Shirley Basin Uranium Waste Pile Reclamation

Scan to view brochure

In the 1960s, large uranium ore deposits were discovered in the Shirley Basin adjacent to the Little Medicine Bow River in southeastern Wyoming. In 1972, the river was diverted to accommodate open pit mining operations. Mining ceased in the mid-1980s, and the area was reclaimed by the early 1990s.

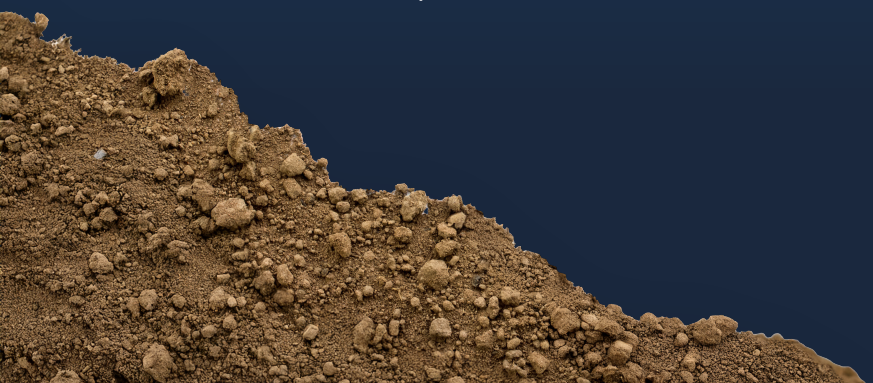
Currently, AML Project 86 is addressing degrading legacy conditions through regrading, stabilization, and revegetation of disturbed areas. Work includes careful management of unsuitable materials through permanent encapsulation in a designated repository, as well as cover and subsurface soil salvage. The site will be reshaped and regraded using natural landform geomorphic grading techniques, amended soils, and revegetated with native plant communities to restore stable landforms, reduce erosion, and reestablish ecosystem function.

One of the key focuses of the project is restoring sagebrush steppe habitat within Greater Sage Grouse Priority Habitat Management Areas, supporting wildlife species that depend on this ecosystem. Final restoration efforts will also enhance riparian and mesic habitats along the Little Medicine Bow River using low tech restoration methods to improve water retention, hydrologic connectivity, and overall habitat quality.

Upon completion, the site will function as a stable, self-sustaining landscape with improved ecological health, reduced environmental risk, and enhanced habitat for sagebrush dependent wildlife and riparian species. During this tour, we will view approximately 60 acres of completed reclamation, with a focus on native plant establishment and site recovery, as well as visually observe surrounding degrading lands scheduled for future maintenance and reclamation work. In addition the tour will also view river restoration work on the Heward's 7E Ranch property.

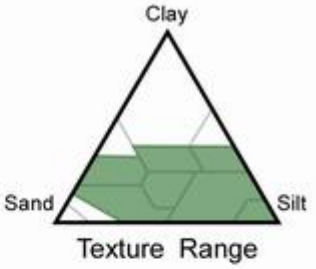
400 Pile Pre-reclamation, 2021

400 Pile Post-reclamation, 2023



HERRERA
Science + Planning + Design

Soil Group 1



Common pH Range	Average pH	Texture
5.5 to 8.0	6.7	Loamy

Soil Group 1 consistently has good soil quality
Common Classification: Coversoil ; Suitable A

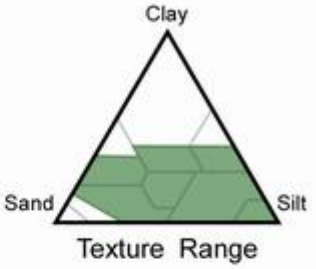
Colors: Brown to Tan to Light Brown. Occasional Dark Brown and Orange. Texture: Sandy Loam

Colors: Tan to Light Brown. Trace Orange and White Texture: Silty Clay Loam

Colors: Tan to Grey. Occasional Dark Brown and Light Grey. Trace Purple Texture: Sandy Clay Loam

Colors: Lite Brown to Red Brown. Texture: Sandy Clay Loam

Soil Group 2



Common pH Range	Average pH	Texture
5.8 to 7.6	6.7	Loamy

Soil Group 2 consistently has the highest soil quality
Common Classification: Coversoil ; Suitable A

Colors: Grey Brown to Light Grey to Dark Grey. Occasional Brown. Texture: Silty Loam

Colors: Light Grey to Light Green Green to Dark Grey. Texture: Silty Loam

Colors: Dark Grey to Grey. Occasional Olive Green, Black and Light Grey Texture: Silty Loam

Soil Group 3

Common pH Range	Average pH	Texture
4.1 to 7.7	5.9	Sandy

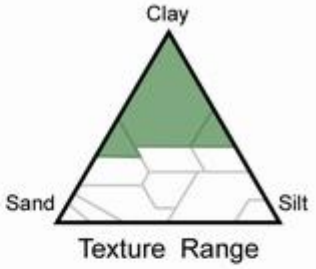
Soil Group 3 will vary in soil quality
Common Classification: Any

Colors: Tan to Brown to Light Brown. Occasional Off White to Black to Orange Texture: Sandy Loam

Colors: Yellow Green Tan Texture: Sandy Loam

Colors:Blue Grey. Occasional Dark Grey. Trace Purple Texture: Sandy Loam

Soil Group 4



Common pH Range	Average pH	Texture
4.6 to 7.3	6.0	Clayey

Soil Group 4 consistently has poor soil quality
Common Classification: Suitable B ; Fill

Colors: Grey to Dark Grey. Occasional Black to Brown to Lite Grey

Texture: Sandy Clay Loam

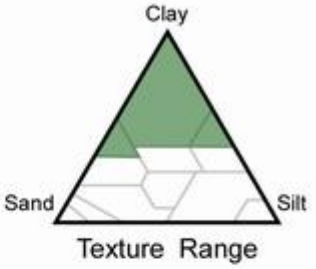
Colors: Grey to Dark Grey. Occasional Red to Black

