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TO: Doug Martin, Montana Natural Resource Damage Program
FROM: Amy Sacry and Gabi Poupart, Geum Environmental Consulting, Inc.
DATE: March 28, 2025
RE: Milltown 2024 Soil Treatment Evaluation Summary

Introduction

This document summarizes observations made in July 2024 of the Milltown Dam Soil Treatment Project (Project, Project Area) completed between November 2017 and October 2019 at the Milltown Dam Project Site by the Montana Natural Resource Damage Program (NRDP). The Project is described in detail in *Milltown Soil Treatment Project Manual State of Montana – Department of Justice Natural Resource Damage Program* (Geum, 2017) and *Milltown Dam Soil Treatment Project – Construction Completion Report* (Geum, 2020). Monitoring of the Project began in August 2020 and was repeated in July 2021, and July 2024. There were two main areas of soil treatment work completed – one in the Bypass Channel Area (Bypass Channel Soil Treatment Area) and one in the Posse Ground Area along the south slope (Posse Ground Soil Treatment Area) (Figure 1 and Figure 2). In the Posse Ground Soil Treatment Area, work included: ripping the soil surface, applying lime, applying cover soil amended with compost, constructing surface roughness, incorporating woody debris into the surface, and hand broadcast seeding a native seed mix. In the Bypass Channel Soil Treatment Area, three separate treatments were applied: 1) ripping the soil surface, applying lime and compost, and no-till drill seeding a native seed mix; 2) ripping the soil surface, incorporating lime, applying cover soil amended with compost, and no-till drill seeding a native seed mix; and 3) no-till drill seeding only. The same seed mix was used in all areas (seed mix provided in Attachment 1). In the Posse Ground Soil Treatment Area, soil treatments occurred between November 13 and 19, 2018 and seeding occurred on November 29, 2018. In the Bypass Channel Soil Treatment Area, soil treatments occurred between July 17 and 21, 2019 and seeding occurred between October 2 and 4, 2019.

This document also describes results of vegetation community mapping in the Bypass Channel Area and Posse Ground Area. Vegetation community mapping was originally done in 2016 as part of initial investigations of the areas to determine potential treatment scenarios. Vegetation community mapping was repeated in 2024 to evaluate the effects of soil treatments on vegetation establishment and overall project goals.

Several documents provide background information on the Project including KC Harvey 2013; and Geum and KC Harvey 2014, 2015, 2016, and 2017. The following summarizes the general background and timeline of the Project:

- **2011-2012 Initial Revegetation of Area:** Seeding and planting of Reach CFR2 (Reservoir Sediments Area) was completed. The area was drill seeded in fall 2011 and due to poor seed establishment, re-seeded in fall 2012. Seed response was poor again in the summer following fall 2012 seeding, which initiated investigation into potential issues with the substrate used for growth media in this area.
- **2013 Soil Samples Collected:** Nine soil samples were collected in July 2013 from poorly vegetated areas and analyzed for pH, electrical conductivity, organic matter, cation exchange capacity, lime, NPK fertility, extractable and exchangeable sodium, SAR, texture, saturation percentage, sulfate, as well as total amounts of As, Cu, Zn, and Mg. Two soil samples were collected in October 2013 from well vegetated areas and submitted for the same analyses. Soil analyses and results are summarized in KC Harvey 2013 which identified metals, pH and nitrates as potential factors limiting vegetation.
- **2013 Adaptive Management Soil Treatments Implemented:** Based on the results of the 2013 soil sampling, nine soil treatment plots were implemented in November 2013 to test a range of treatments to increase vegetation cover. Treatments included lime tilling, compost tilling, fertilizer addition, sediment removal, cover soil addition, and seeding. Soil treatment documentation is provided in Geum and KC Harvey (2014).
- **2014 Adaptive Management Soil Treatments Monitored:** Monitoring of the nine soil test plots and three additional control plots was completed in August, 2014. Monitoring included: vegetation composition and vegetation canopy cover, erosion, and soil chemistry. The monitoring plan is described in Geum and KC Harvey (2014) and monitoring results are described in Geum and KC Harvey (2015).
- **2015 Adaptive Management Soil Treatments Monitored:** Monitoring of the nine soil test plots and three additional control plots was repeated in August 2014. 2015 monitoring provided no clear indication of either natural recovery or an obvious treatment to improve vegetative cover in the area. Monitoring results are described in Geum and KC Harvey (2016).
- **2015 Additional Soil Pits Dug and Samples Collected and Analyzed:** To help determine which soil treatments would be most effective, and the maximum depth of soil issues, thirty-four 24-inch deep pits were dug throughout the area in October 2015. Soil samples were collected at 6-inch increments within each pit. This sampling showed that elevated metal concentrations were present to varying degrees in all pits and all pits sampling intervals. The results of this sampling are described in Geum and KC Harvey (2016).
- **2015 Treatment Recommendation:** Based on soil test plot monitoring and additional test pit sampling, a recommended treatment was proposed for the area that included: preservation, decompaction, lime amendment, compost amendment, cover soil amendment, microtopography and woody debris placement, seeding, and planting of conifers. This recommendation is described in Geum and KC Harvey (2016), which also outlined a desired vegetative objective for the Project Area.
- **2016 Monitoring:** Increased vegetative cover was observed throughout the project area in summer 2016. For this reason, NRDP decided to monitor the adaptive management soil treatment plots again rather than implementing a large-scale treatment. Vegetation cover was also mapped for the entire area. In 2016, soil samples were collected in the Posse Ground Area due to poor vegetation establishment and use of the same reservoir sediment soils in this area as the Bypass Channel Area (soil samples PG 01-07). This area had elevated metal concentrations similar to the Bypass Channel

Area (ranging from 1589 mg/kg to 2,087 mg/kg). Based on 2016 monitoring, treatment extents were reduced and the treatment recommendation refined. The results of 2016 monitoring and soil sampling, and updated treatment recommendation are described in Geum and KC Harvey (2017).

- **2017 Revegetation Treatments:** In 2017, areas outside of proposed soil amendment locations were planted to increase diversity and cover. Areas were planted with ponderosa pine, sub-shrubs (Wood's rose, western snowberry, shrubby cinquefoil, and rubber rabbitbrush), and 17 native forb species in the area to increase diversity (1,007 total plants). Planted areas were watered by Opportunity Resources crews during summer of 2017.
- **2017 Construction:** In October 2017 the larger soil amendment project was put out for bid and awarded to Thompson Contracting, Inc. The final project area treatments are described in Geum (2017). In 2017, compost and soil were hauled to the site and fence installation was completed.
- **2018 Construction:** In October 2018, lime was imported to the site. In November 2018, Thompson completed work in the Posse Ground Soil Treatment Area. Work in the Bypass Channel Soil Treatment Area could not be completed due to wet conditions.
- **2019 Construction:** In July 2019, Thompson completed work in the Bypass Channel Soil Treatment Area. In October 2019 seeding was completed in this area. All completed work is described in Geum (2020).
- **2020-2021 Monitoring:** Soil Treatment Project monitoring is described in Geum (2021, 2022).
- **2024 Monitoring:** Soil Treatment Project monitoring is described in Geum (2021), Geum (2022), and this memo.

In 2024, monitoring included: recording vegetation cover data by species in 1-meter by 1-meter square plots in each treatment type in the Bypass Channel Soil Treatment Area and Posse Ground Soil Treatment Area; mapping vegetation community types in the Bypass Channel Area and Posse Ground Area; collecting vegetation cover data from 10-foot by 10-foot square plots in each vegetation community type; collecting cover data for trees and shrubs greater than 3-feet tall along 22-foot transects; and recording cheatgrass and perennial grass cover in 1-meter by 1-meter square plots in the Bypass Channel Area where imported cover soil was used and where cheatgrass cover is increasing.

2024 Soil Treatment Monitoring

In July 2024, Geum observed each treatment area and monitored vegetation cover in 13, 1-meter by 1-meter square plots. These plots were in the general proximity of plots monitored in 2020 and 2021, but not in the exact locations. Four plots were in the Posse Ground Soil Treatment Area (rip, lime, compost, surface roughness and woody debris, broadcast seed). The remaining nine plots were in the Bypass Channel Soil Treatment Area. Three were in the 'rip, lime, compost, no-till drill seed' treatment; three in the 'rip, lime, cover soil, compost, no-till drill seed' treatment; and three in the 'no-till drill seed' treatment. Plots were randomly located within the boundary of each treatment. Attachment 1 includes the seed mix used in soil treatment areas. Attachment 2 lists all species observed in soil treatment monitoring plots in 2024. Attachment 3 provides photographs of soil treatment monitoring plots in 2020, 2021, and 2024. Attachment 4 compares species observed in soil treatment monitoring plots between 2020, 2021, and 2024.



Figure 1. Location of soil treatment areas within Bypass Channel Area and Posse Ground Area.

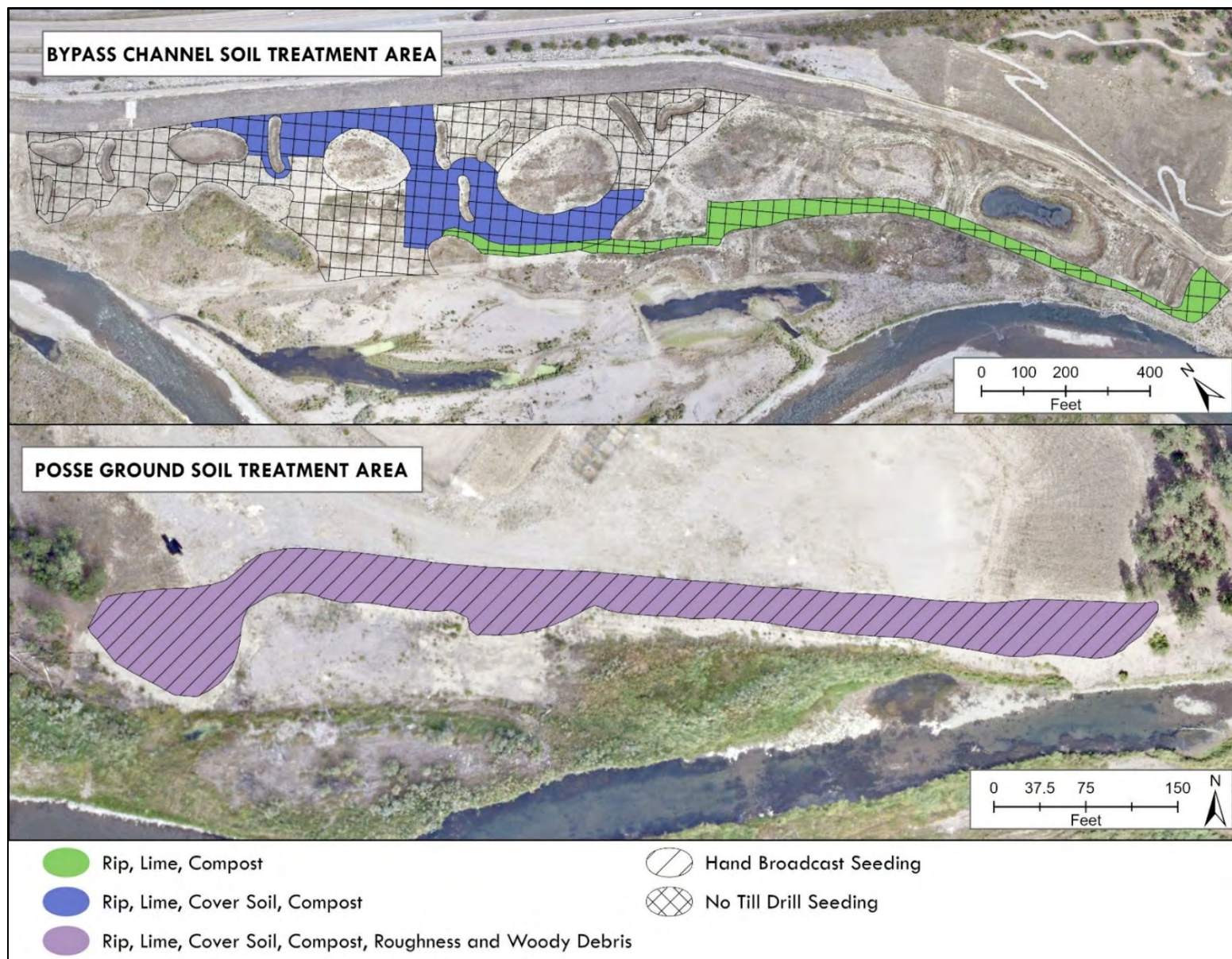


Figure 2. Milltown Soil Treatment Project as-built treatment locations.

Vegetation cover by species was recorded within each plot. A total of 17 species were recorded in monitoring plots in 2024 (Table 1). Of these, 9 were native, 6 were exotic, and 2 were noxious weeds [Japanese brome (*Bromus japonicus*) and cheatgrass (*Bromus tectorum*)]. All native species present were seeded. Total cover and cover by species for 2024 monitoring plots is summarized in Table 2. Total cover ranged from a low of 50% (Bypass Channel Soil Treatment Area) to a high of 136% (Posse Ground Soil Treatment Area). Within the Bypass Channel Soil Treatment Area, vegetation cover in plots ranged from 50% to 107%. In the Bypass Channel Soil Treatment Area in 2024, the three plots in the 'rip, lime, compost, no-till drill seed' treatment had total cover of 107%, 60%, and 50% (mean = 72%). For the three plots in the 'rip, lime, cover soil, compost, no-till drill seed' treatment total cover was 75%, 50%, and 75% (mean = 67%). For the three plots in the 'no-till drill seed' treatment total cover was 75%, 50%, and 50% (mean = 58%). For the four plots in the 'rip, lime, cover soil, compost, surface roughness, woody debris, and broadcast seed' cover was 100%, 100%, 100%, and 136% (mean = 109%). Within the Posse Ground Soil Treatment Area cover ranged from 100% to 136%.

In 2024, native species made up most of the total cover for all treatments (Figure 5). The native species with the highest average cover for all plots were western wheatgrass (*Elymus smithii*, 33%), bluebunch wheatgrass (*Pseudoroegneria spicata*, 50%), Nevada bluegrass (*Poa nevadensis*, 23%), slender wheatgrass (*Elymus trachycaulus*, 23%), and Idaho fescue (*Festuca idahoensis*, 16%). Exotic species with the highest cover included black medic (*Medicago lupulina*, 60%), redtop (*Agrostis stolonifera*, 49%), smooth brome (*Bromus inermis*, 15%), and tall tumble mustard (*Sisymbrium altissimum*, 14%). Noxious weed species occurred in all plots in the Posse Ground Soil Treatment Area and in two plots in the Bypass Channel Soil Treatment Area. In the Posse Ground Soil Treatment Area, cheatgrass (*Bromus tectorum*) had an average cover of 34% and occurred in all four plots, and Japanese brome (*Bromus japonica*) had an average cover of 30% and occurred in Plot 3. In the Bypass Channel Soil Treatment Area, cheatgrass had an average cover of 25% and occurred in Plots 1 and 2 in the rip, lime, cover soil, compost, and no-till drill seed treatment area. Japanese brome had an average cover of 5% and occurred in Plot 2 in the rip, lime, compost, no-till drill seed treatment area. Cheatgrass and Japanese brome are not Montana listed noxious weeds but are categorized as noxious for monitoring purposes because they are highly invasive and have significant management implications.

