4480 Garfield St
Denver, CO 80216
www.quandaryconsultants.com

January 4, 2024

Mr. Jacob Evans
Environmental Compliance Advisor
Civitas Resources
650 Southgate Drive
Windsor, Colorado 80550

Re: Miller 4-17J, 14-17 Pit Excavation
Soil Analytic Summary Report
SWSW Sec 17, T2S, R67W
COGCC Facility ID 103315
Remediation Project # 25332

Dear Mr. Evans,

Site Background

On behalf Civitas Resources (Civitas), Quandary Consultants, LLC (Quandary) has prepared a soil analytic summary report for the site assessment at the Miller 4-17J, 14-17 location (Site). A topographic site location map is presented as Figure 1. An aerial site location map is presented as Figure 2. A soil and hydrology map is presented as Figure 3. Sample locations identified on figures without defined concentrations are non-detect (ND) for all constituents of concern (COCs).

While collecting samples for root zone soil suitability analysis on March 8, 2023, for the Miller 14-17 pit (ECMC Location ID 103309), suspected hydrocarbon impacts were encountered by Quandary. Quandary mobilized again on March 14, 2023, and March 21, 2023 to conduct a site assessment for Energy and Carbon Management Commission (ECMC) Table 915-1. Five source area boreholes (SB01-SB05) and five background boreholes (BG01-BG05) were advanced. All ten boreholes were dry to refusal at approximately 20 to 22 feet (ft.) below ground surface (bgs). After review of the soil delineation samples, it was determined that the impacts were associated with the Miller 4-17J (ECMC location ID 103315), located approximately 60 ft. northeast of Miller 14-17. All samples had been labeled as the Miller 14-17 at the time.

In order to remediate the impacts that were encountered, Civitas commenced with excavation. Approximately 4,000 cubic yards of soil were excavated and taken to the Front Range Landfill in Erie, Colorado. Quandary mobilized to the location July 6, 2023, July 19, 2023, and August 29, 2023, to collect confirmation soil samples from the open excavation. Confirmation soil samples were collected along the sidewalls approximately every 20 ft. and 6 confirmation soil samples were collected from the base of the excavation with an area of approximately 4,225 square ft. A shale layer was encountered at approximately 24 ft. bgs. Groundwater was not encountered in the open excavation.

Soil Analytical Results

Confirmation soil samples were collected on the sidewalls and base of the excavation and analyzed for full Table 915-1 and compared against ECMC Residential Soil Screening Levels (RSSLs). Analytical results indicated nine confirmation soil samples above the ECMC allowable levels for pH at depths ranging from 20 ft. bgs. to 24 ft. bgs. Analytical results indicated five confirmation soil samples above the ECMC allowable level for SAR at depths ranging from 22 ft. bgs. to 24 ft. bgs. Arsenic results indicated that all confirmation soil samples were above the ECMC allowable level. Seven background boreholes were advanced to refusal and soil samples were collected at approximately 4 to 5 ft. intervals. Five additional background boreholes were advanced to 24 ft. bgs. on November 21, 2023. Excavation confirmation and background soil sample results are depicted in Figures 4-12 and presented in Tables 1-4. Site-specific confirmation and background sample figures are presented as Figures 3 through 10. Bore logs, A bore logs and the laboratory analytical reports are attached.

Background Soils and Statistical Analysis

A total of thirty-five (35) background samples were collected from soils at similar depths and lithologies as the excavation soils in March, August, and November of 2023. A statistical evaluation was completed to assess if Site concentrations of Arsenic, SAR, and pH were substantially different than background concentrations. Quandary completed a non-parametric Wilcoxon rank-sum test to compare the concentrations of the background soil sample data and the site excavation (left in place) soil data. The Wilcoxon Rank Sum Test is based on the United States Environmental Protection Agency's (USEPA) 2006 guidance document, *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9s Box 3-34* but reformatted to match US EPA's 2002 *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites Test Form 2.*

The results of the Wilcoxon rank-sum tests (attached) indicate that concentrations of Arsenic, SAR, and pH in excavation confirmation soil samples (representative of the soil left in place) are not indicative of native background soil concentrations.

Conclusion

Soil analytical results for arsenic, SAR, and pH are above the ECMC allowable levels in several source, delineation, and background soil borings. Because the soil analytical results are above background or ECMC allowable levels, Quandary recommends that additional assessment or excavation is required.

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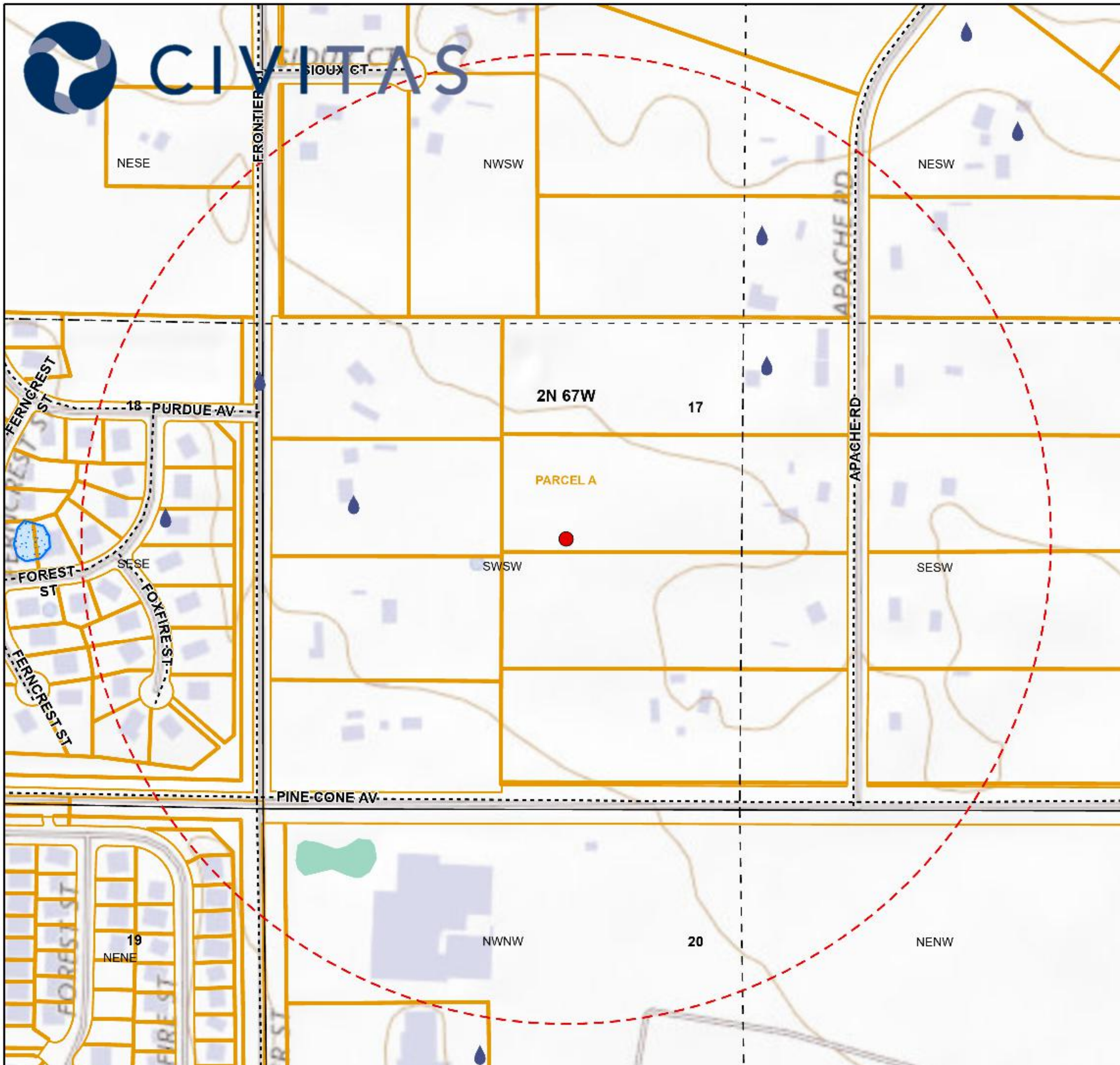
Please let Patrick Lawler know if you have any questions or require additional information on this summary report. He can be reached at plawler@quandaryconsultants.com or 720-480-1035.

Attachments:

Figures
Tables
Wilcoxon Rank Sum Test
Bore Logs
Laboratory Report

FIGURES



Legend

- MILLER 14-17 Pit (103309)
- 0.25-Mile Buffer
- CDWR Water Well Application
- NWI Freshwater Pond
- NHD Waterbody
- Road
- PLSS Township & Range
- PLSS Section
- PLSS Qtr-Qtr
- Parcel Boundary
- County Boundary

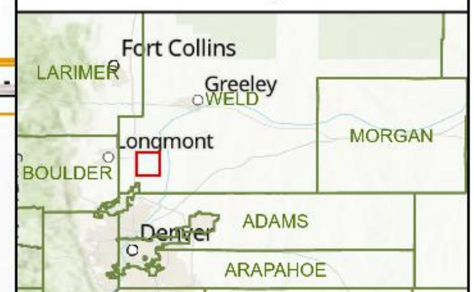
0 125 250 375 500 Feet

N

CIVITAS RESOURCES

Figure 1. MILLER 14-17 & MILLER 4-17J Topographic Site Location Map

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO



QUANDARY CONSULTANTS

Author: CSJ Date: 04/20/2023

PARCEL A: PICKERING, CODY & RANA - 9131 Apache Rd, Longmont, CO 80504-5440 (Account: R5407486, Parcel: 131117005054).

Data Sources: Esri, CGIAR, USGS, Maxar, CDWR, NWI, NHD

Legend

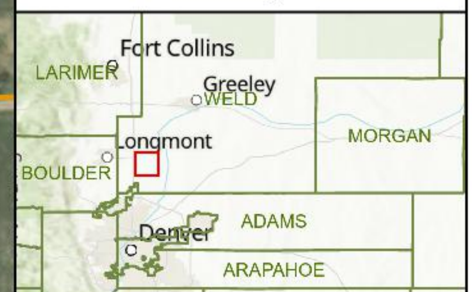
- MILLER 14-17 Pit (103309)
- MILLER 4-17J Pit (103315)
- CDWR Water Well Application
- PLSS Township & Range
- PLSS Section
- PLSS Qtr-Qtr
- Parcel Boundary
- County Boundary

0 125 250 Feet
N

CIVITAS RESOURCES

Figure 2. MILLER 14-17 & MILLER 4-17J Aerial Site Location Map

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO

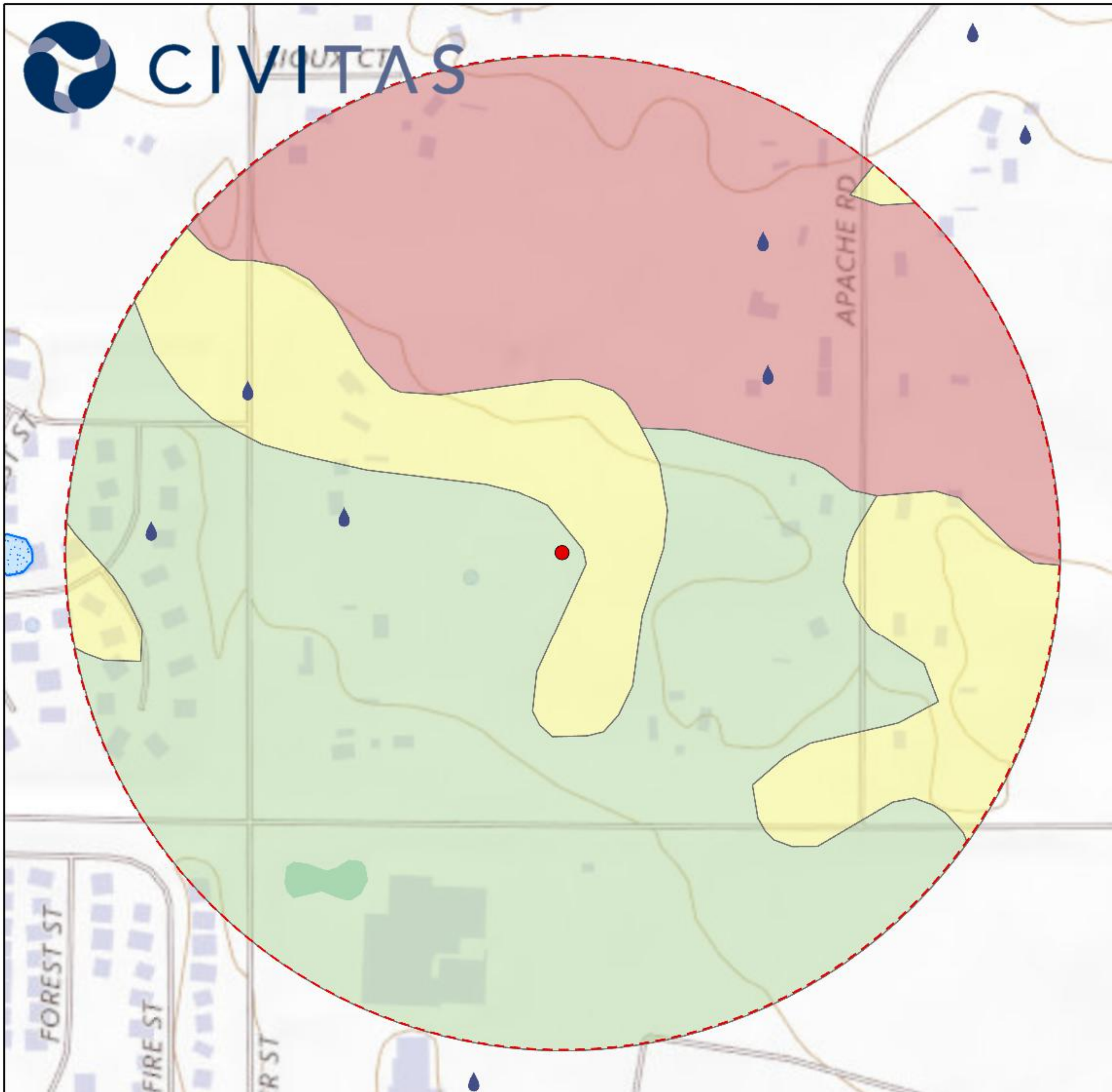


QUANDARY CONSULTANTS

Author: CSJ Date: 04/20/2023

PARCEL A: PICKERING, CODY & RANA - 9131 Apache Rd, Longmont, CO 80504-5440 (Account: R5407486, Parcel: 131117005054).

Data Sources: Esri, CGIAR, USGS, Maxar, CDWR, NWI, NHD



Legend

- MILLER 14-17 Pit (103309)
- 0.25-Mile Buffer
- CDWR Water Well Application
- NWI Freshwater Pond

NRCS Soils
(Map Unit Symbol - Map Unit Name)

- 44 - Olney loamy sand, 1-3% slopes
- 72 - Vona loamy sand, 0-3% slopes
- 73 - Vona loamy sand, 3-5% slopes

0 125 250 375 500 Feet

N

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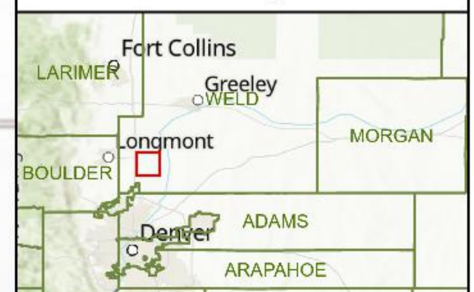
Figure 3. MILLER 14-17 & MILLER 4-17J Soil & Hydrology Map

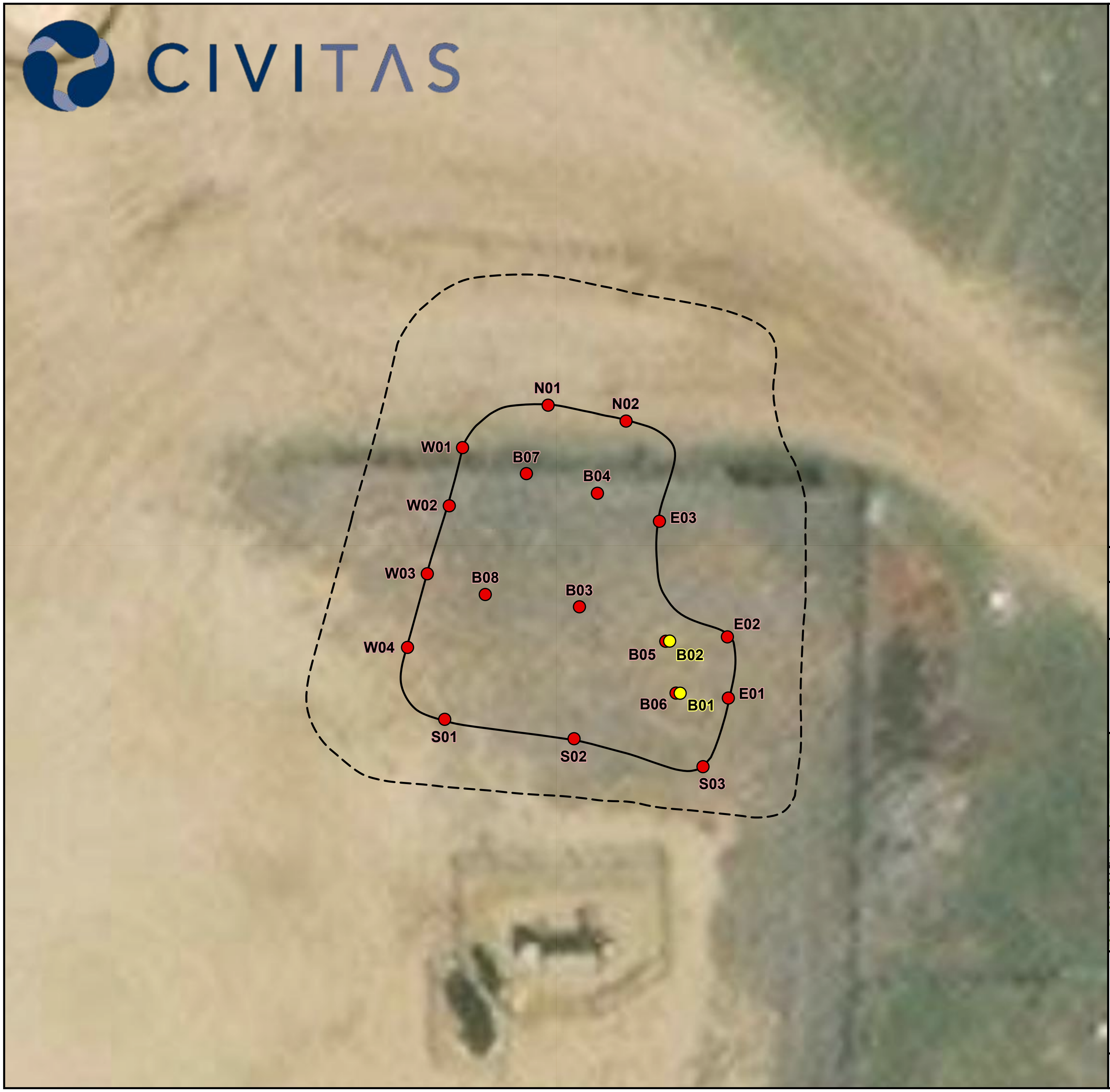
Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO



QUANDARY CONSULTANTS

Author: CSJ Date: 04/20/2023

Data Sources: Esri, CGIAR, USGS, Maxar, CDWR, NWI, NHD, NRCS



Legend

- Soil Sample Location
- Soil Sample Location - Removed by Excavation
- Excavation Extent
- Surface Excavation Extent Due to Sidewall Benching

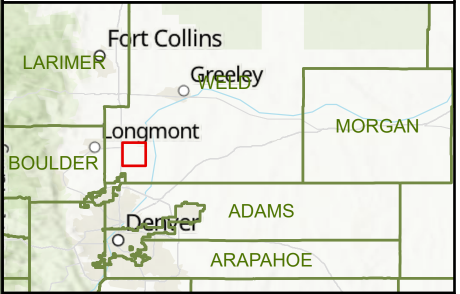
0 12.5 25 Feet

N

CIVITAS RESOURCES

Figure 4. MILLER 14-17 & MILLER 4-17J Excavation Soil Sample Location Map

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO



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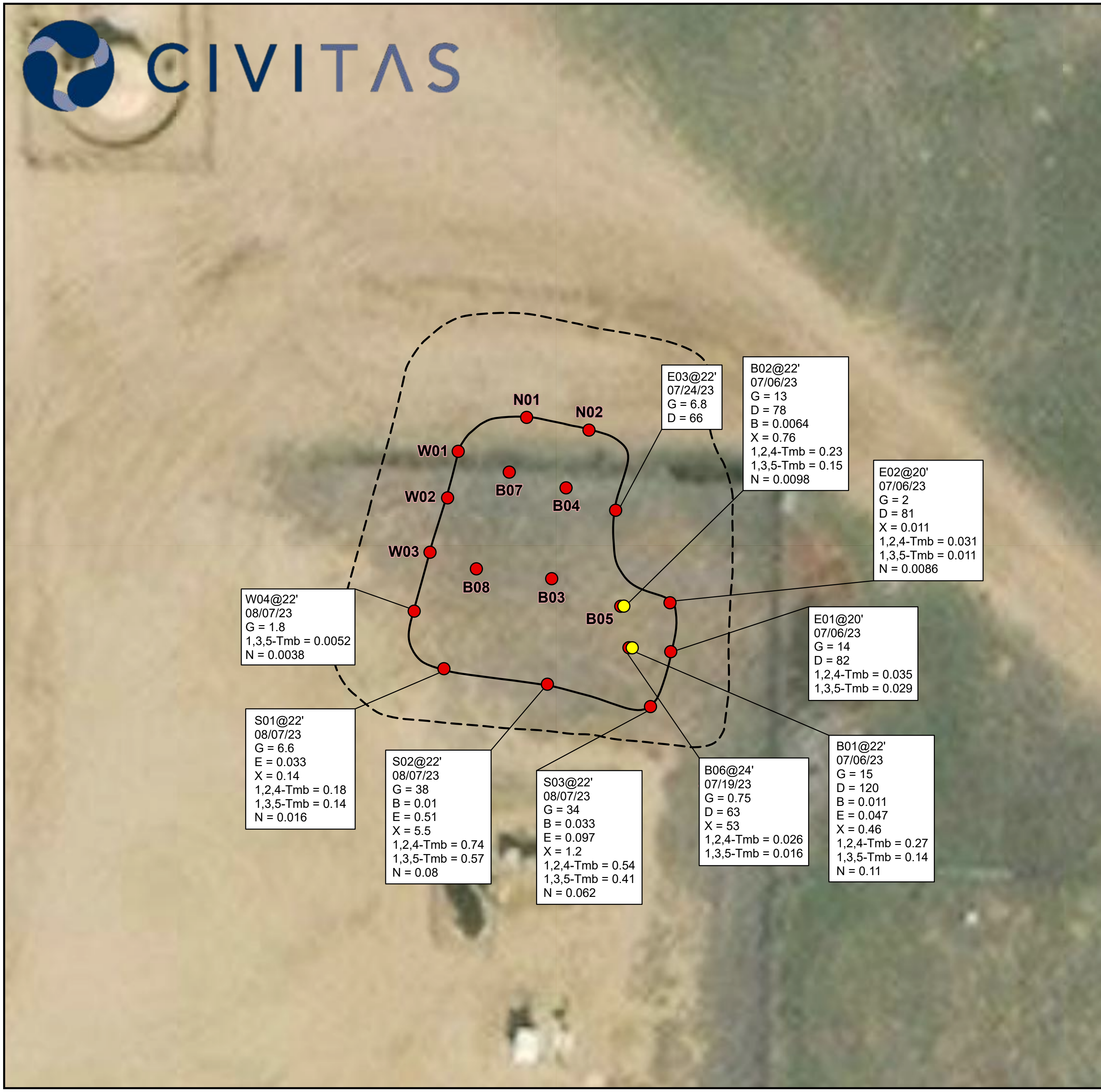
Author: CSJ Date: 09/22/2023

Data Sources: Esri, CGIAR, USGS, Maxar, Civitas



Legend

- Soil Sample Location
- Soil Sample Location - Removed by Excavation
- Excavation Extent
- Surface Excavation Extent Due to Sidewall Benching

Parameters

Sample Location @ Depth (ft.)
Sample Date
G = TPH-GRO (mg/kg)
D = TPH-DRO (mg/kg)
R = TPH-RRO (mg/kg)
B = Benzene (mg/kg)
E = Ethylbenzene (mg/kq)
X = Total Xylenes (mg/kg)
1,2,4-Tmb = 1,2,4-Trimethylbenzene (mg/kg)
1,3,5-Tmb = 1,3,5-Trimethylbenzene (mg/kg)
N = Naphthalene (mg/kg)

mg/kg = Milligrams per Kilogram

TPH-GRO = Total Petroleum Hydrocarbons - Gasoline Range Organics
TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics
TPH-RRO = Total Petroleum Hydrocarbons - Residual Range Organics

Note: Values presented in **bold** indicate an ECMC Table 915-1 exceedance above Residential Soil Screening Levels for that compound.

Values not present for a sample indicate a non-detect for that compound.

N

0 12.5 25 Feet

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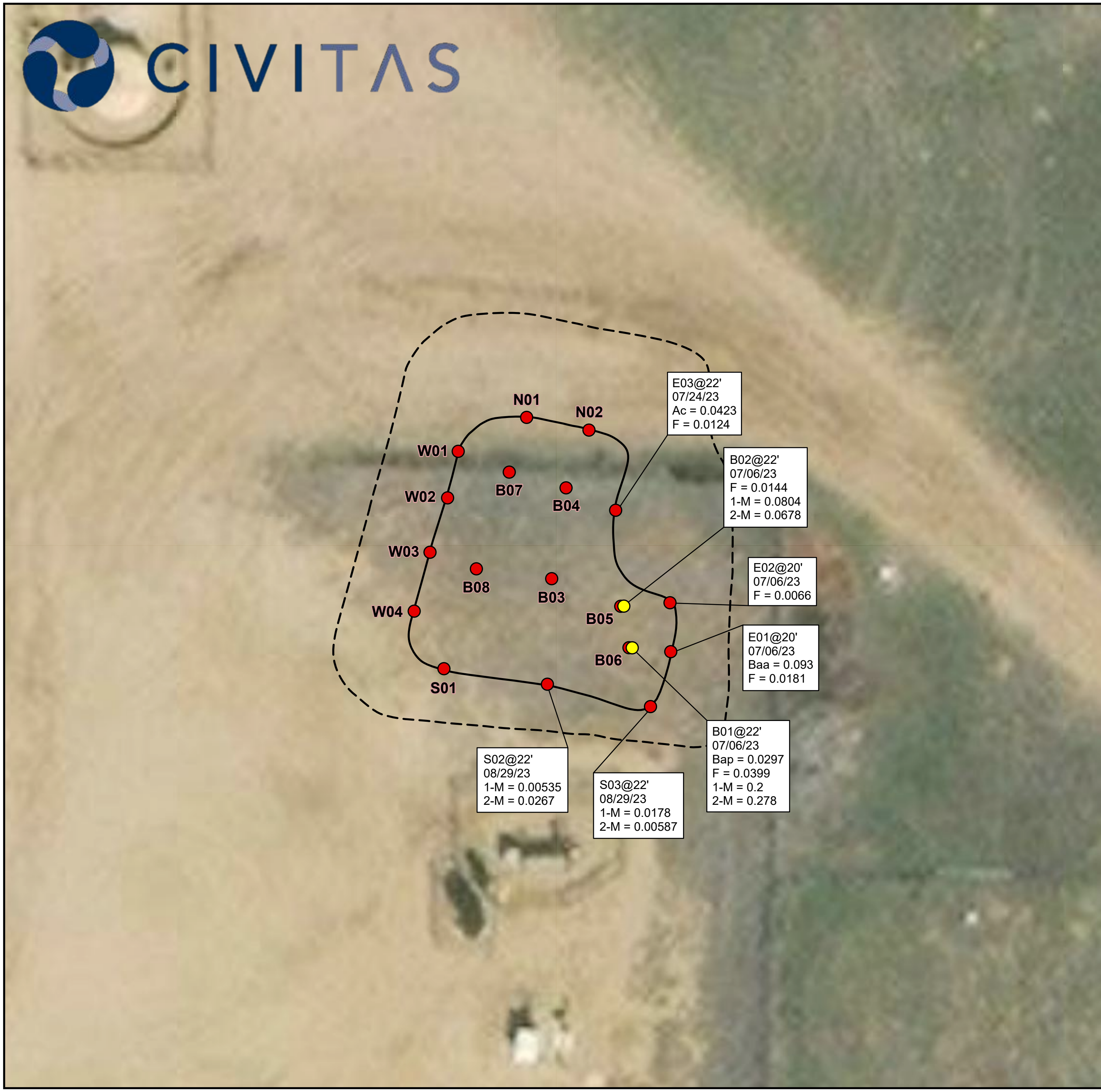
Figure 5. MILLER 14-17 & MILLER 4-17J
Excavation Results Map
Volatile Organic Compounds

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO

QUANDARY CONSULTANTS

Author: CSJ Date: 09/22/2023

Data Sources: Esri, CGIAR, USGS, Maxar, Civitas



Legend

- Soil Sample Location
- Soil Sample Location - Removed by Excavation
- Excavation Extent
- Surface Excavation Extent Due to Sidewall Benching

Parameters

Sample Location @ Depth (ft.)
Sample Date
Ac = Acenaphthene (mg/kg)
An = Anthracene (mg/kg)
Baa = Benz[a]anthracene (mg/kg)
Bap = Benzo[a]pyrene (mg/kg)
Bbf = Benzo[b]fluoranthene (mg/kg)
Bkf = Benzo[k]fluoranthene (mg/kg)
C = Chrysene (mg/kg)
Di = Dibenzo[a,h]anthracene (mg/kg)
Fa = Fluoranthene (mg/kg)
F = Fluorene (mg/kg)
I = Indeno[1,2,3-cd]pyrene (mg/kg)
P = Pyrene (mg/kg)
1-M = 1-Methylnaphthalene (mg/kg)
2-M = 2-Methylnaphthalene (mg/kg)

mg/kg = Milligrams per Kilogram

Note: Values presented in **bold** indicate an ECMC Table 915-1 exceedance above Residential Soil Screening Levels for that compound.

Values not present for a sample indicate a non-detect for that compound.

N

0 12.5 25 Feet

CIVITAS RESOURCES

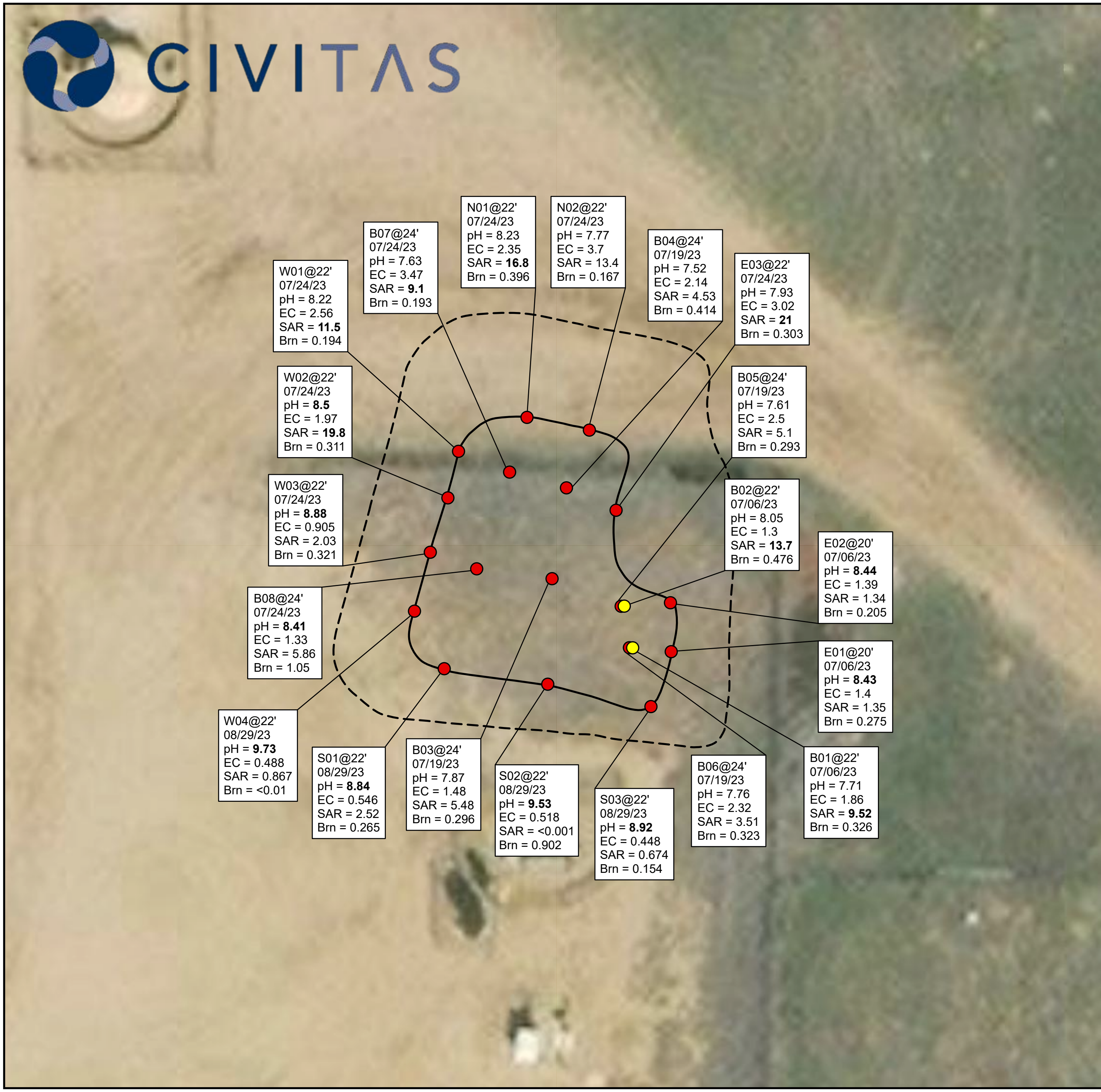
Figure 6. MILLER 14-17 & MILLER 4-17J
Excavation Results Map
Polycyclic Aromatic Hydrocarbons

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO

QUANDARY CONSULTANTS

Author: CSJ Date: 09/22/2023

Data Sources: Esri, CGIAR, USGS, Maxar, Civitas



Legend

- Soil Sample Location
- Soil Sample Location - Removed by Excavation
- Excavation Extent
- Surface Excavation Extent Due to Sidewall Benching

Parameters

Sample Location @ Depth (ft.)
Sample Date
pH = pH
EC = Electrical Conductivity (mmhos/cm)
SAR = Sodium Absorption Ratio
Brn = Boron (mg/L)

mmhos/cm = Millimhos per Centimeter
mg/L = Milligrams per Liter

Note: Values presented in **bold** indicate an ECMC Table 915-1 exceedance above Residential Soil Screening Levels for that compound.

0 12.5 25 Feet

N

CIVITAS RESOURCES

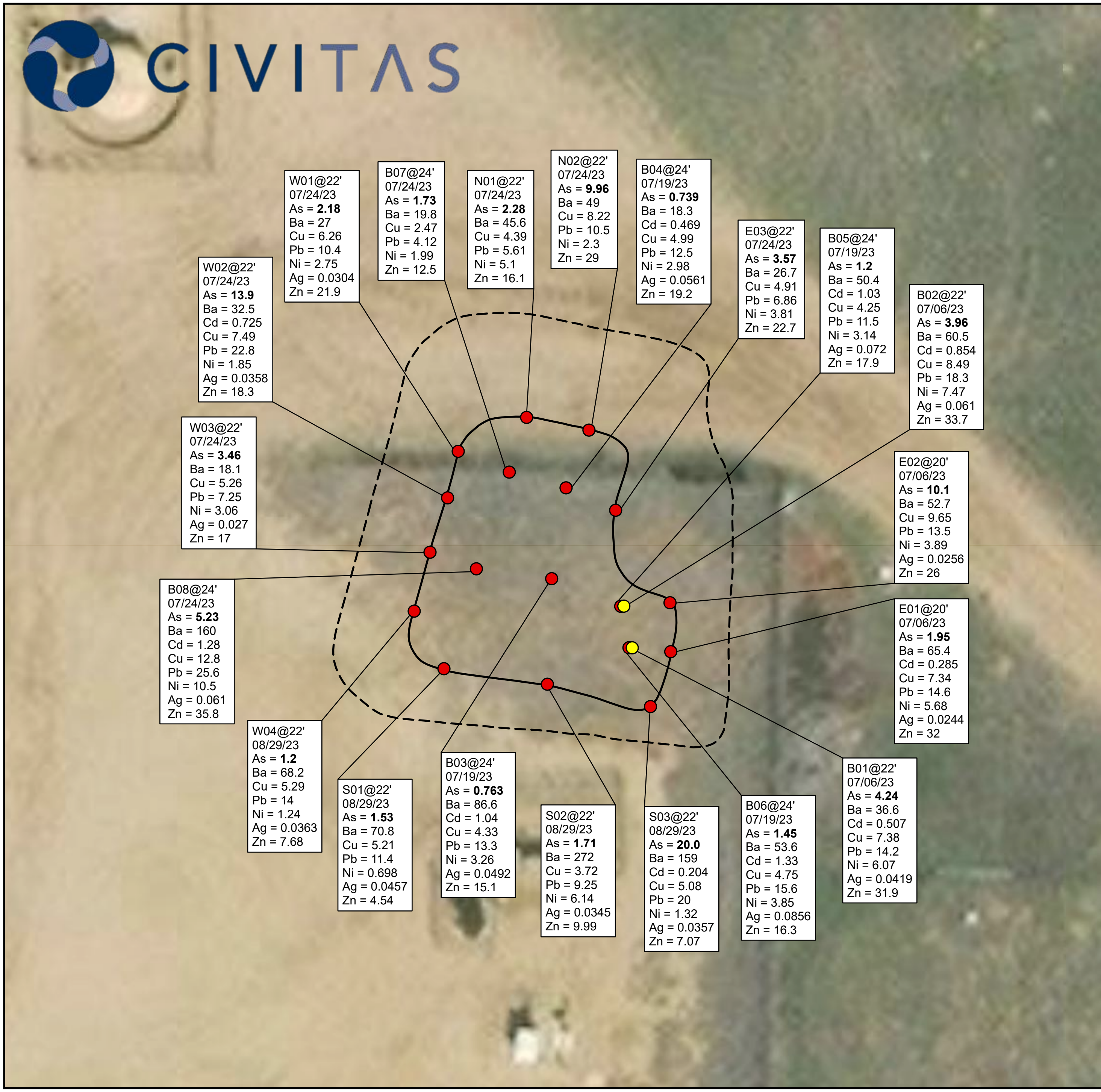
Figure 7. MILLER 14-17 & MILLER 4-17J
Excavation Results Map
Soil Suitability

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO

QUANDARY CONSULTANTS

Author: CSJ Date: 09/22/2023

Data Sources: Esri, CGIAR, USGS, Maxar, Civitas



Legend

- Soil Sample Location
- Soil Sample Location - Removed by Excavation
- Excavation Extent
- Surface Excavation Extent Due to Sidewall Benching

Parameters

Sample Location @ Depth (ft.)
Sample Date
As = Arsenic (mg/kg)
Ba = Barium (mg/kg)
Cd = Cadmium (mg/kq)
Cr = Chromium (VI) (mg/kg)
Cu = Copper (mg/kg)
Pb = Lead (mg/kg)
Ni = Nickel (mg/kg)
Se = Selenium (mg/kg)
Ag = Silver (mg/kg)
Zn = Zinc (mg/kg)

mg/kg = Milligrams per Kilogram

Note: Values presented in **bold** indicate an ECMC Table 915-1 exceedance above Residential Soil Screening Levels for that compound.

Values not present for a sample indicate a non-detect for that compound.

0 12.5 25 Feet

N

CIVITAS RESOURCES

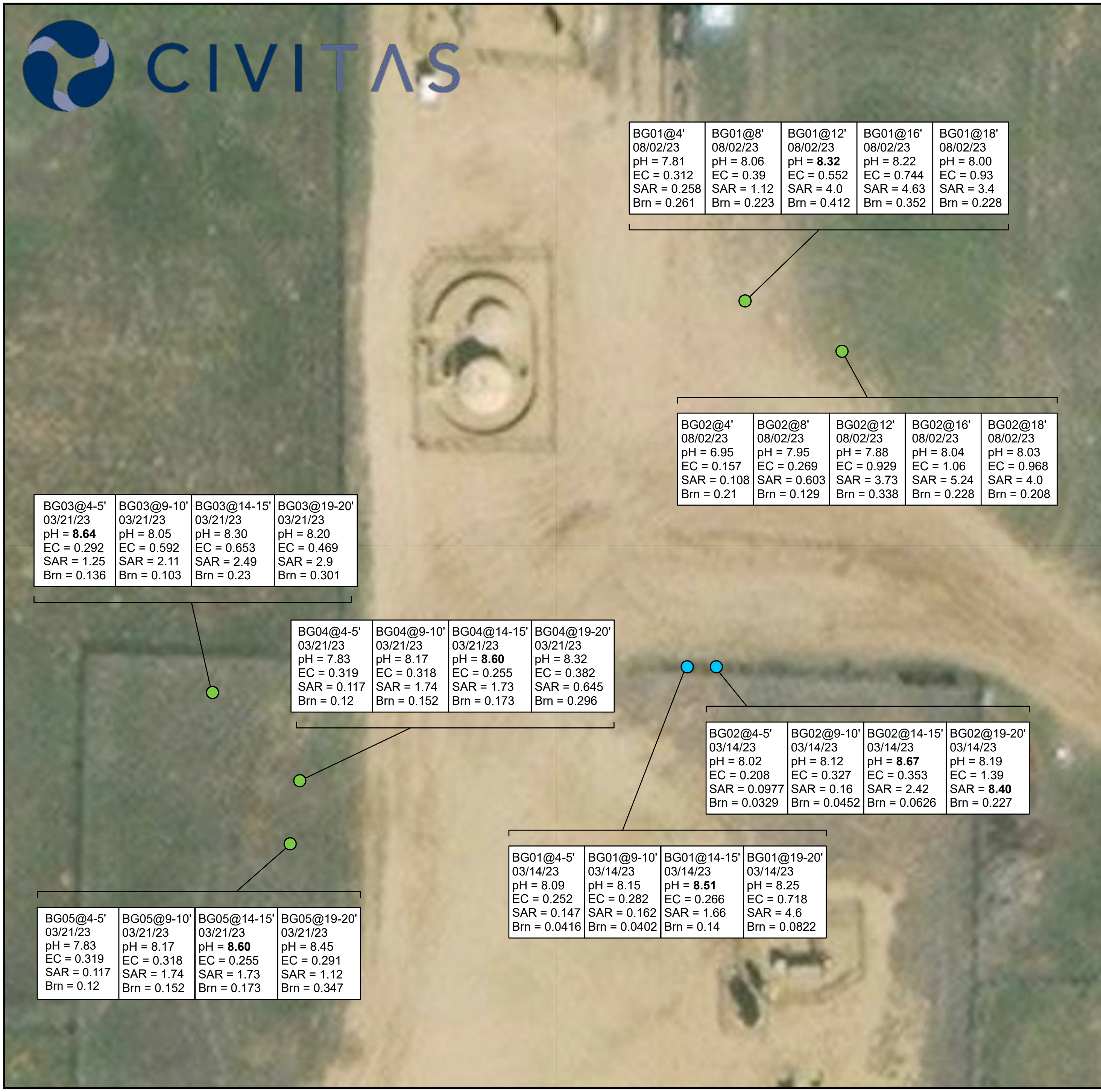
Figure 8. MILLER 14-17 & MILLER 4-17J Excavation Results Map
Metals

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO

QUANDARY CONSULTANTS

Author: CSJ Date: 09/22/2023

Data Sources: Esri, CGIAR, USGS, Maxar, Civitas



Legend

- Background Soil Sample Location
- Background Soil Sample Location - Removed by Excavation

Parameters

Sample Location @ Depth (ft.)
Sample Date
pH = pH
EC = Electrical Conductivity (mmhos/cm)
SAR = Sodium Absorption Ratio
Brn = Boron (mg/L)

mmhos/cm = Millimhos per Centimeter
mg/L = Milligrams per Liter

Note: Values presented in **bold** indicate an ECMC Table 915-1 exceedance above Residential Soil Screening Levels for that compound.

N

0 12.5 25 Feet

CIVITAS RESOURCES

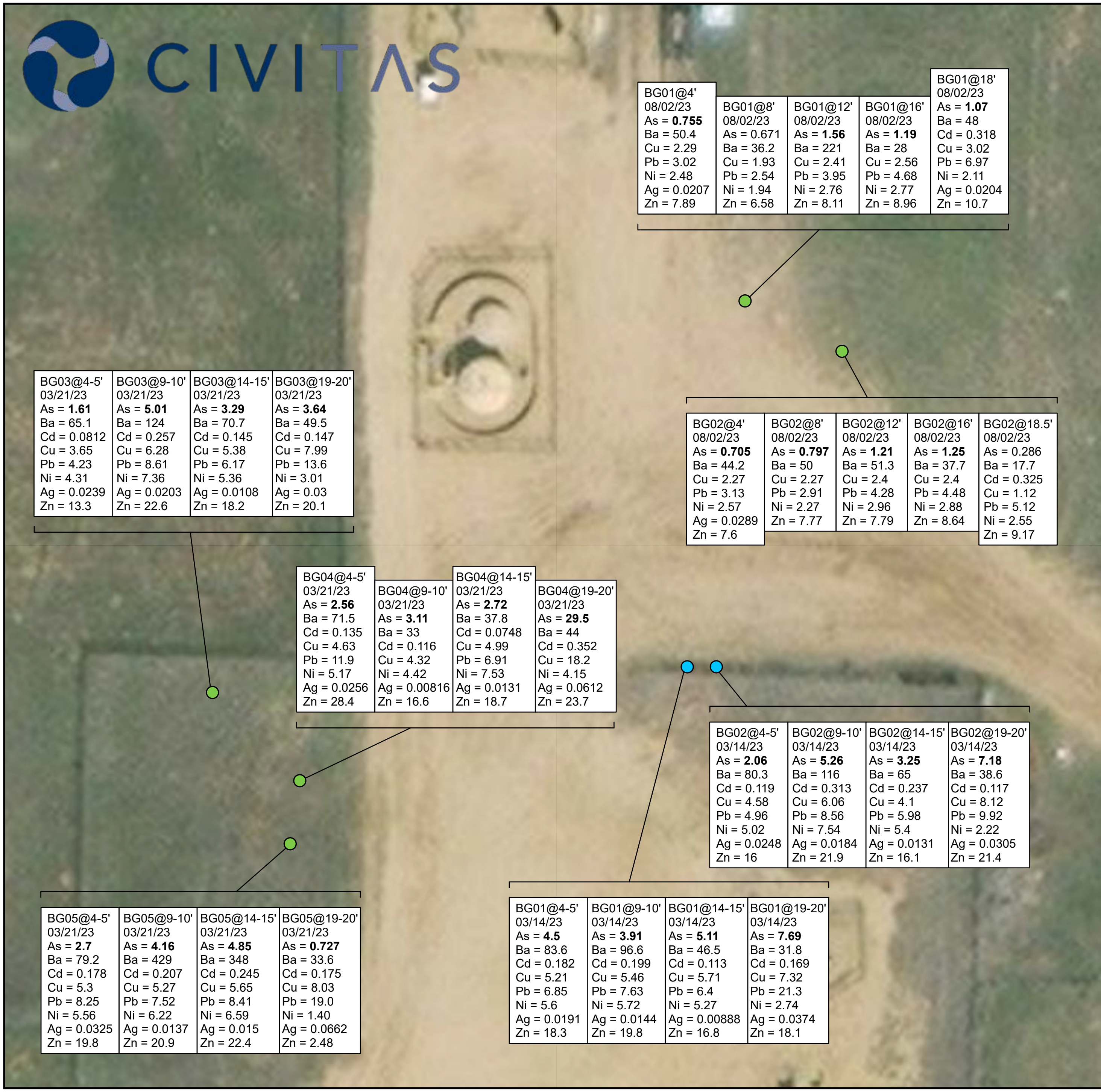
Figure 9. MILLER 14-17 & MILLER 4-17J Excavation Results Map
Background Soil Suitability

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO

QUANDARY CONSULTANTS

Author: CSJ Date: 09/19/2023

Data Sources: Esri, CGIAR, USGS, Maxar, Civitas



Legend

- Background Soil Sample Location
- Background Soil Sample Location - Removed by Excavation

Parameters

Sample Location @ Depth (ft.)
Sample Date
As = Arsenic (mg/kg)
Ba = Barium (mg/kg)
Cd = Cadmium (mg/kq)
Cr = Chromium (VI) (mg/kg)
Cu = Copper (mg/kg)
Pb = Lead (mg/kg)
Ni = Nickel (mg/kg)
Se = Selenium (mg/kg)
Ag = Silver (mg/kg)
Zn = Zinc (mg/kg)

mg/kg = Milligrams per Kilogram

Note: Values presented in **bold** indicate an ECMC Table 915-1 exceedance above Residential Soil Screening Levels for that compound.

Values not present for a sample indicate a non-detect for that compound.

0 12.5 25 Feet

N

CIVITAS RESOURCES

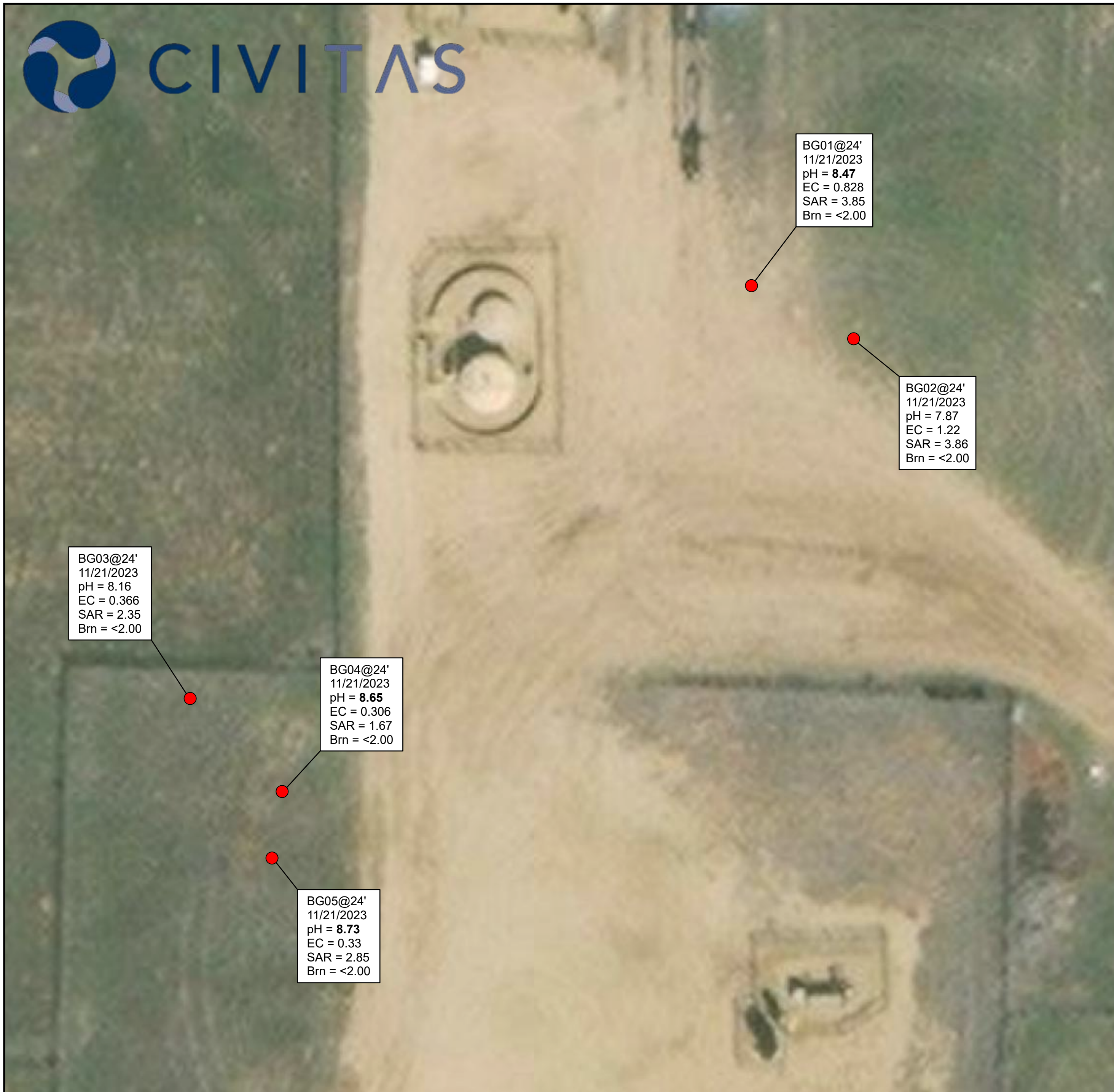
Figure 10. MILLER 14-17 & MILLER 4-17J Excavation Results Map
Background Metals

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO

QUANDARY CONSULTANTS

Author: CSJ Date: 09/19/2023

Data Sources: Esri, CGIAR, USGS, Maxar, Civitas



Legend

● Background Soil Sample Location

Parameters

Sample Location @ Depth (ft.)
Sample Date
pH = pH
EC = Electrical Conductivity (mmhos/cm)
SAR = Sodium Absorption Ratio
Brn = Boron (mg/L)

mmhos/cm = Millimhos per Centimeter
mg/L = Milligrams per Liter

Note: Values presented in **bold** indicate an ECMC Table 915-1 exceedance above Residential Soil Screening Levels for that compound.

0 20 40 Feet

N

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Figure 11. MILLER 14-17 & MILLER 4-17J
Background Soil Suitability

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO

QUANDARY CONSULTANTS

Author: JG Date: 12/13/2023

Data Sources: Esri, CGIAR, USGS, Maxar

Legend

Background Soil Sample Location

Parameters

Sample Location @ Depth (ft.)
Sample Date
As = Arsenic (mg/kg)

(mg/kg) Milligrams per Kilograms

Note: Values presented in **bold** indicate an ECMC Table 915-1 exceedance above Residential Soil Screening Levels for that compound.

