Reclamation Area 44

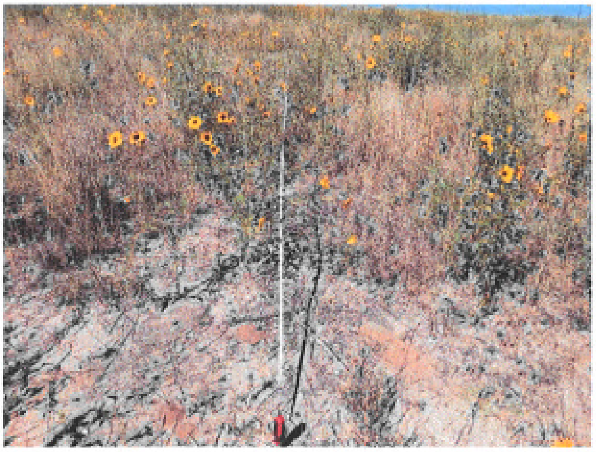
Transect 7

Transect 8

Transect 9

Transect 10

Transect 11



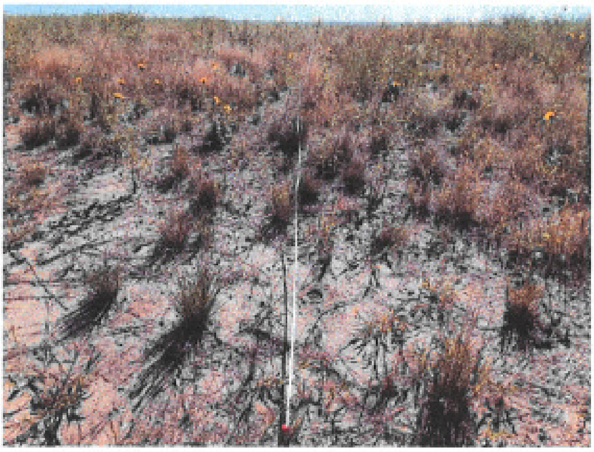
Transect 12

Reclamation Area 44

Transect 13

Transect 14

Transect 15



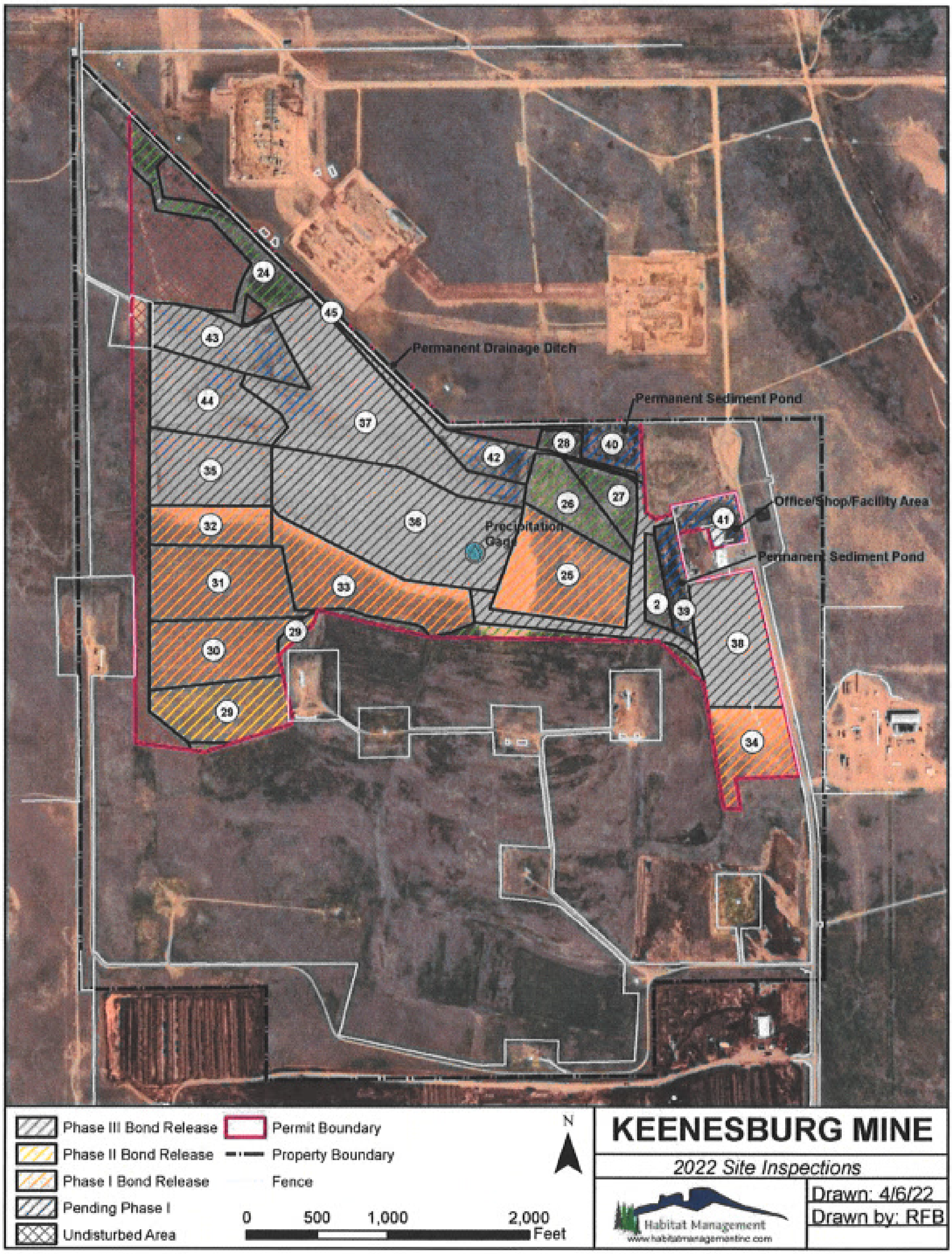
Appendix G: Pest & Disease Inspection Reports

On February 14, 2023 Habitat Management inspected the operational, bonded reclaimed, and shop areas at the Keenesburg Mine for plant pests, plant diseases, and noxious weeds that could or have affected establishment of vegetation on reclaimed lands. The following areas were inspected and are depicted on Map 1:

- Office/shop/facility area;
- Bonded reclamation;
- Permanent sediment ponds; and,
- Undisturbed land within the permit boundary.

Plant pests or diseases were not observed within the areas inspected. The vegetation has not been adversely affected by plant pests. Areas affected by infestation or blight were not identified during this inspection. No areas were observed where noxious weed species were impacting normal growth and establishment of vegetation on reclaimed lands.

