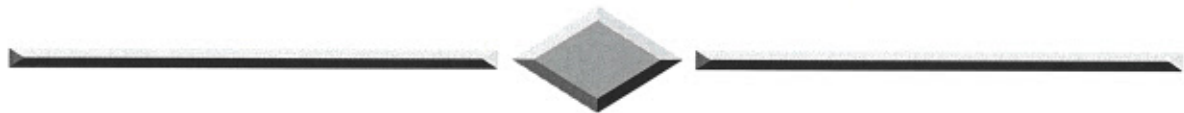


COORS ENERGY COMPANY

**PO Box 4030
Golden, CO 80402**



2021 ANNUAL HYDROLOGY & RECLAMATION REPORT

**Prepared for:
COLORADO DIVISION OF
RECLAMATION, MINING &
SAFETY**

PERMIT NO. C-1981-028

TABLE OF CONTENTS

Vegetation Monitoring –	1
Water Quality Sampling	114
First Semi-Annual Sampling - (4/20 & 21 sampling)	
Second Semi-Annual Sampling (9/28 & 29 sampling)	
Surface Water Hydrology	232
Disposal Activities Data	234
Reclamation Report	236
<i>CDRMS Report Form</i>	239
Mass Balance	242
Revisions Summary for 2021	244

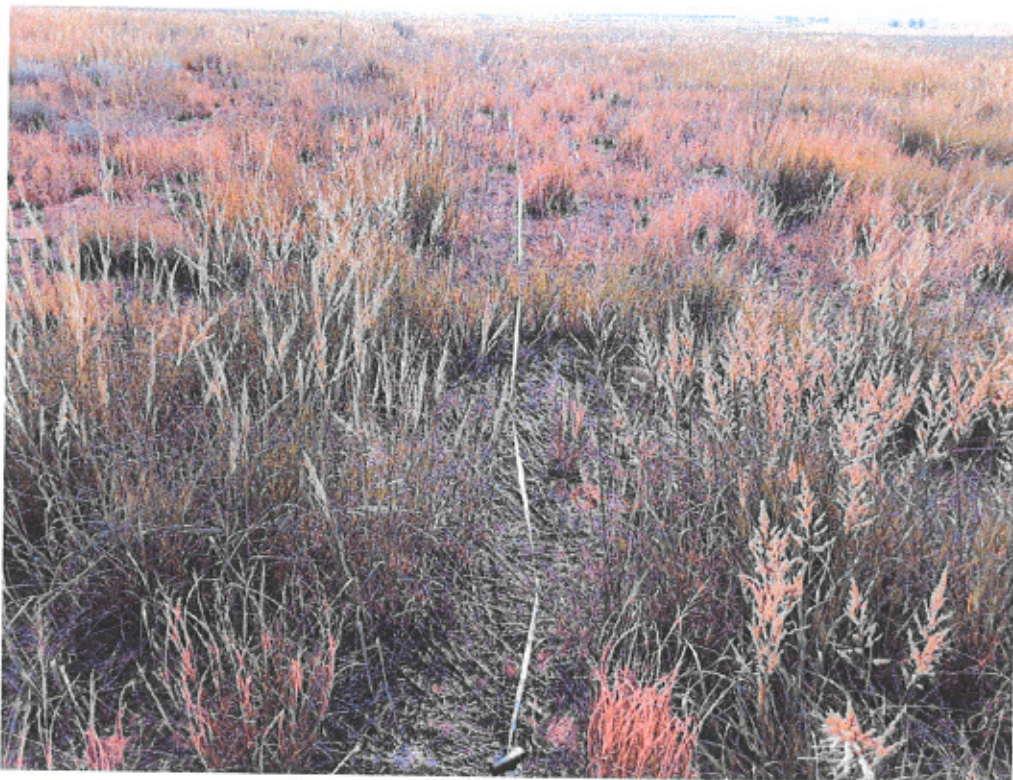
VEGETATION MONITORING 2021

VEGETATION ACTIVITIES

The Habitat Management report is included.

2021 Vegetation Monitoring Report Reclamation Areas 25, 29, 30, 31, 32, 33, 34, 37, and 44

***Coors Energy Company Keenesburg Mine
Keenesburg, Colorado***



October 2021

Prepared by:



Keenesburg Mine 2021 Vegetation Monitoring Report

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1 INTRODUCTION	2
2 METHODS	2
2.1 Sampling Design	4
2.2 Sample Timing	4
2.3 Vegetation Cover	4
2.4 Herbaceous Production	4
2.5 Species Composition	11
2.6 Photographs	11
2.7 Species Identification and Nomenclature	11
3 RECLAMATION SUCCESS STANDARDS	11
3.1 2021 Revegetation Success Standards	12
4 2020-2021 PRECIPITATION	12
5 2021 PEST & DISEASE INSPECTIONS	13
6 RESULTS	14
6.1 Phase III Reclamation Monitoring	14
6.1.1 Reclamation Area 29	14
6.1.2 Reclamation Area 30	16
6.1.3 Reclamation Area 31	18
6.2 Phase II Monitoring	20
6.2.1 Reclamation Area 25	20
6.2.2 Reclamation Area 34	22
6.2.3 Reclamation Area 37	24
6.2.4 Reclamation Area 44	25
6.3 Interim Monitoring	27
6.3.1 Reclamation Area 32	27
6.3.2 Reclamation Area 33	29
7 DISCUSSION	31
7.1 Vegetation Cover	31
7.2 Herbaceous Production	33
7.3 Species Composition	34
8 SUMMARY	34
9 LITERATURE CITED	35

FIGURES

Figure 1: Keenesburg Mine Site Map	3
Figure 2: Sample Point Locations (Area 25)	5
Figure 3: Sample Point Locations (Areas 29 & 30)	6
Figure 4: Sample Point Locations (Areas 31 & 32)	7
Figure 5: Sample Point Locations (Area 33)	8
Figure 6: Sample Point Locations (Area 34)	9
Figure 7: Sample Point Locations (Areas 37 & 44)	10
Figure 8: 2020-2021 Precipitation and Average Annual Precipitation	13
Figure 9: Absolute Cover of Native and Introduced Species 2016 – 2021*	32

Keenesburg Mine 2021 Vegetation Monitoring Report

Figure 10: Cheatgrass Relative Cover 2016 – 2021*	33
Figure 11: Non-Noxious Herbaceous Production by Life Form 2016 – 2021*	34

TABLES

Table 1: Reclamation Areas Monitored in 2021	2
Table 2: Correlation Statistics for On-Site and CoCoRaHS Precipitation Data	13
Table 3: Reclamation Area 29 Summary Statistics	15
Table 4: Reclamation Area 29 Species Composition	15
Table 5: Reclamation Area 29 Success Criteria	16
Table 6: Reclamation Area 30 Summary Statistics	17
Table 7: Reclamation Area 30 Species Composition	17
Table 8: Reclamation Area 30 Success Criteria	18
Table 9: Reclamation Area 31 Summary Statistics	19
Table 10: Reclamation Area 31 Species Composition	19
Table 11: Reclamation Area 31 Success Criteria	20
Table 12: Reclamation Area 25 Summary Statistics	20
Table 13: Reclamation Area 25 Species Composition	21
Table 14: Reclamation Area 25 Success Criteria	21
Table 15: Reclamation Area 34 Summary Statistics	22
Table 16: Reclamation Area 34 Species Composition	23
Table 17: Reclamation Area 34 Success Criteria	23
Table 18: Reclamation Area 37 Summary Statistics	24
Table 19: Reclamation Area 37 Species Composition	25
Table 20: Reclamation Area 37 Success Criteria	25
Table 21: Reclamation Area 44 Summary Statistics	26
Table 22: Reclamation Area 44 Species Composition	26
Table 23: Reclamation Area 44 Success Criteria	27
Table 24: Reclamation Area 32 Summary Statistics	28
Table 25: Reclamation Area 32 Species Composition	28
Table 26: Reclamation Area 32 Success Criteria	29
Table 27: Reclamation Area 33 Summary Statistics	30
Table 28: Reclamation Area 33 Species Composition	30
Table 29: Reclamation Area 33 Success Criteria	31
Table 30: Vegetation Cover Success Standard Comparison	31
Table 31: Herbaceous Production Success Standard Comparison	33
Table 32: Success Standard Summary	35

APPENDICES

Appendix A: Vegetation Cover Data	36
Appendix B: Herbaceous Production Data	58
Appendix C: Complete Species List	65
Appendix D: Precipitation Data 1993 – 2021	70
Appendix E: Cover Transect Photographs	72
Appendix F: Pest & Disease Inspection Reports	100

Keenesburg Mine 2021 Vegetation Monitoring Report

EXECUTIVE SUMMARY

Quantitative vegetation monitoring of Reclamation Areas 25, 29, 30, 31, 32, 33, 34, 37, and 44 at the Coors Energy Company (CEC) Keenesburg Mine was conducted in August 2021. Vegetation cover, herbaceous production, and species composition were evaluated. Comparisons were made between vegetation cover and herbaceous production means from the reclamation areas and predicted values calculated from the approved final revegetation success equations based on on-site precipitation from September 2020 to July 2021. The predictive equations for vegetation cover and herbaceous production were modified in Technical Revisions 43 and 46 to the Colorado Division of Reclamation Mining and Safety (DRMS) Mining and Reclamation Permit C-1981-028. The calculated final revegetation success vegetation cover standard value was 27.2%. The total herbaceous production standard was 21.0 g/m².

Reclamation Areas 29, 30, and 31 were evaluated based on the guidelines for Phase III bond release. Reclamation Area 30 has not yet received Phase II bond release, but it was reclaimed more than 10 years ago and is eligible for the first year of Phase III monitoring. All three areas met the Phase III standards and will be eligible for release if they pass the standards for a second time within the next two years.

Reclamation Areas 25, 30, 34, 37, and 44 were evaluated for Phase II bond release. Only Area 30 met both the vegetation cover and species composition standards and is eligible for Phase II release this year. Phase II bond release guidelines only require that four perennial grasses be present to meet the species composition technical standard and this requirement was met for all Phase II Reclamation Areas. While Phase II bond release does not require a production standard, Reclamation Areas 34 was sampled using the interim production methodology and would have met the Phase III production standard.

Reclamation Areas 32 and 33 were evaluated using interim reclamation monitoring guidelines. They were compared to the Phase III bond release standards to measure their progress towards future release. Reclamation Areas 32 and 33 met both the cover and production standards, but neither area met the species composition standard.

Quarterly inspections of the entire permitted area were conducted during 2021 to monitor for the presence and impacts of noxious weeds, pests, or disease to the revegetation. No pests or diseases were identified during these inspections. The primary noxious weed observed during these inspections was cheatgrass which is pervasive on the reclamation and is being aggressively treated by CEC.

Keenesburg Mine 2021 Vegetation Monitoring Report

1 INTRODUCTION

Coors Energy Company (CEC) operated the Keenesburg Mine for coal extraction from 1980 to 1988 and is now conducting reclamation activities under Colorado Division of Reclamation Mining and Safety (DRMS) Mining and Reclamation Permit C-1981-028. Reclamation activities include backfilling, grading, topsoiling, and revegetation in accordance with CEC's approved DRMS reclamation plan. Vegetation monitoring of reclaimed areas is required by DRMS. This report presents the results of annual reclamation monitoring conducted on August 9 – 13, 2021 by Habitat Management, Inc. (Habitat Management). Quantitative information in this report characterizes the vegetative condition of Reclamation Areas 25, 29, 30, 31, 32, 33, 34, 37, and 44. Vegetation sampling was performed in compliance with Colorado Mined Land Reclamation Board Surface Coal Mining Rules 2.04.10 and 4.15 and currently accepted methods for vegetation sampling.

The Keenesburg Mine is in Weld County, Colorado, approximately seven miles north of the town of Keenesburg and is accessed by Weld County Road 59. In 2002, the Keenesburg Mine assigned numerical designations to each reclamation area starting in the northeast corner of the permit area and continuing clockwise through the reclaimed areas. Newly reclaimed areas are assigned consecutive numbers as needed (Figure 1). Reclamation Areas monitored in 2021 are summarized in Table 1.

Table 1: Reclamation Areas Monitored in 2021

Reclamation Area	Acres	Seeding Date	Bond Release Status	Monitoring Guidelines	
				Cover	Production
25	12.6	2012	Phase I	Phase II	n/a
29*	8.8	2003 (2002*)	Phase II	Phase III	Phase III
30	9.7	2006	Phase I	Phase II/III	Phase III
31	11.9	2009	Phase II	Phase III	Phase III
32	5.5	2015	Phase II	Interim	Interim
33	12.5	2015	Phase II	Interim	Interim
34	6.9	2016	Phase I	Phase II	Interim
37	9.13	2019	None	Phase II	n/a
44	27.39	2019	None	Phase II	n/a

* Includes the previously separated Reclamation Area 23.

Reclamation Areas 29, 30, and 31 were monitored using the guidelines for Phase III bond release. Reclamation Areas 25, 34, 37 and 44 were monitored using the guidelines for Phase II bond release. Reclamation Areas 32 and 33 were monitored using the guidelines for interim vegetation monitoring. All of these Reclamation Areas were last monitored in 2020.

2 METHODS

The monitoring methods and revegetation standards used to evaluate these areas are those currently in effect under the Colorado Surface Coal Mining Reclamation Act (CRS 34-33-101) and the Keenesburg Mining and Reclamation Permit.

Figure 1: Keenesburg Mine Site Map



2.1 Sampling Design

Thirty sample points were located prior to going into the field using mapping software to create a square grid overlaid on each Reclamation Area being sampled. The sample points were located at the intersection of each square created by the grid. The grid size was adjusted to create the appropriate number of sample locations within each Reclamation Area. Sample numbers (1-30) were randomly assigned to each generated sample point along with a randomly generated azimuth (Figure 2, Figure 4, Figure 5, and Figure 6). A minimum of 15 vegetation cover samples were collected in Reclamation Areas 25, 29, 30, 31, 34, 37, and 44 with additional samples collected, if necessary, to meet sample adequacy in any area per DRMS guidelines. Ten cover samples were collected in Reclamation Areas 32 and 33 per CEC's interim reclamation monitoring guidelines. The maximum of 30 herbaceous production samples were collected from Reclamation Areas 29, 30, and 31 and 15 production samples were collected in Reclamation Areas 32, 33, and 34.

2.2 Sample Timing

Vegetation monitoring occurred on August 9 – 13, 2021 which was consistent with the timing of monitoring in previous years. Monitoring also coincided with maximum vegetation development of most plant species found in the reclaimed and adjacent native areas.

2.3 Vegetation Cover

Point-intercept methods were used to collect vegetation and ground cover, as well as species composition data. Each 25-meter transect represents a single sampling unit. Two data points were recorded at one-meter intervals along each transect, 0.5 m to each side of and at a right angle to the transect. A laser bar was used to determine intercepts, with the beam projected vertically to the ground surface. Each point-intercept represented an absolute cover value of 2%.

"First-hit" point-intercepts (the first item that the laser beam intercepts) were recorded as either: live vegetation (by plant species), litter, rock, or bare ground. Litter includes all dead plant material. Subsequent "hits" on vegetation (prior to interception of the ground) were also recorded. Vegetation cover was reported in absolute percentages from the point-intercept data using all 50 first-hit observations for each sample point. Additional interceptions were used to calculate relative cover of individual plant species and life forms. The quantitative cover data also provided the basis for calculation of species composition and relative importance.

2.4 Herbaceous Production

Herbaceous production was sampled using 0.5-square meter circular plots. For samples where cover data was also collected, the plots were located adjacent to the start point to the right of the transect. Additional production samples were collected with the plot centered on the sample point.

All herbaceous non-noxious growth within each plot's vertical projection was clipped, separated by growth form, and placed in labeled paper bags. Current year's herbaceous growth of shrubs was collected in the same manner, but no woody tissue was harvested. The bags containing the clipped material were returned to the Habitat Management office and dried at 30 degrees Celsius until weights stabilized to within 0.1 gram. Herbaceous production was reported in grams per square meter.

Figure 2: Sample Point Locations (Area 25)

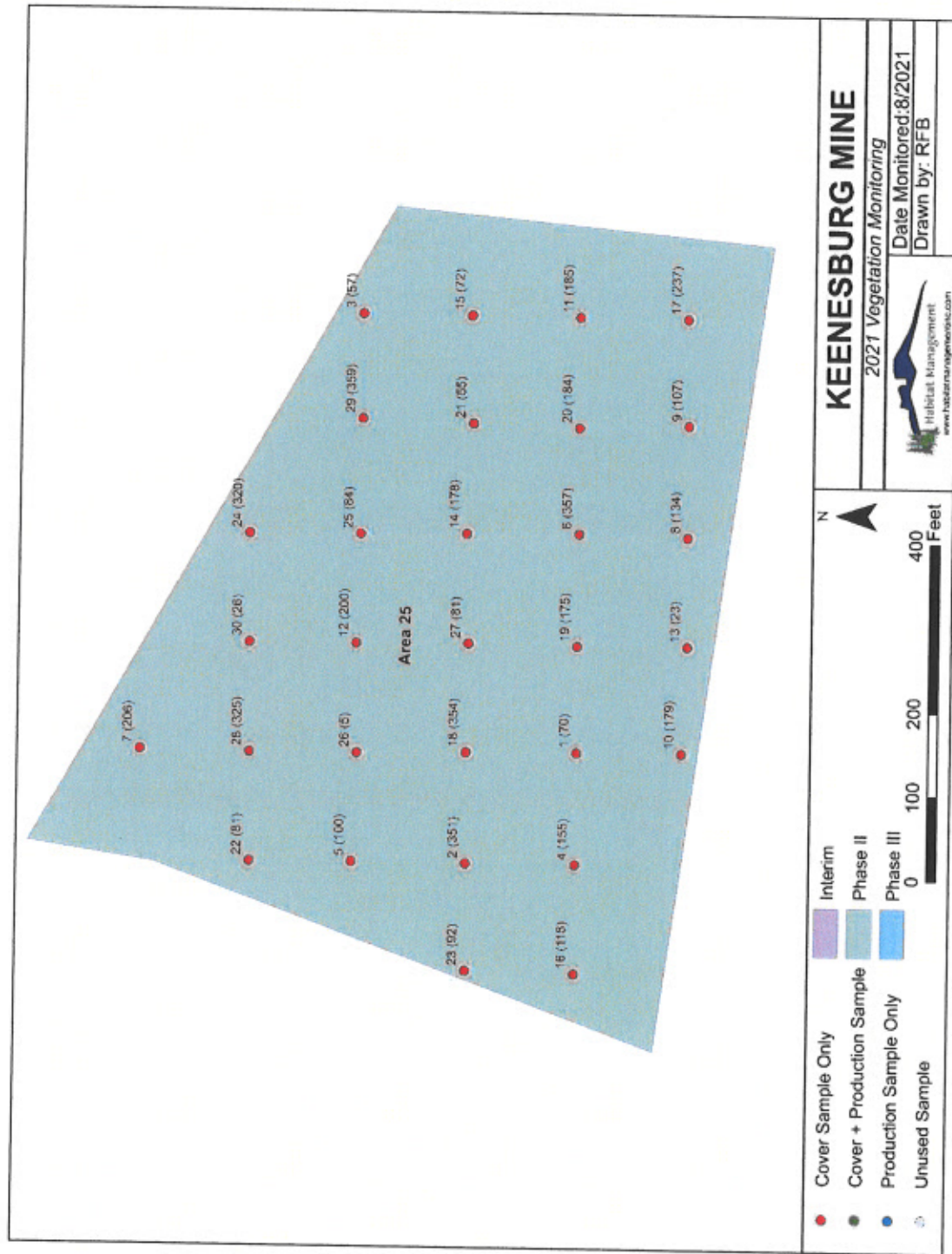


Figure 3: Sample Point Locations (Areas 29 & 30)