Texture: Sandy Clay Loam

Colors: Blue Grey to Dark Grey. Occasional Black. Trace Yellow Tan

Texture: Sandy Clay Loam

Soil Group 5



Common pH Range	Average pH	Texture
3.1 to 6.1	4.6	Clayey

Soil Group 5 consistently has the lowest soil quality
Common Classification: Suitable B ; Fill

Colors:Tan. Trace Orange to White — Texture:Sandy Clay

Colors: Brown to Tan. Occasional Dark Orange to Orange — Texture: Silty Clay

Colors: Brown to Very Dark Brown to Tan. Occasional Grey. — Texture: Silty Clay

Colors: Brown to Tan to Purple. Occasional Orange. Trace Black. — Texture: Sandy Clay Loam

2021 Soil Amendments

Amendment	Application Rate	Area
Lime (Sub-grade)	20 Tons/AC	All Areas Except 0.2 acres in the Roadside Channel and Stock Pond Areas
Lime (Surface)	6.5 Tons/AC	All Areas
Potash	140 Lbs./AC	All Areas
Humic acid	400 Lbs./AC	All Areas
Sustane (4-6-4)	2,000 Lbs./AC	All Areas

2022 Soil Amendments

Amendment	Application Rate	Area
Lime (Sub-grade)	20 Tons/AC	All Areas except 1.1 acres in the Roadside Channel and Stock Pond Areas
Lime (Surface)	6.5 Tons/AC	All Areas except the Lek Area
Mycorrhizal inoculum	140 Lbs./AC	All Areas
Humic acid	400 Lbs./AC	All Areas
Sustane (4-6-4)	1000 Lbs./AC	Riverside Grading Area
Sustane (2-3-3)	2000 Lbs./AC	Borrow Area, Excess Material Placement Area, Lek Area, Rill Area, Haul Road, Yard

Example Seed Mixes

2022 Shirley Basin Upland Channel Seed Mix

ESDs RO34AY304WY, RO34AY312WY, RO34AY326WY, RO34AY374WY

Species	Scientific Name	Total PLS Lbs/Ac	Seed Size & Type	Hopper Box	Carrier Agent	Carrier to Bulk Seed Ratio	Target Seed Depth Inches
Bluebunch Wheatgrass	Pseudoroegneria spicata	2.06	Medium	Drill	Rice Hulls	1:1	≤1/2
Slender Wheatgrass	Elymus trachycaulus	1.28	Medium	Drill	Rice Hulls	1:1	≤1/2
Green Needlegrass	Nassella viridula	1.10	Medium	Drill	Rice Hulls	1:1	≤1/2
Needle and Thread Grass	Hesperostipa comata	1.78	Medium	Drill	Rice Hulls	1:1	≤1/2
Basin Wildrye	Leymus cinereus	2.20	Medium	Drill	Rice Hulls	1:1	≤1/2
Bottlebrush Squirreltai	Elymus elmoides	0.94	Medium	Drill	Rice Hulls	1:1	≤1/2
Blue Gramma	Bouteloua gracilis	0.29	Small	Fluffy	Rice Hulls	3:1	≤1/4
Sandberg Bluegrass	Poa Secunda	0.28	Small	Legume	Kitty Litter	2:1	≤1/4
Alkali Sacaton	Sporobolus airoides	0.24	Small	Legume	Kitty Litter	2:1	≤1/8
QuirGuard Sterile Triticale	Triticale	6.00	Medium	Drill	Rice Hulls	1:1	≤1/2
Candian Milkvetch	Astragalus candensis	1.33	Medium	Drill	Rice Hulls	1:1	≤1/2
Fernleaf Biscuitroot	Lomatium dissectum	5.10	Large	Fluffy	Rice Hulls	3:1	≤1/4
Beardtongue	Penstemon grandiflorus	0.62	Medium	Drill	Rice Hulls	2:1	≤1/8
Mountain Snow berry	Symphoricarpos oreophilus	2.77	Large	Drill	Rice Hulls	1:1	≥1/2
Skunkbush Sumac	Rhus trilobata	6.40	Large	Drill	Rice Hulls	1:1	≥1/2
Wyoming Big Sagebrush	Artemisia tridentata ssp w y	4.36	Small	Fluffy	Rice Hulls	3:1	≤1/8
Totals		**36.74**					

2023 Shirley Basin Upland Overseeding Mix

ESDs RO34AY304, RO34AY312, RO34AY326

Species	Scientific Name	Total PLS Lbs/Ac	Seed Size & Type	Hopper Box	Carrier Agent	Carrier to Bulk Seed Ratio	Target Seed Depth Inches
Bluebunch Wheatgrass	Pseudoroegneria spicata	0.62	Medium	Drill	Rice Hulls	1:1	≤1/2
Western Wheatgrass	Pascopyrum smithii	0.79	Medium	Drill	Rice Hulls	1:1	≤1/2
Green Needlegrass	Nassella viridula	0.47	Medium	Drill	Rice Hulls	1:1	≤1/2
Needle and Thread Grass	Hesperostipa comata	0.76	Medium	Drill	Rice Hulls	1:1	≤1/2
Basin Wildrye	Leymus cinereus	0.66	Medium	Drill	Rice Hulls	1:1	≤1/2
Bottlebrush Squirreltai	Elymus elmoides	0.47	Medium	Drill	Rice Hulls	1:1	≤1/2
Blue Gramma	Bouteloua gracilis	0.14	Small	Fluffy	Rice Hulls	1.5:1	≤1/4
Sandberg Bluegrass	Poa Secunda	0.17	Small	Legume	Corn Grit	2:1	≤1/4
QuickGuard Sterile Triticale	Triticale	12.00	Medium	Drill	Rice Hulls	1:1	≤1/2
Beardtongue	Penstemon grandiflorus	1.24	Medium	Drill	Rice Hulls	1:1	≤1/8
Plains Aster	Dieteria bigelovii	0.64	Small	Fluffy	Rice Hulls	1.5:1	≤1/8
Western Yarrow	Achillea millifolium	0.24	Small	Legume	Corn Grit	2:1	≤1/8
Sulphur Buckw heat	Eriogonum umbellatum	3.72	Medium	Drill	Rice Hulls	1:1	≤1/2
Fernleaf Biscuitroot	Lomatium dissectum	12.24	Large	Fluffy	Rice Hulls	1.5:1	≤1/4
Winterfat	Karscheninnikovia lanata	1.18	Medium	Fluffy	Rice Hulls	1.5:1	≤1/8
Black Sagebrush	Artemisia nova	2.16	Small	Fluffy	Rice Hulls	1.5:1	≤1/8
Wyoming Big Sagebrush	Artemisia trdentata, Wy	2.55	Small	Fluffy	Rice Hulls	1.5:1	≤1/8
Totals		**40.05**					