Map 1: Coors Energy Company-Keenesburg Mine

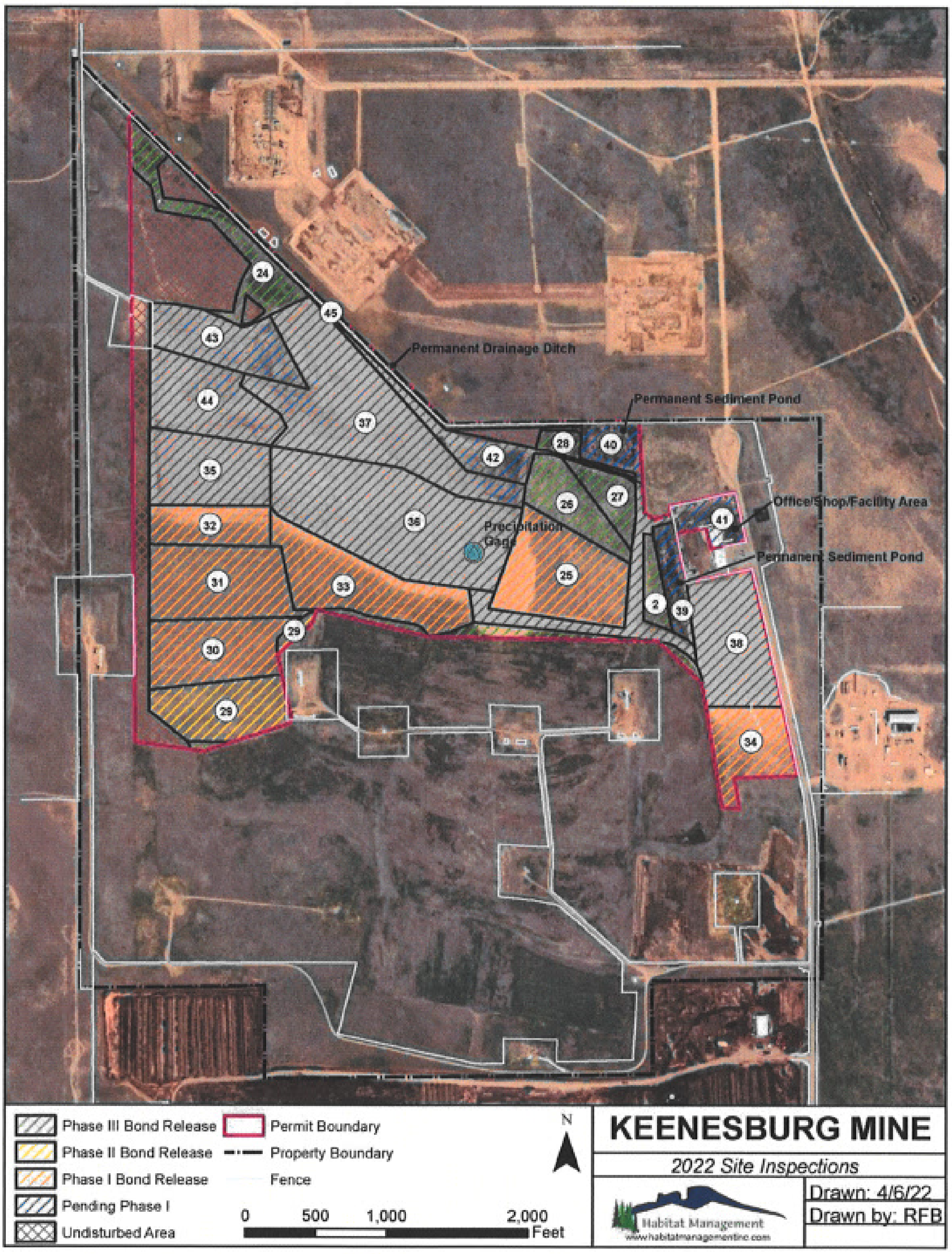


On June 9, 2023 Habitat Management inspected the operational, bonded reclaimed, and shop areas at the Keenesburg Mine for plant pests, plant diseases, and noxious weeds that could or have affected establishment of vegetation on reclaimed lands. The following areas were inspected and are depicted on Map 1:

- Office/shop/facility area;
- Bonded reclamation;
- Permanent sediment ponds; and,
- Undisturbed land within the permit boundary.

Plant pests or diseases were not observed within the areas inspected. The vegetation has not been adversely affected by plant pests. Areas affected by infestation or blight were not identified during this inspection. No areas were observed where noxious weed species were impacting normal growth and establishment of vegetation on reclaimed lands.

Map 1: Coors Energy Company-Keenesburg Mine

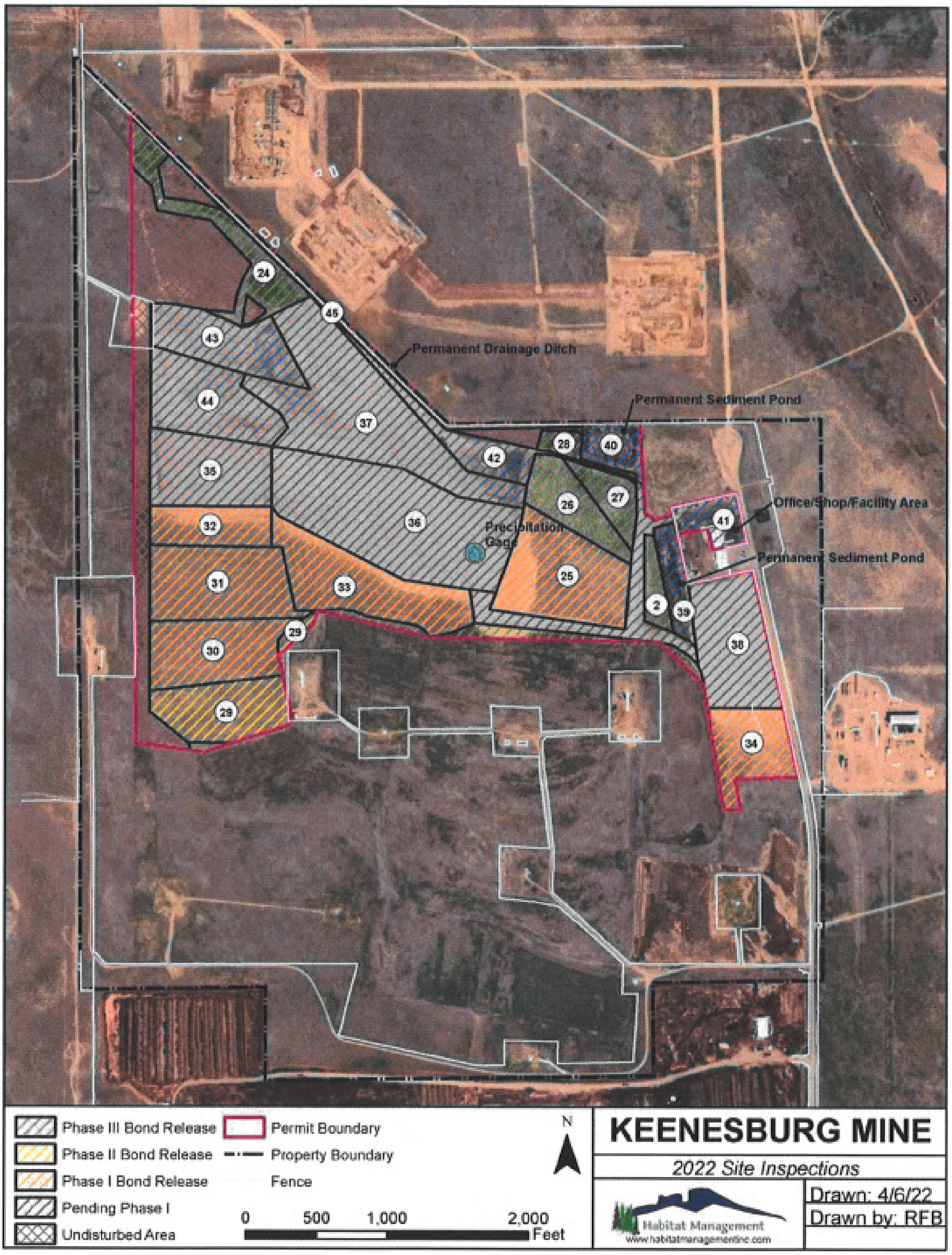


On September 22, 2023 Habitat Management inspected the operational, bonded reclaimed, and shop areas at the Keenesburg Mine for plant pests, plant diseases, and noxious weeds that could or have affected establishment of vegetation on reclaimed lands. The following areas were inspected and are depicted on Map 1:

- Office/shop/facility area;
- Bonded reclamation;
- Permanent sediment ponds; and,
- Undisturbed land within the permit boundary.

