The application includes a request for a Phase I, II and III bond release on two permanent impoundments in VMU 1 and Phase III bond release for the remaining area. The application contains information to demonstrates that 928 acres meet applicable requirements contained in the McKinley Mine's Permit NM-0001K, and the regulatory performance standards in 30 CFR 715, 800 and 816. The current performance bond is $53,921,545 and with this reclamation complete, the application includes calculations to reduce the associated reclamation performance bond by $1,562,000.

VMU 4: The application includes a request for a Phase I, II and III bond release on three permanent impoundments in VMU 4 and Phase III bond release for the remaining area. The application contains information to demonstrates that 1,141 acres meet applicable requirements contained in the McKinley Mine's Permit NM-0001K, and the regulatory performance standards in 30 CFR 715, 800 and 816. The current performance bond is $53,921,545 and with this reclamation complete, the application includes calculations to reduce the associated reclamation performance bond by $2,705,000.

The McKinley Mine is located approximately 22 miles northwest of Gallup, NM, and 2 miles east of Window Rock, AZ, on NM State Highway 264. Figure 1 shows the location and configuration of VMU 4. The McKinley Mine is currently permitted by CMI (formerly the Pittsburg & Midway Coal Mining Co.), but now managed by Chevron Environmental Management Company (CEMC). CEMC is located at 6001 Bollinger Canyon Road, Building C-2144, San Ramon, CA, 94583. The application was filed with the Office of Surface Mining Reclamation and Enforcement (OSMRE) Western Region Office in Denver, Colorado, which has jurisdiction for the McKinley Mine on Navajo Nation lands.

VMU 1 and VMU 4 are situated on land leased from the Navajo Nation to conduct mining and reclamation on lands in the Navajo Reservation. These lands are generally located in former Mining Areas 6, 5 and 3 in the northern part of the McKinley Mine. Mining has been completed as have required reclamation activities that include backfilling and grading, installation of hydrologic controls, topdressing, and revegetation. The Office of Surface Mining has previously approved Phase I and II applications for these lands that included all categories of reclamation with the exception of a demonstration that the mine has successfully revegetated the land to meet the revegetation success standards in Permit No. NM-000K. This application contains information that the revegetation success standards have been met and that the land can be released from further reclamation liability.

A copy of the reclamation liability release and termination of jurisdiction application is available for public inspection at the following locations:

Mr. Jacob Mulinix and Ms. Christy Luciani
Western Region Office
Office of Surface Mining Reclamation and Enforcement
https://www.osmre.gov/programs/regulating-active-coal-mines/indian-lands

County Clerk's Office
McKinley County Courthouse
207 W. Hill Ave.
Gallup, NM 87301

The Navajo Nation Minerals Department – Office
of Surface Mining Program
Window Rock Blvd
Window Rock, AZ 86515

Within 30 days of the fourth and final publication of this bond release application notice in the Gallup Independent or Navajo Times newspaper, written comments, objections, or requests for a public hearing and informal conference on this reclamation liability release application shall be submitted to:

Mr. Jacob Mulinix
Office of Surface Mining Reclamation & Enforcement
Western Region Office
PO Box 25065
One Federal Center, Building 41 Lakewood, CO 80225-0065
303-236-4700
Email: jmulinix@osmre.gov