Table 3 and Figure 5 compare average cover for all plots between 2020, 2021, and 2024 by treatment area, treatment type, and species status – native, exotic, or noxious weed. In the Bypass Channel Soil Treatment Area, plots where the only treatment was no-till drill seeding were only observed in 2021 and 2024. Bypass Channel Soil Treatment Area plot cover decreased from 76.6% in 2020 to 73.1% in 2021 and 65.7% in 2024. In 2024, cover decreased in the 'rip, lime, cover soil, compost, no-till drill seed' treatment in the Bypass Channel Soil Treatment Area (2021= 62.2%, 2021= 79.0%, 2024=67.0%) and increased in the 'rip, lime, compost, no-till drill seed' (2021= 91.0%, 2021= 60.3%, 2024 =72.0%). Native cover increased in all plots in the Bypass Channel Soil Treatment Area except in the 'no-till drill seed' treatment area where cover went from 10% in 2021 to 2% in 2024. Exotic species decreased in 'rip, lime, cover soil, compost, no-till drill seed' plots (2021= 51.6%, 2021= 58.0%, 2024= 0.0%) and continued to decrease in 'rip, lime, compost, no-till drill seed' plots (2021= 84.0%, 2021= 32.3%, 2024= 31.0%). Noxious weed cover increased in the 'rip, lime, cover soil, compost, no-till drill seed' from 1.0% to 10.0% between 2021 and 2024. In the Posse Ground Soil Treatment Area, cover remained nearly the same

between 2020 (73.5%) and 2021 (75.3%) and increased to 109.0% in 2024. Native cover remained the same in 2024 (2020 = 54.0%, 2021= 50.0%, 2024= 50.0%) and exotic cover increased from 16.8% in 2020 to 5.5% in 2021 to 25.0% in 2024. Noxious cover increased greatly between 2020 and 2024 (2020= 4%, 2021= 26.7%, 2024= 34.0%). This is attributed to an increase in cheatgrass cover. Japanese brome was not documented in soil treatment monitoring plots in 2020 or 2021. Figure 6 provides an overview of the Bypass Channel Soil Treatment Area ‘rip, lime, compost, cover soil, no-till drill seed’ treatment. Figure 7 provides an overview of the Bypass Channel Soil Treatment Area ‘rip, lime, compost, no-till drill seed’ treatment. Figure 8 provides an overview of the Posse Ground Soil Treatment Area ‘rip, lime, cover soil, compost, roughness, woody debris, broadcast seed’ treatment.

Table 1. Species observed in soil treatment monitoring plots in July 2024.

Species Name	Species Code	Common Name	Growth Form	Life Cycle	Status	Seeded or Planted
<i>Achillea millefolium</i>	ACHMIL	common yarrow	forb	Perennial	Native	X
<i>Apera interrupta</i>	APEINT	dense silky bentgrass	Grass	Annual	Exotic	
<i>Artemisia ludoviciana</i>	ARTLUD	white sagebrush	forb	Perennial	Native	X
<i>Agrostis stolonifera</i>	AGRSTO	redtop/creeping bentgrass	grass	Perennial	Exotic	
<i>Bromus inermis</i>	BROINE	smooth brome	grass	Perennial	Exotic	
<i>Bromus tectorum</i>	BROTEC	cheatgrass	grass	Annual	Noxious ¹	
<i>Bromus japonica</i>	BROJAP	Japanese brome	grass	Annual	Noxious ²	
<i>Elymus cinereus</i>	ELYCIN	basin wildrye	grass	Perennial	Native	X
<i>Elymus smithii</i>	ELYSMI	Western wheatgrass	grass	Perennial	Native	X
<i>Elymus trachycaulus</i>	ELYTRA	slender wheatgrass	grass	Perennial	Native	X
<i>Epilobium brachycarpum</i>	EPIBRA	panicled willowherb	forb	Annual	Native	
<i>Festuca idahoensis</i>	FESIDA	Idaho fescue	grass	Perennial	Native	X
<i>Medicago lupulina</i>	MEDLUP	black medic	forb	Annual/Perennial	Exotic	
<i>Poa nevadensis</i>	POASEC	Nevada bluegrass	grass	Perennial	Native	X
<i>Pseudoroegneria spicata</i>	PSESPI	bluebunch wheatgrass	grass	Perennial	Native	X
<i>Sisymbrium altissimum</i>	SISALT	field tumble-mustard	forb	Annual/Biennial	Exotic	
<i>Tragopogon dubius</i>	TRADUB	yellow salsify	forb	Annual/Biennial	Exotic	

¹ Priority 3 regulated plant, not Montana listed noxious weed

² Not a Montana listed noxious weed but included as noxious because of invasive ability



Figure 3. Location of 2024 soil treatment monitoring plots within the Posse Ground Soil Treatment Area.

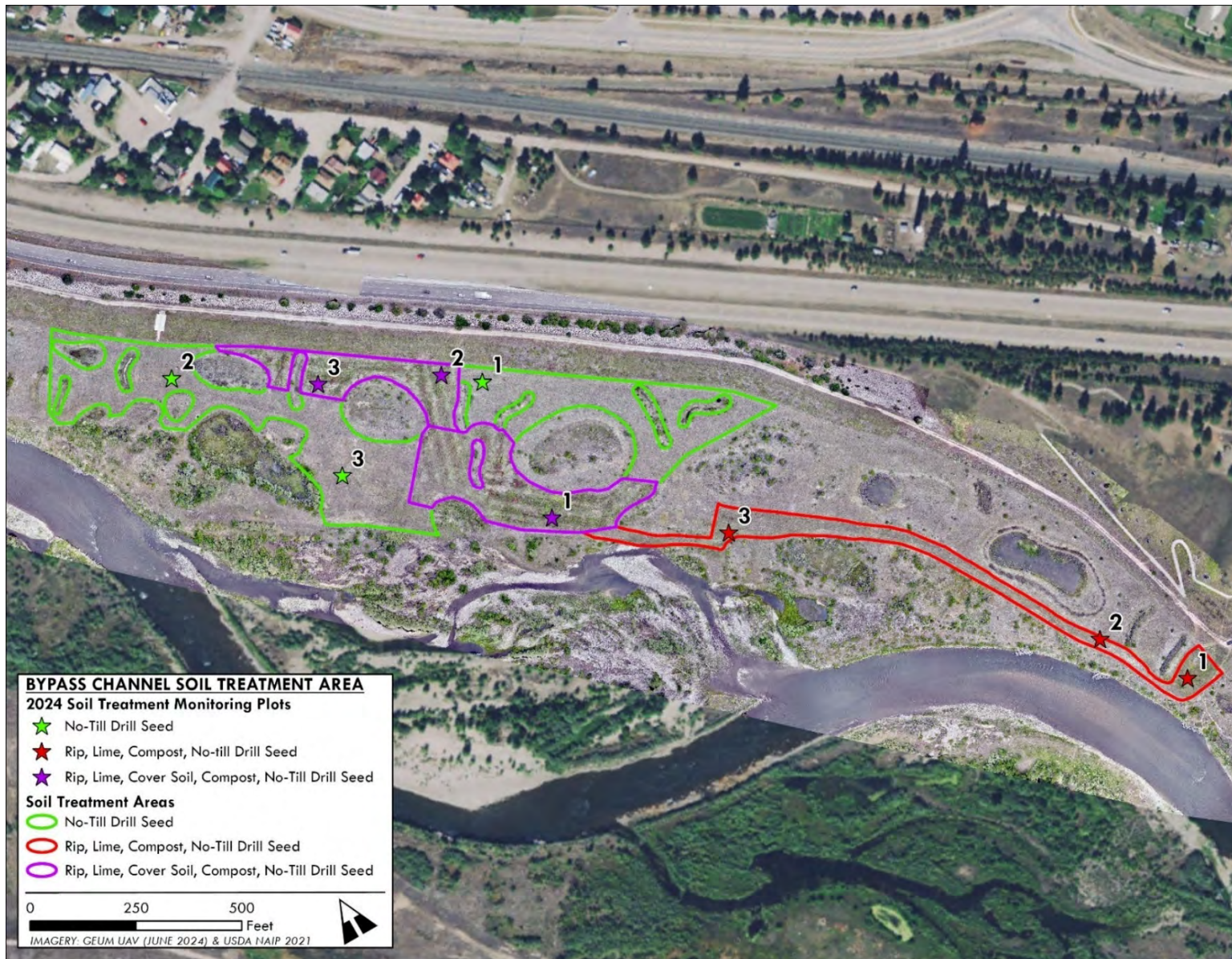


Figure 4. Location of 2024 soil treatment monitoring plots within the Bypass Channel Soil Treatment Area.

Table 2. Total percent cover and percent cover by species for each soil treatment 2024 monitoring plot.

2024 Soil Monitoring Plot Vegetation Cover by Species														
Plot ID	Bypass Channel Soil Treatment Area									Posse Ground Soil Treatment Area				Average % Cover All Plots
	1	2	3	1	2	3	1	2	3	1	2	3	4	
Treatment	Rip, lime, compost, no-till drill seed			Rip, lime, cover soil, compost, no-till			No-till drill seeding			Rip, lime, cover soil, compost, surface roughness, woody debris				
Species														
<i>Achillea millefolium</i>	10	--	--	--	3	--	--	2	--	--	--	3	5	4.6
<i>Apera interrupta</i>	5	--	--	--	--	--	--	--	--	--	--	--	--	5.0
<i>Artemisia ludoviciana</i>	--	--	--	--	1	--	--	--	--	--	10	15	--	8.7
<i>Agrostis stolonifera</i>	--	25	--	--	--	--	7 5	4 5	5 0	--	--	--	--	48.8
<i>Bromus inermis</i>	--	--	--	--	--	--	--	--	--	25	--	4	--	14.5
<i>Bromus tectorum</i>	--	--	--	15	15	--	--	--	--	15	60	30	31	27.7
<i>Bromus japonica</i>	--	5	--	--	--	--	--	--	--	--	--	30	--	17.5
<i>Elymus cinereus</i>	--	--	--	10	--	15	--	--	--	--	--	3	10	9.5
<i>Elymus smithii</i>	--	--	--	--	--	60	--	--	--	5	--	--	--	32.5
<i>Elymus trachycaulus</i>	20	10	50	25	5	--	--	--	--	5	--	15	50	22.5
<i>Epilobium brachycarpum</i>	10	--	--	--	--	--	--	--	--	--	--	--	--	10.0
<i>Festuca idahoensis</i>	--	--	--	--	--	--	--	3	--	--	28	--	--	15.5
<i>Medicago lupulina</i>	60	--	--	--	--	--	--	--	--	--	--	--	--	60.0
<i>Poa nevadensis</i>	--	20	--	25	25	--	--	--	--	--	--	--	--	23.3
<i>Pseudoroegneria spicata</i>	--	--	--	--	--	--	--	--	--	50	--	--	--	50.0
<i>Sisymbrium altissimum</i>	2	--	--	--	1	--	--	--	--	--	--	--	40	14.3
<i>Tragopogon dubius</i>	--	--	--	--	--	--	--	--	--	--	2	--	--	2.0
Total	107	60	50	75	50	75	7 5	5 0	5 0	10 0	10 0	10 0	13 6	21.6

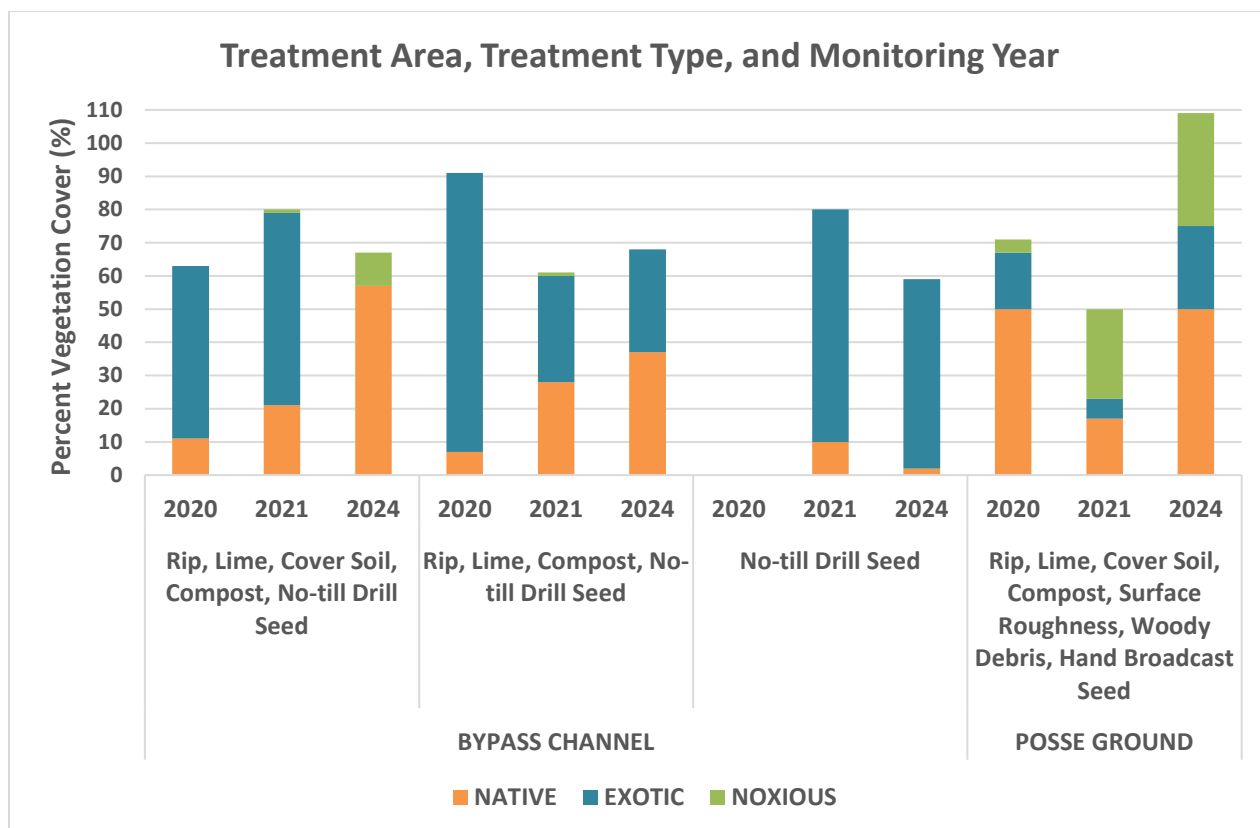


Figure 5. Total percent vegetation broken out by native, exotic and noxious species and by treatment area, treatment type and monitoring year.

Table 3. Average cover by treatment area, treatment type, and species status (native, exotic, or noxious); comparing data from August 2020, July 2021, and July 2024. No-Till Drill seed soil treatment monitoring plots were only recorded during 2021 and 2024.

Treatment Area and Type	Average Plot Cover (%)			Average Native Species Cover (%)			Average Exotic Species Cover (%)			Average Noxious Species Cover (%)		
	2020	2021	2024	2020	2021	2024	2020	2021	2024	2020	2021	2024
Bypass Channel Soil Treatment Area												
Rip, Lime, Cover Soil, Compost, No-till Drill Seed	62	79	67	11	21	57	52	58	0	0	1	10
Rip, Lime, Compost, No-till Drill Seed	91	60	72	21	28	37	84	32	31	84	1	0
No-till Drill Seed	NR	80	58	NR	10	2	NR	70	57	NR	0	0
Total Average	77	73	66	16	20	32	68	53	29	42	1	3
Posse Ground Soil Treatment Area												
Rip, Lime, Cover Soil, Compost, Surface Roughness, Woody Debris, Hand Broadcast Seed	74	75	109	54	50	50	17	6	25	17	27	34
Total Average	74	75	109	54	50	50	17	6	25	17	27	34



Figure 6. Photo series of Bypass Channel Soil Treatment Area 'Rip, Lime, Cover Soil, Compost, No-till Drill Seeding' treatment comparing 2020 (top photo), 2021 (middle photo), and 2024 (bottom photo) monitoring.