0 20 40 Feet

N

CIVITAS RESOURCES

Figure 12. MILLER 14-17 & MILLER 4-17J
Background Soil Suitability - Metals

Facility ID: 103309 (40.133080, -104.921035)
Facility ID: 103315 (40.133170, -104.921157)
SWSW Qtr-Qtr, Sec 17, T2N, R67W, 6PM
Weld County, CO

QUANDARY CONSULTANTS

Author: JG Date: 12/13/2023

Data Sources: Esri, CGIAR, USGS, Maxar

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Denver, CO 80210
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TABLES

Table 1 - Miller 4-17J, 14-17 Excavation VOC Results												
Sample ID	**Date Sampled**	**Depth**	**TPH-GRO**	**TPH-DRO**	**TPH-ORO**	**benzene**	**Toluene**	**ethyl-benzene**	**xylenes (total)**	**1,2,4-trimethyl-benzene**	**1,3,5-trimethyl-benzene**	**Naphthalene**
Table 915-1 - Residential Soil Screening Levels		**ft. (bgs)**	**500 mg/kg**			**1.2 mg/kg**	**490 mg/kg**	**5.8 mg/kg**	**58 mg/kg**	**30 mg/kg**	**27 mg/kg**	**2.4 mg/kg**
B01@22'	7/6/23	22'	15	120	<50	0.011	<0.005	0.047	0.46	0.27	0.14	0.11
B02@22'	7/6/23	22'	13	78	<50	0.0064	<0.005	<0.005	0.76	0.23	0.15	0.0098
E01@20'	7/6/23	20'	14	82	<50	<0.002	<0.005	<0.005	<0.010	0.035	0.029	<0.0038
E02@20'	7/6/23	20'	2	81	<50	<0.002	<0.005	<0.005	0.011	0.031	0.011	0.0086
B03@24'	7/19/23	24'	<0.5	<50	<50	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
B04@24'	7/19/23	24'	<0.5	<50	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
B05@24'	7/19/23	24'	<0.5	<50	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
B06@24'	7/19/23	24'	0.75	63	53	<0.002	<0.005	<0.005	<0.010	0.026	0.016	<0.0038
E03@22'	7/24/23	22'	6.8	66	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
N01@22'	7/24/23	22'	<0.5	<50	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
N02@22'	7/24/23	22'	<0.5	<50	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
B07@24'	7/24/23	24'	<0.5	<50	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
W01@22'	7/24/23	22'	<0.5	<50	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
W02@22'	7/24/23	22'	<0.5	<50	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
W03@22'	7/24/23	22'	<0.5	<50	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
B08@24'	7/24/23	24'	<0.5	<50	<50	<0.002	<0.005	<0.005	<0.010	<0.005	<0.005	<0.0038
SS01@22'	8/29/23	22	6.6	<50	<50	<0.0020	<0.0050	0.033	0.14	0.18	0.14	0.016
SS02@22'	8/29/23	22	38	<50	<50	0.01	<0.0050	0.51	5.5	0.74	0.57	0.08
SS03@22'	8/29/23	22	34	<50	<50	0.033	<0.0050	0.097	1.2	0.54	0.41	0.062
W04@22'	8/29/23	22	1.8	<50	<50	<0.0020	<0.0050	<0.0050	<0.010	<0.0050	0.0052	0.0038

Notes:
mg/kg-milligrams per kilogram
TPH-GRO = total petroleum hydrocarbons-gasoline range organics
TPH-DRO = total petroleum hydrocarbons-diesel range organics
TPH-RRO = total petroleum hydrocarbons-residual range organics
Bold indicates a Table 915-1 exceedance above Residential Soil Screening Levels
Highlighted confirmation samples were removed via excavation

Table 2 - Miller 4-17J, 14-17 PAH results

Sample ID	Date Sampled	Depth	ace-naphthene	anthracene	benz (a)-anthracene	benzo-(a) pyrene	benzo (b)-fluor-anthene	benzo (k)-fluor-anthene	chrysene	dibenzo-(a,h)-anthracene	fluoranthene	fluorene	indeno-(1,2,3-cd)-pyrene	pyrene	1-methyl-naphthalene	2-methyl-naphthalene
Table 915-1 - Residential Soil Screening Levels		**ft. (bgs)**	**360 mg/kg**	**360 mg/kg**	**1800 mg/kg**	**0.11 mg/kg**	**1.1 mg/kg**	**11 mg/kg**	**110 mg/kg**	**110 mg/kg**	**240 mg/kg**	**240 mg/kg**	**240 mg/kg**	**180 mg/kg**	**18 mg/kg**	**24 mg/kg**
B01@22'	7/6/23	22'	<0.005	<0.05	<0.005	0.0297	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.0399	<0.00500	<0.00500	0.2	0.278
B02@22'	7/6/23	22'	<0.05	<0.05	<0.05	<0.05	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.0144	<0.00500	<0.00500	0.0804	0.0678
E01@20'	7/6/23	20'	<0.05	<0.05	0.093	<0.05	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.0181	<0.00500	<0.00500	<0.00500	<0.00500
E02@20'	7/6/23	20'	<0.005	<0.005	<0.005	<0.005	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.0066	<0.00500	<0.00500	<0.00500	<0.00500
B03@24'	7/19/23	24'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
B04@24'	7/19/23	24'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
B05@24'	7/19/23	24'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
B06@24'	7/19/23	24'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
E03@22'	7/24/23	22'	<0.00500	0.0423	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.0124	<0.00500	<0.00500	<0.00500	<0.00500
N01@22'	7/24/23	22'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
N02@22'	7/24/23	22'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
B07@24'	7/24/23	24'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
W01@22'	7/24/23	22'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
W02@22'	7/24/23	22'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
W03@22'	7/24/23	22'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
B08@24'	7/24/23	24'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
S01@22'	8/29/23	22'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
S02@22'	8/29/23	22'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.00535	0.0267
S03@22'	8/29/23	22'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	0.0178	0.00587
W04@22'	8/29/23	22'	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500

Notes:
mg/kg-milligrams per kilogram
Bold indicates a Table 915-1 exceedance above Residential Soil Screening Levels
Highlighted confirmation samples were removed via excavation

Table 3 - Miller 4-17J, 14-17 Soil Suitability Results						
Sample ID	**Date Sampled**	**Depth**	**pH (units)**	**EC (mmhos/ cm)**	**SAR (units)**	**Boron (mg/L)**
Soil Suitabilty for Reclamation Standard (1)			**6-8.3**	**<4**	**<6**	**2**
B01@22'	7/6/23	22'	7.71	1.86	**9.52**	0.326
B02@22'	7/6/23	22'	8.05	1.3	**13.7**	0.476
E01@20'	7/6/23	20'	**8.43**	1.4	1.35	0.275
E02@20'	7/6/23	20'	**8.44**	1.39	1.34	0.205
B03@24'	7/19/23	24'	7.87	1.48	5.48	0.296
B04@24'	7/19/23	24'	7.52	2.14	4.53	0.414
B05@24'	7/19/23	24'	7.61	2.5	5.1	0.293
B06@24'	7/19/23	24'	7.67	2.32	3.51	0.323
E03@22'	7/24/23	22'	7.93	3.02	**21**	0.303
N01@22'	7/24/23	22'	8.23	2.35	**16.8**	0.396
N02@22'	7/24/23	22'	7.77	3.7	13.4	0.167
B07@24'	7/24/23	24'	7.63	3.47	**9.1**	0.193
W01@22'	7/24/23	22'	8.22	2.56	**11.5**	0.194
W02@22'	7/24/23	22'	**8.5**	1.97	**19.8**	0.311
W03@22'	7/24/23	22'	**8.88**	0.905	2.03	0.321
B08@24'	7/24/23	24'	**8.41**	1.33	5.86	1.05
S01@22'	8/29/23	22'	**8.84**	0.546	2.52	0.265
S02@22'	8/29/23	22'	**9.53**	0.518	<0.00100	0.902
S03@22'	8/29/23	22'	**8.92**	0.448	0.674	0.154
W04@22'	8/29/23	22'	**9.73**	0.488	0.867	<0.0100

Notes:
mg/L = milligrams per liter
mg/kg = milligrams per kilogram
mmhos/cm-millimhos per centimeter
EC = Electrical Conductivity
SAR = Sodium absorption ratio
Bold indicates a Table 915-1 exceedance
Highlighted confirmation samples were removed via excavation

Table 3 - Miller 4-17J, 14-17 Soil Suitability Results continued						
Sample ID	**Date Sampled**	**Depth**	**pH**	**EC**	**SAR**	**boron**
Table 915-1 Standards		**ft. (bgs)**	**6–8.3**	**<4 mmhos/cm**	**6**	**2.0 mg/L**
BG01@4-5'	3/14/23	4-5	8.09	0.252	0.147	0.0416
BG01@9-10'	3/14/23	9-10	8.15	0.282	0.162	0.0402
BG01@14-15	3/14/23	14-15	8.51	0.266	1.66	0.14
BG01@19-20'	3/14/23	19-20	8.25	0.718	4.6	0.0822
BG02@4-5'	3/14/23	4-5	8.02	0.208	0.0977	0.0329
BG02@9-10'	3/14/23	9-10	8.12	0.327	0.16	0.0452
BG02@14-15'	3/14/23	14-15	**8.67**	0.353	2.42	0.0626
BG02@19-20'	3/14/23	19-20	8.19	1.39	8.40	0.227
BG03@4.5'	3/21/23	4.5	**8.64**	0.292	1.25	0.136
BG03@9-10'	3/21/23	9-10	8.05	0.592	2.11	0.103
BG03@14-15'	3/21/23	14-15	8.3	0.653	2.49	0.23
BG03@19-20'	3/21/23	19-20	8.2	0.469	2.9	0.301
BG04@4.5'	3/21/23	4.5	7.83	0.319	0.117	0.12
BG04@9-10'	3/21/23	9-10	8.17	0.318	1.74	0.152
BG04@14-15'	3/21/23	14-15	**8.6**	0.255	1.73	0.173
BG04@19-20'	3/21/23	19-20	8.32	0.382	0.645	0.296
BG05@4.5'	3/21/23	4.5	7.91	0.532	1.71	0.0798
BG05@9-10'	3/21/23	9-10	7.99	0.683	2.05	0.0779
BG05@14-15'	3/21/23	14-15	7.91	0.829	2.23	0.113
BG05@19-20'	3/21/23	19-20	8.45	0.291	1.12	0.347
BG01@4'	8/2/23	4	7.81	0.312	0.258	0.261
BG01@8'	8/2/23	8	8.06	0.39	1.12	0.223
BG01@12'	8/2/23	12	**8.32**	0.552	4	0.412
BG01@16'	8/2/23	16	8.22	0.744	4.63	0.352
BG01@18'	8/2/23	18	8	0.93	3.4	0.228
BG02@4'	8/2/23	4	6.95	0.157	0.108	0.21
BG02@8'	8/2/23	8	7.95	0.269	0.603	0.129
BG02@12'	8/2/23	12	7.88	0.929	3.73	0.338
BG02@16'	8/2/23	16	8.04	1.06	5.24	0.228
BG02@18'	8/2/23	18	8.03	0.968	4	0.208

Notes:
mg/L = milligrams per liter
mg/kg = milligrams per kilogram
mmhos/cm-millimhos per centimeter
EC = Electrical Conductivity
SAR = Sodium absorption ratio
Bold indicates background above Table 915-1
Highlighted background samples were removed via excavation

Table 3 - Miller 4-17J, 14-17 Soil Suitability Results continued						
Pod	**Date Sampled**	**Depth**	**EC**	**SAR**	**pH**	**boron**
Table 915-1 Standards		**ft. (bgs)**	**<4 mmhos/cm**	**6**	**6–8.3**	**2.0 mg/L**
BG01@24'	11/21/2023	24'	0.828	3.85	**8.47**	<2.00
BG02@24'	11/21/2023	24'	1.22	3.86	7.87	<2.00
BG03@24'	11/21/2023	24'	0.366	2.35	8.16	<2.00
BG04@24'	11/21/2023	24'	0.306	1.67	**8.65**	<2.00
BG05@24'	11/21/2023	24'	0.33	2.85	**8.73**	<2.00

Notes:
mg/L = milligrams per liter
mg/kg = milligrams per kilogram
mmhos/cm-millimhos per centimeter
EC = Electrical Conductivity
SAR = Sodium absorption ratio
Bold indicates a Table 915-1 exceedance

Table 4 - Miller 4-17J, 14-17 Metals Results												
Sample ID	**Date Sampled**	**Date Sampled**	**arsenic**	**barium**	**cadmium**	**chromium (VI)**	**copper**	**lead**	**nickel**	**selenium**	**silver**	**zinc**
Table 915-1 Standards Residential Soil Screening Levels		**ft. (bgs)**	**0.68 mg/kg**	**15000 mg/kg**	**71 mg/kg**	**0.3 mg/kg**	**3100 mg/kg**	**400 mg/kg**	**1500 mg/kg**	**390 mg/kg**	**390 mg/kg**	**23000 mg/kg**
B01@22'	7/6/23	22'	**4.24**	36.6	0.507	<0.30	7.38	14.2	6.07	<0.299	0.0419	31.9
B02@22'	7/6/23	22'	**3.96**	60.5	0.854	<0.30	8.49	18.3	7.47	<0.300	0.061	33.7
E01@20'	7/6/23	20'	**1.95**	65.4	0.285	<0.30	7.34	14.6	5.68	<0.305	0.0244	32
E02@20'	7/6/23	20'	**10.1**	52.7	<0.232	<0.30	9.65	13.5	3.89	<0.302	0.0256	26
B03@24'	7/19/23	24'	**0.763**	86.6	1.04	<0.30	4.33	13.3	3.36	<0.209	0.0492	15.1
B04@24'	7/19/23	24'	**0.739**	18.3	0.469	<0.30	4.99	12.5	2.98	<0.205	0.0561	19.2
B05@24'	7/19/23	24'	**1.2**	50.4	1.03	<0.30	4.25	11.5	3.14	<0.202	0.072	17.9
B06@24'	7/19/23	24'	**1.45**	53.6	1.33	<0.30	4.75	15.6	3.85	<0.202	0.0856	16.3
E03@22'	7/24/23	22'	**3.57**	26.7	<0.233	<0.30	4.91	6.86	3.81	<0.204	<0.023	22.7
N01@22'	7/24/23	22'	**2.28**	45.6	<0.224	<0.30	4.39	5.61	5.1	<0.196	<0.0224	16.1
N02@22'	7/24/23	22'	**9.96**	49	<0.229	<0.30	8.22	10.5	2.3	<0.201	<0.0426	29
B07@24'	7/24/23	24'	**1.73**	19.8	<0.234	<0.30	2.47	4.12	1.99	<0.205	<0.0234	12.5
W01@22'	7/24/23	22'	**2.18**	27	<0.223	<0.30	6.26	10.4	2.75	<0.195	0.0304	21.9
W02@22'	7/24/23	22'	**13.9**	32.5	0.725	<0.30	7.49	22.8	1.85	<0.201	0.0358	18.3
W03@22'	7/24/23	22'	**3.46**	18.1	<0.229	<0.30	5.26	7.25	3.06	<0.201	0.027	17
B08@24'	7/24/23	24'	**5.23**	160	1.28	<0.30	12.8	25.6	10.5	<0.210	0.061	35.8
S01@22'	8/29/23	22'	**1.53**	70.8	<0.200	<0.30	5.21	11.4	0.698	<0.260	0.0457	4.54
S02@22'	8/29/23	22'	**1.71**	272	<0.200	<0.30	3.72	9.25	6.14	<0.260	0.0345	9.99
S03@22'	8/29/23	22'	**20.0**	159	0.204	<0.30	5.08	20	1.32	<0.260	0.0357	7.07
W04@22'	8/29/23	22'	**1.2**	68.2	<0.200	<0.30	5.29	14	1.24	<0.260	0.0363	7.68

Notes:
mg/kg-milligrams per kilogram
Bold indicates a Table 915-1 exceedance above Residential Soil Screening Levels
Highlighted confirmation samples were removed via excavation

Table 4 -Miller 4-17J, 14-17 Metals Results continued												
Sample ID	**Date Sampled**	**Date Sampled**	**arsenic**	**barium**	**cadmium**	**chromium (VI)**	**copper**	**lead**	**nickel**	**selenium**	**silver**	**zinc**
Table 915-1 Standards Residential Soil Screening		**ft. (bgs)**	**0.68 mg/kg**	**15000 mg/kg**	**71 mg/kg**	**0.3 mg/kg**	**3100 mg/kg**	**400 mg/kg**	**1500 mg/kg**	**390 mg/kg**	**390 mg/kg**	**23000 mg/kg**
BG01@4-5'	3/14/23	4-5	**4.5**	83.6	0.182	<0.3	5.21	6.85	5.60	<0.175	0.0191	18.3
BG01@9-10'	3/14/23	9-10	**3.91**	96.6	0.199	<0.3	5.46	7.63	5.72	<0.175	0.0144	19.8
BG01@14-15	3/14/23	14-15	**5.11**	46.5	0.113	<0.3	5.71	6.4	5.27	<0.175	0.00888	16.8
BG01@19-20'	3/14/23	19-20	**7.69**	31.8	0.169	<0.3	7.32	21.3	2.74	<0.175	0.0374	18.1
BG02@4-5'	3/14/23	4-5	**2.06**	80.3	0.119	<0.3	4.58	4.96	5.02	<0.175	0.0248	16.0
BG02@9-10'	3/14/23	9-10	**5.26**	116	0.313	<0.3	6.06	8.56	7.54	<0.175	0.0184	21.9
BG02@14-15'	3/14/23	14-15	**3.25**	65	0.237	<0.3	4.1	5.98	5.40	<0.175	0.0131	16.1
BG02@19-20'	3/14/23	19-20	**7.18**	38.6	0.117	<0.3	8.12	9.92	2.22	<0.175	0.0305	21.4
BG03@4.5'	3/21/23	4-5	**1.61**	65.1	0.0812	<0.3	3.65	4.23	4.31	<0.175	0.0239	13.3
BG03@9-10'	3/21/23	9-10	**5.01**	124	0.257	<0.3	6.28	8.61	7.36	<0.175	0.0203	22.6
BG03@14-15'	3/21/23	14-15	**3.29**	70.7	0.145	<0.3	5.38	6.17	5.36	<0.175	0.0108	18.2
BG03@19-20'	3/21/23	19-20	**3.64**	49.5	0.147	<0.3	7.99	13.6	3.01	<0.175	0.03	20.1
BG04@4.5'	3/21/23	4-5	**2.56**	71.5	0.135	<0.3	4.63	11.9	5.17	<0.175	0.0256	28.4
BG04@9-10'	3/21/23	9-10	**3.11**	33	0.116	<0.3	4.32	<0.215	4.42	<0.175	0.00816	16.6
BG04@14-15'	3/21/23	14-15	**2.72**	37.8	0.0748	<0.3	4.99	6.91	7.53	<0.175	0.0131	18.7
BG04@19-20'	3/21/23	19-20	**29.5**	44	0.352	<0.3	18.2	<0.235	4.15	<0.175	0.0612	23.7
BG05@4.5'	3/21/23	4.5	**2.7**	79.2	0.178	<0.3	5.3	8.25	5.56	<0.175	0.0325	19.8
BG05@9-10'	3/21/23	9-10	**4.16**	429	0.207	<0.3	5.27	7.52	6.22	<0.175	0.0137	20.9
BG05@14-15'	3/21/23	14-15	**4.85**	348	0.245	<0.3	5.65	8.41	6.59	<0.175	0.015	22.4
BG05@19-20'	3/21/23	19-20	**0.727**	33.6	0.175	<0.3	8.03	19.0	1.4	<0.175	0.0662	2.48
BG01@4'	8/2/23	4	**0.755**	50.4	<0.02	<0.3	2.29	3.02	2.48	<0.26	0.0207	7.89
BG01@8'	8/2/23	8	0.671	36.2	<0.02	<0.3	1.93	2.54	1.94	<0.26	<0.02	6.58
BG01@12'	8/2/23	12	**1.56**	221	<0.02	<0.3	2.41	3.95	2.76	<0.26	<0.02	8.11
BG01@16'	8/2/23	16	**1.19**	28	<0.02	<0.3	2.56	4.68	2.77	<0.26	<0.02	8.96
BG01@18'	8/2/23	18	**1.07**	48	0.318	<0.3	3.02	6.97	2.11	<0.26	0.0204	10.7
BG02@4'	8/2/23	4	**0.705**	44.2	<0.02	<0.3	2.27	3.13	2.57	<0.26	0.0289	7.6
BG02@8'	8/2/23	8	**0.797**	50	<0.02	<0.3	2.27	2.91	2.27	<0.26	<0.02	7.77
BG02@12'	8/2/23	12	**1.21**	51.3	<0.02	<0.3	2.4	4.28	2.96	<0.26	<0.02	7.79
BG02@16'	8/2/23	16	**1.25**	37.7	<0.02	<0.3	2.4	4.48	2.88	<0.26	<0.02	8.64
BG02@18.5'	8/2/23	18.5	0.286	17.7	0.325	<0.3	1.12	5.12	2.55	<0.26	<0.02	9.17

Notes:
mg/kg-milligrams per kilogram
Bold indicates a Table 915-1 exceedance above Residential Soil Screening Levels
Highlighted background samples were removed via excavation

Table 4 - Miller 4-17J, 14-17 Metals Results continued												
Pod	**Date Sampled**	**Date Sampled**	**arsenic**	**barium**	**cadmium**	**chromium (VI)**	**copper**	**lead**	**nickel**	**selenium**	**silver**	**zinc**
Table 915-1 Standards		**ft. (bgs)**	**0.68 mg/kg**	**15000 mg/kg**	**71 mg/kg**	**0.3 mg/kg**	**3100 mg/kg**	**400 mg/kg**	**1500 mg/kg**	**390 mg/kg**	**390 mg/kg**	**23000 mg/kg**
BG01@24'	11/21/2023	24'	0.596	10.4	<0.200	<0.30	0.425	4.15	1.86	<0.260	<0.0200	10.5
BG02@24'	11/21/2023	24'	**0.934**	32.8	<0.200	<0.30	1.03	5.76	2.6	<0.260	<0.0200	14.4
BG03@24'	11/21/2023	24'	**0.768**	25.8	<0.200	<0.30	1.14	8.46	2.53	<0.260	<0.0200	18
BG04@24'	11/21/2023	24'	**0.801**	190	<0.200	<0.30	0.879	8.17	2.43	<0.260	<0.0200	13.6
BG05@24'	11/21/2023	24'	**1.16**	153	0.319	<0.30	1.57	12.3	2.96	<0.260	0.0365	13.5

Notes:
mg/kg-milligrams per kilogram
NA = Not Analyzed
Bold indicates a Table 915-1 exceedance

PHOTOGRAPHIC LOGS

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Photographic Log

Sample ID – E01@20’ (7/6/23)

Sample ID – E02@20’ (7/6/23)

Photographic Log

	
Sample ID – B01@22' (7/6/23)	Sample ID – B02@22' (7/6/23)

Photographic Log

	
Sample ID – B03@24’ (7/19/23)	Sample ID – B05@24’ (7/19/23)

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Photographic Log

	
Sample ID – B06@24' (7/19/23)	Sample ID – B07@24' (7/19/2023)

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Photographic Log

	
Sample ID – N01@22’ (7/24/23)	Sample ID – W01@22’ (7/24/23)

Photographic Log

	
Sample ID – E03@22’ (7/24/23)	Sample ID – N02@22’ (7/24/23)

Photographic Log

	
Sample ID – W02@22' (7/24/23)	Sample ID – W03@22' (7/24/23)

Photographic Log

	
Sample ID – B08@24' (7/24/23)	Sample ID – S03@22' (8/29/23)

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Photographic Log

	
Sample ID – S02@22' (8/29/23)	Sample ID – S01@22' (8/29/23)

4480 Garfield St
Denver, CO 80210
www.quandaryconsultants.com

Wilcoxon Rank-Sum Test

Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - Arsenic
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

Concentrations							
Sample ID (Site)	**As milligrams per kilogram (mg/kg)**		**Sample ID (Background)**	**As (mg/kg)**		**Source**	**As (mg/kg)**
B01@22'	4.24		BG01@4-5'	4.50		bkg + substantial difference (S)	5.33
B02@22'	3.96		BG01@9-10'	3.91		bkg + S	4.74
E01@20'	1.95		BG01@14-15	5.11		bkg + S	5.94
E02@20'	10.10		BG01@19-20'	7.69		bkg + S	8.52
B03@24'	0.76		BG02@4-5'	2.06		bkg + S	2.89
B04@24'	0.739		BG02@9-10'	5.26		bkg + S	6.09
B05@24'	1.20		BG02@14-15'	3.25		bkg + S	4.08
B06@24'	1.45		BG02@19-20'	7.18		bkg + S	8.01
E03@22'	3.57		BG03@4.5'	1.61		bkg + S	2.44
N01@22'	2.28		BG03@9-10'	5.01		bkg + S	5.84
N02@22'	9.96		BG03@14-15'	3.29		bkg + S	4.12
B07@24'	1.73		BG03@19-20'	3.64		bkg + S	4.47
W01@22'	2.180		BG04@4.5'	2.56		bkg + S	3.39
W02@22'	13.90		BG04@9-10'	3.11		bkg + S	3.94
W03@22'	3.46		BG04@14-15'	2.72		bkg + S	3.55
B08@24'	5.23		BG04@19-20'	29.50		bkg + S	30.33
S01@22'	1.53		BG05@4.5'	2.70		bkg + S	3.53
S02@22'	1.71		BG05@9-10'	4.16		bkg + S	4.99
S03@22'	20.000		BG05@14-15'	4.85		bkg + S	5.68
W04@22'	1.20		BG05@19-20'	0.73		bkg + S	1.56
			BG01@4'	0.76		bkg + S	1.59
			BG01@8'	0.67		bkg + S	1.50
			BG01@12'	1.56		bkg + S	2.39
			BG01@16'	1.19		bkg + S	2.02
			BG01@18'	1.07		bkg + S	1.90
			BG02@4'	0.705		bkg + S	1.54
			BG02@8'	0.797		bkg + S	1.63
			BG02@12'	1.21		bkg + S	2.04
			BG02@16'	1.25		bkg + S	2.08
			BG02@18.5'	0.29		bkg + S	1.12
			BG01@24'	0.60		bkg + S	1.43
			BG02@24'	0.934		bkg + S	1.77
			BG03@24'	0.77		bkg + S	1.60
			BG04@24'	0.80		bkg + S	1.63
			BG05@24'	1.16		bkg + S	1.99

Site concentrations (m):	20		
bkg concentrations (n):	35		
mean-Site:	4.56	mean-bkg:	3.33
S, based on mean:	1.139	S, based on mean:	0.833
median-Site:	2.23	median-bkg:	2.06
S, based on median:	0.558	S, based on median:	0.515

Computations				
Source	**Value**	**Rank**	**Site Rank**	**Bkg Rank**
Site	0.739	1	1	
Site	0.76	2	2	
Site	1.20	4.5	4.5	
Site	1.20	4.5	4.5	
Site	1.45	7	7	
Site	1.53	9	9	
Site	1.71	16	16	
Site	1.73	17	17	

NOTES:
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yellow highlight = tied values

Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - Arsenic
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

Site	1.95	20	20	
Site	2.180	25	25	
Site	2.28	26	26	
Site	3.46	31	31	
Site	3.57	34	34	
Site	3.96	36	36	
Site	4.24	39	39	
Site	5.23	43	43	
Site	9.96	51	51	
Site	10.10	52	52	
Site	13.90	53	53	
Site	20.000	54	54	
bkg + S	1.12	3		3
bkg + S	1.43	6		6
bkg + S	1.50	8		8
bkg + S	1.538	10		10
bkg + S	1.56	11		11
bkg + S	1.59	12		12
bkg + S	1.60	13		13
bkg + S	1.630	14		14
bkg + S	1.63	15		15
bkg + S	1.767	18		18
bkg + S	1.90	19		19
bkg + S	1.99	21		21
bkg + S	2.02	22		22
bkg + S	2.04	23		23
bkg + S	2.08	24		24
bkg + S	2.39	27		27
bkg + S	2.44	28		28
bkg + S	2.89	29		29
bkg + S	3.39	30		30
bkg + S	3.53	32		32
bkg + S	3.55	33		33
bkg + S	3.94	35		35
bkg + S	4.08	37		37
bkg + S	4.12	38		38
bkg + S	4.47	40		40
bkg + S	4.74	41		41
bkg + S	4.99	42		42
bkg + S	5.33	44		44
bkg + S	5.68	45		45
bkg + S	5.84	46		46
bkg + S	5.94	47		47
bkg + S	6.09	48		48
bkg + S	8.01	49		49
bkg + S	8.52	50		50
bkg + S	30.33	55		55

Raw Rank Sum (R):	525	1015
Minimum possible value for Rank Sum:	210	630
Adjusted Rank Sum (W_0):	315	385

Sum of all ranks:	1540
n * m:	700

NOTES:
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yellow highlight = tied values

Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - Arsenic
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

QUANDARY CONSULTANTS

Step 1. Null Hypothesis (H_0)
H_0: μ_{site} - (1.25* μ_{bkg}) > 0 Site concentrations exceed 1.25 * background concentrations. (one-sided test)

Step 2. Alternative Hypothesis (H_A)
H_A: μ_{site} - (1.25* μ_{bkg}) ≤ 0 There is no difference between site and 1.25*background concentrations.

Step 3. Test Statistic

m and n > 20, so test statistic is:

$$z_0 = \frac{W_{bkg} - mn/2}{\sqrt{var(W_{bkg})}}$$

Where:

$$var(W_0) = \frac{mn(m+n+1)}{12} - \left\{\frac{mn}{12(m+n)(m+n-1)}\sum_{j=1}^{g} t_j(t_j^2 - 1)\right\}$$

$$var(W_{bkg}) = Term1 - (Term2 \times SumTerm)$$

m is the sample size for Site data
n is the sample size for bkg data
g is number of tied groups

W_{bkg}:	385	
m:	20	
n:	35	
most likely W:	350	
var(W_0)		
tied groups (g):	8	each group has only two tied values
var(W_0) Term 1:	3267	
var(W_0) Term 2:	0.0196	
var(W_0) Sum Term:	48	
var(W_0)	3266	

z_{bkg}	
z_{bkg} numerator:	35
z_{bkg} denominator:	57.1
z_{bkg}:	0.61

Step 4a. Critical Value

False rejection error rate (α):	0.05	falsely conclude that Site ≤ background
False acceptance error rate (β):	0.2	falsely conclude that Site > background

Critical value ($z_{0.95}$):	1.645

Step 4b. p-value

p-value:	2.7E-01

NOTES:
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yellow highlight = tied values

Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - Arsenic
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

Step 5a. Test Stat compared against Critical Value		
Test Statistic (z_{bkg}):	0.61	
Critical Value ($z_{0.95}$):	1.645	
$Z_{bkg} > Z_{0.95}$:	FALSE	fail to reject the null hypothesis - Site dirty

Step 5b. p-value compared against significance level		
p-value:	2.7E-01	
significance level:	0.05	
p-value < significance level:	FALSE	fail to reject the null hypothesis - Site dirty

NOTES:
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CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
yellow highlight = tied values

Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - pH
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

QUANDARY CONSULTANTS

Concentrations

Sample ID (Site)	pH		Sample ID (Background)	pH		Source	pH
B01@22'	7.71		BG01@4-5'	8.09		bkg + substantial difference (S)	8.09
B02@22'	8.05		BG01@9-10'	8		bkg + S	8.15
E01@20'	8.43		BG01@14-15	9		bkg + S	8.51
E02@20'	8.44		BG01@19-20'	8		bkg + S	8.25
B03@24'	7.87		BG02@4-5'	8		bkg + S	8.02
B04@24'	7.52		BG02@9-10'	8.12		bkg + S	8.12
B05@24'	7.61		BG02@14-15'	8.67		bkg + S	8.67
B06@24'	7.67		BG02@19-20'	8.19		bkg + S	8.19
E03@22'	7.93		BG03@4.5'	8.64		bkg + S	8.64
N01@22'	8.23		BG03@9-10'	8.05		bkg + S	8.05
N02@22'	7.77		BG03@14-15'	8.3		bkg + S	8.30
B07@24'	7.63		BG03@19-20'	8.2		bkg + S	8.20
W01@22'	8.220		BG04@4.5'	7.83		bkg + S	7.83
W02@22'	8.50		BG04@9-10'	8.17		bkg + S	8.17
W03@22'	8.88		BG04@14-15'	8.6		bkg + S	8.60
B08@24'	8.41		BG04@19-20'	8.32		bkg + S	8.32
S01@22'	8.84		BG05@4.5'	7.91		bkg + S	7.91
S02@22'	9.53		BG05@9-10'	7.99		bkg + S	7.99
S03@22'	8.920		BG05@14-15'	7.91		bkg + S	7.91
W04@22'	9.73		BG05@19-20'	8.45		bkg + S	8.45
			BG01@4'	7.81		bkg + S	7.81
			BG01@8'	8.06		bkg + S	8.06
			BG01@12'	8.32		bkg + S	8.32
			BG01@16'	8.22		bkg + S	8.22
			BG01@18'	8		bkg + S	8.00
			BG02@4'	6.95		bkg + S	6.95
			BG02@8'	7.95		bkg + S	7.95
			BG02@12'	7.88		bkg + S	7.88
			BG02@16'	8.04		bkg + S	8.04
			BG02@18'	8.03		bkg + S	8.03
			BG01@24'	8.47		bkg + S	8.47
			BG02@24'	7.87		bkg + S	7.87
			BG03@24'	8.16		bkg + S	8.16
			BG04@24'	8.7		bkg + S	8.65
			BG05@24'	8.73		bkg + S	8.73

Site concentrations (m):	20		
bkg concentrations (n):	35		
mean-Site:	8.29	mean-bkg:	8.16
S, based on mean:	2.074	S, based on mean:	
median-Site:	8.23	median-bkg:	8.15
S, based on median:	2.056	S, based on median:	2.038

Computations

Source	Value	Rank	Site Rank	Bkg Rank
Site	7.71	6	6	
Site	8.05	22.5	22.5	
Site	8.43	40	40	
Site	8.44	41	41	
Site	7.87	10.5	10.5	
Site	7.52	2	2	
Site	7.61	3	3	
Site	7.67	5	5	

NOTES:
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yellow highlight = tied values

Large Sample Wilcoxon Rank Sum Test

Miller 14-17 Excavation - pH

From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

Site	7.93	15	15	
Site	8.23	34	34	
Site	7.77	7	7	
Site	7.63	4	4	
Site	8.220	32.5	32.5	
Site	8.50	44	44	
Site	8.88	52	52	
Site	8.41	39	39	
Site	8.84	51	51	
Site	9.53	54	54	
Site	8.920	53	53	
Site	9.73	55	55	
bkg + S	8.09	25		25
bkg + S	8	27		27
bkg + S	9	45		45
bkg + S	8	35		35
bkg + S	8	19		19
bkg + S	8.12	26		26
bkg + S	8.67	49		49
bkg + S	8.19	30		30
bkg + S	8.64	47		47
bkg + S	8.05	22.5		22.5
bkg + S	8.3	36		36
bkg + S	8.2	31		31
bkg + S	7.83	9		9
bkg + S	8.17	29		29
bkg + S	8.6	46		46
bkg + S	8.32	37.5		37.5
bkg + S	7.91	13.5		13.5
bkg + S	7.99	17		17
bkg + S	7.91	13.5		13.5
bkg + S	8.45	42		42
bkg + S	7.81	8		8
bkg + S	8.06	24		24
bkg + S	8.32	37.5		37.5
bkg + S	8.22	32.5		32.5
bkg + S	8	18		18
bkg + S	6.95	1		1
bkg + S	7.95	16		16
bkg + S	7.88	12		12
bkg + S	8.04	21		21
bkg + S	8.03	20		20
bkg + S	8.47	43		43
bkg + S	7.87	10.5		10.5
bkg + S	8.16	28		28
bkg + S	8.7	48		48
bkg + S	8.73	50		50

Raw Rank Sum (R):	570.5	969.5
Minimum possible value for Rank Sum:	210	630
Adjusted Rank Sum (W_0):	360.5	339.5

Sum of all ranks:	1540
n * m:	700

NOTES:

EPA = Environmental Protection Agency

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

yellow highlight = tied values

Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - pH
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

QUANDARY CONSULTANTS

Step 1. Null Hypothesis (H0)

H_0: μ_{site} - (1.25*μ_{bkg}) > 0
Site concentrations exceed 1.25 * background concentrations. (one-sided test)

Step 2. Alternative Hypothesis (HA)

H_A: μ_{site} - (1.25*μ_{bkg}) ≤ 0
There is no difference between site and 1.25*background concentrations.

Step 3. Test Statistic

m and n > 20, so test statistic is:

$$z_0 = \frac{W_{bkg} - mn/2}{\sqrt{var(W_{bkg})}}$$

Where:

$$var(W_0) = \frac{mn(m+n+1)}{12} - \left\{\frac{mn}{12(m+n)(m+n-1)}\sum_{j=1}^{g} t_j(t_j^2 - 1)\right\}$$

$$var(W_{bkg}) = Term1 - (Term2 \times SumTerm)$$

m is the sample size for Site data
n is the sample size for bkg data
g is number of tied groups

W_{bkg}:	339.5	
m:	20	
n:	35	
most likely W:	350	
var(W_0)		
tied groups (g):	5	each group has only two tied values
var(W_0) Term 1:	3267	
var(W_0) Term 2:	0.0196	
var(W_0) Sum Term:	30	
var(W_0)	3266	

z_{bkg}	
z_{bkg} numerator:	-10.5
z_{bkg} denominator:	57.1
z_{bkg}:	-0.18

Step 4a. Critical Value

False rejection error rate (α):	0.05	falsely conclude that Site ≤ background
False acceptance error rate (β):	0.2	falsely conclude that Site > background

Critical value ($z_{0.95}$):	1.645

Step 4b. p-value

p-value:	5.7E-01

NOTES:
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yellow highlight = tied values

Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - pH
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

Step 5a. Test Stat compared against Critical Value		
Test Statistic (z_{bkg}):	-0.18	
Critical Value ($z_{0.95}$):	1.645	
$Z_{bkg} > Z_{0.95}$:	FALSE	fail to reject the null hypothesis - Site dirty

Step 5b. p-value compared against significance level		
p-value:	5.7E-01	
significance level:	0.05	
p-value < significance level:	FALSE	fail to reject the null hypothesis - Site dirty

NOTES:
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CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
yellow highlight = tied values

QUANDARY CONSULTANTS

Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - SAR
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

Concentrations					
Sample ID (Site)	**SAR**	**Sample ID (Background)**	**SAR**	**Source**	**SAR**
B01@22'	9.52	BG01@4-5'	0.147	bkg + substantial difference (S)	0.15
B02@22'	13.70	BG01@9-10'	0	bkg + S	0.16
E01@20'	1.35	BG01@14-15	2	bkg + S	1.66
E02@20'	1.34	BG01@19-20'	5	bkg + S	4.60
B03@24'	5.48	BG02@4-5'	0	bkg + S	0.10
B04@24'	4.53	BG02@9-10'	0.16	bkg + S	0.16
B05@24'	5.10	BG02@14-15'	2.42	bkg + S	2.42
B06@24'	3.51	BG02@19-20'	8.4	bkg + S	8.40
E03@22'	21.00	BG03@4.5'	1.25	bkg + S	1.25
N01@22'	16.80	BG03@9-10'	2.11	bkg + S	2.11
N02@22'	13.40	BG03@14-15'	2.49	bkg + S	2.49
B07@24'	9.10	BG03@19-20'	2.9	bkg + S	2.90
W01@22'	11.500	BG04@4.5'	0.117	bkg + S	0.12
W02@22'	19.80	BG04@9-10'	1.74	bkg + S	1.74
W03@22'	2.03	BG04@14-15'	1.73	bkg + S	1.73
B08@24'	5.86	BG04@19-20'	0.645	bkg + S	0.65
S01@22'	2.52	BG05@4.5'	1.71	bkg + S	1.71
S02@22'	<0.00100	BG05@9-10'	2.05	bkg + S	2.05
S03@22'	0.674	BG05@14-15'	2.23	bkg + S	2.23
W04@22'	0.87	BG05@19-20'	1.12	bkg + S	1.12
		BG01@4'	0.258	bkg + S	0.26
		BG01@8'	1.12	bkg + S	1.12
		BG01@12'	4	bkg + S	4.00
		BG01@16'	4.63	bkg + S	4.63
		BG01@18'	3.4	bkg + S	3.40
		BG02@4'	0.108	bkg + S	0.11
		BG02@8'	0.603	bkg + S	0.60
		BG02@12'	3.73	bkg + S	3.73
		BG02@16'	5.24	bkg + S	5.24
		BG02@18'	4	bkg + S	4.00
		BG01@24'	3.85	bkg + S	3.85
		BG02@24'	3.86	bkg + S	3.86
		BG03@24'	2.35	bkg + S	2.35
		BG04@24'	1.7	bkg + S	1.67
		BG05@24'	2.85	bkg + S	2.85

Site concentrations (m):	19		
bkg concentrations (n):	35		
mean-Site:	7.79	mean-bkg:	2.27
S, based on mean:	1.948	S, based on mean:	
median-Site:	5.48	median-bkg:	2.05
S, based on median:	1.370	S, based on median:	0.513

Computations				
Source	**Value**	**Rank**	**Site Rank**	**Bkg Rank**
Site	9.52	49	49	
Site	13.70	52	52	
Site	1.35	17	17	
Site	1.34	16	16	
Site	5.48	45	45	
Site	4.53	40	40	
Site	5.10	43	43	
Site	3.51	34	34	

NOTES:
EPA = Environmental Protection Agency
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yellow highlight = tied values

Large Sample Wilcoxon Rank Sum Test

Miller 14-17 Excavation - SAR

From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

Site	21.00	55	55	
Site	16.80	53	53	
Site	13.40	51	51	
Site	9.10	48	48	
Site	11.500	50	50	
Site	19.80	54	54	
Site	2.03	23	23	
Site	5.86	46	46	
Site	2.52	30	30	
Site	0.00	1	1	
Site	0.674	11	11	
Site	0.87	12	12	
bkg + S	0.147	5		5
bkg + S	0	7		7
bkg + S	2	18		18
bkg + S	5	41		41
bkg + S	0	2		2
bkg + S	0.16	6		6
bkg + S	2.42	28		28
bkg + S	8.4	47		47
bkg + S	1.25	15		15
bkg + S	2.11	25		25
bkg + S	2.49	29		29
bkg + S	2.9	32		32
bkg + S	0.117	4		4
bkg + S	1.74	22		22
bkg + S	1.73	21		21
bkg + S	0.645	10		10
bkg + S	1.71	20		20
bkg + S	2.05	24		24
bkg + S	2.23	26		26
bkg + S	1.12	13.5		13.5
bkg + S	0.258	8		8
bkg + S	1.12	13.5		13.5
bkg + S	4	38.5		38.5
bkg + S	4.63	42		42
bkg + S	3.4	33		33
bkg + S	0.108	3		3
bkg + S	0.603	9		9
bkg + S	3.73	35		35
bkg + S	5.24	44		44
bkg + S	4	38.5		38.5
bkg + S	3.85	36		36
bkg + S	3.86	37		37
bkg + S	2.35	27		27
bkg + S	1.7	19		19
bkg + S	2.85	31		31

Raw Rank Sum (R):	730	810
Minimum possible value for Rank Sum:	190	630
Adjusted Rank Sum (W_0):	540	180

Sum of all ranks:	1485
n * m:	665

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Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - SAR
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

QUANDARY CONSULTANTS

Step 1. Null Hypothesis (H_0)

H_0: μ_{site} - (1.25*μ_{bkg}) > 0
Site concentrations exceed 1.25 * background concentrations. (one-sided test)

Step 2. Alternative Hypothesis (H_A)

H_A: μ_{site} - (1.25*μ_{bkg}) ≤ 0
There is no difference between site and 1.25*background concentrations.

Step 3. Test Statistic

m and n > 20, so test statistic is:

$$z_0 = \frac{W_{bkg} - mn/2}{\sqrt{var(W_{bkg})}}$$

Where:

$$var(W_0) = \frac{mn(m+n+1)}{12} - \left\{\frac{mn}{12(m+n)(m+n-1)}\sum_{j=1}^{g} t_j(t_j^2 - 1)\right\}$$

$$var\left(W_{bkg}\right) = Term1 - (Term2 \times SumTerm)$$

m is the sample size for Site data
n is the sample size for bkg data
g is number of tied groups

W_{bkg}:	180	
m:	19	
n:	35	
most likely W:	332.5	
var(W_0)		
tied groups (g):	5	each group has only two tied values
var(W_0) Term 1:	3048	
var(W_0) Term 2:	0.0194	
var(W_0) Sum Term:	30	
var(W_0)	3047	

z_{bkg}	
z_{bkg} numerator:	-152.5
z_{bkg} denominator:	55.2
z_{bkg}:	-2.76

Step 4a. Critical Value

False rejection error rate (α):	0.05	falsely conclude that Site ≤ background
False acceptance error rate (β):	0.2	falsely conclude that Site > background

Critical value ($z_{0.95}$):	1.645

Step 4b. p-value

p-value:	1.0E+00

NOTES:
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Large Sample Wilcoxon Rank Sum Test
Miller 14-17 Excavation - SAR
From Box 3-34 of EPA QA/G-9S, but reformulated to match Test Form 2 in CERCLA Background

Step 5a. Test Stat compared against Critical Value		
Test Statistic (z_{bkg}):	-2.76	
Critical Value ($z_{0.95}$):	1.645	
$Z_{bkg} > Z_{0.95}$:	FALSE	fail to reject the null hypothesis - Site dirty

Step 5b. p-value compared against significance level		
p-value:	1.0E+00	
significance level:	0.05	
p-value < significance level:	FALSE	fail to reject the null hypothesis - Site dirty

NOTES:
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yellow highlight = tied values

BORE LOGS

QUANDARY CONSULTANTS

BORING LOG/MONITORING WELL COMPLETION LOG

Boring/Well Number: SB01	Project: Miller 14-17		
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro	
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID	
Gravel Pack: NA	Seal: 0-22' BGS	Grout: NA	
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry
Screen Type: NA / Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 22

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
			Dry						
5			Dry	477	Yes	SB01@4-5'	0-4'	SP - Sand, medium, brown	
10			Dry	778	Yes	SB01@9-10'	4-8'		
15			Dry	1467	Yes	SB01@14-15'	8-12' / 12-16'	SC - Clayey-sand, brown, orange, and gray	
20			Dry	630	Yes	SB01@19-20'	16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	
							20-22'		

NOTES:

QUANDARY CONSULTANTS

BORING LOG/MONITORING WELL COMPLETION LOG

Boring/Well Number: SB02	Project: Miller 14-17		
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro	
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID	
Gravel Pack: NA	Seal: 0-20' BGS	Grout: NA	
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry
Screen Type: NA / Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 20

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
			Dry		No				
5			Dry	1.1	No	SB02@4-5'	0-4'	SP - Sand, medium, brown	
10			Dry	13.8	No	SB02@9-10'	4-8'		
							8-12'		
15			Dry	5.6	No	SB02@14-15'	12-16'	SC - Clayey-sand, brown, orange, and gray	
20			Dry	29.6	No	SB02@19-20'	16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	

NOTES:

QUANDARY CONSULTANTS

BORING LOG/MONITORING WELL COMPLETION LOG

Boring/Well Number: SB03	Project: Miller 14-17		
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro	
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID	
Gravel Pack: NA	Seal: 0-20' BGS	Grout: NA	
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry
Screen Type: NA / Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 20

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
			Dry		No		0-4'	SP - Sand, medium, brown	
5			Dry	0.4	No	SB03@4-5'	4-8'		
10			Dry	0.6	No	SB03@9-10'	8-12'		
15			Dry	1.4	No	SB03@14-15'	12-16'	SC - Clayey-sand, brown, orange, and gray	
20			Dry	1.8	No	SB03@19-20'	16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	

NOTES:

QUANDARY CONSULTANTS

BORING LOG/MONITORING WELL COMPLETION LOG

Boring/Well Number: SB04	Project: Miller 14-17		
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro	
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID	
Gravel Pack: NA	Seal: 0-20' BGS	Grout: NA	
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry
Screen Type: NA / Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 20

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
			Dry		No				
5			Dry	6.8	Yes	SB04@4-5'	0-4'		
10			Dry	4.7	Yes	SB04@9-10'	4-8'	SP - Sand, medium, brown	
15			Dry	877	Yes	SB04@14-15'	8-12'	SC - Clayey-sand, brown, orange, and gray	
20			Dry	345	Yes	SB04@19-20'	12-16' 16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	

NOTES:

QUANDARY CONSULTANTS

BORING LOG/MONITORING WELL COMPLETION LOG

Boring/Well Number: SB05	Project: Miller 14-17		
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro	
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID	
Gravel Pack: NA	Seal: 0-20' BGS	Grout: NA	
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry
Screen Type: NA / Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 20

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
			Dry		No				
5			Dry	2.5	No	SB05@4-5'	0-4'	SP - Sand, medium, brown	
10			Dry	1.5	No	SB05@9-10'	4-8'		
							8-12'		
15			Dry	1.7	No	SB05@14-15'	12-16'	SC - Clayey-sand, brown, orange, and gray	
20			Dry	0.2	No	SB05@19-20'	16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	

NOTES: Stepped out approximately 50' to the west after higher PID detections in the original borehole.

BORING LOG/MONITORING WELL COMPLETION LOG

QUANDARY CONSULTANTS

Boring/Well Number: BG01	Project: Miller 14-17		
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro	
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID	
Gravel Pack: NA	Seal: 0-20' BGS	Grout: NA	
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry
Screen Type: NA / Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 20

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
			Dry						
5			Dry	0	No	BG01@4-5'	0-4'	SP - Sand, medium, brown	
10			Dry	0	No	BG01@9-10	4-8'		
							8-12'		
15			Dry	0	No	BG01@14-15'	12-16'	SC- Clayey-sand, brown, orange, and gray	
20			Dry	0	No	BG01@19-20'	16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	

NOTES:

BORING LOG/MONITORING WELL COMPLETION LOG

QUANDARY CONSULTANTS	Boring/Well Number: BG02	Project: Miller 14-17	
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro	
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID	
Gravel Pack: NA	Seal: 0-20' BGS	Grout: NA	
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry
Screen Type: NA / Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 20

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
5			Dry Dry	0	No	BG02@4-5'	0-4'	SP - Sand, medium, brown	
10			Dry	0	No	BG02@9-10	4-8' 8-12'		
15			Dry	0	No	BG02@14-15'	12-16'	SC - Clayey-sand, brown, orange, and gray	
20			Dry	0	No	BG02@19-20'	16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	

NOTES:

QUANDARY CONSULTANTS

BORING LOG/MONITORING WELL COMPLETION LOG

Boring/Well Number: BG03	Project: Miller 14-17		
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro	
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID	
Gravel Pack: NA	Seal: 0-20' BGS	Grout: NA	
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry
Screen Type: NA / Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 20

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
0-5			Dry / Dry	0	No	BG03@4-5'	0-4'	SP - Sand, medium, brown	
10			Dry	0	No	BG03@9-10	4-8'		
15			Dry	0	No	BG03@14-15'	8-12' / 12-16'	SC - Clayey-sand, brown, orange, and gray	
20			Dry	0	No	BG03@19-20'	16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	

NOTES:

QUANDARY CONSULTANTS	BORING LOG/MONITORING WELL COMPLETION LOG			
	Boring/Well Number: BG04	Project: Miller 14-17		
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro		
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID		
Gravel Pack: NA	Seal: 0-20' BGS	Grout: NA		
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry	
Screen Type: NA	Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 20

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
			Dry				0-4'	SP - Sand, medium, brown	
5			Dry	0	No	BG04@4-5'	4-8'		
10			Dry	0	No	BG04@9-10'	8-12'		
15			Dry	0	No	BG04@14-15'	12-16'	SC - Clayey-sand, brown, orange, and gray	
20			Dry	0	No	BG04@19-20'	16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	

NOTES:

BORING LOG/MONITORING WELL COMPLETION LOG

QUANDARY CONSULTANTS	Boring/Well Number: BG05	Project: Miller 14-17	
Date: 3/14/23	Logged By: Mike Dinkel	Driller: DrillPro	
Drilling Method: Direct Push	Sampling Method: Single Rod	Field Screening Equipment: Mini Rae 2000 PID	
Gravel Pack: NA	Seal: 0-20' BGS	Grout: NA	
Casing Type: NA	Diameter: NA	Length: NA	Depth to Water (ft. bgs): Dry
Screen Type: NA / Slot: NA	Diameter: NA	Length: NA	Total Depth (ft.): 20

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
			Dry						
5			Dry	0	No	BG05@4-5'	0-4'	SP - Sand, medium, brown	
10			Dry	0	No	BG05@9-10'	4-8'		
							8-12'		
15			Dry	0	No	BG05@14-15'	12-16'	SC - Clayey-sand, brown, orange, and gray	
20			Dry	0	No	BG05@19-20'	16-20'	CL - Clay, gray and orange, compacted, refusal at 20'	

NOTES:

QUANDARY CONSULTANTS

BORING LOG/MONITORING WELL COMPLETION LOG

Boring/Well Number: **BG01**	Project: **Miller 14-17**		
Date: **11/21/223**	Logged By: **Will Blust**	Driller: **DrillPro**	
Drilling Method: **HSA**	Sampling Method: **Split Spoon**	Field Screening Equipment: **PID**	
Gravel Pack: **NA**	Seal: **Bentonite**	Grout: **NA**	
Casing Type: **NA**	Diameter: **NA**	Length: **NA**	Depth to Water (ft. bgs): **NA**
Screen Type: **NA**	Slot: **NA** / Diameter: **NA**	Length: **NA**	Total Depth (ft.): **24'**

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
5									
10									
15									
20									
25			Dry	0.5	N	24'		White/Grey Brown, no petrol odor, sandy silt	
30									

NOTES:

QUANDARY CONSULTANTS	BORING LOG/MONITORING WELL COMPLETION LOG	
	Boring/Well Number: **BG02**	Project: **Miller 14-17**
Date: **11/21/223**	Logged By: **Will Blust**	Driller: **DrillPro**
Drilling Method: **HSA**	Sampling Method: **Split Spoon**	Field Screening Equipment: **PID**
Gravel Pack: **NA**	Seal: **Bentonite**	Grout: **NA**

Casing Type: **NA**	Diameter: **NA**	Length: **NA**	Depth to Water (ft. bgs): **NA**

Screen Type: **NA**	Slot: **NA**	Diameter: **NA**	Length: **NA**	Total Depth (ft.): **24'**

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
5									
10									
15									
20									
25			Dry	0.7	N	24'		Light gray, brown, no petrol odor, sandy silt	
30									

NOTES:

QUANDARY CONSULTANTS

BORING LOG/MONITORING WELL COMPLETION LOG

Boring/Well Number: **BG03**	Project: **Miller 14-17**		
Date: **11/21/223**	Logged By: **Will Blust**	Driller: **DrillPro**	
Drilling Method: **HSA**	Sampling Method: **Split Spoon**	Field Screening Equipment: **PID**	
Gravel Pack: **NA**	Seal: **Bentonite**	Grout: **NA**	
Casing Type: **NA**	Diameter: **NA**	Length: **NA**	Depth to Water (ft. bgs): **NA**
Screen Type: **NA** / Slot: **NA**	Diameter: **NA**	Length: **NA**	Total Depth (ft.): **24'**

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
5									
10									
15									
20									
25			Dry	0.9	N	24'		Light gray, orange, brwon, slight petrol odor, sandy silt	
30									

NOTES:

QUANDARY CONSULTANTS	BORING LOG/MONITORING WELL COMPLETION LOG		
	Boring/Well Number: **BG04**	Project: **Miller 14-17**	
Date: **11/21/223**	Logged By: **Will Blust**	Driller: **DrillPro**	
Drilling Method: **HSA**	Sampling Method: **Split Spoon**	Field Screening Equipment: **PID**	
Gravel Pack: **NA**	Seal: **Bentonite**	Grout: **NA**	
Casing Type: **NA**	Diameter: **NA**	Length: **NA**	Depth to Water (ft. bgs): **NA**
Screen Type: **NA** / Slot: **NA**	Diameter: **NA**	Length: **NA**	Total Depth (ft.): **24'**

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
5									
10									
15									
20									
25			Dry	15.8	N	24'		Gray, brown, no petrol odor, sandy silt	
30									

NOTES:

QUANDARY CONSULTANTS

BORING LOG/MONITORING WELL COMPLETION LOG

Boring/Well Number: **BG05**	Project: **Miller 14-17**		
Date: **11/21/223**	Logged By: **Will Blust**	Driller: **DrillPro**	
Drilling Method: **HSA**	Sampling Method: **Split Spoon**	Field Screening Equipment: **PID**	
Gravel Pack: **NA**	Seal: **Bentonite**	Grout: **NA**	
Casing Type: **NA**	Diameter: **NA**	Length: **NA**	Depth to Water (ft. bgs): **NA**
Screen Type: **NA** / Slot: **NA**	Diameter: **NA**	Length: **NA**	Total Depth (ft.): **24'**

Depth (ft. bgs)	Lithology	Water Level	Moisture Content	Vapor (ppm)	Staining (Y/N)	Sample	Sample Run	Lithology/Remarks	Well Completion
5									
10									
15									
20									
25			Dry	12.9	N	24'		Brown, orange, no petrol odor, shale	
30									

NOTES:

4480 Garfield St
Denver, CO 80210
www.quandaryconsultants.com

LABRATORY REPORT

Summit Scientific

4653 Table Mountain Drive, Golden, Colorado 80401

303.277.9310

July 18, 2023

Mike Dinkel

Quandary Consultants

4480 Grfeld St

Denver, CO 80237

RE: Civitas - Miller 4-17J, 14-17

Work Order # 2307065

Enclosed are the results of analyses for samples received by Summit Scientific on 07/06/23 12:35. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jacob Wood For Paul Shrewsbury

President

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
E01@20'	2307065-01	Soil	07/06/23 09:48	07/06/23 12:35
E02@20'	2307065-02	Soil	07/06/23 09:53	07/06/23 12:35
B01@22'	2307065-03	Soil	07/06/23 09:57	07/06/23 12:35
B02@22'	2307065-04	Soil	07/06/23 10:01	07/06/23 12:35

SUMMIT SCIENTIFIC

4653 Table Mountain Drive
Golden, CO 80403
303-277-9310

Lab ID	Page 1 of 1
2307065	

Client: Civitas	Send Data To:	Send Invoice To:	
Address: 650 Southgate	Project Manager: Mike Dinkel	Company: Civitas	
City/State/Zip: Windsor, CO	E-Mail: mdinkel@quandaryconsultants.com	Project Name/Location: Miller 45-17	
Phone: 785-691-7788		AFE#:	
Sampler Name: Mike Dinkel Austin Lange	Project Name:	PO/Billing Codes:	
	Project Number:	Contact: Jacob Evans	

ID	Sample Description	Date Sampled	Time Sampled	# of containers	Preservative: HCl	HNO3	None	Other ___	Matrix: Water	Soil	Air-Canister #	Other ___	Analysis Requested: Full Table 915-1								Special Instructions
1	E01@20'	7-6-23	0948	3			X			X			X								
2	E02@20'	↓	0953	↓			↓			↓			↓								
3	B01@22'	↓	0957	↓			↓			↓			↓								
4	B02@22'	↓	1001	↓			↓			↓			↓								
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					

Relinquished by:	Date/Time:	Received by:	Date/Time:	TAT Business Days		Field DO		Notes:
[signature]	7-6-23/1235	[signature]	7/6/23 12:35	Same Day	x	Field EC		same day for VOC
Relinquished by:	Date/Time:	Received by:	Date/Time:	1 Day		Field ORP		
				2 Days		Field pH		
Relinquished by:	Date/Time:	Received by:	Date/Time:	3 Days		Field Temp.		
				Standard	x	Field Turb.		