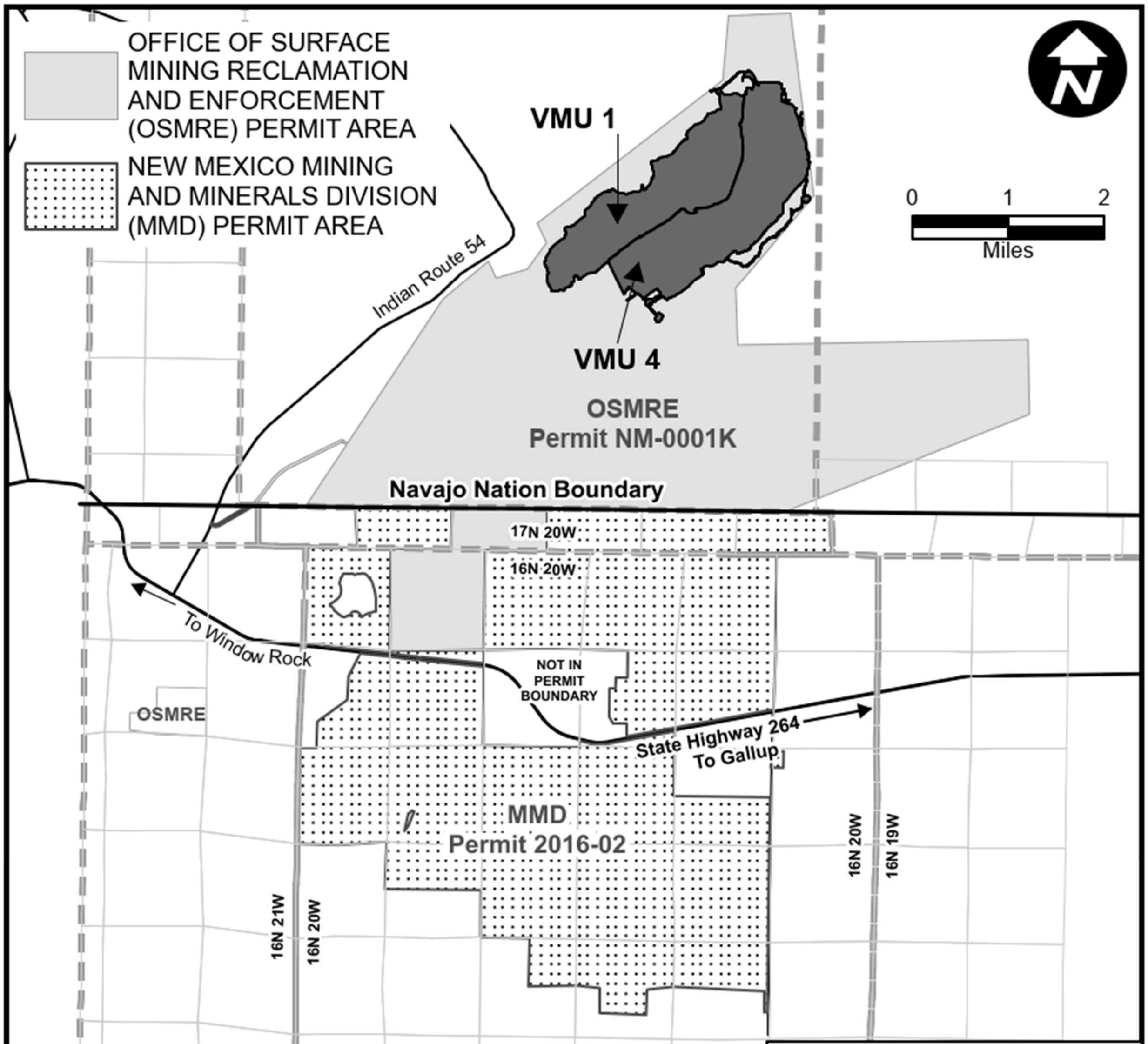


FIGURE 1
MCKINLEY MINE VMU 1 & VMU 4
BOND RELEASE & TOJ

Appendix A9: Newspaper Advertisement

McKinley Mine Permit No. NM-0001K
Vegetation Management Units 1 & 4
Application for Permanent Program Bond Release and
Initial Program Reclamation Liability Release and Termination of Jurisdiction

Chevron Mining Inc. (CMI) has filed an application for bond release of Permanent Program Lands and a reclamation liability release and termination of jurisdiction (TOJ) of Initial Program lands for reclaimed lands in Vegetation Management Units 1 and 4 (VMU 1 and VMU 4) contained in the McKinley Mine's mining and reclamation Permit No. NM-0001K (Permit NM-0001K) approved 09-07-2016, located in McKinley County, New Mexico.

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VMU 1 and VMU 4 are situated on land leased from the Navajo Nation to conduct mining and reclamation on lands in the Navajo Reservation. These lands are generally located in former Mining Areas 6, 5 and 3 in the northern part of the McKinley Mine. Mining has been completed as have required reclamation activities that include backfilling and grading, installation of hydrologic controls, topdressing, and revegetation. The Office of Surface Mining has previously approved Phase I and II applications for these lands that included all categories of reclamation with the exception of a demonstration that the mine has successfully revegetated the land to meet the revegetation success standards in Permit No. NM-000K. This application contains information that the revegetation success standards have been met and that the land can be released from further reclamation liability.