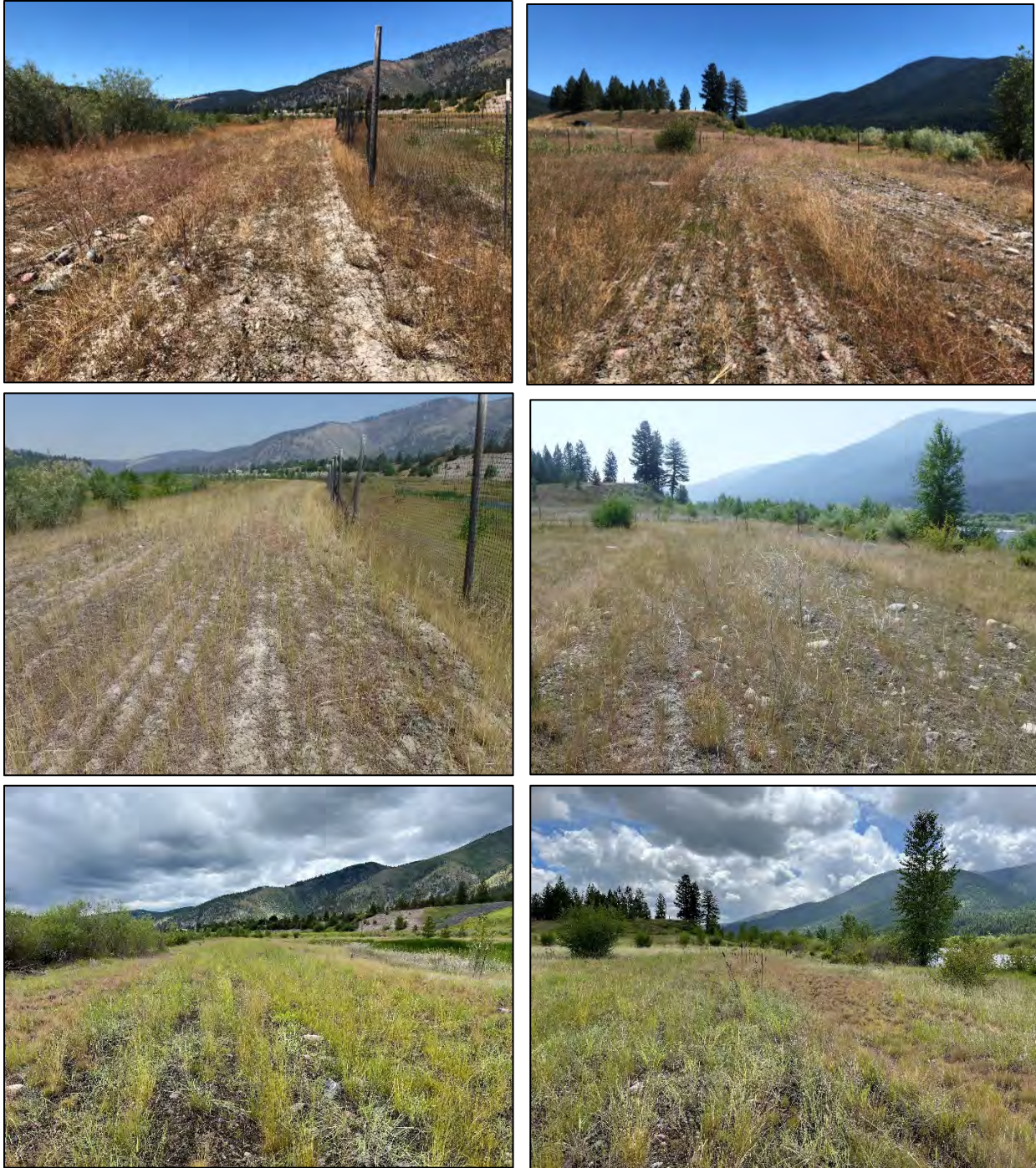


Figure 7. Photo series of Bypass Channel Soil Treatment Area 'Rip, Lime, Compost, No-till Drill Seed' treatment comparing 2020 (top photos), 2021 (middle photos), and 2024 (bottom photos) monitoring.



Figure 8. Photo series of Posse Ground Soil Treatment Area 'Rip, Lime, Cover Soil, Compost, Roughness, Woody Debris, Broadcast Seed' treatment comparing 2020 (left photos), 2021 (middle photos), and 2024 (right photos) monitoring. 2024 photos show the increase in cheatgrass in the area.

2024 Vegetation Community Mapping

Vegetation community mapping was completed in the Project Area (Bypass Channel Area and Posse Ground Area) in August 2024. Vegetation community mapping was originally done in 2016 to identify areas where native species were establishing well, where non-native species were dominant, or where little to no vegetation had established. This was done to support development of the soil treatments that were implemented in 2017. 2016 vegetation mapping is described in are included in the following document: *Milltown Bypass Channel and Posse Ground Slope 2016 Soil and Vegetation Monitoring and Treatment Recommendations* (Geum and KC Harvey, 2017).

Nine vegetation community types were developed based on natural breaks in species composition and dominance of a particular species. 2024 vegetation communities included: Unvegetated, Native, Native and Cheatgrass, Native and Redtop, Redtop, Shrub with Native and Redtop Understory, Shrub with Redtop Understory, Tree with Native and Redtop Understory, and Tree with Redtop Understory. Table 4 describes the vegetation communities identified in 2024. Figure 9 shows 2024 vegetation community mapping for the Posse Ground Soil Treatment Area (0.9 acres). Figure 10 shows 2024 vegetation community mapping for the Bypass Channel Soil Treatment Area (20.6 acres). Table 5 shows the total area of each vegetation community in each treatment area. Table 6 shows the total area of each vegetation community in each treatment area by soil treatment type.

Vegetation communities were initially mapped remotely in ArcGIS on high resolution drone imagery flown in June 2024 (Attachment 5) and adjusted in the field as needed. After initial vegetation mapping was completed, 10-foot by 10-foot plots were established to verify species composition and percent cover in each vegetation community. In woody vegetation community types, a 22-foot long transect was established to determine woody vegetation cover and height. The number of plots monitored within each vegetation community type were determined based on the percent of the total area occupied by the vegetation community type, with vegetation communities occurring in larger areas having more monitoring plots than vegetation communities occupying small areas. A total of 22, 10-foot by 10-foot cover plots and 4, 22-foot long woody vegetation cover transects were monitored in 2024. In the Posse Ground Area, 2, 10-foot by 10-foot cover plots were monitored. The remaining 20 plots and 4 woody vegetation transects were in the Bypass Channel Area. Within each plot, absolute cover of each species, and relative cover of all vegetative cover were recorded. Cover of different ground cover types were also recorded for each plot. Figure 9 shows the location of vegetation community cover plots in the Posse Ground Soil Treatment Area. Figure 10 shows the location of vegetation community cover plots in the Bypass Channel Soil Treatment Area. Attachment 6 includes photos of each vegetation community type.

There are two vegetation communities in the Posse Ground Area – Native (22% of the area) and Native and Cheatgrass (78% of the area) (Figure 9 and Figure 12). In the Native vegetation community, slender wheatgrass and basin wildrye are the dominant species. In the Native and Cheatgrass vegetation community, cheatgrass, Idaho fescue, and basin wildrye are the dominant species. In the Bypass Channel Area, Redtop is the dominant vegetation community type (66%). Attachment 7 provides cover

by species and type of cover for each individual plot for the Posse Ground Area. Figure 11 shows percent cover by type of cover for vegetation communities in the Posse Ground Soil Treatment Area.

All vegetation community types were mapped in the Bypass Channel Area (Figure 10). Table 5 shows the percent of the Bypass Channel Area within each vegetation community type. Figure 13 shows the average percent cover for each type of cover for all plots in each vegetation community. Attachment 7 provides cover by species and type of cover for each individual plot for the Bypass Channel Area. Table 7 shows percent cover and species recorded along woody vegetation transects in the Bypass Channel Area. In the Native vegetation community, slender wheatgrass, basin wildrye, and arctic rush (*Juncus arcticus*) are the dominant species. In the Native and Cheatgrass vegetation community, cheatgrass, basin wildrye and western wheatgrass are the dominant species. Japanese brome is also present in this vegetation community. In the Native and Redtop vegetation community, redtop and timothy (*Phleum pratense*) are the dominant species. In the Redtop vegetation community, redtop is the dominant species. In the Shrub with Native and Redtop Understory vegetation community, redtop is the dominant understory species and water birch (*Betula occidentalis*) is the dominant woody species. In the Shrub with Redtop Understory vegetation community, redtop is the dominant understory species and black cottonwood (*Populus trichocarpa*) and red-osier dogwood (*Cornus sericea*) is the dominant woody species. In the Tree with Native and Redtop Understory vegetation community, Idaho fescue and redtop are the dominant understory species and ponderosa pine and black cottonwood is the dominant woody species.

Table 7 shows woody vegetation cover along 22-foot transects. Woody vegetation cover was 80.9% (TNR-1) and 35.9% (TNR-2) in the Tree, Native, Redtop vegetation community. At TNR-1, woody vegetation was black cottonwood with heights ranging from 3 to 30 feet tall. At TNR-2, woody vegetation was ponderosa pine with heights ranging from 4 to 6 feet tall. Woody vegetation cover was 71.4% for the Shrub, Native Redtop vegetation community transect (SNR-1). Along this transect woody vegetation was water birch (8-15 feet tall) and Pacific willow (10 feet tall). Woody vegetation cover was 53.6% for the Shrub, Redtop vegetation community transect (SR-1). Along this transect woody vegetation was black cottonwood (20 feet tall) and red-osier dogwood (4 feet tall).

Attachment 8 includes maps with 2024 vegetation community types over-laid on 2016 vegetation community types. Vegetation community type changes between 2016 and 2024 reflect maturing vegetation and also on-going issues with exotic and invasive species at the site. Redtop remains the dominant species in the understory in 2024. In 2016, several common kochia (*Kochia scoparia*) vegetation communities were present (Kochia, Native and Kochia, and Redtop and Kochia). No common kochia was recorded in the Bypass Channel Area or Posse Ground Area in 2024. Planted trees in the Bypass Channel Area have reached sufficient height and cover to warrant including tree vegetation community types in 2024 which were not present in 2016.

Vegetation cover increased in both the Bypass Channel Area and Posse Ground Area between 2016 and 2024. In 2016 in the Bypass Channel Area, average relative vegetation cover was 54.7% and increased to 76.7% in 2024. Bare ground in the Bypass Channel Area averaged 20.9% in 2016 and reduced to 8.5% in 2024. In the Posse Ground Area in 2016, vegetation cover was less than 50% and was 100% in 2024.

Imported soil brought in cheatgrass to the site and in 2024 several vegetation community types were named after cheatgrass presence due to its dominant cover in some areas. Due to the increase in cheatgrass cover, cheatgrass was monitored in 2024 by randomly selecting plots in the field and estimating the percent cover of cheatgrass and cover of other species present in the plot. A total of 11 plots were monitored. These results are shown in Attachment 9. The boundaries of cheatgrass infestations were also mapped in 2024 to monitor expansion and effectiveness of herbicide treatments completed in fall, 2024. Maps showing cheatgrass infestations are provided in Attachment 9. In the Posse Ground Area, cheatgrass cover ranged from 40-80% in plots. Other dominant species included basin wildrye, smooth brome, bluebunch wheatgrass, and Idaho fescue. In the Bypass Channel Area, cheatgrass cover ranged from 3 to 50%. Other dominant species included basin wildrye, Idaho fescue, slender wheatgrass, and redtop.

Table 4. Vegetation community types observed in the Project Area and a description of each vegetation community type.

Vegetation Community	Plot Code	Dominant Species/Description
Native	N	Native species comprises >35% of total vegetative cover. High coverage of native grasses and/or forbs.
Native/Cheatgrass	NC	Native vegetation community with >10% cheatgrass
Native/Redtop	NR	Native vegetation community with redtop dominant in the understory.
Redtop	RT	Native species cover comprises <25% of total vegetative cover. Dominant species creeping bentgrass (redtop) <i>Agrostis stolonifera</i> .
Shrub with Native and Redtop Understory	SNR	Native species cover comprises >25% of total vegetative cover. Overstory comminated by shrubs, with a mix of native grasses and/or forbs and creeping bentgrass (redtop) <i>Agrostis stolonifera</i> in the understory.
Shrub with Redtop Understory	SR	Native species cover comprises <25% of total vegetative cover. Overstory dominated by shrubs, and dominated by creeping bentgrass (redtop) <i>Agrostis stolonifera</i> in the understory.
Tree with Native and Redtop Understory	TNR	Native species cover comprises >25% of total vegetative cover. Overstory comminated by trees, with a mix of native grasses and/or forbs and creeping bentgrass (redtop) <i>Agrostis stolonifera</i> in the understory.
Tree with Redtop Understory	TR	Native species cover comprises <25% of total vegetative cover. Overstory dominated by trees, and dominated by creeping bentgrass (redtop) <i>Agrostis stolonifera</i> in the understory.
Unvegetated	N/A	High number of patches within a vegetation community with vegetation cover <25% total vegetative cover.

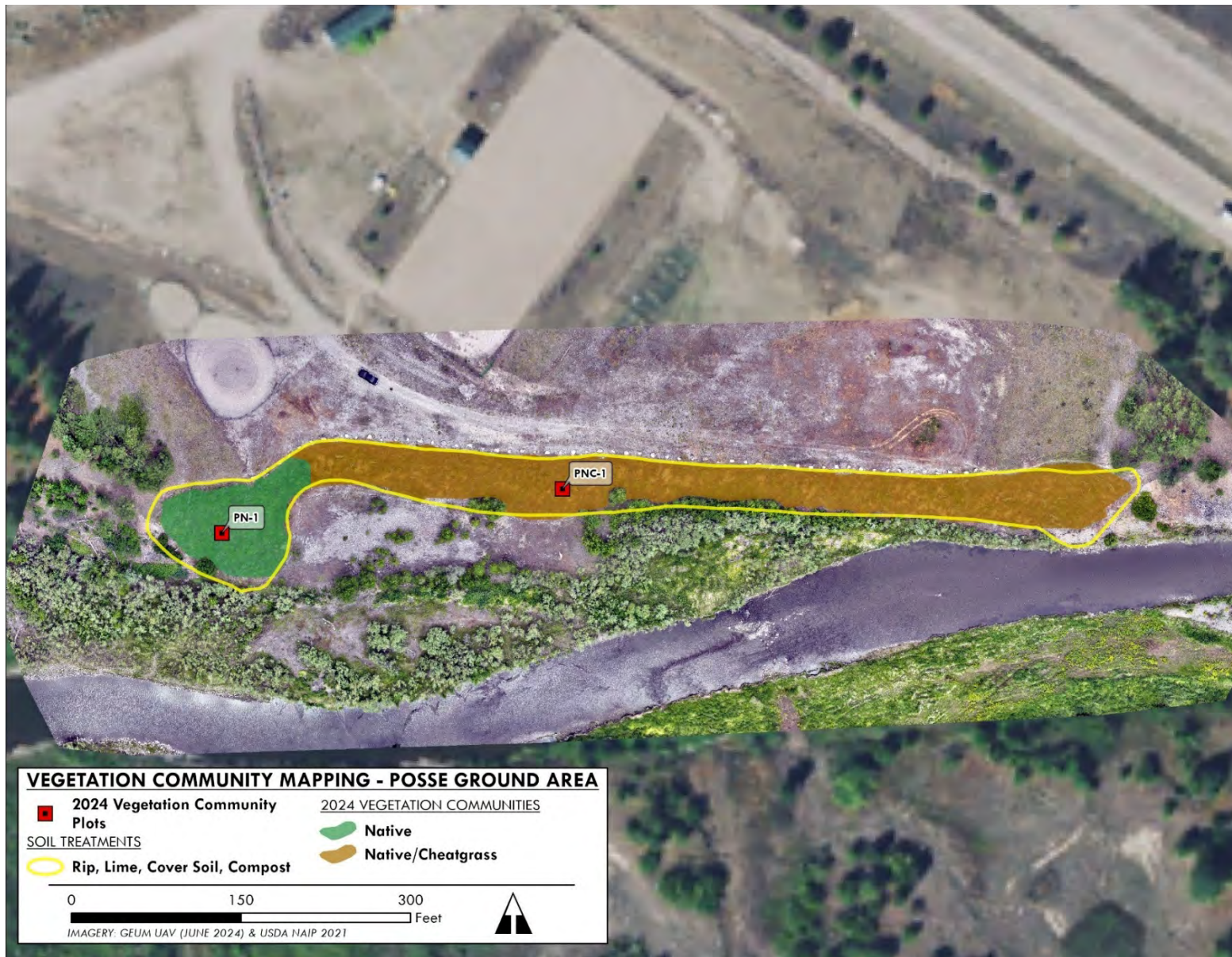


Figure 9. Posse Ground Area 2024 vegetation communities and soil treatments.