Plant pests or diseases were not observed within the areas inspected. The vegetation has not been adversely affected by plant pests. Areas affected by infestation or blight were not identified during this inspection. No areas were observed where noxious weed species were impacting normal growth and establishment of vegetation on reclaimed lands.

Map 1: Coors Energy Company-Keenesburg Mine

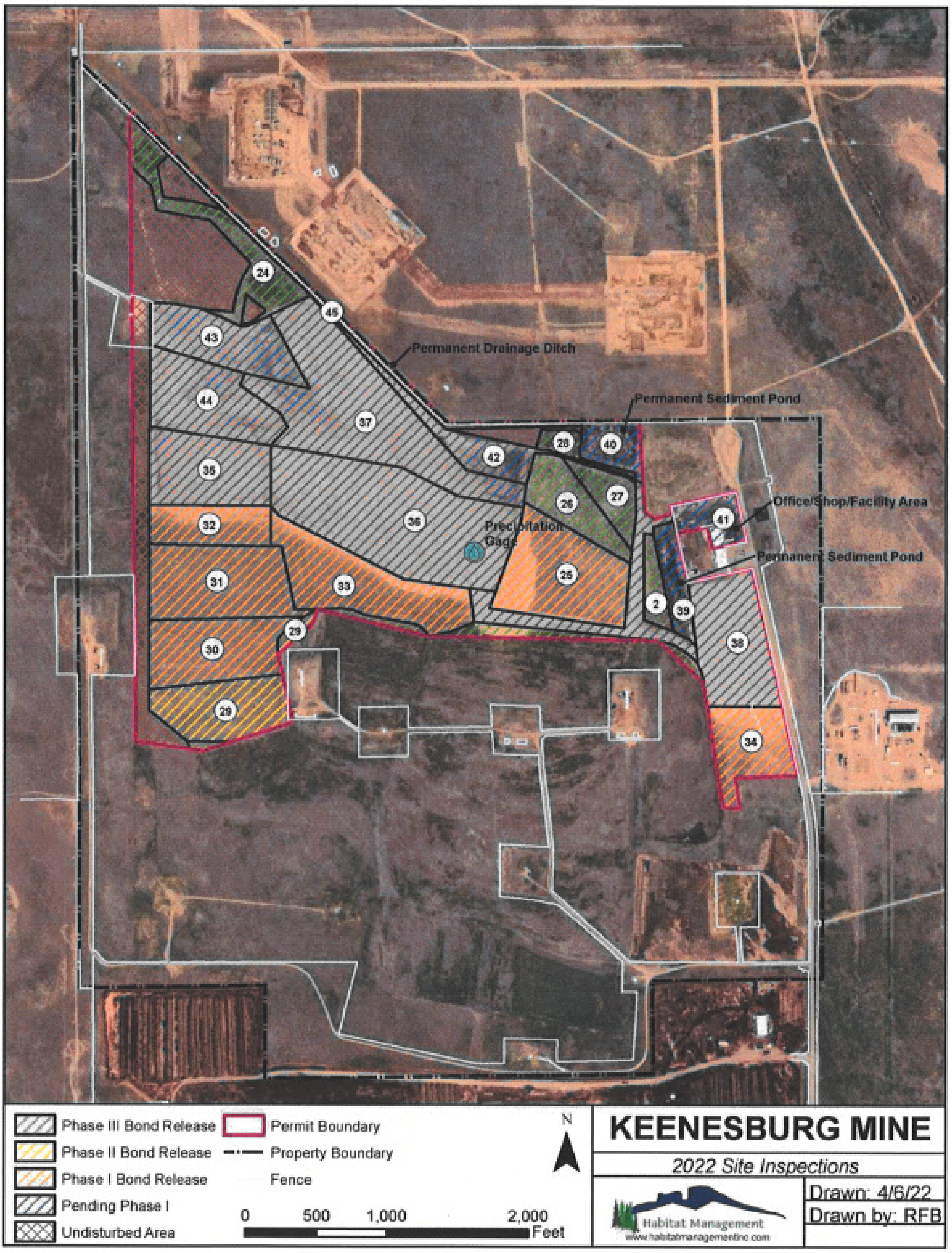


On November 7, 2023 Habitat Management inspected the operational, bonded reclaimed, and shop areas at the Keenesburg Mine for plant pests, plant diseases, and noxious weeds that could or have affected establishment of vegetation on reclaimed lands. The following areas were inspected and are depicted on Map 1:

- Office/shop/facility area;
- Bonded reclamation;
- Permanent sediment ponds; and,
- Undisturbed land within the permit boundary.

Plant pests or diseases were not observed within the areas inspected. The vegetation has not been adversely affected by plant pests. Areas affected by infestation or blight were not identified during this inspection. No areas were observed where noxious weed species were impacting normal growth and establishment of vegetation on reclaimed lands.

Map 1: Coors Energy Company-Keenesburg Mine



WATER QUALITY SAMPLING 2023

AHR-2023

WATER QUALITY SAMPLING PROTOCOL

Procedure

The ground water sampling procedure used at the Keenesburg Mine site during 2023 was originally approved as part of the Coors Energy Company (CEC) Application for Permit Renewal (1997), filed with the then Colorado Division of Minerals and Geology (CDMG). CEC has consistently used this procedure beginning with the fourth quarter, 1997 sample collections. Consent to dispose of Mine Waste Rock at the Keenesburg site (MR #34, 8/98) resulted in minor changes to the approved ground water monitoring plan, pursuant to requests from the Colorado Department of Public Health and Environment (CDPHE). However, field collection procedures, the order of sampling, field measurements and sampling frequency protocols, remain essentially unchanged since 1997. In 2013, CEC applied for and was granted Technical Revision #44 which changed sampling frequency from quarterly to semi-annually. Specifically, sampling was to occur in April and September. This procedure will be under review, with changes contemplated prior to the first sampling event of 2018.

In 2019, AEC took over the water sampling work. They have combined this sampling process with the process approved by CDPHE to more efficiently collect samples that are needed for both DRMS and CDPHE. The full water sampling report, prepared for CDPHE, is included.

Ground Water Monitoring and Quality Analysis

The formal ground water sampling program for the Keenesburg Mine was initiated in 1992. Ground water quality information has consistently been obtained from monitor wells located: 1) upgradient, 2) within the disturbance area, and 3) downgradient from the mine site. The monitoring program provides a basis for comparison of information between a baseline and the existing site conditions relative to ground water flow and water quality at the site.

The water quality test results, obtained from the data collected in the field and from the analytical ground water quality reports, support the contention that the overall groundwater quality in the area has not been adversely affected by; 1) the earlier Keenesburg Coal Strip Mine operations, or 2) the subsequent reclamation activities (which include both the ash and the mine waste rock disposal operations). While questions may have arisen with respect to specific analytes in certain wells (manganese in the SMW-2 well, for example), overall parameters are within the scope of what should be considered acceptable. Any results that are at issue likely reflect recharge of the groundwater through the disturbed soils/spoils from previous operations, as opposed to one of the aforementioned activities.

While they have been altered within the Keenesburg Mine site itself, general ground water flow patterns in the vicinity of the mine appear not to have been significantly changed (or interrupted) by the past mining activities, or by the ongoing ash disposal and mine reclamation.

The six ground water monitoring wells were sampled by CEC on a semi-annual basis in 2018. These wells are designated: AMW-1, AMW-2, DH-96, DH-122, FPW and SMW-2. Water quality analysis incorporates both the fieldwork and the analytical laboratory testing of water samples collected from these wells.