A copy of the reclamation liability release and termination of jurisdiction application is available for public inspection at the following locations:

Mr. Jacob Mulinix and Ms. Christy Luciani
Western Region Office
Office of Surface Mining Reclamation and Enforcement
https://www.osmre.gov/programs/regulating-active-coal-mines/indian-lands

County Clerk's Office
McKinley County Courthouse
207 W. Hill Ave.
Gallup, NM 87301

The Navajo Nation Minerals Department – Office
of Surface Mining Program
Window Rock Blvd
Window Rock, AZ 86515

Within 30 days of the fourth and final publication of this bond release application notice in the Gallup Independent or Navajo Times newspaper, written comments, objections, or requests for a public hearing and informal conference on this reclamation liability release application shall be submitted to:

Mr. Jacob Mulinix
Office of Surface Mining Reclamation & Enforcement
Western Region Office
PO Box 25065
One Federal Center, Building 41 Lakewood, CO 80225-0065
303-236-4700
Email: jmulinix@osmre.gov

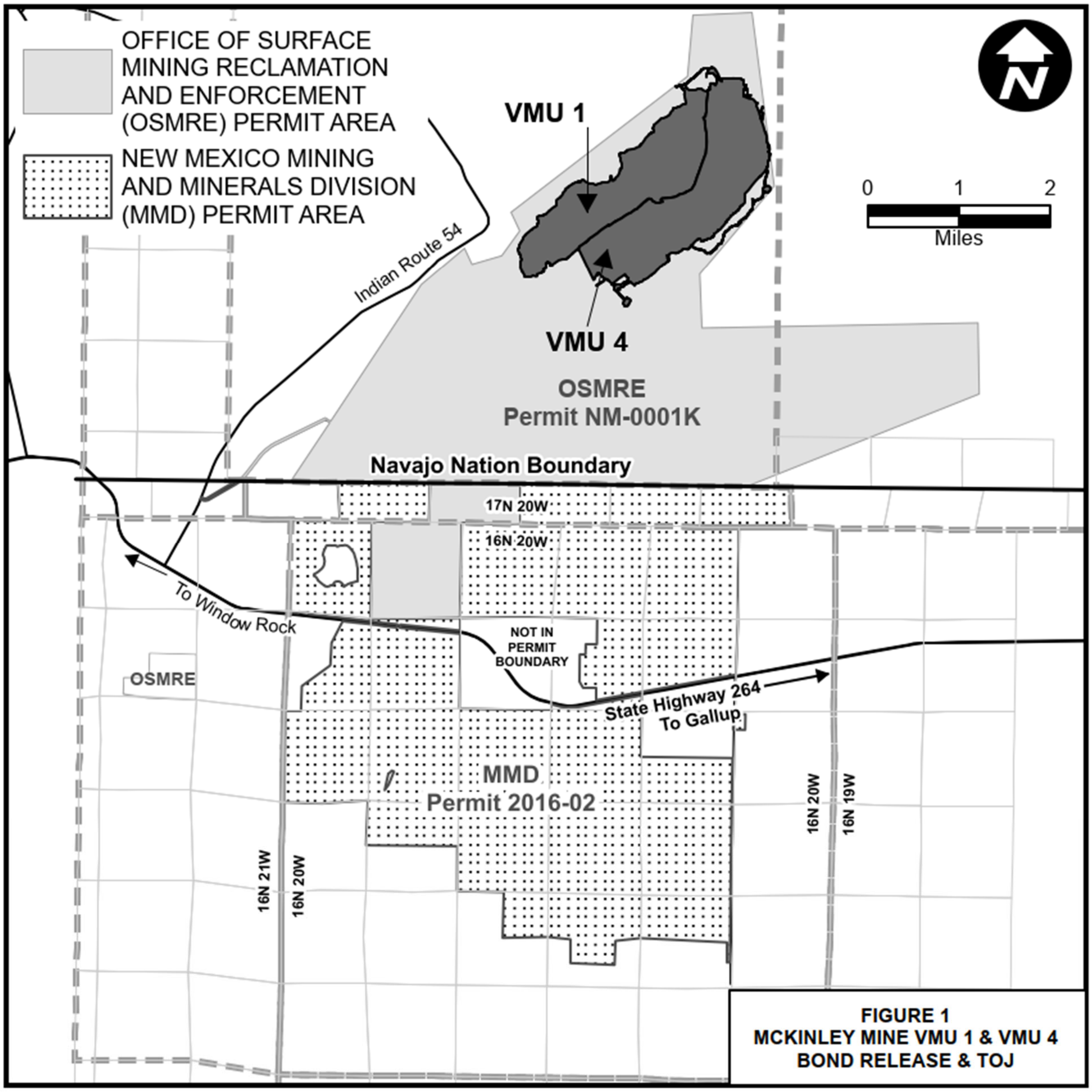

FIGURE 1
MCKINLEY MINE VMU 1 & VMU 4
BOND RELEASE & TOJ

Appendix A10: Riparian PATFM Evaluation

REPORT

McKinley Mine

Riparian PATFM Assesssment

Submitted to:

Chevron EMC

Submitted by:

WSP USA Inc.
701 Emerson Road, Suite 250, Creve Coeur, MO, 63141

T+ 1 314-984-8800

June 04, 2025

1.0 INTRODUCTION

Section 5.3.5.12 in OSMRE Permit No. NM-0001K requires a demonstration that graded spoil in potential riparian areas within permanent program lands meets the suitability criteria for potentially acid and toxic forming materials (PATFM). To that end, WSP USA Inc., (WSP), on behalf of the Chevron Environmental Management Company (CEMC), worked with the Office of Surface Mining Reclamation and Enforcement (OSMRE) to bring this commitment to a successful conclusion. This report documents the results of those efforts and provides the technical information necessary to make the demonstration, and to complete a permit modification to close out this commitment.

2.0 OVERVIEW

Section 5.3.5.12 in OSMRE Permit No. NM-0001K currently states the following:

> Graded spoil sampling will be conducted in grids near or within potential riparian-habitat areas. This sampling program and associated mitigative requirements are designed to prevent the occurrence of potentially acid and toxic-forming materials in the plant-rooting zone of the riparian area. OSMRE will be consulted to review and verify that this program has been completed.