5.2.1 Ground Cover Trends

Based on the 2025 monitoring data, an increase in total native cover occurred in two of the three seeding areas as compared to monitoring data collected in 2024. Total native shrub cover increased in each seeding area and increases in native forb and grass cover were found in the 2022/2023 and 2022/2024 seeding areas. In the 2021 seeding areas, overall native cover increased during the first three years, rising to 36 percent in 2024, and decreasing to 32 percent in 2025, as shown in **Figure 8a**. Grazing occurred on the site prior to monitoring, and cattle were observed in the same area two weeks after monitoring. The cows appeared to prefer the reclaimed area, and grazing is likely the cause of the slight reduction in native ground cover, and this was not interpreted as an increased risk. If further decline in 2026 is observed, it likely would increase the overall risk, depending on the monitoring results. Although grasses, which made up the most of the native cover decreased from the previous monitoring year, the less palatable native shrubs have consistently increased in ground cover each year since the initial monitoring, as shown in **Figure 8b**. After an increase in the first growing season following seeding, non-native ground cover has continued to decline since 2023.

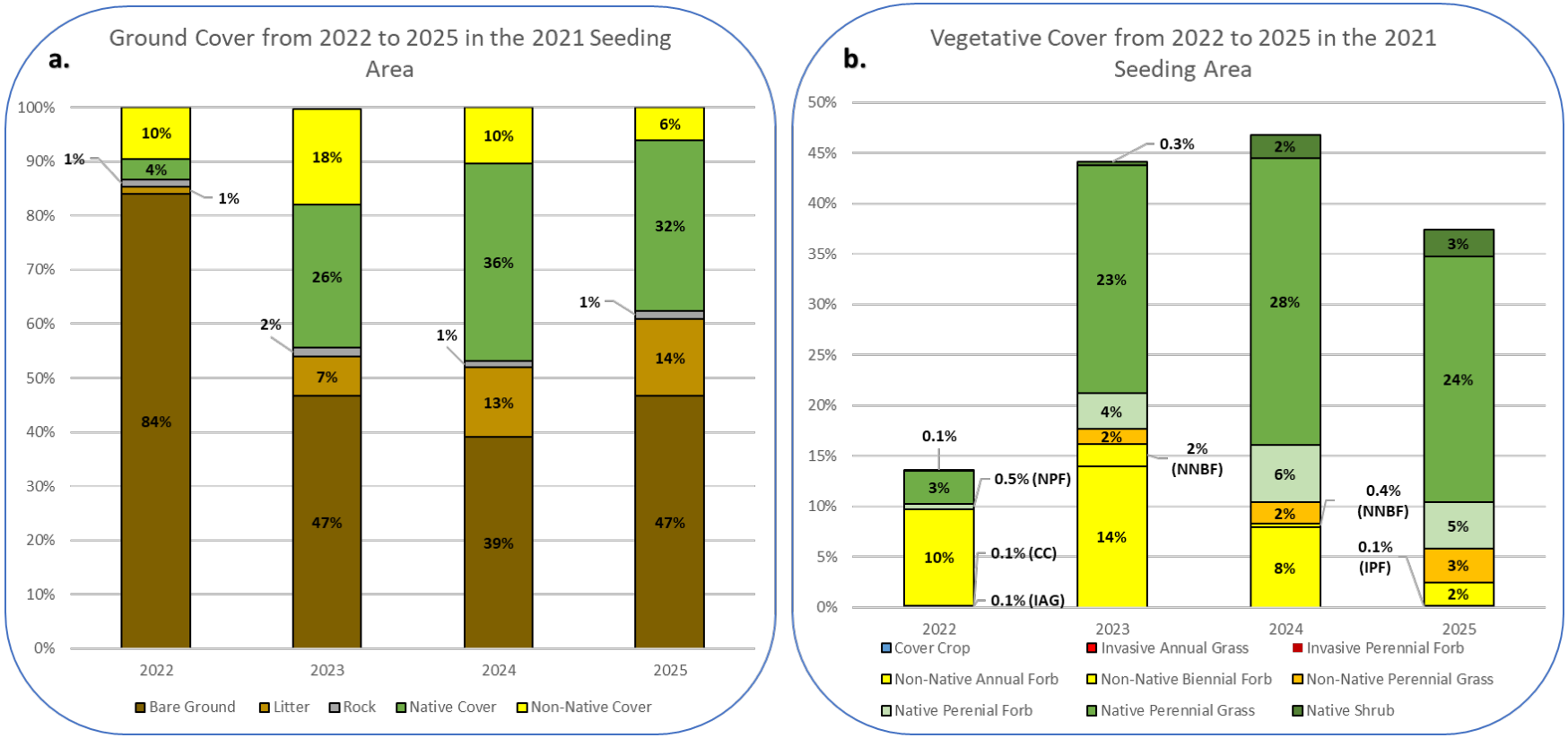


Figure 8: Changes in Ground Cover between 2022 and 2025 at the Shirley Basin 400 Pile (Years 1, 2, 3 & 4) [Seeded 2021]

In the 2022/2023 seeding areas, overall native cover increased from 22 percent to 33 percent, with a corresponding decrease in non-native cover from 15 percent to 4 percent from 2023 to 2025, as shown in **Figure 9a**. This indicates the 2023 overseeding was successful at improving the poorest performing areas at the Site into the best performing areas. As shown in **Figure 9b**, native perennial shrubs and forbs increased in cover substantially between the 2024 and 2025 monitoring years.