Field Measurement Protocol:
Static water level is a tape measurement from the top of the well casing (a known ground elevation) to the current water level in the well. This measurement is taken following a visual inspection of the area surrounding the well casing, and precedes any sampling activity. Water sample temperature, specific conductance and pH are determined using a probe placed in each sample as soon as it is collected. Samples are collected and analyzed both before and after the appropriate well purge procedures are conducted.

Laboratory analysis:

The wells are sampled in a sequence that follows the order of least to greatest level of salinity. At the end of 2016 this sequence continued to be: (1) FPW, (2) AMW-1, (3) DH-96, (4) DH-122, (5) SMW-2 and (6) AMW-2. Ash Monitor Well No. 2 (AMW-2) still continues to recharge following the conclusion of the A-Pit reclamation activity. This process has been ongoing since the end of 1999 when A-Pit reclamation was completed, but only since 2004 has it resulted in volumes sufficient to allow sampling. Adequate water volumes were found in this well during each of the samplings for 2017, making it possible to obtain samples following the standard three-well volume purge procedure. While the well bore water level recovery following testing remains slower, higher static water levels provide evidence that the highly disturbed zone in the reclaimed overburden area is recharging. The timeline for this recharge is consistent with previous predictions.

Copies of the analytical laboratory test results are found in the pages following this text. Each ground water monitoring well was sampled in accordance with the "permit procedure". The "B" designation following the well identification confirms that the laboratory sample was obtained after initial field sampling, well purging and a subsequent (second) field sampling. The 2019 ground water monitoring test results remain consistent with results from previous year's analyses in that there have been no confirmed statistical exceedences, with but one exception, the samples obtained from the SMW-2 well during 2004. The SMW-2 well is completed in the disturbed spoil material which is being subjected to slow re-saturation by ground water, and appears to be leaching dissolved minerals as the water table rises. This has caused manganese concentrations to somewhat exceed the calculated tolerance limit. CEC addressed this tolerance limit exceedence with CDPHE during 2005, and was granted permission to continue the current detection monitoring program *[Doty & Associates letter dated 04/08/05, "Alternate Source Demonstration, Statistically Significant Increase Over Background Manganese in SMW-2, Fourth Quarter 2004, Keenesburg Disposal Facility"].*

The direction of ground water flow, to the extent that it has been documented in the area of the Keenesburg Mine property, trends downgradient to the northeast. Recharge of the aquifer in the "spoil area" continues to be limited to a single source, the localized infiltration of precipitation to the subsurface. There is no evidence of any significant ground water recharge to the site from the Ennis Draw fluvial ground water system. Ground water elevations in the sampled Ennis Draw wells close to the Keenesburg Mine site are significantly higher than in either the spoil monitoring well (SMW-2) or in the ash monitoring wells (AMW-1 or AMW-2).

It is CEC's position that no adverse affect on the overall hydrologic balance of the Keenesburg Mine site will result from, a continuation of the ash disposal operation, from the limited addition of mine waste rock to the B-Pit ash disposal, or from the continuing reclamation operations. Ground water levels in the former coal extraction areas should be expected to recover to their approximate pre-mining levels following the conclusion of all CEC operations (see McWhorter report, Appendix I-1 to Permit C-81-028). Treatment of either the ground water or the surface waters at the Keenesburg Mine site is not anticipated to be necessary.

Notice: In the course of applying for, and obtaining approval to dispose of mine waste rock in the ash disposal pit (B-Pit) at the Keenesburg Mine site, CEC submitted, and received CDPHE approval for, a Ground-Water Monitoring Plan. As a requirement of the approval, CEC is providing notice that the data developed under the Monitoring Plan for 2011 has been placed in the operating records at the site office. This is the fifteenth such notice relative to the Ground-Water Monitoring Plan.

LIST OF MONITOR WELLS

This table summarizes monitor well information, to include: well designation, top of casing elevation, location, and aquifer monitored. The wells monitored during 2019 were:

Well	Elevation	Aquifer	Location
AMW-1	4804'	Alluvial, in Undisturbed Overburden	Mine Site, Down gradient from B-Pit
AMW-2	4811'	Alluvial, in Reclaimed Spoil	Mine Site, Down gradient
DH-96	4764'	Alluvial, in Ennis Draw	Down gradient from Mine Site
DH-122	4814'	Alluvial, in Ennis Draw	Up gradient from Mine Site, from A-Pit

FPW	4780’	Alluvial, in Ennis Draw	Mine Site
SMW-2	4803’	Alluvial, in Reclaimed Spoil	Mine Site

Well locations can be found on the Existing Surface Features and Utilities Map.

WATER QUALITY PARAMETERS ANALYZED

Report Key	Parameter
a	Calcium - dissolved
b	Iron - dissolved
b	Magnesium - dissolved
b	Manganese - dissolved
b	Molybdenum - dissolved
a	Sodium - dissolved
a	Alkalinity - total (as $CaCO_3$)
a	Carbonate - (as CO_3)
a	Hardness - (as $CaCO_3$)
a	Bicarbonate - (as HCO_3)
a	pH - (pH units)
a	Specific conductance - (μmhos/cm)
b	Lead - dissolved
b	Selenium - dissolved
a	Total dissolved solids - at 180°C (TDS)
a	Chloride
a	Sulfate (as SO_4)
a	Sodium absorption ratio (SAR)
a	Hydroxide (as OH)
b	Barium – [added in1998 for mine waste rock]
b	Arsenic – [added in 2000]
b	Cadmium – [added in 2000]

a = General Chemistry Lab Report
b = Metals Lab Report

February 22, 2024

Jerry Henderson
Colorado Department of Public Health and Environment
HMWMD
4300 Cherry Creek Drive South Denver, Colorado 80246-1530

Re: Revision 1: 2023 Annual Groundwater Monitoring Report
Keenesburg Ash Disposal Site
Weld County, Colorado

Dear Mr. Henderson

This groundwater monitoring report describes the groundwater monitoring activities performed at the Keenesburg Ash Disposal Site (the facility) in 2023. Sampling and statistical analysis was conducted by American Environmental Consulting, LLC (AEC) in accordance with the August 5, 2018 Post-Closure Care Plan (PCCP), the August 5, 2018 Post-Closure Groundwater Monitoring Plan (GMP) and the March 2009 Unified Guidance for Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (Unified Guidance).

Please feel free to call of email me with any questions.

Respectfully,
AMERICAN ENVIRONMENTAL CONSULTING, LLC

Ryan Smith-EIT
Field Engineer

Reviewed by:

Curtis Ahrendsen
Project Manager

cc: Ben Moline, Molson Coors Beverage Co.

1.0 Introduction

The site is located approximately 4.5 miles north of Keenesburg (Figure 1) in portions of Sections 25 and 36, Township 3 North, Range 64 West, Sixth Principal Meridian, Weld County, Colorado (Figure 2). The area included in the permit allowing both mining and disposal operations is approximately 788.5 acres. Only 413 acres were actually disturbed by mining activities. Ash disposal occurred in two pits (the A-Pit and B-Pit) totaling about 65.6 acres.

The property was a surface coal mine (with associated support operations) from 1981 through 1987. Disposal of ash began in 1987 as part of the mine reclamation process. The site is permitted to dispose of fly and bottom ash from the coal-fired power plant located at the Molson Coors Brewing complex in Golden, Colorado. The facility also accepted waste rock from other mines on a case-by-case basis. The approved operations plan also allows demolition and disposal of on-site facilities such as the shop/office building. The disposal pit closure was completed in 2019.