The focus of this permit commitment has been on potential and existing post-mining water-holding structures intended to hold water beneficial for livestock and wildlife including approved and proposed permanent impoundments, reclamation channel pools, and small depressions (all three will be referred to as water-holding structures). These water-holding structures are defined as follows:

Approved and proposed permanent impoundments (impoundments) are former sediment ponds or temporary impoundments intended to be retained for livestock watering and wildlife habitat. Proposed permanent impoundments are those structures that are not yet approved as permanent impoundments as of the date of this report (see Table 1).

Reclamation channel pools (RCPs) are elongated shallow pools constructed in reclaimed-channel reaches, typically less than 3 feet deep, and similar in function to a small depression as allowed in 30 CFR 816.102 (h).

Small depressions (SD) are shallow water-holding structures or low-lying areas capable of retaining water as described in 30 CFR 816.102 (h).

An additional characteristic is that many of these water-holding structures are also capable of supporting riparian vegetation. Water-holding structures targeted for riparian habitat enhancements are discussed in Section 5.8.3.4 of Permit No. NM-0001K.

Table 1 lists all these existing and anticipated post-mining water-holding structures and Exhibit 1 shows their location. Exhibit 1 also shows parts of the PATFM grid system associated with the water-holding structures as discussed in this report.

3.0 METHODS

The approximate footprint of the maximum surface-water area for each structure was identified. The surface-water area of each structure was then superimposed onto the PATFM map that shows relevant grids that had already met the graded-spoil suitability criteria contained in Table 5.3-1 in Permit No. NM-0001K.

An assessment was then done to identify the location of passed PATFM grids that would be representative of the graded spoil for a given water-holding structure. The data for those grids was reviewed and verified that it did meet the permit suitability criteria. The criteria includes the following parameters: EC, pH, saturation percentage, SAR, texture, acid-base potential, total selenium, and ABDTPA selenium.