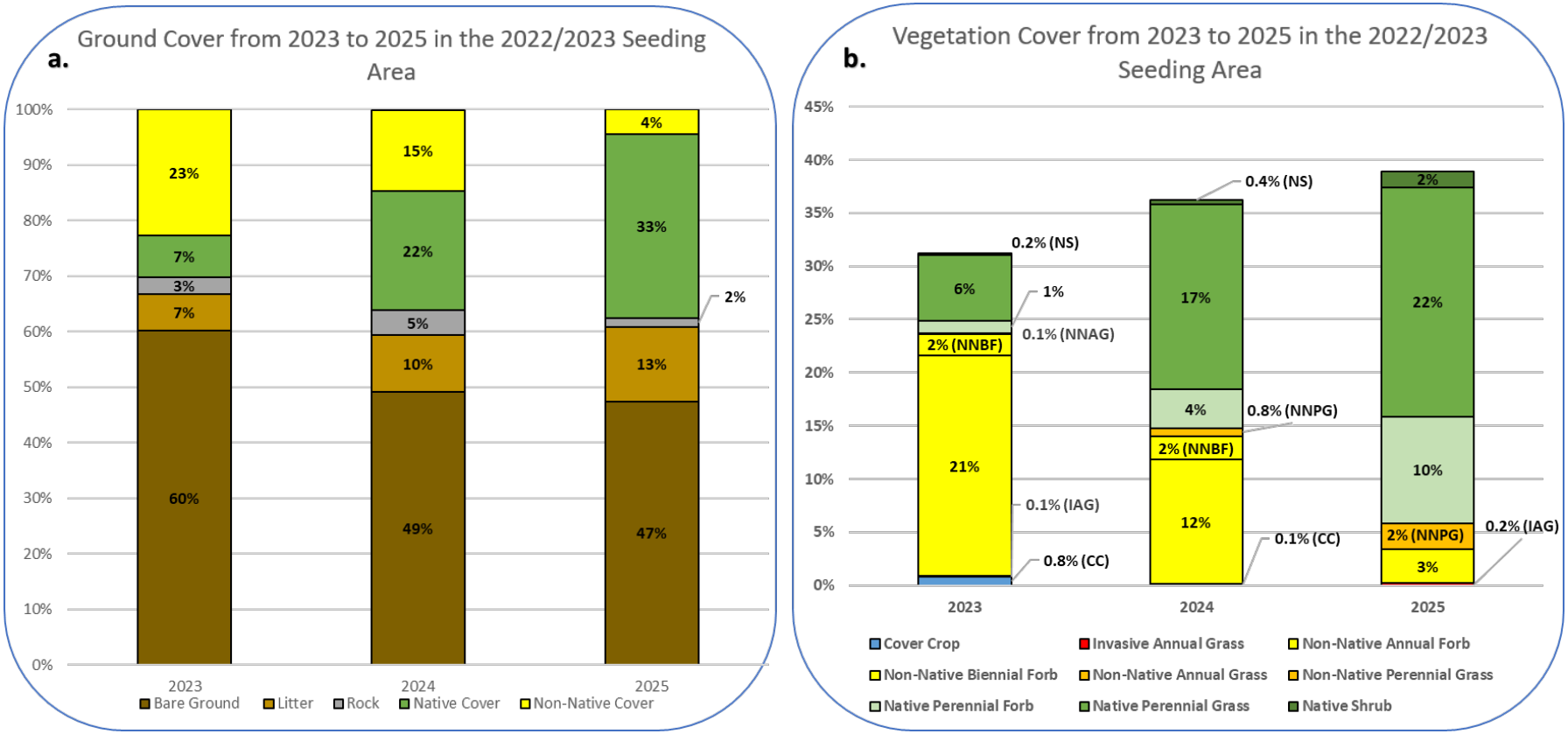


Figure 9: Changes in Ground Cover between 2023 and 2025 at the Shirley Basin 400 Pile (Years 1, 2 & 3) [Seeded in 2022 and Interseeded in 2023]

In the 2022/2024 seeding areas, overall native cover has increased each year since the initial monitoring, rising from 7 percent to 22 percent from 2023 to 2025, corresponding with a decrease in non-native cover from 23 percent to 8 percent over the same period, as shown in **Figure 10a**. Cover values of native grasses, forbs and shrubs have all increased during each monitoring year, as shown in **Figure 10b**, which represents a positive trend for the area and is similar to the trend of the first three monitoring years in the 2021 area.