Temperature Upon Receipt: 10.0 | Corrected Temperature ______ | IR gun #: 2 | HNO3 lot #: ______

S2

S2 Work Order# 2307065

Sample Receipt Checklist

Client: Civitas   Client Project ID: Miller 45-17

Shipped Via: H.D./P.U./FedEx/UPS/USPS/Other [ ] Airbill #:

[X] [ ] [ ] [ ] [ ]

Matrix (Check all that apply) Air [ ] Soil/Solid [X] Water [ ] Other [ ]

Temp (°C) 10.0   Thermometer # 2

	Yes	No	N/A	Comments (if any)
If samples require cooling, is the temperature < 6°C? (1) **NOTE:** If samples are delivered the same day of sampling, this requirement is met if there is evidence that cooling has begun.	X			on file
If custody seals are present, are they intact? (1)			X	
Are samples due within 48 hours present?	X			Same day
Are water samples with short hold times present? Note the short hold analysis in the comments column - pH, Nitrate/Nitrite, Ferrous Iron (Fe^{2+}), Hexavalent Chromium (Cr^{6+}, Cr VI), COD/BOD, Total Coliform, E. Coli, Total Residual Chlorine (TRC), Dissolved Oxygen		X		
Is a chain-of-custody (COC) form present and filled out Completely? (1)	X			
Is the COC properly relinquished by the client w/ date and time recorded? (1)	X			
Were all samples received intact? (1)	X			
Was adequate sample volume provided? (1)	X			
Does the COC agree with the number and type of sample bottles received? (1)	X			
Do the sample IDs on the bottle labels match the COC?(1)	X			
For volatiles in water – is there headspace present? **If yes, contact client and note in narrative.**			X	
Are samples preserved that require preservation **(excluding cooling)?** (1) Note the type of preservative in the comments column – HCl, H_2SO_4, NaOH, HNO_3, etc.			X	
If samples are acid preserved for metals, is the pH ≤ 2? (1) Record the pH in Comments.			X	
If dissolved metals are requested, were samples field filtered?			X	

Additional Comments (if any):

(1) **If NO, then contact the client before proceeding with analysis and note in case narrative.**

Josh Ward   7/6/23 12:35

Custodian Printed Name   **Date/Time**

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

E01@20'
2307065-01 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0150	07/06/23	07/06/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	**0.035**	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	**0.029**	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**14**	0.50		"	"	"	"	"	"	

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*147 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*71.0 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*96.6 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**82**	50		mg/kg	1	BGG0149	07/06/23	07/06/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*91.0 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

E01@20'

2307065-01 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0154	07/07/23	07/08/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	**0.0181**	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*60.1 %*		*40-150*		*"*	*"*	*"*	*"*	
Surrogate: Fluoranthene-d10		*59.0 %*		*40-150*		*"*	*"*	*"*	*"*	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/06/23 09:48**

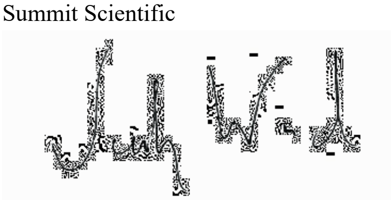
Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.275**	0.0100		mg/L	1	BGG0283	07/11/23	07/13/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Summit Scientific



The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

E01@20'
2307065-01 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**1.95**	0.235		mg/kg dry	1	BGG0253	07/10/23	07/13/23	EPA 6020B	
Barium	**65.4**	0.469		"	"	"	"	"	"	
Cadmium	**0.285**	0.235		"	"	"	"	"	"	
Copper	**7.34**	0.469		"	"	"	"	"	"	
Lead	**14.6**	0.235		"	"	"	"	"	"	
Nickel	**5.68**	0.469		"	"	"	"	"	"	
Selenium	ND	0.305	0.205	"	"	"	"	"	"	
Silver	**0.0244**	0.0235		"	"	"	"	"	"	
Zinc	**32.0**	0.469		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0213	07/10/23	07/10/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**126**	0.0587		mg/L dry	1	BGG0276	07/11/23	07/14/23	EPA 6020B	
Magnesium	**18.3**	0.0587		"	"	"	"	"	"	
Sodium	**61.3**	0.0587		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**1.35**	0.00100		units	1	BGG0461	07/15/23	07/15/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

E01@20'

2307065-01 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**85.2**			%	1	BGG0217	07/10/23	07/10/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

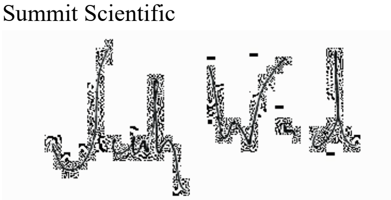
Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**1.39**	0.0100		mmhos/cm	1	BGG0327	07/12/23	07/13/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/06/23 09:48**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.43**			pH Units	1	BGG0328	07/12/23	07/13/23	EPA 9045D	



Quandary Consultants
4480 Grfeld St
Denver CO, 80237

Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
07/18/23 09:26

E02@20'

2307065-02 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0150	07/06/23	07/06/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	**0.011**	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	**0.031**	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	**0.011**	0.0050		"	"	"	"	"	"	
Naphthalene	**0.0086**	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**2.0**	0.50		"	"	"	"	"	"	

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*149 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*77.6 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*81.4 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

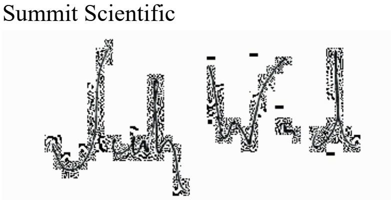
Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**81**	50		mg/kg	1	BGG0149	07/06/23	07/06/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*92.6 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM



E02@20'

2307065-02 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0154	07/07/23	07/08/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	**0.00660**	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*89.6 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*90.0 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.205**	0.0100		mg/L	1	BGG0283	07/11/23	07/13/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

E02@20'

2307065-02 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**10.1**	0.232		mg/kg dry	1	BGG0253	07/10/23	07/13/23	EPA 6020B	
Barium	**52.7**	0.465		"	"	"	"	"	"	
Cadmium	ND	0.232		"	"	"	"	"	"	
Copper	**9.65**	0.465		"	"	"	"	"	"	
Lead	**13.5**	0.232		"	"	"	"	"	"	
Nickel	**3.89**	0.465		"	"	"	"	"	"	
Selenium	ND	0.302	0.203	"	"	"	"	"	"	
Silver	**0.0256**	0.0232		"	"	"	"	"	"	
Zinc	**26.0**	0.465		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0213	07/10/23	07/10/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**163**	0.0581		mg/L dry	1	BGG0276	07/11/23	07/14/23	EPA 6020B	
Magnesium	**19.6**	0.0581		"	"	"	"	"	"	
Sodium	**67.8**	0.0581		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**1.34**	0.00100		units	1	BGG0461	07/15/23	07/15/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

E02@20'

2307065-02 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**86.0**			%	1	BGG0217	07/10/23	07/10/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**1.39**	0.0100		mmhos/cm	1	BGG0327	07/12/23	07/13/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/06/23 09:53**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.44**			pH Units	1	BGG0328	07/12/23	07/13/23	EPA 9045D	

B01@22'

2307065-03 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	**0.011**	0.0020		mg/kg	1	BGG0150	07/06/23	07/06/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	**0.047**	0.0050		"	"	"	"	"	"	
Xylenes (total)	**0.46**	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	**0.27**	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	**0.14**	0.0050		"	"	"	"	"	"	
Naphthalene	**0.11**	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**15**	0.50		"	"	"	"	"	"	

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*149 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*74.2 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*85.5 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**120**	50		mg/kg	1	BGG0149	07/06/23	07/06/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*91.4 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

B01@22'

2307065-03 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0154	07/07/23	07/08/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	**0.00870**	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	**0.0399**	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	**0.229**	0.00500		"	"	"	"	"	"	E
2-Methylnaphthalene	**0.278**	0.00500		"	"	"	"	"	"	E

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*102 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*95.6 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.326**	0.0100		mg/L	1	BGG0283	07/11/23	07/13/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

B01@22'

2307065-03 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**4.24**	0.230		mg/kg dry	1	BGG0253	07/10/23	07/13/23	EPA 6020B	
Barium	**36.6**	0.460		"	"	"	"	"	"	
Cadmium	**0.507**	0.230		"	"	"	"	"	"	
Copper	**7.38**	0.460		"	"	"	"	"	"	
Lead	**14.2**	0.230		"	"	"	"	"	"	
Nickel	**6.07**	0.460		"	"	"	"	"	"	
Selenium	ND	0.299	0.201	"	"	"	"	"	"	
Silver	**0.0419**	0.0230		"	"	"	"	"	"	
Zinc	**31.9**	0.460		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0213	07/10/23	07/10/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**30.2**	0.0575		mg/L dry	1	BGG0276	07/11/23	07/14/23	EPA 6020B	
Magnesium	**22.0**	0.0575		"	"	"	"	"	"	
Sodium	**282**	0.0575		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**9.52**	0.00100		units	1	BGG0461	07/15/23	07/15/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

B01@22'
2307065-03 (Soil)

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Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**87.0**			%	1	BGG0217	07/10/23	07/10/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

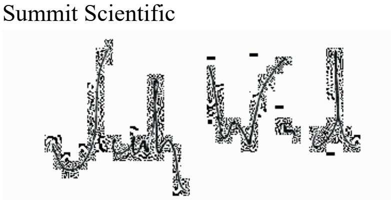
Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**1.86**	0.0100		mmhos/cm	1	BGG0327	07/12/23	07/13/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/06/23 09:57**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.71**			pH Units	1	BGG0328	07/12/23	07/13/23	EPA 9045D	



B02@22'

2307065-04 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	**0.0064**	0.0020		mg/kg	1	BGG0150	07/06/23	07/06/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	**0.060**	0.0050		"	"	"	"	"	"	
Xylenes (total)	**0.76**	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	**0.23**	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	**0.15**	0.0050		"	"	"	"	"	"	
Naphthalene	**0.098**	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**13**	0.50		"	"	"	"	"	"	

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*167 %*		*50-150*		"	"	"	"	*S-02*
Surrogate: Toluene-d8		*75.2 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*89.1 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**78**	50		mg/kg	1	BGG0149	07/06/23	07/06/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*87.5 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

B02@22'

2307065-04 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0154	07/07/23	07/08/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	**0.0144**	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	**0.0804**	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	**0.0678**	0.00500		"	"	"	"	"	"	

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*96.5 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*71.1 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.476**	0.0100		mg/L	1	BGG0283	07/11/23	07/13/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

B02@22'

2307065-04 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**3.96**	0.231		mg/kg dry	1	BGG0253	07/10/23	07/13/23	EPA 6020B	
Barium	**60.5**	0.462		"	"	"	"	"	"	
Cadmium	**0.854**	0.231		"	"	"	"	"	"	
Copper	**8.49**	0.462		"	"	"	"	"	"	
Lead	**18.3**	0.231		"	"	"	"	"	"	
Nickel	**7.47**	0.462		"	"	"	"	"	"	
Selenium	ND	0.300	0.202	"	"	"	"	"	"	
Silver	**0.0610**	0.0231		"	"	"	"	"	"	
Zinc	**33.7**	0.462		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0213	07/10/23	07/10/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/06/23 10:01**

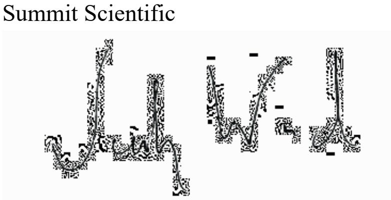
Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**13.4**	0.0577		mg/L dry	1	BGG0276	07/11/23	07/14/23	EPA 6020B	
Magnesium	**5.61**	0.0577		"	"	"	"	"	"	
Sodium	**237**	0.0577		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**13.7**	0.00100		units	1	BGG0461	07/15/23	07/15/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods



Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

B02@22'

2307065-04 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**86.6**			%	1	BGG0217	07/10/23	07/10/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**1.30**	0.0100		mmhos/cm	1	BGG0327	07/12/23	07/13/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/06/23 10:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.05**			pH Units	1	BGG0328	07/12/23	07/13/23	EPA 9045D	

Volatile Organic Compounds by EPA Method 8260B - Quality Control

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Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0150 - EPA 5030 Soil MS										
Blank (BGG0150-BLK1)				Prepared: 07/06/23 Analyzed: 07/07/23						
Benzene	ND	0.0020	mg/kg							
Toluene	ND	0.0050	"							
Ethylbenzene	ND	0.0050	"							
Xylenes (total)	ND	0.010	"							
1,2,4-Trimethylbenzene	ND	0.0050	"							
1,3,5-Trimethylbenzene	ND	0.0050	"							
Naphthalene	ND	0.0038	"							
Gasoline Range Hydrocarbons	ND	0.50	"							
Surrogate: 1,2-Dichloroethane-d4	*0.0326*		*"*	*0.0400*		*81.4*	*50-150*			
Surrogate: Toluene-d8	*0.0397*		*"*	*0.0400*		*99.3*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0398*		*"*	*0.0400*		*99.4*	*50-150*			
LCS (BGG0150-BS1)				Prepared: 07/06/23 Analyzed: 07/07/23						
Benzene	0.0662	0.0020	mg/kg	0.0750		88.2	70-130			
Toluene	0.0816	0.0050	"	0.0750		109	70-130			
Ethylbenzene	0.0917	0.0050	"	0.0750		122	70-130			
m,p-Xylene	0.183	0.010	"	0.150		122	70-130			
o-Xylene	0.0827	0.0050	"	0.0750		110	70-130			
1,2,4-Trimethylbenzene	0.0885	0.0050	"	0.0750		118	70-130			
1,3,5-Trimethylbenzene	0.0924	0.0050	"	0.0750		123	70-130			
Naphthalene	0.0764	0.0038	"	0.0750		102	70-130			
Surrogate: 1,2-Dichloroethane-d4	*0.0326*		*"*	*0.0400*		*81.5*	*50-150*			
Surrogate: Toluene-d8	*0.0399*		*"*	*0.0400*		*99.8*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0389*		*"*	*0.0400*		*97.3*	*50-150*			
Matrix Spike (BGG0150-MS1)	**Source: 2307063-01**			Prepared: 07/06/23 Analyzed: 07/07/23						
Benzene	0.0661	0.0020	mg/kg	0.0750	ND	88.1	70-130			
Toluene	0.0770	0.0050	"	0.0750	ND	103	70-130			
Ethylbenzene	0.0977	0.0050	"	0.0750	ND	130	70-130			
m,p-Xylene	0.192	0.010	"	0.150	ND	128	70-130			
o-Xylene	0.0855	0.0050	"	0.0750	ND	114	70-130			
1,2,4-Trimethylbenzene	0.0913	0.0050	"	0.0750	ND	122	70-130			
1,3,5-Trimethylbenzene	0.0946	0.0050	"	0.0750	ND	126	70-130			
Naphthalene	0.0840	0.0038	"	0.0750	ND	112	70-130			
Surrogate: 1,2-Dichloroethane-d4	*0.0310*		*"*	*0.0400*		*77.4*	*50-150*			
Surrogate: Toluene-d8	*0.0374*		*"*	*0.0400*		*93.5*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0386*		*"*	*0.0400*		*96.4*	*50-150*			

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Summit Scientific

Batch BGG0150 - EPA 5030 Soil MS

Matrix Spike Dup (BGG0150-MSD1) **Source: 2307063-01** Prepared: 07/06/23 Analyzed: 07/07/23

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Benzene	0.0695	0.0020	mg/kg	0.0750	ND	92.7	70-130	5.13	30	
Toluene	0.0813	0.0050	"	0.0750	ND	108	70-130	5.42	30	
Ethylbenzene	0.0951	0.0050	"	0.0750	ND	127	70-130	2.74	30	
m,p-Xylene	0.186	0.010	"	0.150	ND	124	70-130	2.98	30	
o-Xylene	0.0853	0.0050	"	0.0750	ND	114	70-130	0.281	30	
1,2,4-Trimethylbenzene	0.0898	0.0050	"	0.0750	ND	120	70-130	1.66	30	
1,3,5-Trimethylbenzene	0.0946	0.0050	"	0.0750	ND	126	70-130	0.0317	30	
Naphthalene	0.0850	0.0038	"	0.0750	ND	113	70-130	1.24	30	
Surrogate: 1,2-Dichloroethane-d4	*0.0349*		*"*	*0.0400*		*87.2*	*50-150*			
Surrogate: Toluene-d8	*0.0385*		*"*	*0.0400*		*96.2*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0383*		*"*	*0.0400*		*95.8*	*50-150*			

Extractable Petroleum Hydrocarbons by 8015 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0149 - EPA 3550A										
Blank (BGG0149-BLK1)				Prepared & Analyzed: 07/06/23						
C10-C28 (DRO)	ND	50	mg/kg							
C28-C36 (ORO)	ND	50	"							
Surrogate: o-Terphenyl	*11.0*		*"*	*12.5*		*88.3*	*30-150*			
LCS (BGG0149-BS1)				Prepared: 07/06/23 Analyzed: 07/07/23						
C10-C28 (DRO)	478	50	mg/kg	500		95.6	70-130			
Surrogate: o-Terphenyl	*11.7*		*"*	*12.5*		*93.8*	*30-150*			
Matrix Spike (BGG0149-MS1)	**Source: 2307063-01**			Prepared: 07/06/23 Analyzed: 07/07/23						
C10-C28 (DRO)	429	50	mg/kg	500	30.8	79.6	70-130			
Surrogate: o-Terphenyl	*11.4*		*"*	*12.5*		*91.6*	*30-150*			
Matrix Spike Dup (BGG0149-MSD1)	**Source: 2307063-01**			Prepared: 07/06/23 Analyzed: 07/07/23						
C10-C28 (DRO)	429	50	mg/kg	500	30.8	79.6	70-130	0.0431	20	
Surrogate: o-Terphenyl	*11.3*		*"*	*12.5*		*90.2*	*30-150*			

PAH by EPA Method 8270D SIM - Quality Control

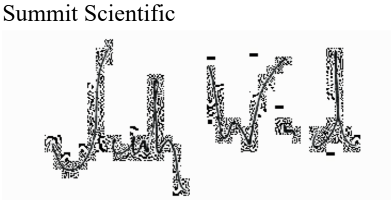
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0154 - EPA 5030 Soil MS										
Blank (BGG0154-BLK1)				Prepared & Analyzed: 07/07/23						
Acenaphthene	ND	0.00500	mg/kg							
Anthracene	ND	0.00500	"							
Benzo (a) anthracene	ND	0.00500	"							
Benzo (a) pyrene	ND	0.00500	"							
Benzo (b) fluoranthene	ND	0.00500	"							
Benzo (k) fluoranthene	ND	0.00500	"							
Chrysene	ND	0.00500	"							
Dibenz (a,h) anthracene	ND	0.00500	"							
Fluoranthene	ND	0.00500	"							
Fluorene	ND	0.00500	"							
Indeno (1,2,3-cd) pyrene	ND	0.00500	"							
Pyrene	ND	0.00500	"							
1-Methylnaphthalene	ND	0.00500	"							
2-Methylnaphthalene	ND	0.00500	"							
Surrogate: 2-Methylnaphthalene-d10	*0.0325*		*"*	*0.0333*		*97.4*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0320*		*"*	*0.0333*		*96.0*	*40-150*			
LCS (BGG0154-BS1)				Prepared & Analyzed: 07/07/23						
Acenaphthene	0.0368	0.00500	mg/kg	0.0333		110	31-137			
Anthracene	0.0374	0.00500	"	0.0333		112	30-120			
Benzo (a) anthracene	0.0398	0.00500	"	0.0333		119	30-120			
Benzo (a) pyrene	0.0346	0.00500	"	0.0333		104	30-120			
Benzo (b) fluoranthene	0.0368	0.00500	"	0.0333		111	30-120			
Benzo (k) fluoranthene	0.0353	0.00500	"	0.0333		106	30-120			
Chrysene	0.0373	0.00500	"	0.0333		112	30-120			
Dibenz (a,h) anthracene	0.0360	0.00500	"	0.0333		108	30-120			
Fluoranthene	0.0346	0.00500	"	0.0333		104	30-120			
Fluorene	0.0361	0.00500	"	0.0333		108	30-120			
Indeno (1,2,3-cd) pyrene	0.0308	0.00500	"	0.0333		92.5	30-120			
Pyrene	0.0399	0.00500	"	0.0333		120	35-142			
1-Methylnaphthalene	0.0291	0.00500	"	0.0333		87.2	35-142			
2-Methylnaphthalene	0.0394	0.00500	"	0.0333		118	35-142			
Surrogate: 2-Methylnaphthalene-d10	*0.0306*		*"*	*0.0333*		*91.9*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0369*		*"*	*0.0333*		*111*	*40-150*			

PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0154 - EPA 5030 Soil MS										
Matrix Spike (BGG0154-MS1)		**Source: 2307053-01**		Prepared & Analyzed: 07/07/23						
Acenaphthene	0.0241	0.00500	mg/kg	0.0333	ND	72.4	31-137			
Anthracene	0.0243	0.00500	"	0.0333	ND	73.0	30-120			
Benzo (a) anthracene	0.0225	0.00500	"	0.0333	ND	67.5	30-120			
Benzo (a) pyrene	0.0202	0.00500	"	0.0333	ND	60.5	30-120			
Benzo (b) fluoranthene	0.0215	0.00500	"	0.0333	ND	64.5	30-120			
Benzo (k) fluoranthene	0.0214	0.00500	"	0.0333	ND	64.2	30-120			
Chrysene	0.0228	0.00500	"	0.0333	ND	68.5	30-120			
Dibenz (a,h) anthracene	0.0202	0.00500	"	0.0333	ND	60.7	30-120			
Fluoranthene	0.0230	0.00500	"	0.0333	ND	69.1	30-120			
Fluorene	0.0235	0.00500	"	0.0333	ND	70.4	30-120			
Indeno (1,2,3-cd) pyrene	0.0179	0.00500	"	0.0333	ND	53.8	30-120			
Pyrene	0.0249	0.00500	"	0.0333	ND	74.6	35-142			
1-Methylnaphthalene	0.0179	0.00500	"	0.0333	ND	53.8	15-130			
2-Methylnaphthalene	0.0255	0.00500	"	0.0333	ND	76.4	15-130			
Surrogate: 2-Methylnaphthalene-d10	*0.0203*		*"*	*0.0333*		*60.8*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0268*		*"*	*0.0333*		*80.5*	*40-150*			
Matrix Spike Dup (BGG0154-MSD1)		**Source: 2307053-01**		Prepared & Analyzed: 07/07/23						
Acenaphthene	0.0254	0.00500	mg/kg	0.0333	ND	76.3	31-137	5.22	30	
Anthracene	0.0265	0.00500	"	0.0333	ND	79.6	30-120	8.67	30	
Benzo (a) anthracene	0.0270	0.00500	"	0.0333	ND	81.0	30-120	18.1	30	
Benzo (a) pyrene	0.0248	0.00500	"	0.0333	ND	74.5	30-120	20.7	30	
Benzo (b) fluoranthene	0.0250	0.00500	"	0.0333	ND	75.1	30-120	15.2	30	
Benzo (k) fluoranthene	0.0246	0.00500	"	0.0333	ND	73.7	30-120	13.7	30	
Chrysene	0.0263	0.00500	"	0.0333	ND	79.0	30-120	14.3	30	
Dibenz (a,h) anthracene	0.0235	0.00500	"	0.0333	ND	70.5	30-120	15.0	30	
Fluoranthene	0.0253	0.00500	"	0.0333	ND	75.9	30-120	9.44	30	
Fluorene	0.0253	0.00500	"	0.0333	ND	75.9	30-120	7.44	30	
Indeno (1,2,3-cd) pyrene	0.0205	0.00500	"	0.0333	ND	61.4	30-120	13.2	30	
Pyrene	0.0287	0.00500	"	0.0333	ND	86.2	35-142	14.4	30	
1-Methylnaphthalene	0.0216	0.00500	"	0.0333	ND	64.7	15-130	18.4	50	
2-Methylnaphthalene	0.0281	0.00500	"	0.0333	ND	84.4	15-130	9.95	50	
Surrogate: 2-Methylnaphthalene-d10	*0.0253*		*"*	*0.0333*		*76.0*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0295*		*"*	*0.0333*		*88.4*	*40-150*			



Total Metals by EPA 6020B Hot Water Soluble Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0283 - EPA 3050B										
Blank (BGG0283-BLK1)				Prepared: 07/11/23 Analyzed: 07/13/23						
Boron	ND	0.0100	mg/L							
LCS (BGG0283-BS1)				Prepared: 07/11/23 Analyzed: 07/13/23						
Boron	5.67	0.0100	mg/L	5.00		113	80-120			
Duplicate (BGG0283-DUP1)		**Source: 2307065-01**		Prepared: 07/11/23 Analyzed: 07/13/23						
Boron	0.245	0.0100	mg/L		0.275			11.4	20	
Matrix Spike (BGG0283-MS1)		**Source: 2307065-01**		Prepared: 07/11/23 Analyzed: 07/13/23						
Boron	5.72	0.0100	mg/L	5.00	0.275	109	75-125			
Matrix Spike Dup (BGG0283-MSD1)		**Source: 2307065-01**		Prepared: 07/11/23 Analyzed: 07/13/23						
Boron	5.86	0.0100	mg/L	5.00	0.275	112	75-125	2.45	25	

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Batch BGG0253 - EPA 3050B

Blank (BGG0253-BLK1) Prepared: 07/10/23 Analyzed: 07/12/23

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	ND	0.200	mg/kg wet							
Barium	ND	0.400	"							
Cadmium	ND	0.200	"							
Copper	ND	0.400	"							
Lead	ND	0.200	"							
Nickel	ND	0.400	"							
Selenium	ND	0.260	"							
Silver	ND	0.0200	"							
Zinc	ND	0.400	"							

LCS (BGG0253-BS1) Prepared: 07/10/23 Analyzed: 07/12/23

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	43.8	0.200	mg/kg wet	40.0		109	80-120			
Barium	46.8	0.400	"	40.0		117	80-120			
Cadmium	2.20	0.200	"	2.00		110	80-120			
Copper	46.1	0.400	"	40.0		115	80-120			
Lead	22.1	0.200	"	20.0		111	80-120			
Nickel	44.3	0.400	"	40.0		111	80-120			
Selenium	4.36	0.260	"	4.00		109	80-120			
Silver	2.10	0.0200	"	2.00		105	80-120			
Zinc	43.9	0.400	"	40.0		110	80-120			

Duplicate (BGG0253-DUP1) **Source: 2306074-01** Prepared: 07/10/23 Analyzed: 07/12/23

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	1.32	0.233	mg/kg dry		1.54			15.8	20	
Barium	106	0.467	"		150			34.5	20	QR-04
Cadmium	0.100	0.233	"		0.137			31.0	20	QR-01
Copper	3.27	0.467	"		3.66			11.4	20	
Lead	6.16	0.233	"		7.56			20.4	20	QR-04
Nickel	2.62	0.467	"		3.14			18.0	20	
Selenium	ND	0.303	"		ND				20	
Silver	0.0135	0.0233	"		0.0163			18.8	20	
Zinc	23.3	0.467	"		35.8			42.4	20	QR-04

Quandary Consultants
4480 Grfeld St
Denver CO, 80237

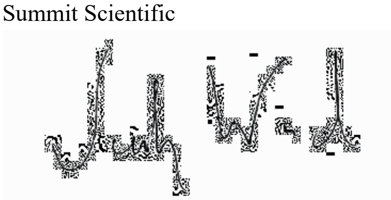
Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
07/18/23 09:26

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0253 - EPA 3050B										
Matrix Spike (BGG0253-MS1)	**Source: 2306074-01**			Prepared: 07/10/23 Analyzed: 07/12/23						
Arsenic	48.8	0.233	mg/kg dry	46.7	1.54	101	75-125			
Barium	262	0.467	"	46.7	150	241	75-125			QM-07
Cadmium	2.60	0.233	"	2.33	0.137	106	75-125			
Copper	43.7	0.467	"	46.7	3.66	85.8	75-125			
Lead	31.3	0.233	"	23.3	7.56	102	75-125			
Nickel	42.0	0.467	"	46.7	3.14	83.3	75-125			
Selenium	5.48	0.303	"	4.67	ND	117	75-125			
Silver	2.31	0.0233	"	2.33	0.0163	98.2	75-125			
Zinc	63.2	0.467	"	46.7	35.8	58.6	75-125			QM-07
Matrix Spike Dup (BGG0253-MSD1)	**Source: 2306074-01**			Prepared: 07/10/23 Analyzed: 07/12/23						
Arsenic	51.2	0.233	mg/kg dry	46.7	1.54	106	75-125	4.64	25	
Barium	259	0.467	"	46.7	150	234	75-125	1.23	25	QM-07
Cadmium	2.62	0.233	"	2.33	0.137	106	75-125	0.733	25	
Copper	46.5	0.467	"	46.7	3.66	91.8	75-125	6.22	25	
Lead	31.4	0.233	"	23.3	7.56	102	75-125	0.350	25	
Nickel	44.6	0.467	"	46.7	3.14	89.0	75-125	6.10	25	
Selenium	5.85	0.303	"	4.67	ND	125	75-125	6.66	25	
Silver	2.37	0.0233	"	2.33	0.0163	101	75-125	2.62	25	
Zinc	74.1	0.467	"	46.7	35.8	82.1	75-125	15.9	25	



Quandary Consultants
4480 Grfeld St
Denver CO, 80237

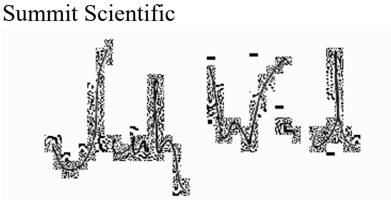
Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
07/18/23 09:26

Hexavalent Chromium by EPA Method 7196 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0213 - 3060A_Mod										
Blank (BGG0213-BLK1)				Prepared & Analyzed: 07/10/23						
Chromium, Hexavalent	ND	0.30	mg/kg wet							
LCS (BGG0213-BS1)				Prepared & Analyzed: 07/10/23						
Chromium, Hexavalent	23.2	0.30	mg/kg wet	25.0		92.8	80-120			
Duplicate (BGG0213-DUP1)	**Source: 2306426-02**			Prepared & Analyzed: 07/10/23						
Chromium, Hexavalent	ND	0.30	mg/kg dry		ND				20	
Matrix Spike (BGG0213-MS1)	**Source: 2306426-02**			Prepared & Analyzed: 07/10/23						
Chromium, Hexavalent	28.5	0.30	mg/kg dry	29.6	ND	96.2	75-125			
Matrix Spike Dup (BGG0213-MSD1)	**Source: 2306426-02**			Prepared & Analyzed: 07/10/23						
Chromium, Hexavalent	28.5	0.30	mg/kg dry	29.6	ND	96.2	75-125	0.00	20	



Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0276 - General Preparation										
Blank (BGG0276-BLK1)				Prepared: 07/11/23 Analyzed: 07/13/23						
Calcium	ND	0.0500	mg/L wet							
Magnesium	ND	0.0500	"							
Sodium	ND	0.0500	"							
LCS (BGG0276-BS1)				Prepared: 07/11/23 Analyzed: 07/13/23						
Calcium	5.76	0.0500	mg/L wet	5.00		115	70-130			
Magnesium	5.60	0.0500	"	5.00		112	70-130			
Sodium	5.61	0.0500	"	5.00		112	70-130			

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control

Summit Scientific

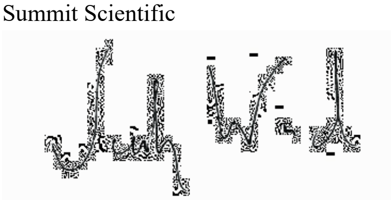
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0217 - General Preparation										
Duplicate (BGG0217-DUP1)	**Source: 2305288-23**			Prepared & Analyzed: 07/10/23						
% Solids	87.7		%		89.3			1.85	20	

Quandary Consultants 4480 Grfeld St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 07/18/23 09:26

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0327 - General Preparation										
Blank (BGG0327-BLK1)				Prepared: 07/12/23 Analyzed: 07/13/23						
Specific Conductance (EC)	ND	0.0100	mmhos/cm							
LCS (BGG0327-BS1)				Prepared: 07/12/23 Analyzed: 07/13/23						
Specific Conductance (EC)	0.158	0.0100	mmhos/cm	0.150		105	95-105			
Duplicate (BGG0327-DUP1)		**Source: 2307052-01**		Prepared: 07/12/23 Analyzed: 07/13/23						
Specific Conductance (EC)	0.413	0.0100	mmhos/cm		0.421			1.89	20	



Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0328 - General Preparation										
LCS (BGG0328-BS1)				Prepared: 07/12/23 Analyzed: 07/13/23						
pH	9.10		pH Units	9.18		99.1	95-105			
Duplicate (BGG0328-DUP1)	**Source: 2307052-01**			Prepared: 07/12/23 Analyzed: 07/13/23						
pH	7.65		pH Units		7.19			6.20	20	

Notes and Definitions

S-02	The surrogate recovery for this sample cannot be accurately quantified due to interference from coeluting organic compounds present in the sample extract.
QR-04	The RPD value for the sample duplicate or MS/MSD was outside of QC acceptance. QC batch accepted based on LCS and/or LCSD recovery and/or RPD values.
QR-01	Analyses are not controlled on RPD values from sample concentrations less than 10 times the reporting limit. QC batch accepted based on LCS and/or LCSD QC results.
QM-07	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS/LCSD recovery.
E	The concentration indicated for this analyte is an estimated value above the calibration range of the instrument.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Summit Scientific

4653 Table Mountain Drive, Golden, Colorado 80401

303.277.9310

August 03, 2023

Mike Dinkel

Civitas Resources

650 Southgate Drive

Windsor, CO 80550

RE: Miller 4-17J, 14-17

Work Order # 2307344

Enclosed are the results of analyses for samples received by Summit Scientific on 07/19/23 11:39. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jacob Wood For Paul Shrewsbury

President

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
B03@24'	2307344-01	Soil	07/19/23 09:30	07/19/23 11:39
B04@24'	2307344-02	Soil	07/19/23 09:42	07/19/23 11:39
B05@24'	2307344-03	Soil	07/19/23 09:58	07/19/23 11:39
B06@24'	2307344-04	Soil	07/19/23 10:08	07/19/23 11:39

Case Narrative

Michael Dinkel took B05@24' & B06@24' off of hold on 7/24/2023.

SUMMIT SCIENTIFIC

4653 Table Mountain Drive
Golden, CO 80403
303-277-9310

Lab ID	Page 1 of 1
2307344	

	Send Data To:	**Send Invoice To:**	
Client: Civitas	Project Manager: Mike Dinkel	Company: Civitas	
Address: 650 Southgate	E-Mail: mdinkel	Project Name/Location: Miller 4-17J, 14-17	
City/State/Zip: Windsor		AFE#:	
Phone: 785-691-7788	Project Name: Miller 4-17J, 14-17	PO/Billing Codes:	
Sampler Name: Mike Dinkel	Project Number:	Contact: Jacob Evans	

ID	Sample Description	Date Sampled	Time Sampled	# of containers	Preservative: HCl	HNO3	None	Other	Matrix: Water	Soil	Air-Canister #	Other	Analysis Requested: Table 915-1								Special Instructions
1	B03 @ 24'	7-19-23	0930	2						X			X								
2	B04 @ 24'	↓	0942	↓						↓			X								
3	B05 @ 24'		0958										X								HOLD
4	B06 @ 24'		1008										X								HOLD
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					

Relinquished by:	Date/Time:	Received by:	Date/Time:	TAT Business Days				Notes:
[signature]	7-19-23/1135	Josh Ward	7/19/23 11:39	Same Day		Field DO		Same day organics
Relinquished by:	Date/Time:	Received by:	Date/Time:	1 Day		Field EC		
				2 Days	X	Field ORP		
Relinquished by:	Date/Time:	Received by:	Date/Time:	3 Days		Field pH		
				Standard		Field Temp.		
						Field Turb.		

Temperature Upon Receipt: 9.1 | Corrected Temperature: | IR gun #: 2 | HNO3 lot #:

S2

Sample Receipt Checklist

S2 Work Order# 2307344

Client: Civitas Client Project ID: Miller 4-17S, 14-17

Shipped Via: H.D./P.U./FedEx/UPS/USPS/Other [ ] Airbill #:

[X] [ ] [ ] [ ] [ ]

Matrix (Check all that apply) Air [ ] Soil/Solid [X] Water [ ] Other [ ]

Temp (°C) 9.1 Thermometer # 2

	Yes	No	N/A	Comments (if any)
If samples require cooling, is the temperature < 6°C? (1) **NOTE:** If samples are delivered the same day of sampling, this requirement is met if there is evidence that cooling has begun.	X			on ice
If custody seals are present, are they intact? (1)			X	
Are samples due within 48 hours present?	X			48 hours + Same day
Are water samples with short hold times present? Note the short hold analysis in the comments column - pH, Nitrate/Nitrite, Ferrous Iron (Fe^{2+}), Hexavalent Chromium (Cr^{6+}, Cr VI), COD/BOD, Total Coliform, E. Coli, Total Residual Chlorine (TRC), Dissolved Oxygen			X	
Is a chain-of-custody (COC) form present and filled out Completely? (1)	X			
Is the COC properly relinquished by the client w/ date and time recorded? (1)	X			
Were all samples received intact? (1)	X			
Was adequate sample volume provided? (1)	X			
Does the COC agree with the number and type of sample bottles received? (1)	X			
Do the sample IDs on the bottle labels match the COC? (1)	X			
For volatiles in water – is there headspace present? **If yes, contact client and note in narrative.**			X	
Are samples preserved that require preservation **(excluding cooling)?** (1) Note the type of preservative in the comments column – HCl, H_2SO_4, NaOH, HNO_3, etc.			X	
If samples are acid preserved for metals, is the pH ≤ 2? (1) Record the pH in Comments.			X	
If dissolved metals are requested, were samples field filtered?			X	

Additional Comments (if any):

(1) **If NO, then contact the client before proceeding with analysis and note in case narrative.**

Vah Ward
Custodian Printed Name

7/19/23 11:39
Date/Time

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B03@24'

2307344-01 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0598	07/19/23	07/19/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*88.0 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*88.6 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*109 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

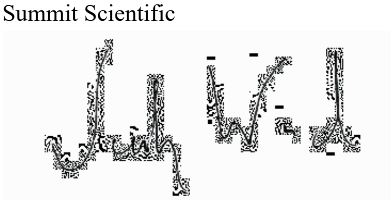
Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0599	07/19/23	07/19/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*89.8 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B03@24'

2307344-01 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0643	07/20/23	07/22/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*53.1 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*55.8 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.296**	0.0100		mg/L	1	BGG0627	07/20/23	07/22/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/03/23 08:25

B03@24'
2307344-01 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.763**	0.239		mg/kg dry	1	BGG0601	07/20/23	07/20/23	EPA 6020B	
Barium	**86.6**	0.478		"	"	"	"	"	"	
Cadmium	**1.04**	0.239		"	"	"	"	"	"	
Copper	**4.33**	0.478		"	"	"	"	"	"	
Lead	**13.3**	0.239		"	"	"	"	"	"	
Nickel	**3.36**	0.478		"	"	"	"	"	"	
Selenium	ND	0.311	0.209	"	"	"	"	"	"	
Silver	**0.0492**	0.0239		"	"	"	"	"	"	
Zinc	**15.1**	0.478		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0603	07/20/23	07/20/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/19/23 09:30**

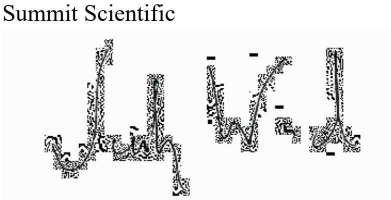
Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**37.5**	0.0598		mg/L dry	1	BGG0623	07/20/23	07/22/23	EPA 6020B	
Magnesium	**46.0**	0.0598		"	"	"	"	"	"	
Sodium	**212**	0.0598		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**5.48**	0.00100		units	1	BGG0744	07/24/23	07/24/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B03@24'

2307344-01 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**83.7**			%	1	BGG0605	07/20/23	07/20/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**1.48**	0.0100		mmhos/cm	1	BGG0663	07/21/23	07/21/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/19/23 09:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.87**			pH Units	1	BGG0662	07/21/23	07/21/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B04@24'

2307344-02 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0598	07/19/23	07/19/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*87.3 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*89.3 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*103 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0599	07/19/23	07/19/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*86.9 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B04@24'

2307344-02 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0643	07/20/23	07/22/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*54.6 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*58.1 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.414**	0.0100		mg/L	1	BGG0627	07/20/23	07/22/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B04@24'

2307344-02 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**0.739**	0.234		mg/kg dry	1	BGG0601	07/20/23	07/20/23	EPA 6020B	
Barium	**18.3**	0.468		"	"	"	"	"	"	
Cadmium	**0.469**	0.234		"	"	"	"	"	"	
Copper	**4.99**	0.468		"	"	"	"	"	"	
Lead	**12.5**	0.234		"	"	"	"	"	"	
Nickel	**2.98**	0.468		"	"	"	"	"	"	
Selenium	ND	0.304	0.205	"	"	"	"	"	"	
Silver	**0.0561**	0.0234		"	"	"	"	"	"	
Zinc	**19.2**	0.468		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0603	07/20/23	07/20/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/19/23 09:42**

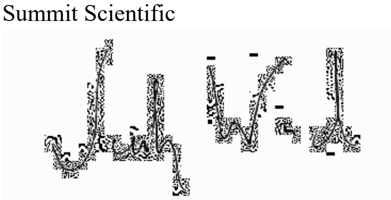
Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**49.6**	0.0585		mg/L dry	1	BGG0623	07/20/23	07/22/23	EPA 6020B	
Magnesium	**65.1**	0.0585		"	"	"	"	"	"	
Sodium	**206**	0.0585		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**4.53**	0.00100		units	1	BGG0744	07/24/23	07/24/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B04@24'

2307344-02 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**85.5**			%	1	BGG0605	07/20/23	07/20/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**2.14**	0.0100		mmhos/cm	1	BGG0663	07/21/23	07/21/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/19/23 09:42**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.52**			pH Units	1	BGG0662	07/21/23	07/21/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B05@24'

2307344-03 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0853	07/26/23	07/26/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*80.4 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*98.6 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*96.7 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

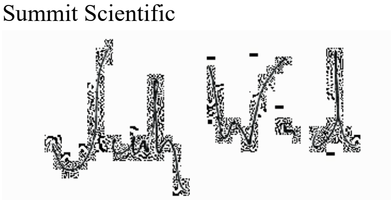
Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0856	07/26/23	07/26/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*90.7 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM



B05@24'

2307344-03 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0833	07/26/23	07/27/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*48.6 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*43.3 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.293**	0.0100		mg/L	1	BGG0916	07/27/23	08/01/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B05@24'

2307344-03 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**1.20**	0.231		mg/kg dry	1	BGG0890	07/27/23	07/28/23	EPA 6020B	
Barium	**50.4**	0.461		"	"	"	"	"	"	
Cadmium	**1.03**	0.231		"	"	"	"	"	"	
Copper	**4.25**	0.461		"	"	"	"	"	"	
Lead	**11.5**	0.231		"	"	"	"	"	"	
Nickel	**3.14**	0.461		"	"	"	"	"	"	
Selenium	ND	0.300	0.202	"	"	"	"	"	"	
Silver	**0.0720**	0.0231		"	"	"	"	"	"	
Zinc	**17.9**	0.461		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0893	07/27/23	07/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**96.4**	0.0577		mg/L dry	1	BGG0911	07/27/23	07/31/23	EPA 6020B	
Magnesium	**50.1**	0.0577		"	"	"	"	"	"	
Sodium	**248**	0.0577		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**5.10**	0.00100		units	1	BGH0027	08/01/23	08/01/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B05@24'

2307344-03 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**86.7**			%	1	BGG0910	07/27/23	07/27/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**2.54**	0.0100		mmhos/cm	1	BGG0963	07/28/23	07/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/19/23 09:58**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.61**			pH Units	1	BGG0962	07/28/23	07/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B06@24'

2307344-04 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0853	07/26/23	07/26/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	**0.026**	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	**0.016**	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**0.75**	0.50		"	"	"	"	"	"	

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*74.9 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*97.6 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*99.3 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

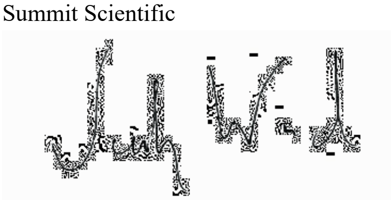
Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**63**	50		mg/kg	1	BGG0856	07/26/23	07/26/23	EPA 8015M	
C28-C36 (ORO)	**53**	50		"	"	"	"	"	"	

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*84.6 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B06@24'

2307344-04 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0833	07/26/23	07/27/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*70.8 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*101 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.323**	0.0100		mg/L	1	BGG0916	07/27/23	08/01/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	Reported: 08/03/23 08:25

B06@24'

2307344-04 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**1.45**	0.231		mg/kg dry	1	BGG0890	07/27/23	07/28/23	EPA 6020B	
Barium	**53.6**	0.463		"	"	"	"	"	"	
Cadmium	**1.33**	0.231		"	"	"	"	"	"	
Copper	**4.75**	0.463		"	"	"	"	"	"	
Lead	**15.6**	0.231		"	"	"	"	"	"	
Nickel	**3.85**	0.463		"	"	"	"	"	"	
Selenium	ND	0.301	0.202	"	"	"	"	"	"	
Silver	**0.0856**	0.0231		"	"	"	"	"	"	
Zinc	**16.3**	0.463		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0893	07/27/23	07/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/19/23 10:08**

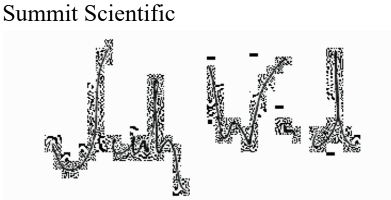
Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**106**	0.0578		mg/L dry	1	BGG0911	07/27/23	08/01/23	EPA 6020B	
Magnesium	**65.0**	0.0578		"	"	"	"	"	"	
Sodium	**186**	0.0578		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**3.51**	0.00100		units	1	BGH0027	08/01/23	08/01/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

B06@24'

2307344-04 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**86.4**			%	1	BGG0910	07/27/23	07/27/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

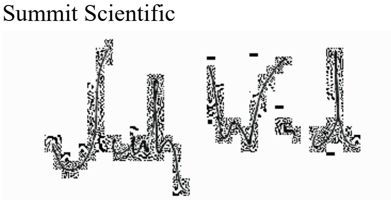
Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**2.32**	0.0100		mmhos/cm	1	BGG0963	07/28/23	07/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/19/23 10:08**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.67**			pH Units	1	BGG0962	07/28/23	07/28/23	EPA 9045D	



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

Volatile Organic Compounds by EPA Method 8260B - Quality Control
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0598 - EPA 5030 Soil MS										
Blank (BGG0598-BLK1)				Prepared & Analyzed: 07/19/23						
Benzene	ND	0.0020	mg/kg							
Toluene	ND	0.0050	"							
Ethylbenzene	ND	0.0050	"							
Xylenes (total)	ND	0.010	"							
1,2,4-Trimethylbenzene	ND	0.0050	"							
1,3,5-Trimethylbenzene	ND	0.0050	"							
Naphthalene	ND	0.0038	"							
Gasoline Range Hydrocarbons	ND	0.50	"							
Surrogate: 1,2-Dichloroethane-d4	*0.0338*		*"*	*0.0400*		*84.4*	*50-150*			
Surrogate: Toluene-d8	*0.0360*		*"*	*0.0400*		*90.0*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0406*		*"*	*0.0400*		*101*	*50-150*			
LCS (BGG0598-BS1)				Prepared & Analyzed: 07/19/23						
Benzene	0.0798	0.0020	mg/kg	0.100		79.8	70-130			
Toluene	0.0827	0.0050	"	0.100		82.7	70-130			
Ethylbenzene	0.0941	0.0050	"	0.100		94.1	70-130			
m,p-Xylene	0.186	0.010	"	0.200		93.0	70-130			
o-Xylene	0.0881	0.0050	"	0.100		88.1	70-130			
1,2,4-Trimethylbenzene	0.100	0.0050	"	0.100		100	70-130			
1,3,5-Trimethylbenzene	0.0958	0.0050	"	0.100		95.8	70-130			
Naphthalene	0.0934	0.0038	"	0.100		93.4	70-130			
Surrogate: 1,2-Dichloroethane-d4	*0.0293*		*"*	*0.0400*		*73.2*	*50-150*			
Surrogate: Toluene-d8	*0.0367*		*"*	*0.0400*		*91.6*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0405*		*"*	*0.0400*		*101*	*50-150*			
Matrix Spike (BGG0598-MS1)	**Source: 2307344-01**			Prepared & Analyzed: 07/19/23						
Benzene	0.0724	0.0020	mg/kg	0.100	ND	72.4	70-130			
Toluene	0.0729	0.0050	"	0.100	ND	72.9	70-130			
Ethylbenzene	0.0803	0.0050	"	0.100	ND	80.3	70-130			
m,p-Xylene	0.160	0.010	"	0.200	ND	79.9	70-130			
o-Xylene	0.0765	0.0050	"	0.100	ND	76.5	70-130			
1,2,4-Trimethylbenzene	0.0849	0.0050	"	0.100	ND	84.9	70-130			
1,3,5-Trimethylbenzene	0.0806	0.0050	"	0.100	ND	80.6	70-130			
Naphthalene	0.0620	0.0038	"	0.100	ND	62.0	70-130			QM-07
Surrogate: 1,2-Dichloroethane-d4	*0.0333*		*"*	*0.0400*		*83.2*	*50-150*			
Surrogate: Toluene-d8	*0.0356*		*"*	*0.0400*		*89.0*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0422*		*"*	*0.0400*		*105*	*50-150*			

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

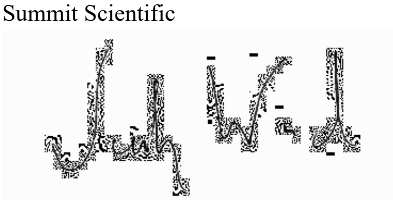
Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/03/23 08:25

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0598 - EPA 5030 Soil MS										
Matrix Spike Dup (BGG0598-MSD1)		**Source: 2307344-01**		Prepared & Analyzed: 07/19/23						
Benzene	0.0702	0.0020	mg/kg	0.100	ND	70.2	70-130	3.11	30	
Toluene	0.0711	0.0050	"	0.100	ND	71.1	70-130	2.50	30	
Ethylbenzene	0.0789	0.0050	"	0.100	ND	78.9	70-130	1.77	30	
m,p-Xylene	0.156	0.010	"	0.200	ND	78.1	70-130	2.26	30	
o-Xylene	0.0749	0.0050	"	0.100	ND	74.9	70-130	2.10	30	
1,2,4-Trimethylbenzene	0.0840	0.0050	"	0.100	ND	84.0	70-130	1.14	30	
1,3,5-Trimethylbenzene	0.0770	0.0050	"	0.100	ND	77.0	70-130	4.57	30	
Naphthalene	0.0630	0.0038	"	0.100	ND	63.0	70-130	1.54	30	QM-07
Surrogate: 1,2-Dichloroethane-d4	*0.0311*		*"*	*0.0400*		*77.8*	*50-150*			
Surrogate: Toluene-d8	*0.0354*		*"*	*0.0400*		*88.4*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0425*		*"*	*0.0400*		*106*	*50-150*			
Batch BGG0853 - EPA 5030 Soil MS										
Blank (BGG0853-BLK1)				Prepared & Analyzed: 07/26/23						
Benzene	ND	0.0020	mg/kg							
Toluene	ND	0.0050	"							
Ethylbenzene	ND	0.0050	"							
Xylenes (total)	ND	0.010	"							
1,2,4-Trimethylbenzene	ND	0.0050	"							
1,3,5-Trimethylbenzene	ND	0.0050	"							
Naphthalene	ND	0.0038	"							
Gasoline Range Hydrocarbons	ND	0.50	"							
Surrogate: 1,2-Dichloroethane-d4	*0.0296*		*"*	*0.0400*		*74.1*	*50-150*			
Surrogate: Toluene-d8	*0.0387*		*"*	*0.0400*		*96.8*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0362*		*"*	*0.0400*		*90.6*	*50-150*			



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	Reported: 08/03/23 08:25

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0853 - EPA 5030 Soil MS										
LCS (BGG0853-BS1)				Prepared & Analyzed: 07/26/23						
Benzene	0.140	0.0020	mg/kg	0.125		112	70-130			
Toluene	0.126	0.0050	"	0.125		101	70-130			
Ethylbenzene	0.121	0.0050	"	0.125		96.6	70-130			
m,p-Xylene	0.314	0.010	"	0.250		125	70-130			
o-Xylene	0.122	0.0050	"	0.125		97.9	70-130			
1,2,4-Trimethylbenzene	0.148	0.0050	"	0.125		118	70-130			
1,3,5-Trimethylbenzene	0.136	0.0050	"	0.125		109	70-130			
Naphthalene	0.128	0.0038	"	0.125		103	70-130			
Surrogate: 1,2-Dichloroethane-d4	*0.0281*		*"*	*0.0400*		*70.4*	*50-150*			
Surrogate: Toluene-d8	*0.0382*		*"*	*0.0400*		*95.6*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0346*		*"*	*0.0400*		*86.6*	*50-150*			
Matrix Spike (BGG0853-MS1)		**Source: 2307344-03**		Prepared & Analyzed: 07/26/23						
Benzene	0.162	0.0020	mg/kg	0.125	ND	130	70-130			
Toluene	0.132	0.0050	"	0.125	ND	106	70-130			
Ethylbenzene	0.143	0.0050	"	0.125	ND	115	70-130			
m,p-Xylene	0.307	0.010	"	0.250	ND	123	70-130			
o-Xylene	0.139	0.0050	"	0.125	ND	111	70-130			
1,2,4-Trimethylbenzene	0.135	0.0050	"	0.125	ND	108	70-130			
1,3,5-Trimethylbenzene	0.117	0.0050	"	0.125	ND	93.8	70-130			
Naphthalene	0.122	0.0038	"	0.125	ND	97.6	70-130			
Surrogate: 1,2-Dichloroethane-d4	*0.0263*		*"*	*0.0400*		*65.7*	*50-150*			
Surrogate: Toluene-d8	*0.0388*		*"*	*0.0400*		*97.1*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0386*		*"*	*0.0400*		*96.4*	*50-150*			
Matrix Spike Dup (BGG0853-MSD1)		**Source: 2307344-03**		Prepared & Analyzed: 07/26/23						
Benzene	0.143	0.0020	mg/kg	0.125	ND	114	70-130	12.5	30	
Toluene	0.145	0.0050	"	0.125	ND	116	70-130	9.04	30	
Ethylbenzene	0.126	0.0050	"	0.125	ND	101	70-130	13.0	30	
m,p-Xylene	0.303	0.010	"	0.250	ND	121	70-130	1.53	30	
o-Xylene	0.142	0.0050	"	0.125	ND	114	70-130	2.58	30	
1,2,4-Trimethylbenzene	0.150	0.0050	"	0.125	ND	120	70-130	10.3	30	
1,3,5-Trimethylbenzene	0.148	0.0050	"	0.125	ND	118	70-130	23.2	30	
Naphthalene	0.142	0.0038	"	0.125	ND	114	70-130	15.2	30	
Surrogate: 1,2-Dichloroethane-d4	*0.0273*		*"*	*0.0400*		*68.2*	*50-150*			
Surrogate: Toluene-d8	*0.0382*		*"*	*0.0400*		*95.6*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0362*		*"*	*0.0400*		*90.6*	*50-150*			