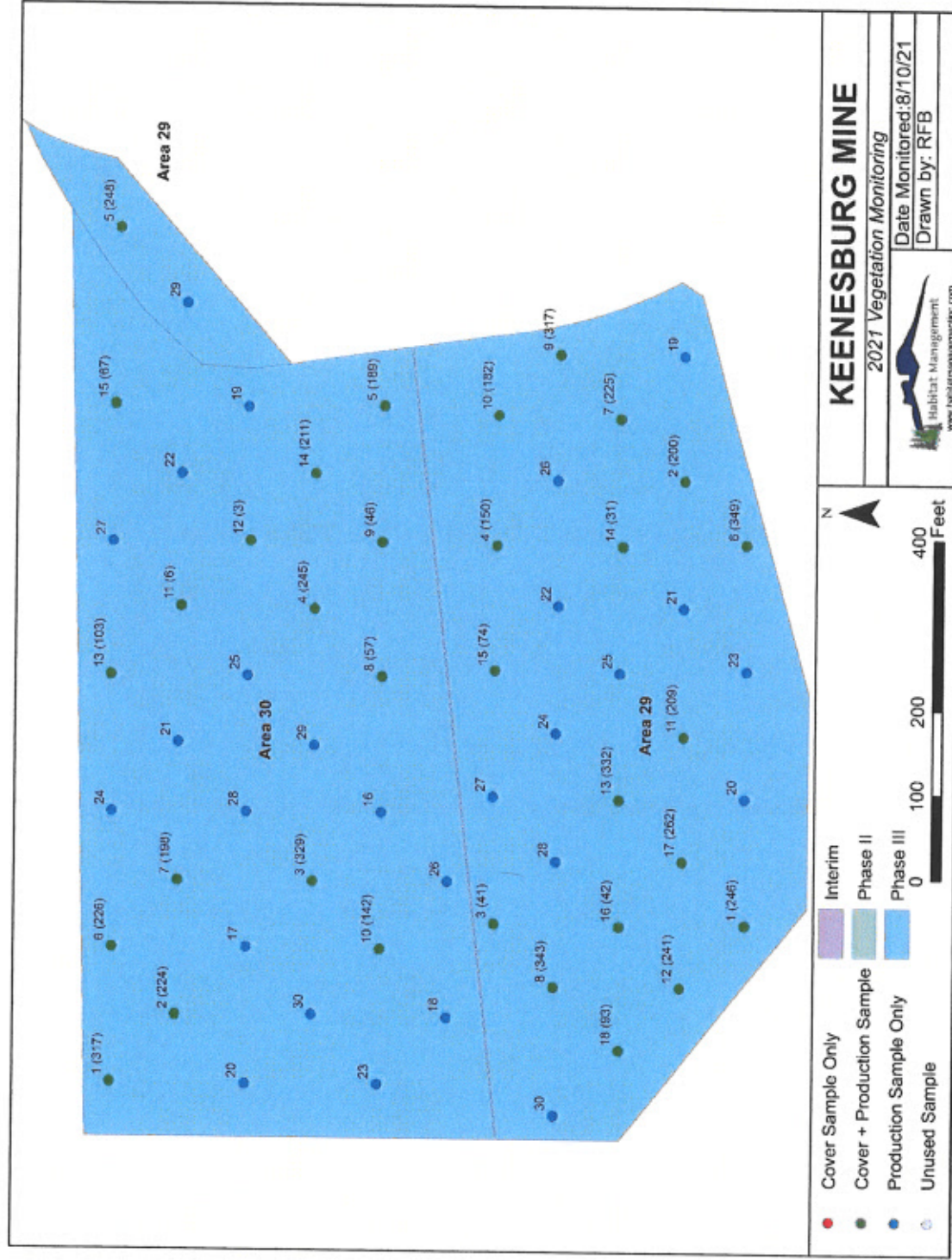


Figure 4: Sample Point Locations (Areas 31 & 32)

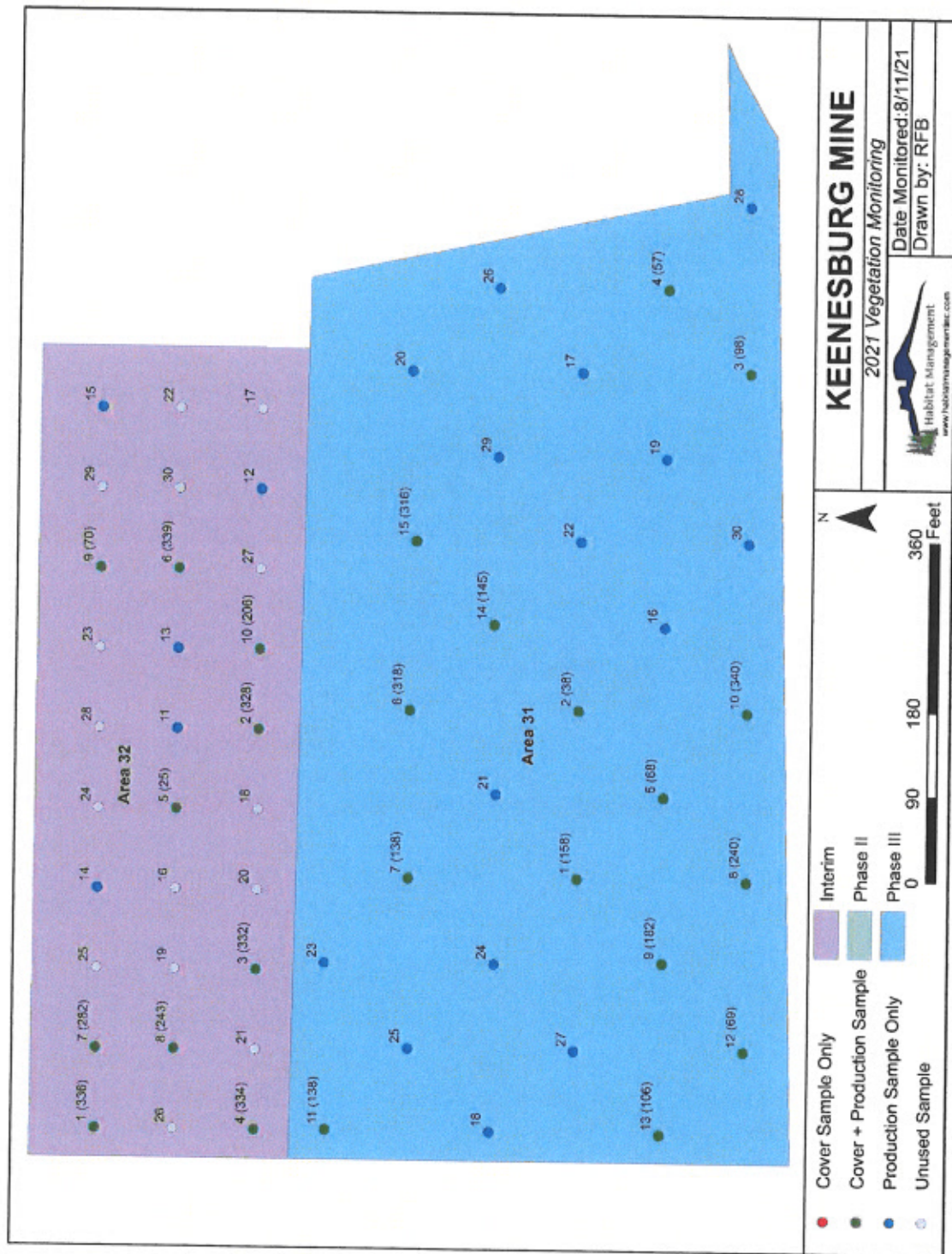


Figure 5: Sample Point Locations (Area 33)

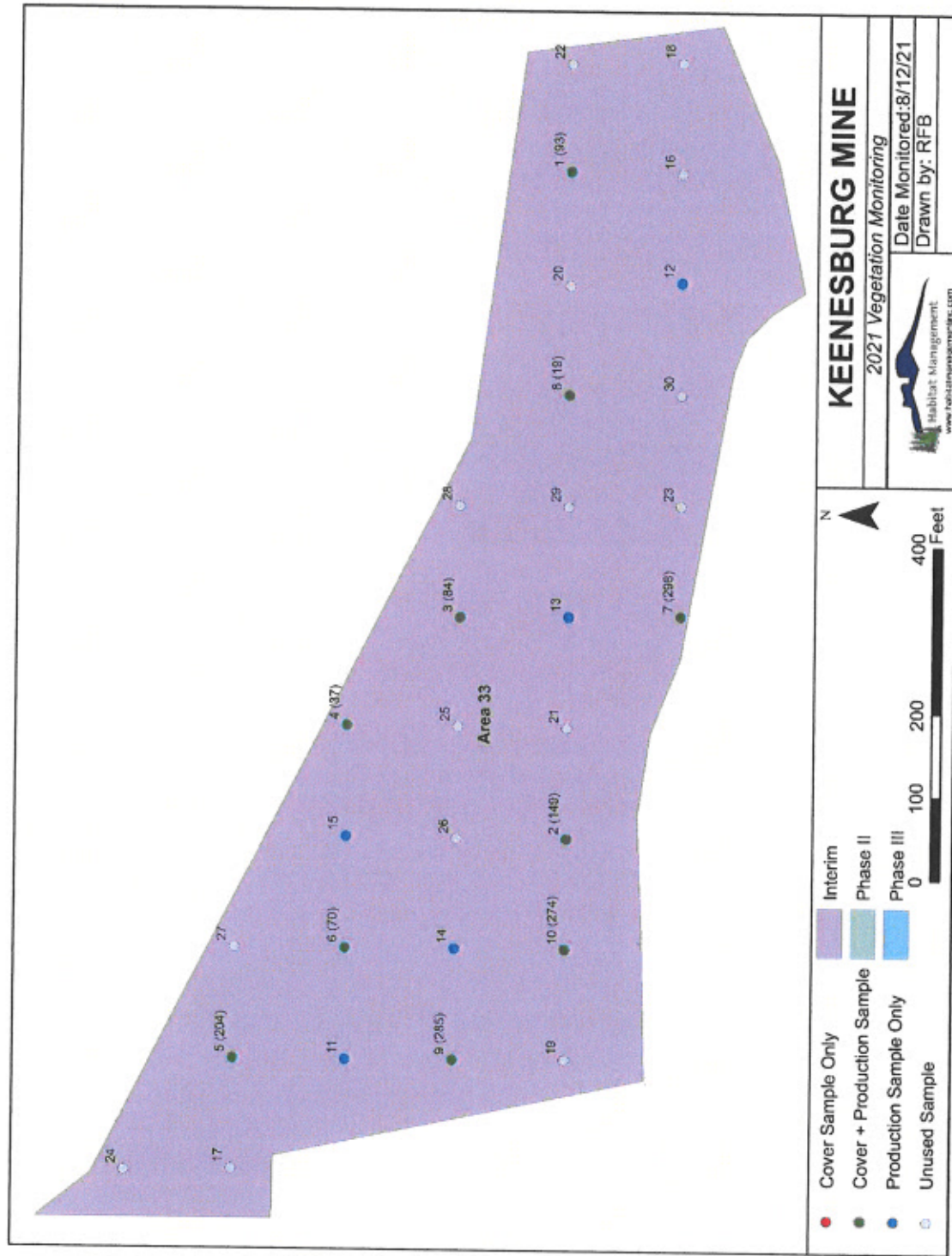


Figure 6: Sample Point Locations (Area 34)

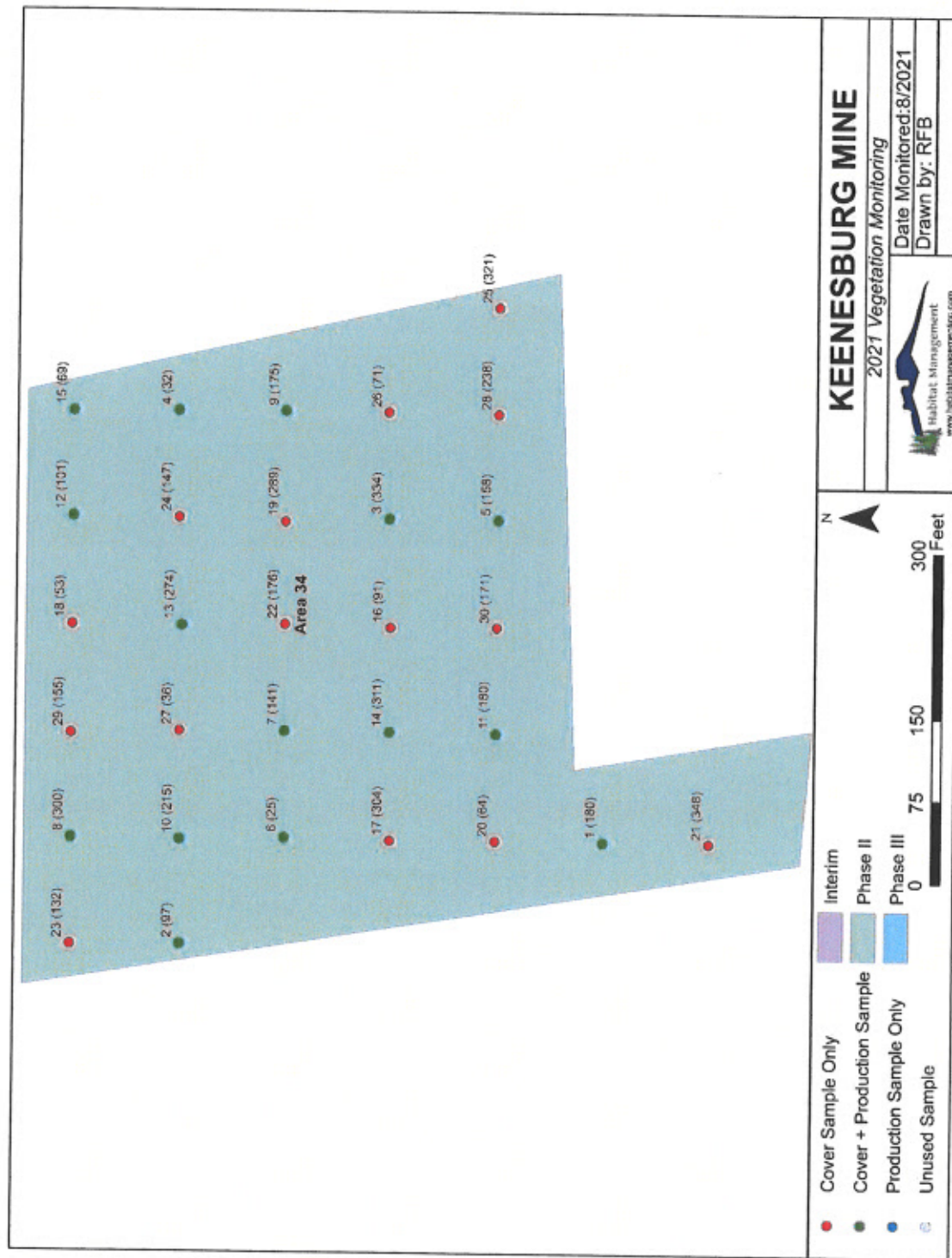
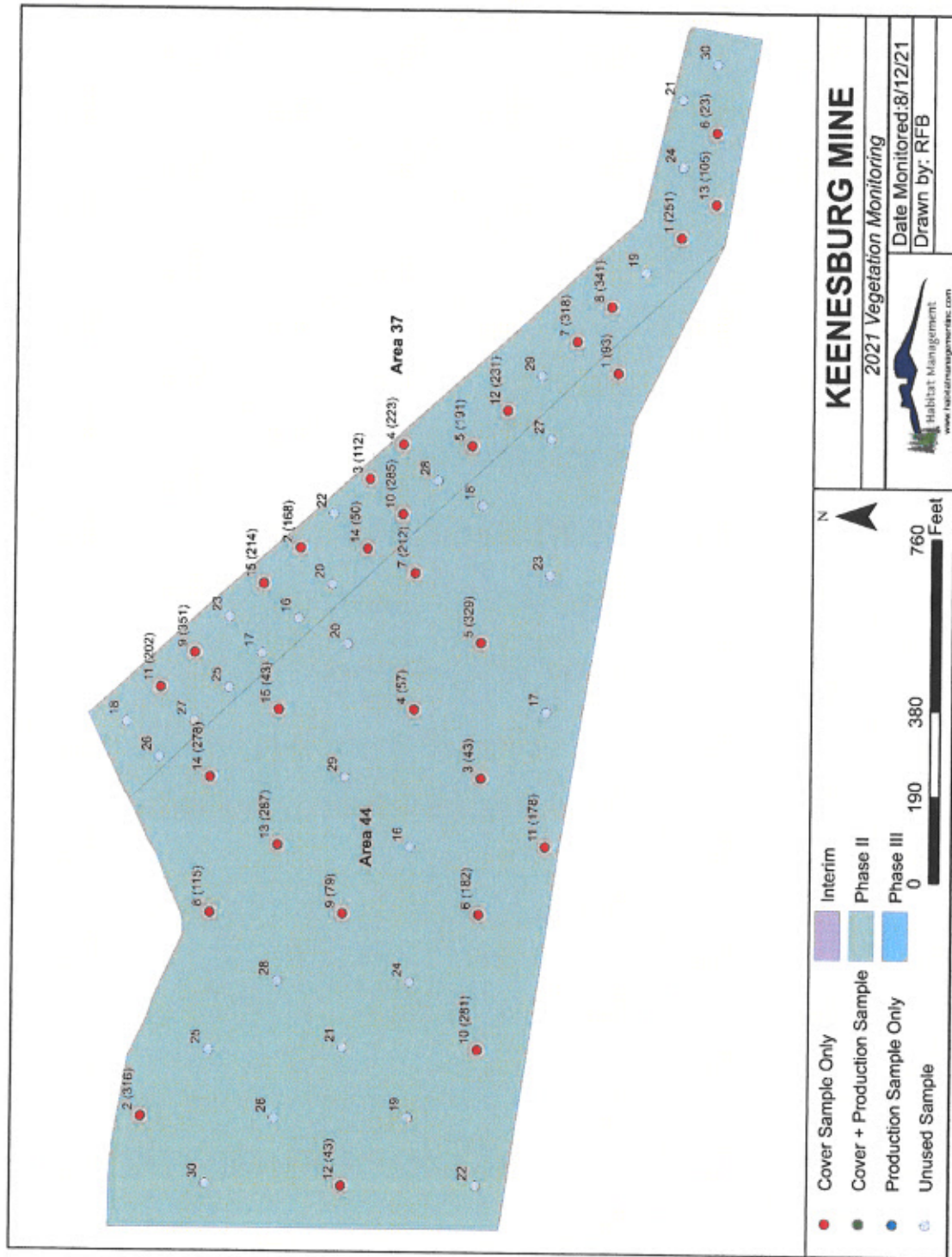


Figure 7: Sample Point Locations (Areas 37 & 44)



2.5 Species Composition

During cover sampling, all plant species occurring within one meter of either side of the cover sample transect were noted as present within each sample. These species are presented in the data tables for each Reclamation Area (Appendix A) as well as on the complete species list (Appendix C).