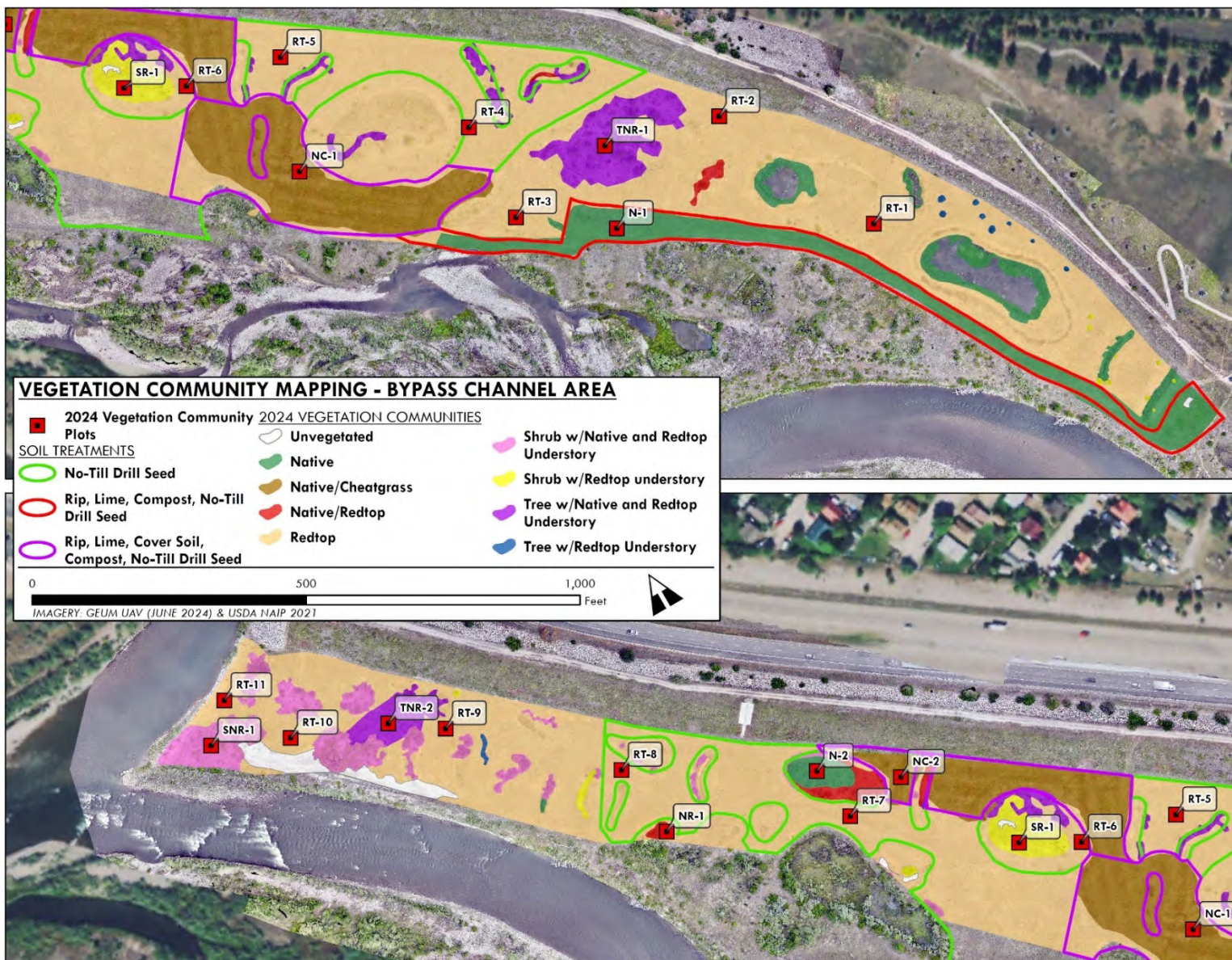


Figure 10. Bypass Channel Area 2024 vegetation communities and soil treatments.

Table 5. Area of 2024 mapped vegetation communities within the Bypass Channel Soil Treatment Area and the Posse Ground Soil Treatment Area.

Bypass Channel Soil Treatment Area	Vegetation Community Type	Acres	% of Area
	Native	1.9	9.4%
	Native/Cheatgrass	2.3	11.3%
	Native/Redtop	0.2	1.1%
	Redtop	13.5	65.7%
	Shrub with Native and Redtop Understory	0.9	4.3%
	Shrub with Redtop understory	0.3	1.3%
	Tree with Native and Redtop Understory	1.1	5.5%
	Tree with Redtop Understory	0.03	0.1%
	Unvegetated	0.3	1.2%
	Total	20.6	100%
Posse Ground Soil Treatment Area	Native	0.2	22.4%
	Native/Cheatgrass	0.7	77.6%
Total		0.9	100%

Table 6. Area of mapped vegetation communities categorized by soil treatment areas within the Bypass Channel Area and Posse Ground.

Bypass Channel Soil Treatment Area	Soil Treatment Area	Vegetation Community Type	Acres	% of Area
	No-Till Drill Seed	Native/Cheatgrass	0.02	0.1%
		Native/Redtop	0.001	0.003%
		Redtop	4.10	19.9%
		Shrub with Native and Redtop Understory	0.03	0.1%
		Tree with Native and Redtop Understory	0.05	0.2%
	Rip, Lime, Compost, No-Till Drill Seed	Native	1.18	5.8%
		Native/Cheatgrass	0.005	0.03%
		Redtop	0.08	0.4%
		Unvegetated	0.005	0.03%
	Rip, Lime, Cover Soil, Compost, No-Till Drill Seed	Native/Cheatgrass	2.19	10.6%
		Native/Redtop	0.007	0.03%
		Redtop	0.329	1.6%
		Shrub with Native and Redtop Understory	0.00	0.02%
		Tree with Native and Redtop Understory	0.01	0.1%
	No Treatment	Native	0.75	3.6%
		Native/Cheatgrass	0.11	0.6%
		Native/Redtop	0.23	1.1%
		Redtop	9.01	43.8%
		Shrub with Native and Redtop Understory	0.86	4.2%
		Shrub with Redtop Understory	0.27	1.3%
		Tree with Native and Redtop Understory	1.06	5.2%
		Tree with Redtop Understory	0.03	0.1%
Unvegetated		0.25	1.2%	
Total			20.6	100%
Posse Ground Soil Treatment Area	Rip, Lime, Cover Soil, Compost	Native	0.2	22.4%
		Native/Cheatgrass	0.7	77.6%
Total			0.9	100%

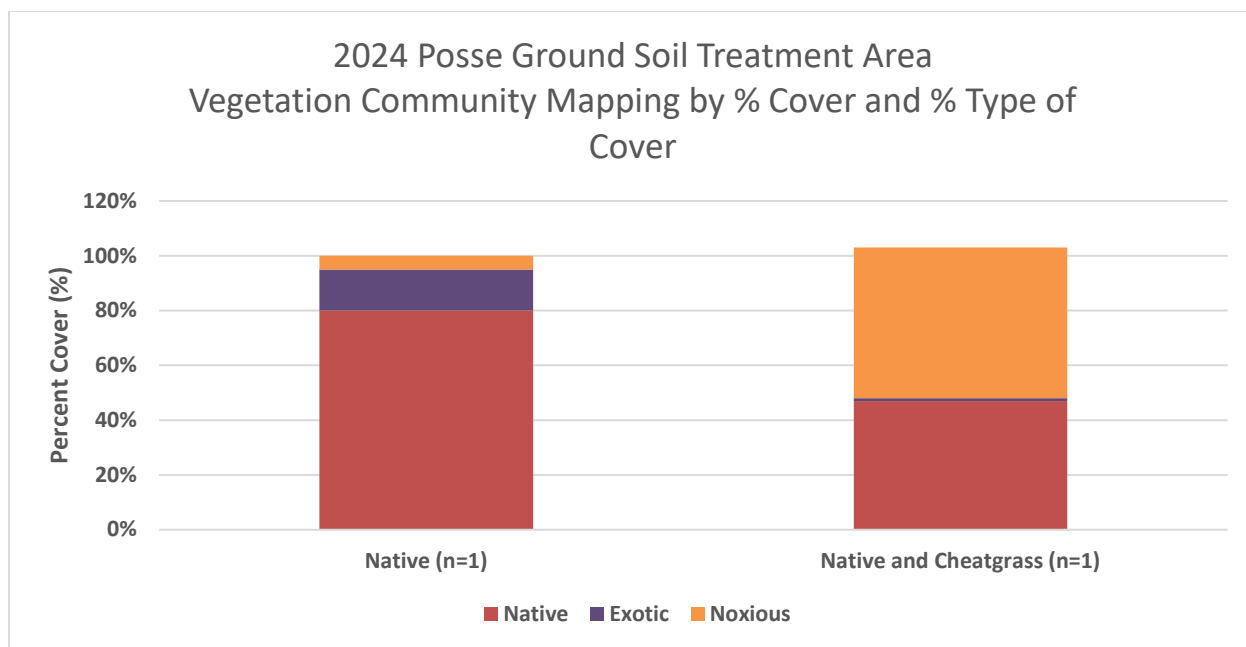


Figure 11. 2024 vegetation community mapping for the Posse Ground Soil Treatment Area by % cover and % of type of cover – native, exotic, or noxious.



Figure 12. Perennial native grasses in the 'Native' vegetation community on the west end of Posse Ground Soil Treatment Area and mix of perennial grasses, cheatgrass, and mustard in the 'Native and Cheatgrass' vegetation community in the middle of the Posse Ground Soil Treatment Area.

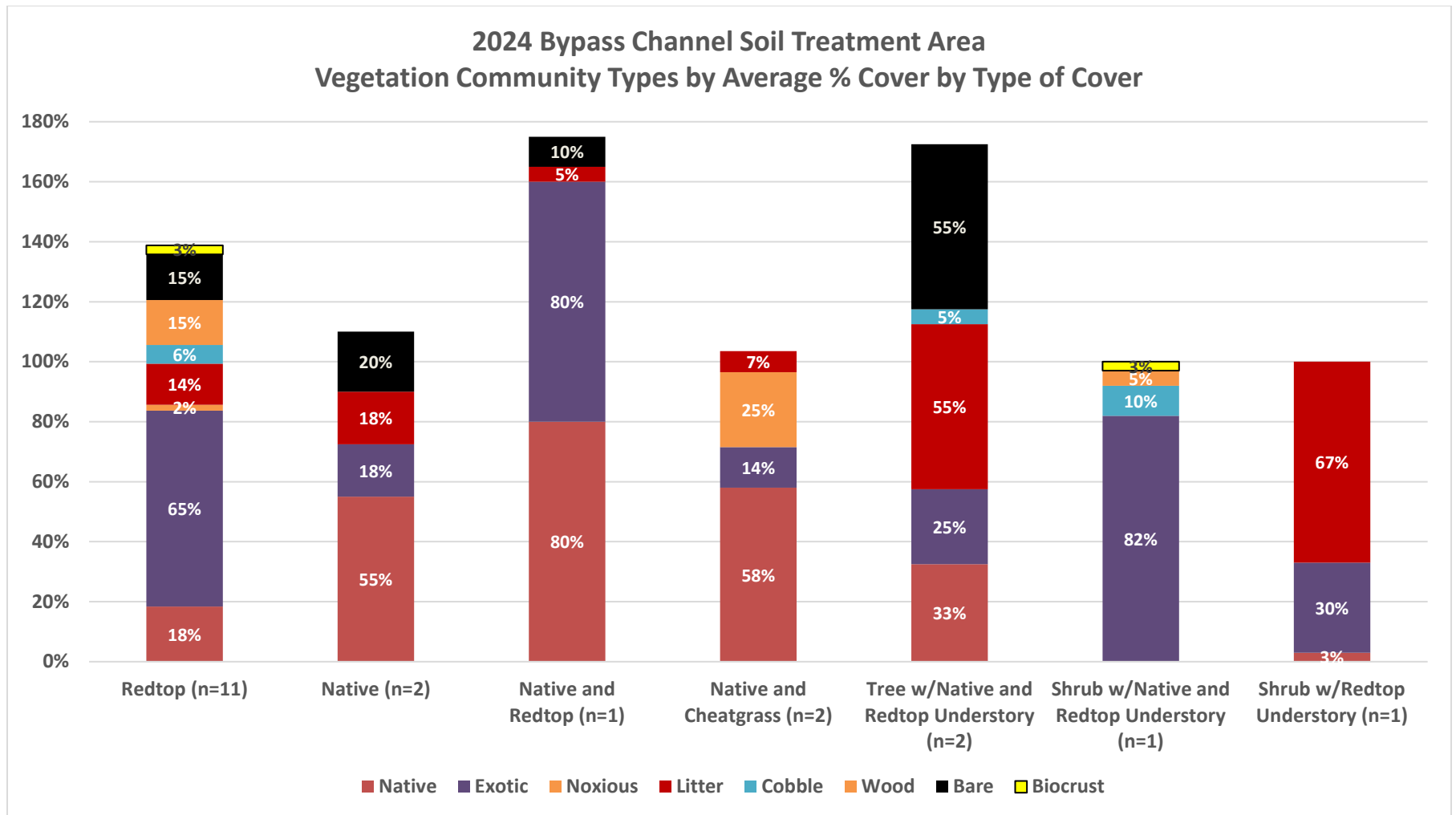


Figure 13. 2024 vegetation community mapping for the Bypass Channel Soil Treatment Area by average % cover for all plots in each vegetation community by type of cover – native, exotic, noxious, litter, cobble, wood, bare ground, or biocrust.

Table 7. Woody vegetation cover, species and species height recorded along 22-foot transects in woody vegetation community types.

Vegetation Community Type	Transect ID	Species	Species Height (ft)	Percent Cover Woody Vegetation
Tree, Native, Redtop	TNR-1	black cottonwood	3	80.9%
		black cottonwood	50	
		black cottonwood	3	
		black cottonwood	3	
Shrub, Native, Redtop	SNR-1	water birch	15	71.4%
		water birch	8	
		Pacific willow	10	
Tree, Native, Redtop	TNR-2	ponderosa pine	4	35.9%
		ponderosa pine	6	
		ponderosa pine	6	
Shrub, Redtop	SR-1	black cottonwood	20	53.6%
		red-osier dogwood	4	

Treatment Effectiveness and Project Area Trends

Overall, soil treatments have helped increase perennial vegetation cover in the Project Area and maturing woody vegetation planted in the Bypass Channel Area helps support restoration objectives for the Milltown Site. However, vegetation continues to be dominated by non-native grass species, primarily redtop. The following overall observations were made of the Milltown Soil Treatment Project effectiveness in 2024:

- Total cover increased in some soil treatment areas and decreased in others between 2020, 2021, and 2024, but remains high overall. Total cover was over 100% in the Posse Ground Soil Treatment Area (Figure 12 and Figure 14).
- Average exotic cover decreased and native species cover increased between 2020 and 2024 in all Bypass Channel Soil Treatment Area treatments except the 'No-till Drill Seed' treatment. The 'No-till Drill Seed' treatment inter-seeded native species into existing redtop stands and did not treat soil conditions. Native species cover was 10% in these plots in 2021 and dropped to 2% in 2024. Despite being seeded with fifteen native species, the only other species besides redtop identified in these plots continued to be Idaho fescue and common yarrow. This is a good indication that treatment of soil conditions was necessary to shift species composition from redtop to native perennial grasses.
- Native cover increased in the Bypass Channel Area and stayed approximately the same in the Posse Ground Area between 2020, 2021, and 2024. Exotic cover increased in the Posse Ground Soil Treatment Area but so did native species cover and total cover. The number of native species recorded between 2021 and 2024 increased from 9 to 13. The number of exotic species also increased from 8 to 10.
- Exotic cover is still predominantly redtop in both treatment areas (Figure 15). Smooth brome cover increased in 2024.
- Noxious weed cover increased in the 'Rip, Lime, Cover Soil, Compost, No-till Drill Seed' treatment in the Bypass Channel Soil Treatment Area and in the Posse Ground Soil Treatment Area. This was due to an increase in cheatgrass which is considered a noxious weed for purposes of monitoring for management decisions, but is not a state-listed noxious weed and therefore doesn't apply to noxious weed cover related to performance standards for the Milltown site (Figure 16). Cheatgrass was likely imported with the cover soil but is also prolific in the Posse Ground Area where it is easily spread by vehicles and livestock.
- Of the seeded species, basin wildrye, bluebunch wheatgrass, Nevada bluegrass, Idaho fescue slender wheatgrass, and western wheatgrass have the highest average cover.
- Similar to 2020 and 2021 observations, several other seeded species were observed in the treatment areas, particularly in the Posse Ground Soil Treatment Area. These species included: common yarrow (*Achillea millefolium*), white sagebrush (*Artemisia ludoviciana*), Lewis flax (*Linum lewisii*), blanketflower (*Gaillardia aristata*), and fuzzy-tongue penstemon (*Penstemon eriantheus*) (Figure 17). Common yarrow cover was much lower in 2024 compared to 2021.
- The surface roughness and woody debris placed on the steep slopes in the Posse Ground Soil Treatment Area continued to be effective in controlling erosion. This is the only area with 100% vegetation cover and the only area that received this treatment. The surface roughness mixed

the cover soil deeper into the soil profile. This area was also broadcast seeded compared to drill seeded.

- In 2024, the I-90 toe road slope treatment implemented by ARCO had higher cover of noxious and exotic species than seeded species (Figure 18). The Bypass Channel Soil Treatment Area has higher native species cover and lower noxious cover compared to the ARCO treatment area. The treatment on this slope included: lime incorporation to 12 inches, fertilizer application, drill seeding, and hydromulch.