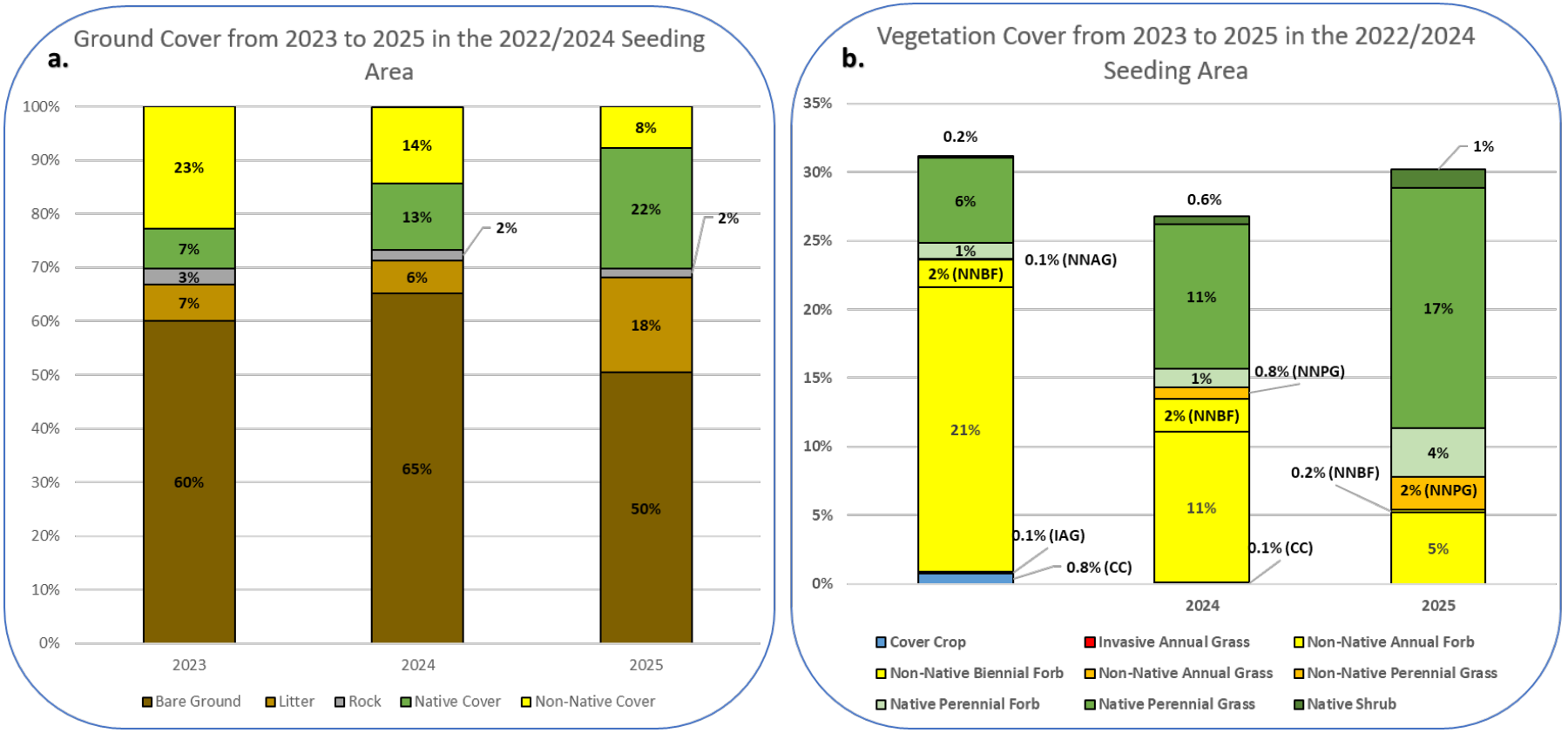


Figure 10: Changes in Ground Cover between 2023 and 2025 at the Shirley Basin 400 Pile (Years 1, 2 & 3) [Seeded 2022 and Interseeded in 2024]

5.3 Desirable Vegetation Status Dashboard Summary

As shown in **Figure 11**, **Figure 12**, and **Figure 13**, corresponding to the 2021, 2022/2023 and 2022/2024 seeding areas, the Site received *Desirable Vegetation Status* rankings of **Low Risk, Low Risk** and **Very Low Risk**, respectively. The as-seeded seed mixes were provided by Herrera in their Certified Seeding Specialist Vegetation Deliverables, and these were used to assess seeded species at the Site. As shown in **Appendix B** and **Figure 11**, **Figure 12**, and **Figure 13**, 19 out of the 31 seeded species were observed at the Site, while 15 out of 31 were measured within VMPs. A total of 51 species were observed on Site, including non-native and invasive species. Total native cover was 31.6 percent, 22.4 percent, and 33.1 in the 2021, 2022/2023 and 2022/2024 seeding areas. Relative native vegetation cover was 84.0 percent, 74.2 percent, and 88.2 percent in the 2021, 2022/2023 and 2022/2024 seeding areas, respectively. Quickguard triticale (*Triticum aestivum x Secale cereale*) was not observed in any of the monitoring areas.

In the 2021 seeding areas, relative cover from native grasses increased from 61 percent to 65 percent and relative native shrub cover increased from 5 percent to 7 percent from 2024 to 2025. Over the same period, native forb cover remained the same and non-native / invasive cover decreased from 22 to 16 percent. For native grasses, western wheatgrass (*Pascopyrum smithii*) had the greatest relative increase, followed by bottlebrush squirreltail (*Elymus elymoides*). Sandberg's bluegrass (*Poa secunda*), and green needlegrass (*Nassella viridula*) showed minor increases in cover, and slender wheatgrass (*Elymus trachycaulus*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) showed a decline in relative cover. Native shrub cover increases came from winterfat (*Krascheninnikovia lanata*) and Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*). Most of the reduction in non-native cover came from decreased cover values of desert alyssum (*Alyssum desertorum*) and Russian thistle (*Salsola tragus*).