Species composition information for comparison to the final revegetation success criterion was derived from quantitative relative vegetation cover data. The total hits (first hits and subsequent hits) for each non-noxious species were used to calculate relative cover as a basis for evaluation of the importance of each encountered plant species and life form.

2.6 Photographs

A photograph was taken at the start point of each cover transect looking along the length of the transect. These photos are presented in Appendix E.

2.7 Species Identification and Nomenclature

Species that were not readily identified in the field were collected for later identification. Specimens were identified using floral keys including Weber and Wittmann (2001) and Wingate (1994). Nomenclature follows the NRCS Plants Database (2019).

3 RECLAMATION SUCCESS STANDARDS

The Keenesburg Mine Reclamation Permit includes a species composition standard and predictive equations to determine the success standards for vegetation cover and herbaceous production. Both the vegetation cover and herbaceous production equations use the previous year's precipitation (September – July) to predict the success standard for any given year. These equations are as follows, where x is equal to the cumulative September – July precipitation:

$$\text{Vegetation Cover Standard} = -0.0127x^3 + 0.2115x^2 + 2.1772x$$

$$\text{Herbaceous Production Standard} = 0.4666x^{2.1405}$$

When these equations were developed, species listed by the Colorado Department of Agriculture as noxious weeds were not excluded from the data. In 2012, DRMS approved a Technical Revision (TR43) to the Keenesburg Mine Reclamation Permit to update the equations to remove noxious plant species from both the cover and production standards. The vegetation cover standard was again updated in a Minor Revision (MR46) to the permit.

To meet the reclamation standard specified in the permit, data are subjected to hypothesis testing as described in the DRMS Regulations of the Colorado Mined Land Reclamation Board for Coal Mining (DRMS 2005). Per this guideline, Reclamation Areas meet the success standard if the dataset is not significantly different from 90% of the standard using a one-sample T-test with a one-tailed confidence interval of 90%. Noxious species cover or production is removed as well as annual vegetation cover in excess of 10% of the overall average for each Reclamation Area to derive the allowable vegetation cover value used for hypothesis testing per the DRMS Guideline Regarding Selected Coal Mine Bond Release Issues (DRMS 1995).

Species composition is considered an indicator of successful vegetation establishment and a diverse vegetation community. The species composition standard for the Keenesburg Mine was modified in 2020 with a Technical Revision to the permit (TR47). The revised standard requires

that there be at least four perennial grass species, each of which comprise between 3% and 40% relative cover. Any perennial grass species, native or introduced, that is not defined as a noxious species may be used in the calculation of species composition.

The Phase III bond release guidelines require that vegetation cover, herbaceous production, and species composition meet the standards for two years. Phase II bond release guidelines require vegetation cover to meet the standard and that four perennial grass species be present in the community to potentially meet the species composition standard in the future.

3.1 2021 Revegetation Success Standards

The following standards were calculated for vegetation cover and herbaceous production using the September 2020 through July 2021 precipitation (9.8 inches) in the permitted predictive equations.

1. Vegetation Cover Standard = 27.2% (90% Standard = 24.5%)
2. Herbaceous Production Standard = 21.0 g/m² (90% Standard = 18.9 g/m²)

4 2020-2021 PRECIPITATION

The climate of the mine and surrounding area is typical of the region and characterized by cold winters and hot, dry summers. Average precipitation is generally lowest during the late fall and winter (October through March) and peaks in April through June (Figure 8).

The Keenesburg Mine Reclamation Permit specifies the use of onsite precipitation from September to July for calculating the vegetation cover and herbaceous production standards. CEC collected precipitation data at the mine from 1984 through August 2020 using a manual rain gauge checked daily by on-site personnel. In January 2021, a solar-powered NOAA IV Total Precipitation Measurement System was installed in the reclamation with a cellular connection to measure precipitation in the absence of on-site personnel. However, no data were collected from September 2020 – January 2021.

Due to insufficient on-site data for the part of previous 11-month period, alternative data were used for the statistics presented in this report. The Community Collaborative Rain, Hail & Snow Network (CoCoRaHS 2021) created by the Colorado Climate Center at Colorado State University in 1998 has three consistent monitoring locations within 16 miles of the Keenesburg Mine located near Greeley, Hudson, and Kersey. These stations have data going back to 2004, 2005, and 2010, respectively. Using correlation statistics on these three datasets and their average were compared to the pre-closure manual data and the data from the new cellular measurement system installed in January. The average of the monthly precipitation from the three CoCoRaHS locations was very highly correlated with both on-site datasets with R-values greater than 0.9 in both cases (Table 2). Thus, these average monthly values were substituted for the missing September 2020 – January 2021 data.

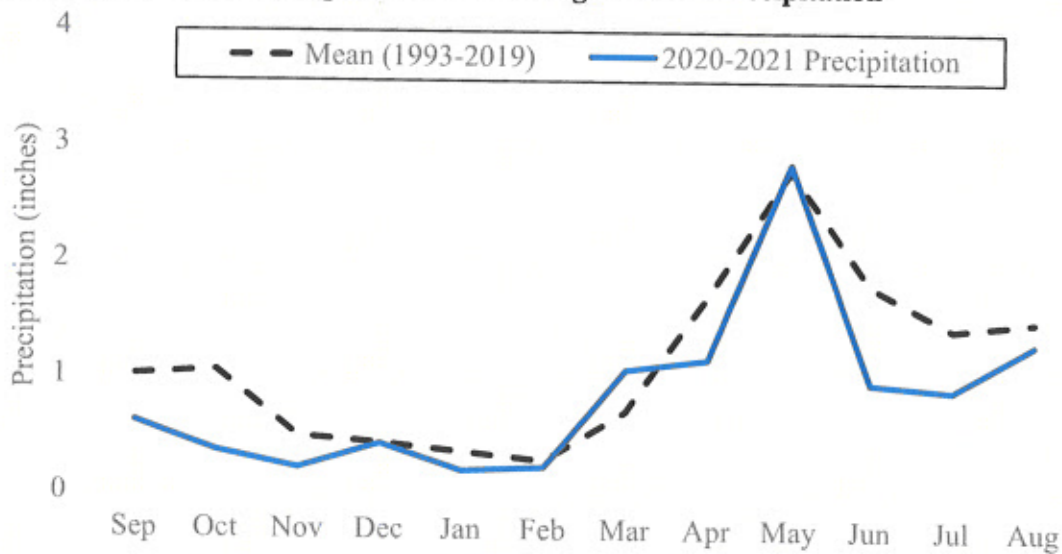
Total cumulative precipitation for the period from September 2020 – July 2021 was 8.6 inches. This represents 74% of the average precipitation amount for the same period (1993-2019). The pattern and timing of the precipitation was very consistent with the average (Figure 8). However, the September-November 2020 precipitation was only 57% of average and summer June-July 2021 was only 46% of average. All data from 1993 – 2021 are presented in Appendix D.

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 2: Correlation Statistics for On-Site and CoCoRaHS Precipitation Data

Station	Pre-Closure Manual Data (2004-2020)			New Cellular Measurement System (2021)		
	Pearson Correlation (R)	Significance (2-tailed)	N	Pearson Correlation (R)	Significance (2-tailed)	N
Greeley 10.5 SSE (10.1 miles NW)	0.900	0.000	195	0.754	0.050	7
Hudson 4.8 WSW (15.8 miles SW)	0.801	0.000	195	0.950	0.001	7
Kersey 4.5 E (13.4 miles N)	0.876	0.000	126	0.794	0.033	7
CoCoRaHS Average	0.902	0.000	126	0.933	0.002	7

Figure 8: 2020-2021 Precipitation and Average Annual Precipitation



5 2021 PEST & DISEASE INSPECTIONS

Habitat Management was contracted to completed quarterly pest and disease inspections at the Keenesburg Mine in 2021. The first three inspections were completed on March 31st, June 23rd, September 8th, and the reports from each inspection are included in Appendix F. The 4th quarter inspection has not yet been completed as of this report; however, it will be completed before the end of the quarter.

6 RESULTS

Vegetation cover, species composition, and herbaceous production results for each Reclamation Area are summarized below. Results for Reclamation Areas monitored for Phase III bond release (Areas 29, 30, and 31) are presented first followed by those areas monitored for Phase II bond release (Areas 25, 34, 37, and 44) and then those areas monitored for interim evaluation (Areas 32 and 33).

Complete vegetation cover and herbaceous production data for each Reclamation Area are presented in Appendix A and Appendix B, respectively. A complete species list for all Reclamation Areas is presented in Appendix C.

6.1 Phase III Reclamation Monitoring

Reclamation Areas 29, 30, and 31 were monitored for Phase III bond release. Because Reclamation Area 30 has not yet received Phase II bond release, it was evaluated using both the Phase II and Phase III bond release guidelines.

6.1.1 Reclamation Area 29

Reclamation Area 29 is an 8.1-acre parcel that was formerly part of the B Pit mining area. This area was graded to blend into the undisturbed area to the west and the reclaimed mining and operational areas to the east resulting in a gentle, east-facing slope. Final revegetation seeding with the DRMS-approved permanent seed mixture took place in 2003. Per approval from DRMS, Reclamation Area 23 was combined with Reclamation Area 29 in 2019. Reclamation Area 23 is a 0.7-acre parcel, formerly part of the B Pit mining area, that was graded to blend into the reclaimed mining and operational areas to the east resulting in an almost flat, east-facing slope. Final revegetation seeding with the DRMS-approved permanent seed mixture took place in November 2002. The total area included in the Reclamation Area 29 sampling was 8.8 acres.

Total vegetation cover averaged 38.3% (Table 3, Appendix A) which was a substantial increase from the 27.6% cover observed in 2020. Non-noxious vegetation cover was 35.9% up from only 11.4% observed in 2020. However, allowable vegetation cover was only 29.1% due to an average annual relative cover that was 28.8% of the total. Area 29 met sample adequacy with 18 samples.

Total non-noxious herbaceous production averaged 70.4 g/m² in 2021 (Table 3, Appendix A) which is a substantial increase from the 22.2 g/m² production observed in 2020. Annual species accounted for 38.1% of this production so the average allowable herbaceous production was only 53.8 g/m².

The only species observed on all 18 transects was sand dropseed (*Sporobolus cryptandrus*) which contributed 23.1% of the overall relative cover. Cheatgrass (*Bromus tectorum*) which contributed 57.0% of the overall relative cover in 2020, only contributed 6.6% in 2021. With cheatgrass removed, four perennial grass species contributed more than 3% of the relative cover including (in decreasing order): sand dropseed, sand bluestem (*Andropogon hallii*), prairie sandreed (*Calamovilfa longifolia*), and blue grama (*Bouteloua gracilis*). Two forb species, redroot amaranth (*Amaranthus retroflexus*) and common sunflower (*Helianthus annuus*) also contributed more than 3% of the relative cover.

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 3: Reclamation Area 29 Summary Statistics

Summary Statistics	Area 29	
	Mean	SE
<i>Absolute Cover Statistics (%)</i>		
Total Ground Cover	81.1	2.8
Total Vegetation Cover	38.3	2.8
Non-Noxious Vegetation Cover	35.9	2.3
Allowable Vegetation Cover	29.1	2.3
Grass Cover	27.0	3.5
Forb Cover	10.3	1.8
Woody Cover	1.0	0.4
<i>Non-Noxious Relative Cover Statistics (%)</i>		
Grass Cover	67.7	5.8
Forb Cover	29.4	5.4
Woody Cover	2.8	1.1
<i>Herbaceous Production Statistics (g/m²)</i>		
Total Production	70.4	16.9
Allowable Production	53.8	16.5
Perennial Production	43.6	12.5
Annual Production	26.8	13.5

Twenty species from seven life forms contributed to the cover data and another 14 species were encountered along the transects (Table 4, Appendix C). Twelve grasses, 20 forbs, and two woody species were recorded, 26 of which were native or desirable and eight were introduced. There were 16 perennial species and 18 annual species.

Table 4: Reclamation Area 29 Species Composition

Life Form	Cover	
	Data	Present
<i>Graminoids</i>		
Perennial	8	9
Annual	1	3
Native	8	10
Introduced	1	2
Cool Season	1	1
Warm Season	7	8
Total	9	12
<i>Forbs</i>		
Perennial	0	5
Annual	10	15
Native	7	14
Introduced	3	6
Total	10	20
Woody Plants	1	2
Total Species	20	34

Keenesburg Mine 2021 Vegetation Monitoring Report

Both the allowable vegetation cover and the allowable herbaceous production passed the technical standard when subjected to hypothesis testing (Table 5). Additionally, four perennial grass species contributed greater than 3% and less than 40% of the non-noxious relative cover. Thus, the Phase III bond release success criteria were met.

Table 5: Reclamation Area 29 Success Criteria

Reclamation Success Criteria	Reclamation Area	Technical Standard	90% Technical Standard	Pass?
Allowable Cover (%)	29.1	27.2	24.5	Yes
Allowable Production (g/m ²)	53.8	21.0	18.9	Yes
Species Composition (perennial grass)	4	4		Yes

6.1.2 Reclamation Area 30

Reclamation Area 30 is a 9.7-acre parcel that was formerly part of the B Pit mining area. This area was graded to blend into the undisturbed area to the west and the reclaimed mining and operational areas to the east resulting in a gentle, east-facing slope. Final revegetation seeding with the DRMS-approved permanent seed mixture took place in November 2006. This Reclamation Area has previously received Phase I bond release but has not received Phase II release.

Total vegetation cover averaged 36.8% (Table 6, Appendix A) which was a slight increase from the 34.3% cover observed in 2020. However, non-noxious vegetation cover was 30.5% up from only 17.1% observed in 2020. Allowable vegetation cover met sample adequacy with 15 samples. Nine annual species (two grasses and seven forbs) contributed a total of 17.0% of the non-noxious relative cover which exceeded the allowable 10% to be used in final hypothesis testing. Thus, the average allowable vegetation cover was 27.5% up from 15.0% in 2020.

Total non-noxious herbaceous production averaged 50.5 g/m² (Table 6, Appendix A) which is substantially more than the 20.9 g/m² production observed in 2020. Annual species accounted for 24.5% of this production. Thus, the average allowable herbaceous production was only 43.5 g/m².

Sand dropseed and sand bluestem were present along all 15 transects and contributed to the cover on 13 and 14 of them, respectively. Together these two species contributed 55.5% of the overall relative cover. Cheatgrass was also present on all 15 transects and contributed 16.6% of the relative cover down from 48.1% in 2020. With cheatgrass removed, five species contributed more than 3% of the relative cover including (in decreasing order): sand bluestem, sand dropseed, redroot amaranth, prairie sandreed, and false buffalograss (*Munroa squarrosa*).

Nineteen species from seven life forms contributed to the cover data and another 11 species were encountered along the transects (Table 7, Appendix C). Fourteen grasses, 14 forbs, and two woody species were recorded, 24 of which were native or desirable and six were introduced. There were 13 perennial species and 17 annual species.

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 6: Reclamation Area 30 Summary Statistics

Summary Statistics	Area 30	
	Mean	SE
<i>Absolute Cover Statistics (%)</i>		
Total Ground Cover	82.4	1.8
Total Vegetation Cover	36.8	2.6
Non-Noxious Vegetation Cover	30.5	2.2
Allowable Vegetation Cover	27.5	2.2
Grass Cover	32.1	2.6
Forb Cover	4.7	0.9
Woody Cover	0.0	0.0
<i>Non-Noxious Relative Cover Statistics (%)</i>		
Grass Cover	84.1	2.5
Forb Cover	15.3	2.5
Woody Cover	0.6	0.4
<i>Herbaceous Production Statistics (g/m²)</i>		
Total Production	50.5	7.0
Allowable Production	43.5	6.9
Perennial Production	38.1	6.3
Annual Production	12.4	4.1

Table 7: Reclamation Area 30 Species Composition

Life Form	Cover	
	Data	Present
<i>Graminoids</i>		
Perennial	8	10
Annual	3	4
Native	10	12
Introduced	1	2
Cool Season	0	1
Warm Season	8	9
Total	11	14
<i>Forbs</i>		
Perennial	1	1
Annual	7	13
Native	6	10
Introduced	2	4
Total	8	14
Woody Plants	0	2
Total Species	19	30

Keenesburg Mine 2021 Vegetation Monitoring Report

Both the allowable vegetation cover and the allowable herbaceous production passed the technical standard when subjected to hypothesis testing (Table 8). Additionally, four perennial grass species contributed greater than 3% and less than 40% of the non-noxious relative cover. With these results, both the Phase II and Phase III bond release success criteria were met.

Table 8: Reclamation Area 30 Success Criteria

Reclamation Success Criteria	Reclamation Area	Technical Standard	90% Technical Standard	Pass?
Allowable Cover (%)	27.5	27.2	24.5	Yes
Allowable Production (g/m ²)	43.5	21.0	18.9	Yes
Species Composition (perennial grass)	4	4		Yes

6.1.3 Reclamation Area 31

Reclamation Area 31 is an 11.9-acre parcel that was also part of the B Pit mining area. This area was graded to blend into the undisturbed area to the west and the reclaimed mining and operational areas to the east resulting in a gentle, east-facing slope. Final revegetation seeding with the DRMS-approved permanent seed mixture took place in the fall of 2009.

Total vegetation cover averaged 38.0% (Table 9, Appendix A) which was a substantial increase from the 27.9% cover observed in 2020. Non-noxious vegetation cover was 37.7% which was a larger increase from the 9.6% observed in 2020. Allowable vegetation cover in Reclamation Area 31 met sample adequacy with the minimum 15 samples. No excess annual cover was recorded; thus, the non-noxious cover was used for hypothesis testing.

Total non-noxious herbaceous production averaged 63.3 g/m² (Table 9, Appendix A) which was substantially more than the 29.9 g/m² production observed in 2020. Annual species accounted for 16.7% of this production. Thus, the average allowable herbaceous production was only 59.0 g/m².

Prairie sandreed contributed to the cover on all 15 transects and comprised 39.5% of the total relative cover. Sand dropseed and redroot amaranth were also observed on all 15 transects and contributed 20.4% and 5.4% of the relative cover, respectively. Cheatgrass comprised only 1.0% of the total relative cover down from 64.9% in 2020. With cheatgrass removed five species contributed more than 3% of the relative cover including (in decreasing order): prairie sandreed, sand bluestem, sand dropseed, redroot amaranth, and sideoats grama (*Bouteloua curtipendula*).

Fourteen species from six life forms contributed to the cover data and 13 more species were encountered along the transects (Table 10). Thirteen grasses, 11 forbs, and three woody species were recorded, 22 of which were native or desirable and five were introduced. There were 13 perennial species and 14 annual species.

Both the allowable vegetation cover and the allowable herbaceous production passed the technical standard when subjected to hypothesis testing (Table 11). Additionally, four perennial grass species contributed greater than 3% and less than 40% of the non-noxious relative cover. Thus, the Phase III bond release success criteria were met.