Table 1: Summary of Water-Holding Structures Assessed for PATFM Grid Data

Structure ID	Structure Type
2-3	Proposed Permanent Impoundment
2-8	Proposed Permanent Impoundment
2-9	Proposed Permanent Impoundment
2-10	Proposed Permanent Impoundment
2-11	Proposed Permanent Impoundment
2-12	Proposed Permanent Impoundment
2-13	Proposed Permanent Impoundment
2-21	Proposed Permanent Impoundment
3-7	Permanent Impoundment
5-1	Permanent Impoundment
5-2	Permanent Impoundment
6-8	Permanent Impoundment
RCP 5-1	Reclamation Channel Pool
RCP 5-2	Reclamation Channel Pool
RCP 5-3	Reclamation Channel Pool
5-SD1	Small Depression
5-SD2	Small Depression
5-SD3	Small Depression
6-SD1	Small Depression
The following structures are not on graded spoil	
3-5	Proposed Permanent Impoundment
6-7	Permanent Impoundment
5N	Proposed Permanent Impoundment
CDK	Permanent Impoundment
15-1	Permanent Impoundment
EW9	Permanent Impoundment

Those water-holding structures that appeared to have adequate passed grids that could be used for the PATFM-free demonstration were then reviewed with OSMRE for concurrence.

The assessment also identified water-holding structures for which grids with passed PATFM information could not be found, which included RCP 5-2, Impoundment 2-13, and the series of impoundments that includes 2-8, 2-9, 2-10, and 2-11 (2-8 series). Proposed grid PATFM sample sites that would best represent these water-holding structures were then reviewed with OSMRE, samples collected, and the data discussed with OSMRE. Impoundment 2-12 was later added to the list; the structure is in series with Impoundment 2-13 and the same PATFM data was used for 2-12 because of its proximity to 2-13.

Finally, water-holding structures that were not constructed on graded spoil were identified, which included Impoundments 5N, CDK, 3-5, and 6-7. Impoundments 15-1 and EW9 were later added to this list since they were proposed and approved as permanent impoundments. All of these impoundments do not require representative graded spoil sample data since they are not on graded spoil; they are, however, included in this report for completeness.

The consultation with OSMRE on the initial list of water-holding structures established demonstration protocols that CMI used to assess any additional structures that were later added to the list. These additional water-holding structures include Impoundment 2-12, 5-SD1, 5-SD2 and 5-SD3.

4.0 RESULTS

Table 2 lists the PATFM-sample grids selected to demonstrate that graded spoil criteria were met for a given water-holding structure. The table also shows the year samples were collected, and the name of the files containing PATFM information for a given grid. Also listed in the table were those water-holding structures that were not on graded spoil and that did not require such a demonstration. PATM sample grids selected as representative grids for a given structure are also shown on Exhibit 1. Appendix 1 contains a copy of the lab data files for the representative grids with an index at the beginning listing the order of the files in the appendix.

5.0 DISCUSSION

The information presented in this report, demonstrates that there are no PATFM materials in the graded spoil that could adversely affect the plant-rooting zone of riparian areas associated with any of the water-holding structures. While the maps and data provided in the results section are self-explanatory, some additional information is provided here to complement that information.

As stated earlier, various proposed water-holding structures are not located in graded spoil (Impoundment 3-5, 5N, CDK, 6-7, 15-1 and EW9); however, they are included here so all structures are addressed in this report.

During the assessment there were three locations that did not have available PATFM data, which included RCP 5-2, Impoundment 2-13, and the series of Impoundments that includes 2-8, 2-9, 2-10, and 2-11 (2-8 series). OSM was consulted on where to collect graded-spoil samples for these three water-holding structures; the locations selected are shown on Exhibit 1. The results of this additional sampling and any explanatory information were reviewed for acceptability with OSMRE; this additional sampling information is also included in Appendix 1.

Only one sample site was necessary for the 2-8 series given the proximity of the impoundments to one another. All the depth intervals for the Impoundment 2-8 samples met all suitability criteria except the saturation percentage of the lowermost 30–42-inch interval, which was 89.3 (the permit standard is 85). This higher saturation value, however, does not pose an actual problem to the rooting zone. Merrill et al (Williams and Shuman, 1987) state that saturation percentages in the 80% to 95% range can be indicative of swelling tendency associated with sodic hazard (see attached excerpt in Appendix 2). There is no concern for sodic hazard in this instance, however, since the data for this interval also showed an SAR of 16.1 and clay at 23.8%. It was concluded that this exceedance of saturation percentage was acceptable given the following: the saturation percentage is just above the threshold, but the low SAR and low clay content show that there would be no sodic hazard; there is existing successful cattail growth in Pond 2-8 near the sample site; and the soil sample with the high saturation percentage is at the bottom of the soil profile. These findings and conclusion were also reviewed with OSMRE for concurrence.