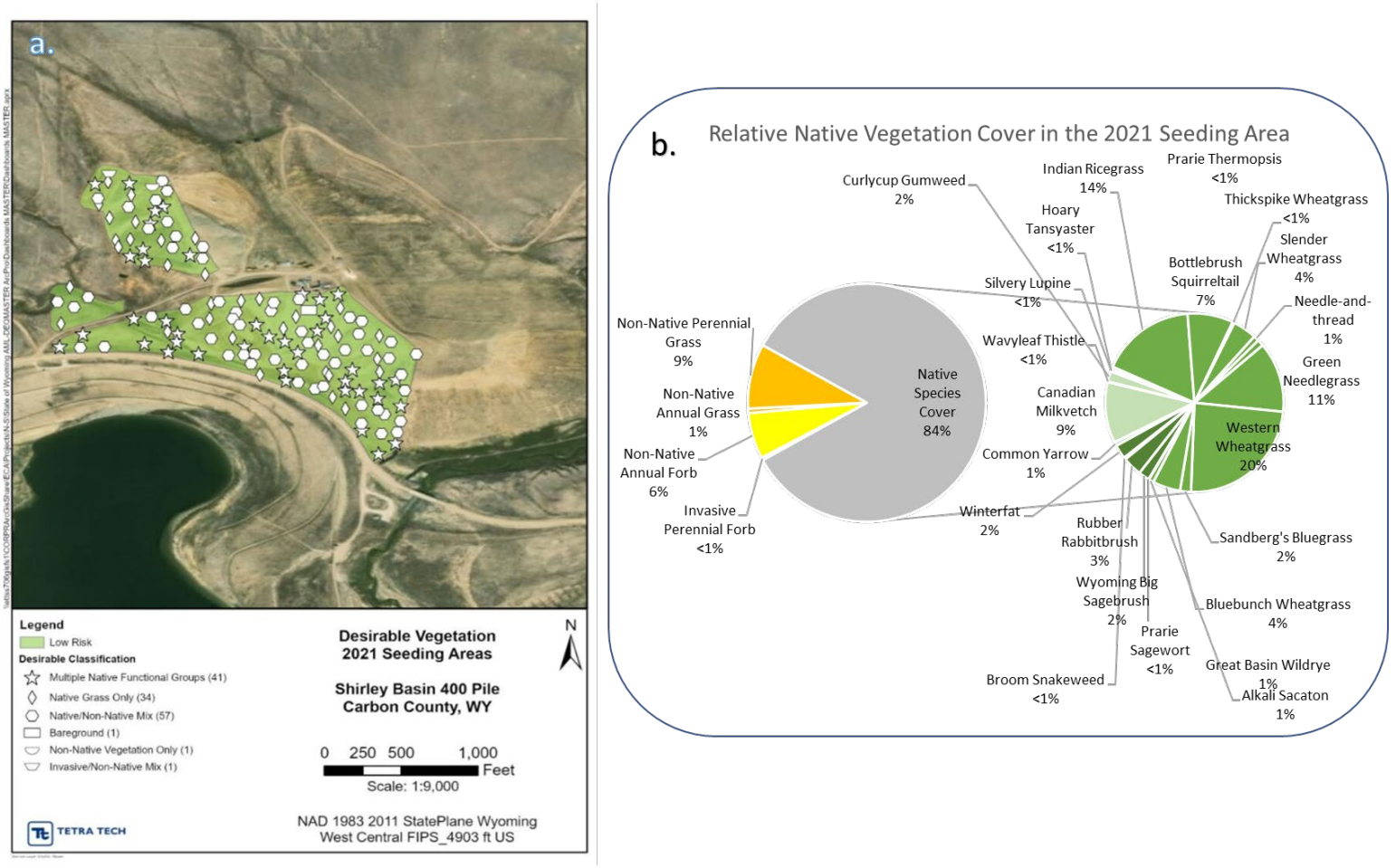


Figure 11: Desirable Vegetation Dashboard for the Shirley Basin 400 Pile (Year 4) [Seeded 2021]

In the 2022/2023 seeding areas, relative native cover increased from 59 percent in 2024 to 88 percent in 2025. Bottlebrush squirreltail showed a decrease in relative cover, as did bluebunch wheatgrass and slender wheatgrass. The increases in relative native grass cover were found in Great Basin wildrye (*Leymus cinereus*), Indian ricegrass (*Achnatherum hymenoides*), western wheatgrass and green needlegrass. Relative native shrub cover increased from 1 percent to 4 percent, and relative native forb cover increased from 10 percent to 27 percent from 2024 to 2025. Native shrub cover increases were primarily from rubber rabbitbrush (*Ericameria nauseosa*) and prairie sagewort (*Artemisia frigida*), while relative native forb increases were exclusively from Canadian milkvetch (astragalus canadensis). As shown in **Figure 12b**, the 2022/2023 seeding areas support high native species richness.