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 9: Reclamation Area 31 Summary Statistics

Summary Statistics	Area 31	
	Mean	SE
<i>Absolute Cover Statistics (%)</i>		
Total Ground Cover	80.9	2.4
Total Vegetation Cover	38.0	2.6
Non-Noxious Vegetation Cover	37.7	2.5
Allowable Vegetation Cover	37.7	2.5
Grass Cover	34.8	2.8
Forb Cover	3.2	0.9
Woody Cover	0.0	0.0
<i>Non-Noxious Relative Cover Statistics (%)</i>		
Grass Cover	90.9	2.9
Forb Cover	9.1	2.9
Woody Cover	0.0	0.0
<i>Herbaceous Production Statistics (g/m²)</i>		
Total Production	63.3	7.5
Allowable Production	59.0	7.5
Perennial Production	52.7	7.1
Annual Production	10.6	3.5

Table 10: Reclamation Area 31 Species Composition

Life Form	Cover	
	Data	Present
<i>Graminoids</i>		
Perennial	7	9
Annual	2	4
Native	8	11
Introduced	1	2
Cool Season	0	1
Warm Season	7	8
Total	9	13
<i>Forbs</i>		
Perennial	1	1
Annual	4	10
Native	4	8
Introduced	1	3
Total	5	11
Woody Plants	0	3
Total Species	14	27

Table 11: Reclamation Area 31 Success Criteria

Reclamation Success Criteria	Reclamation Area	Technical Standard	90% Technical Standard	Pass?
Allowable Cover (%)	37.7	27.2	24.5	Yes
Allowable Production (g/m ²)	59.0	21.0	18.9	Yes
Species Composition (perennial grass)	4	4		Yes

6.2 Phase II Monitoring

Reclamation Areas 25 and 34 were monitored for Phase II bond release. While no production sampling is required as a part of Phase II monitoring, 15 production samples were collected and evaluated for Area 34 based on the Phase III standards as a measure of this area's progress towards future Phase III release.

6.2.1 Reclamation Area 25

Reclamation Area 25 is a 12.6-acre parcel east of the long-term spoil area. This area was graded to blend into the reclaimed areas resulting in a gentle, southwest-facing slope. Revegetation seeding with the DRMS-approved permanent seed mixture took place in 1995, but it was repeated in 2002 and 2012 due to insufficient vegetation cover.

Total vegetation cover averaged 45.9% (Table 12, Appendix A) which was a substantial increase from the 20.2% cover observed in 2020. Non-noxious vegetation cover was also 45.9% up from the 9.9% observed in 2020. However, substantial excess annual cover was recorded, and the allowable cover used for hypothesis testing was only 16.9%. Reclamation Area 25 required the maximum number of 30 samples to meet sample adequacy.

Table 12: Reclamation Area 25 Summary Statistics

Summary Statistics	Area 25	
	Mean	SE
Absolute Cover Statistics (%)		
Total Ground Cover	73.1	2.1
Total Vegetation Cover	45.9	2.7
Non-Noxious Vegetation Cover	45.9	2.7
Allowable Vegetation Cover	16.9	2.7
Grass Cover	11.9	1.4
Forb Cover	33.9	3.6
Woody Cover	0.1	0.1
Non-Noxious Relative Cover Statistics (%)		
Grass Cover	32.2	4.3
Forb Cover	67.4	4.5
Woody Cover	0.4	0.3

The only species observed along all 30 transects Russian thistle (*Salsola tragus*) which comprised 66.6% of the relative cover. An additional 17.0% was contributed by sand dropseed, 5.5% was contributed by prairie sandreed, 3.7% was contributed by sand bluestem, 3.1% was contributed by common sunflower, and the other 4.1% was contributed by 14 different species.

Keenesburg Mine 2021 Vegetation Monitoring Report

Cheatgrass which comprised 49.4% of the relative cover in 2020, was almost completely absent from this Reclamation Area in 2021 due to successful fall pre-emergent herbicide treatment in 2020; however, Russian thistle appears to have filled in to replace it.

Thirty-five species from 11 life forms were encountered along the transects (Appendix C). Eight grasses, nine forbs, two woody species contributed to the cover data; 16 of which were native or desirable, two were introduced annuals, and one was noxious (Table 13). There were 13 perennial species and six annual species observed.

Table 13: Reclamation Area 25 Species Composition

Life Form	Cover Data	Present
<i>Graminoids</i>		
Perennial	7	11
Annual	1	4
Native	8	14
Introduced	0	1
Cool Season	3	4
Warm Season	4	7
Total	8	15
<i>Forbs</i>		
Perennial	4	6
Annual	5	11
Native	6	10
Introduced	3	7
Total	9	17
Woody Plants	2	3
Total Species	19	35

Allowable vegetation cover did not pass the technical standard when subjected to hypothesis testing (Table 14). Eleven perennial grasses were observed along the transects which meets the Phase II bond release success criteria. No production data were collected in the area in 2021.

Table 14: Reclamation Area 25 Success Criteria

Reclamation Success Criteria	Reclamation Area	Technical Standard	90% Technical Standard	Pass?
Allowable Cover (%)	16.9	27.2	24.5	No
Allowable Production (g/m ²)	n/a	n/a	n/a	n/a
Species Composition (perennial grass)	11	4		Yes

Keenesburg Mine 2021 Vegetation Monitoring Report

6.2.2 Reclamation Area 34

Reclamation Area 34 is a 6.9-acre parcel that was formerly part of Topsand piles A and B. This area was graded to blend into the reclaimed mining and operational areas to the south resulting in an almost flat area. Final revegetation seeding with the DRMS-approved permanent seed mixture took place in October 2016.

Total vegetation cover averaged 33.3% up from 14.1% in 2020 and non-noxious vegetation cover averaged 32.6% compared to 12.5% in 2020 (Table 15, Appendix A). Ten annual species (one grass and nine forbs) contributed a total of 46.1% of the non-noxious relative cover which exceeded the allowable 10% to be used in final hypothesis testing. Thus, the average allowable vegetation cover was 20.6% up from 12.5% in 2020. Reclamation Area 34 required the maximum number of 30 samples.

Total non-noxious herbaceous production averaged 70.4 g/m² (Table 15, Appendix A) which was substantially more than the 42.9 g/m² observed in 2020. However, annual species accounted for 58.7% of this production resulting in only 41.4 g/m² of allowable herbaceous production.

Table 15: Reclamation Area 34 Summary Statistics

Summary Statistics	Area 34	
	Mean	SE
<i>Absolute Cover Statistics (%)</i>		
Total Ground Cover	56.1	3.2
Total Vegetation Cover	33.3	2.4
Non-Noxious Vegetation Cover	32.6	2.2
Allowable Vegetation Cover	20.6	2.2
Grass Cover	18.1	2.2
Forb Cover	14.9	2.2
Woody Cover	0.2	0.1
<i>Non-Noxious Relative Cover Statistics (%)</i>		
Grass Cover	55.9	4.3
Forb Cover	43.4	4.4
Woody Cover	0.7	0.4
<i>Herbaceous Production Statistics (g/m²)</i>		
Total Production	70.4	11.3
Allowable Production	41.4	10.4
Perennial Production	29.1	5.1
Annual Production	41.3	9.1

The only species observed on all 30 transects was sand dropseed which contributed 30.8% of the overall relative cover. Cheatgrass contributed to the cover on three transects and only contributed 2.1% of the overall relative cover down from 11.2% in 2020. When cheatgrass was removed five species contributed more than 3% of the relative cover including (in decreasing order): sand dropseed, Russian thistle, prairie sandreed, common sunflower, and Jerusalem oak goosefoot (*Dysphania botrys*).

Keenesburg Mine 2021 Vegetation Monitoring Report

Twenty-eight species from eight life forms contributed to the cover data and 34 other species were encountered along the transects (Table 16, Appendix C). Twenty-three grasses, 35 forbs, and four woody species were recorded, 49 of which were native or desirable and 13 were introduced. There were 36 perennial species and 26 annual species.

Table 16: Reclamation Area 34 Species Composition

Life Form	Cover	
	Data	Present
Graminoids		
Perennial	12	19
Annual	2	4
Native	13	21
Introduced	1	2
Cool Season	5	9
Warm Season	7	10
Total	14	23
Forbs		
Perennial	3	13
Annual	9	22
Native	9	24
Introduced	3	11
Total	12	35
Woody Plants	2	4
Total Species	28	62

The allowable vegetation cover did not pass the technical standard when subjected to hypothesis testing (Table 17). However, 19 perennial grasses were observed along the transects which does meet the Phase II bond release species composition standard. While 30 production samples would have been required for Phase III hypothesis testing, the calculated allowable production based on the 15 samples collected did meet the production standard.

Table 17: Reclamation Area 34 Success Criteria

Reclamation Success Criteria	Reclamation Area	Technical Standard	90% Technical Standard	Pass?
Allowable Cover (%)	20.6	27.2	24.5	No
Allowable Production (g/m ²)	41.4	21.0	18.9	Yes
Species Composition (perennial grass)	19	4		Yes

Keenesburg Mine 2021 Vegetation Monitoring Report

6.2.3 Reclamation Area 37

Reclamation Area 37 is a 9.1-acre parcel where the northern topsand pile was previously located. This area was graded to blend into the reclaimed areas resulting in a gentle, east-facing slope. Revegetation seeding with the DRMS-approved permanent seed mixture took place in 2019. This area has not yet received Phase I bond release.

Total vegetation cover averaged 25.1% (Table 18, Appendix A) and non-noxious vegetation cover was 24.8%. Substantial excess annual cover was recorded; thus, the allowable cover used for hypothesis testing was only 10.9%. While the maximum number of 30 samples would have been required to meet sample adequacy, only the minimum 15 samples were collected due to the obvious lack of sufficient cover to meet the Phase II standards.

Table 18: Reclamation Area 37 Summary Statistics

Summary Statistics	Area 37	
	Mean	SE
<i>Absolute Cover Statistics (%)</i>		
Total Ground Cover	39.6	5.3
Total Vegetation Cover	25.1	3.8
Non-Noxious Vegetation Cover	24.8	3.7
Allowable Vegetation Cover	10.9	3.7
Grass Cover	9.6	2.3
Forb Cover	15.5	4.7
Woody Cover	7.0	1.2
<i>Non-Noxious Relative Cover Statistics (%)</i>		
Grass Cover	44.5	9.8
Forb Cover	55.5	9.8
Woody Cover	7.0	1.2

There were three dominant species observed along at least 14 of the 15 transects: Indian ricegrass (*Achnatherum hymenoides*), Russian thistle, and redroot amaranth (Appendix C). These species comprised 29.7%, 25.6%, and 8.2%, respectively, of the relative cover. An additional 9.7% each was contributed by prostrate knotweed (*Polygonum aviculare*) and common sunflower, and the other 17.1% was contributed by nine other species. Cheatgrass was the only noxious species observed and only comprised 1.0% of the relative cover.

Twenty-eight species from seven life forms were encountered along the transects (Appendix C). Six grasses and eight forbs contributed to the cover data; nine of which were native or desirable, four were introduced annuals, and one was noxious (Table 19). There were three perennial species and 11 annual species observed. Three of the species included in the seed mixture were observed along the transects and contributed 30.3% of the relative cover.

Allowable vegetation cover did not pass the technical standard when subjected to hypothesis testing (Table 20). Seven perennial grasses were observed along the transects which meets the Phase II bond release success criteria. No production data were collected in the area in 2021.

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 19: Reclamation Area 37 Species Composition

Life Form	Cover	
	Data	Present
Graminoids		
Perennial	3	7
Annual	3	5
Native	5	10
Introduced	1	2
Cool Season	2	6
Warm Season	1	1
Total	6	12
Forbs		
Perennial	0	4
Annual	8	12
Native	4	10
Introduced	4	6
Total	8	16
Woody Plants	0	0
Total Species	14	28

Table 20: Reclamation Area 37 Success Criteria

Reclamation Success Criteria	Reclamation Area	Technical Standard	90% Technical Standard	Pass?
Allowable Cover (%)	10.9	27.2	24.5	No
Allowable Production (g/m ²)	n/a	n/a	n/a	n/a
Species Composition (perennial grass)	7	4		Yes

6.2.4 Reclamation Area 44

Reclamation Area 44 is a 27.4-acre parcel encompassing the northern portions of the B Pit and long-term spoils areas. This area was graded to blend into the reclaimed areas resulting in a gentle, east-facing slope. Revegetation seeding with the DRMS-approved permanent seed mixture took place in 2019. This area has not yet received Phase I bond release

Total vegetation cover averaged 31.7% (Table 21, Appendix A) and non-noxious vegetation cover was 26.8%. Substantial excess annual cover was recorded; thus, the allowable cover used for hypothesis testing was only 10.6%. Only the minimum 15 samples were required to meet sample adequacy.

There were seven dominant species observed along at least 10 of the 15 transects and comprising 87.9% of the relative cover: Russian thistle, common sunflower, cheatgrass, sand dropseed, Indian ricegrass, bushy knotweed (*Polygonum ramosissimum*), and redroot amaranth (Appendix C). An additional 8.5% was contributed by kochia and the other 3.6% was contributed by seven other species. Cheatgrass was the only noxious species observed and comprised 16.2% of the relative cover.

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 21: Reclamation Area 44 Summary Statistics

Summary Statistics	Area 44	
	Mean	SE
<i>Absolute Cover Statistics (%)</i>		
Total Ground Cover	46.5	3.6
Total Vegetation Cover	31.7	2.2
Non-Noxious Vegetation Cover	26.8	1.9
Allowable Vegetation Cover	10.6	1.8
Grass Cover	12.8	3.0
Forb Cover	18.9	2.8
Woody Cover	0.0	0.0
<i>Non-Noxious Relative Cover Statistics (%)</i>		
Grass Cover	31.4	8.7
Forb Cover	68.6	8.7
Woody Cover	0.0	0.0

Thirty-three species from eight life forms were encountered along the transects (Appendix C). Six grasses and nine forbs contributed to the cover data; 10 of which were native or desirable, four were introduced annuals, and one was noxious (Table 22). There were four perennial species and 11 annual species observed. Four of the species included in the seed mixture were observed along the transects and contributed 10.5% of the relative cover.

Table 22: Reclamation Area 44 Species Composition

Life Form	Cover	
	Data	Present
<i>Graminoids</i>		
Perennial	3	4
Annual	3	6
Native	5	8
Introduced	1	2
Cool Season	2	2
Warm Season	1	2
<i>Total</i>	6	10
<i>Forbs</i>		
Perennial	1	3
Annual	8	19
Native	5	14
Introduced	4	8
<i>Total</i>	9	22
Woody Plants	0	1
Total Species	15	33

Allowable vegetation cover did not pass the technical standard when subjected to hypothesis testing (Table 23). Four perennial grasses were observed along the transects which meets the Phase II bond release success criteria. No production data were collected in the area in 2021.

Table 23: Reclamation Area 44 Success Criteria

Reclamation Success Criteria	Reclamation Area	Technical Standard	90% Technical Standard	Pass?
Allowable Cover (%)	10.6	27.2	24.5	No
Allowable Production (g/m ²)	n/a	n/a	n/a	n/a
Species Composition (perennial grass)	4	4		Yes

6.3 Interim Monitoring

Reclamation Areas 32 and 33 were monitored under the interim evaluation guidelines. The interim monitoring guidelines call for the collection of 10 cover samples and 15 production samples which were not a statistically adequate sample sizes for hypothesis testing. However, to evaluate the progress of reclamation establishment on these sites, the data were compared to the Phase III standards anyway.

6.3.1 Reclamation Area 32

Reclamation Area 32 is a 5.5-acre parcel that was formerly part of the B Pit mining area. This area was graded to blend into the undisturbed area to the west and the reclaimed mining and operational areas to the east resulting in a gentle, east-facing slope. Final revegetation seeding with the DRMS-approved permanent seed mixture took place in November 2015.

Total vegetation cover averaged 45.6% (Table 24, Appendix A) which was an increase from the 24.2% cover observed in 2020. Non-noxious vegetation cover was 43.4% up from 16.8% in 2020. Five non-noxious annual species (one grass and four forbs) contributed a total of 26.7% of the non-noxious relative cover which exceeded the allowable 10% to be used in final hypothesis testing. Thus, the average allowable vegetation cover was only 36.1% up from 16.1% in 2020.

Total non-noxious herbaceous production averaged 67.5 g/m² (Table 24, Appendix A) up from 48.5 g/m² in 2019. Annual species accounted for 13.5% of this production. Thus, the average allowable herbaceous production was 65.1 g/m².

The only species contributing to cover in all 10 transects was prairie sandreed which contributed 53.4% of the overall relative cover. Cheatgrass was observed on nine transects but contributed only 4.7% of the total relative cover down from 29.8% in 2020. When cheatgrass was removed five species contributed more than 3% of the relative cover including (in decreasing order): prairie sandreed, redroot amaranth, Russian thistle, blue grama, and sand bluestem.

Thirteen species from seven life forms contributed to the cover data and 10 other species were encountered along the transects (Table 25, Appendix C). Fourteen grasses, eight forbs, and one woody species were recorded, 18 of which were native or desirable and five were introduced. There were 12 perennial species and 11 annual species.

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 24: Reclamation Area 32 Summary Statistics

Summary Statistics	Area 32	
	Mean	SE
<i>Absolute Cover Statistics (%)</i>		
Total Ground Cover	79.2	2.6
Total Vegetation Cover	45.6	1.8
Non-Noxious Vegetation Cover	43.4	1.7
Allowable Vegetation Cover	36.1	1.7
Grass Cover	34.2	4.6
Forb Cover	11.4	4.4
Woody Cover	0.0	0.0
<i>Non-Noxious Relative Cover Statistics (%)</i>		
Grass Cover	74.3	10.1
Forb Cover	25.2	9.9
Woody Cover	0.5	0.5
<i>Herbaceous Production Statistics (g/m²)</i>		
Total Production	67.5	5.2
Allowable Production	65.1	5.2
Perennial Production	58.4	5.8
Annual Production	9.1	2.6

Table 25: Reclamation Area 32 Species Composition

Life Form	Cover	
	Data	Present
<i>Graminoids</i>		
Perennial	7	11
Annual	2	3
Native	8	13
Introduced	1	1
Cool Season	1	4
Warm Season	6	7
Total	9	14
<i>Forbs</i>		
Perennial	0	0
Annual	4	8
Native	2	4
Introduced	2	4
Total	4	8
Woody Plants	0	1
Total Species	13	23

Keenesburg Mine 2021 Vegetation Monitoring Report

The interim monitoring guidelines call for the collection of 10 cover samples and 15 production samples. This was an adequate sample for the cover data; however, sample adequacy would have required 30 production samples. Both the allowable cover and allowable herbaceous production calculated from the samples collected exceeded the technical standard (Table 26). Only two perennial grass species contributed greater than 3% and less than 40% of the non-noxious relative cover and a third species contributed more than 40% of the relative cover.

Table 26: Reclamation Area 32 Success Criteria

Reclamation Success Criteria	Reclamation Area	Technical Standard	90% Technical Standard	Pass?
Allowable Cover (%)	36.1	27.2	24.5	Yes
Allowable Production (g/m ²)	65.1	21.0	18.9	Yes
Species Composition (perennial grass)	2	4		No

6.3.2 Reclamation Area 33

Reclamation Area 33 is a 12.5-acre parcel that was formerly part of the Long-Term Spoil Area. This area was graded to blend into the reclaimed mining and operational areas to the west resulting in an almost flat, east-facing slope. Final revegetation seeding with the DRMS-approved permanent seed mixture took place in November 2015.

Total vegetation cover averaged 53.6% (Table 27, Appendix A) up from 27.8% in 2020. Non-noxious vegetation cover was 40.6% up from 22.8% in 2020. Four non-noxious annual forb species contributed a total of 15.8% of the non-noxious relative cover which exceeded the allowable 10% to be used in final hypothesis testing. Thus, the average allowable vegetation cover was only 38.3% up from 22.8% in 2020.

Total non-noxious herbaceous production averaged 88.0 g/m² (Table 27, Appendix A) up from 47.0 g/m² in 2020. Annual species accounted for 17.5% of this production; thus, the average allowable herbaceous production was 81.4 g/m².