In 2024, vegetation community mapping was done to evaluate how the Project Area is progressing towards meeting restoration goals and objectives (Table 8). Vegetation community mapping was originally done for the Project Area in 2016 to develop soil treatments. The following observations were made of Bypass Channel Area and Posse Ground Area vegetation community composition:

- In 2016, Kochia vegetation communities were present but were no longer present in 2024.
- In 2024, Cheatgrass vegetation communities were present that were not present in 2016.
- Redtop vegetation communities continue to dominate the Project Area.
- Planted trees have reached a sufficient height for 1.2 acres of the 20.6 acre area to be mapped as tree vegetation community types.
- Native vegetation communities only occur in constructed wetlands (Figure 19).
- Vegetation community types with woody vegetation did not increase in area between 2016 and 2024 but woody vegetation cover within these areas increased greatly.
- The area mapped as Unvegetated decreased from 6.6 acres in 2016 to 0.3 acres in 2024.

Performance standards applicable to the Milltown Dam site are shown in Table 8. These include achieving at least 90 percent cover of vegetation in seeded areas and not exceeding 10 percent cover of invasive plants in the reservoir sediments area (EPA, 2004). All Posse Ground Area plots (soil treatment and vegetation community cover plots) meet the 90 percent cover performance standard. Three of the 20 vegetation community cover plots in the Bypass Channel Area meet the 90 percent over performance standard. Only one of the 9 soil treatment monitoring plots had vegetation cover of 90 percent or greater.

Average percent cover of noxious weeds in the Posse Ground Area was 34%. However, noxious weed cover mapped for this monitoring effort is all cheatgrass, which is not a state-listed noxious weed. Noxious weed species recorded in the Posse Ground Area include Dalmatian toadflax and leafy spurge. Total cover of these species is very low. Average percent cover of noxious weeds in the Bypass Channel Area was 3.3%. Most of this is also attributed to cheatgrass. Dalmatian toadflax was the only noxious weed species recorded in the Bypass Channel Area and cover is very low.

Table 8. . Soil test plot monitoring metrics related to restoration project objectives, limiting factors and performance requirements.

Restoration Vegetation Objective (paraphrased from State of Montana 2008)	Limiting Factor	Restoration Performance Standard or Criteria	Soil Test Plot Monitoring Metrics
4-2. Floodplain is stable	Bare soil creates potential for erosion	Less than 10% of floodplain area with rills and gullies	Percent cover of rills and gullies
4-3. Appropriate native plant communities are present	Soil chemistry does not support plant growth	-Greater than 90% herbaceous vegetation cover in seeded areas -Less than 10% cover of invasive species	Vegetation canopy cover by species (including invasive species) and total vegetative cover -Soil chemistry parameters (Table 6) -Plant species composition

Geum and KC Harvey (2015) described a desired vegetation objective for the Project Area based on the restoration plan: “According to the restoration plan, the desired vegetation condition for this area is a surface with multiple layers of vegetation, including herbaceous, shrub, and tree layers. If so, establishment of conifers, cottonwoods, and shrubs should be the focus of vegetation establishment in this area in addition to herbaceous species. If native trees and shrubs are able to grow to maturity and reproduce successfully in this area, diversity and cover of herbaceous vegetation may be of less importance for overall function (stability, habitat, etc.) and large-scale soil treatments may be less warranted.” The area of woody vegetation has not increased greatly since 2020; however, woody vegetation size and cover in planted swales and wetlands (Figure 20 and Figure 21); the conifer planting area (Figure 22); and along streambanks in the Bypass Channel Area continues to increase (Figure 23). Woody vegetation is also beginning to expand in some areas, such as along streambanks and in some swales where planted aspen trees are starting to sucker (Figure 24). Attachment 10 provides repeat monitoring photos of survival plots established in 2012. These time series photos also illustrate how woody vegetation has matured in the last twelve years at the site.



Figure 14. Posse Ground Area in 2016 (left) and 2024 (right).



Figure 15. Redtop dominated vegetation community in the Bypass Channel Soil Treatment Area.



Figure 16. Cheatgrass and basin wildrye in the Bypass Channel Soil Treatment Area 'Rip, Lime, Cover Soil, Compost, No-till Drill Seed' treatment.



Figure 17. Forb species present in the Project Area (from top left - prairie coneflower, showy milkweed and blanketflower.



Figure 18. I-90 buttress road ARCO treatment in 2016 (left) and 2024 (right). Cheatgrass and weeds are increasing.



Figure 19. Wetland vegetation in constructed wetland in the Bypass Channel Area. Cattails are dominant in the deepest area transitioning to arctic rush and heavily browsed planted willows on wetland slopes.



Figure 20. Bypass Channel Area showing increasing cover of trees and shrubs. The darker green herbaceous vegetation in the center of the photo is part of the Bypass Channel Soil Treatment Area.



Figure 21. Typical size of cottonwood trees in 2024 in swales planted in in 2012.



Figure 22. Idaho fescue and planted ponderosa pine on the north end of the Bypass Channel Area.



Figure 23. Looking southwest along Blackfoot River streambank in 2016 (left) and 2024 (right).



Figure 24. Aspen trees planted in 2012 with suckering from the roots in the bottom of the swale.

Next Steps

The following next steps were recommended in 2021 for 2024 and were completed in 2024:

- Monitor the Project Area again in 2024, which would represent 5-years post treatment, to confirm whether vegetation performance standards have been met or if further actions are required. Suggested 5-year monitoring metrics would be similar to those used to monitor the adaptive management soil treatment plots in 2014-2016 and include:
 - Delineate distinct vegetation communities and compare to 2016 mapping.
 - Collect vegetation cover data from plots within mapped vegetation communities.
 - Collect vegetation cover data from soil treatment areas.
 - Repeat photo monitoring of survival plots to document increased woody vegetation cover.

Vegetation cover is high in the Project Area and noxious weed cover is very low, with the exception of cheatgrass which is not a state-listed noxious weed. Woody vegetation continues to grow and is beginning to expand some at the site. The Project Area remains dominated by redtop outside of soil treatment areas but within soil treatment areas perennial native grasses are present. These areas also have increasing cover of cheatgrass which will continue to expand and reduce native species cover and diversity. While the extensive cover of exotic grasses is undesirable, woody vegetation continues to grow and is beginning to shift site conditions and create habitat. The establishment and expansion of woody vegetation should be used to determine if restoration goals have been met.

The recommended next steps for the Project Area include:

- Noxious weed control has been effective and should continue in 2025.
- Cheatgrass was treated with herbicide in fall 2024. This treatment should be evaluated in 2025 and continued if effective.
- Coordinate with FWP on a long-term strategy for management of this area.

References

EPA. 2004. Record of Decision for Milltown Reservoir Sediments Operable Unit of the Milltown Reservoir /Clark Fork River Superfund Site. U.S. Environmental Protection Agency, Region 8, Helena, Montana.

Geum Environmental Consulting. 2017. Milltown Soil Treatment Project Manual State of Montana – Department of Justice Natural Resource Damage Program. October, 2017.

Geum Environmental Consulting. 2020. Milltown Dam Soil Treatment Project Construction Completion Report. Report prepared for Doug Martin, DOJ/NRDP. February, 2020.

Geum Environmental Consulting. 2021. Milltown 2020 Soil Treatment Evaluation Summary. Technical Memorandum prepared for Doug Martin, DOJ/NRDP dated March 17, 2021.

Geum Environmental Consulting. 2022. Milltown 2021 Soil Treatment Evaluation Summary. Technical Memorandum prepared for Doug Martin, DOJ/NRDP dated March 30, 2022.

Geum Environmental Consulting and K.C. Harvey. 2014. Milltown Soil Treatment Test Plot Monitoring Plan. Technical Memorandum prepared for Doug Martin, DOJ/NRDP. July 3, 2014.

Geum Environmental Consulting and K.C. Harvey. 2015. Milltown Soil Treatment Test Plot 2014 Monitoring Results. Technical Memorandum prepared for Doug Martin, DOJ/NRDP. February 4, 2015.

Geum Environmental Consulting and K.C. Harvey. 2016. Milltown Soil Treatment Test Plot 2015 Monitoring Results and Recommended Treatment. Technical Memorandum prepared for Doug Martin, DOJ/NRDP. February 16, 2016.

Geum Environmental Consulting and K.C. Harvey. 2017. Milltown Bypass Channel and Posse Ground Slope 2016 Soil and Vegetation Monitoring and Treatment Recommendations. Technical Memorandum prepared for Doug Martin, DOJ/NRDP. April 13, 2017.

KC Harvey. 2013. Technical memorandum Milltown Reservoir Soils Analysis. Prepared for Doug Martin, DOJ/NRDP. September 20, 2013 and expanded October 29, 2013.

Geum Environmental Consulting. 2022. Milltown 2021 Soil Treatment Evaluation Summary. Technical Memorandum prepared for Doug Martin, DOJ/NRDP. March 30, 2022

Attachment 1. Seed Mix

Milltown Soil Treatment Seed Mix		
Scientific Name	Common Name and Variety/Cultivar	PLS LB
Heavy Seed Mix		
<i>Elymus trachycaulus</i>	Pryor slender wheatgrass	50
<i>Festuca idahoensis</i>	Idaho fescue	7.5
<i>Koeleria macrantha</i>	prairie junegrass	5
<i>Leymus cinereus</i>	basin wildrye	25
<i>Poa nevadensis</i>	Opportunity Nevada bluegrass	8
<i>Pascopyron smithii</i>	Rosana Western wheatgrass	80
<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	2.5
<i>Gaillardia aristata</i>	Meriwether blanketflower	10
<i>Linum lewisii</i>	Appar Lewis blue flax	10
<i>Ratibida columnifera</i>	Stillwater prairie coneflower	5
<i>Sphaeralcea coccinea</i>	scarlet globemallow	5
Total PLS #		208
Total PLS #/acre (10 acres)		20.8
Light Seed Mix		
<i>Achillea millefolium</i>	common yarrow	2
<i>Artemisia frigida</i>	prairie sage	0.5
<i>Penstemon eriantherus</i>	Old Works fuzzytongue penstemon	2.8
<i>Ericameria nauseosa</i>	rubber rabbitbrush	0.25
Total PLS #		5.55
Total PLS #/acre (10 acres)		0.555
Total PLS # Seed Ordered		213.5
PLS # Seeding Rate/Acre		21.355*

*Note that the bulk seeding rate/acre (rate that includes actual weight of seed delivered with inert material) is 23.775 pounds

Attachment 2. All Species Observed in Soil Treatment Areas in 2024

Species Name	Species Code	Common Name	Growth Form	Life Cycle	Status	Seeded or planted
<i>Achillea millefolium</i>	ACHMIL	common yarrow	F	Perennial	Native	X
<i>Apera interrupta</i>	APEINT	dense silky bentgrass	G	Annual	Exotic	
<i>Artemisia ludoviciana</i>	ARTLUD	white sagebrush	F	Perennial	Native	X
<i>Agrostis stolonifera</i>	AGRSTO	redtop/creeping bentgrass	G	Perennial	Exotic	
<i>Bromus inermis</i>	BROINE	smooth brome	G	Perennial	Exotic	
<i>Bromus tectorum</i>	BROTEC	cheatgrass	G	Annual	Noxious	
<i>Bromus japonica</i>	BROJAP	Japanese brome	G	Annual	Noxious	
<i>Elymus smithii</i>	ELYSMI	Western wheatgrass	G	Perennial	Native	X
<i>Elymus trachycaulus</i>	ELYTRA	slender wheatgrass	G	Perennial	Native	X
<i>Euphorbia esula</i>	EUPESU	leafy spurge	F	Perennial	Noxious	
<i>Festuca idahoensis</i>	FESIDA	Idaho fescue	G	Perennial	Native	X
<i>Gaillardia aristata</i>	GAIIARI	blanketflower	F	Perennial	Native	X
<i>Lactuca serriola</i>	LACSER	prickly lettuce	F	Annual/Biennial	Exotic	
<i>Lepidium campestre</i>	LEPCAM	field peppergrass	F	Annual/Biennial	Exotic	
<i>Leymus cinereus</i>	ELYCIN	basin wildrye	G	Perennial	Native	X
<i>Linaria dalmatica</i>	LINDAL	Dalmatian toadflax	F	Perennial	Noxious	
<i>Linum lewisii</i>	LINLEW	prairie flax	F	Perennial	Native	X
<i>Medicago lupulina</i>	MEDLUP	black medic	F	Annual/Perennial	Exotic	
<i>Penstemon eriantheus</i>	PENERI	fuzzy-tongue penstemon	F	Perennial	Native	X
<i>Pinus ponderosa</i>	PINPON	ponderosa pine	T	Perennial	Native	X
<i>Poa nevadensis</i>	POANEV	Nevada bluegrass	G	Perennial	Native	X
<i>Pseudoroegneria spicata</i>	PSESPI	bluebunch wheatgrass	G	Perennial	Native	X
<i>Rumex spp</i>	---	rumex species	F	Perennial	Native/Exotic	
<i>Sisymbrium loeselii</i>	SISLOE	tall hedge mustard	F	Annual/Biennial	Exotic	
<i>Silene latifolia</i>	SILLAT	bladder campion	F	Biennial/Perennial	Exotic	
<i>Thlaspi arvense</i>	THLARV	field pennycress	F	Annual	Exotic	
<i>Tragopogon dubius</i>	TRADUB	yellow salsify	F	Annual/Biennial	Exotic	
<i>Verbascum thapsus</i>	VERTHA	common mullein	F	Biennial	Exotic	
<i>Veronica spp</i>	---	speedwell species	F	Perennial	Native	

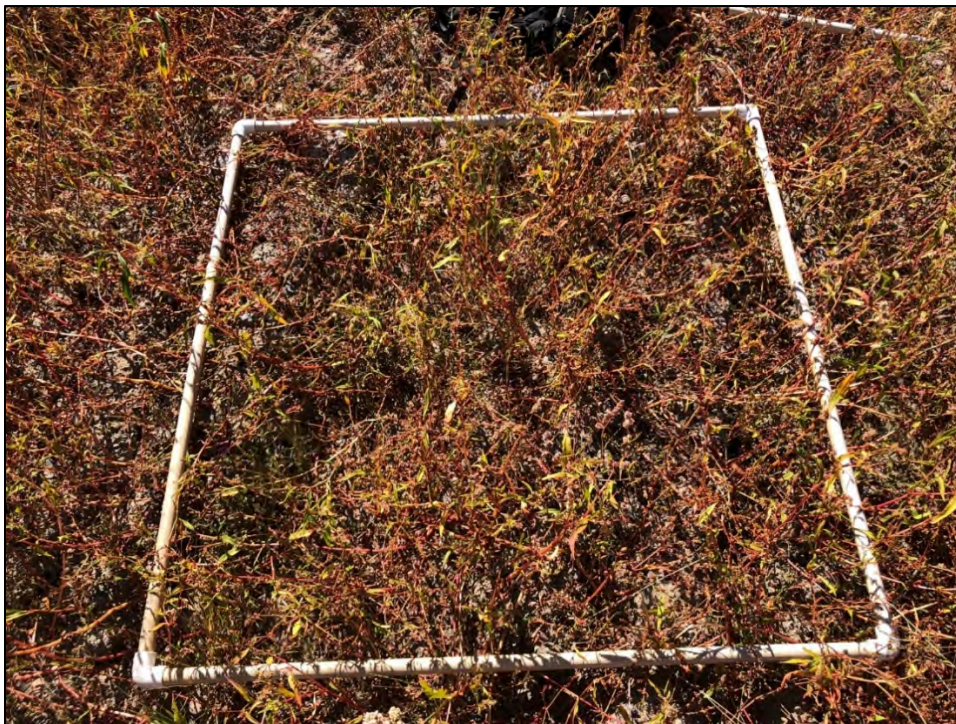
Attachment 3. Soil Treatment Monitoring Plot Photos 2020, 2021 and 2024 – Posse Ground