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

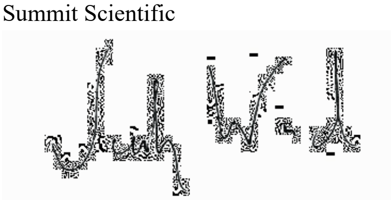
Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/03/23 08:25

Extractable Petroleum Hydrocarbons by 8015 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0599 - EPA 3550A										
Blank (BGG0599-BLK1)				Prepared & Analyzed: 07/19/23						
C10-C28 (DRO)	ND	50	mg/kg							
C28-C36 (ORO)	ND	50	"							
Surrogate: o-Terphenyl	*11.2*		*"*	*12.5*		*89.8*	*30-150*			
LCS (BGG0599-BS1)				Prepared & Analyzed: 07/19/23						
C10-C28 (DRO)	723	50	mg/kg	500		145	70-130			QR-02
Surrogate: o-Terphenyl	*15.4*		*"*	*12.5*		*123*	*30-150*			
Matrix Spike (BGG0599-MS1)	**Source: 2307344-01**			Prepared: 07/19/23 Analyzed: 07/20/23						
C10-C28 (DRO)	494	50	mg/kg	500	28.4	93.2	70-130			
Surrogate: o-Terphenyl	*11.2*		*"*	*12.5*		*89.3*	*30-150*			
Matrix Spike Dup (BGG0599-MSD1)	**Source: 2307344-01**			Prepared: 07/19/23 Analyzed: 07/20/23						
C10-C28 (DRO)	607	50	mg/kg	500	28.4	116	70-130	20.5	20	QR-02
Surrogate: o-Terphenyl	*11.7*		*"*	*12.5*		*93.8*	*30-150*			
Batch BGG0856 - EPA 3550A										
Blank (BGG0856-BLK1)				Prepared & Analyzed: 07/26/23						
C10-C28 (DRO)	ND	50	mg/kg							
C28-C36 (ORO)	ND	50	"							
Surrogate: o-Terphenyl	*11.5*		*"*	*12.5*		*91.6*	*30-150*			
LCS (BGG0856-BS1)				Prepared & Analyzed: 07/26/23						
C10-C28 (DRO)	444	50	mg/kg	500		88.8	70-130			
Surrogate: o-Terphenyl	*11.6*		*"*	*12.5*		*92.5*	*30-150*			



Extractable Petroleum Hydrocarbons by 8015 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0856 - EPA 3550A										
Matrix Spike (BGG0856-MS1)	**Source: 2307344-03**			Prepared & Analyzed: 07/26/23						
C10-C28 (DRO)	419	50	mg/kg	500	5.89	82.7	70-130			
Surrogate: o-Terphenyl	*10.7*		"	*12.5*		*85.8*	*30-150*			
Matrix Spike Dup (BGG0856-MSD1)	**Source: 2307344-03**			Prepared & Analyzed: 07/26/23						
C10-C28 (DRO)	480	50	mg/kg	500	5.89	94.8	70-130	13.5	20	
Surrogate: o-Terphenyl	*11.6*		"	*12.5*		*92.6*	*30-150*			

PAH by EPA Method 8270D SIM - Quality Control

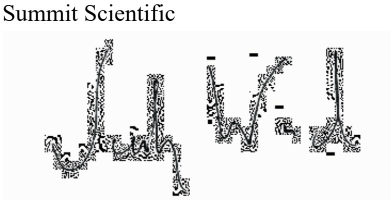
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0643 - EPA 5030 Soil MS										
Blank (BGG0643-BLK1)				Prepared: 07/20/23 Analyzed: 07/22/23						
Acenaphthene	ND	0.00500	mg/kg							
Anthracene	ND	0.00500	"							
Benzo (a) anthracene	ND	0.00500	"							
Benzo (a) pyrene	ND	0.00500	"							
Benzo (b) fluoranthene	ND	0.00500	"							
Benzo (k) fluoranthene	ND	0.00500	"							
Chrysene	ND	0.00500	"							
Dibenz (a,h) anthracene	ND	0.00500	"							
Fluoranthene	ND	0.00500	"							
Fluorene	ND	0.00500	"							
Indeno (1,2,3-cd) pyrene	ND	0.00500	"							
Pyrene	ND	0.00500	"							
1-Methylnaphthalene	ND	0.00500	"							
2-Methylnaphthalene	ND	0.00500	"							
Surrogate: 2-Methylnaphthalene-d10	*0.0194*		*"*	*0.0333*		*58.2*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0237*		*"*	*0.0333*		*71.1*	*40-150*			
LCS (BGG0643-BS1)				Prepared: 07/20/23 Analyzed: 07/22/23						
Acenaphthene	0.0297	0.00500	mg/kg	0.0333		89.2	31-137			
Anthracene	0.0301	0.00500	"	0.0333		90.2	30-120			
Benzo (a) anthracene	0.0198	0.00500	"	0.0333		59.3	30-120			
Benzo (a) pyrene	0.0301	0.00500	"	0.0333		90.2	30-120			
Benzo (b) fluoranthene	0.0318	0.00500	"	0.0333		95.4	30-120			
Benzo (k) fluoranthene	0.0287	0.00500	"	0.0333		86.0	30-120			
Chrysene	0.0304	0.00500	"	0.0333		91.1	30-120			
Dibenz (a,h) anthracene	0.0281	0.00500	"	0.0333		84.2	30-120			
Fluoranthene	0.0271	0.00500	"	0.0333		81.3	30-120			
Fluorene	0.0284	0.00500	"	0.0333		85.1	30-120			
Indeno (1,2,3-cd) pyrene	0.0217	0.00500	"	0.0333		65.0	30-120			
Pyrene	0.0350	0.00500	"	0.0333		105	35-142			
1-Methylnaphthalene	0.0319	0.00500	"	0.0333		95.7	35-142			
2-Methylnaphthalene	0.0234	0.00500	"	0.0333		70.2	35-142			
Surrogate: 2-Methylnaphthalene-d10	*0.0237*		*"*	*0.0333*		*71.1*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0276*		*"*	*0.0333*		*82.9*	*40-150*			

PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0643 - EPA 5030 Soil MS										
Matrix Spike (BGG0643-MS1)		**Source: 2307320-01**		Prepared: 07/20/23 Analyzed: 07/22/23						
Acenaphthene	0.0230	0.00500	mg/kg	0.0333	ND	69.1	31-137			
Anthracene	0.0241	0.00500	"	0.0333	ND	72.4	30-120			
Benzo (a) anthracene	0.0234	0.00500	"	0.0333	ND	70.1	30-120			
Benzo (a) pyrene	0.0236	0.00500	"	0.0333	ND	70.8	30-120			
Benzo (b) fluoranthene	0.0248	0.00500	"	0.0333	ND	74.3	30-120			
Benzo (k) fluoranthene	0.0228	0.00500	"	0.0333	ND	68.4	30-120			
Chrysene	0.0245	0.00500	"	0.0333	ND	73.4	30-120			
Dibenz (a,h) anthracene	0.0234	0.00500	"	0.0333	ND	70.1	30-120			
Fluoranthene	0.0224	0.00500	"	0.0333	ND	67.2	30-120			
Fluorene	0.0233	0.00500	"	0.0333	ND	70.0	30-120			
Indeno (1,2,3-cd) pyrene	0.0185	0.00500	"	0.0333	ND	55.5	30-120			
Pyrene	0.0280	0.00500	"	0.0333	ND	84.0	35-142			
1-Methylnaphthalene	0.0172	0.00500	"	0.0333	ND	51.5	15-130			
2-Methylnaphthalene	0.0222	0.00500	"	0.0333	ND	66.7	15-130			
Surrogate: 2-Methylnaphthalene-d10	*0.0190*		*"*	*0.0333*		*57.0*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0228*		*"*	*0.0333*		*68.3*	*40-150*			
Matrix Spike Dup (BGG0643-MSD1)		**Source: 2307320-01**		Prepared: 07/20/23 Analyzed: 07/22/23						
Acenaphthene	0.0201	0.00500	mg/kg	0.0333	ND	60.4	31-137	13.5	30	
Anthracene	0.0198	0.00500	"	0.0333	ND	59.5	30-120	19.6	30	
Benzo (a) anthracene	0.0205	0.00500	"	0.0333	ND	61.6	30-120	12.9	30	
Benzo (a) pyrene	0.0206	0.00500	"	0.0333	ND	61.7	30-120	13.7	30	
Benzo (b) fluoranthene	0.0211	0.00500	"	0.0333	ND	63.2	30-120	16.1	30	
Benzo (k) fluoranthene	0.0194	0.00500	"	0.0333	ND	58.3	30-120	16.0	30	
Chrysene	0.0209	0.00500	"	0.0333	ND	62.6	30-120	15.9	30	
Dibenz (a,h) anthracene	0.0194	0.00500	"	0.0333	ND	58.2	30-120	18.5	30	
Fluoranthene	0.0179	0.00500	"	0.0333	ND	53.6	30-120	22.5	30	
Fluorene	0.0203	0.00500	"	0.0333	ND	60.9	30-120	13.9	30	
Indeno (1,2,3-cd) pyrene	0.0146	0.00500	"	0.0333	ND	43.9	30-120	23.4	30	
Pyrene	0.0258	0.00500	"	0.0333	ND	77.4	35-142	8.26	30	
1-Methylnaphthalene	0.0106	0.00500	"	0.0333	ND	31.8	15-130	47.5	50	
2-Methylnaphthalene	0.0135	0.00500	"	0.0333	ND	40.4	15-130	49.2	50	
Surrogate: 2-Methylnaphthalene-d10	*0.0135*		*"*	*0.0333*		*40.6*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0176*		*"*	*0.0333*		*52.7*	*40-150*			



PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0833 - EPA 5030 Soil MS										
Blank (BGG0833-BLK1)				Prepared: 07/26/23 Analyzed: 07/27/23						
Acenaphthene	ND	0.00500	mg/kg							
Anthracene	ND	0.00500	"							
Benzo (a) anthracene	ND	0.00500	"							
Benzo (a) pyrene	ND	0.00500	"							
Benzo (b) fluoranthene	ND	0.00500	"							
Benzo (k) fluoranthene	ND	0.00500	"							
Chrysene	ND	0.00500	"							
Dibenz (a,h) anthracene	ND	0.00500	"							
Fluoranthene	ND	0.00500	"							
Fluorene	ND	0.00500	"							
Indeno (1,2,3-cd) pyrene	ND	0.00500	"							
Pyrene	ND	0.00500	"							
1-Methylnaphthalene	ND	0.00500	"							
2-Methylnaphthalene	ND	0.00500	"							
Surrogate: 2-Methylnaphthalene-d10	*0.0239*		*"*	*0.0333*		*71.6*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0161*		*"*	*0.0333*		*48.2*	*40-150*			
LCS (BGG0833-BS1)				Prepared: 07/26/23 Analyzed: 07/27/23						
Acenaphthene	0.0195	0.00500	mg/kg	0.0333		58.6	31-137			
Anthracene	0.0177	0.00500	"	0.0333		53.2	30-120			
Benzo (a) anthracene	0.0171	0.00500	"	0.0333		51.3	30-120			
Benzo (a) pyrene	0.0154	0.00500	"	0.0333		46.3	30-120			
Benzo (b) fluoranthene	0.0156	0.00500	"	0.0333		46.7	30-120			
Benzo (k) fluoranthene	0.0171	0.00500	"	0.0333		51.2	30-120			
Chrysene	0.0186	0.00500	"	0.0333		55.9	30-120			
Dibenz (a,h) anthracene	0.0141	0.00500	"	0.0333		42.3	30-120			
Fluoranthene	0.0164	0.00500	"	0.0333		49.3	30-120			
Fluorene	0.0187	0.00500	"	0.0333		56.2	30-120			
Indeno (1,2,3-cd) pyrene	0.0147	0.00500	"	0.0333		44.2	30-120			
Pyrene	0.0185	0.00500	"	0.0333		55.5	35-142			
1-Methylnaphthalene	0.0169	0.00500	"	0.0333		50.6	35-142			
2-Methylnaphthalene	0.0188	0.00500	"	0.0333		56.5	35-142			
Surrogate: 2-Methylnaphthalene-d10	*0.0190*		*"*	*0.0333*		*57.0*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0142*		*"*	*0.0333*		*42.7*	*40-150*			

PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0833 - EPA 5030 Soil MS										
Matrix Spike (BGG0833-MS1)	**Source: 2307344-03**			Prepared: 07/26/23 Analyzed: 07/27/23						
Acenaphthene	0.0146	0.00500	mg/kg	0.0333	ND	43.8	31-137			
Anthracene	0.0165	0.00500	"	0.0333	ND	49.5	30-120			
Benzo (a) anthracene	0.0169	0.00500	"	0.0333	ND	50.8	30-120			
Benzo (a) pyrene	0.0136	0.00500	"	0.0333	ND	40.7	30-120			
Benzo (b) fluoranthene	0.0150	0.00500	"	0.0333	ND	44.9	30-120			
Benzo (k) fluoranthene	0.0157	0.00500	"	0.0333	ND	47.2	30-120			
Chrysene	0.0134	0.00500	"	0.0333	ND	40.3	30-120			
Dibenz (a,h) anthracene	0.0139	0.00500	"	0.0333	ND	41.6	30-120			
Fluoranthene	0.0140	0.00500	"	0.0333	ND	41.9	30-120			
Fluorene	0.0141	0.00500	"	0.0333	ND	42.3	30-120			
Indeno (1,2,3-cd) pyrene	0.0136	0.00500	"	0.0333	ND	40.7	30-120			
Pyrene	0.0139	0.00500	"	0.0333	ND	41.8	35-142			
1-Methylnaphthalene	0.0183	0.00500	"	0.0333	ND	54.8	15-130			
2-Methylnaphthalene	0.0158	0.00500	"	0.0333	ND	47.4	15-130			
Surrogate: 2-Methylnaphthalene-d10	*0.0139*		*"*	*0.0333*		*41.6*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0137*		*"*	*0.0333*		*41.2*	*40-150*			
Matrix Spike Dup (BGG0833-MSD1)	**Source: 2307344-03**			Prepared: 07/26/23 Analyzed: 07/27/23						
Acenaphthene	0.0168	0.00500	mg/kg	0.0333	ND	50.3	31-137	13.9	30	
Anthracene	0.0154	0.00500	"	0.0333	ND	46.2	30-120	6.90	30	
Benzo (a) anthracene	0.0154	0.00500	"	0.0333	ND	46.1	30-120	9.70	30	
Benzo (a) pyrene	0.0134	0.00500	"	0.0333	ND	40.2	30-120	1.40	30	
Benzo (b) fluoranthene	0.0134	0.00500	"	0.0333	ND	40.3	30-120	10.7	30	
Benzo (k) fluoranthene	0.0145	0.00500	"	0.0333	ND	43.6	30-120	7.81	30	
Chrysene	0.0155	0.00500	"	0.0333	ND	46.6	30-120	14.6	30	
Dibenz (a,h) anthracene	0.0153	0.00500	"	0.0333	ND	45.8	30-120	9.58	30	
Fluoranthene	0.0145	0.00500	"	0.0333	ND	43.5	30-120	3.88	30	
Fluorene	0.0153	0.00500	"	0.0333	ND	46.0	30-120	8.37	30	
Indeno (1,2,3-cd) pyrene	0.0164	0.00500	"	0.0333	ND	49.2	30-120	19.0	30	
Pyrene	0.0164	0.00500	"	0.0333	ND	49.3	35-142	16.5	30	
1-Methylnaphthalene	0.0136	0.00500	"	0.0333	ND	40.9	15-130	28.9	50	
2-Methylnaphthalene	0.0175	0.00500	"	0.0333	ND	52.4	15-130	9.91	50	
Surrogate: 2-Methylnaphthalene-d10	*0.0163*		*"*	*0.0333*		*49.0*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0144*		*"*	*0.0333*		*43.2*	*40-150*			

Total Metals by EPA 6020B Hot Water Soluble Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0627 - EPA 3050B										
Blank (BGG0627-BLK1)				Prepared: 07/20/23 Analyzed: 07/21/23						
Boron	ND	0.0100	mg/L							
LCS (BGG0627-BS1)				Prepared: 07/20/23 Analyzed: 07/21/23						
Boron	5.71	0.0100	mg/L	5.00		114	80-120			
Duplicate (BGG0627-DUP1)		**Source: 2307320-01**		Prepared: 07/20/23 Analyzed: 07/21/23						
Boron	0.440	0.0100	mg/L		0.431			2.14	20	
Matrix Spike (BGG0627-MS1)		**Source: 2307320-01**		Prepared: 07/20/23 Analyzed: 07/21/23						
Boron	7.12	0.0100	mg/L	5.00	0.431	134	75-125			QM-07
Matrix Spike Dup (BGG0627-MSD1)		**Source: 2307320-01**		Prepared: 07/20/23 Analyzed: 07/21/23						
Boron	7.18	0.0100	mg/L	5.00	0.431	135	75-125	0.881	25	QM-07
Batch BGG0916 - EPA 3050B										
Blank (BGG0916-BLK1)				Prepared: 07/27/23 Analyzed: 08/01/23						
Boron	ND	0.0100	mg/L							
LCS (BGG0916-BS1)				Prepared: 07/27/23 Analyzed: 08/01/23						
Boron	5.25	0.0100	mg/L	5.00		105	80-120			
Duplicate (BGG0916-DUP1)		**Source: 2307344-03**		Prepared: 07/27/23 Analyzed: 08/01/23						
Boron	0.321	0.0100	mg/L		0.293			8.96	20	
Matrix Spike (BGG0916-MS1)		**Source: 2307344-03**		Prepared: 07/27/23 Analyzed: 08/01/23						
Boron	5.34	0.0100	mg/L	5.00	0.293	101	75-125			

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	Reported: 08/03/23 08:25

Total Metals by EPA 6020B Hot Water Soluble Extraction - Quality Control

Summit Scientific

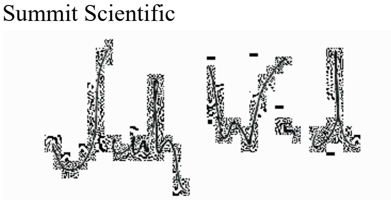
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0916 - EPA 3050B										
Matrix Spike Dup (BGG0916-MSD1)	**Source: 2307344-03**		Prepared: 07/27/23 Analyzed: 08/01/23							
Boron	5.39	0.0100	mg/L	5.00	0.293	102	75-125	0.999	25	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0601 - EPA 3050B										
Blank (BGG0601-BLK1)				Prepared & Analyzed: 07/20/23						
Arsenic	ND	0.200	mg/kg wet							
Barium	ND	0.400	"							
Cadmium	ND	0.200	"							
Copper	ND	0.400	"							
Lead	ND	0.200	"							
Nickel	ND	0.400	"							
Selenium	ND	0.260	"							
Silver	ND	0.0200	"							
Zinc	ND	0.400	"							
LCS (BGG0601-BS1)				Prepared & Analyzed: 07/20/23						
Arsenic	38.3	0.200	mg/kg wet	40.0		95.7	80-120			
Barium	32.2	0.400	"	40.0		80.4	80-120			
Cadmium	1.90	0.200	"	2.00		94.8	80-120			
Copper	38.2	0.400	"	40.0		95.5	80-120			
Lead	16.2	0.200	"	20.0		80.8	80-120			
Nickel	37.5	0.400	"	40.0		93.9	80-120			
Selenium	4.50	0.260	"	4.00		112	80-120			
Silver	1.97	0.0200	"	2.00		98.4	80-120			
Zinc	38.5	0.400	"	40.0		96.2	80-120			
Duplicate (BGG0601-DUP1)	**Source: 2306023-01**			Prepared & Analyzed: 07/20/23						
Arsenic	1.96	0.252	mg/kg dry		1.75			11.0	20	
Barium	111	0.503	"		73.9			40.3	20	QR-04
Cadmium	0.343	0.252	"		0.219			43.9	20	QR-01
Copper	3.02	0.503	"		2.80			7.25	20	
Lead	5.76	0.252	"		4.14			32.8	20	QR-04
Nickel	3.08	0.503	"		2.75			11.4	20	
Selenium	ND	0.327	"		ND				20	
Silver	0.0307	0.0252	"		0.0211			36.9	20	QR-01
Zinc	9.93	0.503	"		8.48			15.7	20	



Civitas Resources
650 Southgate Drive
Windsor CO, 80550

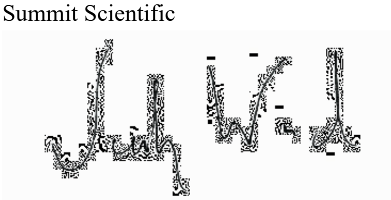
Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported: 08/03/23 08:25

Total Metals by EPA 6020B - Quality Control

Summit Scientific

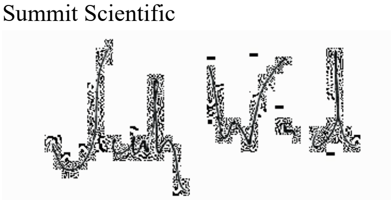
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0601 - EPA 3050B										
Matrix Spike (BGG0601-MS1)		**Source: 2306023-01**		Prepared & Analyzed: 07/20/23						
Arsenic	17.0	0.252	mg/kg dry	50.3	1.75	30.3	75-125			QM-01
Barium	130	0.503	"	50.3	73.9	112	75-125			
Cadmium	1.89	0.252	"	2.52	0.219	66.3	75-125			QM-01
Copper	17.7	0.503	"	50.3	2.80	29.7	75-125			QM-01
Lead	20.4	0.252	"	25.2	4.14	64.7	75-125			QM-01
Nickel	17.9	0.503	"	50.3	2.75	30.2	75-125			QM-01
Selenium	3.68	0.327	"	5.03	ND	73.1	75-125			QM-01
Silver	1.62	0.0252	"	2.52	0.0211	63.7	75-125			QM-01
Zinc	25.1	0.503	"	50.3	8.48	33.0	75-125			QM-01
Matrix Spike Dup (BGG0601-MSD1)		**Source: 2306023-01**		Prepared & Analyzed: 07/20/23						
Arsenic	17.8	0.252	mg/kg dry	50.3	1.75	31.8	75-125	4.44	25	QM-01
Barium	129	0.503	"	50.3	73.9	109	75-125	1.40	25	
Cadmium	1.96	0.252	"	2.52	0.219	69.0	75-125	3.61	25	QM-01
Copper	18.5	0.503	"	50.3	2.80	31.1	75-125	4.07	25	QM-01
Lead	21.1	0.252	"	25.2	4.14	67.3	75-125	3.11	25	QM-01
Nickel	18.7	0.503	"	50.3	2.75	31.7	75-125	4.18	25	QM-01
Selenium	3.69	0.327	"	5.03	ND	73.3	75-125	0.301	25	QM-01
Silver	1.67	0.0252	"	2.52	0.0211	65.6	75-125	2.84	25	QM-01
Zinc	25.7	0.503	"	50.3	8.48	34.2	75-125	2.40	25	QM-01
Batch BGG0890 - EPA 3050B										
Blank (BGG0890-BLK1)				Prepared: 07/27/23 Analyzed: 07/28/23						
Arsenic	ND	0.200	mg/kg wet							
Barium	ND	0.400	"							
Cadmium	ND	0.200	"							
Copper	ND	0.400	"							
Lead	ND	0.200	"							
Nickel	ND	0.400	"							
Selenium	ND	0.260	"							
Silver	ND	0.0200	"							
Zinc	ND	0.400	"							



Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0890 - EPA 3050B										
LCS (BGG0890-BS1)				Prepared: 07/27/23 Analyzed: 07/28/23						
Arsenic	34.0	0.200	mg/kg wet	40.0		84.9	80-120			
Barium	34.2	0.400	"	40.0		85.4	80-120			
Cadmium	1.93	0.200	"	2.00		96.5	80-120			
Copper	40.3	0.400	"	40.0		101	80-120			
Lead	18.3	0.200	"	20.0		91.4	80-120			
Nickel	36.5	0.400	"	40.0		91.3	80-120			
Selenium	4.10	0.260	"	4.00		102	80-120			
Silver	1.84	0.0200	"	2.00		92.0	80-120			
Zinc	36.6	0.400	"	40.0		91.4	80-120			
Duplicate (BGG0890-DUP1)	**Source: 2307344-03**			Prepared: 07/27/23 Analyzed: 07/28/23						
Arsenic	1.25	0.231	mg/kg dry		1.20			4.10	20	
Barium	52.1	0.461	"		50.4			3.32	20	
Cadmium	1.15	0.231	"		1.03			10.9	20	
Copper	5.06	0.461	"		4.25			17.6	20	
Lead	12.2	0.231	"		11.5			5.63	20	
Nickel	3.26	0.461	"		3.14			3.81	20	
Selenium	0.261	0.300	"		ND			200	20	J, QR-01
Silver	0.0978	0.0231	"		0.0720			30.4	20	QR-01
Zinc	18.4	0.461	"		17.9			2.57	20	
Matrix Spike (BGG0890-MS1)	**Source: 2307344-03**			Prepared: 07/27/23 Analyzed: 07/28/23						
Arsenic	9.60	0.231	mg/kg dry	46.1	1.20	18.2	75-125			QM-01
Barium	92.6	0.461	"	46.1	50.4	91.6	75-125			
Cadmium	2.68	0.231	"	2.31	1.03	71.3	75-125			QM-01
Copper	14.1	0.461	"	46.1	4.25	21.3	75-125			QM-01
Lead	25.6	0.231	"	23.1	11.5	61.1	75-125			QM-01
Nickel	11.2	0.461	"	46.1	3.14	17.5	75-125			QM-01
Selenium	3.97	0.300	"	4.61	ND	86.1	75-125			
Silver	1.79	0.0231	"	2.31	0.0720	74.7	75-125			QM-01
Zinc	26.9	0.461	"	46.1	17.9	19.4	75-125			QM-01



Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0890 - EPA 3050B										
Matrix Spike Dup (BGG0890-MSD1)	**Source: 2307344-03**			Prepared: 07/27/23 Analyzed: 07/28/23						
Arsenic	8.79	0.231	mg/kg dry	46.1	1.20	16.5	75-125	8.83	25	QM-01
Barium	97.9	0.461	"	46.1	50.4	103	75-125	5.53	25	
Cadmium	2.87	0.231	"	2.31	1.03	79.8	75-125	7.05	25	
Copper	13.2	0.461	"	46.1	4.25	19.5	75-125	6.17	25	QM-01
Lead	28.0	0.231	"	23.1	11.5	71.5	75-125	8.94	25	QM-01
Nickel	10.8	0.461	"	46.1	3.14	16.7	75-125	3.44	25	QM-01
Selenium	4.41	0.300	"	4.61	ND	95.6	75-125	10.4	25	
Silver	1.90	0.0231	"	2.31	0.0720	79.3	75-125	5.74	25	
Zinc	25.7	0.461	"	46.1	17.9	17.0	75-125	4.28	25	QM-01

Hexavalent Chromium by EPA Method 7196 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0603 - 3060A_Mod										
Blank (BGG0603-BLK1)				Prepared & Analyzed: 07/20/23						
Chromium, Hexavalent	ND	0.30	mg/kg wet							
LCS (BGG0603-BS1)				Prepared & Analyzed: 07/20/23						
Chromium, Hexavalent	23.5	0.30	mg/kg wet	25.0		94.0	80-120			
Duplicate (BGG0603-DUP1)	**Source: 2306023-01**			Prepared & Analyzed: 07/20/23						
Chromium, Hexavalent	ND	0.30	mg/kg dry		ND				20	
Matrix Spike (BGG0603-MS1)	**Source: 2306023-01**			Prepared & Analyzed: 07/20/23						
Chromium, Hexavalent	30.0	0.30	mg/kg dry	31.5	ND	95.2	75-125			
Matrix Spike Dup (BGG0603-MSD1)	**Source: 2306023-01**			Prepared & Analyzed: 07/20/23						
Chromium, Hexavalent	29.8	0.30	mg/kg dry	31.5	ND	94.6	75-125	0.632	20	
Batch BGG0893 - 3060A_Mod										
Blank (BGG0893-BLK1)				Prepared & Analyzed: 07/27/23						
Chromium, Hexavalent	ND	0.30	mg/kg wet							
LCS (BGG0893-BS1)				Prepared & Analyzed: 07/27/23						
Chromium, Hexavalent	23.8	0.30	mg/kg wet	25.0		95.2	80-120			
Duplicate (BGG0893-DUP1)	**Source: 2306638-04**			Prepared & Analyzed: 07/27/23						
Chromium, Hexavalent	ND	0.30	mg/kg dry		ND				20	
Matrix Spike (BGG0893-MS1)	**Source: 2306638-04**			Prepared & Analyzed: 07/27/23						
Chromium, Hexavalent	26.9	0.30	mg/kg dry	28.9	ND	93.0	75-125			

Civitas Resources	Project: Miller 4-17J, 14-17	
650 Southgate Drive	Project Number: [none]	**Reported:**
Windsor CO, 80550	Project Manager: Mike Dinkel	08/03/23 08:25

Hexavalent Chromium by EPA Method 7196 - Quality Control

Summit Scientific

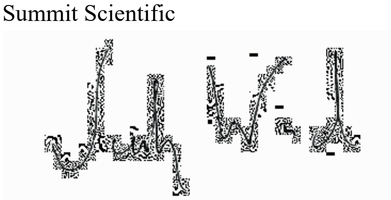
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0893 - 3060A_Mod										
Matrix Spike Dup (BGG0893-MSD1)	**Source: 2306638-04**		Prepared & Analyzed: 07/27/23							
Chromium, Hexavalent	26.9	0.30	mg/kg dry	28.9	ND	93.0	75-125	0.00	20	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/03/23 08:25

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction - Quality Control

Summit Scientific

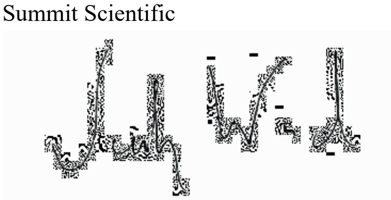
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0623 - General Preparation										
Blank (BGG0623-BLK1)				Prepared: 07/20/23 Analyzed: 07/22/23						
Calcium	ND	0.0500	mg/L wet							
Magnesium	ND	0.0500	"							
Sodium	ND	0.0500	"							
LCS (BGG0623-BS1)				Prepared: 07/20/23 Analyzed: 07/22/23						
Calcium	4.76	0.0500	mg/L wet	5.00		95.1	70-130			
Magnesium	6.05	0.0500	"	5.00		121	70-130			
Sodium	6.30	0.0500	"	5.00		126	70-130			
Batch BGG0911 - General Preparation										
Blank (BGG0911-BLK1)				Prepared: 07/27/23 Analyzed: 07/31/23						
Calcium	ND	0.0500	mg/L wet							
Magnesium	ND	0.0500	"							
Sodium	ND	0.0500	"							
LCS (BGG0911-BS1)				Prepared: 07/27/23 Analyzed: 07/31/23						
Calcium	5.05	0.0500	mg/L wet	5.00		101	70-130			
Magnesium	6.18	0.0500	"	5.00		124	70-130			
Sodium	6.26	0.0500	"	5.00		125	70-130			



Physical Parameters by APHA/ASTM/EPA Methods - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0605 - General Preparation										
Duplicate (BGG0605-DUP1)	**Source: 2307335-01**			Prepared & Analyzed: 07/20/23						
% Solids	90.0		%		90.2			0.216	20	
Batch BGG0910 - General Preparation										
Duplicate (BGG0910-DUP1)	**Source: 2307344-03**			Prepared & Analyzed: 07/27/23						
% Solids	86.4		%		86.7			0.339	20	



Civitas Resources
650 Southgate Drive
Windsor CO, 80550

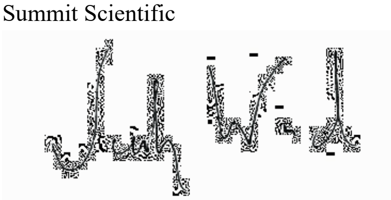
Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/03/23 08:25

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0663 - General Preparation										
Blank (BGG0663-BLK1)				Prepared & Analyzed: 07/21/23						
Specific Conductance (EC)	ND	0.0100	mmhos/cm							
LCS (BGG0663-BS1)				Prepared & Analyzed: 07/21/23						
Specific Conductance (EC)	0.156	0.0100	mmhos/cm	0.150		104	95-105			
Duplicate (BGG0663-DUP1)		**Source: 2307344-01**		Prepared & Analyzed: 07/21/23						
Specific Conductance (EC)	1.48	0.0100	mmhos/cm		1.48			0.00	20	
Batch BGG0963 - General Preparation										
Blank (BGG0963-BLK1)				Prepared & Analyzed: 07/28/23						
Specific Conductance (EC)	ND	0.0100	mmhos/cm							
LCS (BGG0963-BS1)				Prepared & Analyzed: 07/28/23						
Specific Conductance (EC)	0.157	0.0100	mmhos/cm	0.150		105	95-105			
Duplicate (BGG0963-DUP1)		**Source: 2307344-03**		Prepared & Analyzed: 07/28/23						
Specific Conductance (EC)	2.52	0.0100	mmhos/cm		2.54			0.435	20	



Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0662 - General Preparation										
LCS (BGG0662-BS1)				Prepared & Analyzed: 07/21/23						
pH	8.83		pH Units	9.18		96.2	95-105			
Duplicate (BGG0662-DUP1)	**Source: 2307344-01**			Prepared & Analyzed: 07/21/23						
pH	8.19		pH Units		7.87			3.99	20	
Batch BGG0962 - General Preparation										
LCS (BGG0962-BS1)				Prepared & Analyzed: 07/28/23						
pH	9.02		pH Units	9.18		98.3	95-105			
Duplicate (BGG0962-DUP1)	**Source: 2307344-03**			Prepared & Analyzed: 07/28/23						
pH	7.66		pH Units		7.61			0.655	20	

Notes and Definitions

QR-04	The RPD value for the sample duplicate or MS/MSD was outside of QC acceptance. QC batch accepted based on LCS and/or LCSD recovery and/or RPD values.
QR-02	The RPD result exceeded the QC control limits; however, both percent recoveries were acceptable. Sample results for the QC batch were accepted based on percent recoveries and completeness of QC data.
QR-01	Analyses are not controlled on RPD values from sample concentrations less than 10 times the reporting limit. QC batch accepted based on LCS and/or LCSD QC results.
QM-07	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS/LCSD recovery.
QM-01	The spike recovery for this QC sample is outside of established control limits due to sample matrix interference.
J	Detected but below the Reporting Limit; therefore, result is an estimated concentration
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Summit Scientific

4653 Table Mountain Drive, Golden, Colorado 80401

303.277.9310

August 02, 2023

Mike Dinkel

Civitas Resources

650 Southgate Drive

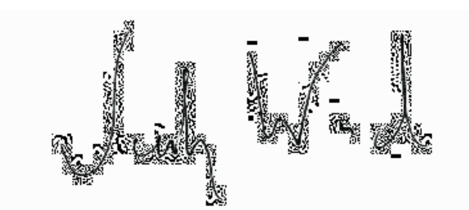
Windsor, CO 80550

RE: Miller 4-17J, 14-17

Work Order # 2307427

Enclosed are the results of analyses for samples received by Summit Scientific on 07/24/23 16:32. If you have any questions concerning this report, please feel free to contact me.

Sincerely,



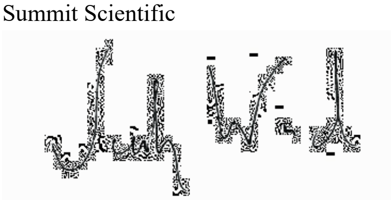
Jacob Wood For Paul Shrewsbury

President

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
E03@22'	2307427-01	Soil	07/24/23 14:16	07/24/23 16:32
N01@22'	2307427-02	Soil	07/24/23 14:25	07/24/23 16:32
N02@22'	2307427-03	Soil	07/24/23 14:35	07/24/23 16:32
B07@24'	2307427-04	Soil	07/24/23 14:40	07/24/23 16:32
W01@22'	2307427-05	Soil	07/24/23 14:45	07/24/23 16:32
W02@22'	2307427-06	Soil	07/24/23 14:51	07/24/23 16:32
W03@22'	2307427-07	Soil	07/24/23 15:01	07/24/23 16:32
B08@24'	2307427-08	Soil	07/24/23 15:09	07/24/23 16:32



The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

SUMMIT SCIENTIFIC

4653 Table Mountain Drive
Golden, CO 80403
303-277-9310

Lab ID: 2307427

Page 1 of 1

Client:	Civitas
Address:	650 Southgate
City/State/Zip:	Windsor, CO
Phone:	785-691-7788
Sampler Name:	Mike Dinkel

Send Data To:

Project Manager:	Mike Dinkel
E-Mail:	mdinkel@quandaryconsultants
Project Name:	Miller 4-17S, 14-17
Project Number:	

Send Invoice To:

Company:	Civitas
Project Name/Location:	Miller 4-17S, 14-17
AFE#:	
PO/Billing Codes:	
Contact:	J. Evans

ID	Sample Description	Date Sampled	Time Sampled	# of containers	Preservative: HCl	HNO3	None	Other	Matrix: Water	Soil	Air-Canister #	Other	Analysis Requested: Full Table 915-1							Special Instructions
1	E03@22'	7-24-23	1416	2						X			X							
2	N01@22'	↓	1425	↓						↓			↓							
3	N02@22'		1435																	
4	E07@24'		1440																	
5	W01@22'		1445																	
6	W02@22'		1451																	
7	W03@22'		1501																	
8	B08@24'		1509																	
9																				
10																				
11																				
12																				
13																				
14																				
15																				

Relinquished by:	Date/Time:	Received by:	Date/Time:
[signature]	7/24/1430	[signature]	7/24/23 16:32
Relinquished by:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Date/Time:	Received by:	Date/Time:

TAT Business Days			
Same Day		Field DO	
1 Day		Field EC	
2 Days	X	Field ORP	
3 Days		Field pH	
Standard		Field Temp.	
		Field Turb.	

Notes: same day organics

Temperature Upon Receipt: 10.9
Corrected Temperature: ______
IR gun #: 2
HNO3 lot #: ______

S2

Sample Receipt Checklist

S2 Work Order# 2307427

Client: Civitas　Client Project ID: Miller 4-175, 14-17

Shipped Via: H.D./P.U./FedEx/UPS/USPS/Other [ ]　Airbill #:

[X] [ ] [ ] [ ] [ ]

Matrix (Check all that apply)　Air [ ]　Soil/Solid [X]　Water [ ]　Other [ ]

Temp (^oC) 10.9　Thermometer # 2

	Yes	No	N/A	Comments (if any)
If samples require cooling, is the temperature < 6^oC? (1) **NOTE:** If samples are delivered the same day of sampling, this requirement is met if there is evidence that cooling has begun.	X			on ice
If custody seals are present, are they intact? (1)			X	
Are samples due within 48 hours present?	X			48 hours + Same day
Are water samples with short hold times present? Note the short hold analysis in the comments column - pH, Nitrate/Nitrite, Ferrous Iron (Fe^{2+}), Hexavalent Chromium (Cr^{6+}, Cr VI), COD/BOD, Total Coliform, E. Coli, Total Residual Chlorine (TRC), Dissolved Oxygen			X	
Is a chain-of-custody (COC) form present and filled out Completely? (1)	X			
Is the COC properly relinquished by the client w/ date and time recorded? (1)	X			
Were all samples received intact? (1)	X			
Was adequate sample volume provided? (1)	X			
Does the COC agree with the number and type of sample bottles received? (1)	X			
Do the sample IDs on the bottle labels match the COC? (1)	X			
For volatiles in water – is there headspace present? **If yes, contact client and note in narrative.**			X	
Are samples preserved that require preservation **(excluding cooling)?** (1) Note the type of preservative in the comments column – HCl, H_2SO_4, NaOH, HNO_3, etc.			X	
If samples are acid preserved for metals, is the pH ≤ 2? (1) Record the pH in Comments.			X	
If dissolved metals are requested, were samples field filtered?			X	

Additional Comments (if any):

(1) **If NO, then contact the client before proceeding with analysis and note in case narrative.**

Jay Ward　　7/24/23 16:32

Custodian Printed Name　　**Date/Time**

E03@22'

2307427-01 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0764	07/24/23	07/24/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**6.8**	0.50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*94.0 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*94.7 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*130 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

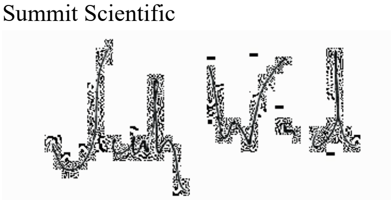
Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**66**	50		mg/kg	1	BGG0765	07/24/23	07/24/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*95.0 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

E03@22'

2307427-01 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0776	07/25/23	07/25/23	EPA 8270D SIM	
Anthracene	**0.0420**	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	**0.0124**	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*44.2 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*42.1 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.303**	0.0100		mg/L	1	BGG0838	07/26/23	07/28/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/02/23 11:42

E03@22'
2307427-01 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**3.57**	0.233		mg/kg dry	1	BGG0770	07/25/23	07/27/23	EPA 6020B	
Barium	**26.7**	0.467		"	"	"	"	"	"	
Cadmium	ND	0.233		"	"	"	"	"	"	
Copper	**4.91**	0.467		"	"	"	"	"	"	
Lead	**6.86**	0.233		"	"	"	"	"	"	
Nickel	**3.81**	0.467		"	"	"	"	"	"	
Selenium	ND	0.303	0.204	"	"	"	"	"	"	
Silver	ND	0.0233		"	"	"	"	"	"	
Zinc	**22.7**	0.467		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0772	07/25/23	07/25/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**18.1**	0.0584		mg/L dry	1	BGG0790	07/25/23	07/26/23	EPA 6020B	
Magnesium	**18.1**	0.0584		"	"	"	"	"	"	
Sodium	**527**	0.0584		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**21.0**	0.00100		units	1	BGG0936	07/27/23	07/27/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

E03@22'

2307427-01 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**85.7**			%	1	BGG0778	07/25/23	07/25/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**3.02**	0.0100		mmhos/cm	1	BGG0841	07/26/23	07/27/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/24/23 14:16**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.93**			pH Units	1	BGG0839	07/26/23	07/26/23	EPA 9045D	

N01@22'

2307427-02 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0764	07/24/23	07/24/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*94.5 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*103 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*113 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0765	07/24/23	07/24/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*92.6 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

N01@22'

2307427-02 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0776	07/25/23	07/25/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*85.3 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*40.3 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.396**	0.0100		mg/L	1	BGG0838	07/26/23	07/28/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

N01@22'

2307427-02 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**2.28**	0.224		mg/kg dry	1	BGG0770	07/25/23	07/27/23	EPA 6020B	
Barium	**45.6**	0.448		"	"	"	"	"	"	
Cadmium	ND	0.224		"	"	"	"	"	"	
Copper	**4.39**	0.448		"	"	"	"	"	"	
Lead	**5.61**	0.224		"	"	"	"	"	"	
Nickel	**5.10**	0.448		"	"	"	"	"	"	
Selenium	ND	0.291	0.196	"	"	"	"	"	"	
Silver	ND	0.0224		"	"	"	"	"	"	
Zinc	**16.1**	0.448		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0772	07/25/23	07/25/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/24/23 14:25**

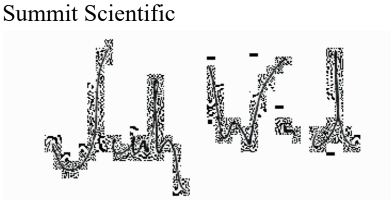
Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**10.1**	0.0560		mg/L dry	1	BGG0790	07/25/23	07/26/23	EPA 6020B	
Magnesium	**13.9**	0.0560		"	"	"	"	"	"	
Sodium	**351**	0.0560		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**16.8**	0.00100		units	1	BGG0936	07/27/23	07/27/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods



N01@22'

2307427-02 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**89.2**			%	1	BGG0778	07/25/23	07/25/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

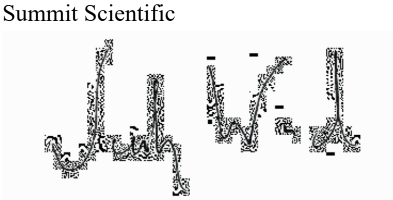
Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**2.35**	0.0100		mmhos/cm	1	BGG0841	07/26/23	07/27/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/24/23 14:25**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.23**			pH Units	1	BGG0839	07/26/23	07/26/23	EPA 9045D	



Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported: 08/02/23 11:42

N02@22'
2307427-03 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0764	07/24/23	07/24/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*96.7 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*103 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*107 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

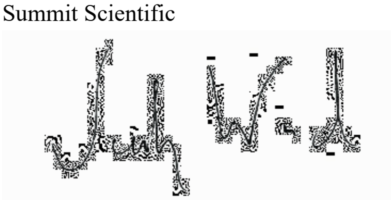
Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0765	07/24/23	07/24/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*97.4 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM



N02@22'

2307427-03 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0776	07/25/23	07/25/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*42.8 %*		*40-150*		*"*	*"*	*"*	*"*	
Surrogate: Fluoranthene-d10		*44.4 %*		*40-150*		*"*	*"*	*"*	*"*	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.167**	0.0100		mg/L	1	BGG0838	07/26/23	07/28/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	Reported: 08/02/23 11:42

N02@22'

2307427-03 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**9.96**	0.229		mg/kg dry	1	BGG0770	07/25/23	07/27/23	EPA 6020B	
Barium	**49.0**	0.458		"	"	"	"	"	"	
Cadmium	ND	0.229		"	"	"	"	"	"	
Copper	**8.22**	0.458		"	"	"	"	"	"	
Lead	**10.5**	0.229		"	"	"	"	"	"	
Nickel	**2.30**	0.458		"	"	"	"	"	"	
Selenium	ND	0.298	0.201	"	"	"	"	"	"	
Silver	**0.0426**	0.0229		"	"	"	"	"	"	
Zinc	**29.0**	0.458		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0772	07/25/23	07/25/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**37.9**	0.0573		mg/L dry	1	BGG0790	07/25/23	07/26/23	EPA 6020B	
Magnesium	**41.0**	0.0573		"	"	"	"	"	"	
Sodium	**500**	0.0573		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**13.4**	0.00100		units	1	BGG0936	07/27/23	07/27/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/02/23 11:42

N02@22'
2307427-03 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**87.3**			%	1	BGG0778	07/25/23	07/25/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**3.72**	0.0100		mmhos/cm	1	BGG0841	07/26/23	07/27/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/24/23 14:35**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.77**			pH Units	1	BGG0839	07/26/23	07/26/23	EPA 9045D	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

B07@24'

2307427-04 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0764	07/24/23	07/24/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*95.8 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*102 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*108 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0765	07/24/23	07/24/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*91.9 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

B07@24'

2307427-04 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0776	07/25/23	07/25/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*41.1 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*43.7 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.193**	0.0100		mg/L	1	BGG0838	07/26/23	07/28/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

B07@24'

2307427-04 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**1.73**	0.234		mg/kg dry	1	BGG0770	07/25/23	07/27/23	EPA 6020B	
Barium	**19.8**	0.468		"	"	"	"	"	"	
Cadmium	ND	0.234		"	"	"	"	"	"	
Copper	**2.47**	0.468		"	"	"	"	"	"	
Lead	**4.12**	0.234		"	"	"	"	"	"	
Nickel	**1.99**	0.468		"	"	"	"	"	"	
Selenium	ND	0.304	0.205	"	"	"	"	"	"	
Silver	ND	0.0234		"	"	"	"	"	"	
Zinc	**12.5**	0.468		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0772	07/25/23	07/25/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**60.2**	0.0585		mg/L dry	1	BGG0790	07/25/23	07/26/23	EPA 6020B	
Magnesium	**59.5**	0.0585		"	"	"	"	"	"	
Sodium	**416**	0.0585		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**9.10**	0.00100		units	1	BGG0936	07/27/23	07/27/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/02/23 11:42

B07@24'

2307427-04 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**85.5**			%	1	BGG0778	07/25/23	07/25/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**3.47**	0.0100		mmhos/cm	1	BGG0841	07/26/23	07/27/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/24/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.63**			pH Units	1	BGG0839	07/26/23	07/26/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	Reported: 08/02/23 11:42

W01@22'

2307427-05 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0764	07/24/23	07/24/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*93.2 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*103 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*106 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

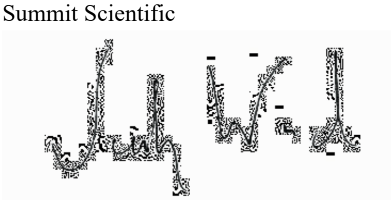
Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0765	07/24/23	07/24/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*76.4 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM



Civitas Resources	Project:	Miller 4-17J, 14-17	
650 Southgate Drive	Project Number:	[none]	**Reported:**
Windsor CO, 80550	Project Manager:	Mike Dinkel	08/02/23 11:42

W01@22'

2307427-05 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0776	07/25/23	07/25/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*46.9 %*		*40-150*		*"*	*"*	*"*	*"*	
Surrogate: Fluoranthene-d10		*56.9 %*		*40-150*		*"*	*"*	*"*	*"*	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.194**	0.0100		mg/L	1	BGG0838	07/26/23	07/28/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/02/23 11:42

W01@22'
2307427-05 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**2.18**	0.223		mg/kg dry	1	BGG0770	07/25/23	07/27/23	EPA 6020B	
Barium	**27.0**	0.446		"	"	"	"	"	"	
Cadmium	ND	0.223		"	"	"	"	"	"	
Copper	**6.26**	0.446		"	"	"	"	"	"	
Lead	**10.4**	0.223		"	"	"	"	"	"	
Nickel	**2.75**	0.446		"	"	"	"	"	"	
Selenium	ND	0.290	0.195	"	"	"	"	"	"	
Silver	**0.0304**	0.0223		"	"	"	"	"	"	
Zinc	**21.9**	0.446		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0772	07/25/23	07/25/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/24/23 14:45**

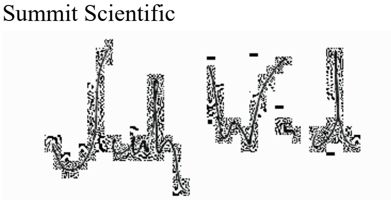
Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**26.9**	0.0558		mg/L dry	1	BGG0790	07/25/23	07/26/23	EPA 6020B	
Magnesium	**30.2**	0.0558		"	"	"	"	"	"	
Sodium	**367**	0.0558		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**11.5**	0.00100		units	1	BGG0936	07/27/23	07/27/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

W01@22'
2307427-05 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**89.6**			%	1	BGG0778	07/25/23	07/25/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**2.56**	0.0100		mmhos/cm	1	BGG0841	07/26/23	07/27/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/24/23 14:45**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.22**			pH Units	1	BGG0839	07/26/23	07/26/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	Reported: 08/02/23 11:42

W02@22'

2307427-06 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0764	07/24/23	07/24/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*95.5 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*103 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*105 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0765	07/24/23	07/24/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*81.8 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

W02@22'

2307427-06 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0776	07/25/23	07/26/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*94.8 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*43.3 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.311**	0.0100		mg/L	1	BGG0838	07/26/23	07/28/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/02/23 11:42

W02@22'

2307427-06 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**13.9**	0.230		mg/kg dry	1	BGG0770	07/25/23	07/27/23	EPA 6020B	
Barium	**32.5**	0.459		"	"	"	"	"	"	
Cadmium	**0.725**	0.230		"	"	"	"	"	"	
Copper	**7.49**	0.459		"	"	"	"	"	"	
Lead	**22.8**	0.230		"	"	"	"	"	"	
Nickel	**1.85**	0.459		"	"	"	"	"	"	
Selenium	ND	0.298	0.201	"	"	"	"	"	"	
Silver	**0.0358**	0.0230		"	"	"	"	"	"	
Zinc	**18.3**	0.459		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0772	07/25/23	07/25/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**2.85**	0.0574		mg/L dry	1	BGG0790	07/25/23	07/26/23	EPA 6020B	
Magnesium	**5.57**	0.0574		"	"	"	"	"	"	
Sodium	**250**	0.0574		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**19.8**	0.00100		units	1	BGG0936	07/27/23	07/27/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/02/23 11:42

W02@22'

2307427-06 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**87.1**			%	1	BGG0778	07/25/23	07/25/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

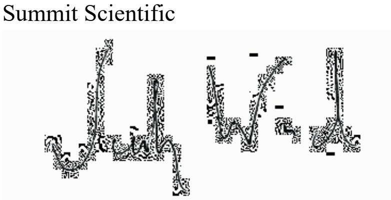
Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**1.97**	0.0100		mmhos/cm	1	BGG0841	07/26/23	07/27/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/24/23 14:51**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.50**			pH Units	1	BGG0839	07/26/23	07/26/23	EPA 9045D	



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

W03@22'

2307427-07 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0764	07/24/23	07/24/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*95.8 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*103 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*111 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0765	07/24/23	07/24/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*82.6 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

W03@22'

2307427-07 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0776	07/25/23	07/26/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*47.8 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*45.5 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

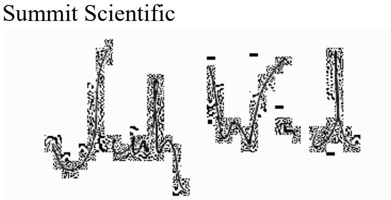
Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.321**	0.0100		mg/L	1	BGG0838	07/26/23	07/28/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes



W03@22'

2307427-07 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**3.46**	0.229		mg/kg dry	1	BGG0770	07/25/23	07/27/23	EPA 6020B	
Barium	**18.1**	0.458		"	"	"	"	"	"	
Cadmium	ND	0.229		"	"	"	"	"	"	
Copper	**5.26**	0.458		"	"	"	"	"	"	
Lead	**7.25**	0.229		"	"	"	"	"	"	
Nickel	**3.06**	0.458		"	"	"	"	"	"	
Selenium	ND	0.298	0.201	"	"	"	"	"	"	
Silver	**0.0270**	0.0229		"	"	"	"	"	"	
Zinc	**17.0**	0.458		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0772	07/25/23	07/25/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**266**	0.0573		mg/L dry	1	BGG0790	07/25/23	07/26/23	EPA 6020B	
Magnesium	**86.4**	0.0573		"	"	"	"	"	"	
Sodium	**149**	0.0573		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**2.03**	0.00100		units	1	BGG0936	07/27/23	07/27/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

W03@22'

2307427-07 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**87.3**			%	1	BGG0778	07/25/23	07/25/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

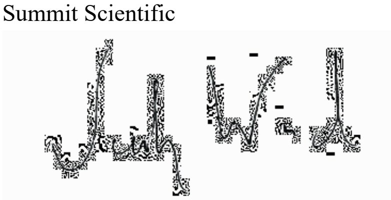
Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.905**	0.0100		mmhos/cm	1	BGG0841	07/26/23	07/27/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/24/23 15:01**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.80**			pH Units	1	BGG0839	07/26/23	07/26/23	EPA 9045D	



Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/02/23 11:42

B08@24'
2307427-08 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020		mg/kg	1	BGG0764	07/24/23	07/24/23	EPA 8260B	
Toluene	ND	0.0050		"	"	"	"	"	"	
Ethylbenzene	ND	0.0050		"	"	"	"	"	"	
Xylenes (total)	ND	0.010		"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
1,3,5-Trimethylbenzene	ND	0.0050		"	"	"	"	"	"	
Naphthalene	ND	0.0038		"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50		"	"	"	"	"	"	

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*95.3 %*		*50-150*		"	"	"	"	
Surrogate: Toluene-d8		*101 %*		*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*111 %*		*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50		mg/kg	1	BGG0765	07/24/23	07/24/23	EPA 8015M	
C28-C36 (ORO)	ND	50		"	"	"	"	"	"	

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*71.3 %*		*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

Civitas Resources	Project:	Miller 4-17J, 14-17	
650 Southgate Drive	Project Number:	[none]	**Reported:**
Windsor CO, 80550	Project Manager:	Mike Dinkel	08/02/23 11:42

B08@24'

2307427-08 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500		mg/kg	1	BGG0776	07/25/23	07/26/23	EPA 8270D SIM	
Anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500		"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500		"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500		"	"	"	"	"	"	
Chrysene	ND	0.00500		"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500		"	"	"	"	"	"	
Fluoranthene	ND	0.00500		"	"	"	"	"	"	
Fluorene	ND	0.00500		"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500		"	"	"	"	"	"	
Pyrene	ND	0.00500		"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500		"	"	"	"	"	"	