The only species contributing to cover in all 10 transects was prairie sandreed which contributed 47.1% of the overall relative cover. Cheatgrass was also observed on all 10 transects and contributed 24.1% of the total relative cover up from 17.7% in 2020. When cheatgrass was removed six species contributed more than 3% of the relative cover including (in decreasing order): prairie sandreed, blue grama, redroot amaranth, switchgrass (*Panicum virgatum*), Russian thistle, and bushy knotweed.

Fourteen species from six life forms contributed to the cover data and 12 other species were encountered along the transects (Table 28, Appendix C). Sixteen grasses and 10 forbs were recorded, 23 of which were native or desirable and three were introduced. There were 14 perennial species and 12 annual species.

Sample adequacy would have required 21 cover samples and 30 production samples. Both the allowable cover and allowable herbaceous production calculated from the samples collected exceeded the technical standard (Table 29). Only two perennial grass species contributed greater than 3% and less than 40% of the non-noxious relative cover and a third species contributed more than 40% of the relative cover.

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 27: Reclamation Area 33 Summary Statistics

Summary Statistics	Area 33	
	Mean	SE
<i>Absolute Cover Statistics (%)</i>		
Total Ground Cover	84.8	3.9
Total Vegetation Cover	53.6	4.2
Non-Noxious Vegetation Cover	40.6	4.2
Allowable Vegetation Cover	38.3	4.2
Grass Cover	47.2	5.5
Forb Cover	6.4	3.4
Woody Cover	4.5	1.0
<i>Non-Noxious Relative Cover Statistics (%)</i>		
Grass Cover	85.3	7.7
Forb Cover	14.8	7.7
Woody Cover	0.0	0.0
<i>Herbaceous Production Statistics (g/m²)</i>		
Total Production	88.0	7.3
Allowable Production	81.4	7.3
Perennial Production	72.6	6.4
Annual Production	15.4	9.1

Table 28: Reclamation Area 33 Species Composition

Life Form	Cover	
	Data	Present
<i>Graminoids</i>		
Perennial	9	13
Annual	1	3
Native	9	15
Introduced	1	1
Cool Season	2	5
Warm Season	7	8
Total	10	16
<i>Forbs</i>		
Perennial	0	1
Annual	4	9
Native	3	8
Introduced	1	2
Total	4	10
Woody Plants	0	0
Total Species	14	26

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 29: Reclamation Area 33 Success Criteria

Reclamation Success Criteria	Reclamation Area	Technical Standard	90% Technical Standard	Pass?
Allowable Cover (%)	38.3	27.2	24.5	Yes
Allowable Production (g/m ²)	81.4	21.0	18.9	Yes
Species Composition (perennial grass)	2	4		No

7 DISCUSSION

Reclamation Areas 29, 30, and 31 were previously monitored in 2015, 2016, 2018, 2019 and 2020, Reclamation Area 25 was monitored in 2016, 2018, 2019, and 2020 and Reclamation Areas 32, 33, and 34 were monitored in 2018, 2019, and 2020. Reclamation Areas 37 and 44 were monitored for the first time in 2021. No data were collected in 2017 due to a hailstorm on August 10, 2017, that destroyed the above-ground vegetation.

7.1 Vegetation Cover

Based on the results of the quantitative sampling, five of the nine Reclamation Areas had allowable vegetation cover that passed the success standard (Table 30). This included all of the Phase III and interim monitoring areas. The Phase II Reclamation Areas (25, 34, 37, and 44) all would have passed using the total non-noxious cover including the excess annuals. Most of the Phase II areas (Reclamation Areas 34, 37, and 44) are recently reclaimed and would be expected to have more annual cover. Typically, it takes several years for the perennial vegetation to establish and begin to displace the early seral annual species. Reclamation Area 25, while older reclamation, was treated with a pre-emergent herbicide in 2020 to control the cheatgrass. This treatment effectively treated the cheatgrass, but this left substantial bare areas for the invasion of other annual species. It may take a few years for the perennial grasses to fill in.

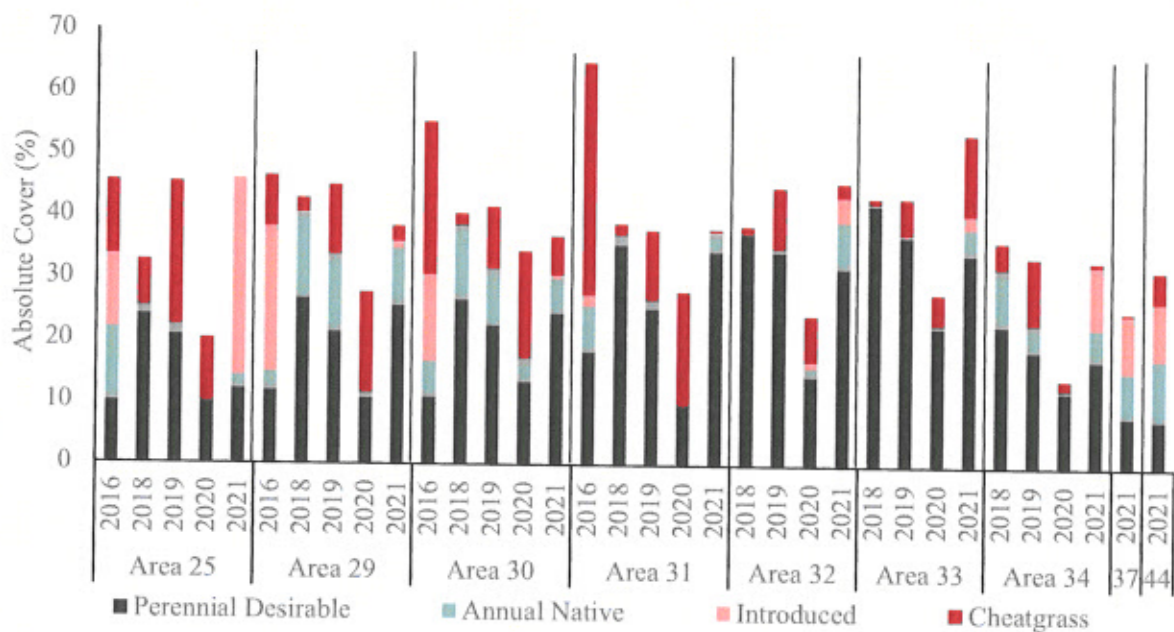
Table 30: Vegetation Cover Success Standard Comparison

Vegetation Cover	Phase III Monitoring			Phase II Monitoring				Interim Monitoring	
	Area 29	Area 30	Area 31	Area 25	Area 34	Area 37	Area 44	Area 32	Area 33
Average Vegetation Cover	38.3	36.8	38.0	45.9	33.3	25.1	31.7	45.6	53.6
Average Non-Noxious Cover	35.9	30.5	37.7	45.9	32.6	24.8	26.8	43.4	40.6
Average Allowable Cover	29.1	27.5	37.7	16.9	20.6	10.9	10.6	36.1	38.26
N	18	15	15	30	30	15	15	10	10
Nmin (non-noxious)	13	14	12	18	24	62	13	3	21
Stdev Allowable Cover	9.9	8.5	9.6	14.6	12.0	14.4	7.0	5.5	13.3
Standard	27.2								
90% of Standard	24.5								
T (one-tail, $\alpha=0.9$)	1.333	1.345	1.345	1.311	1.311	1.345	1.345	1.383	1.383
Standard Passed?	Yes	Yes	Yes	No	No	No	No	Yes*	Yes*

Keenesburg Mine 2021 Vegetation Monitoring Report

Desirable vegetation cover increased from 2020 to 2021 in all previously monitored Reclamation Areas after a steady decrease from 2018 to 2020 (Figure 9). In most of the Reclamation Areas (all except for Area 25), the desirable perennial cover is almost back to its 2019 level. The desirable cover in Reclamation Area 37 and 44 was lower than all other areas; however, this was only the second growing season for these two areas (seeded in fall 2019). Thus, their cover was expected to be lower. Several portions of both these areas were identified for interseeding in fall 2021 to enhance their success.

Figure 9: Absolute Cover of Native and Introduced Species 2016 – 2021*

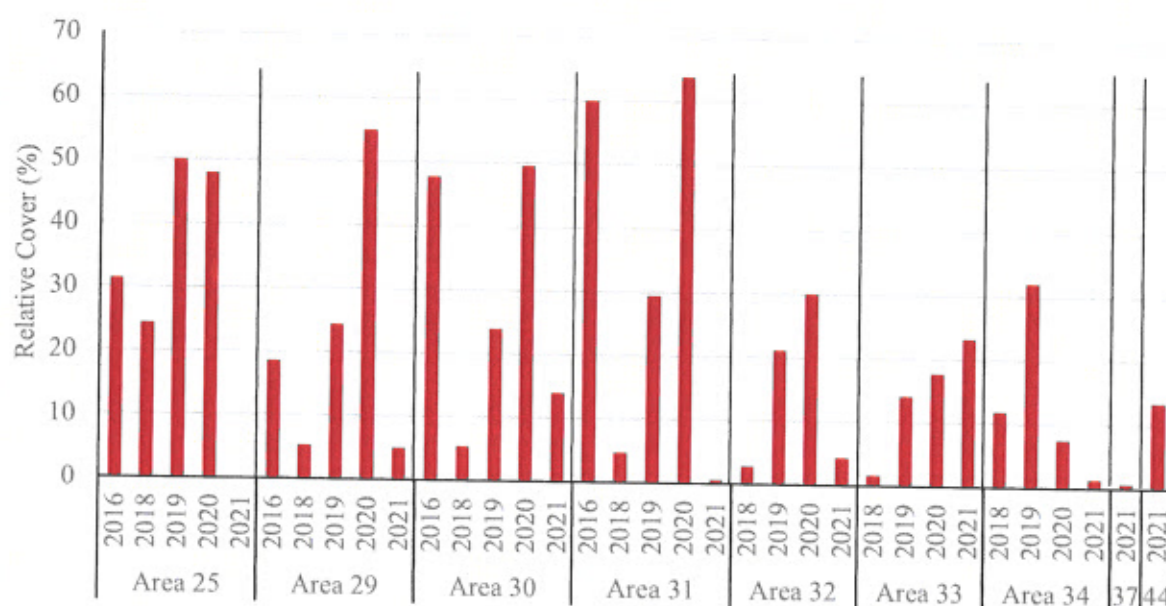


* No data collected in 2017

Cheatgrass cover decreased markedly from 2020 to 2021 in all Reclamation Areas except Area 33 (Figure 10). In fall 2020, several Reclamation Areas were treated with herbicide for cheatgrass mitigation which appears to have been very successful. Reclamation Areas 33 and 34 had the lowest 2020 cheatgrass cover and were not treated. However, Reclamation Area 33 may benefit from a future treatment.

Keenesburg Mine 2021 Vegetation Monitoring Report

Figure 10: Cheatgrass Relative Cover 2016 – 2021*



* No data collected in 2017

7.2 Herbaceous Production

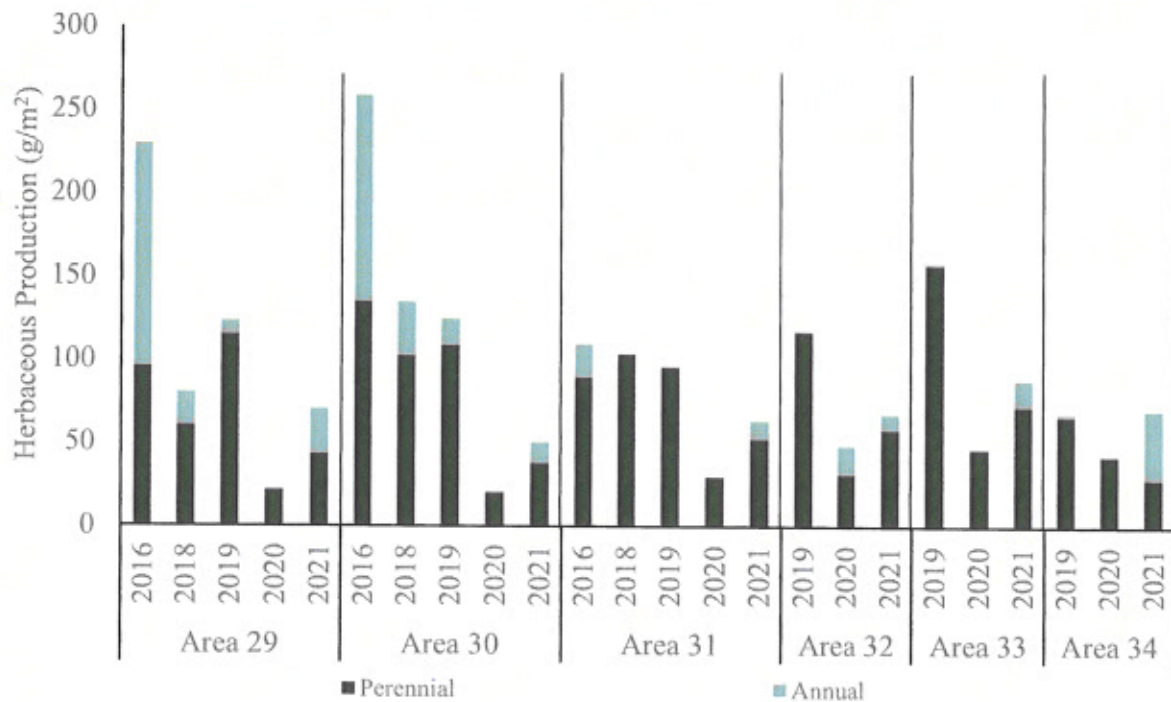
Based on the results of the herbaceous production sampling, all Reclamation Areas passed the calculated production success standard (Table 31). Overall, non-noxious herbaceous production increased from 2020 to 2021 in all areas (Figure 11). Allowable herbaceous production increased in all areas except for Area 34. None of the areas have rebounded to the levels that were observed in 2018. However, continued drought conditions did result in a reduced production standard as well.

Table 31: Herbaceous Production Success Standard Comparison

Herbaceous Production	Phase III Monitoring			Interim Monitoring		
	Area 29	Area 30	Area 31	Area 32	Area 33	Area 34
Average Total Production	70.4	50.5	63.3	67.5	88.0	70.4
Average Allowable Production	53.8	43.5	59.0	65.1	81.4	41.4
N	30	30	30	15	15	15
Nmin (non-noxious)	298	99.5	72.8	32.1	37.3	139.2
Stdev Allowable Production	90.5	38.0	41.2	28.4	40.0	56.9
Standard	21.0					
90% of Standard	18.9					
T (one-tail, $\alpha=0.9$)	1.311	1.311	1.311	1.345	1.345	1.345
Standard Passed?	Yes	Yes	Yes	Yes*	Yes*	Yes*

* Only sampled to the minimum sample size

Figure 11: Non-Noxious Herbaceous Production by Life Form 2016 – 2021*



* No data collected in 2017

7.3 Species Composition

The Phase III species composition bond release standard requires that four perennial grass species each contribute a minimum of 3% and a maximum of 40% of the relative non-noxious vegetation cover. All of the reclamation areas monitored for Phase III release met this standard. The species composition standard for Phase II bond release is that a sufficient number of species be present to meet the future Phase III bond release cover requirements. All four of the reclamation areas monitored for Phase II release exhibited at least four perennial grasses in the data. The two areas monitored using the interim monitoring methods each exhibited at least 11 perennial grass species, but neither one has yet met the Phase III standard.

8 SUMMARY

Quantitative monitoring revealed that Reclamation Areas 29, 30, and 31 all met the revegetation success standards for Phase III bond release (Table 32). This was the first year that these areas have met the standard, so they are not eligible for release until next year. Reclamation Area 30 also met the standard for Phase II bond release and would be eligible for Phase II release this year. Reclamation Areas 25, 34, 37, and 44 were also monitored under the Phase II bond release guidelines, but none of the areas met the vegetation cover standard. They did all meet the Phase II species composition standard and Area 34 met the interim monitoring production standard. Both Reclamation Areas 32 and 33 were monitored under the interim monitoring program and both met the herbaceous production standards. However, neither area met the vegetation cover or species composition standards. All nine reclamation areas will require additional sampling in 2022.

Keenesburg Mine 2021 Vegetation Monitoring Report

Table 32: Success Standard Summary

Reclamation Standard	Phase III Monitoring			Phase II Monitoring					Interim Monitoring*	
	Area 29	Area 30	Area 31	Area 25	Area 30	Area 34	Area 37	Area 44	Area 32	Area 33
Vegetation Cover	Yes	Yes	Yes	No	Yes	No	No	No	Yes	Yes
Herbaceous Production	Yes	Yes	Yes	n/a	n/a	Yes*	n/a	n/a	Yes	Yes
Species Composition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Eligible for Release	Next Year	Next Year	Next Year	No	Yes	No	No	No	n/a	n/a

9 LITERATURE CITED

- Community Collaborative Rain, Hail and Snow Network (CoCoRaHS). 2021. Daily Precipitation Records by Station.
<https://www.cocorahs.org/ViewData/ListDailyPrecipReports.aspx> [Accessed September 2021]
- Colorado Division of Reclamation Mining and Safety (DRMS). 1995. Guideline Regarding Selected Coal Mine Bond Release Issues (DRMS 1995).
<http://mining.state.co.us/Programs/Coal/RulesRegs/Documents/BondReleaseGuidelines.pdf> [Accessed October 2016].
- Colorado Division of Reclamation Mining and Safety (DRMS). 2005. Regulations of the Colorado Mined Land Reclamation Board for Coal Mining, Effective August 30, 1980, revised September 14, 2005.
<https://mining.state.co.us/SiteCollectionDocuments/CoalRegulations91405.pdf> [Accessed October 2019].
- USDA, NRCS. 2021. The PLANTS Database. National Plant Data Team, Greensboro, NC.
<http://plants.usda.gov> [Accessed August 2021].
- Weber, W. A. and R. C. Wittmann. 2001. Colorado Flora Easter Slope: Third Edition. University Press of Colorado, Boulder, CO.
- Wingate, J. L. 1994. Illustrated Keys to the Grasses of Colorado. Wingate Consulting, Denver, CO.