BYPASS CHANNEL

Rip, Lime, Cover Soil, Compost, No-till Drill Seed

2020



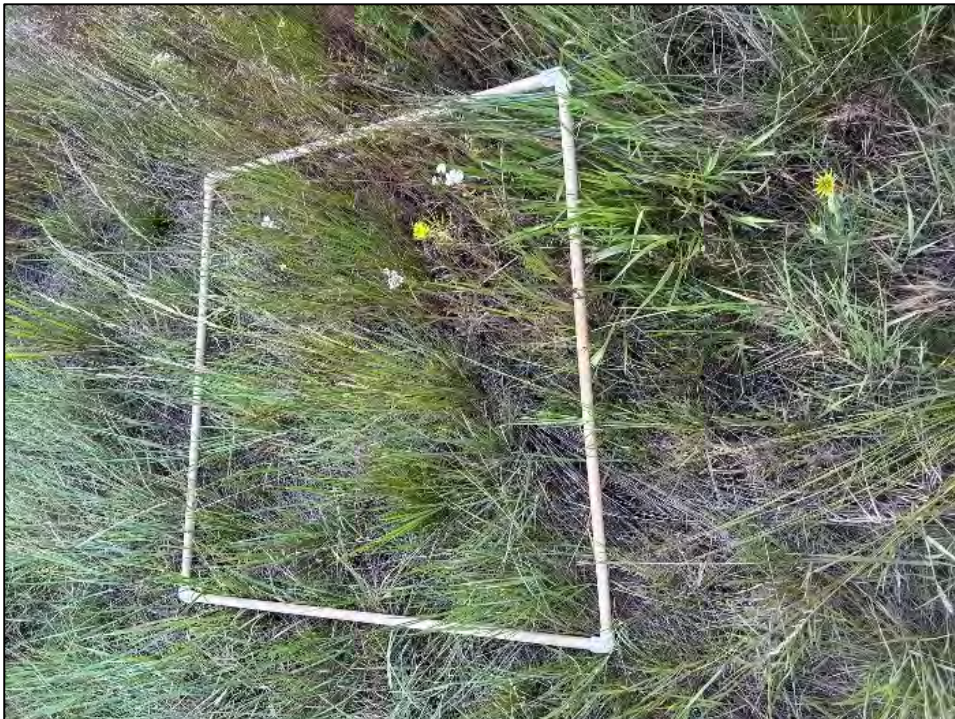
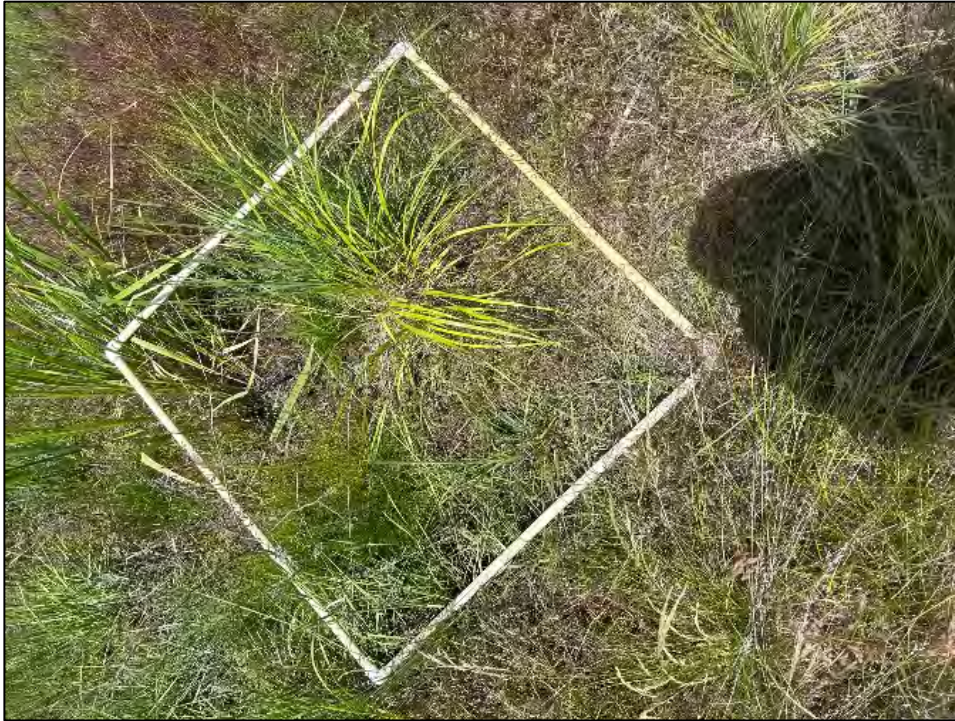


2021





2024

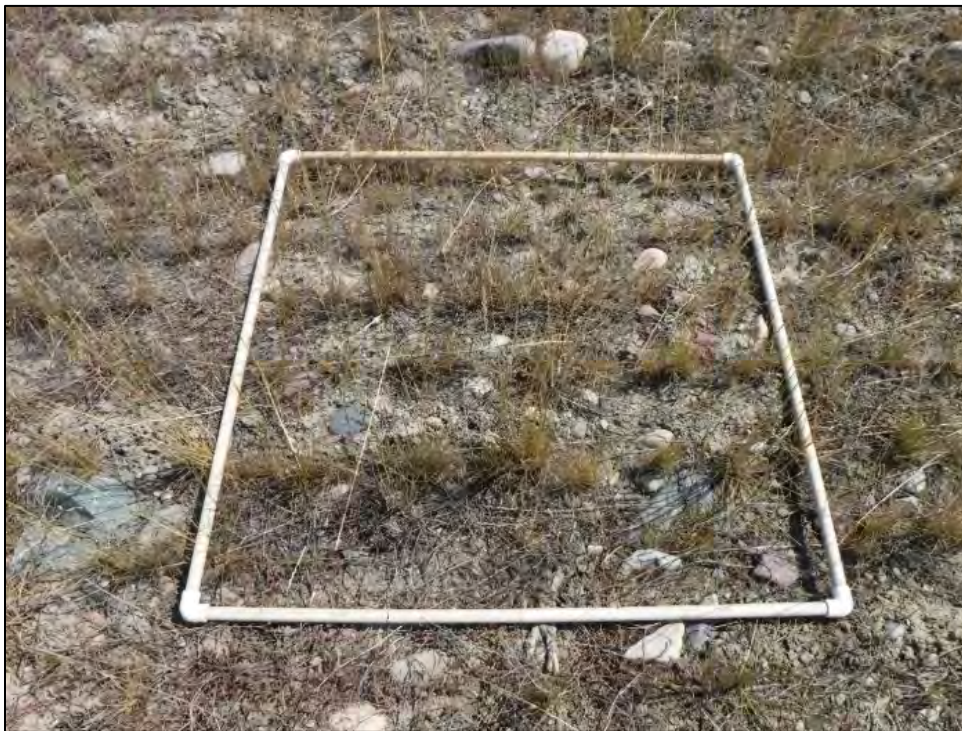




Rip, Lime, Compost, No-till Drill Seed
2020



2021





2024



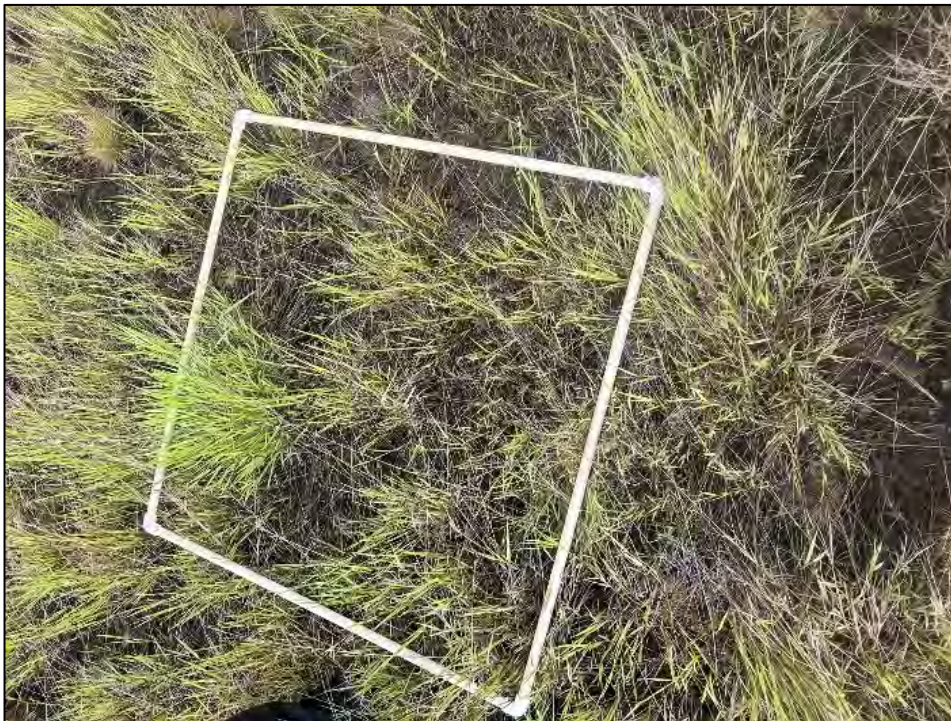


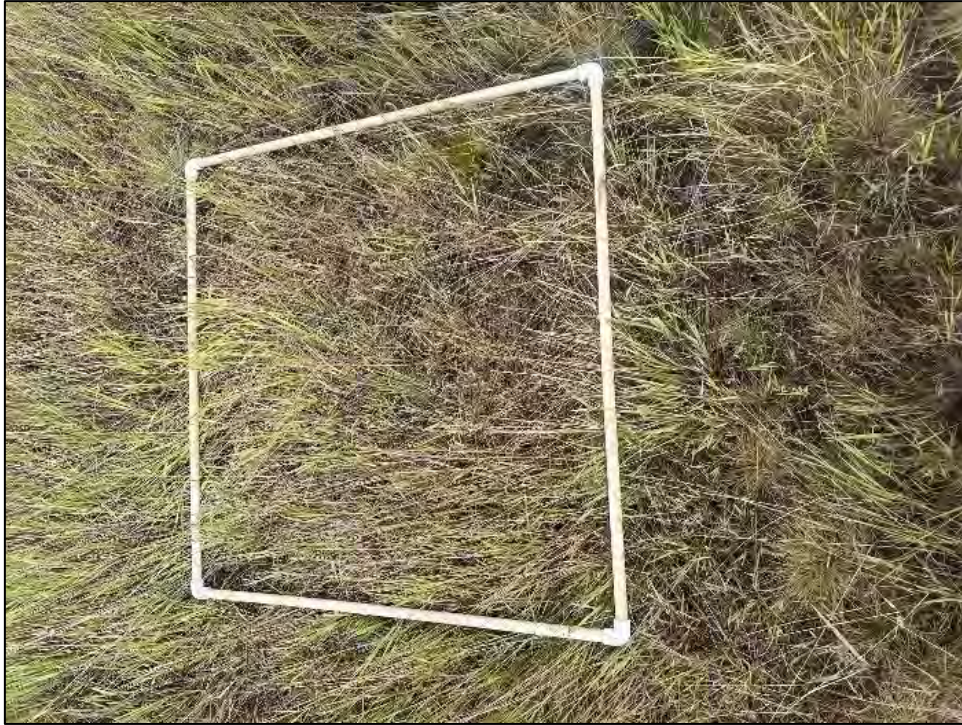
No-till Drill Seed
2021





2024





POSSE GROUND SOIL TREATMENT AREA (Rip, Lime, Compost, Cover Soil, Roughness, Woody Debris, Broadcast Seed)

2020





2021





2024





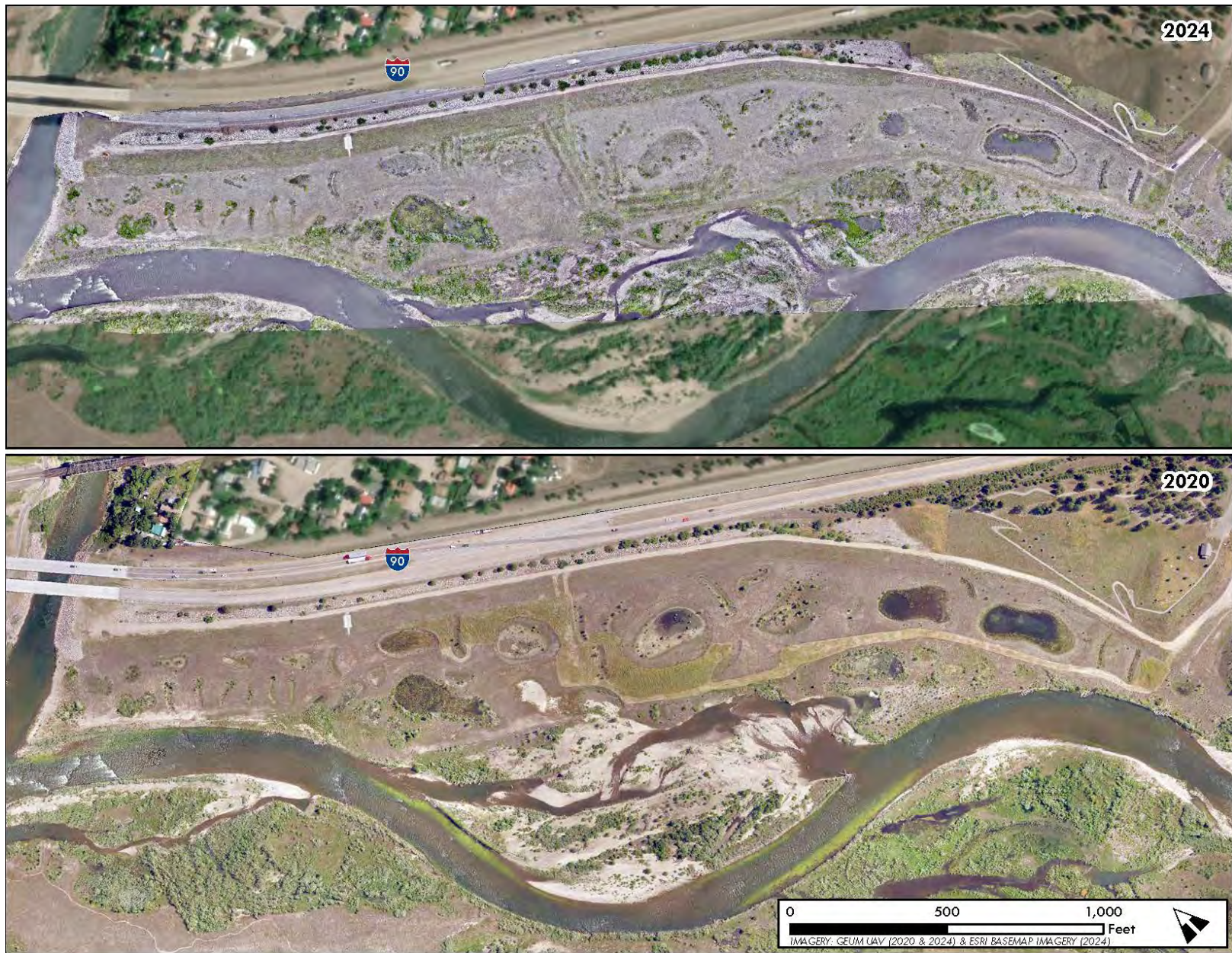
Attachment 4. Species Observed in Soil Treatment Monitoring Plots in 2020, 2021, and 2024

Species Name	Species Code	Growth Form	Life Cycle	Status	Seeded or Planted	Common Name	Present in 2020	Present in 2021	Present in 2024
<i>Achillea millefolium</i>	ACHMIL	G	Perennial	Native	X	common yarrow	X	X	X
<i>Apera interrupta</i>	APEINT	G	Annual	Exotic		dense silky bentgrass			
<i>Agrostis stolonifera</i>	AGRSTO	G	Perennial	Exotic		redtop/creeping bentgrass	X	X	X
<i>Artemisia frigida</i>	ARTFRI	F	Perennial	Native	X	prairie sage	X	X	X
<i>Bromus inermis</i>	BROINE	G	Perennial	Exotic		smooth brome			X
<i>Bromus japonicus</i>	BROJAP	G	Annual	Noxious		Japanese brome		X	X
<i>Bromus tectorum</i>	BROTEC	G	Annual	Noxious		cheatgrass	X	X	X
<i>Centaurea stoebe</i>	CENSTO	F	Biennial/ Perennial	Noxious		spotted knapweed	X	X	
<i>Chenopodium album</i>	CHEALB	F	Annual	Exotic		lambsquarters	X	X	
<i>Cirsium vulgare</i>	CIRVUL	F	Biennial	Exotic		bull thistle	X		
<i>Dianthus armeria</i>	DIAARM	F	Annual/ Biennial	Exotic		deptford pink		X	
<i>Elymus trachycaulus</i>	ELYTRA	G	Perennial	Native	X	slender wheatgrass	X	X	X
<i>Epilobium brachycarpum</i>	EPIBRA	F	Annual	Native		panicked willowherb			X
<i>Festuca idahoensis</i>	FESIDA	G	Perennial	Native	X	Idaho fescue	X	X	X
<i>Gaillardia aristata</i>	GAIARI	F	Perennial	Native	X	blanketflower		X	
<i>Koeleria macrantha</i>	KOEMAC	G	Perennial	Native	X	prairie junegrass		X	
<i>Lactuca serriola</i>	LACSER	F	Annual/ Biennial	Exotic		prickly lettuce	X	X	
<i>Leymus cinereus</i>	ELYCIN	G	Perennial	Native	X	basin wildrye			X
<i>Linaria dalmatica</i>	LINDAL	F	Perennial	Noxious		Dalmatian toadflax		X	
<i>Linum lewisii</i>	LINLEW	F	Perennial	Native	X	Lewis blue flax		X	
<i>Medicago lupulina</i>	MEDLUP	F	Annual/ Perennial	Exotic		Black medic	X		X