6.0 CONCLUSION

All the impoundments, RCPs, and small depressions meet the graded-spoil suitability requirements and intent of Section 5.3.5.12 in OSMRE Permit No. NM-0001K. Subsequently, the permit can be modified to close out this commitment.

Table 2: Grid and PATFM Data Summary by Structure

Structure ID	Structure Type	Representative Grids	*Yr Sampled or Ann Rpt Yr	File Name with PATFM Data	Comments
2-3	Impoundment	2-53-16	12	2012 Grid 2-53-16 (From HTM)	
2-8	Impoundment	2-59-16 (PATFM2-8)	19	2018 RiparianPATFM 1802-011EDD	One sample collected to represent 2-8, 2-9, 2-10 & 2-11
2-9	Impoundment	2-59-16 (PATFM2-8)	19	2018 RiparianPATFM 1802-011EDD	One sample collected to represent 2-8, 2-9, 2-10 & 2-11
2-10	Impoundment	2-59-16 (PATFM2-8)	19	2018 RiparianPATFM 1802-011EDD	One sample collected to represent 2-8, 2-9, 2-10 & 2-11
2-11	Impoundment	2-59-16 (PATFM2-8)	19	2018 RiparianPATFM 1802-011EDD	One sample collected to represent 2-8, 2-9, 2-10 & 2-11
2-12	Impoundment	2-64--9 (PATFM2-13)	19	2018 RiparianPATFM 1802-011EDD	One sample collected to represent 2-12 and 2-13
2-13	Impoundment	2-64-9 (PATFM2-13)	19	2018 RiparianPATFM 1802-011EDD	One sample collected to represent 2-12 and 2-13
2-21	Impoundment	2-74-35, 2-74-36, 2-75-34,2-76-32, 2-76-33, 2-77-32, 2-77-33,	07, 07, 07, 07,10,07,11	2007 OSM Soils-Passed GridsRip; 2010 OSM Passed Grids Revised_CompleteRip, 2011 OSM Passed Grids Revised_CompleteRip	
3-7	Impoundment	3-47-48, 3-47-49, 3-47-50, 3-48-48	05, 05, 05, 05	2005_AR_PATFM_PassingA35Rip	
5-1	Impoundment	5-45-29, 5-46-29	94, 94	1994_AR_PATFM_PassingA35Rip	
5-2	Impoundment	5-34-35	94	1994_AR_PATFM_PassingA35Rip	
6-8	Impoundment	6-41-57, 3-42-56	06, 10	2006 ARRip,2010 OSM Passed Grids Revised_CompleteRip	
RCP 5-1	Reclamation Channel Pool	5-30-46	92	PATFM_90s_All_A35RIP	
RCP 5-2	Reclamation Channel Pool	5-31-42 (RCP-5-2)	18	2018 RiparianPATFM 1802-011EDD	
RCP 5-3	Reclamation Channel Pool	5-39-31	94	1994_AR_PATFM_PassingA35Rip	
5-SD1	Small Depression	5-31-41	19	2019_PATFM_PassingA35	
5-SD2	Small Depression	5-31-45	92	PATFM_90s_All_A35RIP	
5-SD3	Small Depression	5-31-50	94	1994_AR_PATFM_PassingA35Rip	
6-SD1	Small Depression	6-38-54, 6-39-54	94, 97	Early_90s, 1997ARRip	
The following structures are not on graded spoil					
3-5	Impoundment	Not applicable	NA		Located in unmined land with no graded spoil
6-7	Impoundment	Not applicable	NA		Located in unmined land with no graded spoil
5N	Impoundment	Not applicable	NA		Located in unmined land with no graded spoil
CDK	Impoundment	Not applicable	NA		Located in unmined land with no graded spoil
15-1	Impoundment	Not applicable	NA		Located in unmined land with no graded spoil
EW9	Impoundment	Not applicable	NA		Located in unmined land with no graded spoil

Notes

*Yr corresponds respectively to grid numbers in previous column (e.g, 6-SD1 Grid 6-38-54 info is in 19 annual report and 6-39-54 info is in 97 annual report).

HTM is a Golder internal data base

7.0 LITERATURE

Williams, R.D and Shuman, G.E., Editors. 1987. Reclaiming Mine Spoils and Overburden in the Western United States, Analytic Parameters and Procedures. Soil Conservation Society of America.

8.0 CLOSING

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