Keenesburg Mine 2021 Vegetation Monitoring Report

Appendix A: Vegetation Cover Data

Reclamation Area 25 Vegetation Cover Data

Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Grass: Annual Native																			
Cenchrus longispinus	mat sandbur																		
Munroa squarrosa	false buffalograss	p																	
Panicum capillare	witchgrass																		
Subtotal																			
Grass: Annual Introduced																			
Bromus tectorum	cheatgrass																		
Subtotal																			
Grass: Perennial Desirable (Cool)																			
Achnatherum hymenoides	Indian ricegrass																		
Hesperostipa comata	needle and thread																		
Pascopyrum smithii	western wheatgrass	p																	
Pseudoroegneria spicata	bluebunch wheatgrass																		
Subtotal																			
Grass: Perennial Desirable (Warm)																			
Andropogon hallii	sand bluestem	p																	
Bouteloua gracilis	blue grama																		
Calamovilfa longifolia	prairie sandreed	1	1																
Panicum virgatum	switchgrass																		
Schizachyrium scoparium	little bluestem	p																	
Sorghastrum nutans	Indiangrass																		
Sporobolus cryptandrus	sand dropseed	3																	
Subtotal																			
Total Grass Cover																			
Forbs: Annual & Biennial Native																			
Amaranthus retroflexus	redroot amaranth																		
Argemone polyanthemos	crested pricklypoppy	p	1	1															
Chenopodium desiccatum	aridland goosefoot																		
Croton texensis	Texas croton																		
Erigeron bellidistrum	western daisy fleabane																		
Helianthus annuus	common sunflower	p	1	3															
Subtotal																			
Forbs: Annual & Biennial Introduced																			
Amaranthus bioides	mat amaranth																		
Bassia scoparia	burningbush	p	p																
Dysphania botrys	Jerusalem oak goosefoot																		
Salvia tragus	prickly Russian thistle	23	29	4	23	36	1	9	14	17	12	32	2	12	20	8	29	13	20
Tribulus terrestris	puncturevine																		
Subtotal																			

Keenesburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 25 Vegetation Cover Data (continued)

Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd
Forbs: Perennial Native																			
Ambrosia psilostachya	Cuman ragweed																		
Physalis hispida	prairie groundcherry	p																	
Rumex venosus	veiny dock	1																	
Symphyotrichum lakatum	white prairie aster																		
Subtotal		1																	
Forbs: Perennial Introduced																			
Cardaria draba	whitclop																		
Convolvulus arvensis	field bindweed																		
Subtotal																			
Total Forb Cover		24	0	31	0	8	0	25	0	37	1	9	0	14	0	20	0	14	0
Subshrubs/Shrubs/Succulents: Perennial Native																			
Artemisia filifolia	sand sagebrush																		
Opuntia phaeacantha	tulip pricklypear																		
Yucca glauca	soapweed yucca																		
Subtotal																			
Total Shrub Cover		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock		9	2	22	1	1	19	10	5	15	9	26	14	18	10	18		20	13
Litter		13	16	8	24	10	15	21	23	14	4	9	18	6	22	18	17	4	13
Total Hits		50	1	50	2	50	1	50	2	50	0	50	2	50	1	50	1	50	1
Total Vegetation Cover		56	2	64	0	40	4	50	2	78	4	32	0	38	4	44	0	42	0
Non-Noxious Vegetation Cover		56	2	64	0	40	4	50	2	78	4	32	0	38	4	44	0	42	0
Total Ground Cover		74	68	84	52	80	70	58	54	72	92	82	64	88	56	64	66	92	74
Allowable Vegetation Cover		26.8	34.8	10.8	20.8	48.8	2.8	8.8	12.8	12.8	44.8	0.8	6.8	22.8	6.8	0.0	36.8	22.8	18.8
Non-Noxious Annual Cover		33.8																	
Excess Annual Cover		29.2																	

Reclamation Area 25 Vegetation Cover Data (continued)

Scientific Name	Common Name	19	20	21	22	23	24	25	26	27	28	29	30	Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)
Grass: Annual Native		1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd			
Cenchrus longispinus	mat sandbar													0 0	0.0	0.0	0.0
Munroa squarrosa	false buffalograss	p							p					2 2	0.1	0.3	0.3
Panicum capillare	wickgrass					p								0 0	0.0	0.0	0.0
Subtotal														2 2	0.1	0.3	0.3
Grass: Annual Introduced																	
Bromus tectorum	cheatgrass			p										0 0	0.0	0.0	0.0
Subtotal				p										0 0	0.0	0.0	0.0
Grass: Perennial Desirable (Cool)																	
Achnatherum hymenoides	Indian ricegrass													1 1	0.1	0.1	0.1
Hesperostipa comata	needle and thread	p												0 0	0.0	0.0	0.0
Pascopyrum smithii	western wheatgrass	p								3				3 3	0.2	0.4	0.4
Pseudoroegneria spicata	bluebunch wheatgrass													1 1	0.1	0.1	0.1
Subtotal														5 5	0.3	0.7	0.7
Grass: Perennial Desirable (Warm)																	
Andropogon hallii	sand bluestem	1	4										5	24 26	1.6	3.7	3.7
Bouteloua gracilis	blue grama	p	1			4	p	p						4 4	0.3	0.6	0.6
Calamovilfa longifolia	prairie sandreed			11	2	1	4		p	2				34 39	2.3	5.5	5.5
Panicum virgatum	switchgrass													0 0	0.0	0.0	0.0
Schizachyrium scoparium	little bluestem													0 0	0.0	0.0	0.0
Sorghastrum nutans	Indiangrass													0 0	0.0	0.0	0.0
Sporobolus cryptandrus	sand dropseed	3	1	5	1	1	4	8	1	2	1	6	1	109 121	7.3	17.0	17.0
Subtotal		7	7	10	11	3	12	8	1	4	1	6	1	171 190	11.4	26.7	26.7
Total Grass Cover		7	7	10	11	3	12	8	1	4	1	6	1	178 197	11.9	27.7	27.7
Forbs: Annual & Biennial Native																	
Amaranthus retroflexus	redroot amaranth	p			p	p		p	p	1			p	4 4	0.3	0.6	0.6
Argemone polyanthemos	crested pricklypoppy		p	p				p						4 4	0.3	0.6	0.6
Chenopodium desiccatum	aridland goosefoot													0 0	0.0	0.0	0.0
Croton texensis	Texas croton					p							p	0 0	0.0	0.0	0.0
Erigeron bellidistrum	western daisy fleabane		p											0 0	0.0	0.0	0.0
Helianthus annuus	common sunflower	p	2	2	2	2	3	p	p	p	2	2	p	22 22	1.5	3.1	3.1
Subtotal		p	2	2	2	2	3	p	p	1	p	2	p	30 30	2.0	4.2	4.2
Forbs: Annual & Biennial Introduced																	
Amaranthus bioides	mat amaranth													0 0	0.0	0.0	0.0
Bassia scoparia	burningbush	p		1	p					p				5 5	0.3	0.7	0.7
Dysphania borys	Jerusalem oak goosefoot													0 0	0.0	0.0	0.0
Salsola tragus	prickly Russian thistle	22	4	3	18	1	32	2	8	17	16	21	6	470 474	31.3	66.6	66.6
Tribulus terrestris	puncturevine													0 0	0.0	0.0	0.0
Subtotal		22	4	3	19	1	32	2	8	17	16	21	6	475 479	31.7	67.3	67.4

Reclamation Area 25 Vegetation Cover Data (continued)

Scientific Name	Common Name	19	20	21	22	23	24	25	26	27	28	29	30	Total Hits	Average	Average	Non-Noxious									
1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	All	Absolute	Relative									
Forbs: Perennial Native																										
Ambrosia psilostachya	Cuman ragweed														1	0.1	0.1									
Physalis hispida	prairie groundcherry														1	0.1	0.1									
Rumex venosus	veiny dock														0	0.0	0.0									
Symphoricarum falcatum	white prairie aster														1	0.1	0.1									
Subtotal															3	0.2	0.4									
Forbs: Perennial Introduced																										
Cardaria draba	whitetop																									
Convolvulus arvensis	field bindweed														0	0.0	0.0									
Subtotal															1	0.1	0.1									
Total Forb Cover																										
22	0	4	0	5	0	21	1	34	2	5	0	8	0	6	0	509	513	33.9	72.1	72.0						
Subshrubs/Shrubs/Succulents: Perennial Native																										
Artemisia filifolia	sand sagebrush														1	0.1	0.1									
Opuntia phaeacantha	tulip pricklypear												1	1	1	0.1	0.1	0.1	0.1							
Yucca glauca	soapweed yucca														0	0.0	0.0	0.0	0.0							
Subtotal															2	0.1	0.3	0.3	0.3							
Total Shrub Cover																										
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2	0.1	0.3	0.3						
Rock																										
15	17	25	2	4	23	16	19	8	25	19	8	25	19	408	408	27.2										
6	22	10	16	9	10	11	16	9	20	8	11	403	403	26.9												
Bare Ground																										
50	1	50	1	50	3	50	0	50	0	50	0	50	1	50	0	1500	1523	100.0								
Total Hits																										
Total Vegetation Cover																										
58	2	22	0	30	2	64	2	74	6	34	0	32	0	36	0	44	0	44	0	34	2	40	0	45.9	100.0	100.0
Non-Noxious Vegetation Cover																										
58	2	22	0	30	2	64	2	74	6	34	0	32	0	36	0	44	0	44	0	34	2	40	0	45.9		
Total Ground Cover																										
88	56	80	68	82	80	78	68	82	60	84	78	73.1														
Allowable Vegetation Cover																										
28.8	0.0	0.8	34.8	44.8	4.8	2.8	6.8	14.8	14.8	4.8	10.8	16.9														
Non-Noxious Annual Cover																										
Excess Annual Cover																										

Reclamation Area 29 Vegetation Cover Data (continued)

Scientific Name	Common Name	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
		1st		2nd		1st		2nd		1st		2nd		1st		2nd		1st		2nd		1st		2nd		1st		2nd		1st		2nd		1st		2nd																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Forbs: Perennial Native																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
Lithospermum incisum	narrowleaf stone-seed																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Lygodesmia juncea	rush skeletonplant																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Mirabilis hirsuta	hairy four o'clock																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Physalis hispida	prairie groundcherry																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Ratibida columbifera	upright prairie coneflower																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Subtotal																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
Total Forb Cover		14	0	8	0	5	0	7	1	0	0	13	1	7	0	2	0	5	0	3	1	8	0	3	0	2	0	0	4	0	6	0	3	0	3	0	93	96	10.3	26.4	28.3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
Subshrubs/Succulents: Perennial Native																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
Artemisia filifolia	sand sagebrush																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Opuntia phaeacantha	walp pricklypear																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Subtotal																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
Total Shrub Cover		1	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	9	1.0	2.5	2.7																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Rock																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
Litter		27	27	19	21	20	19	10	17	19	21	29	25	27	14	20	25	28	16	384	384	42.7																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Bare Ground			8	16	14	1	14	9	15	2	10	8	9	9	22	2	10	5	16	170	170	18.9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Total Hits		50	0	50	0	50	1	50	2	50	1	50	1	50	1	50	0	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	900	918	100.0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Total Vegetation Cover		46	0	30	0	30	0	30	2	58	4	34	4	62	2	36	2	58	6	38	2	26	2	32	2	28	2	28	0	56	2	30	2	34	2	34	2	38.3	100.0	100.0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
Non-Noxious Vegetation Cover		46	0	30	0	30	0	30	2	40	4	30	4	62	2	36	2	52	4	38	2	26	2	32	2	26	2	28	0	46	0	30	2	30	2	34	2	35.9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Total Ground Cover		100	84	68	72	98	72	82	70	96	80	84	82	82	56	96	80	90	68																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Allowable Vegetation Cover		39.3	23.3	23.3	23.3	33.3	23.3	55.3	29.3	45.3	31.3	19.3	25.3	19.3	21.3	39.3	23.3	23.3	27.3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Non-Noxious Annual Cover																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			</	

Reclamation Area 30 Vegetation Cover Data

Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)
Grass: Annual Native		1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st All			
Munroa squarrosa	false buffalograss																			
Vulpia octoflora	sixweeks fescue																			
Subtotal																				
Grass: Annual Introduced																				
Bromus tectorum	cheatgrass																			
Eragrostis cilanensis	sinkgrass																			
Subtotal																				
Grass: Perennial Desirable (Cool)																				
Pascopyrum smithii	western wheatgrass																			
Subtotal																				
Grass: Perennial Desirable (Warm)																				
Andropogon hallii	sand bluestem																			
Aristida purpurea	purple threeawn																			
Bouteloua curtipendula	sideouts grama																			
Bouteloua gracilis	blue grama																			
Calamovilfa longifolia	prairie sandreed																			
Panicum virgatum	switchgrass																			
Schizachyrium scoparium	little bluestem																			
Sporobolus airoides	alkali sacaton																			
Sporobolus cryptandrus	sand dropseed																			
Subtotal																				
Total Grass Cover																				
Forbs: Annual & Biennial Native																				
Amaranthus retroflexus	redroot amaranth																			
Ambrosia artemisiifolia	annual ragweed																			
Argemone polyanthemos	crested pricklypoppy																			
Chamaesyce glyptosperma	ribseed sandmat																			
Chenopodium leptophyllum	narrowleaf goosefoot																			
Coryza canadensis	Canadian horseweed																			
Croton texensis	Texas croton																			
Erigeron bellidistrum	western daisy fleabane																			
Helianthus annuus	common sunflower																			
Subtotal																				
Forbs: Annual & Biennial Introduced																				
Amaranthus blitoides	mat amaranth																			
Lactuca serriola	prickly lettuce																			
Melilotus officinalis	sweetclover																			
Salsola tragus	prickly Russian thistle																			
Subtotal																				

Reclamation Area 30 Vegetation Cover Data (continued)

Scientific Name	Common Name		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)																											
Forbs : Perennial Native			1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	All																												
Ambrosia psilostachya	Cuman ragweed		p																																																												
Subtotal			p																																																												
Total Forb Cover			3	0	1	1	3	0	3	0	0	0	2	0	2	0	0	0	1	0	2	0	3	0	3	0	4	0	1	0	7	0	35	36		4.7	12.7	15.3																									
Subshrubs/Shrubs/Succulents : Perennial Native																																																															
Artemisia filifolia	sand sagebrush		p																																																												
Opuntia phaeacantha	tulip pricklypear		p																																																												
Subtotal			p																																																												
Total Shrub Cover			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0	0.0	0.7	0.8																										
Rock																																																															
Litter			25	29	18	12	21	22	26	22	18	23	24	28	9	10	22	18	22	24	8	7	28	22	22	10	3	12	4	342	342	45.6																															
Bare Ground			8	13	12	12	2	10	11	11	11	7	8	9	10	3	3	12	4	132	132	17.6																																									
Total Hits			50	1	50	1	50	0	50	1	50	1	50	0	50	1	50	1	50	2	50	0	50	0	50	0	50	1	50	0	50	0	750	757	100.0																												
Total Vegetation Cover			34	2	16	2	40	0	34	0	52	2	28	0	34	0	42	2	40	4	36	0	26	0	36	0	58	2	32	0	44	0		36.8	100.0	100.0																											
Non-Noxious Vegetation Cover			24	2	16	2	38	0	34	0	14	2	28	0	26	0	42	2	30	4	36	0	24	0	36	0	40	2	32	0	38	0		30.5																													
Total Ground Cover			84	74	76	76	96	80	78	78	78	86	84	82	80	94	76	92																																													
Allowable Vegetation Cover			20.9	12.9	34.9	30.9	10.9	24.9	22.9	38.9	26.9	32.9	20.9	32.9	36.9	28.9	34.9																																														
Non-Noxious Annual Cover																															6.1																																
Excess Annual Cover																															3.1																																

Reclamation Area 31 Vegetation Cover Data (continued)

Scientific Name	Common Name		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)	
Subshrubs/Shrubs/Succulents: Perennial Native	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	All				
Artemisia filifolia																																					
Opuntia phaeacantha																																					
Yucca glauca																																					
Subtotal																																					
Total Shrub Cover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
Rock																																					
Litter	27	23	21	23	30	16	27	16	28	18	13	23	15	22	20	20	322	322	42.9																		
Bare Ground	3	12	5	14	3	17	7	17	7	10	12	13	4	11	8	8	143	143	19.1																		
Total Hits	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	1	50	4	750	759	100.0
Total Vegetation Cover	40	2	30	0	48	2	26	0	34	2	34	0	32	0	34	0	30	2	44	0	50	0	28	0	62	2	34	0	44	8							
Non-Noxious Vegetation Cover	40	2	30	0	48	2	26	0	32	2	34	0	32	0	34	0	30	2	44	0	50	0	28	0	60	2	34	0	44	6							100.0
Total Ground Cover	94	76	90	72	94	66	86	66	86	80	76	74	92	78	84	84																					
Allowable Vegetation Cover	40.0	30.0	48.0	26.0	32.0	34.0	32.0	34.0	30.0	44.0	50.0	28.0	60.0	34.0	44.0	44.0																					

Non-Noxious Annual Cover	3.3
Excess Annual Cover	0.0

Reclamation Area 32 Vegetation Cover Data

Scientific Name	Common Name	1		2		3		4		5		6		7		8		9		10		Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	All				
Grass: Annual Native																										
Munroa squarrosa	false buffalo grass																									
Panicum capillare	witchgrass	p	1	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	0	0	0.0	0.0	
Subtotal		p	1	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	1	1	0.2	0.4	
Grass: Annual Introduced																										
Bromus tectorum	cheatgrass																									
Subtotal		p	p	p	p	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	11	11	2.2	4.7	
Grass: Perennial Desirable (Cool)																										
Agropyron cristatum	crested wheatgrass																									
Bromus inermis	smooth brome																									
Elymus lanceolatus	thickspike wheatgrass																									
Pseudoroegneria spicata	bluebunch wheatgrass																									
Subtotal																										
Grass: Perennial Desirable (Warm)																										
Andropogon hallii	sand bluestem	p																								
Bouteloua curtipendula	sidecoats grama	1	p	3																						
Bouteloua gracilis	blue grama			p	1																					
Calamovilfa longifolia	prairie sandreed	2	16	1	13	17	1	15	13	1																
Panicum virgatum	switchgrass	1	p	1	p	1	1	2	p																	
Schizachyrium scoparium	little bluestem		p	p																						
Sporobolus cryptandrus	sand dropseed																									
Subtotal		4	20	19	5	16	18	1	22	16	13	1	23	16	16	1	16	1	24	0	171	173	34.2	67.5	70.9	
Total Grass Cover																										
4	0	21	0	19	0	5	0	24	0	19	1	23	0	16	0	16	1	24	0	171	173			73.9	72.6	
Forbs: Annual & Biennial Native																										
Amaranthus retroflexus	redroot amaranth	11	p	p	15	1	3																			
Chenopodium desiccatum	aridland goosefoot	p																								
Helianthus annuus	common sunflower	1	p		p																					
Solanum triflorum	cutleaf nightshade	p																								
Subtotal		12	p	p	15	1	3																			
Forbs: Annual & Biennial Introduced																										
Dysphania botrys	Jerusalem oak goosefoot	1	1																							
Melilotus officinalis	sweetclover																									
Salsola collina	slender Russian thistle	p																								
Salsola tragus	prickly Russian thistle	5			1	1	1	2																		
Subtotal		6	1																							
Total Forb Cover																										
18	1	0	0	0	0	16	0	2	0	5	0	0	0	4	0	12	2	0	0	57	60			11.4	25.6	
26.9																										

Keenesburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 32 Vegetation Cover Data (continued)

Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative
Subshrubs/Shrubs/Succulents: Perennial Native		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	All		
Artemisia filifolia	sand sagebrush	p										0	1	0.0	0.4
Subtotal		p										0	1	0.0	0.4
Total Shrub Cover		0	0	0	0	0	0	0	0	0	0	0	1	0.0	0.4
Rock												0	0	0.0	
Litter												0	0	0.0	
Bare Ground		14	15	25	22	12	19	14	25	5	17	168	168	33.6	
		14	14	6	7	12	7	13	5	17	9	104	104	20.8	
Total Hits		50	1	50	0	50	1	50	0	50	3	500	506	100.0	
Total Vegetation Cover		44	2	42	0	38	0	42	2	52	0	48	2	45.6	100.0
Non-Noxious Vegetation Cover		44	2	42	0	38	0	42	2	36	0	46	2	43.4	
Total Ground Cover		72	72	88	86	76	86	74	90	66	82			79.2	
Allowable Vegetation Cover		36.7	34.7	30.7	34.7	28.7	38.7	36.7	32.7	48.7	38.7			36.1	