Species Name	Species Code	Growth Form	Life Cycle	Status	Seeded or Planted	Common Name	Present in 2020	Present in 2021	Present in 2024
<i>Oenothera biennis</i>	OENBIE	F	Biennial	Native	X	common evening primrose	X		
<i>Pascopyrum smithii</i>	PASSMI	G	Perennial	Native	X	western wheatgrass	X	X	X
<i>Poa nevadensis</i>	POANEV	G	Perennial	Native	X	Opportunity Nevada bluegrass		X	X
<i>Poa pratensis</i>	POAPRA	G	Perennial	Exotic		Kentucky bluegrass	X		
<i>Polygonum aviculare</i>	POLAVI	F	Annual/Perennial	Exotic		prostrate knotweed, dooryard knotweed	X	X	
<i>Polygonum persicaria</i>	POLPER	F	Annual/Perennial	Exotic		Spotted ladythumb	X		
<i>Pseudoroegneria spicata</i>	PSESPI	G	Perennial	Native	X	bluebunch wheatgrass			X
<i>Rumex crispus</i>	RUMCRI	F	Perennial	Exotic		curly dock	X		
<i>Sisymbrium altissimum</i>	SISALT	F	Annual/Biennial	Exotic		tall tumbled mustard	X	X	X
<i>Tanacetum vulgare</i>	TANVUL	F	Perennial	Noxious		common tansy	X	X	
<i>Thlaspi arvense</i>	THLARV	F	Annual	Exotic		field penny cress	X	X	
<i>Tragopogon dubius</i>	TRADUB	F	Mixed-Annual/Biennial	Exotic		goat's beard/salsify	X		X
<i>Trifolium pratense</i>	TRIPRA	F	Mixed - Biennial/Perennial	Exotic		red clover	X		
<i>Trifolium repens</i>	TRIREF	F	Perennial	Exotic		white clover	X	X	

Attachment 5. 2024 v. 2020 Drone Imagery





Attachment 6. Vegetation Community Type Monitoring Plot Photos

POSSE GROUND AREA VEGETATION COMMUNITY TYPE PLOTS



Posse Ground Area, Native – PN-1

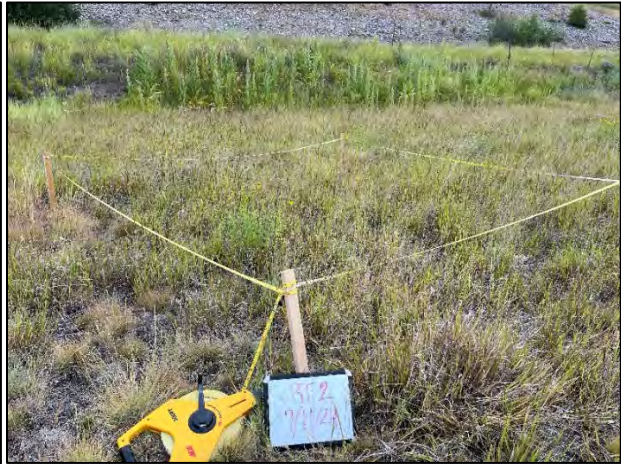


Posse Ground Area, Native and Cheatgrass – PNC-1

BYPASS CHANNEL AREA VEGETATION COMMUNITY TYPE PLOTS



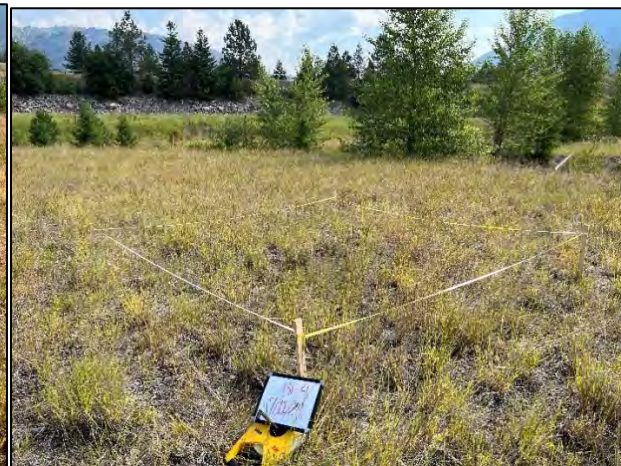
Redtop – RT-1



Redtop – RT-2



Redtop – RT-3



Redtop – RT-4



Redtop – RT-5



Redtop – RT-6



Redtop – RT-7



Redtop – RT-8



Redtop – RT-9



Redtop – RT-10



Redtop – RT-11



Shrub with Native/Redtop Understory – SNR-1



Shrub with Native/Redtop Understory – SNR-1 Transect



Shrub with Redtop Understory – SR-1



Shrub with Redtop Understory – SR-1 Transect



Tree with Native/Redtop Understory – TNR-1



Tree with Native/Redtop Understory – TNR-1 Transect



Tree with Native/Redtop Understory – TNR-2



Tree with Native/Redtop Understory – TNR-2 Transect



BPC Area, Native/Redtop – NR-1



BPC Area, Native/Cheatgrass – NC-1



BPC Area, Native/Cheatgrass – NC-2



BPC Area, Native – N-1



BPC Area, Native – N-2

Attachment 7. 2024 Vegetation Community Cover Data

POSSE GROUND SOIL TREATMENT AREA									
Vegetation Community Type	Plot ID	Species	Species Code	% Cover	Total % Vegetative Cover	Vegetative Cover % Native	Vegetative Cover % Exotic	Vegetative Cover % Noxious	Other Species Near Plot
Native	PN-1	<i>Artemisia ludoviciana</i>	white sagebrush	5	100	80	15	5	western wheatgrass, tall hedge mustard
		<i>Bromus inermis</i>	smooth brome	15					
		<i>Bromus tectorum</i>	cheatgrass	5					
		<i>Elymus trachycaulus</i>	slender wheatgrass	45					
		<i>Leymus cinereus</i>	basin wildrye	25					
		<i>Pseudoroegneria spicata</i>	western wheatgrass	5					
Native, Cheatgrass	PNC-1	<i>Artemisia ludoviciana</i>	white sagebrush	2	103	47	1	55	tall hedge mustard, smooth brome, timothy, Dalmatian toadflax
		<i>Bromus tectorum</i>	cheatgrass	55					
		<i>Elymus trachycaulus</i>	slender wheatgrass	2					
		<i>Leymus cinereus</i>	basin wildrye	15					
		<i>Festuca idahoensis</i>	Idaho fescue	20					
		<i>Pascopyrum smithii</i>	western wheatgrass	8					
		<i>Tragopogon dubius</i>	salsify	1					

BYPASS CHANNEL SOIL TREATMENT AREA											
Vegetation Community Type	Plot ID	Species		% Cover	Total % Vegetative Cover	Total % Other Cover	Total % Cover	Vegetative Cover % Native	Vegetative Cover % Exotic	Vegetative Cover % Noxious	Other Species Near Plot
Native	N-1	<i>Agrostis stolonifera</i>	redtop	15	70	30	100	55	15		basin wildrye, yarrow
		<i>Elymus trachycaulus</i>	slender wheatgrass	20							
		<i>Leymus cinereus</i>	basin wildrye	20							
		<i>Pascopyrum smith</i>	western wheatgrass	15							
		bare		20							
		litter		10							
Native	N-2	<i>Juncus arcticus</i>	arctic rush	50	75	25	100	55	20		prickly lettuce, red-osier dogwood, sandbar willow, bladder campion, currant
		<i>Agrostis stolonifera</i>	redtop	20							
		<i>Typha latifolia</i>	common cattail	5							
				25							
Native, Cheatgrass	NC-1	<i>Bromus tectorum</i>	cheatgrass	25	93	7	100	66	2	25	sorrel or dock species
		<i>Leymus cinereus</i>	basin wildrye	45							
		<i>Elymus trachycaulus</i>	slender wheatgrass	5							
		<i>Lactuca serriola</i>	prickly lettuce	2							
		<i>Pascopyrum smith</i>	western wheatgrass	15							
		forb x		1							
		litter		7							
Native, Cheatgrass	NC-2	<i>Bromus tectorum</i>	cheatgrass	25	100	0	100	50	25	25	common yarrow
		<i>Bromus japonicus</i>	Japanese brome	15							
		<i>Leymus cinereus</i>	basin wildrye	15							
		<i>Pascopyrum smithii</i>	western wheatgrass	30							
		<i>Elymus glaucus</i>	blue wildrye	5							
		<i>Agrostis stolonifera</i>	redtop	10							
Native, Redtop	NR-1	<i>Agrostis stolonifera</i>	redtop	55	85	15	100	5	80		
		<i>Phleum pratense</i>	timothy	25							

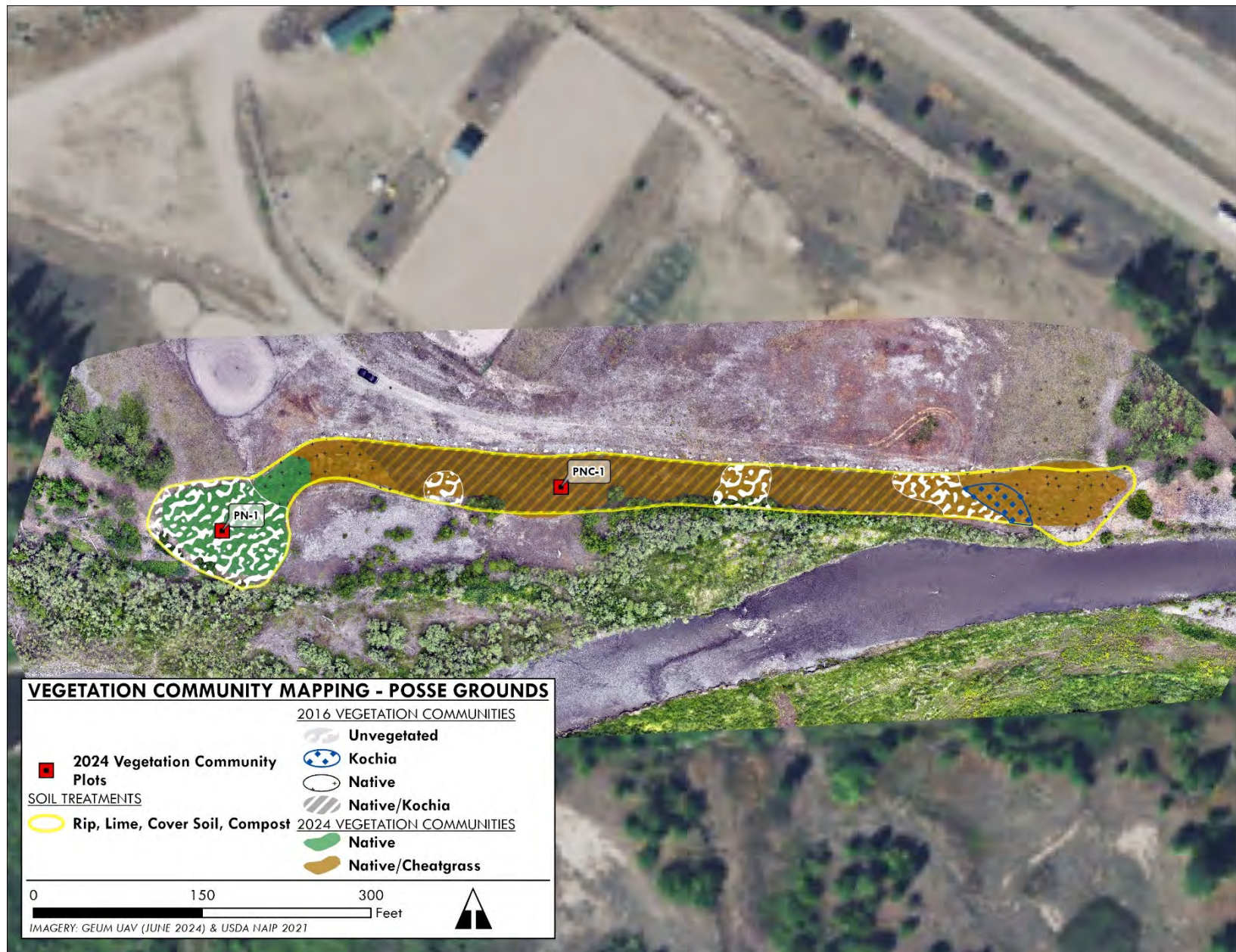
BYPASS CHANNEL SOIL TREATMENT AREA											
Vegetation Community Type	Plot ID	Species		% Cover	Total % Vegetative Cover	Total % Other Cover	Total % Cover	Vegetative Cover % Native	Vegetative Cover % Exotic	Vegetative Cover % Noxious	Other Species Near Plot
		<i>Typha latifolia</i>	common cattail	5							
		<i>bare</i>		10							
		<i>litter</i>		5							
Redtop	RT-1	<i>Agrostis stolonifera</i>	redtop	75	75	25	100		75		Dalmatian toadflax, timothy, bladder campion, prairie junegrass, sweet clover, slender wheatgrass
		<i>litter</i>		20							
		<i>biocrust</i>		5							
Redtop	RT-2	<i>Agrostis stolonifera</i>	redtop	65	85	15	100	20	65		salsify, common yarrow, Dalmatian toadflax, Wood's rose, sorrel or dock species, showy milkweed
		<i>Poa pratensis</i>	Kentucky bluegrass	10							
		<i>Ratibida columnifera</i>	prairie coneflower	10							
		<i>litter</i>		8							
		<i>bare</i>		5							
		<i>biocrust</i>		2							
Redtop	RT-3	<i>Agrostis stolonifera</i>	redtop	55	90	10	100	27	60	3	basin wildrye, common yarrow
		<i>Linaria dalmatia</i>	Dalmatian toadflax	3							
		<i>Poa x.</i>	grass species	20							
		<i>Linum lewisii</i>	Lewis blue flax	5							
		<i>Tragopogon dubius</i>	salsify	5							
		<i>Festuca idahoensis</i>	Idaho fescue	2							
		<i>bare</i>		5							
		<i>litter</i>		5							