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10		*52.6 %*		*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10		*51.5 %*		*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**1.05**	0.0100		mg/L	1	BGG0838	07/26/23	07/28/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/02/23 11:42

B08@24'
2307427-08 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**5.23**	0.240		mg/kg dry	1	BGG0770	07/25/23	07/27/23	EPA 6020B	
Barium	**160**	0.480		"	"	"	"	"	"	
Cadmium	**1.28**	0.240		"	"	"	"	"	"	
Copper	**12.8**	0.480		"	"	"	"	"	"	
Lead	**25.6**	0.240		"	"	"	"	"	"	
Nickel	**10.5**	0.480		"	"	"	"	"	"	
Selenium	ND	0.312	0.210	"	"	"	"	"	"	
Silver	**0.0610**	0.0240		"	"	"	"	"	"	
Zinc	**35.8**	0.480		"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGG0772	07/25/23	07/25/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**43.9**	0.0600		mg/L dry	1	BGG0790	07/25/23	07/26/23	EPA 6020B	
Magnesium	**57.0**	0.0600		"	"	"	"	"	"	
Sodium	**250**	0.0600		"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**5.86**	0.00100		units	1	BGG0936	07/27/23	07/27/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

B08@24'

2307427-08 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**83.3**			%	1	BGG0778	07/25/23	07/25/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

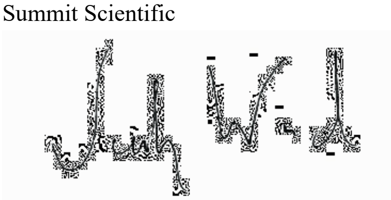
Date Sampled: **07/24/23 15:09**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**1.33**	0.0100		mmhos/cm	1	BGG0841	07/26/23	07/27/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **07/24/23 15:09**

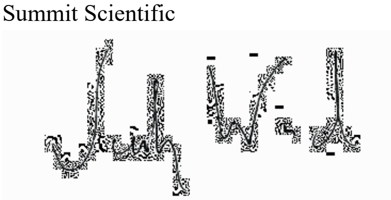
Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.41**			pH Units	1	BGG0839	07/26/23	07/26/23	EPA 9045D	



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

Volatile Organic Compounds by EPA Method 8260B - Quality Control
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0764 - EPA 5030 Soil MS										
Blank (BGG0764-BLK1)				Prepared & Analyzed: 07/24/23						
Benzene	ND	0.0020	mg/kg							
Toluene	ND	0.0050	"							
Ethylbenzene	ND	0.0050	"							
Xylenes (total)	ND	0.010	"							
1,2,4-Trimethylbenzene	ND	0.0050	"							
1,3,5-Trimethylbenzene	ND	0.0050	"							
Naphthalene	ND	0.0038	"							
Gasoline Range Hydrocarbons	ND	0.50	"							
Surrogate: 1,2-Dichloroethane-d4	*0.0331*		*"*	*0.0400*		*82.8*	*50-150*			
Surrogate: Toluene-d8	*0.0384*		*"*	*0.0400*		*96.0*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0382*		*"*	*0.0400*		*95.6*	*50-150*			
LCS (BGG0764-BS1)				Prepared: 07/24/23 Analyzed: 07/25/23						
Benzene	0.101	0.0020	mg/kg	0.100		101	70-130			
Toluene	0.103	0.0050	"	0.100		103	70-130			
Ethylbenzene	0.120	0.0050	"	0.100		120	70-130			
m,p-Xylene	0.236	0.010	"	0.200		118	70-130			
o-Xylene	0.111	0.0050	"	0.100		111	70-130			
1,2,4-Trimethylbenzene	0.108	0.0050	"	0.100		108	70-130			
1,3,5-Trimethylbenzene	0.116	0.0050	"	0.100		116	70-130			
Naphthalene	0.0708	0.0038	"	0.100		70.8	70-130			
Surrogate: 1,2-Dichloroethane-d4	*0.0320*		*"*	*0.0400*		*80.0*	*50-150*			
Surrogate: Toluene-d8	*0.0384*		*"*	*0.0400*		*96.1*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0399*		*"*	*0.0400*		*99.7*	*50-150*			
Matrix Spike (BGG0764-MS1)	**Source: 2307427-01**			Prepared: 07/24/23 Analyzed: 07/25/23						
Benzene	0.101	0.0020	mg/kg	0.100	ND	101	70-130			
Toluene	0.103	0.0050	"	0.100	ND	103	70-130			
Ethylbenzene	0.121	0.0050	"	0.100	ND	121	70-130			
m,p-Xylene	0.238	0.010	"	0.200	ND	119	70-130			
o-Xylene	0.112	0.0050	"	0.100	ND	112	70-130			
1,2,4-Trimethylbenzene	0.108	0.0050	"	0.100	ND	108	70-130			
1,3,5-Trimethylbenzene	0.116	0.0050	"	0.100	ND	116	70-130			
Naphthalene	0.0930	0.0038	"	0.100	ND	93.0	70-130			
Surrogate: 1,2-Dichloroethane-d4	*0.0154*		*"*	*0.0400*		*38.6*	*50-150*			*QM-07*
Surrogate: Toluene-d8	*0.0391*		*"*	*0.0400*		*97.6*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0405*		*"*	*0.0400*		*101*	*50-150*			



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0764 - EPA 5030 Soil MS										
Matrix Spike Dup (BGG0764-MSD1)		**Source: 2307427-01**		Prepared: 07/24/23 Analyzed: 07/25/23						
Benzene	0.103	0.0020	mg/kg	0.100	ND	103	70-130	1.56	30	
Toluene	0.105	0.0050	"	0.100	ND	105	70-130	1.15	30	
Ethylbenzene	0.123	0.0050	"	0.100	ND	123	70-130	1.67	30	
m,p-Xylene	0.237	0.010	"	0.200	ND	118	70-130	0.606	30	
o-Xylene	0.113	0.0050	"	0.100	ND	113	70-130	0.879	30	
1,2,4-Trimethylbenzene	0.110	0.0050	"	0.100	ND	110	70-130	1.35	30	
1,3,5-Trimethylbenzene	0.121	0.0050	"	0.100	ND	121	70-130	4.47	30	
Naphthalene	0.101	0.0038	"	0.100	ND	101	70-130	7.96	30	
Surrogate: 1,2-Dichloroethane-d4	*0.0298*		*"*	*0.0400*		*74.5*	*50-150*			
Surrogate: Toluene-d8	*0.0384*		*"*	*0.0400*		*96.1*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0445*		*"*	*0.0400*		*111*	*50-150*			

Extractable Petroleum Hydrocarbons by 8015 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0765 - EPA 3550A										
Blank (BGG0765-BLK1)				Prepared: 07/24/23 Analyzed: 07/25/23						
C10-C28 (DRO)	ND	50	mg/kg							
C28-C36 (ORO)	ND	50	"							
Surrogate: o-Terphenyl	*11.5*		"	*12.5*		*91.7*	*30-150*			
LCS (BGG0765-BS1)				Prepared: 07/24/23 Analyzed: 07/25/23						
C10-C28 (DRO)	534	50	mg/kg	500		107	70-130			
Surrogate: o-Terphenyl	*11.4*		"	*12.5*		*91.2*	*30-150*			
Matrix Spike (BGG0765-MS1)	**Source: 2307427-01**			Prepared: 07/24/23 Analyzed: 07/25/23						
C10-C28 (DRO)	482	50	mg/kg	500	66.2	83.1	70-130			
Surrogate: o-Terphenyl	*11.4*		"	*12.5*		*91.5*	*30-150*			
Matrix Spike Dup (BGG0765-MSD1)	**Source: 2307427-01**			Prepared: 07/24/23 Analyzed: 07/25/23						
C10-C28 (DRO)	458	50	mg/kg	500	66.2	78.4	70-130	5.03	20	
Surrogate: o-Terphenyl	*11.1*		"	*12.5*		*88.4*	*30-150*			

PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0776 - EPA 5030 Soil MS										
Blank (BGG0776-BLK1)				Prepared & Analyzed: 07/25/23						
Acenaphthene	ND	0.00500	mg/kg							
Anthracene	ND	0.00500	"							
Benzo (a) anthracene	ND	0.00500	"							
Benzo (a) pyrene	ND	0.00500	"							
Benzo (b) fluoranthene	ND	0.00500	"							
Benzo (k) fluoranthene	ND	0.00500	"							
Chrysene	ND	0.00500	"							
Dibenz (a,h) anthracene	ND	0.00500	"							
Fluoranthene	ND	0.00500	"							
Fluorene	ND	0.00500	"							
Indeno (1,2,3-cd) pyrene	ND	0.00500	"							
Pyrene	ND	0.00500	"							
1-Methylnaphthalene	ND	0.00500	"							
2-Methylnaphthalene	ND	0.00500	"							
Surrogate: 2-Methylnaphthalene-d10	*0.0245*		*"*	*0.0333*		*73.6*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0178*		*"*	*0.0333*		*53.3*	*40-150*			
LCS (BGG0776-BS1)				Prepared & Analyzed: 07/25/23						
Acenaphthene	0.0315	0.00500	mg/kg	0.0333		94.6	31-137			
Anthracene	0.0331	0.00500	"	0.0333		99.2	30-120			
Benzo (a) anthracene	0.0278	0.00500	"	0.0333		83.3	30-120			
Benzo (a) pyrene	0.0295	0.00500	"	0.0333		88.6	30-120			
Benzo (b) fluoranthene	0.0290	0.00500	"	0.0333		86.9	30-120			
Benzo (k) fluoranthene	0.0301	0.00500	"	0.0333		90.3	30-120			
Chrysene	0.0299	0.00500	"	0.0333		89.6	30-120			
Dibenz (a,h) anthracene	0.0308	0.00500	"	0.0333		92.5	30-120			
Fluoranthene	0.0338	0.00500	"	0.0333		101	30-120			
Fluorene	0.0245	0.00500	"	0.0333		73.5	30-120			
Indeno (1,2,3-cd) pyrene	0.0223	0.00500	"	0.0333		66.8	30-120			
Pyrene	0.0216	0.00500	"	0.0333		64.7	35-142			
1-Methylnaphthalene	0.0246	0.00500	"	0.0333		73.9	35-142			
2-Methylnaphthalene	0.0262	0.00500	"	0.0333		78.6	35-142			
Surrogate: 2-Methylnaphthalene-d10	*0.0242*		*"*	*0.0333*		*72.7*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0343*		*"*	*0.0333*		*103*	*40-150*			

PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

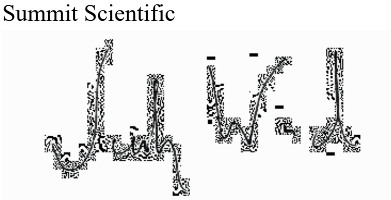
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0776 - EPA 5030 Soil MS										
Matrix Spike (BGG0776-MS1)		**Source: 2307402-21**		Prepared & Analyzed: 07/25/23						
Acenaphthene	0.0237	0.00500	mg/kg	0.0333	ND	71.1	31-137			
Anthracene	0.0247	0.00500	"	0.0333	ND	74.0	30-120			
Benzo (a) anthracene	0.0224	0.00500	"	0.0333	ND	67.2	30-120			
Benzo (a) pyrene	0.0209	0.00500	"	0.0333	ND	62.7	30-120			
Benzo (b) fluoranthene	0.0209	0.00500	"	0.0333	ND	62.7	30-120			
Benzo (k) fluoranthene	0.0204	0.00500	"	0.0333	ND	61.2	30-120			
Chrysene	0.0248	0.00500	"	0.0333	ND	74.5	30-120			
Dibenz (a,h) anthracene	0.0208	0.00500	"	0.0333	ND	62.3	30-120			
Fluoranthene	0.0239	0.00500	"	0.0333	ND	71.6	30-120			
Fluorene	0.0260	0.00500	"	0.0333	ND	78.1	30-120			
Indeno (1,2,3-cd) pyrene	0.0205	0.00500	"	0.0333	ND	61.4	30-120			
Pyrene	0.0148	0.00500	"	0.0333	ND	44.4	35-142			
1-Methylnaphthalene	0.0179	0.00500	"	0.0333	ND	53.6	15-130			
2-Methylnaphthalene	0.0261	0.00500	"	0.0333	ND	78.2	15-130			
Surrogate: 2-Methylnaphthalene-d10	*0.0142*		*"*	*0.0333*		*42.6*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0194*		*"*	*0.0333*		*58.2*	*40-150*			
Matrix Spike Dup (BGG0776-MSD1)		**Source: 2307402-21**		Prepared & Analyzed: 07/25/23						
Acenaphthene	0.0263	0.00500	mg/kg	0.0333	ND	78.8	31-137	10.3	30	
Anthracene	0.0242	0.00500	"	0.0333	ND	72.6	30-120	1.96	30	
Benzo (a) anthracene	0.0236	0.00500	"	0.0333	ND	70.9	30-120	5.40	30	
Benzo (a) pyrene	0.0204	0.00500	"	0.0333	ND	61.1	30-120	2.57	30	
Benzo (b) fluoranthene	0.0202	0.00500	"	0.0333	ND	60.6	30-120	3.48	30	
Benzo (k) fluoranthene	0.0191	0.00500	"	0.0333	ND	57.3	30-120	6.60	30	
Chrysene	0.0256	0.00500	"	0.0333	ND	76.7	30-120	2.88	30	
Dibenz (a,h) anthracene	0.0192	0.00500	"	0.0333	ND	57.5	30-120	8.00	30	
Fluoranthene	0.0181	0.00500	"	0.0333	ND	54.3	30-120	27.5	30	
Fluorene	0.0334	0.00500	"	0.0333	ND	100	30-120	24.8	30	
Indeno (1,2,3-cd) pyrene	0.0203	0.00500	"	0.0333	ND	60.9	30-120	0.750	30	
Pyrene	0.0197	0.00500	"	0.0333	ND	59.1	35-142	28.3	30	
1-Methylnaphthalene	0.0198	0.00500	"	0.0333	ND	59.3	15-130	10.0	50	
2-Methylnaphthalene	0.0288	0.00500	"	0.0333	ND	86.5	15-130	10.2	50	
Surrogate: 2-Methylnaphthalene-d10	*0.0144*		*"*	*0.0333*		*43.2*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0142*		*"*	*0.0333*		*42.7*	*40-150*			

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

Total Metals by EPA 6020B Hot Water Soluble Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0838 - EPA 3050B										
Blank (BGG0838-BLK1)				Prepared: 07/26/23 Analyzed: 07/27/23						
Boron	ND	0.0100	mg/L							
LCS (BGG0838-BS1)				Prepared: 07/26/23 Analyzed: 07/27/23						
Boron	5.24	0.0100	mg/L	5.00		105	80-120			
Duplicate (BGG0838-DUP1)	**Source: 2307427-01**			Prepared: 07/26/23 Analyzed: 07/28/23						
Boron	0.542	0.0100	mg/L		0.303			56.4	20	QM-04
Matrix Spike (BGG0838-MS1)	**Source: 2307427-01**			Prepared: 07/26/23 Analyzed: 07/28/23						
Boron	5.09	0.0100	mg/L	5.00	0.303	95.7	75-125			
Matrix Spike Dup (BGG0838-MSD1)	**Source: 2307427-01**			Prepared: 07/26/23 Analyzed: 07/28/23						
Boron	5.20	0.0100	mg/L	5.00	0.303	97.9	75-125	2.11	25	



Total Metals by EPA 6020B - Quality Control

Summit Scientific

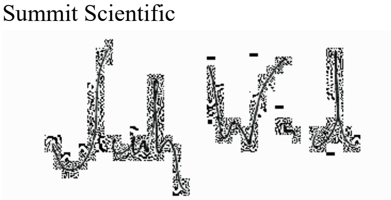
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0770 - EPA 3050B										
Blank (BGG0770-BLK1)				Prepared: 07/25/23 Analyzed: 07/27/23						
Arsenic	ND	0.200	mg/kg wet							
Barium	ND	0.400	"							
Cadmium	ND	0.200	"							
Copper	ND	0.400	"							
Lead	ND	0.200	"							
Nickel	ND	0.400	"							
Selenium	ND	0.260	"							
Silver	ND	0.0200	"							
Zinc	ND	0.400	"							
LCS (BGG0770-BS1)				Prepared: 07/25/23 Analyzed: 07/27/23						
Arsenic	33.1	0.200	mg/kg wet	40.0		82.7	80-120			
Barium	35.3	0.400	"	40.0		88.2	80-120			
Cadmium	1.64	0.200	"	2.00		82.0	80-120			
Copper	36.3	0.400	"	40.0		90.7	80-120			
Lead	16.1	0.200	"	20.0		80.6	80-120			
Nickel	35.3	0.400	"	40.0		88.2	80-120			
Selenium	4.11	0.260	"	4.00		103	80-120			
Silver	1.63	0.0200	"	2.00		81.5	80-120			
Zinc	35.2	0.400	"	40.0		88.1	80-120			
Duplicate (BGG0770-DUP1)	**Source: 2307426-01**			Prepared: 07/25/23 Analyzed: 07/27/23						
Arsenic	1.58	0.240	mg/kg dry		1.76			10.7	20	
Barium	18.2	0.480	"		22.4			20.6	20	QR-04
Cadmium	0.102	0.240	"		0.127			21.8	20	QR-01
Copper	3.73	0.480	"		4.34			14.9	20	
Lead	4.11	0.240	"		4.67			12.9	20	
Nickel	3.12	0.480	"		3.55			12.8	20	
Selenium	ND	0.312	"		ND				20	
Silver	0.0115	0.0240	"		0.0154			28.6	20	QR-01
Zinc	12.2	0.480	"		14.3			16.0	20	

Civitas Resources	Project: Miller 4-17J, 14-17	
650 Southgate Drive	Project Number: [none]	Reported:
Windsor CO, 80550	Project Manager: Mike Dinkel	08/02/23 11:42

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0770 - EPA 3050B										
Matrix Spike (BGG0770-MS1)		**Source: 2307426-01**		Prepared: 07/25/23 Analyzed: 07/27/23						
Arsenic	32.8	0.240	mg/kg dry	48.0	1.76	64.7	75-125			QM-07
Barium	61.7	0.480	"	48.0	22.4	82.0	75-125			
Cadmium	1.97	0.240	"	2.40	0.127	76.7	75-125			
Copper	35.0	0.480	"	48.0	4.34	63.9	75-125			QM-07
Lead	22.0	0.240	"	24.0	4.67	72.2	75-125			QM-07
Nickel	34.3	0.480	"	48.0	3.55	64.1	75-125			QM-07
Selenium	4.33	0.312	"	4.80	ND	90.4	75-125			
Silver	1.82	0.0240	"	2.40	0.0154	75.1	75-125			
Zinc	44.4	0.480	"	48.0	14.3	62.8	75-125			QM-07
Matrix Spike Dup (BGG0770-MSD1)		**Source: 2307426-01**		Prepared: 07/25/23 Analyzed: 07/27/23						
Arsenic	32.5	0.240	mg/kg dry	48.0	1.76	64.1	75-125	0.860	25	QM-07
Barium	62.3	0.480	"	48.0	22.4	83.1	75-125	0.884	25	
Cadmium	2.01	0.240	"	2.40	0.127	78.7	75-125	2.41	25	
Copper	35.0	0.480	"	48.0	4.34	63.9	75-125	0.0302	25	QM-07
Lead	22.2	0.240	"	24.0	4.67	73.1	75-125	0.940	25	QM-07
Nickel	34.4	0.480	"	48.0	3.55	64.3	75-125	0.356	25	QM-07
Selenium	4.37	0.312	"	4.80	ND	91.0	75-125	0.761	25	
Silver	1.83	0.0240	"	2.40	0.0154	75.5	75-125	0.501	25	
Zinc	43.9	0.480	"	48.0	14.3	61.8	75-125	1.09	25	QM-07

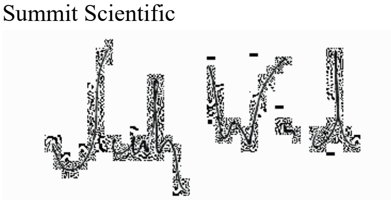


Civitas Resources	Project: Miller 4-17J, 14-17	
650 Southgate Drive	Project Number: [none]	Reported:
Windsor CO, 80550	Project Manager: Mike Dinkel	08/02/23 11:42

Hexavalent Chromium by EPA Method 7196 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0772 - 3060A_Mod										
Blank (BGG0772-BLK1)				Prepared & Analyzed: 07/25/23						
Chromium, Hexavalent	ND	0.30	mg/kg wet							
LCS (BGG0772-BS1)				Prepared & Analyzed: 07/25/23						
Chromium, Hexavalent	23.4	0.30	mg/kg wet	25.0		93.6	80-120			
Duplicate (BGG0772-DUP1)	**Source: 2307426-01**			Prepared & Analyzed: 07/25/23						
Chromium, Hexavalent	ND	0.30	mg/kg dry		ND				20	
Matrix Spike (BGG0772-MS1)	**Source: 2307426-01**			Prepared & Analyzed: 07/25/23						
Chromium, Hexavalent	27.7	0.30	mg/kg dry	30.0	ND	92.4	75-125			
Matrix Spike Dup (BGG0772-MSD1)	**Source: 2307426-01**			Prepared & Analyzed: 07/25/23						
Chromium, Hexavalent	28.5	0.30	mg/kg dry	30.0	ND	95.2	75-125	2.99	20	



Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction - Quality Control

Summit Scientific

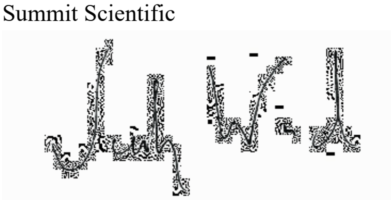
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0790 - General Preparation										
Blank (BGG0790-BLK1)				Prepared: 07/25/23 Analyzed: 07/26/23						
Calcium	ND	0.0500	mg/L wet							
Magnesium	ND	0.0500	"							
Sodium	ND	0.0500	"							
LCS (BGG0790-BS1)				Prepared: 07/25/23 Analyzed: 07/26/23						
Calcium	4.20	0.0500	mg/L wet	5.00		84.0	70-130			
Magnesium	5.14	0.0500	"	5.00		103	70-130			
Sodium	4.91	0.0500	"	5.00		98.2	70-130			

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/02/23 11:42

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0778 - General Preparation										
Duplicate (BGG0778-DUP1)	**Source: 2307396-01**		Prepared & Analyzed: 07/25/23							
% Solids	78.3		%		89.6			13.4	20	



Specific Conductance by EPA Method 120.1, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0841 - General Preparation										
Blank (BGG0841-BLK1)				Prepared: 07/26/23 Analyzed: 07/27/23						
Specific Conductance (EC)	ND	0.0100	mmhos/cm							
LCS (BGG0841-BS1)				Prepared: 07/26/23 Analyzed: 07/27/23						
Specific Conductance (EC)	0.153	0.0100	mmhos/cm	0.150		102	95-105			
Duplicate (BGG0841-DUP1)		**Source: 2307241-01**		Prepared: 07/26/23 Analyzed: 07/27/23						
Specific Conductance (EC)	0.487	0.0100	mmhos/cm		0.487			0.144	20	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGG0839 - General Preparation										
LCS (BGG0839-BS1)				Prepared & Analyzed: 07/26/23						
pH	9.03		pH Units	9.18		98.4	95-105			
Duplicate (BGG0839-DUP1)		**Source: 2307186-03**		Prepared & Analyzed: 07/26/23						
pH	7.84		pH Units		7.78			0.768	20	

Notes and Definitions

QR-04	The RPD value for the sample duplicate or MS/MSD was outside of QC acceptance. QC batch accepted based on LCS and/or LCSD recovery and/or RPD values.
QR-01	Analyses are not controlled on RPD values from sample concentrations less than 10 times the reporting limit. QC batch accepted based on LCS and/or LCSD QC results.
QM-07	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS/LCSD recovery.
QM-04	Visual evaluation of the sample indicates the RPD is above the control limit due to a non-homogeneous sample matrix.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Summit Scientific

4653 Table Mountain Drive, Golden, Colorado 80403

303.277.9310

September 07, 2023

Mike Dinkel
Civitas Resources
650 Southgate Drive
Windsor, CO 80550

RE: Miller 14-17, 4-175

Work Order #2308637

Enclosed are the results of analyses for samples received by Summit Scientific on 08/29/23 15:59. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jacob Wood For Paul Shrewsbury
President

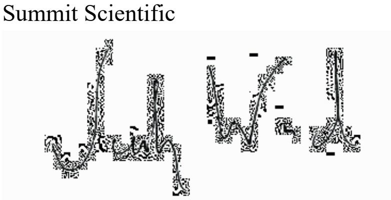
Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 14-17, 4-175
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
09/07/23 09:05

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
S01@22'	2308637-01	Soil	08/29/23 10:17	08/29/23 15:59
S02@22'	2308637-02	Soil	08/29/23 10:04	08/29/23 15:59
S03@22'	2308637-03	Soil	08/29/23 09:57	08/29/23 15:59
W04@22'	2308637-04	Soil	08/29/23 10:22	08/29/23 15:59



SUMMIT SCIENTIFIC

4653 Table Mountain Drive
Golden, CO 80403
303-277-9310

Lab ID: 2308637

Page 1 of 1

Client: Civitas	Send Data To:	Send Invoice To:
Address: 656 Southgate	Project Manager: Mike Dinkel	Company: Civitas
City/State/Zip: Windsor CO	E-Mail: mdinkel@quandaryconsultants.com samples@quandaryconsultants.com	Project Name/Location: Miller 14-17, 4-17J
Phone: 785-691-7788	Project Name: Miller 14-17, 4-17J	AFE#:
Sampler Name: Mike Dinkel	Project Number:	PO/Billing Codes:
		Contact: Jacob Evans

ID	Sample Description	Date Sampled	Time Sampled	# of containers	Preservative: HCl	HNO3	None	Other	Matrix: Water	Soil	Air-Canister #	Other	Analysis Requested: Table 915-1							Special Instructions
1	S01@22'	8-29-23	1017	2						X			X							
2	S02@22'	↓	1004	↓						↓			X							
3	S03@22'	↓	0957	↓						↓			X							
4	W04@22'	↓	1022	↓						↓			X							
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				

Relinquished by:	Date/Time:	Received by:	Date/Time:	TAT Business Days				Notes:
[signature]	8-29-23/1458	[signature]	8/29/23 15:59	Same Day	X	Field DO		same day VOCs standard everything else
Relinquished by:	Date/Time:	Received by:	Date/Time:	1 Day		Field EC		
				2 Days		Field ORP		
Relinquished by:	Date/Time:	Received by:	Date/Time:	3 Days		Field pH		
				Standard	X	Field Temp.		
						Field Turb.		

Temperature Upon Receipt: 8.4 | Corrected Temperature ______ | IR gun #: 2 | HNO3 lot #: ______

S2

Sample Receipt Checklist

S2 Work Order# 2308637

Client: Civitas Client Project ID: Miller 14-17, 4-175

Shipped Via: H.D./P.U./FedEx/UPS/USPS/Other [ ] Airbill #: ________

[X] H.D. [ ] P.U. [ ] FedEx [ ] UPS [ ] USPS

Matrix (Check all that apply) Air [ ] Soil/Solid [X] Water [ ] Other [ ]

Temp (^oC) 8.4 Thermometer # 2

	Yes	No	N/A	Comments (if any)
If samples require cooling, is the temperature < 6^oC? (1) **NOTE:** If samples are delivered the same day of sampling, this requirement is met if there is evidence that cooling has begun.	X			on ice
If custody seals are present, are they intact? (1)			X	
Are samples due within 48 hours present?	X			Same day
Are water samples with short hold times present? Note the short hold analysis in the comments column - pH, Nitrate/Nitrite, Ferrous Iron (Fe^{2+}), Hexavalent Chromium (Cr^{6+}, Cr VI), COD/BOD, Total Coliform, E. Coli, Total Residual Chlorine (TRC), Dissolved Oxygen			X	
Is a chain-of-custody (COC) form present and filled out Completely? (1)	X			
Is the COC properly relinquished by the client w/ date and time recorded? (1)	X			
Were all samples received intact? (1)	X			
Was adequate sample volume provided? (1)	X			
Does the COC agree with the number and type of sample bottles received? (1)	X			
Do the sample IDs on the bottle labels match the COC? (1)	X			
For volatiles in water – is there headspace present? **If yes, contact client and note in narrative.**			X	
Are samples preserved that require preservation **(excluding cooling)?** (1) Note the type of preservative in the comments column – HCl, H_2SO_4, NaOH, HNO_3, etc.			X	
If samples are acid preserved for metals, is the pH ≤ 2? (1) Record the pH in Comments.			X	
If dissolved metals are requested, were samples field filtered?			X	

Additional Comments (if any):

(1) **If NO, then contact the client before proceeding with analysis and note in case narrative.**

Jah Wid
Custodian Printed Name

8/29/23 15:59
Date/Time

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 14-17, 4-175
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
09/07/23 09:05

S01@22'
2308637-01 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020	mg/kg	1	BGH1192	08/29/23	08/30/23	EPA 8260B	
Toluene	ND	0.0050	"	"	"	"	"	"	
Ethylbenzene	**0.033**	0.0050	"	"	"	"	"	"	
Xylenes (total)	**0.14**	0.010	"	"	"	"	"	"	
1,2,4-Trimethylbenzene	**0.18**	0.0050	"	"	"	"	"	"	
1,3,5-Trimethylbenzene	**0.14**	0.0050	"	"	"	"	"	"	
Naphthalene	**0.016**	0.0038	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**6.6**	0.50	"	"	"	"	"	"	

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4	0.0271	*67.7 %*	*50-150*		"	"	"	"	
Surrogate: Toluene-d8	0.0371	*92.8 %*	*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene	0.0387	*96.7 %*	*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

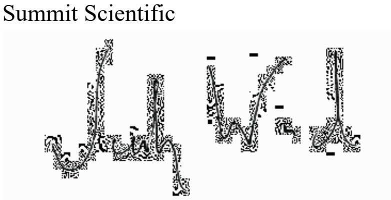
Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50	mg/kg	1	BGH1136	08/29/23	08/29/23	EPA 8015M	
C28-C36 (ORO)	ND	50	"	"	"	"	"	"	

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl	12.1	*97.0 %*	*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17, 4-175 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 09/07/23 09:05

S01@22'

2308637-01 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500	mg/kg	1	BGI0012	09/01/23	09/01/23	EPA 8270D SIM	
Anthracene	ND	0.00500	"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500	"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500	"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500	"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500	"	"	"	"	"	"	
Chrysene	ND	0.00500	"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500	"	"	"	"	"	"	
Fluoranthene	ND	0.00500	"	"	"	"	"	"	
Fluorene	ND	0.00500	"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500	"	"	"	"	"	"	
Pyrene	ND	0.00500	"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500	"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500	"	"	"	"	"	"	

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10	0.0158	*47.4 %*	*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10	0.0141	*42.4 %*	*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

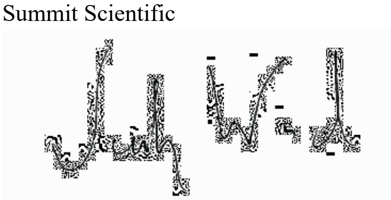
Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.265**	0.0100	mg/L	1	BGH1200	08/30/23	08/31/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes



S01@22'
2308637-01 (Soil)

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Total Metals by EPA 6020B

Arsenic	**1.53**	0.200	mg/kg dry	1	BGH1207	08/30/23	08/31/23	EPA 6020B	
Barium	**70.8**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**5.21**	0.400	"	"	"	"	"	"	
Lead	**11.4**	0.200	"	"	"	"	"	"	
Nickel	**0.698**	0.400	"	"	"	"	"	"	
Silver	**0.0457**	0.0200	"	"	"	"	"	"	
Zinc	**4.54**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH1208	08/30/23	08/30/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/29/23 10:17**

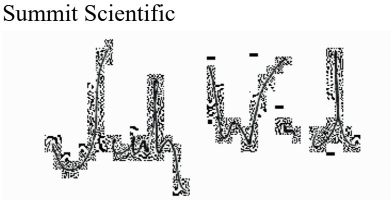
Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**50.4**	0.0642	mg/L dry	1	BGH1254	08/31/23	09/04/23	EPA 6020B	
Magnesium	**8.48**	0.0642	"	"	"	"	"	"	
Sodium	**73.4**	0.0642	"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**2.52**	0.00100	units	1	BGI0094	09/05/23	09/05/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods



Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 14-17, 4-175
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
09/07/23 09:05

S01@22'

2308637-01 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**77.8**		%	1	BGH1199	08/30/23	08/30/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

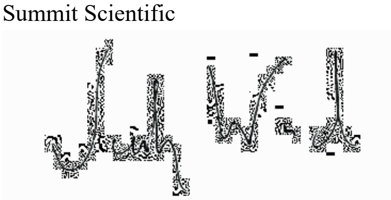
Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.546**	0.0100	mmhos/cm	1	BGI0003	09/01/23	09/01/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/29/23 10:17**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.84**		pH Units	1	BGI0004	09/01/23	09/01/23	EPA 9045D	



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17, 4-175 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 09/07/23 09:05

S02@22'

2308637-02 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	**0.010**	0.0020	mg/kg	1	BGH1192	08/29/23	08/30/23	EPA 8260B	
Toluene	ND	0.0050	"	"	"	"	"	"	
Ethylbenzene	**0.51**	0.0050	"	"	"	"	"	"	
Xylenes (total)	**5.5**	0.010	"	"	"	"	08/29/23	"	
1,2,4-Trimethylbenzene	**0.74**	0.050	"	10	"	"	"	"	
1,3,5-Trimethylbenzene	**0.57**	0.050	"	"	"	"	"	"	
Naphthalene	**0.080**	0.0038	"	1	"	"	08/30/23	"	
Gasoline Range Hydrocarbons	**38**	5.0	"	10	"	"	08/29/23	"	

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4	0.0348	*87.0 %*	*50-150*		*"*	*"*	*08/30/23*	*"*	
Surrogate: Toluene-d8	0.0368	*91.9 %*	*50-150*		*"*	*"*	*"*	*"*	
Surrogate: 4-Bromofluorobenzene	0.134	*335 %*	*50-150*		*"*	*"*	*"*	*"*	*S-02*

Extractable Petroleum Hydrocarbons by 8015

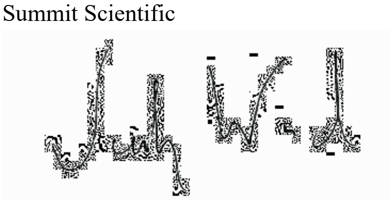
Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50	mg/kg	1	BGH1136	08/29/23	08/29/23	EPA 8015M	
C28-C36 (ORO)	ND	50	"	"	"	"	"	"	

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl	13.1	*105 %*	*30-150*		*"*	*"*	*"*	*"*	

PAH by EPA Method 8270D SIM



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17, 4-175 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 09/07/23 09:05

S02@22'

2308637-02 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500	mg/kg	1	BGI0012	09/01/23	09/01/23	EPA 8270D SIM	
Anthracene	ND	0.00500	"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500	"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500	"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500	"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500	"	"	"	"	"	"	
Chrysene	ND	0.00500	"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500	"	"	"	"	"	"	
Fluoranthene	ND	0.00500	"	"	"	"	"	"	
Fluorene	ND	0.00500	"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500	"	"	"	"	"	"	
Pyrene	ND	0.00500	"	"	"	"	"	"	
1-Methylnaphthalene	**0.00535**	0.00500	"	"	"	"	"	"	
2-Methylnaphthalene	**0.0267**	0.00500	"	"	"	"	"	"	

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10	0.00719	*21.6 %*	*40-150*		"	"	"	"	*S-04*
Surrogate: Fluoranthene-d10	0.0139	*41.7 %*	*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.902**	0.0100	mg/L	1	BGH1200	08/30/23	08/31/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17, 4-175 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 09/07/23 09:05

S02@22'

2308637-02 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**1.71**	0.200	mg/kg dry	1	BGH1207	08/30/23	08/31/23	EPA 6020B	
Barium	**272**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**3.72**	0.400	"	"	"	"	"	"	
Lead	**9.25**	0.200	"	"	"	"	"	"	
Nickel	**6.14**	0.400	"	"	"	"	"	"	
Silver	**0.0345**	0.0200	"	"	"	"	"	"	
Zinc	**9.99**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH1208	08/30/23	08/30/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/29/23 10:04**

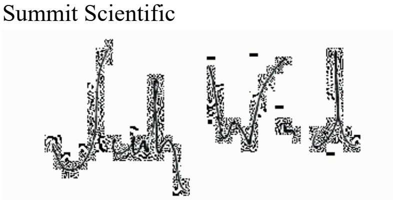
Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**0.204**	0.0616	mg/L dry	1	BGH1254	08/31/23	09/04/23	EPA 6020B	
Magnesium	ND	0.0616	"	"	"	"	"	"	
Sodium	ND	0.0616	"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	ND	0.00100	units	1	BGI0094	09/05/23	09/05/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods



Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 14-17, 4-175
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
09/07/23 09:05

S02@22'

2308637-02 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**81.2**		%	1	BGH1199	08/30/23	08/30/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

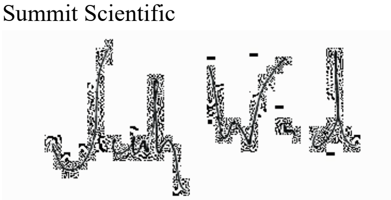
Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.518**	0.0100	mmhos/cm	1	BGI0003	09/01/23	09/01/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/29/23 10:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**9.53**		pH Units	1	BGI0004	09/01/23	09/01/23	EPA 9045D	



S03@22'

2308637-03 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	**0.033**	0.0020	mg/kg	1	BGH1192	08/29/23	08/30/23	EPA 8260B	
Toluene	ND	0.0050	"	"	"	"	"	"	
Ethylbenzene	**0.097**	0.0050	"	"	"	"	"	"	
Xylenes (total)	**1.2**	0.010	"	"	"	"	"	"	
1,2,4-Trimethylbenzene	**0.54**	0.0050	"	"	"	"	"	"	
1,3,5-Trimethylbenzene	**0.41**	0.0050	"	"	"	"	"	"	
Naphthalene	**0.062**	0.0038	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**34**	0.50	"	"	"	"	"	"	

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4	0.0281	*70.4 %*		*50-150*	"	"	"	"	
Surrogate: Toluene-d8	0.0394	*98.6 %*		*50-150*	"	"	"	"	
Surrogate: 4-Bromofluorobenzene	0.0640	*160 %*		*50-150*	"	"	"	"	*S-02*

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50	mg/kg	1	BGH1136	08/29/23	08/29/23	EPA 8015M	
C28-C36 (ORO)	ND	50	"	"	"	"	"	"	

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl	12.1	*96.9 %*		*30-150*	"	"	"	"	

PAH by EPA Method 8270D SIM

S03@22'

2308637-03 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500	mg/kg	1	BGI0012	09/01/23	09/01/23	EPA 8270D SIM	
Anthracene	ND	0.00500	"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500	"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500	"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500	"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500	"	"	"	"	"	"	
Chrysene	ND	0.00500	"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500	"	"	"	"	"	"	
Fluoranthene	ND	0.00500	"	"	"	"	"	"	
Fluorene	ND	0.00500	"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500	"	"	"	"	"	"	
Pyrene	ND	0.00500	"	"	"	"	"	"	
1-Methylnaphthalene	**0.0178**	0.00500	"	"	"	"	"	"	
2-Methylnaphthalene	**0.00587**	0.00500	"	"	"	"	"	"	

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10	0.00985	*29.6 %*	*40-150*		"	"	"	"	*S-04*
Surrogate: Fluoranthene-d10	0.0143	*43.0 %*	*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.154**	0.0100	mg/L	1	BGH1200	08/30/23	08/31/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 14-17, 4-175
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
09/07/23 09:05

S03@22'
2308637-03 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**20.0**	0.200	mg/kg dry	1	BGH1207	08/30/23	08/31/23	EPA 6020B	
Barium	**159**	0.400	"	"	"	"	"	"	
Cadmium	**0.204**	0.200	"	"	"	"	"	"	
Copper	**5.08**	0.400	"	"	"	"	"	"	
Lead	**20.0**	0.200	"	"	"	"	"	"	
Nickel	**1.32**	0.400	"	"	"	"	"	"	
Silver	**0.0357**	0.0200	"	"	"	"	"	"	
Zinc	**7.07**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH1208	08/30/23	08/30/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**104**	0.0594	mg/L dry	1	BGH1254	08/31/23	09/04/23	EPA 6020B	
Magnesium	**16.4**	0.0594	"	"	"	"	"	"	
Sodium	**28.0**	0.0594	"	"	"	"	"	"	

Calculated Analysis

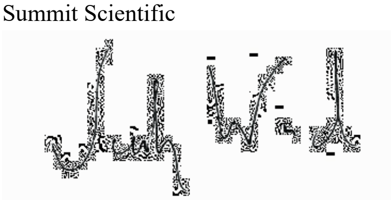
Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**0.674**	0.00100	units	1	BGI0094	09/05/23	09/05/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes



S03@22'

2308637-03 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

% Solids	**84.1**		%	1	BGH1199	08/30/23	08/30/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.448**	0.0100	mmhos/cm	1	BGI0003	09/01/23	09/01/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/29/23 09:57**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.92**		pH Units	1	BGI0004	09/01/23	09/01/23	EPA 9045D	

W04@22'

2308637-04 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020	mg/kg	1	BGH1192	08/29/23	08/29/23	EPA 8260B	
Toluene	ND	0.0050	"	"	"	"	"	"	
Ethylbenzene	ND	0.0050	"	"	"	"	"	"	
Xylenes (total)	ND	0.010	"	"	"	"	"	"	
1,2,4-Trimethylbenzene	ND	0.0050	"	"	"	"	"	"	
1,3,5-Trimethylbenzene	**0.0052**	0.0050	"	"	"	"	"	"	
Naphthalene	ND	0.0038	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**1.8**	0.50	"	"	"	"	"	"	

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4	0.0263	*65.7 %*	*50-150*		"	"	"	"	
Surrogate: Toluene-d8	0.0362	*90.5 %*	*50-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene	0.0391	*97.6 %*	*50-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50	mg/kg	1	BGH1136	08/29/23	08/29/23	EPA 8015M	
C28-C36 (ORO)	ND	50	"	"	"	"	"	"	

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl	12.9	*103 %*	*30-150*		"	"	"	"	

PAH by EPA Method 8270D SIM

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Project Number: Project Manager:	Miller 14-17, 4-175 [none] Mike Dinkel	**Reported:** 09/07/23 09:05

W04@22'

2308637-04 (Soil)

Summit Scientific

PAH by EPA Method 8270D SIM

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Acenaphthene	ND	0.00500	mg/kg	1	BGI0070	09/05/23	09/05/23	EPA 8270D SIM	
Anthracene	ND	0.00500	"	"	"	"	"	"	
Benzo (a) anthracene	ND	0.00500	"	"	"	"	"	"	
Benzo (a) pyrene	ND	0.00500	"	"	"	"	"	"	
Benzo (b) fluoranthene	ND	0.00500	"	"	"	"	"	"	
Benzo (k) fluoranthene	ND	0.00500	"	"	"	"	"	"	
Chrysene	ND	0.00500	"	"	"	"	"	"	
Dibenz (a,h) anthracene	ND	0.00500	"	"	"	"	"	"	
Fluoranthene	ND	0.00500	"	"	"	"	"	"	
Fluorene	ND	0.00500	"	"	"	"	"	"	
Indeno (1,2,3-cd) pyrene	ND	0.00500	"	"	"	"	"	"	
Pyrene	ND	0.00500	"	"	"	"	"	"	
1-Methylnaphthalene	ND	0.00500	"	"	"	"	"	"	
2-Methylnaphthalene	ND	0.00500	"	"	"	"	"	"	

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 2-Methylnaphthalene-d10	0.0177	*53.2 %*	*40-150*		"	"	"	"	
Surrogate: Fluoranthene-d10	0.0144	*43.2 %*	*40-150*		"	"	"	"	

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	ND	0.0100	mg/L	1	BGH1200	08/30/23	08/31/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 14-17, 4-175
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
09/07/23 09:05

W04@22'

2308637-04 (Soil)

Summit Scientific

Total Metals by EPA 6020B

Arsenic	**1.20**	0.200	mg/kg dry	1	BGH1207	08/30/23	08/31/23	EPA 6020B	
Barium	**68.2**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**5.29**	0.400	"	"	"	"	"	"	
Lead	**14.0**	0.200	"	"	"	"	"	"	
Nickel	**1.24**	0.400	"	"	"	"	"	"	
Silver	**0.0363**	0.0200	"	"	"	"	"	"	
Zinc	**7.68**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH1208	08/30/23	08/30/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/29/23 10:22**

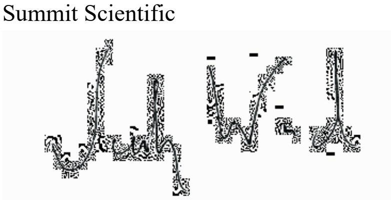
Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**204**	0.0597	mg/L dry	1	BGH1254	08/31/23	09/04/23	EPA 6020B	
Magnesium	**32.2**	0.0597	"	"	"	"	"	"	
Sodium	**50.5**	0.0597	"	"	"	"	"	"	

Calculated Analysis

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**0.867**	0.00100	units	1	BGI0094	09/05/23	09/05/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17, 4-175 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 09/07/23 09:05

W04@22'

2308637-04 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**83.7**		%	1	BGH1199	08/30/23	08/30/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

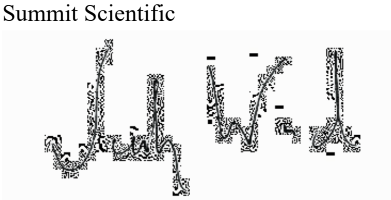
Date Sampled: **08/29/23 10:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.488**	0.0100	mmhos/cm	1	BGI0003	09/01/23	09/01/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/29/23 10:22**

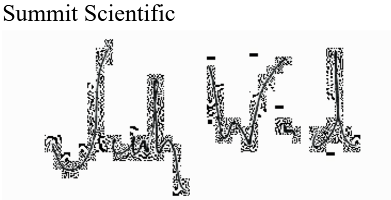
Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**9.73**		pH Units	1	BGI0004	09/01/23	09/01/23	EPA 9045D	



Volatile Organic Compounds by EPA Method 8260B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH1192 - EPA 5030 Soil MS										
Blank (BGH1192-BLK1)				Prepared: 08/29/23 Analyzed: 08/30/23						
Benzene	ND	0.0020	mg/kg							
Toluene	ND	0.0050	"							
Ethylbenzene	ND	0.0050	"							
Xylenes (total)	ND	0.010	"							
1,2,4-Trimethylbenzene	ND	0.0050	"							
1,3,5-Trimethylbenzene	ND	0.0050	"							
Naphthalene	ND	0.0038	"							
Gasoline Range Hydrocarbons	ND	0.50	"							
Surrogate: 1,2-Dichloroethane-d4	*0.0255*		*"*	*0.0400*		*63.7*	*50-150*			
Surrogate: Toluene-d8	*0.0359*		*"*	*0.0400*		*89.7*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0300*		*"*	*0.0400*		*75.1*	*50-150*			
LCS (BGH1192-BS1)				Prepared: 08/29/23 Analyzed: 08/30/23						
Benzene	0.0922	0.0020	mg/kg	0.100		92.2	70-130			
Toluene	0.0906	0.0050	"	0.100		90.6	70-130			
Ethylbenzene	0.102	0.0050	"	0.100		102	70-130			
m,p-Xylene	0.188	0.010	"	0.200		93.8	70-130			
o-Xylene	0.0746	0.0050	"	0.100		74.6	70-130			
1,2,4-Trimethylbenzene	0.0785	0.0050	"	0.100		78.5	70-130			
1,3,5-Trimethylbenzene	0.0732	0.0050	"	0.100		73.2	70-130			
Naphthalene	0.100	0.0038	"	0.100		100	70-130			
Surrogate: 1,2-Dichloroethane-d4	*0.0260*		*"*	*0.0400*		*65.0*	*50-150*			
Surrogate: Toluene-d8	*0.0367*		*"*	*0.0400*		*91.7*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0300*		*"*	*0.0400*		*74.9*	*50-150*			
Matrix Spike (BGH1192-MS1)	**Source: 2308385-01RE1**			Prepared: 08/29/23 Analyzed: 08/30/23						
Benzene	0.0977	0.0020	mg/kg	0.100	ND	97.7	70-130			
Toluene	0.0892	0.0050	"	0.100	ND	89.2	70-130			
Ethylbenzene	0.149	0.0050	"	0.100	ND	149	70-130			QM-07
m,p-Xylene	0.351	0.010	"	0.200	ND	175	70-130			QM-07
o-Xylene	0.0907	0.0050	"	0.100	ND	90.7	70-130			
1,2,4-Trimethylbenzene	0.242	0.0050	"	0.100	ND	242	70-130			QM-07
1,3,5-Trimethylbenzene	0.197	0.0050	"	0.100	ND	197	70-130			QM-07
Naphthalene	0.116	0.0038	"	0.100	ND	116	70-130			
Surrogate: 1,2-Dichloroethane-d4	*0.0279*		*"*	*0.0400*		*69.8*	*50-150*			
Surrogate: Toluene-d8	*0.0381*		*"*	*0.0400*		*95.3*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0351*		*"*	*0.0400*		*87.8*	*50-150*			



Volatile Organic Compounds by EPA Method 8260B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH1192 - EPA 5030 Soil MS										
Matrix Spike Dup (BGH1192-MSD1)		**Source: 2308385-01RE1**		Prepared: 08/29/23 Analyzed: 08/30/23						
Benzene	0.0912	0.0020	mg/kg	0.100	ND	91.2	70-130	6.89	30	
Toluene	0.0861	0.0050	"	0.100	ND	86.1	70-130	3.56	30	
Ethylbenzene	0.156	0.0050	"	0.100	ND	156	70-130	4.78	30	QM-07
m,p-Xylene	0.376	0.010	"	0.200	ND	188	70-130	7.00	30	QM-07
o-Xylene	0.100	0.0050	"	0.100	ND	100	70-130	9.84	30	
1,2,4-Trimethylbenzene	0.350	0.0050	"	0.100	ND	350	70-130	36.3	30	QM-07
1,3,5-Trimethylbenzene	0.287	0.0050	"	0.100	ND	287	70-130	37.4	30	QM-07
Naphthalene	0.118	0.0038	"	0.100	ND	118	70-130	1.69	30	
Surrogate: 1,2-Dichloroethane-d4	*0.0282*		*"*	*0.0400*		*70.5*	*50-150*			
Surrogate: Toluene-d8	*0.0388*		*"*	*0.0400*		*97.0*	*50-150*			
Surrogate: 4-Bromofluorobenzene	*0.0421*		*"*	*0.0400*		*105*	*50-150*			

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17, 4-175 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 09/07/23 09:05

Extractable Petroleum Hydrocarbons by 8015 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH1136 - EPA 3550A										
Blank (BGH1136-BLK1)				Prepared: 08/28/23 Analyzed: 08/29/23						
C10-C28 (DRO)	ND	50	mg/kg							
C28-C36 (ORO)	ND	50	"							
Surrogate: o-Terphenyl	*12.4*		*"*	*12.5*		*99.2*	*30-150*			
LCS (BGH1136-BS1)				Prepared: 08/28/23 Analyzed: 08/29/23						
C10-C28 (DRO)	524	50	mg/kg	500		105	70-130			
Surrogate: o-Terphenyl	*12.9*		*"*	*12.5*		*103*	*30-150*			
Matrix Spike (BGH1136-MS1)	**Source: 2308616-01**			Prepared: 08/28/23 Analyzed: 08/29/23						
C10-C28 (DRO)	440	50	mg/kg	500	5.38	86.9	70-130			
Surrogate: o-Terphenyl	*12.1*		*"*	*12.5*		*96.4*	*30-150*			
Matrix Spike Dup (BGH1136-MSD1)	**Source: 2308616-01**			Prepared: 08/28/23 Analyzed: 08/29/23						
C10-C28 (DRO)	470	50	mg/kg	500	5.38	92.9	70-130	6.55	20	
Surrogate: o-Terphenyl	*12.5*		*"*	*12.5*		*99.7*	*30-150*			

PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGI0012 - EPA 5030 Soil MS										
Blank (BGI0012-BLK1)				Prepared & Analyzed: 09/01/23						
Acenaphthene	ND	0.00500	mg/kg							
Anthracene	ND	0.00500	"							
Benzo (a) anthracene	ND	0.00500	"							
Benzo (a) pyrene	ND	0.00500	"							
Benzo (b) fluoranthene	ND	0.00500	"							
Benzo (k) fluoranthene	ND	0.00500	"							
Chrysene	ND	0.00500	"							
Dibenz (a,h) anthracene	ND	0.00500	"							
Fluoranthene	ND	0.00500	"							
Fluorene	ND	0.00500	"							
Indeno (1,2,3-cd) pyrene	ND	0.00500	"							
Pyrene	ND	0.00500	"							
1-Methylnaphthalene	ND	0.00500	"							
2-Methylnaphthalene	ND	0.00500	"							
Surrogate: 2-Methylnaphthalene-d10	*0.0248*		*"*	*0.0333*		*74.5*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0224*		*"*	*0.0333*		*67.2*	*40-150*			
LCS (BGI0012-BS1)				Prepared & Analyzed: 09/01/23						
Acenaphthene	0.0248	0.00500	mg/kg	0.0333		74.3	31-137			
Anthracene	0.0241	0.00500	"	0.0333		72.2	30-120			
Benzo (a) anthracene	0.0265	0.00500	"	0.0333		79.5	30-120			
Benzo (a) pyrene	0.0240	0.00500	"	0.0333		71.9	30-120			
Benzo (b) fluoranthene	0.0261	0.00500	"	0.0333		78.4	30-120			
Benzo (k) fluoranthene	0.0255	0.00500	"	0.0333		76.5	30-120			
Chrysene	0.0255	0.00500	"	0.0333		76.5	30-120			
Dibenz (a,h) anthracene	0.0244	0.00500	"	0.0333		73.2	30-120			
Fluoranthene	0.0235	0.00500	"	0.0333		70.5	30-120			
Fluorene	0.0257	0.00500	"	0.0333		77.1	30-120			
Indeno (1,2,3-cd) pyrene	0.0200	0.00500	"	0.0333		60.0	30-120			
Pyrene	0.0266	0.00500	"	0.0333		79.7	35-142			
1-Methylnaphthalene	0.0242	0.00500	"	0.0333		72.5	35-142			
2-Methylnaphthalene	0.0246	0.00500	"	0.0333		73.9	35-142			
Surrogate: 2-Methylnaphthalene-d10	*0.0278*		*"*	*0.0333*		*83.3*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0232*		*"*	*0.0333*		*69.7*	*40-150*			

PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

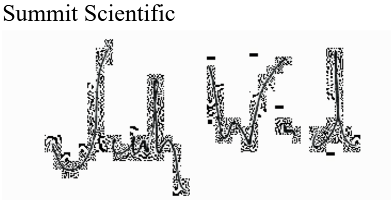
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGI0012 - EPA 5030 Soil MS										
Matrix Spike (BGI0012-MS1)	**Source: 2308633-01**			Prepared & Analyzed: 09/01/23						
Acenaphthene	0.0173	0.00500	mg/kg	0.0333	ND	52.0	31-137			
Anthracene	0.0159	0.00500	"	0.0333	ND	47.7	30-120			
Benzo (a) anthracene	0.0179	0.00500	"	0.0333	ND	53.7	30-120			
Benzo (a) pyrene	0.0160	0.00500	"	0.0333	ND	48.0	30-120			
Benzo (b) fluoranthene	0.0182	0.00500	"	0.0333	ND	54.7	30-120			
Benzo (k) fluoranthene	0.0180	0.00500	"	0.0333	ND	54.1	30-120			
Chrysene	0.0172	0.00500	"	0.0333	ND	51.6	30-120			
Dibenz (a,h) anthracene	0.0169	0.00500	"	0.0333	ND	50.8	30-120			
Fluoranthene	0.0153	0.00500	"	0.0333	ND	46.0	30-120			
Fluorene	0.0171	0.00500	"	0.0333	ND	51.3	30-120			
Indeno (1,2,3-cd) pyrene	0.0144	0.00500	"	0.0333	ND	43.1	30-120			
Pyrene	0.0185	0.00500	"	0.0333	ND	55.6	35-142			
1-Methylnaphthalene	0.0159	0.00500	"	0.0333	ND	47.6	15-130			
2-Methylnaphthalene	0.0167	0.00500	"	0.0333	ND	50.2	15-130			
Surrogate: 2-Methylnaphthalene-d10	*0.0145*		*"*	*0.0333*		*43.5*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0145*		*"*	*0.0333*		*43.6*	*40-150*			
Matrix Spike Dup (BGI0012-MSD1)	**Source: 2308633-01**			Prepared & Analyzed: 09/01/23						
Acenaphthene	0.0146	0.00500	mg/kg	0.0333	ND	43.8	31-137	17.1	30	
Anthracene	0.0138	0.00500	"	0.0333	ND	41.4	30-120	14.1	30	
Benzo (a) anthracene	0.0157	0.00500	"	0.0333	ND	47.1	30-120	13.2	30	
Benzo (a) pyrene	0.0139	0.00500	"	0.0333	ND	41.7	30-120	14.0	30	
Benzo (b) fluoranthene	0.0162	0.00500	"	0.0333	ND	48.5	30-120	11.9	30	
Benzo (k) fluoranthene	0.0160	0.00500	"	0.0333	ND	48.1	30-120	11.6	30	
Chrysene	0.0152	0.00500	"	0.0333	ND	45.6	30-120	12.3	30	
Dibenz (a,h) anthracene	0.0151	0.00500	"	0.0333	ND	45.4	30-120	11.4	30	
Fluoranthene	0.0144	0.00500	"	0.0333	ND	43.1	30-120	6.49	30	
Fluorene	0.0151	0.00500	"	0.0333	ND	45.4	30-120	12.3	30	
Indeno (1,2,3-cd) pyrene	0.0126	0.00500	"	0.0333	ND	37.9	30-120	12.9	30	
Pyrene	0.0161	0.00500	"	0.0333	ND	48.3	35-142	14.0	30	
1-Methylnaphthalene	0.0198	0.00500	"	0.0333	ND	59.5	15-130	22.1	50	
2-Methylnaphthalene	0.0135	0.00500	"	0.0333	ND	40.6	15-130	21.2	50	
Surrogate: 2-Methylnaphthalene-d10	*0.0172*		*"*	*0.0333*		*51.7*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0135*		*"*	*0.0333*		*40.6*	*40-150*			

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17, 4-175 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 09/07/23 09:05

PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGI0070 - EPA 5030 Soil MS										
Blank (BGI0070-BLK1)				Prepared & Analyzed: 09/05/23						
Acenaphthene	ND	0.00500	mg/kg							
Anthracene	ND	0.00500	"							
Benzo (a) anthracene	ND	0.00500	"							
Benzo (a) pyrene	ND	0.00500	"							
Benzo (b) fluoranthene	ND	0.00500	"							
Benzo (k) fluoranthene	ND	0.00500	"							
Chrysene	ND	0.00500	"							
Dibenz (a,h) anthracene	ND	0.00500	"							
Fluoranthene	ND	0.00500	"							
Fluorene	ND	0.00500	"							
Indeno (1,2,3-cd) pyrene	ND	0.00500	"							
Pyrene	ND	0.00500	"							
1-Methylnaphthalene	ND	0.00500	"							
2-Methylnaphthalene	ND	0.00500	"							
Surrogate: 2-Methylnaphthalene-d10	*0.0245*		*"*	*0.0333*		*73.6*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0372*		*"*	*0.0333*		*112*	*40-150*			
LCS (BGI0070-BS1)				Prepared & Analyzed: 09/05/23						
Acenaphthene	0.0228	0.00500	mg/kg	0.0333		68.4	31-137			
Anthracene	0.0283	0.00500	"	0.0333		84.9	30-120			
Benzo (a) anthracene	0.0301	0.00500	"	0.0333		90.4	30-120			
Benzo (a) pyrene	0.0279	0.00500	"	0.0333		83.8	30-120			
Benzo (b) fluoranthene	0.0295	0.00500	"	0.0333		88.6	30-120			
Benzo (k) fluoranthene	0.0313	0.00500	"	0.0333		93.8	30-120			
Chrysene	0.0327	0.00500	"	0.0333		98.0	30-120			
Dibenz (a,h) anthracene	0.0245	0.00500	"	0.0333		73.4	30-120			
Fluoranthene	0.0312	0.00500	"	0.0333		93.7	30-120			
Fluorene	0.0235	0.00500	"	0.0333		70.4	30-120			
Indeno (1,2,3-cd) pyrene	0.0324	0.00500	"	0.0333		97.1	30-120			
Pyrene	0.0331	0.00500	"	0.0333		99.3	35-142			
1-Methylnaphthalene	0.0352	0.00500	"	0.0333		106	35-142			
2-Methylnaphthalene	0.0357	0.00500	"	0.0333		107	35-142			
Surrogate: 2-Methylnaphthalene-d10	*0.0279*		*"*	*0.0333*		*83.8*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0317*		*"*	*0.0333*		*95.0*	*40-150*			



Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 14-17, 4-175
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
09/07/23 09:05

PAH by EPA Method 8270D SIM - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGI0070 - EPA 5030 Soil MS										
Matrix Spike (BGI0070-MS1)		**Source: 2308637-04**		Prepared & Analyzed: 09/05/23						
Acenaphthene	0.0135	0.00500	mg/kg	0.0333	ND	40.6	31-137			
Anthracene	0.0138	0.00500	"	0.0333	ND	41.4	30-120			
Benzo (a) anthracene	0.0169	0.00500	"	0.0333	ND	50.8	30-120			
Benzo (a) pyrene	0.0147	0.00500	"	0.0333	ND	44.2	30-120			
Benzo (b) fluoranthene	0.0156	0.00500	"	0.0333	ND	46.8	30-120			
Benzo (k) fluoranthene	0.0164	0.00500	"	0.0333	ND	49.2	30-120			
Chrysene	0.0175	0.00500	"	0.0333	ND	52.6	30-120			
Dibenz (a,h) anthracene	0.0151	0.00500	"	0.0333	ND	45.2	30-120			
Fluoranthene	0.0153	0.00500	"	0.0333	ND	46.0	30-120			
Fluorene	0.0137	0.00500	"	0.0333	ND	41.0	30-120			
Indeno (1,2,3-cd) pyrene	0.0168	0.00500	"	0.0333	ND	50.3	30-120			
Pyrene	0.0177	0.00500	"	0.0333	ND	53.2	35-142			
1-Methylnaphthalene	0.0171	0.00500	"	0.0333	ND	51.4	15-130			
2-Methylnaphthalene	0.0190	0.00500	"	0.0333	ND	57.0	15-130			
Surrogate: 2-Methylnaphthalene-d10	*0.0190*		*"*	*0.0333*		*57.0*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0160*		*"*	*0.0333*		*48.0*	*40-150*			
Matrix Spike Dup (BGI0070-MSD1)		**Source: 2308637-04**		Prepared & Analyzed: 09/05/23						
Acenaphthene	0.0135	0.00500	mg/kg	0.0333	ND	40.5	31-137	0.288	30	
Anthracene	0.0140	0.00500	"	0.0333	ND	42.1	30-120	1.79	30	
Benzo (a) anthracene	0.0138	0.00500	"	0.0333	ND	41.5	30-120	20.0	30	
Benzo (a) pyrene	0.0146	0.00500	"	0.0333	ND	43.7	30-120	1.17	30	
Benzo (b) fluoranthene	0.0140	0.00500	"	0.0333	ND	41.9	30-120	11.2	30	
Benzo (k) fluoranthene	0.0153	0.00500	"	0.0333	ND	45.8	30-120	7.03	30	
Chrysene	0.0143	0.00500	"	0.0333	ND	42.9	30-120	20.4	30	
Dibenz (a,h) anthracene	0.0135	0.00500	"	0.0333	ND	40.4	30-120	11.2	30	
Fluoranthene	0.0140	0.00500	"	0.0333	ND	41.9	30-120	9.30	30	
Fluorene	0.0162	0.00500	"	0.0333	ND	48.6	30-120	16.9	30	
Indeno (1,2,3-cd) pyrene	0.0134	0.00500	"	0.0333	ND	40.3	30-120	22.1	30	
Pyrene	0.0150	0.00500	"	0.0333	ND	45.0	35-142	16.6	30	
1-Methylnaphthalene	0.0138	0.00500	"	0.0333	ND	41.3	15-130	21.8	50	
2-Methylnaphthalene	0.0144	0.00500	"	0.0333	ND	43.3	15-130	27.2	50	
Surrogate: 2-Methylnaphthalene-d10	*0.0157*		*"*	*0.0333*		*47.2*	*40-150*			
Surrogate: Fluoranthene-d10	*0.0140*		*"*	*0.0333*		*41.9*	*40-150*			

Total Metals by EPA 6020B Hot Water Soluble Extraction - Quality Control

Summit Scientific

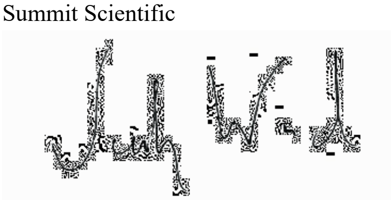
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH1200 - EPA 3050B										
Blank (BGH1200-BLK1)				Prepared: 08/30/23 Analyzed: 08/31/23						
Boron	ND	0.0100	mg/L							
LCS (BGH1200-BS1)				Prepared: 08/30/23 Analyzed: 08/31/23						
Boron	5.91	0.0100	mg/L	5.00		118	80-120			
Duplicate (BGH1200-DUP1)		**Source: 2306151-10**		Prepared: 08/30/23 Analyzed: 08/31/23						
Boron	ND	0.0100	mg/L		0.0456			200	20	QR-01
Matrix Spike (BGH1200-MS1)		**Source: 2306151-10**		Prepared: 08/30/23 Analyzed: 08/31/23						
Boron	6.40	0.0100	mg/L	5.00	0.0456	127	75-125			QM-01
Matrix Spike Dup (BGH1200-MSD1)		**Source: 2306151-10**		Prepared: 08/30/23 Analyzed: 08/31/23						
Boron	6.86	0.0100	mg/L	5.00	0.0456	136	75-125	6.93	25	QM-01

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17, 4-175 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 09/07/23 09:05

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH1207 - EPA 3050B										
Blank (BGH1207-BLK1)				Prepared: 08/30/23 Analyzed: 08/31/23						
Arsenic	ND	0.200	mg/kg wet							
Barium	ND	0.400	"							
Cadmium	ND	0.200	"							
Copper	ND	0.400	"							
Lead	ND	0.200	"							
Nickel	ND	0.400	"							
Silver	ND	0.0200	"							
Zinc	ND	0.400	"							
Selenium	ND	0.260	"							
LCS (BGH1207-BS1)				Prepared: 08/30/23 Analyzed: 08/31/23						
Arsenic	38.2	0.200	mg/kg wet	40.0		95.6	80-120			
Barium	41.4	0.400	"	40.0		103	80-120			
Cadmium	2.10	0.200	"	2.00		105	80-120			
Copper	37.1	0.400	"	40.0		92.9	80-120			
Lead	20.7	0.200	"	20.0		103	80-120			
Nickel	36.9	0.400	"	40.0		92.1	80-120			
Silver	2.08	0.0200	"	2.00		104	80-120			
Zinc	37.4	0.400	"	40.0		93.5	80-120			
Duplicate (BGH1207-DUP1)		**Source: 2308637-01**		Prepared: 08/30/23 Analyzed: 08/31/23						
Arsenic	2.08	0.200	mg/kg dry		1.53			30.2	20	QR-01
Barium	73.3	0.400	"		70.8			3.40	20	
Cadmium	0.0612	0.200	"		0.0653			6.50	20	
Copper	5.61	0.400	"		5.21			7.48	20	
Lead	11.7	0.200	"		11.4			2.81	20	
Nickel	0.834	0.400	"		0.698			17.6	20	
Silver	0.0380	0.0200	"		0.0457			18.4	20	
Zinc	4.90	0.400	"		4.54			7.81	20	
Selenium	ND	0.260	"		ND				200	



Civitas Resources
650 Southgate Drive
Windsor CO, 80550

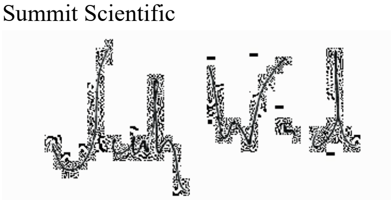
Project: Miller 14-17, 4-175
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
09/07/23 09:05

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH1207 - EPA 3050B										
Matrix Spike (BGH1207-MS1)		**Source: 2308637-01**		Prepared: 08/30/23 Analyzed: 08/31/23						
Arsenic	16.2	0.200	mg/kg dry	51.4	1.53	28.4	75-125			QM-01
Barium	120	0.400	"	51.4	70.8	96.0	75-125			
Cadmium	2.48	0.200	"	2.57	0.0653	94.1	75-125			
Copper	20.3	0.400	"	51.4	5.21	29.4	75-125			QM-01
Lead	33.4	0.200	"	25.7	11.4	85.7	75-125			
Nickel	15.6	0.400	"	51.4	0.698	29.1	75-125			QM-01
Silver	2.49	0.0200	"	2.57	0.0457	95.1	75-125			
Zinc	19.3	0.400	"	51.4	4.54	28.8	75-125			QM-01
Matrix Spike Dup (BGH1207-MSD1)		**Source: 2308637-01**		Prepared: 08/30/23 Analyzed: 08/31/23						
Arsenic	16.6	0.200	mg/kg dry	51.4	1.53	29.4	75-125	2.93	25	QM-01
Barium	141	0.400	"	51.4	70.8	136	75-125	15.9	25	QM-01
Cadmium	2.63	0.200	"	2.57	0.0653	99.9	75-125	5.82	25	
Copper	20.0	0.400	"	51.4	5.21	28.8	75-125	1.45	25	QM-01
Lead	34.4	0.200	"	25.7	11.4	89.7	75-125	3.02	25	
Nickel	15.8	0.400	"	51.4	0.698	29.4	75-125	1.19	25	QM-01
Silver	2.59	0.0200	"	2.57	0.0457	99.1	75-125	4.09	25	
Zinc	20.4	0.400	"	51.4	4.54	31.0	75-125	5.70	25	QM-01



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17, 4-175 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 09/07/23 09:05

Hexavalent Chromium by EPA Method 7196 - Quality Control

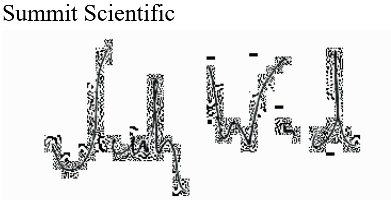
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH1208 - 3060A_Mod										
Blank (BGH1208-BLK1)				Prepared & Analyzed: 08/30/23						
Chromium, Hexavalent	ND	0.30	mg/kg wet							
LCS (BGH1208-BS1)				Prepared & Analyzed: 08/30/23						
Chromium, Hexavalent	27.0	0.30	mg/kg wet	25.0		108	80-120			
Duplicate (BGH1208-DUP1)	**Source: 2308637-01**			Prepared & Analyzed: 08/30/23						
Chromium, Hexavalent	ND	0.30	mg/kg dry		ND				20	
Matrix Spike (BGH1208-MS1)	**Source: 2308637-01**			Prepared & Analyzed: 08/30/23						
Chromium, Hexavalent	31.8	0.30	mg/kg dry	32.1	ND	99.0	75-125			
Matrix Spike Dup (BGH1208-MSD1)	**Source: 2308637-01**			Prepared & Analyzed: 08/30/23						
Chromium, Hexavalent	31.6	0.30	mg/kg dry	32.1	ND	98.4	75-125	0.608	20	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH1254 - General Preparation										
Blank (BGH1254-BLK1)				Prepared: 08/31/23 Analyzed: 09/04/23						
Calcium	ND	0.0500	mg/L wet							
Magnesium	ND	0.0500	"							
Sodium	ND	0.0500	"							
LCS (BGH1254-BS1)				Prepared: 08/31/23 Analyzed: 09/04/23						
Calcium	4.99	0.0500	mg/L wet	5.00		99.7	70-130			
Magnesium	5.94	0.0500	"	5.00		119	70-130			
Sodium	5.99	0.0500	"	5.00		120	70-130			



Physical Parameters by APHA/ASTM/EPA Methods - Quality Control

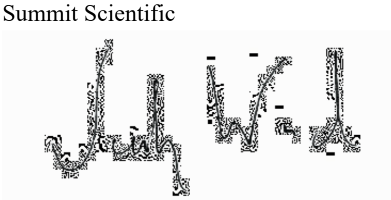
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH1199 - General Preparation										
Duplicate (BGH1199-DUP1)	**Source: 2308632-01**		Prepared & Analyzed: 08/30/23							
% Solids	85.9		%		86.4			0.648	20	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGI0003 - General Preparation										
Blank (BGI0003-BLK1)				Prepared & Analyzed: 09/01/23						
Specific Conductance (EC)	ND	0.0100	mmhos/cm							
LCS (BGI0003-BS1)				Prepared & Analyzed: 09/01/23						
Specific Conductance (EC)	0.155	0.0100	mmhos/cm	0.150		103	95-105			
Duplicate (BGI0003-DUP1)		**Source: 2308633-01**		Prepared & Analyzed: 09/01/23						
Specific Conductance (EC)	0.359	0.0100	mmhos/cm		0.359			0.0279	20	



Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGI0004 - General Preparation										
LCS (BGI0004-BS1)				Prepared & Analyzed: 09/01/23						
pH	9.12		pH Units	9.18		99.3	95-105			
Duplicate (BGI0004-DUP1)		**Source: 2308633-01**		Prepared & Analyzed: 09/01/23						
pH	8.35		pH Units		8.35			0.00	20	

Notes and Definitions

S-04	A sample matrix effect prevented complete surrogate recovery.
S-02	The surrogate recovery for this sample cannot be accurately quantified due to interference from coeluting organic compounds present in the sample extract.
QR-01	Analyses are not controlled on RPD values from sample concentrations less than 10 times the reporting limit. QC batch accepted based on LCS and/or LCSD QC results.
QM-07	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS/LCSD recovery.
QM-01	The spike recovery for this QC sample is outside of established control limits due to sample matrix interference.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Summit Scientific

4653 Table Mountain Drive, Golden, Colorado 80401

303.277.9310

April 03, 2023

Mike Dinkel

Civitas Resources

650 Southgate Drive

Windsor, CO 80550

RE: Miller 14-17

Work Order # 2303556

Enclosed are the results of analyses for samples received by Summit Scientific on 03/22/23 17:02. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Scott Sheely For Paul Shrewsbury

President

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BG03@4.5'	2303556-01	Soil	03/21/23 13:40	03/22/23 17:02
BG03@9-10'	2303556-02	Soil	03/21/23 13:50	03/22/23 17:02
BG03@14-15'	2303556-03	Soil	03/21/23 13:55	03/22/23 17:02
BG03@19-20'	2303556-04	Soil	03/21/23 14:00	03/22/23 17:02
BG04@4.5'	2303556-05	Soil	03/21/23 14:10	03/22/23 17:02
BG04@9-10'	2303556-06	Soil	03/21/23 14:20	03/22/23 17:02
BG04@14-15'	2303556-07	Soil	03/21/23 14:30	03/22/23 17:02
BG04@19-20'	2303556-08	Soil	03/21/23 14:40	03/22/23 17:02
BG05@4.5'	2303556-09	Soil	03/21/23 14:50	03/22/23 17:02
BG05@9-10'	2303556-10	Soil	03/21/23 15:00	03/22/23 17:02
BG05@14-15'	2303556-11	Soil	03/21/23 15:10	03/22/23 17:02
BG05@19-20'	2303556-12	Soil	03/21/23 15:20	03/22/23 17:02

SUMMIT SCIENTIFIC

4653 Table Mountain Drive
Golden, CO 80403
303-277-9310

Lab ID	Page 1 of 1
2303556	

	Send Data To:	Send Invoice To:
Client: Civitas	Project Manager: Mike Dinkel	Company: Civitas
Address: 650 Southgate	E-Mail: mdinkel@guardianconsultants	Project Name/Location:
City/State/Zip: Windsor CO	rshaw@guardianconsultants.com	AFE#:
Phone: 785-691-77	Project Name: Miller 14-17	PO/Billing Codes:
Sampler Name: Mike Dinkel	Project Number:	Contact: Jacob Evans

ID	Sample Description	Date Sampled	Time Sampled	# of containers	Preservative: HCl	HNO3	None	Other	Matrix: Water	Soil	Air-Canister #	Other	Analysis Requested: Table 915-1 Inorganics							Special Instructions
1	BG03@4-5'	3-21-23	1340	1			X			X			X							
2	BG03@ 9-10'		1350																	
3	BG03@ 14-15'		1355																	
4	BG03@ 19-20'		1400																	
5	BG04@4-5'		1410																	
6	BG04@ 9-10'		1420																	
7	BG04@14-15'		1430																	
8	BG04 @19-20'		1440																	
9	BG05 @4-5'		1450																	
10	BG05 @9-10'		1500																	
11	BG05 @14-15'		1510																	
12	BG05 @19-20		1520																	
13																				
14																				
15																				

Relinquished by:	Date/Time:	Received by:	Date/Time:	TAT Business Days		Field DO		Notes:
[signature]	3-22-23/1300	[signature]	3/22/23 1654	Same Day		Field EC		
Relinquished by: [signature]	Date/Time: 3/22/23 1654	Received by: [signature]	Date/Time: 3/22/23 1702	1 Day		Field ORP		
				2 Days		Field pH		
Relinquished by:	Date/Time:	Received by:	Date/Time:	3 Days		Field Temp.		
				Standard	X	Field Turb.		
Temperature Upon Receipt: 9.9		Corrected Temperature —		IR gun #: 02		HNO3 lot #:		

S2

Sample Receipt Checklist

S2 Work Order# 2303556

Client: Civitas Client Project ID: Miller 14-17

Shipped Via: H.D./P.U./FedEx/UPS/USPS/Other [ ] Airbill #:

[✓] [ ] [ ] [ ] [ ]

Matrix (Check all that apply) Air [ ] Soil/Solid [✓] Water [ ] Other [ ]

Temp (°C) 9.7 Thermometer # 02

	Yes	No	N/A	Comments (if any)
If samples require cooling, is the temperature < 6°C? (1) **NOTE:** If samples are delivered the same day of sampling, this requirement is met if there is evidence that cooling has begun.	✓			On Ice
If custody seals are present, are they intact? (1)			✓	
Are samples due within 48 hours present?		✓		
Are water samples with short hold times present? Note the short hold analysis in the comments column - pH, Nitrate/Nitrite, Ferrous Iron (Fe^{2+}), Hexavalent Chromium (Cr^{6+}, Cr VI), COD/BOD, Total Coliform, E. Coli, Total Residual Chlorine (TRC), Dissolved Oxygen			✓	
Is a chain-of-custody (COC) form present and filled out Completely? (1)	✓			
Is the COC properly relinquished by the client w/ date and time recorded? (1)	✓			
Were all samples received intact? (1)	✓			
Was adequate sample volume provided? (1)	✓			
Does the COC agree with the number and type of sample bottles received? (1)	✓			
Do the sample IDs on the bottle labels match the COC?(1)	✓			
For volatiles in water – is there headspace present? **If yes, contact client and note in narrative.**			✓	
Are samples preserved that require preservation **(excluding cooling)?** (1) Note the type of preservative in the comments column – HCl, H_2SO_4, NaOH, HNO_3, etc.			✓	
If samples are acid preserved for metals, is the pH ≤ 2? (1) Record the pH in Comments.			✓	
If dissolved metals are requested, were samples field filtered?			✓	
Additional Comments (if any):				

(1) **If NO, then contact the client before proceeding with analysis and note in case narrative.**

SS
Custodian Printed Name

3/22/23 1702
Date/Time

BG03@4.5'

2303556-01 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 13:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.136**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 13:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**1.61**	0.209	0.176	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**65.1**	0.419	0.331	"	"	"	"	"	"	
Cadmium	**0.0812**	0.209	0.00754	"	"	"	"	"	"	
Copper	**3.65**	0.419	0.0219	"	"	"	"	"	"	
Lead	**4.23**	0.209	0.0575	"	"	"	"	"	"	
Nickel	**4.31**	0.419	0.0639	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0239**	0.0209	0.00279	"	"	"	"	"	"	
Zinc	**13.3**	0.419	0.278	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 13:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 13:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**26.3**	0.0523		mg/L dry	1	BGC0912	03/27/23	03/28/23	EPA 6020B	
Magnesium	**4.46**	0.0523		"	"	"	"	"	"	
Sodium	**26.3**	0.0523		"	"	"	"	"	"	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG03@4.5'

2303556-01 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 13:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**1.25**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 13:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**95.5**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 13:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.292**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 13:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.64**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG03@9-10'

2303556-02 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 13:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.103**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 13:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**5.01**	0.225	0.190	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**124**	0.450	0.356	"	"	"	"	"	"	
Cadmium	**0.257**	0.225	0.00811	"	"	"	"	"	"	
Copper	**6.28**	0.450	0.0235	"	"	"	"	"	"	
Lead	**8.61**	0.225	0.0619	"	"	"	"	"	"	
Nickel	**7.36**	0.450	0.0687	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0203**	0.0225	0.00301	"	"	"	"	"	"	
Zinc	**22.6**	0.450	0.300	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 13:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 13:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**29.0**	0.0563		mg/L dry	1	BGC0912	03/27/23	03/28/23	EPA 6020B	
Magnesium	**16.9**	0.0563		"	"	"	"	"	"	
Sodium	**57.9**	0.0563		"	"	"	"	"	"	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG03@9-10'

2303556-02 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 13:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**2.11**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 13:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**88.8**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 13:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.592**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 13:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.05**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	Reported: 04/03/23 13:31

BG03@14-15'
2303556-03 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 13:55**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.230**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 13:55**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**3.29**	0.226	0.190	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**70.7**	0.451	0.356	"	"	"	"	"	"	
Cadmium	**0.145**	0.226	0.00812	"	"	"	"	"	"	
Copper	**5.38**	0.451	0.0236	"	"	"	"	"	"	
Lead	**6.17**	0.226	0.0620	"	"	"	"	"	"	
Nickel	**5.36**	0.451	0.0688	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0108**	0.0226	0.00301	"	"	"	"	"	"	
Zinc	**18.2**	0.451	0.300	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 13:55**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 13:55**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**28.5**	0.0564		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**15.0**	0.0564		"	"	"	"	"	"	
Sodium	**66.1**	0.0564		"	"	"	"	"	"	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Project Number: Project Manager:	Miller 14-17 [none] Mike Dinkel	**Reported:** 04/03/23 13:31

BG03@14-15'

2303556-03 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 13:55**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**2.49**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 13:55**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**88.7**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 13:55**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.653**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 13:55**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.30**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG03@19-20'
2303556-04 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 14:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.301**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 14:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**3.64**	0.231	0.194	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**49.5**	0.461	0.365	"	"	"	"	"	"	
Cadmium	**0.147**	0.231	0.00831	"	"	"	"	"	"	
Copper	**7.99**	0.461	0.0241	"	"	"	"	"	"	
Lead	**13.6**	0.231	0.0634	"	"	"	"	"	"	
Nickel	**3.01**	0.461	0.0704	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0300**	0.0231	0.00308	"	"	"	"	"	"	
Zinc	**20.1**	0.461	0.307	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 14:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 14:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**16.8**	0.0577		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**8.73**	0.0577		"	"	"	"	"	"	
Sodium	**58.8**	0.0577		"	"	"	"	"	"	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	Reported: 04/03/23 13:31

BG03@19-20'

2303556-04 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 14:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**2.90**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 14:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**86.7**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 14:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.469**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 14:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.20**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG04@4.5'

2303556-05 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 14:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.120**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 14:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**2.56**	0.210	0.177	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**71.5**	0.420	0.332	"	"	"	"	"	"	
Cadmium	**0.135**	0.210	0.00756	"	"	"	"	"	"	
Copper	**4.63**	0.420	0.0219	"	"	"	"	"	"	
Lead	**11.9**	0.210	0.0577	"	"	"	"	"	"	
Nickel	**5.17**	0.420	0.0640	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0256**	0.0210	0.00280	"	"	"	"	"	"	
Zinc	**28.4**	0.420	0.279	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

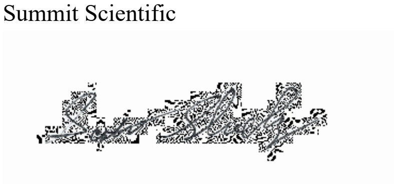
Date Sampled: **03/21/23 14:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 14:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**33.9**	0.0525		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**9.05**	0.0525		"	"	"	"	"	"	
Sodium	**2.97**	0.0525		"	"	"	"	"	"	



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG04@4.5'

2303556-05 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 14:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**0.117**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 14:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**95.2**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 14:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.319**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 14:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.83**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
04/03/23 13:31

BG04@9-10'
2303556-06 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 14:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.152**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 14:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**3.11**	0.215	0.181	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**33.0**	0.429	0.339	"	"	"	"	"	"	
Cadmium	**0.116**	0.215	0.00773	"	"	"	"	"	"	
Copper	**4.32**	0.429	0.0224	"	"	"	"	"	"	
Lead	ND	0.215	0.0590	"	"	"	"	"	"	
Nickel	**4.42**	0.429	0.0655	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.00816**	0.0215	0.00287	"	"	"	"	"	"	
Zinc	**16.6**	0.429	0.286	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

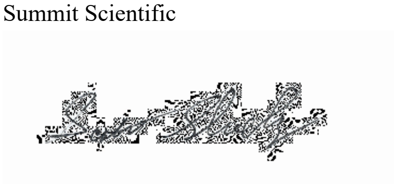
Date Sampled: **03/21/23 14:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 14:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**15.5**	0.0537		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**7.19**	0.0537		"	"	"	"	"	"	
Sodium	**32.9**	0.0537		"	"	"	"	"	"	



BG04@9-10'

2303556-06 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 14:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**1.74**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 14:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**93.2**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 14:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.318**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 14:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.17**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG04@14-15'

2303556-07 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 14:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.173**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 14:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**2.72**	0.219	0.184	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**37.8**	0.437	0.345	"	"	"	"	"	"	
Cadmium	**0.0748**	0.219	0.00787	"	"	"	"	"	"	
Copper	**4.99**	0.437	0.0228	"	"	"	"	"	"	
Lead	**6.91**	0.219	0.0601	"	"	"	"	"	"	
Nickel	**7.53**	0.437	0.0667	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0131**	0.0219	0.00292	"	"	"	"	"	"	
Zinc	**18.7**	0.437	0.291	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 14:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 14:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**20.8**	0.0547		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**6.78**	0.0547		"	"	"	"	"	"	
Sodium	**35.6**	0.0547		"	"	"	"	"	"	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG04@14-15'

2303556-07 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 14:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**1.73**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 14:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**91.5**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 14:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.255**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 14:30**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.60**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG04@19-20'

2303556-08 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.296**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**29.5**	0.235	0.198	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**44.0**	0.470	0.372	"	"	"	"	"	"	
Cadmium	**0.352**	0.235	0.00847	"	"	"	"	"	"	
Copper	**18.2**	0.470	0.0246	"	"	"	"	"	"	
Lead	ND	0.235	0.0646	"	"	"	"	"	"	
Nickel	**4.15**	0.470	0.0717	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0612**	0.0235	0.00314	"	"	"	"	"	"	
Zinc	**23.7**	0.470	0.313	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**95.3**	0.0588		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**23.5**	0.0588		"	"	"	"	"	"	
Sodium	**27.1**	0.0588		"	"	"	"	"	"	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG04@19-20'

2303556-08 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**0.645**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**85.0**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.382**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 14:40**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.32**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG05@4.5'

2303556-09 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 14:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.0798**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 14:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**2.70**	0.211	0.178	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**79.2**	0.422	0.333	"	"	"	"	"	"	
Cadmium	**0.178**	0.211	0.00759	"	"	"	"	"	"	
Copper	**5.30**	0.422	0.0220	"	"	"	"	"	"	
Lead	**8.25**	0.211	0.0579	"	"	"	"	"	"	
Nickel	**5.56**	0.422	0.0643	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0325**	0.0211	0.00282	"	"	"	"	"	"	
Zinc	**19.8**	0.422	0.280	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 14:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 14:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**34.2**	0.0527		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**8.54**	0.0527		"	"	"	"	"	"	
Sodium	**43.0**	0.0527		"	"	"	"	"	"	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG05@4.5'

2303556-09 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 14:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**1.71**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 14:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**94.8**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 14:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.532**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 14:50**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.91**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG05@9-10'

2303556-10 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 15:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.0779**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 15:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**4.16**	0.220	0.186	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**429**	0.441	0.348	"	"	"	"	"	"	
Cadmium	**0.207**	0.220	0.00793	"	"	"	"	"	"	
Copper	**5.27**	0.441	0.0230	"	"	"	"	"	"	
Lead	**7.52**	0.220	0.0606	"	"	"	"	"	"	
Nickel	**6.22**	0.441	0.0672	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0137**	0.0220	0.00294	"	"	"	"	"	"	
Zinc	**20.9**	0.441	0.293	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 15:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 15:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**33.0**	0.0551		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**17.8**	0.0551		"	"	"	"	"	"	
Sodium	**58.8**	0.0551		"	"	"	"	"	"	

BG05@9-10'

2303556-10 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 15:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**2.05**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 15:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**90.8**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

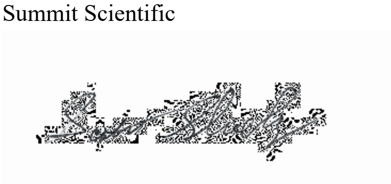
Date Sampled: **03/21/23 15:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.683**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 15:00**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.99**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	



Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG05@14-15'

2303556-11 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 15:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.113**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 15:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**4.85**	0.227	0.192	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**348**	0.455	0.359	"	"	"	"	"	"	
Cadmium	**0.245**	0.227	0.00819	"	"	"	"	"	"	
Copper	**5.65**	0.455	0.0238	"	"	"	"	"	"	
Lead	**8.41**	0.227	0.0625	"	"	"	"	"	"	
Nickel	**6.59**	0.455	0.0694	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0150**	0.0227	0.00304	"	"	"	"	"	"	
Zinc	**22.4**	0.455	0.302	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 15:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 15:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**41.3**	0.0568		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**21.5**	0.0568		"	"	"	"	"	"	
Sodium	**70.8**	0.0568		"	"	"	"	"	"	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG05@14-15'

2303556-11 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 15:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**2.23**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 15:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**88.0**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **03/21/23 15:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.829**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 15:10**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.91**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 04/03/23 13:31

BG05@19-20'

2303556-12 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **03/21/23 15:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.347**	0.0100		mg/L	1	BGC0937	03/27/23	03/29/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **03/21/23 15:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.727**	0.235	0.198	mg/kg dry	1	BGC0929	03/27/23	03/31/23	EPA 6020B	
Barium	**33.6**	0.470	0.371	"	"	"	"	"	"	
Cadmium	**0.175**	0.235	0.00845	"	"	"	"	"	"	
Copper	**8.03**	0.470	0.0245	"	"	"	"	"	"	
Lead	**19.0**	0.235	0.0645	"	"	"	"	"	"	
Nickel	**1.40**	0.470	0.0716	"	"	"	"	"	"	
Selenium	ND	0.260	0.175	"	"	"	"	"	"	
Silver	**0.0662**	0.0235	0.00313	"	"	"	"	"	"	
Zinc	**2.48**	0.470	0.312	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **03/21/23 15:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30		mg/kg dry	1	BGC0901	03/27/23	03/27/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **03/21/23 15:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**35.1**	0.0587		mg/L dry	1	BGC0912	03/27/23	03/29/23	EPA 6020B	
Magnesium	**16.3**	0.0587		"	"	"	"	"	"	
Sodium	**32.0**	0.0587		"	"	"	"	"	"	

Civitas Resources
650 Southgate Drive
Windsor CO, 80550

Project: Miller 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
04/03/23 13:31

BG05@19-20'
2303556-12 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **03/21/23 15:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**1.12**	0.00100		units	1	BGC0976	03/29/23	03/29/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **03/21/23 15:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**85.2**			%	1	BGC0903	03/27/23	03/28/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

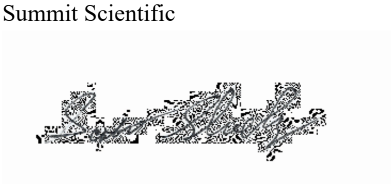
Date Sampled: **03/21/23 15:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.291**	0.0100		mmhos/cm	1	BGC0958	03/28/23	03/28/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **03/21/23 15:20**

Analyte	Result	Reporting Limit	MDL	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.45**			pH Units	1	BGC0957	03/28/23	03/28/23	EPA 9045D	



Civitas Resources	Project:	Miller 14-17	
650 Southgate Drive	Project Number:	[none]	**Reported:**
Windsor CO, 80550	Project Manager:	Mike Dinkel	04/03/23 13:31

Total Metals by EPA 6020B Hot Water Soluble Extraction - Quality Control

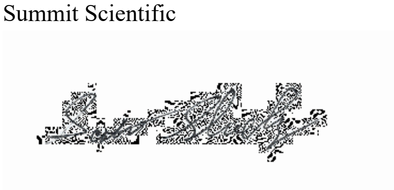
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGC0937 - EPA 3050B										
Blank (BGC0937-BLK1)				Prepared: 03/27/23 Analyzed: 03/29/23						
Boron	ND	0.0100	mg/L							
LCS (BGC0937-BS1)				Prepared: 03/27/23 Analyzed: 03/29/23						
Boron	5.98	0.0100	mg/L	5.00		120	80-120			
Duplicate (BGC0937-DUP1)		**Source: 2303540-01**		Prepared: 03/27/23 Analyzed: 03/29/23						
Boron	0.249	0.0100	mg/L		0.237			5.12	20	
Matrix Spike (BGC0937-MS1)		**Source: 2303540-01**		Prepared: 03/27/23 Analyzed: 03/29/23						
Boron	6.09	0.0100	mg/L	5.00	0.237	117	75-125			
Matrix Spike Dup (BGC0937-MSD1)		**Source: 2303540-01**		Prepared: 03/27/23 Analyzed: 03/29/23						
Boron	6.14	0.0100	mg/L	5.00	0.237	118	75-125	0.785	25	

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGC0929 - EPA 3050B										
Blank (BGC0929-BLK1)				Prepared: 03/27/23 Analyzed: 03/31/23						
Arsenic	ND	0.200	mg/kg wet							
Barium	ND	0.400	"							
Cadmium	ND	0.200	"							
Copper	ND	0.400	"							
Lead	ND	0.200	"							
Nickel	ND	0.400	"							
Selenium	ND	0.260	"							
Silver	ND	0.0200	"							
Zinc	ND	0.400	"							
LCS (BGC0929-BS1)				Prepared: 03/27/23 Analyzed: 03/31/23						
Arsenic	41.0	0.200	mg/kg wet	40.0		103	80-120			
Barium	40.0	0.400	"	40.0		100	80-120			
Cadmium	1.94	0.200	"	2.00		97.1	80-120			
Copper	39.0	0.400	"	40.0		97.4	80-120			
Lead	19.3	0.200	"	20.0		96.4	80-120			
Nickel	37.3	0.400	"	40.0		93.3	80-120			
Selenium	4.10	0.260	"	4.00		103	80-120			
Silver	1.95	0.0200	"	2.00		97.5	80-120			
Zinc	37.1	0.400	"	40.0		92.7	80-120			
Duplicate (BGC0929-DUP1)	**Source: 2303556-01**			Prepared: 03/27/23 Analyzed: 03/31/23						
Arsenic	1.62	0.209	mg/kg dry		1.61			0.569	20	
Barium	66.1	0.419	"		65.1			1.41	20	
Cadmium	0.0854	0.209	"		0.0812			5.03	20	
Copper	3.70	0.419	"		3.65			1.24	20	
Lead	4.29	0.209	"		4.23			1.33	20	
Nickel	4.37	0.419	"		4.31			1.52	20	
Selenium	ND	0.260	"		ND				20	
Silver	0.0239	0.0209	"		0.0239			0.00	20	
Zinc	13.4	0.419	"		13.3			0.710	20	



Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGC0929 - EPA 3050B										
Matrix Spike (BGC0929-MS1)	**Source: 2303556-01**			Prepared: 03/27/23 Analyzed: 03/31/23						
Arsenic	45.1	0.209	mg/kg dry	41.9	1.61	104	75-125			
Barium	115	0.419	"	41.9	65.1	120	75-125			
Cadmium	2.19	0.209	"	2.09	0.0812	101	75-125			
Copper	32.7	0.419	"	41.9	3.65	69.3	75-125			QM-07
Lead	25.5	0.209	"	20.9	4.23	101	75-125			
Nickel	32.6	0.419	"	41.9	4.31	67.5	75-125			QM-07
Selenium	4.75	0.260	"	4.19	ND	114	75-125			
Silver	2.04	0.0209	"	2.09	0.0239	96.3	75-125			
Zinc	43.4	0.419	"	41.9	13.3	72.0	75-125			QM-07
Matrix Spike Dup (BGC0929-MSD1)	**Source: 2303556-01**			Prepared: 03/27/23 Analyzed: 03/31/23						
Arsenic	44.6	0.209	mg/kg dry	41.9	1.61	103	75-125	1.06	25	
Barium	114	0.419	"	41.9	65.1	116	75-125	1.20	25	
Cadmium	2.20	0.209	"	2.09	0.0812	101	75-125	0.476	25	
Copper	32.8	0.419	"	41.9	3.65	69.6	75-125	0.462	25	QM-07
Lead	ND	0.209	"	20.9	4.23	NR	75-125	200	25	QM-07
Nickel	32.6	0.419	"	41.9	4.31	67.6	75-125	0.215	25	QM-07
Selenium	4.89	0.260	"	4.19	ND	117	75-125	2.90	25	
Silver	2.04	0.0209	"	2.09	0.0239	96.4	75-125	0.103	25	
Zinc	43.8	0.419	"	41.9	13.3	73.0	75-125	0.924	25	QM-07

Hexavalent Chromium by EPA Method 7196 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGC0901 - 3060A_Mod										
Blank (BGC0901-BLK1)				Prepared & Analyzed: 03/27/23						
Chromium, Hexavalent	ND	0.30	mg/kg wet							
LCS (BGC0901-BS1)				Prepared & Analyzed: 03/27/23						
Chromium, Hexavalent	25.3	0.30	mg/kg wet	25.0		101	80-120			
Duplicate (BGC0901-DUP1)	**Source: 2303552-01**			Prepared & Analyzed: 03/27/23						
Chromium, Hexavalent	ND	0.30	mg/kg dry		ND				20	
Matrix Spike (BGC0901-MS1)	**Source: 2303552-01**			Prepared & Analyzed: 03/27/23						
Chromium, Hexavalent	33.1	0.30	mg/kg dry	33.9	ND	97.8	75-125			
Matrix Spike Dup (BGC0901-MSD1)	**Source: 2303552-01**			Prepared & Analyzed: 03/27/23						
Chromium, Hexavalent	33.3	0.30	mg/kg dry	33.9	ND	98.4	75-125	0.612	20	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGC0912 - General Preparation										
Blank (BGC0912-BLK1)				Prepared: 03/27/23 Analyzed: 03/28/23						
Calcium	ND	0.0500	mg/L wet							
Magnesium	ND	0.0500	"							
Sodium	ND	0.0500	"							
LCS (BGC0912-BS1)				Prepared: 03/27/23 Analyzed: 03/28/23						
Calcium	4.88	0.0500	mg/L wet	5.00		97.7	70-130			
Magnesium	4.70	0.0500	"	5.00		93.9	70-130			
Sodium	4.87	0.0500	"	5.00		97.3	70-130			

Civitas Resources	Project:	Miller 14-17	
650 Southgate Drive	Project Number:	[none]	**Reported:**
Windsor CO, 80550	Project Manager:	Mike Dinkel	04/03/23 13:31

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGC0903 - General Preparation										
Duplicate (BGC0903-DUP1)	**Source: 2303539-01**		Prepared: 03/27/23 Analyzed: 03/28/23							
% Solids	71.9		%		73.1			1.70	20	

Civitas Resources 650 Southgate Drive Windsor CO, 80550	Project: Miller 14-17 Project Number: [none] Project Manager: Mike Dinkel	Reported: 04/03/23 13:31

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGC0958 - General Preparation										
Blank (BGC0958-BLK1)				Prepared & Analyzed: 03/28/23						
Specific Conductance (EC)	ND	0.0100	mmhos/cm							
LCS (BGC0958-BS1)				Prepared & Analyzed: 03/28/23						
Specific Conductance (EC)	0.151	0.0100	mmhos/cm	0.150		101	95-105			
Duplicate (BGC0958-DUP1)		**Source: 2303556-01**		Prepared & Analyzed: 03/28/23						
Specific Conductance (EC)	0.287	0.0100	mmhos/cm		0.292			1.90	20	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGC0957 - General Preparation										
LCS (BGC0957-BS1)				Prepared & Analyzed: 03/28/23						
pH	9.14		pH Units	9.18		99.6	95-105			
Duplicate (BGC0957-DUP1)	**Source: 2303556-01**			Prepared & Analyzed: 03/28/23						
pH	8.65		pH Units		8.64			0.116	20	

Notes and Definitions

QM-07	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS/LCSD recovery.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Summit Scientific

4653 Table Mountain Drive, Golden, Colorado 80403

303.277.9310

August 14, 2023

Mike Dinkel
Quandary Consultants
4480 Garfield St
Denver, CO 80237
RE: Civitas - Miller 4-17J, 14-17
Work Order #2308047

Enclosed are the results of analyses for samples received by Summit Scientific on 08/02/23 15:23. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jacob Wood For Paul Shrewsbury
President

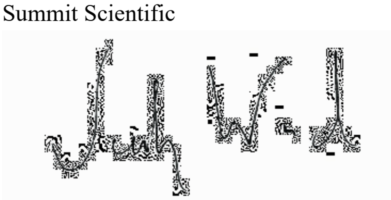
S2

Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BG01@4'	2308047-01	Soil	08/02/23 12:10	08/02/23 15:23
BG01@8'	2308047-02	Soil	08/02/23 12:13	08/02/23 15:23
BG01@12'	2308047-03	Soil	08/02/23 12:14	08/02/23 15:23
BG01@16'	2308047-04	Soil	08/02/23 12:20	08/02/23 15:23
BG01@18'	2308047-05	Soil	08/02/23 12:22	08/02/23 15:23
BG02@4'	2308047-06	Soil	08/02/23 12:30	08/02/23 15:23
BG02@8'	2308047-07	Soil	08/02/23 12:32	08/02/23 15:23
BG02@12'	2308047-08	Soil	08/02/23 12:35	08/02/23 15:23
BG02@16'	2308047-09	Soil	08/02/23 12:39	08/02/23 15:23
BG02@18.5'	2308047-10	Soil	08/02/23 12:42	08/02/23 15:23

Summit Scientific



The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

SUMMIT SCIENTIFIC

4653 Table Mountain Drive
Golden, CO 80403
303-277-9310

Lab ID	Page 1 of 1
2308047	

	Send Data To:	Send Invoice To:
Client: Quandary Consultants	Project Manager: Mike Dinkel	Company: Civitas
Address: 4490 Garfield St	E-Mail: mdinkel@quandaryconsultants.com wblust@quandaryconsultants.com	Project Name/Location: Miller 4D-17, 14-17
City/State/Zip: Denver, CO 80216		AFE#:
Phone: 239-465-1052	Project Name: Miller 4D-17, 14-17	PO/Billing Codes:
Sampler Name: WB	Project Number:	Contact:

ID	Sample Description	Date Sampled	Time Sampled	# of containers	Preservative: HCl	HNO3	None	Other	Matrix: Water	Soil	Air-Canister #	Other	Analysis Requested: All Inorganics							Special Instructions
1	B601 @ 4'	8/2/23	12:10	1			X			X			X							
2	B601 @ 8'	↓	12:13	↓			↓			↓			↓							
3	B601 @ 12'	↓	12:19	↓			↓			↓			↓							
4	B601 @ 16'	↓	12:20	↓			↓			↓			↓							
5	B601 @ 18'	↓	12:22	↓			↓			↓			↓							
6	B602 @ 4'	↓	12:30	↓			↓			↓			↓							
7	B602 @ 8'	↓	12:32	↓			↓			↓			↓							
8	B602 @ 12'	↓	12:35	↓			↓			↓			↓							
9	B602 @ 16'	↓	12:39	↓			↓			↓			↓							
10	B602 @ 19.5'	↓	12:42	↓			↓			↓			↓							
11																				
12																				
13																				
14																				
15																				

Relinquished by:	Date/Time:	Received by:	Date/Time:	TAT Business Days		Field		Notes:
WB	8/2/23 3:18	[signature]	8/2/23 15:23	Same Day		Field DO		
Relinquished by:	Date/Time:	Received by:	Date/Time:	1 Day		Field EC		
				2 Days		Field ORP		
Relinquished by:	Date/Time:	Received by:	Date/Time:	3 Days		Field pH		
				Standard	X	Field Temp.		
						Field Turb.		