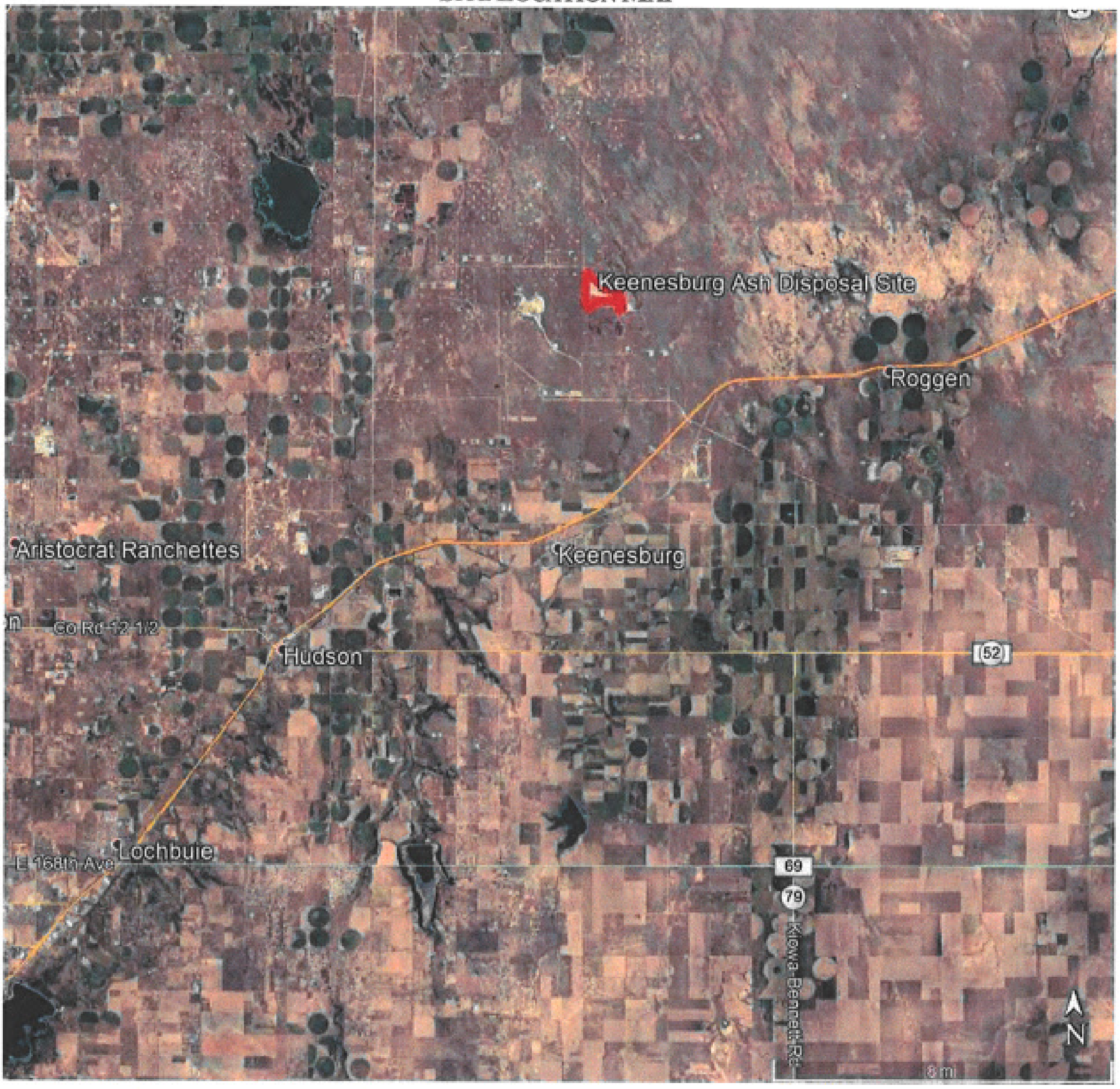
The facility began post-closure groundwater monitoring in the 4th Quarter of 2019 in accordance with the PCCP and GMP. According to the GMP, water levels will be measured quarterly and sampling is conducted semiannually. In accordance with the PCCP, four new groundwater monitoring wells were installed at the facility in July 2019 (PC-1, PC-2, PC-5 and PC-6). These new wells were sampled for the first time during the 4th Quarter 2019 groundwater monitoring event. Statistical analysis of the facility's groundwater will begin after the new wells have been sampled eight times. Statistical analyses began upon receiving the sampling results of the April event in 2023.

The monitoring well network consists of seven wells including:

PC-1 PC-2 PC5 PC-6 AMW-1 AMW-2 SMW-2

The original closure plan included two additional wells, PC-3 and PC-4. PC-3 was not installed due to encountering ash and darker materials during drilling. AMW-2 is in the same area and became part of the CDPHE's post-closure monitoring program taking the place of PC-3. PC-4 also encountered similar materials during drilling and therefore was not completed to groundwater. CDPHE and CEC agreed that if a need for a well replacing the planned PC-4 well is discovered in the future we would address the location of a replacement well. Approval of these changes was noted in an email from Eric Jacobs of the CDPHE on August 29, 2019.

FIGURE 1
SITE LOCATION MAP



2.0 Sampling

All seven monitoring wells in the post-closure monitoring network were sampled by AEC twice in 2023. Additionally, AEC personnel sampled wells FPW, DH-96, and DH-122 twice in 2023. These wells are not in the monitoring network but data for these wells may be included in future statistical analyses. The first 2023 semiannual sampling event was conducted on April 17 and April 18, 2023, and the second sampling event was conducted on September 12 and 13, 2023.

All sampling activities were performed by AEC in accordance with the GMP procedures with the exception that water levels were collected immediately before each well was sampled rather than from all wells prior to commencing sampling.

Upon arriving at each monitoring well, the sampling technician first measured the static water levels and recorded the measurements on the field forms. The technician then purged the wells using the dedicated 12V pumps. At wells with adequate recharge, three wellbore storage volumes were purged prior to sampling. Wells with poor recharge were purged until dry and then sampled the following day. After each wellbore storage volume was purged, the technician measured the purged water's pH, temperature and conductivity using a portable meter that was calibrated that day. The technician recorded the water level, total volume of water purged, and field parameter measurements onto field sampling forms which are included in Attachment 1.

After each well was purged, the technician collected groundwater samples into new sample containers, containing appropriate preservatives as required, provided by Pace Analytical. A duplicate sample was collected from AMW-2 during the April monitoring event and AMW-1 during the September monitoring event. All sample containers were labeled with the well name, the date and time collected, the analyses to be performed, the preservative used (if any), and the sampler's initials. The sample containers were immediately sealed and placed on ice in a cooler after collection. A chain of custody form (COC) was provided by the laboratory. The technician added each sample to the COC, along with the date and time it was collected, and the analyses to be performed.

Samples were preserved during collection activities by placing them in ice-packed coolers. After the last samples were collected on the second day of sampling during each monitoring event, the coolers were filled with fresh ice and sealed with the COCs inside. The coolers were shipped via FedEx™ overnight to the Pace Analytical laboratory in Mount Juliet, TN.

3.0 Groundwater Hydrology

The groundwater monitoring network at the facility is made up of seven wells: PC-1, PC-2, PC-5, PC-6, AMW-1, AMW-2, and SMW-2, and water levels in in these wells are measured quarterly. The field technician measured the depths to water in each well using an electronic water level indicator, and the indicator was decontaminated after measuring water levels in each well. Table 1 shows the depth to groundwater measurements and static water elevations during each quarterly water level monitoring event.