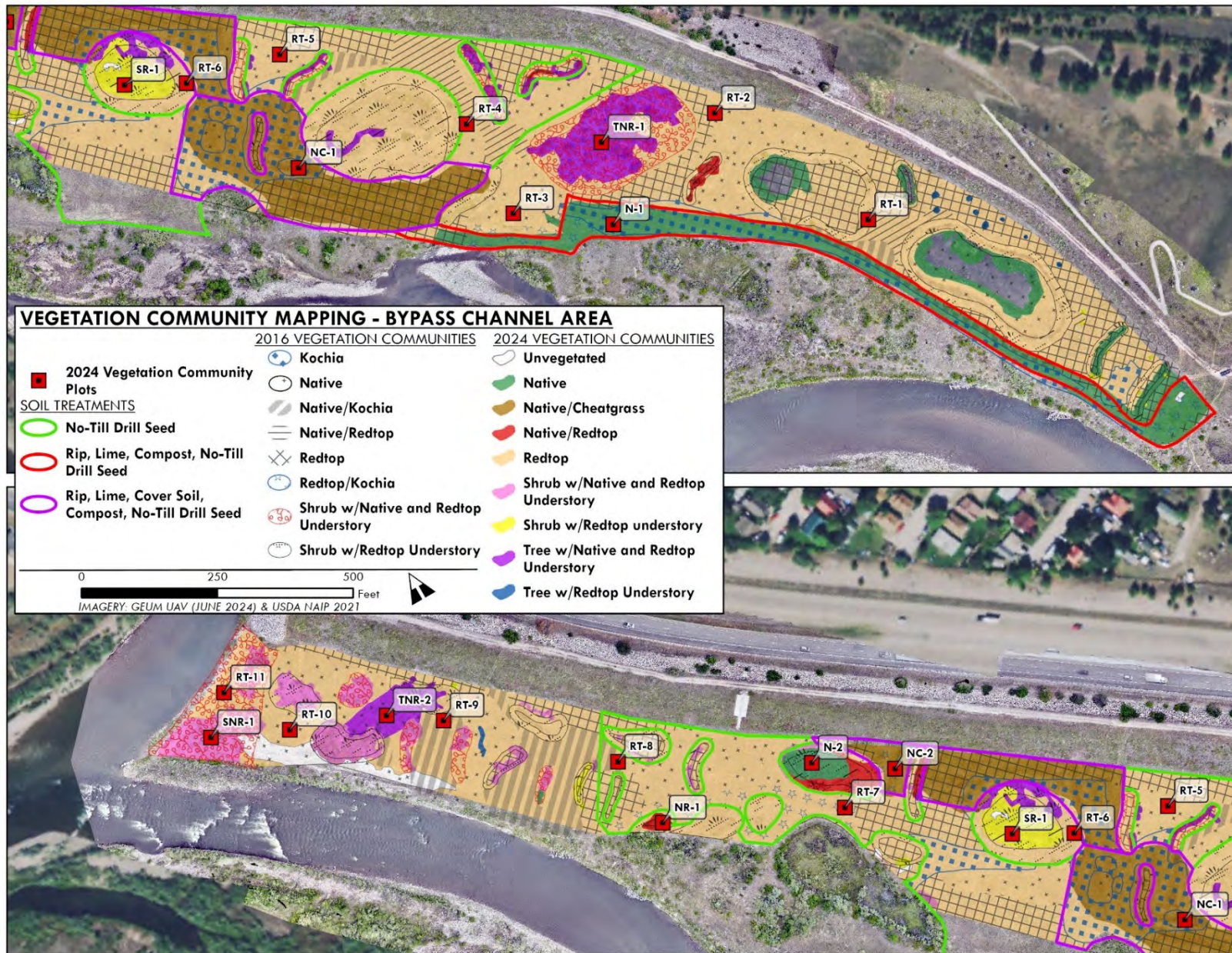
BYPASS CHANNEL SOIL TREATMENT AREA											
Vegetation Community Type	Plot ID	Species		% Cover	Total % Vegetative Cover	Total % Other Cover	Total % Cover	Vegetative Cover % Native	Vegetative Cover % Exotic	Vegetative Cover % Noxious	Other Species Near Plot
Redtop	RT-4	<i>Agrostis stolonifera</i>	redtop	65	65	35	100		65		bluebunch wheatgrass, Dalmatian toadflax
		<i>litter</i>		25							
		<i>bare</i>		8							
		<i>cobble</i>		2							
Redtop	RT-5	<i>Agrostis stolonifera</i>	redtop	75	75	25	100		75		unknown bunchgrass
		<i>litter</i>		20							
		<i>bare</i>		5							
Redtop	RT-6	<i>Agrostis stolonifera</i>	redtop	80	80	20	100		80		tall hedge mustard, Dalmatian toadflax, Wood's rose, red-osier dogwood
		<i>litter</i>		10							
		<i>bare</i>		8							
		<i>cobble</i>		2							
Redtop	RT-7	<i>Agrostis stolonifera</i>	redtop	75	76	24	100		76		redtop
		<i>Silene latifolia</i>	bladder campion	1							
		<i>litter</i>		9							
		<i>bare</i>		10							
		<i>crust</i>		5							
Redtop	RT-8	<i>Agrostis stolonifera</i>	redtop	75	80	20	100	5	75		
		<i>Festuca idahoensis</i>	Idaho fescue	5							
		<i>litter</i>		20							
Redtop	RT-9	<i>Agrostis stolonifera</i>	redtop	60	81	19	100	20	20	1	ponderosa pine
		<i>Festuca idahoensis</i>	Idaho fescue	20							
		<i>Linaria dalmatica</i>	Dalmatian toadflax	1							
		<i>litter</i>		9							
		<i>cobble</i>		5							
		<i>bare</i>		5							
Redtop		<i>Agrostis stolonifera</i>	redtop	30	82	18	100	20	82		

BYPASS CHANNEL SOIL TREATMENT AREA											
Vegetation Community Type	Plot ID	Species		% Cover	Total % Vegetative Cover	Total % Other Cover	Total % Cover	Vegetative Cover % Native	Vegetative Cover % Exotic	Vegetative Cover % Noxious	Other Species Near Plot
	RT-10	<i>Agropyron intermedium</i>	intermediate wheatgrass	2							ponderosa pine, currant, Dalmatian toadflax, common mullien
		<i>Festuca idahoensis</i>	Idaho fescue	20							
		<i>Tragopogon dubius</i>	salsify	30							
		cobble		17							
		bare		1							
Redtop	RT-11	<i>Agrostis stolonifera</i>	redtop	65	65	35	100		65		redtop
		large wood		15							
		cobble		5							
		litter		10							
		bare		3							
		biocrust		2							
Shrub with Native and Redtop Understory	SNR-1	<i>Agrostis stolonifera</i>	redtop	75	82	18	100		82		oxeye daisy, quaking aspen, Wood's rose, sweet clover, hairy goldenaster, water birch, red-osier dogwood, sandbar willow, Booth's willow
		<i>Agropyron intermedium</i>	intermediate wheatgrass	2							
		<i>Silene latifolia</i>	bladder campion	5							
		wood		5							
		cobble		10							
		biocrust		3							
Shrub with Redtop Understory	SR-1	<i>Agrostis stolonifera</i>	redtop	30	33	67	100	3	30		red-osier dogwood, reed canarygrass
		<i>Populus balsamifera</i>	black cottonwood	3							
		litter		67							
Tree with Native and	TNR-1	<i>Agrostis stolonifera</i>	redtop	25	45	55	100	15	25		arctic rush, Booth's willow,
		<i>Cornus sericea</i>	red-osier dogwood	5							
		<i>Populus balsamifera</i>	black cottonwood	15							

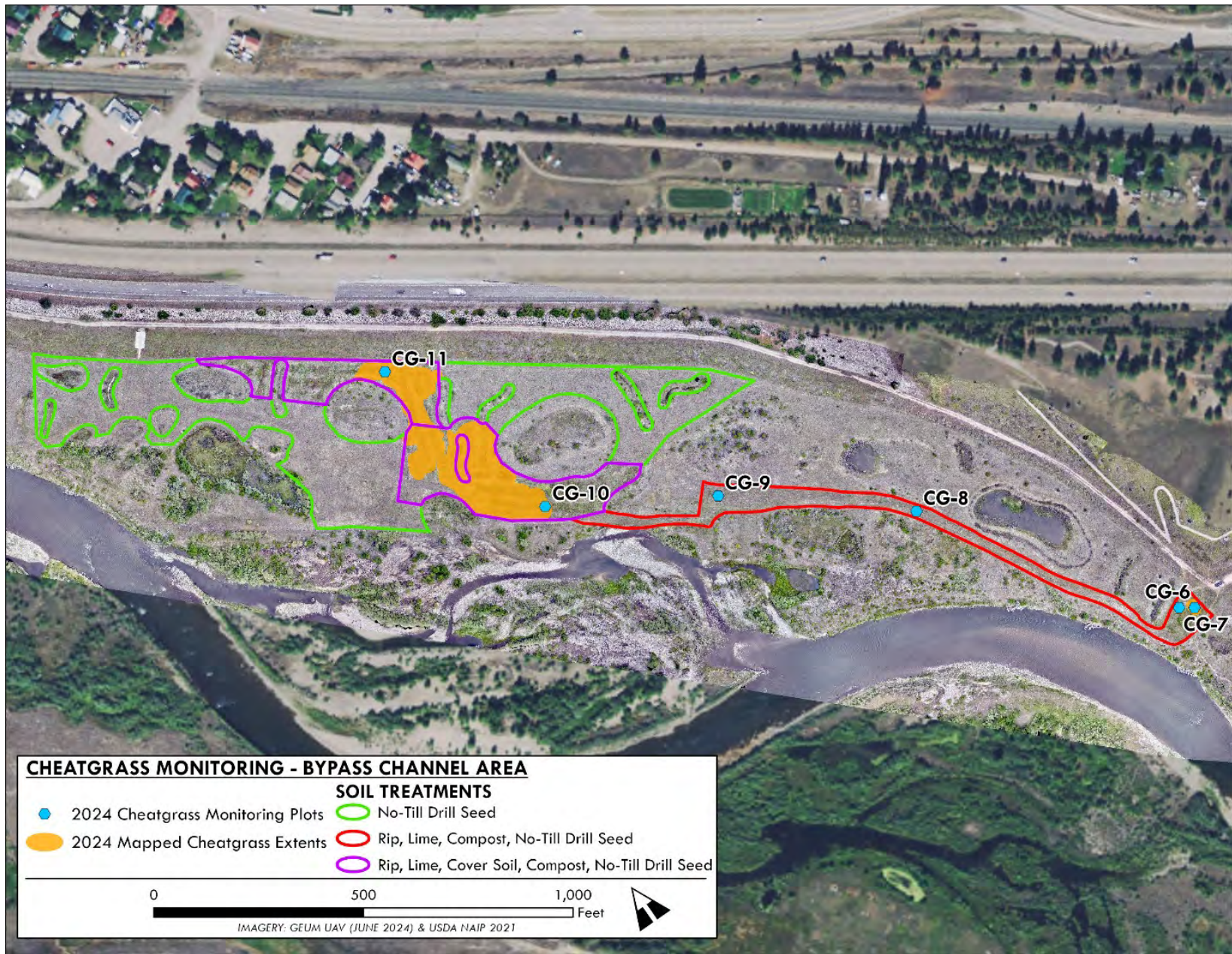
BYPASS CHANNEL SOIL TREATMENT AREA											
Vegetation Community Type	Plot ID	Species		% Cover	Total % Vegetative Cover	Total % Other Cover	Total % Cover	Vegetative Cover % Native	Vegetative Cover % Exotic	Vegetative Cover % Noxious	Other Species Near Plot
Redtop Understory		<i>litter</i>		50							Wood's rose, blue elderberry, quaking aspen
		<i>bare</i>		5							
Tree with Native and Redtop Understory	TNR-2	<i>Agrostis stolonifera</i>	redtop	25	70	30	100	45	25		Dalmatian toadflax, bladder campion, ponderosa pine, Wood's rose
		<i>Festuca idahoensis</i>	Idaho fescue	45							
		<i>bare</i>		25							
		<i>cobble</i>		5							

Attachment 8. Vegetation Communities Compared to Soil Treatments and 2016 Vegetation Communities





Attachment 9. Cheatgrass Plot Data





Bypass Channel Area Cheatgrass Plots						
Plot ID	% cover cheatgrass	% cover other dominant species	% bare	% litter	Total % cover	Other dominant species
CG-6	50	50	0	0	100	basin wildrye, tumble mustard, Idaho fescue, slender wheatgrass
CG-7	10	88	2	0	100	slender wheatgrass, bluebunch wheatgrass, Nevada bluegrass, common yarrow
CG-8	3	97	0	0	100	slender wheatgrass, Idaho fescue, redtop
CG-9	40	60	0	0	100	slender wheatgrass, basin wildrye
CG-10	35	65	0	0	100	basin wildrye, slender wheatgrass, redtop
CG-11	5	95	0	0	100	basin wildrye, western wheatgrass, slender wheatgrass

Posse Ground Area Cheatgrass Plots						
Plot ID	% cover cheatgrass	% cover other dominant species	% bare	% litter	Total % cover	Other dominant species
CG-1	40	60	0	0	100	basin wildrye, smooth brome, bluebunch wheatgrass
CG-2	55	45	0	0	100	basin wildrye, Idaho fescue, tumble mustard
CG-3	60	40	0	0	100	basin wildrye, Idaho fescue, bluebunch wheatgrass
CG-4	40	60	0	0	100	Idaho fescue, basin wildrye, smooth brome
CG-5	80	20	0	0	100	white sage, smooth brome, basin wildrye

Attachment 10. Survival Plot Photo Comparisons 2012 v. 2016 v.
2024



CFR2 Unit 331 - 112 degrees 2012



CFR 2 Unit 331 - 112 degrees 2016



CFR 2 Unit 331 - 246 degrees 2024



CFR 2 Unit 331 - 246 degrees 2012



CFR 2 Unit 331 - 246 degrees 2016



CFR 2 Unit 331 - 246 degrees 2024



CFR 2 Unit 334 - 310 degrees 2012



CFR 2 Unit 334 – 310 Degrees 2016



CFR 2 Unit 334 - 310 degrees 2024



CFR 2 Unit 334 - 122 Degrees 2012



CFR 2 Unit 334 - 122 Degrees 2016



CFR 2 Unit 334 – 122 Degrees 2024



CFR 2 Unit 345 - 78 Degrees 2012



CFR2 Unit 345 - 78 Degrees 2016



CFR2 Unit 345 - 78 Degrees 2024



CFR 2 Unit 345 - 242 Degrees 2012



CFR2 Unit 345 - 242 Degrees 2016



CFR Unit 345 - 242 Degrees 2024



CFR2 Unit 346 - 318 Degrees 2012



CFR 2 Unit 346 - 172 Degrees 2016



CFR 2 Unit 346 - 172 Degrees 2024



CFR2 Unit 346 - 318 Degrees 2012



CFR 2 Unit 346 - 172 Degrees 2016



CFR Unit 346 - 172 Degrees 2024



CFR2 Unit 349 - 26 Degrees 2012



CFR2 Unit 349 26 Degrees 2016



CFR2 Unit 349 – 26 Degrees 2024



CFR2 Unit 349 – 208 Degrees 2012



CFR2 Unit 349 - 208 Degrees 2016



CFR2 Unit 349 – 208 Degrees 2024



CFR2 Unit 231A – 62 Degrees 2012



CFR2 Unit 231A – 62 Degrees 2016



CFR2 Unit 231A – 62 Degrees 2024



CFR2 Unit 231A – 232 Degrees 2012



CFR2 Unit 231A - 232 Degrees 2016



CFR2 Unit 231A – 232 Degrees 2024



CFR2 Unit 231B - 356 Degrees 2012



CFR2 Unit 231B - 356 Degrees 2016



CFR2 Unit 231B – 356 Degrees 2024



CFR2 Unit 231B - 168 Degrees 2016



CFR2 Unit 231B - 168 Degrees 2016



CFR2 Unit 231B – 168 Degrees 2024



CFR2 Unit 358 - 26 Degrees 2012



CFR2 Unit 358 - 26 Degrees 2016



CFR2 Unit 358 – 26 Degrees 2024



CFR2 Unit 358 - 202 Degrees 2012



CFR2 Unit 358 - 202 Degrees 2016



CFR2 Unit 358 - 2024 (Angle was missed for this Unit)



CFR2 UNIT 155 - 276 Degrees 2012



CFR2 UNIT 155 - 276 Degrees 2016



CFR2 Unit 155 – 276 Degrees 2024



CFR2 UNIT 155 - 102 Degrees 2012



CFR2 UNIT 155 - 102 Degrees 2016



CFR2 Unit 155 – 102 Degrees 2024



CFR2 Unit 352 - 224 Degrees 2012



CFR2 Unit 352 - 224 Degrees 2016



CFR2 Unit 352 – 224 Degrees 2024



CFR2 Unit 352 - 15 Degrees 2012



CFR2 Unit 352 - 15 Degrees 2016



CFR2 Unit 352 – 15 Degrees 2024



CFR2 Unit 337 - 22 Degrees 2012



CFR2 Unit 337 - 22 Degrees 2016



CFR2 Unit 337 - 22 Degrees 2024



CFR2 Unit 337 - 278 Degrees 2012



CFR2 Unit 337 - 278 Degrees 2016



CFR2 Unit 337 - 278 Degrees 2024



CFR2 Unit 355 - 38 Degrees 2012



CFR2 Unit 355 - 38 Degrees 2016



CFR2 Unit 355 - 38 Degrees 2024



CFR2 Unit 355 - 218 Degrees 2012



CFR2 Unit 355 - 218 Degrees 2016



CFR2 Unit 355 - 218 Degrees 2024