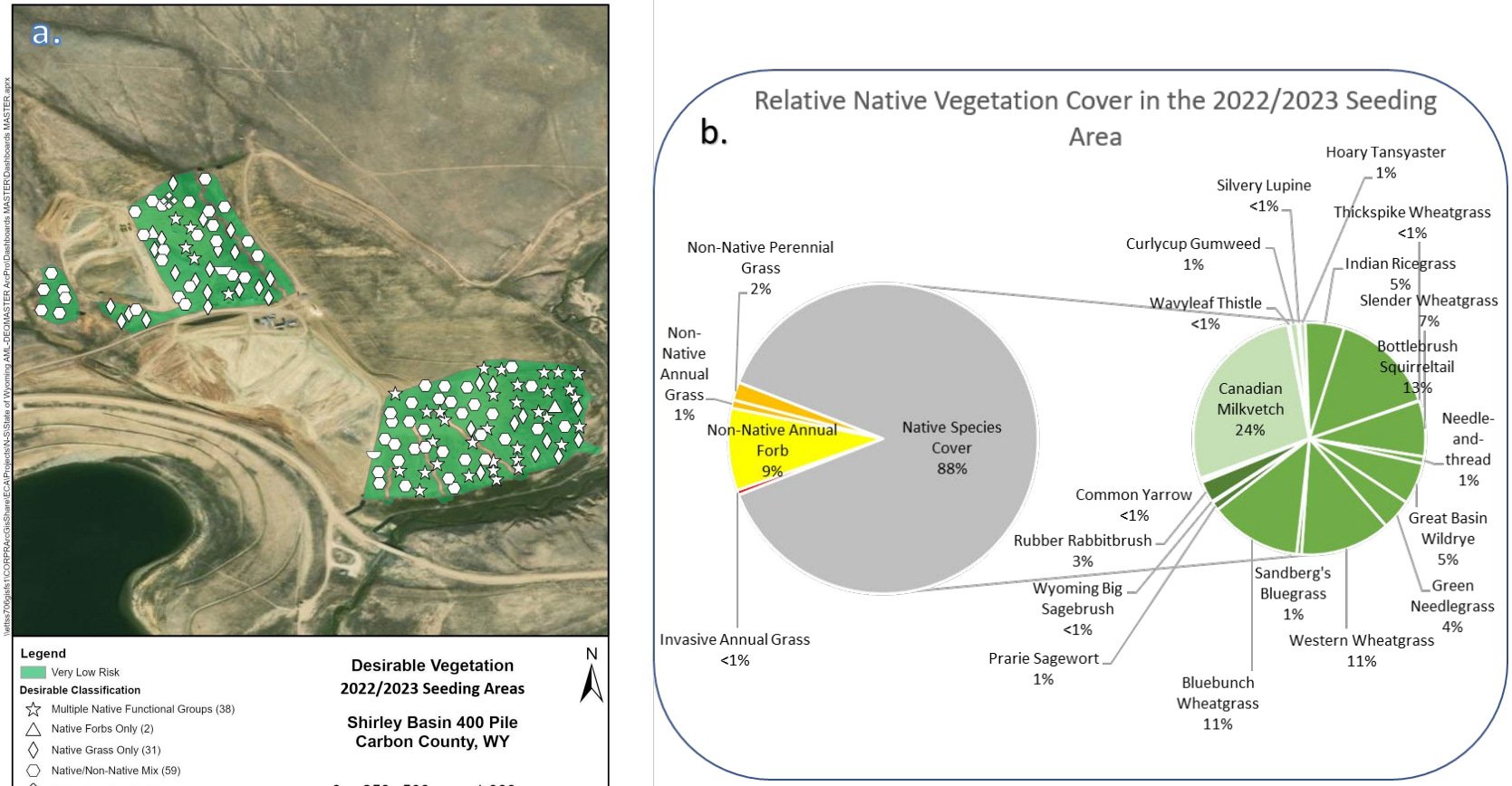
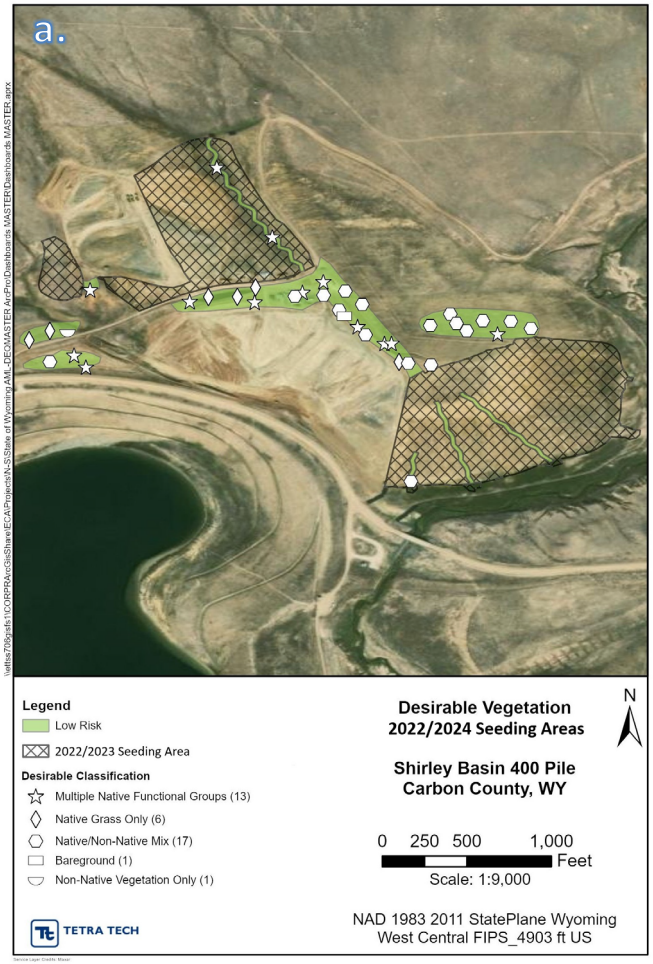


Figure 12: Desirable Vegetation Dashboard for the Shirley Basin 400 Pile (Year 3) [Seeded in 2022 and Interseeded in 2023]

In the 2022/2024 seeding areas, relative native cover increased from 47 percent to 74 percent and showed a similar change in relative native grass cover to the 2021 area with Bottlebrush squirreltail, Western wheatgrass and Green needlegrass making up the greatest relative increase. Relative native shrub cover increased from 3 percent to 5 percent, and relative native forb cover increased from 5 percent to 12 percent from 2024 to 2025. Native shrub cover increases were primarily from Winterfat, and native forb cover increases were primarily associated with *Astragalus canadensis* (Canadian milkvetch). As shown in **Figure 13b**, the 2022/2024 seeding areas support high native species richness.