Non-Noxious Annual Cover	11.6
Excess Annual Cover	7.3

Reclamation Area 33 Vegetation Cover Data

Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)
Grass: Annual Native		1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st All			
Munroa squarrosa	false buffalo grass											0 0	0.0	0.0	0.0
Vulpia octoflora	sixweeks fescue										p 1	0 1	0.0	0.3	0.5
Subtotal											p 1	0 1	0.0	0.3	0.5
Grass: Annual Introduced															
Bromus tectorum	cheatgrass	p	4 1	18	6	13 1	6	2	8 2	p	8 1	65 70	13.0	24.1	
Subtotal		p	4 1	18	6	13 1	6	2	8 2	p	8 1	65 70	13.0	24.1	0.0
Grass: Perennial Desirable (Cool)															
Achnatherum hymenoides	Indian ricegrass	p								p		0 0	0.0	0.0	0.0
Agropyron cristatum	crested wheatgrass			p					p			0 0	0.0	0.0	0.0
Bromus inermis	smooth brome			p								0 0	0.0	0.0	0.0
Elymus lanceolatus	thickspike wheatgrass	3		p								3 3	0.6	1.0	1.4
Pseudoroegneria spicata	bluebunch wheatgrass								1			1 1	0.2	0.3	0.5
Subtotal		3		p	p				1	p		4 4	0.8	1.4	1.8
Grass: Perennial Desirable (Warm)															
Andropogon hallii	sand bluestem	p										0 0	0.0	0.0	0.0
Bouteloua curtipendula	sideoats grama							p		p		1 1	0.2	0.3	0.5
Bouteloua gracilis	blue grama						4 1	p		6 3	4	20 24	4.0	8.2	10.9
Calamovilfa longifolia	prairie sandreed	8	13	8	11 1	16 2	13 1	10	8 1	21 1	21 2	129 137	25.8	47.1	62.0
Panicum virgatum	switchgrass	2	2			p	2			2 3	9 11	3 9	1.8	3.8	5.0
Schizachyrium scoparium	little bluestem							p		1		1 1	0.2	0.3	0.5
Sorghastrum nutans	Indiangrass	p	p	p	p	p	p	p	p		2 2	2 2	0.4	0.7	0.9
Sporobolus cryptandrus	sand dropseed	3	2			p	p 1	p	p	p	p	5 6	1.0	2.1	2.7
Subtotal		8	21 2	10	12 1	18 2	19 3	11	8 1	30 4	30 2	167 182	33.4	62.5	82.4
Total Grass Cover		11 0	25 3	28 0	18 1	31 3	25 3	13 0	17 3	30 4	38 4	236 257	47.2	88.3	84.6
Forbs: Annual & Biennial Native															
Amaranthus retroflexus	redroot amaranth				3	p			9			12 12	2.4	4.1	5.4
Ambrosia artemisiifolia	annual ragweed									p		0 0	0.0	0.0	0.0
Chenopodium discatum	aridland goosefoot	p							p			0 0	0.0	0.0	0.0
Chenopodium leptophyllum	narrowleaf goosefoot						p					0 0	0.0	0.0	0.0
Cleome serrulata	Rocky Mountain beeplant											0 0	0.0	0.0	0.0
Helianthus annuus	common sunflower	1	p	p	p	p	p		p	p		1 1	0.2	0.3	0.5
Polygonum ramosissimum	bushy knotweed	7 2					p		1			8 10	1.6	3.4	4.5
Subtotal		8 2	p	p	3	p	p		10	p		21 23	4.2	7.9	10.4
Forbs: Annual & Biennial Introduced															
Alyssum sp.	mudwort											0 0	0.0	0.0	0.0
Salsola tragus	prickly Russian thistle	3	p		4	p			4			11 11	2.2	3.8	5.0
Subtotal		3	p		4	p			4			11 11	2.2	3.8	5.0

Reclamation Area 33 Vegetation Cover Data (continued)

Scientific Name	Common Name		1		2		3		4		5		6		7		8		9		10		Total Hits		Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)
Forbs: Perennial Native	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	All		
Ratibida columnifera																											
Subtotal																											
Total Forb Cover	11	2	0	0	0	0	0	0	7	0	0	0	0	0	0	0	14	0	0	0	0	0	32	34	6.4	11.7	15.4
Rock																											
Litter	7	23	14	15	11	23	26	8	19	10	156	156	31.2														
Bare Ground	21	2	8	10	8	2	11	11	1	2	76	76	15.2														
Total Hits	50	2	50	3	50	1	50	3	50	3	50	3	50	3	50	0	50	3	50	4	50	4	500	523	100.0		
Total Vegetation Cover	44	4	50	6	56	0	50	2	62	6	50	6	26	0	62	6	60	8	76	8					53.6	100.0	100.0
Non-Noxious Vegetation Cover	44	4	42	4	20	0	38	2	36	4	38	6	22	0	46	2	60	8	60	6					40.6		
Total Ground Cover	58	96	84	80	84	96	78	78	98	96															84.8		
Allowable Vegetation Cover	41.7	39.7	17.7	35.7	33.7	35.7	19.7	43.7	57.7	57.7															38.3		

Non-Noxious Annual Cover	6.4
Excess Annual Cover	2.3

Reclamation Area 34 Vegetation Cover Data

Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Grass: Annual Native																			
Cenchrus ciliaris	nut sandbar																		
Munro squarrosa	false buffalgrass																		
Subtotal																			
Grass: Annual Introduced																			
Bromus tectorum	cheatgrass																		
Eragrostis ciliaris	stinkgrass																		
Subtotal																			
Grass: Perennial Desirable (Cool)																			
Achnatherum lymnoides	Indian ricegrass																		
Agropyron cristatum	crested wheatgrass																		
Bromus inermis	smooth brome																		
Cyperus schweinitzii	Schweinitz's fatseed																		
Elymus elymoides	squirreltail																		
Hesperostipa comata	needle and thread																		
Pascopyrum smithii	western wheatgrass																		
Pseudoroegneria spicata	bluebunch wheatgrass																		
Thinopyrum intermedium	intermediate wheatgrass																		
Subtotal																			
Grass: Perennial Desirable (Warm)																			
Andropogon hallii	sand bluestem																		
Aristida purpurea	purple threeawn																		
Bouteloua curtipendula	sideoats grama																		
Bouteloua gracilis	blue grama																		
Calamovilfa longifolia	prairie sandreed																		
Distichlis spicata	saltgrass																		
Panicum virgatum	switchgrass																		
Schizachyrium scoparium	little bluestem																		
Sorghastrum nutans	Indiangrass																		
Sporobolus cryptandrus	sand dropseed																		
Subtotal																			
Total Grass Cover																			
Forbs: Annual & Biennial Native																			
Amaranthus retroflexus	redroot amaranth																		
Ambrosia artemisiifolia	annual ragweed																		
Angemone polyanthemos	crested pricklypoppy																		
Chamaecypariss glaucosperma	ribweed sandbar																		
Chenopodium discicatum	artichoke goosefoot																		
Chenopodium leptophyllum	narrow-leaf goosefoot																		
Croton texensis	Texas croton																		
Helianthus annuus	common sunflower																		
Lepidium densiflorum	common pepperweed																		
Nacheraanthra bigelovii	Bigelow's tansyaster																		
Polygonum ramossissimum	brushy knotweed																		
Verbena bracteata	bigbract verbena																		
Subtotal																			

Reclamation Area 34 Vegetation Cover Data (continued)

Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd
Forbs: Annual & Biennial Introduced																				
Bassia scoparia	burningbush																			
Carduus nutans	nodding plumeless thistle																			
Chenopodium album	lambquarters																			
Dysphania borys	Jerusalem oak goosefoot																			
Lactuca serriola	prickly lettuce																			
Melilotus officinalis	sweetclover																			
Polygonum aviculare	prostrate knotweed																			
Salvia collina	skender Russian thistle																			
Salvia tragus	prickly Russian thistle																			
Tragopogon dubius	yellow rattle																			
Forbs: Perennial Native																				
Ambrosia psilostachya	Common ragweed																			
Cirsium undulatum	wavyleaf thistle																			
Evolvulus nuttallianus	shaggy dwarf morning-glory																			
Machaeranthera pinnatifida	lacy tansyaster																			
Mentzelia laevis	bristly blazingstar																			
Mercurialis annua	hairy four o'clock																			
Physalis hispida	prairie groundcherry																			
Psoralea tenuiflora	slimflower scarifica																			
Ranunculus columbifera	upright prairie coneflower																			
Rumex crispus	very dock																			
Symphoricarpos albertinum	white prairie aster																			
Tradescantia occidentalis	prairie spiderwort																			
Forbs: Perennial Introduced																				
Taraxacum officinale	common dandelion																			
Subtotal																				
Total Forb Cover																				
Subshrubs/Shrubs/Succulents: Perennial Native																				
Artemisia filifolia	sand sagebrush																			
Cylindropuntia whipplei	Whipple cholla																			
Opuntia phaeacantha	tulip pricklypear																			
Yucca glauca	soapweed yucca																			
Subtotal																				
Total Shrub Cover																				
Rock																				
Liter																				
Bare Ground																				
Total Hits																				
Total Vegetation Cover																				
Non-Noxious Vegetation Cover																				
Total Ground Cover																				
Allowable Vegetation Cover																				
Non-Noxious Annual Cover																				
Excess Annual Cover																				

Reclamation Area 34 Vegetation Cover Data (continued)

Scientific Name	Common Name	19	20	21	22	23	24	25	26	27	28	29	30	Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)
Grass: Annual Native		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Cenchrus longispinus	mat sandbur													0	0	0.0	0.0
Munroa squarrosa	false buffalograss	p			p	p								9	9	1.7	1.8
Subtotal														9	9	1.7	1.8
Grass: Annual Introduced																	
Bromus tectorum	cheatgrass		p											4	10	2.1	2.1
Fragaria virginiana	strawberry													0	0	0.0	0.0
Subtotal														4	10	2.1	2.1
Grass: Perennial Desirable (Cool)																	
Acrobarberum lutescens	Indian ricegrass	p				p								10	12	2.3	2.3
Agropyron cristatum	crested wheatgrass													0	0	0.0	0.0
Bromus inermis	smooth brome	1	p											3	3	0.6	0.6
Cyperus schweinitzii	Schweinitz's flatsedge													3	3	0.6	0.6
Elymus elymoides	squirreltail													2	2	0.4	0.4
Hesperostipa comata	needle and thread													0	0	0.0	0.0
Pascopyrum smithii	western wheatgrass	3												3	3	0.6	0.6
Pseudoroegneria spicata	bluebunch wheatgrass													0	0	0.0	0.0
Thinopyrum intermedium	intermediate wheatgrass													0	0	0.0	0.0
Subtotal		1	1	3	p	p	1							21	23	4.4	4.5
Grass: Perennial Desirable (Warm)																	
Andropogon hallii	sand bluestem													11	11	2.1	2.1
Aristida purpurea	purple threeawn	4												0	0	0.0	0.0
Bouteloua curtipendula	skidcoats grama					1								2	2	0.1	0.4
Bouteloua gracilis	blue grama													4	4	0.3	0.8
Calamovilfa longifolia	prairie sandreed	4	10	1										59	62	11.9	12.1
Distichlis spicata	saltgrass													0	0	0.0	0.0
Panicum virgatum	switchgrass	p												0	0	0.0	0.0
Schizachyrium scoparium	little bluestem			1										3	4	0.2	0.8
Sorghastrum nutans	Indiangrass													3	3	0.2	0.6
Sporobolus cryptandrus	sand dropseed	4	1	3	1	6	2	2	2	2	1	4	1	150	161	30.8	31.4
Subtotal		4	1	11	15	17	7	2	2	2	1	5	4	232	247	47.2	48.2
Total Grass Cover		5	1	12	18	1	7	0	2	3	0	2	16	272	290	55.4	54.5
Forbs: Annual & Biennial Native																	
Amaranthus retroflexus	redroot amaranth	p												3	3	0.2	0.6
Ambrosia artemisiifolia	annual ragweed	p												2	2	0.1	0.4
Argemone polyanthemos	crested pricklypoppy	p												1	1	0.1	0.2
Chamaecrista glaberrima	ribweed													0	0	0.0	0.2
Chenopodium deserticum	artichoke goosefoot													0	0	0.0	0.0
Chenopodium leptophyllum	narrowleaf goosefoot													0	0	0.0	0.0
Croton texensis	Texas croton	1												7	7	1.3	1.4
Helianthus annuus	common sunflower	p												55	55	10.5	10.7
Lepidium densiflorum	common pepperweed													0	0	0.0	0.0
Machaeranthera bigelovii	Bigelow's tansyaster													0	0	0.0	0.0
Polygonum ramosissimum	brushy knotweed													1	1	0.1	0.2
Verbena bracteata	bigbract verbena	1	p	1	3	3	1	10	7	1	2	1	3	69	70	13.4	13.7
Subtotal		1	p	1	3	3	1	10	7	1	2	1	3	69	70	13.4	13.7

Reclamation Area 34 Vegetation Cover Data (continued)

Scientific Name	Common Name	19 1st 2nd	20 1st 2nd	21 1st 2nd	22 1st 2nd	23 1st 2nd	24 1st 2nd	25 1st 2nd	26 1st 2nd	27 1st 2nd	28 1st 2nd	29 1st 2nd	30 1st 2nd	Total Hits 1st All	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)
Forbs: Annual & Biennial Introduced																	
Bassia scoparia	burningbush													0	0.0		0.0
Carduus nutans	snodding plumeless thistle													0	0.0		0.0
Chenopodium album	lambsquarters													0	0.0		0.0
Dryophila botrys	Jerusalem oak goosefoot	1												19	20	3.8	3.9
Lactuca serriola	prickly lettuce													0	0.0		0.0
Meibomia officinalis	sweetclover													0	0.0		0.0
Polygonum aviculare	prostrate knotweed													1	1	0.2	0.2
Salsola collina	slender Russian thistle													1	1	0.2	0.2
Salsola tragus	prickly Russian thistle	5	1	5		9	6	11	8	2	7	1		132	136	26.0	26.6
Tragopogon dubius	yellow stinkweed													0	0.0		0.0
Subtotal		6	1	5		9	12	12	10	3	8	1		152	157	30.0	30.7
Forbs: Perennial Native																	
Ambrosia trifida	Common ragweed													0	0.0		0.0
Cirsium undulatum	wavyleaf thistle													0	0.0		0.0
Eriogonum fasciculatum	shaggy dwarf morning-glory													0	0.0		0.0
Malvastrum coccineum	lacy linsyaster													1	1	0.2	0.2
Monarda mollis	bractless blazingstar													0	0.0		0.0
Monarda mollis	hairy four o'clock													0	0.0		0.0
Physalis hispida	prairie groundcherry													0	0.0		0.0
Psoralea tenuiflorum	stinkweed scurfpea													0	0.0		0.0
Rudbeckia hirta	upright prairie coneflower													0	0.0		0.0
Rumex crispus	viney dock													1	1	0.2	0.2
Symphyotrichum sp.	white prairie aster													0	0.0		0.0
Tridax canadensis	prairie spiderwort													0	0.0		0.0
Subtotal														3	3	0.6	0.6
Forbs: Perennial Introduced																	
Taraxacum officinale	common dandelion													0	0.0		0.0
Subtotal														0	0.0		0.0
Total Forb Cover		7	1	5	0	1	0	3	0	13	0	2	0	3	0	44.6	44.9
Subshrubs/Shrubs/Succulents: Perennial Native																	
Artemisia filifolia	sand sagebrush													1	1	0.2	0.2
Cylindropuntia whipplei	Whipple cholla													0	0.0		0.0
Opuntia phaeacantha	tuft pricklypear													2	2	0.4	0.4
Yucca glauca	sagebrush yucca													0	0.0		0.0
Subtotal														3	3	0.6	0.6
Total Shrub Cover		0	0	0	1	0	0	0	0	0	0	0	1	3	0.2	0.6	0.6
Rock														0	0.0		0.0
Litter														0	0.0		0.0
Bare Ground		7	18	19	6	9	3	14	12	8	13	9	8	341	341	22.7	
Total Hits		31	15	11	33	22	31	11	19	29	23	31	22	658	658	43.9	
Total Vegetation Cover		50	2	50	0	50	1	50	0	50	1	50	1	50	0	100.0	100.0
Non-Noxious Vegetation Cover		24	4	34	0	40	2	22	0	38	4	38	0	33	0	33.3	33.3
Total Ground Cover		24	4	34	0	40	2	22	0	38	4	38	0	33	0	32.6	32.6
Allowable Vegetation Cover		38	70	78	34	56	38	78	62	42	54	38	56	56	56	56.1	56.1
Non-Noxious Annual Cover		11.9	21.9	27.9	9.9	25.9	19.9	37.9	25.9	11.9	15.9	7.9	19.9			26.6	26.6
Excess Annual Cover																	

Keenesburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 37 Vegetation Cover Data

Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Native Relative Cover (%)
Grass: Annual Native		1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd	1st 2nd			
<i>Cynodon dactylon</i>	dog fescue																0	0.0	0.0	0.0
<i>Stachys recta</i>	spike thistle																0	0.0	0.0	0.0
<i>Stachys recta</i>	spike thistle																0	0.0	0.0	0.0
<i>Stachys recta</i>	spike thistle																0	0.0	0.0	0.0
Grass: Annual Introduced																				
<i>Bromus tectorum</i>	crabgrass																2	0.3	1.0	0.0
<i>Eragrostis ciliaris</i>	stinkgrass																2	0.3	1.0	0.0
Grass: Perennial Desirable (Cool)																				
<i>Achillea millefolium</i>	Indian ragwort																57	58	7.6	29.7
<i>Agropyron cristatum</i>	crested wheatgrass																0	0.0	0.0	0.0
<i>Cyperus tenuifolius</i>	Schreitz's flaxseed																0	0.0	0.0	0.0
<i>Elymus lanceolatus</i>	thickspike wheatgrass																1	0.1	0.5	0.5
<i>Poa sp.</i>	bluegrass																0	0.0	0.0	0.0
Grass: Perennial Desirable (Warm)																				
<i>Sorghum bicolor</i>	sudangrass																58	59	7.7	30.6
Grass: Annual & Biennial Native																				
<i>Chenopodium album</i>	amaranth																4	4	0.5	2.1
<i>Chenopodium album</i>	amaranth																4	4	0.5	2.1
<i>Chenopodium album</i>	amaranth																4	4	0.5	2.1
Forbs: Annual & Biennial Native																				
<i>Chenopodium album</i>	amaranth																35	16	2.0	8.3
<i>Chenopodium album</i>	amaranth																8	8	1.1	4.1
<i>Chenopodium album</i>	amaranth																6	6	0.8	3.1
<i>Chenopodium album</i>	amaranth																0	0.0	0.0	0.0
<i>Chenopodium album</i>	amaranth																17	19	2.3	9.7
<i>Chenopodium album</i>	amaranth																46	49	6.1	25.4
Forbs: Annual & Biennial Introduced																				
<i>Chenopodium album</i>	amaranth																3	3	0.4	1.5
<i>Chenopodium album</i>	amaranth																0	0.0	0.0	0.0
<i>Chenopodium album</i>	amaranth																1	1	0.1	0.5
<i>Chenopodium album</i>	amaranth																0	0.0	0.0	0.0
<i>Chenopodium album</i>	amaranth																19	19	2.5	9.7
<i>Chenopodium album</i>	amaranth																47	50	6.3	25.9
<i>Chenopodium album</i>	amaranth																70	73	9.3	37.8
Forbs: Perennial Native																				
<i>Chenopodium album</i>	amaranth																0	0.0	0.0	0.0
<i>Chenopodium album</i>	amaranth																0	0.0	0.0	0.0
<i>Chenopodium album</i>	amaranth																0	0.0	0.0	0.0
<i>Chenopodium album</i>	amaranth																0	0.0	0.0	0.0
Total Forb Cover																	116	122	15.5	62.6
Total Hits																	0	0	0.0	0.0
Total Vegetation Cover																	116	122	15.5	62.6
Non-Native Vegetation Cover																	116	122	15.5	62.6
Total Ground Cover																	116	122	15.5	62.6
Native Vegetation Cover																	0	0	0.0	0.0
Non-Native Annual Cover																	116	122	15.5	62.6
Non-Native Perennial Cover																	0	0	0.0	0.0
Native Annual Cover																	0	0	0.0	0.0
Native Perennial Cover																	0	0	0.0	0.0