TABLE 1
2023 QUARTERLY WATER LEVELS

Well	ToC Elevation	3/06/2023		4/18/2023		9/12/2023		12/18/2023	
		Depth	Elev	Depth	Elev	Depth	Elev	Depth	Elev
AMW-1	4,804.55	28.48	4,776.07	28.47	4,776.08	26.62	4,777.93	26.94	4,777.61
AMW-2	4,808.88	23.63	4,785.25	23.70	4,785.18	23.23	4,785.65	23.38	4,785.50
PC-1	4,830.46	20.46	4,810.00	20.38	4,810.08	18.61	4,811.85	18.97	4,811.49
PC-2	4,819.29	35.99	4,783.30	36.95	4,782.34	36.07	4,783.22	36.19	4,783.10
PC-5	4,803.16	32.66	4,770.50	32.40	4,770.76	32.48	4,770.68	32.49	4,770.67
PC-6	4,798.63	28.12	4,770.51	28.13	4,770.50	26.21	4,772.42	26.75	4,771.88
SMW-2	4,803.80	33.13	4,770.67	32.34	4,771.46	32.78	4,771.02	33.29	4,770.51

Notes: Elevation is feet above mean sea level.
Depth measured in feet from top of casing.

AEC constructed groundwater potentiometric surface maps for each monitoring quarter in 2023 using the groundwater elevations from Table 1. Additionally, water levels were voluntarily measured in well SMW-1 during the quarterly events, and those measurements were included in the potentiometric surface maps. The potentiometric surface maps are included in Attachment 2 and are labeled Figure 2-1 through 2-4.

All four of the 2023 maps are substantially similar, and they show groundwater generally flowing east to north-northeast beneath the facility. Near the A-Pit, groundwater flows north-northeast at a gradient of approximately 2.44% to 2.58%. Near the B-Pit, groundwater flows east at a gradient of approximately 0.60% to 0.71%. The observed quarterly groundwater gradients beneath each pit are shown in Table 2 on the following page.

Groundwater flow velocities beneath both the A-Pit and B-Pit were calculated using the formula from the GMP. The GMP lists the average hydraulic conductivity beneath the site as $3x10^{-5}$ cm/s and the porosity as 0.1; however, the actual hydraulic gradient varies across the site. The formula provided in the GMP for calculating groundwater flow velocity is:

$$V_s = 2830\frac{Ki}{n_e}$$

Where:

V_s	=	groundwater seepage velocity (ft/day)
K	=	hydraulic conductivity (cm/s)
i	=	hydraulic gradient (dimensionless)
n_e	=	effective porosity (dimensionless)
2830	=	unit conversion factor ((s*ft)/(cm*day))

Using that formula, AEC calculated the groundwater flow velocity beneath both the A-Pit and B-Pit for each of the 2023 quarterly water level monitoring events, and the results are shown in Table 2 below.

TABLE 2
2023 QUARTERLY GROUNDWATER FLOW VELOCITIES

Monitoring Quarter	Pit	Gradient	Velocity	
			(ft/day)	(ft/year)
1st Quarter	A-Pit	2.44%	0.02073	7.6
	B-Pit	0.71%	0.00603	2.2
2nd Quarter	A-Pit	2.46%	0.02085	7.6
	B-Pit	0.66%	0.00558	2.0
3rd Quarter	A-Pit	2.58%	0.02194	8.0
	B-Pit	0.60%	0.00509	1.9
4th Quarter	A-Pit	2.56%	0.02177	7.9
	B-Pit	0.62%	0.00529	1.9

4.0 Laboratory Results

The samples collected by AEC for the 2nd Quarter monitoring event were received by Pace Analytical on April 20, 2023, and the 3rd Quarter monitoring event samples were received by Pace Analytical on September 14, 2023. The laboratory noted that all samples were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times for both 2023 monitoring events. Duplicate samples were collected from AMW-2 in the Spring and AMW-1 in the Fall. Table 3 shows the analytical results from the primary and duplicate samples and the relative percent difference (RPD) between them for both 2023 monitoring events. The primary and duplicate samples showed good agreement for both monitoring events, with nearly all parameters differing by less than 10%.

TABLE 3
PRIMARY AND DUPLICATE SAMPLE RESULTS AND COMPARISON

Constituent	23-Apr			23-Sep		
	AMW-2	DUP	RPD	AMW-1	DUP	RPD
Sodium Adsorption Ratio	14.1	14.4	2%	2.01	1.97	2%
Hardness (calculated) as CaCO3	1910	1930	1%	942	953	1%
Dissolved Solids	6970	5480	21%	1540	1610	5%
Alkalinity,Bicarbonate	771	789	2%	199	199	0%
Alkalinity,Carbonate	ND	ND	0%	ND	ND	0%
Chloride	368	351	5%	32.2	32.9	2%
Fluoride	ND	ND	0%	0.972	0.955	2%
Sulfate	3420	3170	7%	874	897	3%
Antimony,Dissolved	ND	ND	0%	ND	ND	0%
Arsenic,Dissolved	ND	ND	0%	ND	ND	0%
Barium,Dissolved	0.0204	0.0202	1%	0.0275	0.0273	1%
Boron,Dissolved	0.241	0.243	1%	ND	ND	0%
Cadmium,Dissolved	ND	ND	0%	ND	ND	0%
Calcium	458	464	1%	260	262	1%
Calcium,Dissolved	459	477	4%	247	252	2%
Iron,Dissolved	ND	ND	0%	ND	ND	0%
Lead,Dissolved	ND	ND	0%	ND	ND	0%
Magnesium	186	187	1%	71.5	72.4	1%
Magnesium,Dissolved	187	193	3%	70.1	71.8	2%
Manganese,Dissolved	3.46	3.56	3%	ND	ND	0%
Molybdenum,Dissolved	ND	ND	0%	ND	ND	0%
Potassium,Dissolved	28.4	29.4	4%	3.25	3.63	12%
Selenium,Dissolved	0.0119	ND	0%	0.0175	ND	n/a
Sodium	1420	1450	2%	142	140	1%
Sodium,Dissolved	1420	1460	3%	139	141	1%

The complete laboratory analytical reports for both 2023 semiannual water quality sampling events are included in Attachment 3.

5.0 Statistical Analysis

The GMP specifies that the analytical data will be statistically analyzed using interwell prediction limits, which requires a minimum of eight observations in the up-gradient wells (PC-1 and PC-2). Currently, eight observations have been collected. Based on the semiannual water quality monitoring schedule, the first statistical analysis will be conducted as part of this report. Additionally, the GMP specifies that the default configuration options in the Sanitas software shall be used for statistical analysis. A description of each statistical tool used in this report is in Sections 5.1 through 5.6 below.

5.1 Data Input Protocol

Regulations require that data reported as being below the "detection limits" be included in the statistical evaluation. For the purpose of this monitoring report, the term Detection Limit is synonymous with the Method Detection Limit (MDL), and the term Reporting Limit (RL) is synonymous with the Practical Quantification Limit (PQL). If the data for a particular constituent is observed above its RL, it is assumed that the reported concentration is a "true" value with a high degree of certainty. Observations below the detection limit may be reported as non-detected (ND), below detection limits (BDL), undetected (U) or other notation such as "<##" with ## denoting the RL, and is also referred to as "censored" data. Concentrations may also be reported as a value between the Method Detection Limit (MDL) and the quantitation limit (PQL or RL), in which case the value is accompanied by a qualifier (commonly a "J"). Values reported between the MDL and the RL are estimated values and the true value may be anywhere between the MDL and RL; however, an estimated concentration may or may not be reported by the laboratory, These three types of observations (quantified, estimated and non-detect) are recorded in the facility's database as described below.

1. When data is reported as non-detect ("ND", "BDL", "U", etc.), the data will be input using a less-than symbol (<) followed by the reporting limit (PQL or RL). For example, if the RL for a specific event is reported as 10.0 mg/l and a result is reported as "ND", the value "<10.0" will be input into the database for modeling. Consequently, values preceded by a "<" will be recognized as non-detect measurements.
2. If the data is reported at an estimated concentration (a "J', value), the estimated value will be entered into the database followed by a "J" in parentheses. While true concentrations may vary from an estimated concentration, using an estimated value is always preferable to treating the measurement as a non-detect. In the event that the laboratory does not report the estimated concentration, the value shall be input in the same was as non-detect data as described above.
3. If the data is reported at a quantifiable concentration above the RL, the reported value will be input and used by the model for the statistical evaluation.