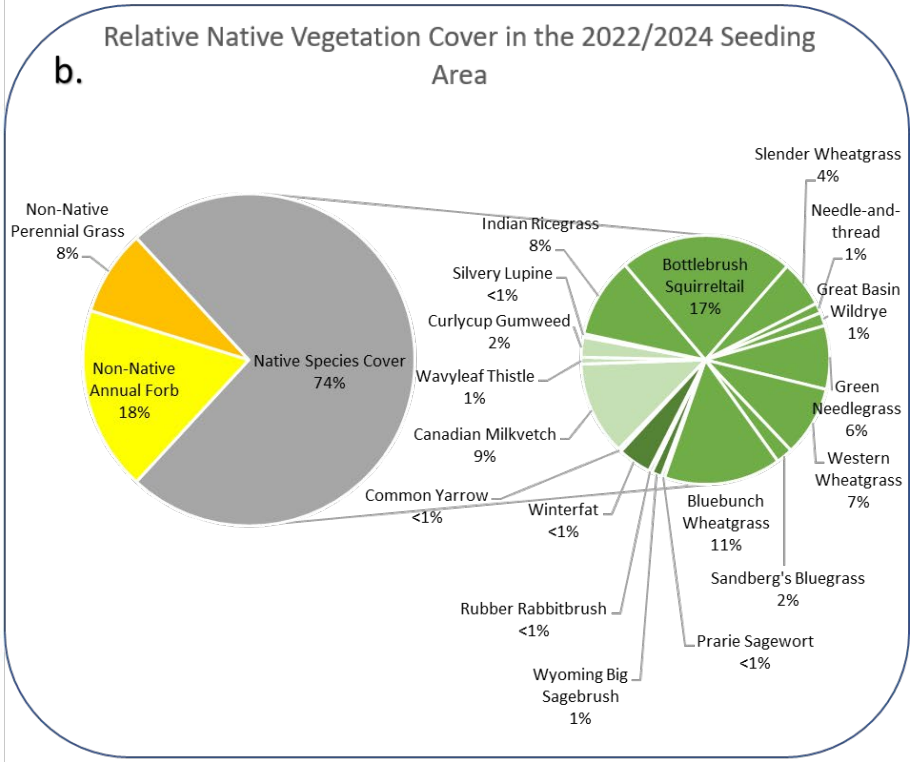
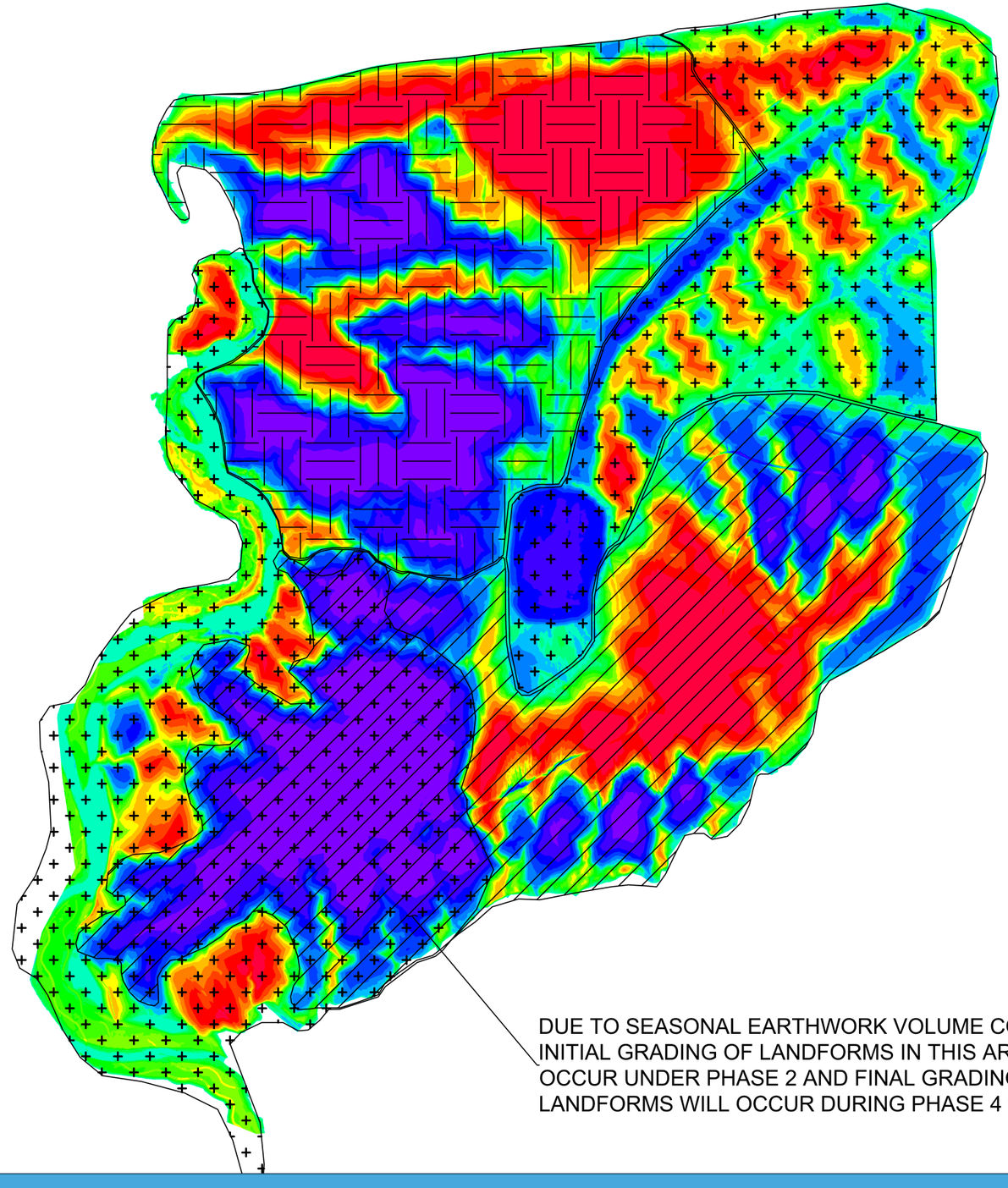


Figure 13: Desirable Vegetation Dashboard for the Shirley Basin 400 Pile (Year 3) [Seeded 2022 and Interseeded in 2024]

HERRERA
Science + Planning + Design

Figure 3.
500 Pile Cut/Fill Map and Draft Phasing Boundaries.

N



DUE TO SEASONAL EARTHWORK VOLUME CONSTRAINTS, INITIAL GRADING OF LANDFORMS IN THIS AREA WILL OCCUR UNDER PHASE 2 AND FINAL GRADING OF LANDFORMS WILL OCCUR DURING PHASE 4 WORK.

ELEVATION TABLE			
RANGE	MINIMUM ELEVATION	MAXIMUM ELEVATION	COLOR
1	-54.10	-20.70	
2	-20.70	-15.00	
3	-15.00	-11.00	
4	-11.00	-7.90	
5	-7.90	-5.90	
6	-5.90	-4.40	
7	-4.40	-3.30	
8	-3.30	-2.40	
9	-2.40	-1.60	
10	-1.60	-0.70	
11	-0.70	-0.10	
12	-0.10	0.20	
13	0.20	1.50	
14	1.50	3.60	
15	3.60	6.80	
16	6.80	10.10	
17	10.10	17.60	
18	17.60	50.71	

CUT/FILL VOLUMES PER PHASE			
	CUT (CY)	FILL (CY)	NET (CY)
PHASE 2	691K	691K	
PHASE 3	713K	711K	
PHASE 4	680K	495K	185K

LEGEND

PHASE 2

PHASE 3

PHASE 4

NOTE:
PHASING BOUNDARIES SHOWN ARE DRAFT LEVEL AND MAY BE SUBJECT TO CHANGE.

0 250 500 1000 Feet