Temperature Upon Receipt: 8.6 | Corrected Temperature ______ | IR gun #: L | HNO3 lot #: ______

S2

Sample Receipt Checklist

S2 Work Order# 2308047

Client: Ghanlaty Client Project ID: Miller 4J-17, 14-17

Shipped Via: H.D./P.U./FedEx/UPS/USPS/Other [X] [ ] [ ] [ ] [ ] [ ] Airbill #:

Matrix (Check all that apply) Air [ ] Soil/Solid [✓] Water [ ] Other [ ]

Temp (^{o}C) 8.6 Thermometer # 2

	Yes	No	N/A	Comments (if any)
If samples require cooling, is the temperature < $6^{o}C$? (1) **NOTE:** If samples are delivered the same day of sampling, this requirement is met if there is evidence that cooling has begun.	X			on ice
If custody seals are present, are they intact? (1)			X	
Are samples due within 48 hours present?		X		
Are water samples with short hold times present? Note the short hold analysis in the comments column - pH, Nitrate/Nitrite, Ferrous Iron (Fe^{2+}), Hexavalent Chromium (Cr^{6+}, Cr VI), COD/BOD, Total Coliform, E. Coli, Total Residual Chlorine (TRC), Dissolved Oxygen			X	
Is a chain-of-custody (COC) form present and filled out Completely? (1)	X			
Is the COC properly relinquished by the client w/ date and time recorded? (1)	X			
Were all samples received intact? (1)	X			
Was adequate sample volume provided? (1)	X			
Does the COC agree with the number and type of sample bottles received? (1)	X			
Do the sample IDs on the bottle labels match the COC?(1)	X			
For volatiles in water – is there headspace present? **If yes, contact client and note in narrative.**			X	
Are samples preserved that require preservation **(excluding cooling)?** (1) Note the type of preservative in the comments column – HCl, H_2SO_4, NaOH, HNO_3, etc.			X	
If samples are acid preserved for metals, is the pH $\leq$ 2? (1) Record the pH in Comments.			X	
If dissolved metals are requested, were samples field filtered?			X	

Additional Comments (if any):

(1) **If NO, then contact the client before proceeding with analysis and note in case narrative.**

Josh Ward 8/2/23 15:23

Custodian Printed Name **Date/Time**

Quandary Consultants
4480 Grfield St
Denver CO, 80237

Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/14/23 10:49

BG01@4'

2308047-01 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:10**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.261**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:10**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.755**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**50.4**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**2.29**	0.400	"	"	"	"	"	"	
Lead	**3.02**	0.200	"	"	"	"	"	"	
Nickel	**2.48**	0.400	"	"	"	"	"	"	
Selenium	ND	0.269	"	"	"	"	"	"	
Silver	**0.0207**	0.0200	"	"	"	"	"	"	
Zinc	**7.89**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/02/23 12:10**

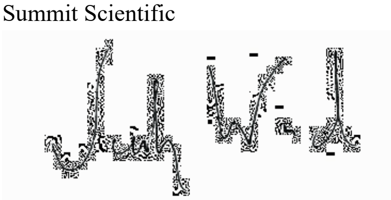
Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:10**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**37.3**	0.0517	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**6.25**	0.0517	"	"	"	"	"	"	
Sodium	**6.46**	0.0517	"	"	"	"	"	"	

Summit Scientific



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Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

BG01@4'

2308047-01 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **08/02/23 12:10**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**0.258**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:10**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**96.7**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **08/02/23 12:10**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.312**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:10**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.81**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	

Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

BG01@8'

2308047-02 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:13**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.223**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:13**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.671**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**36.2**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**1.93**	0.400	"	"	"	"	"	"	
Lead	**2.54**	0.200	"	"	"	"	"	"	
Nickel	**1.94**	0.400	"	"	"	"	"	"	
Selenium	ND	0.266	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**6.58**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/02/23 12:13**

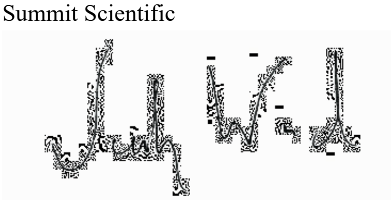
Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:13**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**18.6**	0.0511	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**13.6**	0.0511	"	"	"	"	"	"	
Sodium	**26.0**	0.0511	"	"	"	"	"	"	

Summit Scientific



The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Quandary Consultants
4480 Grfield St
Denver CO, 80237

Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/14/23 10:49

BG01@8'
2308047-02 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **08/02/23 12:13**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**1.12**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:13**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**97.9**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **08/02/23 12:13**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.390**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:13**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.06**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	

Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

BG01@12'

2308047-03 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:14**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.412**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:14**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**1.56**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**221**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**2.41**	0.400	"	"	"	"	"	"	
Lead	**3.95**	0.200	"	"	"	"	"	"	
Nickel	**2.76**	0.400	"	"	"	"	"	"	
Selenium	ND	0.280	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**8.11**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/02/23 12:14**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:14**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**14.9**	0.0538	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**9.01**	0.0538	"	"	"	"	"	"	
Sodium	**79.2**	0.0538	"	"	"	"	"	"	

Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

BG01@12'

2308047-03 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **08/02/23 12:14**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**4.00**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:14**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**93.0**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

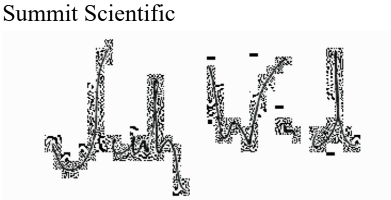
Date Sampled: **08/02/23 12:14**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.552**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:14**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.32**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	



Quandary Consultants
4480 Grfield St
Denver CO, 80237

Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/14/23 10:49

BG01@16'
2308047-04 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.352**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**1.19**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**28.0**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**2.56**	0.400	"	"	"	"	"	"	
Lead	**4.68**	0.200	"	"	"	"	"	"	
Nickel	**2.77**	0.400	"	"	"	"	"	"	
Selenium	ND	0.284	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**8.96**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

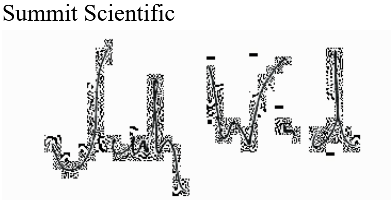
Date Sampled: **08/02/23 12:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**21.6**	0.0547	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**11.5**	0.0547	"	"	"	"	"	"	
Sodium	**107**	0.0547	"	"	"	"	"	"	



Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel		**Reported:** 08/14/23 10:49

BG01@16'

2308047-04 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **08/02/23 12:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**4.63**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**91.5**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

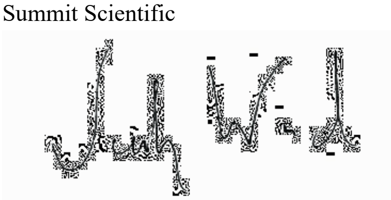
Date Sampled: **08/02/23 12:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.744**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.22**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	



Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

BG01@18'

2308047-05 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.228**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**1.07**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**48.0**	0.400	"	"	"	"	"	"	
Cadmium	**0.318**	0.200	"	"	"	"	"	"	
Copper	**3.02**	0.400	"	"	"	"	"	"	
Lead	**6.97**	0.200	"	"	"	"	"	"	
Nickel	**2.11**	0.400	"	"	"	"	"	"	
Selenium	ND	0.301	"	"	"	"	"	"	
Silver	**0.0204**	0.0200	"	"	"	"	"	"	
Zinc	**10.7**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

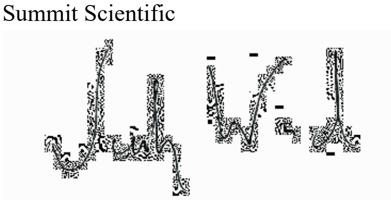
Date Sampled: **08/02/23 12:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**43.0**	0.0578	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**24.7**	0.0578	"	"	"	"	"	"	
Sodium	**113**	0.0578	"	"	"	"	"	"	



Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

BG01@18'

2308047-05 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **08/02/23 12:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**3.40**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**86.5**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

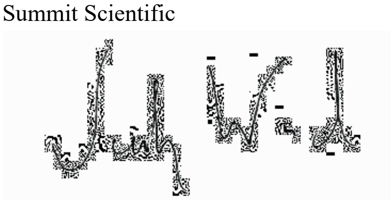
Date Sampled: **08/02/23 12:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.930**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:22**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.00**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	



BG02@4'

2308047-06 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.210**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.705**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**44.2**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**2.27**	0.400	"	"	"	"	"	"	
Lead	**3.13**	0.200	"	"	"	"	"	"	
Nickel	**2.57**	0.400	"	"	"	"	"	"	
Selenium	ND	0.272	"	"	"	"	"	"	
Silver	**0.0289**	0.0200	"	"	"	"	"	"	
Zinc	**7.60**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/02/23 12:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**198**	0.0523	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**32.1**	0.0523	"	"	"	"	"	"	
Sodium	**6.24**	0.0523	"	"	"	"	"	"	

Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

BG02@4'

2308047-06 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **08/02/23 12:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**0.108**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**95.5**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **08/02/23 12:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.157**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**6.95**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	

Quandary Consultants
4480 Grfield St
Denver CO, 80237

Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/14/23 10:49

BG02@8'

2308047-07 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.129**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.797**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**50.0**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**2.27**	0.400	"	"	"	"	"	"	
Lead	**2.91**	0.200	"	"	"	"	"	"	
Nickel	**2.27**	0.400	"	"	"	"	"	"	
Selenium	ND	0.274	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**7.77**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

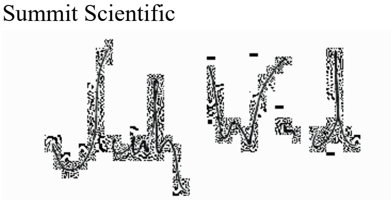
Date Sampled: **08/02/23 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**21.4**	0.0526	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**8.72**	0.0526	"	"	"	"	"	"	
Sodium	**13.1**	0.0526	"	"	"	"	"	"	



Quandary Consultants
4480 Grfield St
Denver CO, 80237

Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/14/23 10:49

BG02@8'
2308047-07 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **08/02/23 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**0.603**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**95.0**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **08/02/23 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.269**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.95**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	

S2

Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

BG02@12'

2308047-08 (Soil)

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Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:35**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.338**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:35**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**1.21**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**51.3**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**2.40**	0.400	"	"	"	"	"	"	
Lead	**4.28**	0.200	"	"	"	"	"	"	
Nickel	**2.96**	0.400	"	"	"	"	"	"	
Selenium	ND	0.278	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**7.79**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/02/23 12:35**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:35**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**37.9**	0.0534	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**18.4**	0.0534	"	"	"	"	"	"	
Sodium	**112**	0.0534	"	"	"	"	"	"	

Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

BG02@12'

2308047-08 (Soil)

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Calculated Analysis

Date Sampled: **08/02/23 12:35**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**3.73**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:35**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**93.6**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **08/02/23 12:35**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.929**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:35**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.88**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	

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Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/14/23 10:49

BG02@16'

2308047-09 (Soil)

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Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:39**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.228**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:39**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**1.25**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**37.7**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**2.40**	0.400	"	"	"	"	"	"	
Lead	**4.48**	0.200	"	"	"	"	"	"	
Nickel	**2.88**	0.400	"	"	"	"	"	"	
Selenium	ND	0.286	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**8.64**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/02/23 12:39**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:39**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**41.9**	0.0550	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**18.6**	0.0550	"	"	"	"	"	"	
Sodium	**162**	0.0550	"	"	"	"	"	"	

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Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
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BG02@16'

2308047-09 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **08/02/23 12:39**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**5.24**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:39**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**90.9**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

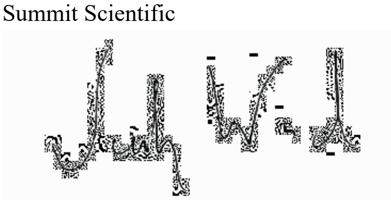
Date Sampled: **08/02/23 12:39**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**1.06**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:39**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.04**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	



BG02@18.5'

2308047-10 (Soil)

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Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **08/02/23 12:42**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	**0.208**	0.0100	mg/L	1	BGH0207	08/04/23	08/08/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **08/02/23 12:42**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.286**	0.200	mg/kg dry	1	BGH0173	08/04/23	08/08/23	EPA 6020B	
Barium	**17.7**	0.400	"	"	"	"	"	"	
Cadmium	**0.325**	0.200	"	"	"	"	"	"	
Copper	**1.12**	0.400	"	"	"	"	"	"	
Lead	**5.12**	0.200	"	"	"	"	"	"	
Nickel	**2.55**	0.400	"	"	"	"	"	"	
Selenium	ND	0.298	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**9.17**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

Date Sampled: **08/02/23 12:42**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGH0205	08/04/23	08/04/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **08/02/23 12:42**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**41.0**	0.0573	mg/L dry	1	BGH0192	08/04/23	08/09/23	EPA 6020B	
Magnesium	**21.5**	0.0573	"	"	"	"	"	"	
Sodium	**127**	0.0573	"	"	"	"	"	"	

BG02@18.5'

2308047-10 (Soil)

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Calculated Analysis

Date Sampled: **08/02/23 12:42**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**4.00**	0.00100	units	1	BGH0426	08/10/23	08/10/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **08/02/23 12:42**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**87.3**		%	1	BGH0165	08/03/23	08/04/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **08/02/23 12:42**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.968**	0.0100	mmhos/cm	1	BGH0257	08/07/23	08/08/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **08/02/23 12:42**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.03**		pH Units	1	BGH0258	08/07/23	08/08/23	EPA 9045D	

Total Metals by EPA 6020B Hot Water Soluble Extraction - Quality Control

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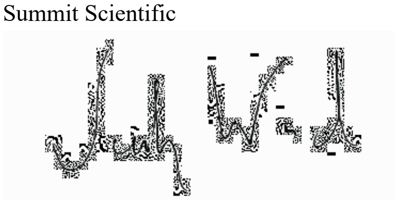
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH0207 - EPA 3050B										
Blank (BGH0207-BLK1)				Prepared: 08/04/23 Analyzed: 08/08/23						
Boron	ND	0.0100	mg/L							
LCS (BGH0207-BS1)				Prepared: 08/04/23 Analyzed: 08/08/23						
Boron	5.16	0.0100	mg/L	5.00		103	80-120			
Duplicate (BGH0207-DUP1)	**Source: 2308047-01**			Prepared: 08/04/23 Analyzed: 08/08/23						
Boron	0.222	0.0100	mg/L		0.261			16.2	20	
Matrix Spike (BGH0207-MS1)	**Source: 2308047-01**			Prepared: 08/04/23 Analyzed: 08/08/23						
Boron	6.08	0.0100	mg/L	5.00	0.261	116	75-125			
Matrix Spike Dup (BGH0207-MSD1)	**Source: 2308047-01**			Prepared: 08/04/23 Analyzed: 08/08/23						
Boron	6.31	0.0100	mg/L	5.00	0.261	121	75-125	3.61	25	



Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

Total Metals by EPA 6020B - Quality Control

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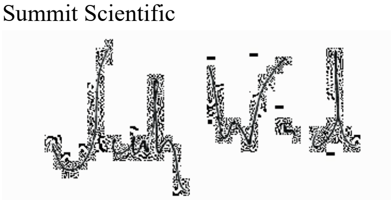
Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH0173 - EPA 3050B										
Blank (BGH0173-BLK1)				Prepared: 08/04/23 Analyzed: 08/08/23						
Arsenic	ND	0.200	mg/kg wet							
Barium	ND	0.400	"							
Cadmium	ND	0.200	"							
Copper	ND	0.400	"							
Lead	ND	0.200	"							
Nickel	ND	0.400	"							
Selenium	ND	0.260	"							
Silver	ND	0.0200	"							
Zinc	ND	0.400	"							
Selenium	ND	0.260	"							
LCS (BGH0173-BS1)				Prepared: 08/04/23 Analyzed: 08/08/23						
Arsenic	36.8	0.200	mg/kg wet	40.0		91.9	80-120			
Barium	33.0	0.400	"	40.0		82.5	80-120			
Cadmium	1.79	0.200	"	2.00		89.5	80-120			
Copper	35.1	0.400	"	40.0		87.7	80-120			
Lead	17.6	0.200	"	20.0		88.1	80-120			
Nickel	34.8	0.400	"	40.0		87.0	80-120			
Selenium	3.95	0.260	"	4.00		98.8	80-120			
Silver	1.83	0.0200	"	2.00		91.6	80-120			
Zinc	37.3	0.400	"	40.0		93.3	80-120			
Duplicate (BGH0173-DUP1)	**Source: 2308047-01**			Prepared: 08/04/23 Analyzed: 08/08/23						
Arsenic	0.722	0.200	mg/kg dry		0.755			4.54	20	
Barium	48.2	0.400	"		50.4			4.37	20	
Cadmium	0.0732	0.200	"		0.0773			5.49	20	
Copper	2.10	0.400	"		2.29			8.55	20	
Lead	2.90	0.200	"		3.02			3.93	20	
Nickel	2.18	0.400	"		2.48			12.5	20	
Selenium	ND	0.269	"		ND				20	
Silver	0.0232	0.0200	"		0.0207			11.3	20	
Zinc	6.89	0.400	"		7.89			13.6	20	
Selenium	ND	0.260	"		ND				200	



Quandary Consultants
4480 Grfield St
Denver CO, 80237

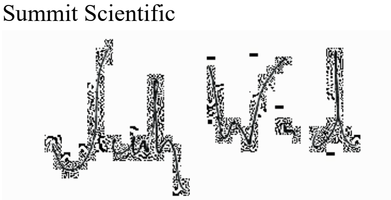
Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/14/23 10:49

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH0173 - EPA 3050B										
Matrix Spike (BGH0173-MS1)	**Source: 2308047-01**			Prepared: 08/04/23 Analyzed: 08/08/23						
Arsenic	17.1	0.200	mg/kg dry	41.4	0.755	39.4	75-125			QM-01
Barium	80.6	0.400	"	41.4	50.4	73.0	75-125			QM-01
Cadmium	1.49	0.200	"	2.07	0.0773	68.1	75-125			QM-01
Copper	17.7	0.400	"	41.4	2.29	37.3	75-125			QM-01
Lead	15.8	0.200	"	20.7	3.02	61.7	75-125			QM-01
Nickel	17.8	0.400	"	41.4	2.48	37.1	75-125			QM-01
Selenium	3.61	0.269	"	4.14	ND	87.3	75-125			
Silver	1.41	0.0200	"	2.07	0.0207	67.3	75-125			QM-01
Zinc	24.0	0.400	"	41.4	7.89	39.0	75-125			QM-01
Matrix Spike Dup (BGH0173-MSD1)	**Source: 2308047-01**			Prepared: 08/04/23 Analyzed: 08/08/23						
Arsenic	17.0	0.200	mg/kg dry	41.4	0.755	39.2	75-125	0.457	25	QM-01
Barium	78.0	0.400	"	41.4	50.4	66.9	75-125	3.22	25	QM-01
Cadmium	1.46	0.200	"	2.07	0.0773	66.8	75-125	1.88	25	QM-01
Copper	17.4	0.400	"	41.4	2.29	36.5	75-125	1.78	25	QM-01
Lead	15.2	0.200	"	20.7	3.02	59.1	75-125	3.52	25	QM-01
Nickel	17.6	0.400	"	41.4	2.48	36.6	75-125	1.19	25	QM-01
Selenium	3.38	0.269	"	4.14	ND	81.8	75-125	6.56	25	
Silver	1.40	0.0200	"	2.07	0.0207	66.6	75-125	0.971	25	QM-01
Zinc	23.6	0.400	"	41.4	7.89	38.1	75-125	1.66	25	QM-01



Hexavalent Chromium by EPA Method 7196 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH0205 - 3060A_Mod										
Blank (BGH0205-BLK1)				Prepared & Analyzed: 08/04/23						
Chromium, Hexavalent	ND	0.30	mg/kg wet							
LCS (BGH0205-BS1)				Prepared & Analyzed: 08/04/23						
Chromium, Hexavalent	21.8	0.30	mg/kg wet	25.0		87.4	80-120			
Duplicate (BGH0205-DUP1)	**Source: 2308003-01**			Prepared & Analyzed: 08/04/23						
Chromium, Hexavalent	ND	0.30	mg/kg dry		ND				20	
Matrix Spike (BGH0205-MS1)	**Source: 2308003-01**			Prepared & Analyzed: 08/04/23						
Chromium, Hexavalent	29.8	0.30	mg/kg dry	30.5	ND	97.6	75-125			
Matrix Spike Dup (BGH0205-MSD1)	**Source: 2308003-01**			Prepared & Analyzed: 08/04/23						
Chromium, Hexavalent	30.1	0.30	mg/kg dry	30.5	ND	98.4	75-125	0.816	20	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction - Quality Control

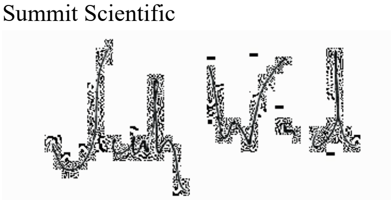
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH0192 - General Preparation										
Blank (BGH0192-BLK1)				Prepared: 08/04/23 Analyzed: 08/09/23						
Calcium	ND	0.0500	mg/L wet							
Magnesium	ND	0.0500	"							
Sodium	ND	0.0500	"							
LCS (BGH0192-BS1)				Prepared: 08/04/23 Analyzed: 08/09/23						
Calcium	6.18	0.0500	mg/L wet	5.00		124	70-130			
Magnesium	5.87	0.0500	"	5.00		117	70-130			
Sodium	6.21	0.0500	"	5.00		124	70-130			

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH0165 - General Preparation										
Duplicate (BGH0165-DUP1)	**Source: 2308047-01**			Prepared: 08/03/23 Analyzed: 08/04/23						
% Solids	96.8		%		96.7			0.104	20	

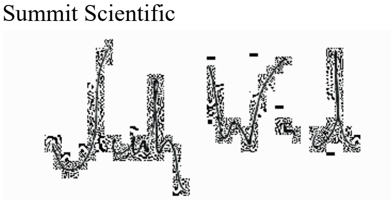


Quandary Consultants 4480 Grfield St Denver CO, 80237	Project: Civitas - Miller 4-17J, 14-17 Project Number: [none] Project Manager: Mike Dinkel	**Reported:** 08/14/23 10:49

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH0257 - General Preparation										
Blank (BGH0257-BLK1)				Prepared: 08/07/23 Analyzed: 08/08/23						
Specific Conductance (EC)	ND	0.0100	mmhos/cm							
LCS (BGH0257-BS1)				Prepared: 08/07/23 Analyzed: 08/08/23						
Specific Conductance (EC)	0.156	0.0100	mmhos/cm	0.150		104	95-105			
Duplicate (BGH0257-DUP1)		**Source: 2308047-01**		Prepared: 08/07/23 Analyzed: 08/08/23						
Specific Conductance (EC)	0.310	0.0100	mmhos/cm		0.312			0.900	20	



Quandary Consultants
4480 Grfield St
Denver CO, 80237

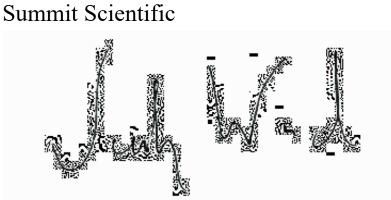
Project: Civitas - Miller 4-17J, 14-17
Project Number: [none]
Project Manager: Mike Dinkel

Reported:
08/14/23 10:49

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGH0258 - General Preparation										
LCS (BGH0258-BS1)				Prepared: 08/07/23 Analyzed: 08/08/23						
pH	9.02		pH Units	9.18		98.3	95-105			
Duplicate (BGH0258-DUP1)	**Source: 2308047-01**			Prepared: 08/07/23 Analyzed: 08/08/23						
pH	7.73		pH Units		7.81			1.03	20	



Notes and Definitions

QM-01	The spike recovery for this QC sample is outside of established control limits due to sample matrix interference.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Summit Scientific

4653 Table Mountain Drive, Golden, Colorado 80403

303.277.9310

December 05, 2023

Patrick Lawer
Quandary Consultants
4480 Garfield St
Denver, CO 80237

RE: Civitas - Miller 14-17

Work Order #2311455

Enclosed are the results of analyses for samples received by Summit Scientific on 11/21/23 14:38. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

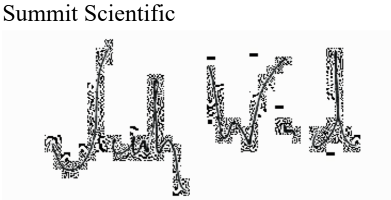
Jacob Wood For Paul Shrewsbury
President

Quandary Consultants 4480 Garfield St Denver CO, 80237	Project: Civitas - Miller 14-17 Project Number: [none] Project Manager: Patrick Lawer	**Reported:** 12/05/23 11:59

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BG01@24'	2311455-01	Soil	11/21/23 12:18	11/21/23 14:38
BG02@24'	2311455-02	Soil	11/21/23 11:47	11/21/23 14:38
BG03@24'	2311455-03	Soil	11/21/23 11:04	11/21/23 14:38
BG05@24'	2311455-04	Soil	11/21/23 09:40	11/21/23 14:38
BG04@24'	2311455-05	Soil	11/21/23 10:34	11/21/23 14:38

Summit Scientific



The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

SUMMIT SCIENTIFIC

4653 Table Mountain Drive
Golden, CO 80403
303-277-9310

Lab ID	Page 1 of 1
2311455	

Client: Quandary Consultants	**Send Data To:**
Address: 4480 Garfield St	Project Manager: Patrick Lawler
City/State/Zip: Denver, CO 80216	E-Mail: samples@quandaryconsultants.com
Phone: 239-465-1052	Project Name: Miller 14-17
Sampler Name: Will Blust	Project Number:

Send Invoice To:

Company: Civitas
Project Name/Location: Miller 14-17 Excavation
AFE#:
PO/Billing Codes:
Contact: Jacob Evans

					Preservative				Matrix				Analysis Requested								Special Instructions
ID	Sample Description	Date Sampled	Time Sampled	# of containers	HCl	HNO3	None	Other	Water	Soil	Air-Canister #	Other	Table 915-1 Inorganics								
1	BG01 @ 24'	11/21/23	12:18	1			X			X			X								
2	BG02 @ 24'	↓	1:47	↓			↓			↓			↓								
3	BG03 @ 24'	↓	11:04	↓			↓			↓			↓								
4	BG05 @ 24'	↓	9:40	↓			↓			↓			↓								
5	BG04 @ 24'	↓	10:34	↓			↓			↓			↓								
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					

Relinquished by:	Date/Time:	Received by:	Date/Time:
[signature]	11/21/23 2:37	[signature]	11/21/23 14:38
Relinquished by:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Date/Time:	Received by:	Date/Time:

TAT Business Days			
Same Day		Field DO	
1 Day		Field EC	
2 Days		Field ORP	
3 Days		Field pH	
Standard	X	Field Temp.	
		Field Turb.	

Notes:

Temperature Upon Receipt: 5.2
Corrected Temperature
IR gun #: 2
HNO3 lot #:

S2

Sample Receipt Checklist

S2 Work Order# 2311455

Client: Quandary Client Project ID: Miller 14-17

Shipped Via: H.D./P.U./FedEx/UPS/USPS/Other [ ] Airbill #:

[X] [ ] [ ] [ ] [ ]

Matrix (Check all that apply) Air [ ] Soil/Solid [X] Water [ ] Other [ ]

Temp (°C) 5.2 Thermometer # 2

	Yes	No	N/A	Comments (if any)
If samples require cooling, is the temperature < 6°C? (1) **NOTE:** If samples are delivered the same day of sampling, this requirement is met if there is evidence that cooling has begun.	X			on ice
If custody seals are present, are they intact? (1)			X	
Are samples due within 48 hours present?		X		
Are water samples with short hold times present? Note the short hold analysis in the comments column - pH, Nitrate/Nitrite, Ferrous Iron (Fe^{2+}), Hexavalent Chromium (Cr^{6+}, Cr VI), COD/BOD, Total Coliform, E. Coli, Total Residual Chlorine (TRC), Dissolved Oxygen			X	
Is a chain-of-custody (COC) form present and filled out Completely? (1)	X			
Is the COC properly relinquished by the client w/ date and time recorded? (1)	X			
Were all samples received intact? (1)	Y			
Was adequate sample volume provided? (1)	Y			
Does the COC agree with the number and type of sample bottles received? (1)	Y			
Do the sample IDs on the bottle labels match the COC? (1)	X			
For volatiles in water – is there headspace present? **If yes, contact client and note in narrative.**			X	
Are samples preserved that require preservation **(excluding cooling)?** (1) Note the type of preservative in the comments column – HCl, H_2SO_4, NaOH, HNO_3, etc.			X	
If samples are acid preserved for metals, is the pH ≤ 2? (1) Record the pH in Comments.			X	
If dissolved metals are requested, were samples field filtered?			X	

Additional Comments (if any):

(1) If NO, then contact the client before proceeding with analysis and note in case narrative.

John Ward
Custodian Printed Name

11/21/23 14:38
Date/Time

Quandary Consultants
4480 Garfield St
Denver CO, 80237

Project: Civitas - Miller 14-17
Project Number: [none]
Project Manager: Patrick Lawer

Reported:
12/05/23 11:59

BG01@24'
2311455-01 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **11/21/23 12:18**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	ND	2.00	mg/L	1	BGK1119	11/30/23	12/02/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **11/21/23 12:18**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.596**	0.200	mg/kg dry	1	BGL0028	12/01/23	12/02/23	EPA 6020B	
Barium	**10.4**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**0.425**	0.400	"	"	"	"	"	"	
Lead	**4.15**	0.200	"	"	"	"	"	"	
Nickel	**1.86**	0.400	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**10.5**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

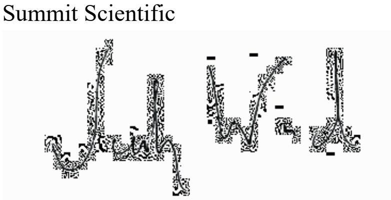
Date Sampled: **11/21/23 12:18**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGK1080	11/29/23	12/01/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **11/21/23 12:18**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**19.8**	0.0500	mg/L dry	1	BGK1164	11/30/23	12/03/23	EPA 6020B	
Magnesium	**18.6**	0.0500	"	"	"	"	"	"	
Sodium	**99.4**	0.0500	"	"	"	"	"	"	



Quandary Consultants
4480 Garfield St

Denver CO, 80237

Project: Civitas - Miller 14-17

Project Number: [none]
Project Manager: Patrick Lawer

Reported:
12/05/23 11:59

BG01@24'
2311455-01 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **11/21/23 12:18**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**3.85**	0.00100	units	1	BGL0070	12/04/23	12/04/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **11/21/23 12:18**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**86.4**		%	1	BGK1133	11/30/23	11/30/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

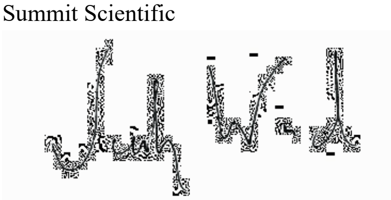
Date Sampled: **11/21/23 12:18**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.828**	0.0100	mmhos/cm	1	BGL0003	12/01/23	12/04/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **11/21/23 12:18**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.47**		pH Units	1	BGL0001	12/01/23	12/04/23	EPA 9045D	



Quandary Consultants
4480 Garfield St
Denver CO, 80237

Project: Civitas - Miller 14-17
Project Number: [none]
Project Manager: Patrick Lawer

Reported:
12/05/23 11:59

BG02@24'

2311455-02 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **11/21/23 11:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	ND	2.00	mg/L	1	BGK1119	11/30/23	12/02/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **11/21/23 11:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.934**	0.200	mg/kg dry	1	BGL0028	12/01/23	12/02/23	EPA 6020B	
Barium	**32.8**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**1.03**	0.400	"	"	"	"	"	"	
Lead	**5.76**	0.200	"	"	"	"	"	"	
Nickel	**2.60**	0.400	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**14.4**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

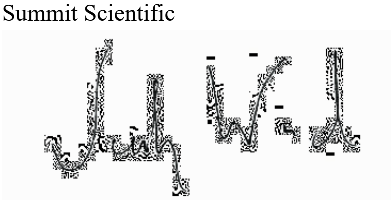
Date Sampled: **11/21/23 11:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGK1080	11/29/23	12/01/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **11/21/23 11:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**37.4**	0.0500	mg/L dry	1	BGK1164	11/30/23	12/03/23	EPA 6020B	
Magnesium	**28.6**	0.0500	"	"	"	"	"	"	
Sodium	**129**	0.0500	"	"	"	"	"	"	



BG02@24'

2311455-02 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **11/21/23 11:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**3.86**	0.00100	units	1	BGL0070	12/04/23	12/04/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **11/21/23 11:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**86.7**		%	1	BGK1133	11/30/23	11/30/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

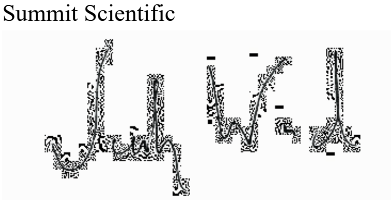
Date Sampled: **11/21/23 11:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**1.22**	0.0100	mmhos/cm	1	BGL0003	12/01/23	12/04/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **11/21/23 11:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**7.87**		pH Units	1	BGL0001	12/01/23	12/04/23	EPA 9045D	



Quandary Consultants 4480 Garfield St Denver CO, 80237	Project: Civitas - Miller 14-17 Project Number: [none] Project Manager: Patrick Lawer	**Reported:** 12/05/23 11:59

BG03@24'

2311455-03 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **11/21/23 11:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	ND	2.00	mg/L	1	BGK1119	11/30/23	12/02/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **11/21/23 11:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.768**	0.200	mg/kg dry	1	BGL0028	12/01/23	12/02/23	EPA 6020B	
Barium	**25.8**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**1.14**	0.400	"	"	"	"	"	"	
Lead	**8.46**	0.200	"	"	"	"	"	"	
Nickel	**2.53**	0.400	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**18.0**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

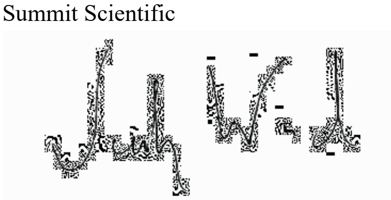
Date Sampled: **11/21/23 11:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGK1080	11/29/23	12/01/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **11/21/23 11:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**18.4**	0.0500	mg/L dry	1	BGK1164	11/30/23	12/03/23	EPA 6020B	
Magnesium	**10.1**	0.0500	"	"	"	"	"	"	
Sodium	**50.6**	0.0500	"	"	"	"	"	"	



Quandary Consultants 4480 Garfield St Denver CO, 80237	Project: Project Number: Project Manager:	Civitas - Miller 14-17 [none] Patrick Lawer	**Reported:** 12/05/23 11:59

BG03@24'

2311455-03 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **11/21/23 11:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**2.35**	0.00100	units	1	BGL0070	12/04/23	12/04/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **11/21/23 11:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**84.5**		%	1	BGK1133	11/30/23	11/30/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

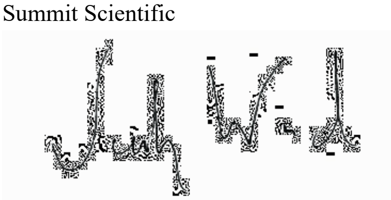
Date Sampled: **11/21/23 11:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.366**	0.0100	mmhos/cm	1	BGL0003	12/01/23	12/04/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **11/21/23 11:04**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.16**		pH Units	1	BGL0001	12/01/23	12/04/23	EPA 9045D	



Quandary Consultants 4480 Garfield St Denver CO, 80237	Project: Project Number: Project Manager:	Civitas - Miller 14-17 [none] Patrick Lawer	**Reported:** 12/05/23 11:59

BG05@24'

2311455-04 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **11/21/23 09:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	ND	2.00	mg/L	1	BGK1119	11/30/23	12/02/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **11/21/23 09:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**1.16**	0.200	mg/kg dry	1	BGL0028	12/01/23	12/02/23	EPA 6020B	
Barium	**153**	0.400	"	"	"	"	"	"	
Cadmium	**0.319**	0.200	"	"	"	"	"	"	
Copper	**1.57**	0.400	"	"	"	"	"	"	
Lead	**12.3**	0.200	"	"	"	"	"	"	
Nickel	**2.96**	0.400	"	"	"	"	"	"	
Silver	**0.0365**	0.0200	"	"	"	"	"	"	
Zinc	**13.5**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

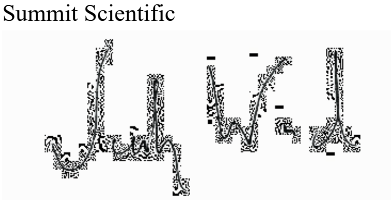
Date Sampled: **11/21/23 09:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGK1080	11/29/23	12/01/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **11/21/23 09:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**8.91**	0.0500	mg/L dry	1	BGK1164	11/30/23	12/03/23	EPA 6020B	
Magnesium	**7.60**	0.0500	"	"	"	"	"	"	
Sodium	**48.0**	0.0500	"	"	"	"	"	"	



Quandary Consultants 4480 Garfield St Denver CO, 80237	Project: Civitas - Miller 14-17 Project Number: [none] Project Manager: Patrick Lawer	**Reported:** 12/05/23 11:59

BG05@24'

2311455-04 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **11/21/23 09:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**2.85**	0.00100	units	1	BGL0070	12/04/23	12/04/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **11/21/23 09:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**87.8**		%	1	BGK1133	11/30/23	11/30/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **11/21/23 09:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.330**	0.0100	mmhos/cm	1	BGL0003	12/01/23	12/04/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **11/21/23 09:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.73**		pH Units	1	BGL0001	12/01/23	12/04/23	EPA 9045D	

S2

Quandary Consultants 4480 Garfield St Denver CO, 80237	Project: Civitas - Miller 14-17 Project Number: [none] Project Manager: Patrick Lawer	**Reported:** 12/05/23 11:59

BG04@24'

2311455-05 (Soil)

Summit Scientific

Total Metals by EPA 6020B Hot Water Soluble Extraction

Date Sampled: **11/21/23 10:34**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Boron	ND	2.00	mg/L	1	BGK1119	11/30/23	12/02/23	EPA 6020B	

Total Metals by EPA 6020B

Date Sampled: **11/21/23 10:34**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Arsenic	**0.801**	0.200	mg/kg dry	1	BGL0028	12/01/23	12/02/23	EPA 6020B	
Barium	**190**	0.400	"	"	"	"	"	"	
Cadmium	ND	0.200	"	"	"	"	"	"	
Copper	**0.879**	0.400	"	"	"	"	"	"	
Lead	**8.17**	0.200	"	"	"	"	"	"	
Nickel	**2.43**	0.400	"	"	"	"	"	"	
Silver	ND	0.0200	"	"	"	"	"	"	
Zinc	**13.6**	0.400	"	"	"	"	"	"	
Selenium	ND	0.260	"	"	"	"	"	"	

Hexavalent Chromium by EPA Method 7196

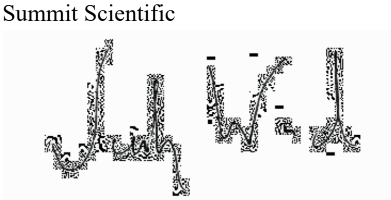
Date Sampled: **11/21/23 10:34**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Chromium, Hexavalent	ND	0.30	mg/kg dry	1	BGK1080	11/29/23	12/01/23	EPA 7196A	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction

Date Sampled: **11/21/23 10:34**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Calcium	**25.0**	0.0500	mg/L dry	1	BGK1164	11/30/23	12/03/23	EPA 6020B	
Magnesium	**9.14**	0.0500	"	"	"	"	"	"	
Sodium	**38.4**	0.0500	"	"	"	"	"	"	



Quandary Consultants 4480 Garfield St Denver CO, 80237	Project: Project Number: Project Manager:	Civitas - Miller 14-17 [none] Patrick Lawer	**Reported:** 12/05/23 11:59

BG04@24'

2311455-05 (Soil)

Summit Scientific

Calculated Analysis

Date Sampled: **11/21/23 10:34**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sodium Adsorption Ratio	**1.67**	0.00100	units	1	BGL0070	12/04/23	12/04/23	Calculation	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **11/21/23 10:34**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**87.9**		%	1	BGK1133	11/30/23	11/30/23	Calculation	

Specific Conductance by EPA Method 120.1, Saturated Paste Extraction

Date Sampled: **11/21/23 10:34**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	**0.306**	0.0100	mmhos/cm	1	BGL0003	12/01/23	12/04/23	EPA 120.1	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction

Date Sampled: **11/21/23 10:34**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	**8.65**		pH Units	1	BGL0001	12/01/23	12/04/23	EPA 9045D	

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Denver CO, 80237

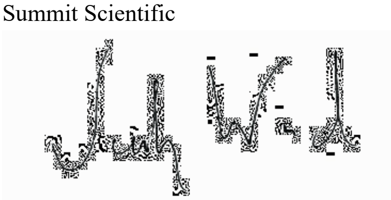
Project: Civitas - Miller 14-17
Project Number: [none]
Project Manager: Patrick Lawer

Reported:
12/05/23 11:59

Total Metals by EPA 6020B Hot Water Soluble Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGK1119 - EPA 3050B										
Blank (BGK1119-BLK1)				Prepared: 11/30/23 Analyzed: 12/02/23						
Boron	ND	2.00	mg/L							
LCS (BGK1119-BS1)				Prepared: 11/30/23 Analyzed: 12/02/23						
Boron	5.16	2.00	mg/L	5.00		103	80-120			
Duplicate (BGK1119-DUP1)		**Source: 2311431-01**		Prepared: 11/30/23 Analyzed: 12/02/23						
Boron	ND	2.00	mg/L		ND				20	
Matrix Spike (BGK1119-MS1)		**Source: 2311431-01**		Prepared: 11/30/23 Analyzed: 12/02/23						
Boron	5.20	2.00	mg/L	5.00	ND	104	75-125			
Matrix Spike Dup (BGK1119-MSD1)		**Source: 2311431-01**		Prepared: 11/30/23 Analyzed: 12/02/23						
Boron	5.30	2.00	mg/L	5.00	ND	106	75-125	1.78	25	



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Denver CO, 80237

Project: Civitas - Miller 14-17
Project Number: [none]
Project Manager: Patrick Lawer

Reported:
12/05/23 11:59

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Batch BGL0028 - EPA 3050B

Blank (BGL0028-BLK1) Prepared: 12/01/23 Analyzed: 12/02/23

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	ND	0.200	mg/kg wet							
Barium	ND	0.400	"							
Cadmium	ND	0.200	"							
Copper	ND	0.400	"							
Lead	ND	0.200	"							
Nickel	ND	0.400	"							
Silver	ND	0.0200	"							
Zinc	ND	0.400	"							
Selenium	ND	0.260	"							

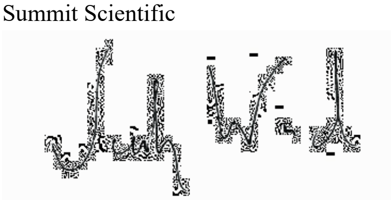
LCS (BGL0028-BS1) Prepared: 12/01/23 Analyzed: 12/02/23

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	44.0	0.200	mg/kg wet	40.0		110	80-120			
Barium	43.7	0.400	"	40.0		109	80-120			
Cadmium	2.10	0.200	"	2.00		105	80-120			
Copper	42.0	0.400	"	40.0		105	80-120			
Lead	20.1	0.200	"	20.0		101	80-120			
Nickel	42.8	0.400	"	40.0		107	80-120			
Silver	2.05	0.0200	"	2.00		103	80-120			
Zinc	43.6	0.400	"	40.0		109	80-120			
Selenium	4.06	0.260	"	4.00		102	80-120			

Duplicate (BGL0028-DUP1) **Source: 2310194-07** Prepared: 12/01/23 Analyzed: 12/02/23

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	0.492	0.200	mg/kg dry		0.498			1.14	20	
Barium	14.3	0.400	"		12.1			16.4	20	
Cadmium	0.0451	0.200	"		0.0515			13.3	20	
Copper	ND	0.400	"		ND				20	
Lead	2.23	0.200	"		2.15			3.85	20	
Nickel	0.745	0.400	"		0.687			8.09	20	
Silver	0.0113	0.0200	"		0.0117			3.51	20	
Zinc	3.73	0.400	"		3.19			15.5	20	
Selenium	ND	0.260	"		ND				20	

Summit Scientific

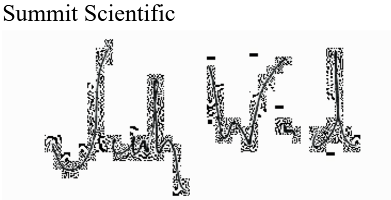


The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Total Metals by EPA 6020B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGL0028 - EPA 3050B										
Matrix Spike (BGL0028-MS1)	**Source: 2310194-07**		Prepared: 12/01/23 Analyzed: 12/02/23							
Arsenic	22.0	0.200	mg/kg dry	40.2	0.498	53.6	75-125			QM-07
Barium	62.2	0.400	"	40.2	12.1	124	75-125			
Cadmium	2.17	0.200	"	2.01	0.0515	105	75-125			
Copper	20.8	0.400	"	40.2	ND	51.8	75-125			QM-07
Lead	20.9	0.200	"	20.1	2.15	93.3	75-125			
Nickel	21.4	0.400	"	40.2	0.687	51.6	75-125			QM-07
Silver	1.99	0.0200	"	2.01	0.0117	98.1	75-125			
Zinc	24.9	0.400	"	40.2	3.19	53.8	75-125			QM-07
Selenium	7.27	0.260	"	4.02	ND	181	75-125			QM-07
Matrix Spike Dup (BGL0028-MSD1)	**Source: 2310194-07**		Prepared: 12/01/23 Analyzed: 12/02/23							
Arsenic	22.0	0.200	mg/kg dry	40.2	0.498	53.5	75-125	0.0146	25	QM-07
Barium	63.8	0.400	"	40.2	12.1	128	75-125	2.62	25	QM-07
Cadmium	2.24	0.200	"	2.01	0.0515	109	75-125	3.41	25	
Copper	21.0	0.400	"	40.2	ND	52.1	75-125	0.545	25	QM-07
Lead	21.7	0.200	"	20.1	2.15	97.3	75-125	3.76	25	
Nickel	21.6	0.400	"	40.2	0.687	52.0	75-125	0.931	25	QM-07
Silver	2.03	0.0200	"	2.01	0.0117	100	75-125	2.26	25	
Zinc	24.7	0.400	"	40.2	3.19	53.5	75-125	0.549	25	QM-07
Selenium	8.45	0.260	"	4.02	ND	210	75-125	15.1	25	QM-07



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Hexavalent Chromium by EPA Method 7196 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGK1080 - 3060A_Mod										
Blank (BGK1080-BLK1)				Prepared: 11/29/23 Analyzed: 12/01/23						
Chromium, Hexavalent	ND	0.30	mg/kg wet							
LCS (BGK1080-BS1)				Prepared: 11/29/23 Analyzed: 12/01/23						
Chromium, Hexavalent	25.0	0.30	mg/kg wet	25.0		100	80-120			
Duplicate (BGK1080-DUP1)	**Source: 2311455-01**			Prepared: 11/29/23 Analyzed: 12/01/23						
Chromium, Hexavalent	ND	0.30	mg/kg dry		ND				20	
Matrix Spike (BGK1080-MS1)	**Source: 2311455-01**			Prepared: 11/29/23 Analyzed: 12/01/23						
Chromium, Hexavalent	28.9	0.30	mg/kg dry	28.9	ND	99.8	75-125			
Matrix Spike Dup (BGK1080-MSD1)	**Source: 2311455-01**			Prepared: 11/29/23 Analyzed: 12/01/23						
Chromium, Hexavalent	28.8	0.30	mg/kg dry	28.9	ND	99.4	75-125	0.402	20	

Soluble Nutrients by EPA 6020/USDA60 6(2) - Saturated Paste Extraction - Quality Control

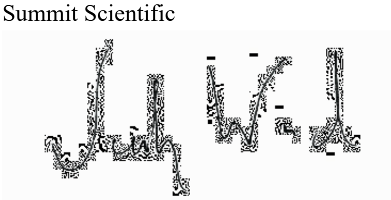
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGK1164 - General Preparation										
Blank (BGK1164-BLK1)				Prepared: 11/30/23 Analyzed: 12/03/23						
Calcium	ND	0.0500	mg/L wet							
Magnesium	ND	0.0500	"							
Sodium	ND	0.0500	"							
LCS (BGK1164-BS1)				Prepared: 11/30/23 Analyzed: 12/03/23						
Calcium	5.19	0.0500	mg/L wet	5.00		104	70-130			
Magnesium	5.55	0.0500	"	5.00		111	70-130			
Sodium	5.78	0.0500	"	5.00		116	70-130			

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGK1133 - General Preparation										
Duplicate (BGK1133-DUP1)	**Source: 2311455-01**			Prepared & Analyzed: 11/30/23						
% Solids	86.1		%		86.4			0.318	20	



Specific Conductance by EPA Method 120.1, Saturated Paste Extraction - Quality Control

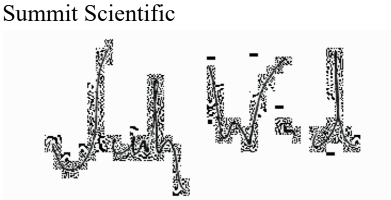
Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGL0003 - General Preparation										
Blank (BGL0003-BLK1)				Prepared: 12/01/23 Analyzed: 12/04/23						
Specific Conductance (EC)	ND	0.0100	mmhos/cm							
LCS (BGL0003-BS1)				Prepared: 12/01/23 Analyzed: 12/04/23						
Specific Conductance (EC)	0.157	0.0100	mmhos/cm	0.150		104	95-105			
Duplicate (BGL0003-DUP1)		**Source: 2311455-01**		Prepared: 12/01/23 Analyzed: 12/04/23						
Specific Conductance (EC)	0.828	0.0100	mmhos/cm		0.828			0.00	20	

Physical Parameters by APHA/ASTM/EPA Methods, Saturated Paste Extraction - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch BGL0001 - General Preparation										
LCS (BGL0001-BS1)				Prepared: 12/01/23 Analyzed: 12/04/23						
pH	9.00		pH Units	9.18		98.0	95-105			
Duplicate (BGL0001-DUP1)	**Source: 2311455-01**			Prepared: 12/01/23 Analyzed: 12/04/23						
pH	8.47		pH Units		8.47			0.00	20	



Notes and Definitions

QM-07	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS/LCSD recovery.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

4480 Garfield St
Denver, CO 80210
www.quandaryconsultants.com

CUSTOM SOILS REPORT

United States Department of Agriculture

NRCS

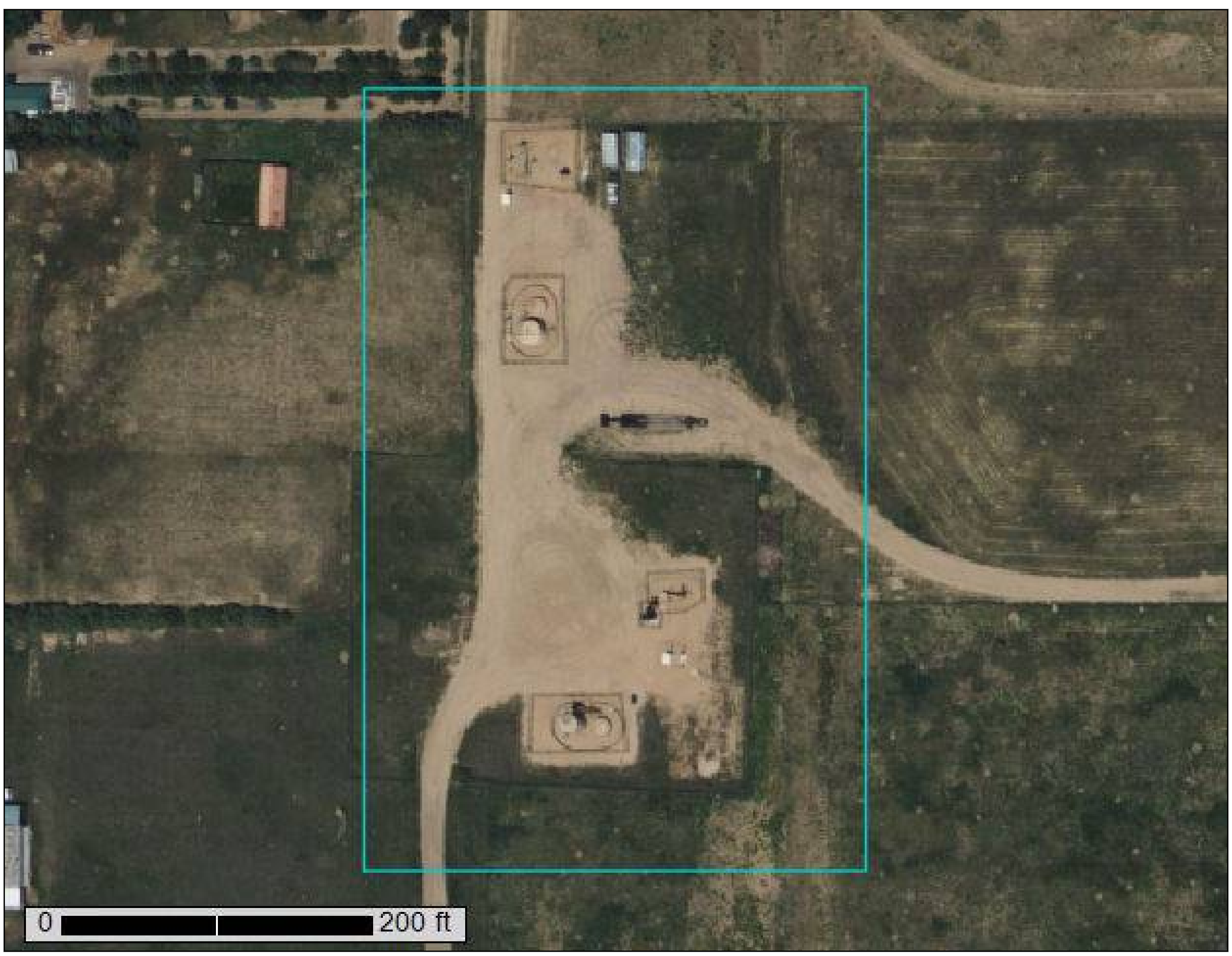
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Weld County, Colorado, Southern Part

Miller 14-17 Excavation Custom Soils Report



January 2, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

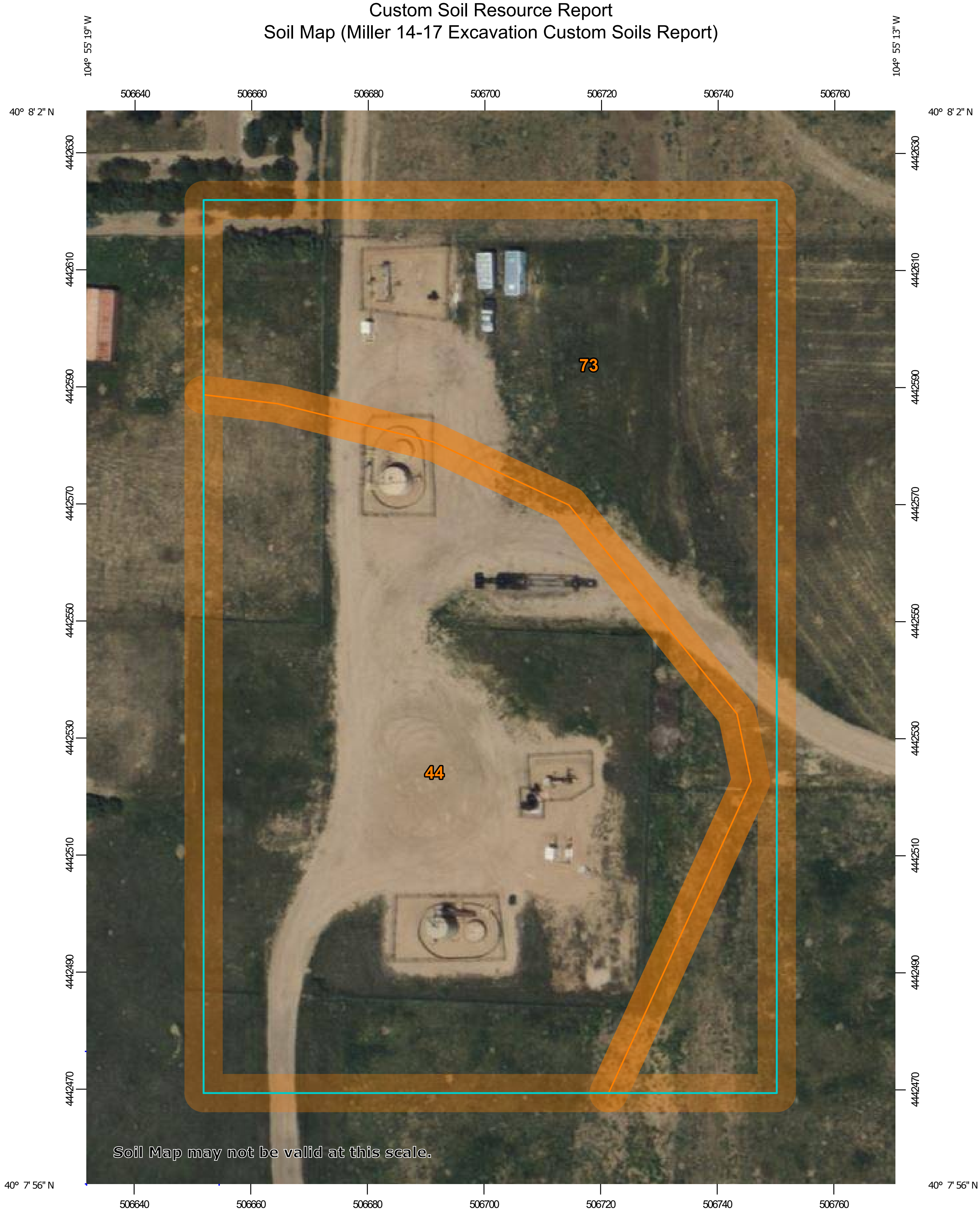
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map (Miller 14-17 Excavation Custom Soils Report)



Map Scale: 1:894 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 10, 20, 40, 60

Feet: 0, 40, 80, 160, 240

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 22, Aug 24, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 8, 2021—Jun 12, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Miller 14-17 Excavation Custom Soils Report)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
44	Olney loamy sand, 1 to 3 percent slopes	2.2	59.3%
73	Vona loamy sand, 3 to 5 percent slopes	1.5	40.7%
Totals for Area of Interest		**3.7**	**100.0%**

Map Unit Descriptions (Miller 14-17 Excavation Custom Soils Report)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Weld County, Colorado, Southern Part

44—Olney loamy sand, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 362r
Elevation: 4,600 to 5,200 feet
Mean annual precipitation: 11 to 15 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 125 to 175 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Olney and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Olney

Setting

Landform: Plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed deposit outwash

Typical profile

H1 - 0 to 10 inches: loamy sand
H2 - 10 to 20 inches: sandy clay loam
H3 - 20 to 25 inches: sandy clay loam
H4 - 25 to 60 inches: fine sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Vona

Percent of map unit: 8 percent

Hydric soil rating: No

Zigweid

Percent of map unit: 7 percent
Hydric soil rating: No

73—Vona loamy sand, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2x0j8
Elevation: 4,100 to 5,200 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 130 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Vona and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vona

Setting

Landform: Hills, hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Eolian sands

Typical profile

A - 0 to 7 inches: loamy sand
Bt1 - 7 to 14 inches: sandy loam
Bt2 - 14 to 20 inches: sandy loam
Bk - 20 to 45 inches: sandy loam
C - 45 to 80 inches: loamy sand

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline (0.1 to 1.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: R067BY015CO - Deep Sand
Hydric soil rating: No

Minor Components

Ascalon

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Manter

Percent of map unit: 5 percent
Landform: Hills, interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Olnest

Percent of map unit: 3 percent
Landform: Interfluves, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Valent

Percent of map unit: 2 percent
Landform: Dunes
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R067BY015CO - Deep Sand
Hydric soil rating: No

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4480 Garfield St
Denver, CO 80210
www.quandaryconsultants.com

USDA FACT SHEETS

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Plant Guide

WINTERFAT

Krascheninnikovia lanata (Pursh) A.D.J. Meeuse and Smit

plant symbol = KRLA2

Northern Cold Desert Germplasm
Loren St. John, Aberdeen PMC

Contributed By: USDA, NRCS, Idaho State Office

Alternate Names

White sage, winter-sage, feather-sage, sweet sage, lambstail, *Eurotia lanata, and Ceratoides lanata*

Uses

Rangeland/Grazing – Winterfat is superior winter browse for livestock and wildlife. It is rated as excellent to good browse for cattle, sheep, and goats and fair browse for horses. It is one of the most valuable rangeland browse plants for maintaining the weight of adult animals on winter grazing ranges because of the high (>10 percent) crude protein content in winter.

Wildlife – Winterfat is considered very good browse for wildlife and is extensively utilized by rodents, rabbits, antelope, deer, elk, and bighorn sheep.

Erosion Control – Winterfat is a good erosion control plant when planted in a mixture to provide greater plant density. It has a deep taproot and an extensive fibrous root system near the soil surface, which helps stabilize soils. It germinates readily and provides fairly rapid growth under favorable growing conditions.

Reclamation – Winterfat is an important pioneer species and establishes fairly easily on drastically disturbed sites or poorly developed soils such as those commonly found on mine lands.

Status

Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status such as, state noxious status and wetland indicator values.

Description

Winterfat (*Krascheninnikovia lanata* (Pursh) A.D.J. Meeuse and Smit is an erect to spreading, low-growing, long-lived half-shrub native to the western United States. It is a cool season plant, typically with a central woody stem arising from a woody crown. Annual secondary stems, 8 inches to 4 feet and sometimes taller, are herbaceous on dwarf forms and herbaceous to woody throughout on taller forms, wooly and branched. Winterfat has an extensive fibrous root system and a deep penetrating taproot.

Leaves are simple, alternate, mostly linear, and revolutely margined (rolled back from the margin). The inflorescence is a spike. Plants are monoecious with staminate flowers above the pistillate ones or occasionally they are dioecious. Pollination usually occurs between plants, but self-pollination may occur on monecious plants. Wind is the principal mode of pollination. The seed is a utricle and the seed coat is thin and covered with fine white, silky pilose hairs to ½ inch long.

Active growth begins in early to mid spring, flowering occurs from mid spring to early summer, and seed maturity is reached by mid to late fall. Winterfat has many common names including white sage, winter-sage, feather-sage, sweet sage, and lambstail.

Distribution
This plant is widely distributed from Saskatchewan and Manitoba, Canada to western Nebraska, Colorado, west Texas, California and Washington.

Adaptation
Winterfat is most common in the 7 to 16 inch annual precipitation zones, but has been found in areas with less than 6 inches of annual precipitation and in areas with greater than 20 inches annual precipitation. Winterfat is found from near sea level to 10,000 feet elevation. It occurs in salt desert shrub, pinyon juniper, sagebrush grass and near the edges of some forested plant communities.

Winterfat grows well on a wide range of soil textures, although it prefers more basic or limy soils. It tolerates moderate to highly saline conditions, but is not tolerant of acidic soils. It does not tolerate flooding or extended wet conditions. Refer to soil surveys and ecological site descriptions for additional guidance. It generally has good cold tolerance with some accessions (see Northern Cold Desert Germplasm and Open Range Germplasm) being more tolerant.

Establishment
Planting: Winterfat seed does not remain viable for extended periods and use of seed no older than two years is recommended. Winterfat seed may lose as much as 50 percent or more viability during the first year of storage. It is very important to have current germination test results for seed that is to be planted.

Dormant fall - winter or very early spring plantings result in the best stands. Studies indicate that winterfat seedlings can survive freezing temperatures and do well at cool temperatures, but growth is very slow during hot summer periods.

Winterfat utricles are covered with fine silky hairs that will not flow through a drill. . Debearded seed flows readily through a drill, but this seed (with hairs removed) may be viable for a shorter period of time than non-debearded seed.