5.2 Preliminary Statistical Evaluation

Prior to evaluating the data for background data set development and conducting a formal statistical analysis, the data will be evaluated for outliers and seasonality using the formulas and algorithms outlined in the EPA's Unified Guidance. Regulations require that data reported as "censored data" be included in the statistical evaluation. These censored data are represented in the database in the form of "<##", where ## is the associated reporting limit as described above. In order to use the majority of statistical analyses conducted in this report, a numerical value needs to be entered for non-detect measurements. Inputting a hard value for a non-detect measurement is known as simple substitution, and the Unified Guidance recommends using ½ of the RL as the substitution value. This will be done for all of the statistical tests used by this report with the exception of some special cases where the Kaplan-Meier adjustment is used to compute parametric prediction limits as described in Section 5.6.1.

5.3 Identification of Statistical Outliers

A statistical outlier is a value that is significantly different and is not representative of the natural population from which the sample was drawn. The default configuration for identifying outliers in Sanitas is to first screen for potential ouliers with ASTM E178 (aka EPA's 1989 Outlier Screening test) at a 95% significance level (0.05 α). Then after potential outliers are identified Dixon's Outlier Screening test at a 95% significance level (0.05 α) is used if the number of observations is less than 22 and Rosner's Outlier Screening Test if the number of observations is greater than 22. This method assumes normally distributed data after the identified outliers have been removed, thus the data must be tested for normality after performing the outlier test. Normality will be tested using the Shapiro-Wilk/Francia test for normality at a 90% significance level (0.1 α). If the data are not normal, an attempt will be made to transform the data to a normal distribution using a ladder of powers approach. This approach will transform all values in a dataset in the order of $x^{1/2}$, x^2, $x^{1/3}$, x^3, $\ln(x)$, x^4, x^5, x^6, where x is each value in the dataset. After each transformation, the data will again be tested for normality using the Shapiro-Wilk/Francia test for normality at a 90% significance level. If the data are normal or can be transformed to normal, the observations identified by Dixon's Outlier Test or Rosner's Outlier Test will be considered potential outliers. If the data are not normal and cannot be transformed normal, Tukey's non-parametric outlier test will be used to evaluate the presence of outliers at an interquartile range multiplier of 3.

Once outliers are identified through the methods discussed above, additional evidence will be sought to justify their removal from future statistical analysis, with the exception that outliers may be appropriate for removal from the background data set without further justification as recognized by the EPA in Section 2.3.5 of the Unified Guidance. No identified potential outliers will be removed unless supporting evidence can be found that the measurement in question is not a true value or is not representative of actual groundwater conditions. Such supporting evidence may include the presence of the constituent in the equipment, method or trip blanks, laboratory quality control data that is outside of control limits, or anecdotal information indicating that sampling or shipping issues are present. If any of these issues are discovered, the samples may be re-analyzed if the sample holding times have not been exceeded. If the sample is re-analyzed and the new measurement is not identified as an outlier, then the re-analyzed value shall replace the original value in the database. Except for cases where a sample is re-analyzed, outliers will not be removed from the database. Instead, the database entry shall be flagged with an "(o)" after the measurement and excluded from statistical analysis.

5.4 Evaluation of Seasonality

Background data will be analyzed for seasonality assuming two seasons per year that coincide with the semiannual sampling events. Once the data are separated into two seasons, the presence of seasonality will be tested using the Kruskal-Wallis (non-parametric ANOVA) test at the 95% significance level (0.05 α) in accordance with the suggested method in the Unified Guidance. This test requires a minimum of three years of data (three complete sets of seasons) to test for seasonality. If seasonality is detected, all data for the seasonal well-constituent pair will be deseasonalized by subtracting the seasonal mean of the background data (mean of the values in the background data's season) and adding the grand mean of the background data (mean of all values in the background dataset) to every measurement for that well-constituent pair. Seasonality evaluation is included the interwell prediction limits in Attachment 4.2. The Sanitas software automatically conducts this evaluation when calculating interwell prediction limits.

5.5 Background Dataset

When establishing the background, the historical data should meet the assumptions that the data is statistically independent (random); stationary over time (possesses no trends, spatial and temporal variations); and possesses no outliers (observations that are statistically different from the rest of the data). In order to meet these requisites the data should be analyzed for trends, seasonality and outliers prior to establishing a background. Data that display either significantly increasing or decreasing trends and or spatial variation (for inter-well analysis) should not be used to establish background since it displays a data population that is changing. Several statistical tools are used to evaluate the historic dataset to determine if the data meets background

requisites. An outlier test will be performed on all data being considered for background as described in Section 5.3. Unlike identified outliers in compliance data, however, outliers in background may be removed without corroborating evidence in accordance with the unified guidance. A Mann-Kendall trend analysis at at will be used to determine significant increasing or decreasing trends. Seasonality of the background is also tested to determine if the dataset (and future compliance values) should be deseasonalized.

The first background dataset for interwell prediction limit analyses is included in this report, and the procedures followed for defining background as well as for updating background in the future are described in Section 5.5 below.

5.5.1 Background Outlier Analysis

As stated in Section 5.2.3 of the Unified Guidance, it may be appropriate to remove high-magnitude outliers in background even if the reasons for these apparently extreme observations are not known. The overall impact of removal will tend to improve the power of prediction limits and control charts, and thus result in a more environmentally protective program. Thus, AEC performed a statistical outlier analysis on the background dataset of all observations in wells PC-1 and PC-2, and through September 2023 using the tests described in Section 5.3.

In this report there were 12 outliers identified and removed from the dataset. They are listed in Table 4 below.

TABLE 4
BACKGROUND OUTLIERS

Well ID	Constituent	Date(s)
PC-1	Barium	12/18/2019
PC-2	Barium	12/19/2019
PC-1	Boron	9/28/2022
PC-2	Calcium	4/18/2023
PC-1	Manganese	12/18/2019
PC-2	Molybdenum	9/13/2023
PC-1	Potassium	9/30/2021, 5/1/2022
PC-2	Potassium	9/30/2021, 5/1/2022, 4/18/2023
PC-1	Selenium	9/30/2021

All high-magnitude outliers removed from the background dataset in the future will be noted in the detection monitoring reports.

5.5.2 Background Seasonality Analysis

Background data will be deseasonalized with the methods described in Section 5.4.

5.5.3 Background Trend Analysis

Data in the upgradient wells PC-1 and PC-2, used as background will be tested for the presence of trends using a Mann-Kendall Trend Test. Presence of trends in the upgradient wells may indicate that natural groundwater quality is changing over time. In accordance the Unified Guidance Section 5.2.5 Interwell prediction limits shall not be determined for well-constituent pairs exhibiting statistically significant increasing trends since the presence of these trends violates the assumption of no temporal variation. For well constituent pairs exhibiting decreasing trends, prediction limits may be determined, however, they will likely be too high in value and will likely have a lower false positive rate than desired, resulting in less statistical power for detecting contamination. An intrawell statistical approach may be more appropriate if there are a significant number of well-constituent pairs exhibiting trends in the background/upgradient wells.

In the background data only Barium in PC-2 and PC-2 exhibited statistically significant trends. Both had decreasing trends so prediction limits will be determined for all well-constituent pairs in PC-1 and PC-2.