Reclamation Area 44 Vegetation Cover Data

Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)
Grass: Annual Native																				
Cenchrus longispinus	mat sandbur																2	2	0.3	0.8
Munroa squarrosa	false buffalograss																1	1	0.1	0.4
Panicum capillare	witchgrass																0	0	0.0	0.0
Vulpia octoflora	sixweeks fescue																0	0	0.0	0.0
Subtotal																				
Grass: Annual Introduced																				
Bromus tectorum	cheatgrass																			
Eragrostis cilanensis	stinkgrass																			
Subtotal																				
Grass: Perennial Desirable (Cool)																				
Achnatherum hymenoides	Indian ricegrass																			
Elymus laevis	thickspike wheatgrass																			
Subtotal																				
Grass: Perennial Desirable (Warm)																				
Calamovilfa longifolia	prairie sandreed																			
Sporobolus cryptandrus	sand dropseed																			
Subtotal																				
Total Grass Cover																				
Forbs: Annual & Biennial Native																				
Amaranthus retroflexus	redroot amaranth																			
Argemone polyanthemos	crested pricklypoppy																			
Chenopodium desiccatum	aridland goosefoot																			
Chenopodium sp.	goosefoot																			
Cleome serrulata	Rocky Mountain beeplant																			
Coryza canadensis	Canadian horseweed																			
Croton texensis	Texas croton																			
Eriogonum annuum	annual buckwheat																			
Helianthus annuus	common sunflower																			
Plantago patagonica	woolly plantain																			
Polygonum ramosissimum	bushy knotweed																			
Subtotal																				
Forbs: Annual & Biennial Introduced																				
Ambrosia artemisiifolia	annual ragweed																			
Bassia scoparia	burningbush																			
Dysphania borys	Jerusalem oak goosefoot																			
Lactuca scariola	prickly lettuce																			
Medicago officinalis	sweetclover																			
Polygonum aviculare	prostrate knotweed																			
Salicaria collina	slender Russian thistle																			
Salicaria tragus	prickly Russian thistle																			
Subtotal																				

Keeneyburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 44 Vegetation Cover Data (continued)

Scientific Name	Common Name	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		Total Hits	Average Absolute Cover (%)	Average Relative Cover (%)	Non-Noxious Relative Cover (%)
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	All			
Forbs: Perennial Native																																			
Cuscuta indecora	bigseed alfalfa dodder																																		
Mentzelia nuda	bractless blazingstar	2																																	
Ratibida columnifera	upright prairie coneflower																																		
Subtotal		2																																	
Total Forb Cover		16	1	6	0	14	0	11	1	11	2	17	0	10	0	1	0	14	0	14	1	10	0	5	0	0	10	0	3	0	142	147	18.9	59.5	71.0
Subshrubs/Shrubs/Succulents: Perennial Native																																			
Yucca glauca	soapweed yucca																																		
Subtotal																																			
Total Shrub Cover		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	
Rock		1																																	
Litter		5	9	6	5	7	12	4	14	12	3	1	2	14	8	7	109	109	14.5																
Bare Ground		28	20	29	29	23	21	31	17	20	25	39	40	21	25	33	401	401	53.5																
Total Hits		50	1	50	0	50	2	50	1	50	2	50	0	50	2	50	0	50	0	50	1	50	0	50	1	50	0	50	0	750	759	100.0			
Total Vegetation Cover		32	2	42	2	30	0	32	2	40	4	34	0	38	4	36	0	36	0	44	2	20	0	14	2	30	0	34	0	20	0		31.7	100.0	100.0
Non-Noxious Vegetation Cover		32	2	26	0	30	0	26	2	24	4	34	0	30	0	32	0	32	0	44	2	20	0	14	2	22	0	22	0	20	0		26.8		
Total Ground Cover		44	60	42	42	54	58	38	66	60	50	22	20	58	50	34																			
Allowable Vegetation Cover		15.6	9.6	13.6	9.6	7.6	17.6	13.6	9.6	15.6	27.6	3.6	0.0	5.6	5.6	3.6																	10.6		

Non-Noxious Annual Cover	19.1
Excess Annual Cover	16.4

Keenesburg Mine 2021 Vegetation Monitoring Report

Appendix B: Herbaceous Production Data

Keenesburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 29 Herbaceous Production Data

Sample	Herbaceous Production (g/m2)			
	Annual Species	Perennial Species	Total	Allowable
1	2	355.8	357.8	338.0
2	0	17	17	0.0
3	105.4	35.8	141.2	121.4
4	0	7.3	7.3	0.0
5	0	23.3	23.3	3.5
6	381.7	0	381.7	361.9
7	0	15.1	15.1	0.0
8	0	11	11	0.0
9	0	2.5	2.5	0.0
10	0	29.7	29.7	9.9
11	0	20.7	20.7	0.9
12	0	71.6	71.6	51.8
13	100.9	54.2	155.1	135.3
14	0	24.1	24.1	4.3
15	0	166.9	166.9	147.1
16	0	54.2	54.2	34.4
17	0	35.4	35.4	15.6
18	0	2.8	2.8	0.0
19	47.9	0.8	48.7	28.9
20	61.6	19.3	80.9	61.1
21	0	99.2	99.2	79.4
22	0	13.6	13.6	0.0
23	81.5	0	81.5	61.7
24	1.1	43.5	44.6	24.8
25	0.6	61.1	61.7	41.9
26	0	57.3	57.3	37.5
27	0	8.8	8.8	0.0
28	0	4.7	4.7	0.0
29	21.7	14.8	36.5	16.7
30	0	57.4	57.4	37.6
Average	26.8	43.6	70.4	53.8

Excess Annual Production	19.8
--------------------------	------

If average annual production is greater than 10%, subtract the average excess

Keenesburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 30 Herbaceous Production Data

Sample	Herbaceous Production (g/m ²)			
	Annual Species	Perennial Species	Total	Allowable
1	0	6.2	6.2	0.0
2	16.9	31.7	48.6	41.3
3	8.7	15.6	24.3	17.0
4	13.8	46.6	60.4	53.1
5	0	0	0	0.0
6	6.7	23.4	30.1	22.8
7	24.3	44.5	68.8	61.5
8	0	141.5	141.5	134.2
9	22.5	75.1	97.6	90.3
10	11.6	44.8	56.4	49.1
11	3.8	22	25.8	18.5
12	2.6	3.9	6.5	0.0
13	3	81.5	84.5	77.2
14	0	43.9	43.9	36.6
15	6.1	16.1	22.2	14.9
16	5.2	55.8	61	53.7
17	120.1	26.2	146.3	139.0
18	0	136.1	136.1	128.8
19	0	44	44	36.7
20	0	68.5	68.5	61.2
21	10.1	15.1	25.2	17.9
22	0	54.7	54.7	47.4
23	5.5	28.4	33.9	26.6
24	38	6.4	44.4	37.1
25	29.4	16.4	45.8	38.5
26	6.1	30.5	36.6	29.3
27	23.1	20.8	43.9	36.6
28	1.6	7.9	9.5	2.2
29	11.7	24	35.7	28.4
30	0	11.5	11.5	4.2
Average	12.4	38.1	50.5	43.5

Excess Annual Production	7.3
--------------------------	-----

If average annual production is greater than 10%, subtract the average excess

Keenesburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 31 Herbaceous Production Data

Sample	Herbaceous Production (g/m2)			
	Annual Species	Perennial Species	Total	Allowable
1	82.8	21.3	104.1	99.8
2	3.3	50.9	54.2	49.9
3	0.6	40.9	41.5	37.2
4	4.8	12.8	17.6	13.3
5	0	158.4	158.4	154.1
6	0	47.9	47.9	43.6
7	0	29.1	29.1	24.8
8	0	63.8	63.8	59.5
9	13.7	66.4	80.1	75.8
10	9.5	60.6	70.1	65.8
11	17	148.8	165.8	161.5
12	59.5	23.4	82.9	78.6
13	1.3	48.7	50	45.7
14	2.3	25.5	27.8	23.5
15	0	39.7	39.7	35.4
16	42.3	31.5	73.8	69.5
17	0	101.3	101.3	97.0
18	27.7	135.2	162.9	158.6
19	0	13.9	13.9	9.6
20	0	45.6	45.6	41.3
21	0	92.3	92.3	88.0
22	0	35	35	30.7
23	8.5	23.9	32.4	28.1
24	7.9	7.7	15.6	11.3
25	1.5	42	43.5	39.2
26	0	45	45	40.7
27	0	68.3	68.3	64.0
28	20	39.4	59.4	55.1
29	0.4	30.5	30.9	26.6
30	14.6	31.5	46.1	41.8
Average	10.6	52.7	63.3	59.0

Excess Annual Production	4.3
--------------------------	-----

If average annual production is greater than 10%, subtract the average excess

Keenesburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 32 Herbaceous Production Data

Sample	Herbaceous Production (g/m ²)			
	Annual Species	Perennial Species	Total	Allowable
1	12.9	52	64.9	62.6
2	0	54.7	54.7	52.4
3	0	61.6	61.6	59.3
4	14.7	70.3	85	82.7
5	0.3	25.6	25.9	23.6
6	0	59.8	59.8	57.5
7	0	127.9	127.9	125.6
8	0	103.5	103.5	101.2
9	13.6	91.8	105.4	103.1
10	0.1	76.9	77	74.7
11	11.4	40.6	52	49.7
12	0.7	41.1	41.8	39.5
13	0	28	28	25.7
14	38.1	28.6	66.7	64.4
15	44.4	13.6	58	55.7
Average	9.1	58.4	67.5	65.1

Excess Annual Production	2.3
--------------------------	-----

If average annual production is greater than 10%, subtract the average excess

Keenesburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 33 Herbaceous Production Data

Sample	Herbaceous Production (g/m2)			
	Annual Species	Perennial Species	Total	Allowable
1	36	37.7	73.7	67.1
2	0	59.6	59.6	53.0
3	0	114.2	114.2	107.6
4	191.8	2.2	194	187.4
5	3.1	125.4	128.5	121.9
6	0	97.8	97.8	91.2
7	0	61.9	61.9	55.3
8	0	52.1	52.1	45.5
9	0	76.3	76.3	69.7
10	0	130.8	130.8	124.2
11	0	37.4	37.4	30.8
12	0	58.4	58.4	51.8
13	0	81.5	81.5	74.9
14	0	71.2	71.2	64.6
15	0	83	83	76.4
Average	15.4	72.6	88.0	81.4

Excess Annual Production	6.6
--------------------------	-----

If average annual production is greater than 10%, subtract the average excess

Keenesburg Mine 2021 Vegetation Monitoring Report

Reclamation Area 34 Herbaceous Production Data

Sample	Herbaceous Production (g/m2)			
	Annual Species	Perennial Species	Total	Allowable
1	0.6	81.7	82.3	48.0
2	0.4	32.6	33	0.0
3	0	30.9	30.9	0.0
4	5.7	2.9	8.6	0.0
5	0	5.9	5.9	0.0
6	9	28.8	37.8	3.5
7	0	13.8	13.8	0.0
8	72	0.4	72.4	38.1
9	138.9	86.4	225.3	191.0
10	0	42	42	7.7
11	104.3	3.5	107.8	73.5
12	88.5	57.1	145.6	111.3
13	44.2	3.4	47.6	13.3
14	114.3	30.4	144.7	110.4
15	42.1	16.3	58.4	24.1
Average	41.3	29.1	70.4	41.4

Excess Annual Production	34.3
--------------------------	------

If average annual production is greater than 10%, subtract the average excess

Appendix C: Complete Species List

Keenesburg Mine Reclamation Species List 2021

Scientific Name	Common Name	Area 25	Area 29	Area 30	Area 31	Area 32	Area 33	Area 34	Area 37	Area 44
Grass: Annual Native										
Cenchrus longispinus	mat sandbur	3.3								
Munroa squarrosa	false buffalograss	33.3	22.2	100.0	93.3	70.0	10.0	3.3	13.3	20.0
Panicum capillare	witchgrass	3.3			13.3	20.0		60.0	66.7	40.0
Vulpia octoflora	sixweeks fescue			13.3			20.0		26.7	46.7
Grass: Annual Introduced										
Bromus tectorum	cheatgrass	6.7	88.9	100.0	46.7	90.0	100.0	36.7	33.3	66.7
Eragrostis cilianensis	stinkgrass		5.6	13.3	6.7			3.3	6.7	6.7
Grass: Perennial Desirable (Cool)										
Achnatherum hymenoides	Indian ricegrass	13.3			20.0		20.0	66.7	93.3	80.0
Agropyron cristatum	crested wheatgrass					10.0	30.0	10.0	6.7	
Bromus inermis	smooth brome					10.0	10.0	23.3		
Cyperus schweinitzii	Schweinitz's flatsedge							33.3	6.7	
Elymus elymoides	squirreltail						20.0	30.0		
Elymus lanceolatus	thickspike wheatgrass					30.0	20.0		6.7	26.7
Hesperostipa comata	needle and thread	3.3						3.3		
Pascopyrum smithii	western wheatgrass	13.3	16.7	6.7				3.3	6.7	
Poa sp.	bluegrass								13.3	
Pseudoroegneria spicata	bluebunch wheatgrass	3.3				10.0	10.0	3.3		
Thinopyrum intermedium	intermediate wheatgrass							3.3		
Grass: Perennial Desirable (Warm)										
Andropogon hallii	sand bluestem	43.3	77.8	100.0	93.3	50.0	30.0	23.3		
Aristida purpurea	purple threeawn			13.3				3.3		
Bouteloua curtipendula	sideoats grama		11.1	26.7	40.0	40.0	20.0	20.0		
Bouteloua gracilis	blue grama	30.0	88.9	40.0	86.7	90.0	80.0	30.0		
Calamovilfa longifolia	prairie sandreed	56.7	83.3	60.0	100.0	100.0	100.0	53.3		6.7
Distichlis spicata	saltgrass							3.3		

Keenesburg Mine Reclamation Species List 2021 (continued)

Scientific Name	Common Name	Area 25	Area 29	Area 30	Area 31	Area 32	Area 33	Area 34	Area 37	Area 44
Grass: Perennial Desirable (Warm)										
<i>Panicum virgatum</i>	switchgrass	3.3	5.6	20.0	33.3	80.0	50.0	6.7		
<i>Schizachyrium scoparium</i>	little bluestem	3.3	11.1	53.3	20.0	30.0	20.0	23.3		
<i>Sorghastrum nutans</i>	Indiangrass	3.3	5.6		13.3		70.0	3.3		
<i>Sporobolus airoides</i>	alkali sacaton			6.7						
<i>Sporobolus cryptandrus</i>	sand dropseed	90.0	100.0	100.0	100.0	60.0	80.0	100.0	66.7	73.3
Forbs: Annual & Biennial Native										
<i>Amaranthus retroflexus</i>	redroot amaranth	43.3	83.3	86.7	100.0	90.0	30.0	60.0	100.0	80.0
<i>Ambrosia artemisiifolia</i>	annual ragweed		16.7	6.7			10.0	43.3		
<i>Argemone polyanthemus</i>	crested pricklypoppy	46.7	38.9	20.0				40.0	20.0	13.3
<i>Chamaesyce glyptosperma</i>	ribseed sandmat		16.7	13.3	33.3			3.3		
<i>Chenopodium desiccatum</i>	aridland goosefoot	3.3			20.0	20.0	20.0	3.3		46.7
<i>Chenopodium leptophyllum</i>	narrowleaf goosefoot		11.1	13.3	13.3		10.0	10.0	66.7	
<i>Chenopodium</i> sp.	goosefoot									26.7
<i>Cleome serrulata</i>	Rocky Mountain beeplant						20.0		20.0	13.3
<i>Conyza canadensis</i>	Canadian horseweed		22.2	80.0	40.0					13.3
<i>Croton texensis</i>	Texas croton	10.0		13.3				60.0	20.0	20.0
<i>Erigeron bellidiflorum</i>	western daisy fleabane		5.6	6.7						6.7
<i>Eriogonum annuum</i>	annual buckwheat									
<i>Helianthus annuus</i>	common sunflower		94.4	33.3	33.3	70.0	60.0	96.7	100.0	100.0
<i>Lepidium densiflorum</i>	common pepperveed							3.3		
<i>Machaeranthera bigelovii</i>	Bigelow's tansyaster	86.7						6.7		
<i>Plantago patagonica</i>	woolly plantain									6.7
<i>Polygonum ramosissimum</i>	bushy knotweed		22.2		13.3		30.0	3.3		73.3
<i>Solanum triflorum</i>	cutleaf nightshade					10.0				
<i>Verbena bracteata</i>	bigbract verbena							3.3		

Keenesburg Mine Reclamation Species List 2021 (continued)

Scientific Name	Common Name	Area 25	Area 29	Area 30	Area 31	Area 32	Area 33	Area 34	Area 37	Area 44
Forbs: Annual & Biennial Introduced										
Alyssum sp.	madwort									
Amaranthus blitoides	mat amaranth	3.3	22.2	6.7	13.3		10.0			
Ambrosia artemisiifolia	annual ragweed									33.3
Bassia scoparia	burningbush	53.3	11.1					3.3	46.7	60.0
Carduus nutans	nodding plumeless thistle							3.3		
Chenopodium album	lambsquarters							3.3	13.3	
Dysphania botrys	Jerusalem oak goosefoot	3.3	5.6			10.0		80.0	46.7	40.0
Lactuca serriola	prickly lettuce		22.2	26.7	13.3			6.7		13.3
Melilotus officinalis	sweetclover			13.3		10.0		3.3	13.3	6.7
Polygonum aviculare	prostrate knotweed							6.7	60.0	6.7
Salsola collina	slender Russian thistle					10.0		3.3		20.0
Salsola tragus	prickly Russian thistle	100.0	61.1	40.0	66.7	60.0	40.0	90.0	93.3	86.7
Tragopogon dubius	yellow salsify									
Tribulus terrestris	puncturevine	3.3	11.1					6.7		
Forbs: Perennial Native										
Ambrosia psilostachya	Cuman ragweed	20.0		13.3	20.0			10.0	6.7	
Cirsium undulatum	wavyleaf thistle							10.0		
Cuscuta indecora	bigseed alfalfa dodder								13.3	6.7
Evolvulus nuttallianus	shaggy dwarf morning-glory									
Lithospermum incisum	narrowleaf stonecrop		11.1					3.3		
Lygodesmia juncea	rush skeletonplant		5.6							
Machaeranthera pinnatifida	lacy tansyaster							3.3		
Mentzelia nuda	bractless blazingstar							3.3	6.7	13.3
Mirabilis hirsuta	hairy four o'clock		5.6					3.3		
Physalis hispida	prairie groundcherry	3.3	16.7		33.3			6.7		
Psoraleidium tenuiflorum	slimflower scurfpea							3.3		