5.6 Interwell Prediction Limits

Interwell prediction limits will be the primary statistical compliance test used at the facility. A prediction limit is a type of statistical interval that defines a range (upper and lower limits) in which future observations are expected to fall. The GMP states that an interwell approach shall be used so compliance/downgradient wells shall be compared to background/upgradient UPLs. A compliance measurement above the calculated UPL is considered an initial SSI and is subject to retesting as discussed in Section 5.7.

5.6.1 Parametric Prediction Limits

Parametric Prediction Limits rely on the assumption that the background data being analyzed are normal or can be transformed normal. Prior to testing for normality, the data will be analyzed for the percentage of ND observations. Datasets containing greater than 50% ND observations will automatically be treated as non-normal and will be subject to a non-parametric prediction limit evaluation as described below. If the data contains between 15% and 50% ND observations, the data will be adjusted using the Kaplan-Meier estimator and tested for normality using the

correlation coefficient on the adjusted values at the 90% confidence level (0.10 α). If the background dataset contains less than 15% ND data, the normality of the background data shall be tested using the Shapiro-Wilk/Francia test at a 90% significance level (0.1 α). If the data are found to be non-normal by either test, the data will be transformed using a ladder of powers approach (described in Section 5.3) and re-tested for normality after each transformation. If the data are normal, the UPL will be calculated from the untransformed data. If the data are transform-normal, the transformed UPL will be calculated using the transformed data and then converted back to an untransformed value via the inverse of the transformation function used. If the data are not normal and cannot be transformed normal, a non-parametric prediction limit will be calculated as described in Section 5.6.2 below.

The parametric UPL is calculated by multiplying the sample standard deviation of the data by a kappa (κ) value and adding the product to the arithmetic mean of the data. The kappa value is determined by site specific parameters (number of well-constituent pairs of concern, sampling frequency, retesting plan and the number of observations in the background dataset). The purpose of the κ value is to control the SWFPR as discussed in Section 5.6.3. The appropriate κ value is obtained from Table 19-11 in Appendix D of the Unified Guidance.

5.6.2 Non-Parametric Prediction Limits

As discussed above, if the background data for a particular well-constituent pair are not normal, cannot be transformed normal, or contain greater than 70% ND data, the data are treated as non-normal and a non-parametric approach must be taken when computing the UPL. Generally, a non-parametric UPL will be equal to the highest or second-highest value observed in the background dataset being considered. To achieve a lower false positive rate (comparable to the target test-wise false positive rate calculated for the facility as described in Section 5.6.3), this report will set the non-parametric UPL equal to the highest background observation for most non-parametric well-constituent pairs with the exception of well-constituent pairs with a sufficiently large background data set where using the second highest background observation will bring their associated test-wise false positive rate closer to the target, as opposed to being far below the target if the highest background observation were used. These decisions are explained in more detail below. Each time the background is updated, the distributions and test-wise false positive rates will be reevaluated to determine the new prediction limits.

There are 12 well-constituent pairs that exceeded their respective UPLs and are marked as initial SSIs in this first statistical analysis. These initial SSIs will be (dis)confirmed in the next monitoring report. The prediction limits determined in this report are summarized in Table 5 below. Rows that are bolded indicate a well-constituent pair that exceeds its relative UPL and is an initial SSI in this report.

TABLE 5
INTERWELL PREDICTION LIMITS SUMMARY

Constituent	Well	UPL	Date	Observ.	Sig.	%NDs	ND	Alpha	Method
Bicarbonate	PC-5	956	9/13/2023	575	No	0	n/a	0.01086	NP
Bicarbonate	PC-6	956	9/13/2023	307	No	0	n/a	0.01086	NP
Bicarbonate	AMW-	956	9/13/2023	199	No	0	n/a	0.01086	NP
Bicarbonate	AMW-	956	9/13/2023	760	No	0	n/a	0.01086	NP
Bicarbonate	**SMW-2**	**956**	**9/13/2023**	**981**	**Yes**	**0**	**n/a**	**0.01086**	**NP**
Carbonate	PC-5	20	9/13/2023	20ND	No	100	n/a	0.01086	NP
Carbonate	PC-6	20	9/13/2023	20ND	No	100	n/a	0.01086	NP
Carbonate	AMW-	20	9/13/2023	20ND	No	100	n/a	0.01086	NP
Carbonate	AMW-	20	9/13/2023	20ND	No	100	n/a	0.01086	NP
Carbonate	SMW-2	20	9/13/2023	20ND	No	100	n/a	0.01086	NP
Arsenic	PC-5	0.01	9/13/2023	0.01ND	No	100	n/a	0.005432	NP
Arsenic	PC-6	0.01	9/13/2023	0.01ND	No	100	n/a	0.005432	NP
Arsenic	AMW-	0.01	9/13/2023	0.01ND	No	100	n/a	0.005432	NP
Arsenic	AMW-	0.01	9/13/2023	0.01ND	No	100	n/a	0.005432	NP
Arsenic	SMW-2	0.01	9/13/2023	0.01ND	No	100	n/a	0.005432	NP
Barium	**PC-5**	**0.01634**	**9/13/2023**	**0.036**	**Yes**	**0**	**None**	**0.007498**	**Param**
Barium	PC-6	0.01634	9/13/2023	0.00968	No	0	None	0.007498	Param
Barium	**AMW-**	**0.01634**	**9/13/2023**	**0.0275**	**Yes**	**0**	**None**	**0.007498**	**Param**
Barium	**AMW-**	**0.01634**	**9/13/2023**	**0.019**	**Yes**	**0**	**None**	**0.007498**	**Param**
Barium	SMW-2	0.01634	9/13/2023	0.0109	No	0	None	0.007498	Param
Boron	PC-5	0.532	9/13/2023	0.2ND	No	0	n/a	0.005984	NP
Boron	**PC-6**	**0.532**	**9/13/2023**	**0.557**	**Yes**	**0**	**n/a**	**0.005984**	**NP**
Boron	AMW-	0.532	9/13/2023	0.2ND	No	0	n/a	0.005984	NP
Boron	AMW-	0.532	9/13/2023	0.229	No	0	n/a	0.005984	NP
Boron	SMW-2	0.532	9/13/2023	0.339	No	0	n/a	0.005984	NP
Cadmium	PC-5	0.00219	9/13/2023	0.002ND	No	94.44	n/a	0.005432	NP
Cadmium	PC-6	0.00219	9/13/2023	0.002ND	No	94.44	n/a	0.005432	NP
Cadmium	AMW-	0.00219	9/13/2023	0.002ND	No	94.44	n/a	0.005432	NP
Cadmium	AMW-	0.00219	9/13/2023	0.002ND	No	94.44	n/a	0.005432	NP
Cadmium	SMW-2	0.00219	9/13/2023	0.002ND	No	94.44	n/a	0.005432	NP
Calcium	**PC-5**	**516.4**	**9/13/2023**	**585**	**Yes**	**0**	**None**	**0.007498**	**Param**
Calcium	PC-6	516.4	9/13/2023	176	No	0	None	0.007498	Param
Calcium	AMW-	516.4	9/13/2023	260	No	0	None	0.007498	Param
Calcium	AMW-	516.4	9/13/2023	462	No	0	None	0.007498	Param
Calcium	SMW-2	516.4	9/13/2023	468	No	0	None	0.007498	Param
Chloride	PC-5	943	9/13/2023	135	No	0	n/a	0.005432	NP
Chloride	PC-6	943	9/13/2023	58.7	No	0	n/a	0.005432	NP
Chloride	AMW-	943	9/13/2023	32.2	No	0	n/a	0.005432	NP
Chloride	AMW-	943	9/13/2023	391	No	0	n/a	0.005432	NP
Chloride	SMW-2	943	9/13/2023	795	No	0	n/a	0.005432	NP