Winterfat should be seeded on the soil surface to no deeper than ¼ inch. Broadcasting seed on snow or broadcasting on a moist firm soil surface followed by a packing operation results in the best stands. Drilling seed from 1/16 to ¼ inch deep using a drill with good depth control and packer wheels into firm soil also results in satisfactory stands.

When drill seeded alone to reclaim winterfat monoculture plant communities, 15 Pure Live seeds (PLS) per square foot (5.0 pounds PLS per acre) is recommended. If broadcast seeded, the seeding rate should be increased to 21 PLS seeds per square foot or 7.0 pounds PLS per acre.

When seeded as a component of a mix, 0.025 to 0.5 pound PLS per acre drilled or 0.05 to 1.0 pound PLS per acre broadcast is recommended. Seeding in alternate or cross rows promotes optimum establishment of winterfat. A seeding rate of 1/40 (0.025) pound PLS per acre will result in approximately 400 plants per acre under favorable establishment and growing conditions.

If winterfat is seeded in areas where annual weeds such as cheatgrass, medusahead rye, and/or tumble mustard are prevalent, it should be seeded in a mixture of adapted, vigorous native grasses following control practices such as tillage or herbicide treatment for the annual weeds.

Management
Winterfat has excellent tolerance to browsing during the winter. However, over-browsing has greatly reduced or eliminated it in some areas. No more than 25 percent of the annual season growth should be removed during the active growing period (less during active spring growth period) and no more than 50 percent of the annual season growth should be removed during dormant periods.

New plantings should be excluded from browsing by livestock and wildlife until plants are well established and producing seed.

Environmental Concerns
Winterfat is native, long-lived, and spreads by seed distribution. It is not considered "weedy", but could slowly spread into adjoining vegetative communities under ideal climatic and environmental conditions.

This species is well documented as having beneficial qualities and no negative impacts on wild or domestic animals.

Seed Production

Seed production fields can be established from transplants or by direct seeding. Establishing plants in a greenhouse and transplanting to the field will result in the most satisfactory stands for seed production. Plant spacing under transplant conditions should be 4 - 5 feet within row and a minimum of 5 feet between rows. Transplanting into weed barrier fabric can also improve plant establishment and seed production, weed control, and moisture conservation. Transplanting is recommended in the spring prior to hot summer temperatures. . Full seed production is usually reached the second to third year following transplanting.

Plantings can also be established by direct seeding. A minimum of 15 to 20 PLS seeds per linear foot of drill row should be planted. Hand seeding in late fall or very early spring may also be an option. Plant 5 to 10 seeds in a close group at desired spacing and thin to 1 or 2 plants after emergence. Full seed production may be reached the third to fourth year following direct seeding.

Winterfat requires an equivalent of 10 to 12 inches annual precipitation for seed production. Irrigation may only be needed for establishment. Expected seed yields may range from 200 to 400 pounds per acre. Fertilization is not generally recommended unless soil tests indicate severe nutrient deficiencies. Rabbits and rodents can damage stands and may destroy seedlings. Insects such as grasshoppers and Mormon crickets infrequently damage stands beyond recovery.

Harvesting seed is best accomplished by hand stripping. Mechanized harvesting has been used, but seed requires additional conditioning to properly dry and clean excessive trash (leaves, stems, other inert matter). Harvested seed is usually threshed by debearding or run through a hammermill to remove the fine silky hairs that cover the seed followed by screening. This process greatly enhances the ability of the seed to flow through planting equipment. Removing the white hairs that surround the seed can injure the seed resulting in reduced viability, seedling vigor, and stand establishment. One must be extremely careful when threshing seed to limit the amount of mechanical action on the seed to minimize seed damage. Unthreshed seed is recommended for best stand establishment if hand seeding directly or for transplants.

Viability of winterfat seed rapidly decreases after storage for 1 to 2 years even under the best storage conditions. Germination of fresh seed can be as high as 85 to 95 percent. Germination of seed 3 years or older is commonly below 25 percent. It is extremely important to have a current germination test for seed that will be planted. Seeds per pound will vary by accession, but averages 125,000 with bracts intact. Seed conditioned with a hammer-mill to remove bracts averages 200,000 seeds per pound.

Cultivars, Improved and Selected Materials (and area of origin)

Foundation and Registered seed is available through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

'Hatch' winterfat was released in 1985 by the USDA-NRCS Los Lunas Plant Materials Center in cooperation with New Mexico, Colorado, Utah, and Idaho Agricultural Experiment Stations, USDA-Forest Service, and Utah Division of Wildlife Resources. Hatch was selected for improved seed production, germination, seedling vigor, and big game wildlife preference.

Hatch originated from the Hatch, Utah area at a site with 11 to 12 inches annual precipitation, 7300 feet elevation, and a mixed pinyon-juniper to mountain big sagebrush plant community. It performs well in New Mexico, Arizona, western Colorado, southern Utah, and southern Nevada. It is best adapted to upland sites and less adapted to arid desert shrub sites. Field plantings in the northern regions of the Great Basin and Intermountain West generally fail due to poor cold tolerance.

Northern Cold Desert Germplasm Selected Class winterfat was released in 2001 by the USDA-NRCS Aberdeen Plant Materials Center and Idaho Agricultural Experiment Station. Northern Cold Desert Germplasm winterfat was selected for improved cold hardiness and is better adapted to the northern regions of the natural range of winterfat.

Northern Cold Desert Germplasm winterfat is a composite of five accessions of winterfat. These accessions were selected from a collection of 45 accessions evaluated and found to be significantly more cold tolerant than others in the study. Source locations include a site southeast of Price, Utah; a site near Castledale, Utah; a site six miles east of Kanab, Utah; a site along Northfork Road in Washington County, Utah; and a site in Rio Blanco County, Colorado.

The Northern Cold Desert Germplasm winterfat is an erect shrub that can grow to 3 feet tall with a 2 feet diameter canopy cover. It is better adapted to the colder, northern portions of the Great Basin and Intermountain West than Hatch. It tolerates very dry conditions in the 7 – 14 inch annual precipitation zone. It is highly tolerant of alkaline/saline soils and soils derived from limestone parent materials. Uses include rangeland restoration, erosion control, and browse for livestock and wildlife.

Open Range Germplasm winterfat is a Tested Class germplasm released in 2002 by Bridger, Montana Plant Materials Center. It is a composite of three superior accessions from near Terry in Prairie County, Montana; near Bridger in Carbon County, Montana; and near Rawlins in Carbon County, Wyoming. Open Range Germplasm is adapted for use throughout the Northern Great Plains region including north-central U.S. and south-central Canada.

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Prepared By

Daniel G. Ogle, Plant Materials Specialist, USDA, NRCS, Boise, Idaho

Loren St. John, Team Leader, USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Larry Holzworth, Plant Materials Specialist, USDA, NRCS, Bozeman, Montana

Susan R. Winslow, Agronomist, USDA, NRCS, Bridger, Montana

Species Coordinator

Daniel G. Ogle, Plant Materials Specialist, USDA, NRCS, Boise, Idaho

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For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS <http://plants.usda.gov> and Plant Materials Program Web sites <http://Plant-Materials.nrcs.usda.gov>.

United States Department of Agriculture
Natural Resources Conservation Service

Plant Guide

THICKSPIKE WHEATGRASS

Elymus lanceolatus (Scribn. & J.G. Sm.) Gould

Plant Symbol = ELLA3

Including

E. l. subsp. *lanceolatus*

Thickspike Wheatgrass
Plant Symbol = ELLAL

E. l. subsp. *riparius* (Scribn. & J.G. Sm.) Barkworth

Streambank Wheatgrass
Plant Symbol = ELLAR

And

E .l. subsp. *psammophilus* (J.M. Gillett & H. Senn) Á. Löve

Great Lakes Wheatgrass
Plant Symbol = ELLAP

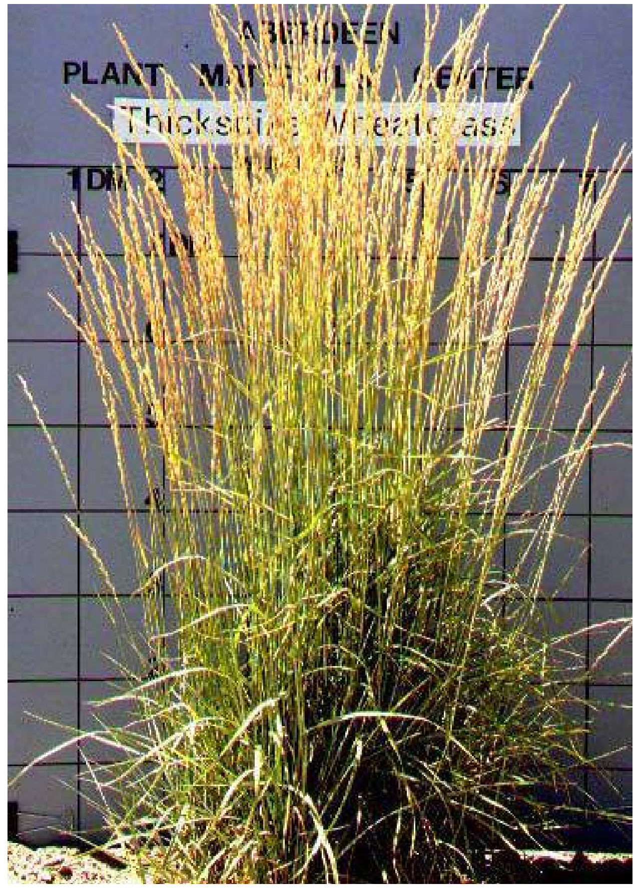
***Contributed by*: USDA NRCS Idaho Plant Materials Program**

Alternate Names

Common Alternate Names:
E. l. subsp. *psammophilus* is also known as sand dune wheatgrass

Scientific Alternate Names:
Agropyron dasystachyum, A. lanceolatum,

Although streambank wheatgrass (*E. l.* subsp. *riparius*) is currently not recognized by the PLANTS Data Center as a valid taxon (USDA NRCS 2012); separation of this subspecies is useful in describing ecological sites, predicting revegetation performance and in making land management decisions. In this light, the authors have decided to follow the treatment of the species following Barkworth et al. (2007).



Thickspike wheatgrass. Loren St. John, USDA NRCS.

Uses

Grazing/rangeland/hayland: Thickspike wheatgrass and its subspecies are palatable to all classes of livestock and wildlife. It is a preferred feed for cattle, sheep, horses, and elk in spring and is considered a desirable feed for deer and antelope in spring (Ogle and Brazee 2009). It is considered a desirable feed for cattle, sheep, horses, and elk in summer, fall, and winter. In the spring, the protein levels can be as high as 20 percent and decreases to about 4 percent, as it matures and cures. Digestible carbohydrates remain about 45 percent throughout the active growth period. This species is generally a relatively low forage producer with the exception of the cultivar, 'Bannock', but can be utilized as native hay when planted in association with other species. It has been noted as one of the highest yielding forage grasses in the Red Desert and Big Horn Basin of Wyoming (Krysl et al. 1984.).

Erosion control/reclamation: Thickspike wheatgrass and streambank wheatgrass are well adapted for the stabilization of disturbed soils. They do not compete well with aggressive introduced grasses during the establishment period, but are very compatible with slower developing native grasses, such as Snake River wheatgrass (*Elymus wawawaiensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), western wheatgrass (*Pascopyrum smithii*), and needlegrass (*Stipa* and *Hesperostipa*) species. Their drought tolerance, dense root system and good seedling vigor make these species ideal for reclamation in areas receiving 200 to 500 mm (8 to 20 in) annual precipitation.

The low growth form, vigorous sod, and low maintenance requirements of streambank wheatgrass make it ideal for stabilization and ground cover purposes. These grasses can be used in urban areas where irrigation water is limited to provide ground cover and to stabilize ditch banks, dikes, and roadsides. It has even been used as cover for grassed airplane runways.

Wildlife: Thickspike wheatgrass provides some cover for small mammals and upland birds (Scher 2002). In addition to big game it is also grazed by jackrabbits (Ganskopp et al. 1993).

Status
Great Lakes wheatgrass (*E. l.* subsp. *psammophilus*) is threatened in Wisconsin (Wisconsin DNR 2012). Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Description
General: Grass family (Poaceae). Thickspike wheatgrass is a long-lived, strongly rhizomatous, perennial grass with erect culms 0.3 to 1.3 m (12 to 50 in) tall. The leaves are involute (rolled) or flat, 1.0 to 3.5 mm (0.04 to 0.14 in) wide and typically stiffly ascending. The leaf sheaths are glabrous or rarely ciliate to long-hairy on the margins (Welsh et al. 2003). Auricles are well-developed, 0.4 to 1.5 mm (0.02 to 0.06 in) long, and the ligule is membranous, 0.3 to 0.5 mm (0.01 to 0.02 in) long (Skinner 2010). The inflorescence is an erect spike, 6 to 22 cm (2.4 to 8.7 in) long with a continuous rachis. The internodes of the spike are approximately 5 to 16 mm (0.2 to 0.6 in) long. Spikelets are solitary at each node of the rachis, bear 3 to 12 florets, and closely overlap. The glumes are 4 to 10 mm (0.16 to 0.4 in) long, acute-acuminate with a 0.5 to 3 mm (0.02 to 0.1 in) awn. Lemmas are 8 to 12 mm (0.3 to 0.5 in) long and awn-tipped. Anthers are 3 to 5 mm (0.1 to 0.2 in) long (Welsh et al. 2003). There are approximately 135,000 seeds per pound (Ogle et al. 2011a).

Thickspike wheatgrass creates a dense rhizomatous matrix. The majority of the root mass is located in the upper 24 cm (9 in) of soil with some roots extending 38 cm (15 in) deep (USDA FS 1937).

The subspecies of *E. lanceolatus* can be separated primarily on the basis of lemma pubescence. Those with densely hairy lemmas with flexible hairs approximately 1 mm (0.04 in) long or longer are considered Great Lakes, or sand dune, wheatgrass (*E. l.* subsp. *psammophilus*). Plants with lemmas pubescent of stiff hairs less than 1 mm (0.04 in) are thickspike wheatgrass (*E. l.* subsp. *lanceolatus*), while plants with lemmas mostly glabrous to scabrous are considered streambank wheatgrass (*E. l.* subsp. *riparius*) (Barkworth et al. 2007).

Streambank and thickspike wheatgrasses are similar to western wheatgrass in appearance, except they are not as coarse, their rhizomatous trait is not as aggressive, and their coloration is somewhat greener. They are also more drought tolerant than western wheatgrass. In comparison to western wheatgrass, they "green up" and "head out" earlier and total biomass production is generally lower.

Distribution:
Thickspike wheatgrass and streambank wheatgrass occur throughout most of western North America with primary distribution in the Intermountain and Rocky Mountain areas. Great Lakes wheatgrass was described around the Great Lakes region; however specimens have also been identified throughout the western range of the species (Barkworth et al. 2007). For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Habitat:
Thickspike wheatgrass occurs from near sea level in the Great Lakes region to 10,000 feet in the Rocky Mountains (Scher 2002; Welsh et al 2003). This is a very polymorphic species and is a component of the vegetation on such diverse sites as stabilized sand dunes in eastern Washington, glacial outwash fans in Montana and loess (wind blown silt loam) soils in southern Idaho (Scher 2002). Thickspike and streambank wheatgrass are components of many western native plant communities and generally occupy a small percentage of the overall composition. An exception to this may be short periods following fire in Juniper stands, when they may nearly dominate the site.

Species often associated with these wheatgrasses in the west include the big sagebrush (*Artemisia tridentata*) complex, juniper (*Juniperus* spp.), needlegrasses, sand dropseed (*Sporobolus airoides*), prairie sandreed (*Calamovilfa longifolia*), bluebunch wheatgrass, Snake River wheatgrass, and Idaho fescue (*Festuca idahoensis*).

Adaptation
Thickspike and streambank wheatgrass prefer medium to coarse textured soils; however, streambank wheatgrass can also be found on slightly fine textured soils. Western wheatgrass may be a better choice on fine textured soils in sites receiving 300 mm (12 in) or more annual precipitation. Thickspike and streambank wheatgrass will

tolerate slightly acidic to moderately saline conditions with a pH of 6.0 to 9.5 (Scher 2002). They are cold tolerant, can withstand moderate periodic flooding in the spring, are moderately shade tolerant, and very tolerant of fire. They will not tolerate long periods of inundation, poorly drained soils, or excessive irrigation (Holzworth and Lacey 1993).

Second season 'Sodar' streambank wheatgrass growing in a 6-9 inch precipitation site northwest of Aberdeen, Idaho. Derek Tilley, USDA NRCS.

On native sites, streambank and thickspike wheatgrasses are most abundant in the 200 to 500 mm (8 to 20 in) annual precipitation zones. Seeded varieties do best with 250 to 500 mm (10 to 20 in) of precipitation; however they have been successfully established on sites receiving as low as 125 mm (5 in) of precipitation.

Establishment

These species should be seeded with a drill at a depth of 1.2 cm (0.5 in) or less on medium to fine textured soils and 1 inch or less on coarse textured soils. Single species seeding rates recommended for both grasses are 8 pounds Pure Live Seed (PLS) per acre or 20 to 25 PLS per square foot (Ogle et al. 2011a). If used as a component of a mix, adjust to percent of mix desired. For mined lands and other harsh critical areas, the seeding rate should be increased to 40 to 50 PLS per square foot. Mulching and light irrigation are beneficial for stand establishment.

The best seeding results are obtained from seeding in very early spring on fine to medium textured soils and in late fall on medium to coarse textured soils. Late summer (August - mid September) seedings are not recommended unless irrigation is available. There are reports of pre-chilling treatments aiding seed germination (Monsen et al. 2004); however others indicate seed is viable and non-dormant at maturation (Zhang and Maun 1994). Seedling vigor is good to excellent, exceeding that of western wheatgrass, but less than crested wheatgrass (*Agropyron cristatum*).

Thickspike and streambank wheatgrass establish more quickly than western wheatgrass. They are the most rapidly establishing native species next to slender wheatgrass (*Elymus trachycaulus*). They are compatible with other native species and can be used in seeding mixtures. They should not be seeded with strongly competitive introduced species.

Stands may require weed control measures during establishment, but application of 2,4-D should not be made until plants have reached the three to five leaf stage (Smith et al. 1996). Mowing the stand when weeds are beginning to bloom will reduce weed seed development.

Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Management

This grass begins growth in the spring about 2 weeks after bluegrass (*Poa* spp.) species and about 3 weeks earlier than western wheatgrass. They make good spring growth, fair summer growth, and good fall growth if moisture is available.

Streambank wheatgrass is not recommended for forage production. Thickspike wheatgrass has good palatability for livestock and wildlife. Livestock and wildlife will graze thickspike wheatgrass throughout the growing season, until the plants become too coarse toward fall. Established stands can withstand heavy grazing.

New stands should not be grazed until they have firmly established and have headed out. Six inches of new growth should be attained in spring before grazing is allowed in established stands and four inches of stubble should be left at the end of the grazing season (Ogle, 2011b).

These wheatgrasses are low maintenance plants, requiring little additional care. However, on better sites, stands can become sod-bound and may need attention in the form of fertilization and moderate spring/fall grazing deferment. Stands may also benefit from ripping if sod-bound conditions occur to revitalize plants and to increase forage production. Care should be taken to avoid excessive tillage during ripping because stands may be damaged beyond their ability to respond to the positive influences of ripping.

Thickspike and streambank wheatgrass are competitive with weedy species, but can be crowded out by some aggressive introduced species.

Pests and Potential Problems
Under certain environmental conditions, rust can severely reduce seed yields (Skinner 2004). Head smut has also been noted as a problem in seed production fields (Skinner 2004). Grasshoppers and other insects may also damage new stands and the use of pesticides may be required.

Environmental Concerns
Thickspike wheatgrass are long-lived, spread primarily via vegetative means (rhizomes), but also spread via seed distribution. They are not considered "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. Most seedings do not spread from original plantings, or if they do spread, the rate of spread is slow.

Thickspike wheatgrass has been shown to form hybrids with bluebunch wheatgrass. The resulting offspring has been described as Montana wheatgrass (*Elymus albicans*) (Dewey 1970).

Seed and Plant Production
Seed production of streambank and thickspike wheatgrass has been very successful under cultivated conditions. Row spacing of 71 to 91 cm (28 to 36 in) is recommended. The seeding rate for 36 inch row spacing is 3.3 pounds PLS/ac. Row culture via cultivation should be maintained for optimum seed production however this can be difficult because of the rhizomatous nature of the grass. Vigorous mechanical cultivation between the rows is required to reduce the vegetative spread by rhizomes in order to maintain the row culture.

Seed fields are productive for two to four years. Average production of 100 to 250 pounds per acre can be expected under dryland conditions in 355 (14 in) plus rainfall areas. Average production of 200 to 400 pounds per acre can be expected under irrigated conditions (Cornforth et al. 2001; Smith et al 1996). Seed is harvested by swathing, followed by combining of the cured windrows (Smith et al. 1996). The seed heads readily shatter and require close scrutiny of maturing stands. Seed is generally harvested in mid July to mid August.

Clean seed retains high germination for at least ten years under cool, dry storage conditions. High temperatures t and/or high humidity reduce seed storage life (Skinner 2004).

Cultivars, Improved, and Selected Materials (and area of origin)
Foundation and registered seed is available through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

'Bannock' (*E. lanceolatus* spp. *lanceolatus*) was developed by the Aberdeen Plant Materials Center and released in 1995. It is a composite of collections from near The Dalles, Oregon; Pocatello, Idaho; and Quincy, Washington. It is adapted to the Northwest and Intermountain regions where precipitation averages 200 mm (8 in) or above. It prefers moderately deep loamy soils, but does grow in sandy to clayey soils. It is noted for rapid establishment, moderate formation of sod, high forage production and ability to survive and thrive under dry conditions. Certified seed is available and Aberdeen PMC maintains Breeder and Foundation seed (Kiger et al. 1995). Variety protection has been granted under the Plant Variety Protection Act of 1970. Conditions of this license specify that Bannock seed can be marketed only as a class of certified seed.

'Critana' (*E. lanceolatus* spp. *lanceolatus*) was developed by the Bridger Plant Materials Center and released in 1971. The original collection site was in north central Montana near Havre. It is drought tolerant, has good seedling vigor and readily establishes on critically disturbed sites. I t is especially good as a sand dune stabilization species. Critana is noted for its variable genetic expression. Certified seed is available and Bridger PMC maintains Breeder seed (Winslow and Hybner. 2009).

'**Schwendimar'** (*E. lanceolatus* spp. *lanceolatus*) was developed by the Pullman Plant Materials Center and released in 1994. It was collected on wind-blown sands along the Columbia River near The Dalles, Oregon. It is adapted to northwest sites with 8 inches or greater precipitation and is recommended primarily for quick stabilization of coarse textured soils (Alderson and Sharp 1994). Certified seed is limited. Washington State Crop Improvement Association maintains Breeder and Foundation seed.

'Sodar' (*E. lanceolatus* spp. *riparius*) was released by the Aberdeen Plant Materials Center in 1954. It is a variety of streambank wheatgrass and is a subspecies of thickspike wheatgrass. The original collection was made in Grant County, Oregon. Its drought tolerance, excellent seedling vigor, vigorous rhizomatous trait once established, and ability to compete with weeds characterizes it. It is most commonly used for stabilization of critical sites. Certified seed is available and Aberdeen PMC maintains Breeder and Foundation seed (Douglas and Ensign 1954).

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Prepared By:
Dan Ogle, USDA NRCS, Boise, ID (ret.)

Loren St. John, USDA NRCS Plant Materials Center, Aberdeen, ID

Larry K. Holzworth, USDA NRCS, Bozeman, MT

Susan R. Winslow, USDA NRCS, Bridger, MT

Dr. Thomas A. Jones, USDA-ARS, Logan, UT

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Materials Program Web site http://plant-materials.nrcs.usda.gov.

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Plant Fact Sheet

SWITCHGRASS
Panicum virgatum L.
Plant Symbol = PAVI2

Contributed by: USDA NRCS Jimmy Carter Plant Materials Center

Mike Owsley
USDA Natural Resources Conservation Service
Jimmy Carter Plant Materials Center

Alternate Names
Panic raide

Uses
Livestock: Switchgrass produces heavy growth during late spring and early summer. It provides good warm-season pasture and high quality hay for livestock.

Erosion Control: Switchgrass is perhaps our most valuable native grass, adapted to a wide range of sites. It stabilizes soil on strip-mine spoils, sand dunes, dikes, gullies and other critical areas. It is also suitable for low windbreak plantings in crop fields.

Wildlife: Switchgrass provides excellent nesting and cover for pheasants, quail, and rabbits. It holds up in heavy snow (particularly 'Shelter' and 'Kanlow') and is useful on shooting preserves. The seed provide food for pheasants, quail, turkeys, doves, and songbirds. Due to its potential to spread some wildlife biologists have reduced or eliminated the use of switchgrass in some plantings.

Biofuel Source: Switchgrass is a native perennial warm season grass with the ability to produce moderate to high biomass yields on marginal lands. These characters have resulted in the use of switchgrass in several bioenergy conversion processes, including cellulosic ethanol production, biogas, and direct combustion for thermal energy applications.

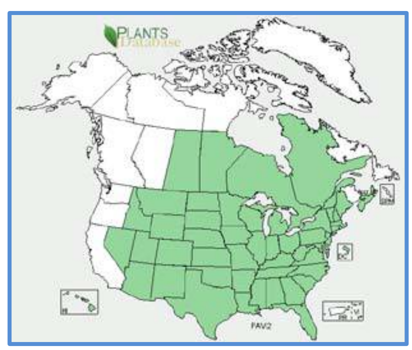
Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Weediness
This plant may become weedy or invasive in some regions or habitats and may displace other vegetation if not properly managed. Please consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use. Weed information is also available from the PLANTS Web site at http://plants.usda.gov. Please consult the Related Web Sites on the Plant Profile for this species for further information.

Description and Adaptation
Switchgrass is native in the continental United States except California and the Pacific Northwest. It is a perennial bunch grass averaging 3 to 5 feet tall and may spread from short, stout rhizomes. The stem (culm) is round and can have a red to straw colored tint. The seed head is an open, spreading panicle.

Switchgrass is climatically adapted throughout most of the United States when planted on suitable soils. Moderately deep to deep, somewhat dry to poorly drained, sandy to clay loam soils are best. It does poorly on some heavy soils. In the East, it performs well on shallow and droughty soils. Switchgrass occurs naturally on prairies, open oak and pine woodlands, shores, riverbanks, and high brackish marshes along maritime forest ecotones.

For updated distribution, please consult the Plant Profile page for this species on the PLANTS Web site.



Switchgrass distribution from USDA-NRCS PLANTS Database.

Establishment

Switchgrass is planted using the pure live seed (PLS), typically at a seeding rate of 6-12 lbs. PLS/acre. Seeding rates and dates vary according to cultivar, region of adaptation, and purpose. Consult with your local NRCS office or extension office for the proper seeding rates and dates for switchgrass cultivars in your region. Mixed plantings may be seeded at a lower rate. The seed can be planted using seed drills or broadcast spreaders. Seedbeds should be firmed prior to seeding. When using the broadcast method, the area should be rolled after seeding to increase the seed to soil contact. No till seedings in closely grazed or burned sod also have been successful.

For further information on establishing switchgrass, see NRCS Technical Note No. 3, *Planting and Managing Switchgrass as a Biomass Energy Crop*

Management

Control weeds during establishment by mowing to a height of 4 inches in May or 6 inches in June or July. Grazing is generally not recommended the first year.

Established stands of switchgrass may be fertilized in accordance with soil tests. Switchgrass benefits from burning prior to initiation of spring growth. Burning every 3 to 5 years decreases weed competition, eliminates excessive residue and stimulates growth. Switchgrass for wildlife food and cover should be burned once every 2 years to reduce mulch accumulations that inhibits movement of hatchlings and attracts nest predators.

Switchgrass can provide quality forage for livestock when properly managed for grazing or cut for hay . Consult with your local NRCS office or extension service in developing a grazing and hay management plan for your region.

Pests and Potential Problems

Grasshoppers, leafhoppers and armyworms can be major pests in new seedings and established stands. Some stands are impacted by damping off and seedling blight. Leaf rust may affect forage quality. Smut can cause significant seed loss. Smut has been found on the cultivars 'Cave-in-Rock', 'Blackwell', 'Pathfinder', 'Shelter', and 'Summer'. A switchgrass moth has been reported on young switchgrass tillers that could affect stand and productivity in the northern Great Plains.

Environmental Concerns

Switchgrass can spread, especially in a wildlife planting, and reduce growth of other native warm season grasses such as big bluestem, Indiangrass and little bluestem. Cultivars have been reported to dominate and reduce native switchgrasses stands in natural plant communities and restoration sites.

Control

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Cultivars, Improved, and Selected Materials (and area of origin)

'Alamo' (TX), 'Blackwell' (OK), Bomaster (NC) 'Carthage' (NC), 'Cave-In-Rock' (IL), Central Iowa Germplasm, 'Dacotah' (ND), Durham Germplasm (NC),'Forestburg' (SD), HighTide Germplasm (MD), 'Kanlow' (OK), 'Nebraska 28' (NE), 'Pathfinder', 'Shawnee', 'Shelter' (WV), 'Sunburst' (SD), 'Summer', Southlow Michigan Germplasm, Timber Germplasm (NC), Grenville (NM), Miami (Dade Co, FL), Stuart (Stuart, FL), Wabasso (Wabasso, FL), Penn Center (Beaufort Co.SC.; source identified vegetative)

Prepared By: *Jimmy Carter Plant Materials Center*

Citation

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Edited: [e.g., 08Sep2009 rg, 08Sep2009 jfh; 17Sep2009 jfe 21Jan 2011 mo]

For more information about this and other plants, please contact your local NRCS field office or Conservation District <http://www.nrcs.usda.gov/>, and visit the PLANTS Web site <http://plants.usda.gov> or the Plant Materials Program Web site <http://plant-materials.nrcs.usda.gov>

Plant Guide

SIDE-OATS GRAMA
Bouteloua curtipendula (Michx.) Torr.
Plant Symbol = BOCU

Contributed by: USDA NRCS Plant Materials Center, Manhattan, Kansas


Alan Shadow, East Texas Plant Materials Center, Nacogdoches, Texas

Uses
Forage: Side-oats grama produces high quality, nutritious forage that is relished by all classes of livestock throughout the summer and fall, and it remains moderately palatable into winter. This makes it one of the most important range grass species.

Erosion Control: Weaver and Albertson (1944) described the role of side-oats grama in the recovery of grasslands following the drought of the 1930's. It was one of the few grasses that covered large areas bared by the loss of other grasses during the drought period. Side-oats grama is recommended in grass mixtures for range and pasture seeding, for earth fill and bank stabilization, for other critical areas and recreational plantings. Successful seeding can be obtained in rocky, stony or shallow soil sites. In fact side-oats is often found in nearly pure stands on caliche outcrops, stony hillsides and breaks (Harlan, 1954).

Wildlife: Side-oats provides some forage for antelope and deer when actively growing. Elk will use this grass as forage throughout the year. Leithead et al. (1971) indicated that the seed of this species was consumed by wild turkeys.

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
General: Side-oats grama is a deep rooted, perennial grass. The plants crown will spread very slowly by means of extremely short, stout rhizomes. A mid-grass in height, it has rather wide leaves and a very distinct inflorescence consisting of a zigzag stalk with small compressed spikes dangling from it at even intervals. The short spikes dangle from one side of the stalk, thus providing the plant with its common name. In the vegetative state the grass is easily recognized by the long, evenly spaced hairs attached to the margins of the leaf near its base. Side-oats grama possesses the C-4 photosynthetic pathway common to warm-season grasses (Waller and Lewis, 1979).

Distribution: For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site. One of the most widely distributed of the grama grasses. It has a widespread distribution eastward from the Rocky Mountains to near the east coast except in the southeast.

Habitat: Side-oats grama grows effectively in the dryer mid-grass prairie section of the Great Plains that has an annual rainfall of 12-20 inches. This species occurs naturally in mixed stands with blue grama (*Bouteloua gracilis*) and little bluestem (*Schizachyrium scoparium*). This grass is better adapted to calcareous and moderately alkaline soils than to neutral or acidic soils (Leithead etal., 1971)

Adaptation
Side-oats is adapted to a broad range of sandy to clayey textured soils; it is least tolerant of loose sands and dense clays. The best stands of side-oats are found on medium to fine texture upland soils. This species has shown varying tolerance to soil salinity from weak to moderate. Side-oats is moderately drought tolerant, but less than blue grama. It is moderately tolerant of semi-shaded conditions and can be found in open woodlands. It will sustain damage from wildfires when actively growing and under drought stress conditions, but is fairly tolerant of fire in a dormant state. It is also fairly tolerant of spring flooding. It probably has the widest range of adaptation of any of the warm-season perennial grass plants. It grows in combination with tall warm-season

grasses such as big bluestem (*Andropogon gerardii*) and switchgrass (*Panicum virgatum*) all the way to the short grass plants such as buffalo grass (*Bouteloua dactyloides*) and blue grama (*Bouteloua gracilis*). Thus, it can successfully grow in a variety of climates and habitats in the continental U.S.

Establishment
Seed improved cultivars of this grass no deeper than ¼ inch on fine textured soils and ¾ inch on coarser textured soils. Planting with a grass seed drill on a firm, weed free seedbed at the rate of 2.5 to 5.0 pounds of pure live seed (PLS) is encouraged. Broadcasting at a higher seeding rate (50 to 100 percent increase) can be utilized on a previously prepared seedbed that will be culti-packed after seeding is completed. Increased seeding rate should also be used on bare areas, harsh sites, or on areas that require denser or quicker stand establishment. Seeding is more likely to be successful if moisture conditions are good and if mulch is used to retain moisture on the seeding site. Most seed germinates within 7 days under good field conditions. Seedling vigor is good when compared to other warm season grasses. Field germination, emergence and establishment of this species are better than other grama grasses. Protection from grazing is encouraged while seedlings are in the juvenile stage of growth.

Management
As a mid-grass, side-oats grama is intermediate in many respects between the tall and short grass species. Side-oats grama is not as resistant to grazing pressure as is blue grama due to its taller growth habit. Side-oats seedlings are vigorous and stands tend to establish quickly and can often be utilized for forage production the second year after planting. Side-oats grama is usually included in range mixes and should be managed as native rangeland. Management should include proper livestock stocking rates and correct season of use.

Pests and Potential Problems
Grasshoppers can be destructive of seedling stands. Some stem and leaf rust occurs in wet years and Mankin (1969) found several leaf spot and root rot fungi occurred on side-oats grama.

Seeds and Plant Production
Seed production experiments conducted in Nebraska in the 1950's found that side-oats grama response to nitrogen fertilization was dependent on moisture conditions during critical growth periods (Newell et al., 1962). Seed yields measured as whole spikes were substantially increased over unfertilized check plots by all rates of nitrogen applied. Under drought conditions the application of 60 and 90 pounds of nitrogen yielded whole spike yields of approximately equal amounts. Under favorable moisture conditions nitrogen fertilization improved the quality of the caryopsis by increased weight per 1000 caryopsis over unfertilized plots.

Seed of side-oats grama normally found on the open market consists of either whole spikes or individual florets, or mixtures of these, which vary widely in their content of germinable caryopsis. Thus, seeding rates of side-oats must be computed on the basis of purity and viability of the seed lot. Purity analysis of side-oats can be complicated by the inclusion of adhering glumes and spike fragments as part of the seed unit. As long as the seed unit has a germinable caryopsis in the spike it is considered viable and used in the computation of pure live seed by the seed analyst. Thus a spike may contain several germinable caryopses, but is counted only as one for the purpose of germination percentage.

The effect of burning on seed yield was studied by Newell etal. (1962) in fertilized and unfertilized plots. Although the seed yield results were numerically larger from both levels of fertilized plots when burned, the differences could not be proven to be statistically different. This finding is noteworthy since it proves that proper burning, if not conducted too late in the spring, does not reduce seed yield. Burning is a proven method of cleaning the field for the new seed crop year. Burning has also been known to help control cool season weeds and reduce disease inoculums for the new crop.

Thus, side-oats grama may be grown for seed in cultivated rows, and will respond to timely fertilization and irrigation applications.

Cultivars, Improved, and Selected Materials (and area of origin)
Contact your local Natural Resources Conservation Service (formerly Soil Conservation Service) office for more information. Look in the phone book under "United States Government". The Natural Resources Conservation Service will be listed under the subheading "Department of Agriculture."

'Butte' was selected at Nebraska AES, Lincoln, USDA-ARS and SCS cooperatively by E.C. Conard and L.C. Newell. It represents native collections from Holt and Platte Counties in Nebraska that were combined and tested as Nebraska 37. Repeated field plantings revealed superior germination and establishment characteristics when compared with other sources.

‘El Reno’ was released cooperatively in 1944 by the SCS, Manhattan, Kansas Plant Materials Center and Kansas AES. The original seed was collected in a field location near El Reno, Oklahoma in 1934. The material was outstanding for leafiness, forage production and vigor. It also ranked well for disease resistance, seed production, and winter hardiness. It is widely used in range seedings and is adapted to Kansas, Oklahoma and northern Texas.

‘Haskell’ was released in 1983 by the James E. “Bud” Smith Plant Materials Center, Texas AES and USDA-ARS. The seed for this release was originally collected in 1960 by J.C. Yeary, Jr. in Haskell, Texas. It was selected based on rhizome production and adaptation as far south as the Rio Grande Valley in Texas. It is also known for its high forage palatability and prolific seed production.

Killdeer was informally released in the late 1960’s by the Bismarck Plant Materials Center in Bismarck, ND. It is composed of seed collected from native stands in 1956 near Bowman, Bowman County and Killdeer, Dunn County, North Dakota. Killdeer possesses outstanding vigor, leafiness, fair seed production, freedom from disease and persistence in a cold, semi-arid environment.

‘Niner’ was released in 1984 by SCS and the New Mexico and Colorado AES. The original seed for the release was collected by G.C. Niner and J.A. Anderson in 1957 west of Socorro, New Mexico. Niner was a bulk increase of the collection made by Niner and Anderson.

Pierre was informally released in 1961 by the Bismarck Plant Materials Center and the South Dakota AES. The original seed for the release was collected in 1954 in Stanley County west of Pierre, South Dakota. The release is described as outstanding in vigor, leafiness, freedom from disease, seedling vigor and persistence in a semi-arid environment.

‘Premier’ was released in 1960 cooperatively by Texas AES and USDA-ARS and NRCS. The original seed was collected in 1953 from a single plant growing between Cuauhtemoc and Chichuahua, Mexico. The release is described as having good seedling vigor, good seed yield, drought tolerance, upright growth form and leafiness.

‘Trailway’ was cooperatively released in 1958 by Nebraska AES and USDA-ARS. The original seed was collected in 1953 in northern Holt County by L.C. Newell. The release is described as winter hardy, long lived, late maturing with a somewhat indeterminate heading and flowering response. Requires most of the growing season to mature a crop in eastern Nebraska and may fail to produce seed in areas with a shorter growing season.

‘Vaughn’ was released in 1940 by the New Mexico AES and SCS Plant Science Division. The original seed was collected from native stands in 1935 near Vaughn, New Mexico. The release is described as slightly variable, but all have erect leaves, good seedling vigor and easy to establish.

Northern, Central and Southern Iowa Germplasms were released in 1995 as source identified releases, by the Elsberry Plant Materials Center, University of Northern Iowa, Iowa Department of Transportation, Iowa Crop Improvement Association and NRVC. They are all composite lines from collections made in Northern, Central and Southern Iowa.

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Prepared by and Species Coordinator

Richard Wynia, USDA NRCS Manhattan Plant Materials Center, Manhattan, Kansas

Edited: 070717 jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

Plant Guide

SAND DROPSEED

Sporobolus cryptandrus (Torr.) A. Gray

Plant Symbol = SPCR

Contributed by: *USDA NRCS Idaho Plant Materials Program*

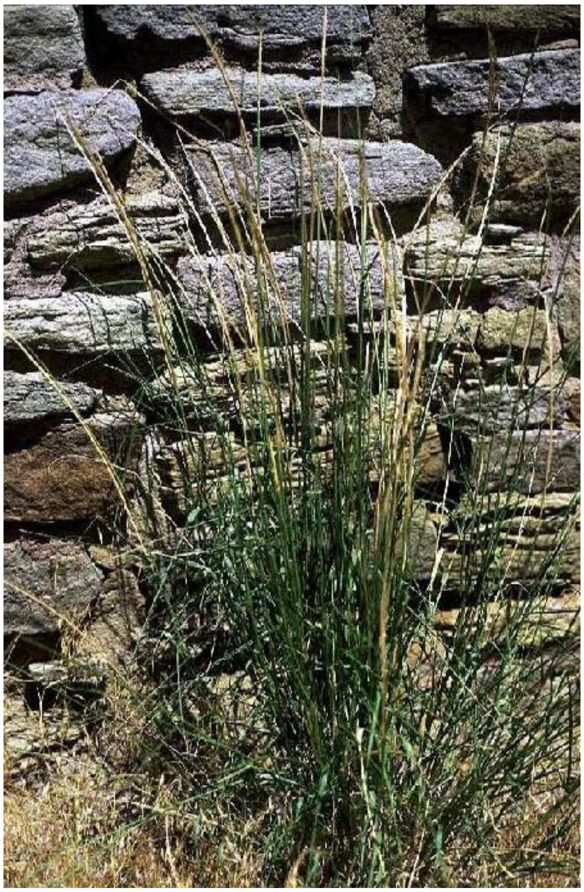

Figure 1. Sand dropseed. Photo by Robert Soreng @ USDA-NRCS PLANTS Database.

Alternate Names

Agrostis cryptandra Torr.
Vilfa cryptandra (Torr.) Trin.

Uses

Livestock and range:
Sand dropseed provides a fair to good source of spring and winter forage for livestock (Jensen et al., 2001; Ogle et al., 2009; Welsh et al., 2003). The palatability of the mature plant is low; however, when other choices of forage are limited, livestock will graze sand dropseed which remain green longer into the winter than many other forage species. The ability of sand dropseed to green-up following fall rains is especially important in southwestern regions of the country. Palatability depends on other species that are growing nearby and the time of year. According to Ogle and Brazee (2009), sand dropseed is preferred forage for cattle, horses and elk in all seasons, and preferred forage for sheep, deer and antelope in the spring. Sand dropseed is valuable as a native forage alternative on arid rangelands receiving nine inches or less annual precipitation (Plummer et al., 1955).

Wildlife:
Large mammals such as deer, elk and pronghorn generally prefer other forage species over sand dropseed (Mower and Smith, 1989), but it increases in use during winter months when other forages become less abundant (Roebuck, 1982) . The plant and seed are eaten by small birds, rodents and other small mammals. Mature plants are used as cover for sage grouse (Wyoming Game and Fish Department, 2009).

Ethnobotanic:
Sand dropseed seed has been used to make bread and porridge by Apache, Hopi and Navajo tribes (Castetter et al., 1936; Colton, 1974; Vestal, 1952). The plant has also been used to create a cold infusion that is applied to sores and bruises on the legs of horses (Vestal, 1952).

Erosion control/rehabilitation of disturbed areas:
Sand dropseed is widely used in disturbed area plantings in the Southwest, Intermountain West and short-grass prairies of the Great Plains. The fibrous root system effectively stabilizes sand dunes and hills. Its abundant seed production makes it a pioneer plant in disturbed areas and an invader of sandy soils. It has also been noted as an early native colonizer in sites suffering from water stress (Coupland, 1958).

Status

This species is listed as threatened in Connecticut and New Hampshire (New Hampshire Natural Heritage Bureau, 2006; State of Connecticut, 2004), and rare in Pennsylvania (Commonwealth of PA, 2009). It is not considered a rare plant in the western United States. Consult the PLANTS Web site and your State Department of Natural Resources for this plant’s current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Weediness
Sand dropseed may become weedy or invasive in some regions or habitats and may displace more desirable vegetation if not properly managed. Sand dropseed is considered an invader species in the Central and Northern Great Plains where it provides lower quality forage than other native species (Stubbendieck et al., 1994). Consult your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use. Weed information is available from the PLANTS Web site at plants.usda.gov. Consult the related web sites on the Plant Profile for this species for additional information.

Description
General:
Grass Family (Poaceae). Sand dropseed is a long-lived perennial warm season bunchgrass, native throughout North America (Monsen et al., 2004; Ogle et al., 2009). The scientific name, *Sporobolus*, comes from the Greek *sporos* (seed) and *bolos* (a throw), and the common name, dropseed, both refer to the seeds which fall or may be ejected from the inflorescence when the mucilaginous fruit wall dries (Peterson, et al., 2003). Mature plants range from 11 to 40 inches tall. Plants are typically erect but may also be decumbent. The collar is a conspicuous tuft of white hairs which may be up to 0.16 inches long. Leaf blades are 0.08 to 0.25 inches wide and 3 to 10 inches long. The inflorescence is a panicle, 6 to 16 inches long and 1 to 5 inches wide, initially contracted and spike-like, but opening with maturity into a pyramidal shape as the inflorescence escapes the subtending sheath (Welsh et al., 2003). Spikelets contain a small, single brown to purplish floret, 0.06 to 0.1 inches long. The glumes, lemmas and paleas are membranous (Peterson, et al., 2003) and contain a 1 mm long caryopsis (Welsh et al., 2003).

This species produces a dense, sand binding network of roots which can spread up to 2 feet laterally and over 8 feet deep (Coupland and Johnson, 1965).

Sand dropseed is a prolific seed producer. In one study, a single panicle yielded approximately 10,000 seeds (Brown, 1943). Seeds are very small; there are approximately 5.6 million seeds/lb, and 67 pounds of seed per bushel.

Figure 2. Sand dropseed florets and seed. Photo by Steve Hurst @ USDA-NRCS PLAANTS Database.

Distribution:
Sand dropseed is native throughout North America but is most important as a rangeland species in the Southwest and certain parts of the Snake, Salmon, and Clearwater River drainages in Idaho and Oregon (USDA, 1937). For current distribution, consult the Plant Profile page for this species on the PLANTS web site.

Habitat:
In the Intermountain West it sand dropseed is commonly associated with Indian ricegrass, bluebunch wheatgrass and Galletta grass in sagebrush, desert shrub and pinyon-juniper plant communities. In its southern range it is often found growing with side-oats grama and muhly species. In other regions it is common in the short-grass prairies and chaparral communities.

Adaptation
Sand dropseed is extremely drought tolerant and is adapted to sites receiving 7 to 16 inches annual precipitation (Ogle et al., 2009; USDA 2009). Its fine root system allows sand dropseed to extract water at depths between 0 and 30 cm more effectively than broom snakeweed (*Gutierrezia sarothrae*) (Wan et al., 1993). During periods of summer drought the leaves roll up to reduce surface area and evapotranspiration (Wan et al. 1993). It is considered to be one of the most drought resistant species in short-grass prairie (Wan et al. 1993).

Sand dropseed is most common at lower elevations in sandy soils but can also be found on coarse soils at upper elevations to 8,000 ft (Jensen et al., 2001; Ogle et al., 2009). It is adapted to slightly acidic to slightly basic soils and has a salt tolerance of less than 4 mmhos/cm (Dickerson, 1998).

Establishment
Sand dropseed requires overwintering or scarification for successful germination. The seed coat is very hard and impermeable. Seed lots frequently contain up to 50% hard seed; however, the seed can retain high levels of viability for many years under proper seed storage conditions. One seed lot that was twenty year old recorded 75% viability (USDA, 1937). Older seed generally has better germination and establishment than younger seed (Monsen et al., 2004).

For rangeland plantings, seed 0.5 to 1.0 lbs pure live seed (PLS)/ac for solid stands (Allison, 1988; Ogle et al., 2009). Drill or broadcast seed onto the surface to 1/8 inch depth into lightly prepared sandy and fine soils. Seed can be planted slightly deeper into coarse soils. Follow seeding with a light harrowing or cultipacking. Establishment is dependant upon spring and summer soil moisture. Sand dropseed seedlings have low vigor, but once established the plants are able to withstand severe summer drought periods. Due to slow development, grazing should be deferred for at least two years to ensure good establishment.

Management
This species spreads naturally from seed once established (Plummer et al., 1955) and increases on depleted rangelands and wastelands (Welsh et al., 2003). Sand dropseed plants are able to withstand heavy use due to their protected root crown, late maturity and because they are less preferred than other species (Monsen et al., 2004). Plants can be killed by overgrazing as a result of continued close cropping; however, when grazed properly, sand dropseed increases on poor condition low seral ecological sites (USDA, 1937).

Pests and Potential Problems
There are no pests or potential problems associated with sand dropseed.

Environmental Concerns
There are no known environmental concerns associated with sand dropseed.

Seeds and Plant Production
For seed production fields, sand dropseed should be seeded at a rate of 3.0 lbs/ac in 20 to 36 inch row spacing in a firm weed-free seedbed. In the Southwest it is possible to have two harvests in one growing season in June and September (USDA-NRCS, 2006). Seed shatters readily, however portions of the mature inflorescence are held in the sheath preventing some seed loss (Majerus 2009). Seed yields range from 250 to 1,000 lbs/ac with an average of 90% PLS. Fields will produce good seed yields for two to three years before needing to be re-established.

Cultivars, Improved, and Selected Materials (and area of origin)
Borden County Germplasm sand dropseed was released in 2000 by the James E. 'Bud' Smith Plant Materials Center in Knox City, Texas. The original collection was made near Gail, Texas in MLRA 78B. Its primary intended use is for rangeland seeding for livestock and wildlife. It is recommended for use in central and western Texas and western Oklahoma in MLRAs 42, 77, 78, 80A, 80B, 81A, 81B and 84B. Generation 0 seed is maintained by the Plant Materials Center and is available in limited quantities for seed increase (USDA-NRCS, 1999).

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Prepared By

Derek Tilley; USDA NRCS Plant Materials Center, Aberdeen, Idaho.

Loren St. John; USDA NRCS Plant Materials Center, Aberdeen, Idaho.

Dan Ogle; Plant Materials Specialist, USDA NRCS, Boise, Idaho.

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For more information about this and other plants, please contact your local NRCS field office or Conservation District <http://www.nrcs.usda.gov/>, and visit the PLANTS Web site <http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

Read about Civil Rights at the Natural Resources Conservation Service.

United States Department of Agriculture

A Conservation Plant Released by the Natural Resources Conservation Service
Manhattan Plant Materials Center, Manhattan, Kansas

'Chet'
Sand bluestem
Andropogon hallii Hack.

Figure 1. Photograph of Chet sand bluestem inflorescence beginning the process of flowering and seed production. Photograph by R. Alan Shadow, East Texas Plant Materials Center.

'Chet' sand bluestem (*Andropogon hallii* Hack.) is a cultivar released in 2004 in cooperation with the U.S. Department of Agriculture (USDA) Agriculture Research Service (ARS) Southern Plains Range Research Station, Woodward, Oklahoma, and the Plant Materials Centers located in Manhattan, Kansas, and Knox City and Nacogdoches, Texas.

Description
Sand bluestem is a native, perennial, warm-season, tall grass species that spreads by seed and elongated creeping, scaly rhizomes. It is commonly found on loamy or sandy textured soils. It forms a sod with its well-developed rhizomes and often forms dense colonies of 15 to 20 feet in diameter. This medium stature species produces seed from August to October on seed culms that are 3 to 6 feet in height. Leaf blades are up to 12 inches long and 1/8 to 3/8 inch wide. Leaf sheaths are shorter than internodes and hairless. Inflorescences are extremely hairy. The rest of the plant body is glaucous and is described as being blue green in overall color. It is similar in appearance to big bluestem and the two will occasionally hybridize in nature.

Source
Chet was derived from a collection of big bluestem (*Andropogon gerardii* Vitman) and sand bluestem that consisted of 158 accessions received as seed from the USDA-ARS North Central Regional Plant Introduction Station in 1985. The collection was assembled by the late Dr. Kling Anderson, Kansas State University, Manhattan, Kansas. Chet went through three cycles of phenotypic mass selection for growth, re-growth, disease resistance, and leafiness. Plant selections in subsequent cycles focused on seedling vigor and seed size to some extent and also on selection for a medium stature population. Seed from the third cycle of selection was called population 'AB medium,' which was subsequently released as Chet sand bluestem in 2004.

Conservation Uses
Chet is a warm-season, perennial grass utilized for forage production in the warm summer months. At five test locations in Oklahoma, Texas, and Kansas average forage dry matter yield was 5,700 pounds per acre an 8.8 percent greater yield than 'Woodward' sand bluestem at these same test sites. The seasonal average crude protein and *in vitro* digestible dry matter were not significantly different from Woodward in these field trials. The species is also found in conservation plantings especially on sandy areas where it performs well in preventing soil erosion and dune formation. Wildlife habitat and forage production are important qualities of Chet sand bluestem. Upland song birds eat the seeds and its upright growth habit provides nesting habitat for birds and small mammals. With the increased popularity of low input, low maintenance landscaping, sand bluestem has grown in use as an accent or unique focus plant in some home flower displays.

Area of Adaptation and Use
Chet is a stable, random mating population selected for increased seedling vigor, seed size, disease resistance, and medium stature. It is adapted to USDA Plant Hardiness Zones 5b, 6, and 7a in the Central and Southern Great Plains of the United States. With additional testing, it may be adapted to other parts of the same hardiness zones or different hardiness zones.

Establishment and Management for Conservation Plantings
Sand bluestem should be seeded in the spring when the soil temperature has warmed sufficiently to enhance germination. The best method to seed sand bluestem is by using a drill with picker wheels to ensure seed flow within the box and depth bands provide correct planting depth for the seed. A press wheel assembly located behind the double-disk openers and depth bands is a plus for ensuring good seed-to-soil contact. The seeding should be completed on a firm, weed-free seed bed for best results. Nitrogen fertilization is discouraged since high nitrogen would mainly enhance annual weedy species and compete with the desirable planted species. Control of competitive weedy species may be accomplished by mowing at a height 6 to 8 inches to reduce weed pressure. Prescribed burning in the spring can damage cool-season species and remove previous year's residue and invigorate sand bluestem seedlings.

Ecological Considerations
Sand bluestem does not pose any known negative concerns for the environment. It can form dense colonies on coarse soils where it is well adapted. This attribute is seen as a positive trait for increasing ground cover which tends to reduce water and wind erosion on fragile soil sites. Grasshopper infestations can cause damage on juvenile seedling stands. Leaf rust is an anti-quality factor when using sand bluestem for livestock forage consumption.

Seed and Plant Production
Seed production of Chet sand bluestem is the best method of widespread propagation. Planting of seed in the spring or early summer is ideal when the soil temperature has reached at least 50 degrees Fahrenheit (F). The planting site should be firm, weed free, and clean-tilled to enhance seed germination and establishment. Ideally a site could be fallowed a year prior to planting to ensure no perennial persistent weeds are evident and no herbicide has been used on the site that would inhibit germination or establishment of the grass. A drill equipped with depth bands, press wheels and picker wheels in the seed box would provide optimum placement of seed units at 1/4 to 1/2 inch depth in the soil. A seeding rate of 30 pure live seeds per linear foot of row and rows spaced at 24 to 36 inches will provide a good stand. Application of nitrogen fertilizer to newly planted field is not recommended since annual weed growth would be stimulated by fertility much more than the sand bluestem. Harvest seed in the fall with a combine and clean with a fanning mill and debearder to produce saleable seed. Seed yield average annual production in non-replicated plots at Woodward and Perkins, Oklahoma, produced 52.6 pounds of seed per acre.

Availability
For conservation use: Chet is available in the commercial seed trade.

For seed or plant increase: Breeder seed can be obtained from USDA-ARS, Southern Plains Range Research Station at Woodward, Oklahoma. Four classes of seed are recognized for Chet sand bluestem (Breeder, Foundation, Registered, and Certified). One generation of seed increase will be allowed for each seed class. Foundation Seed is produced by the Oklahoma Foundation Seed Stock Inc., Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, Oklahoma 74078.

For more information, contact:
Southern Plains Range Research Station,
2000 18th Street
Woodward, Oklahoma 73801
(580) 256-7449 FAX (580) 256-1322
http://www.sprrs.usda.gov

Citation
Release brochure for Chet sand bluestem (Andropogon hallii). USDA-NRCS Plant Materials Centers located at Knox City and Nacogdoches, Texas, and Manhattan, Kansas.
Published: [July, 2015]

For additional information about this and other plants, please contact your local USDA Service Center, NRCS field office, or conservation district at http://www.nrcs.usda.gov/, and visit the PLANTS Web site http://plants.usda.gov or the Plant Materials Program Web site http://www.plant-materials.nrcs.usda.gov

United States Department of Agriculture
NATURAL RESOURCES CONSERVATION SERVICE
Plant Materials Technical Note No. MT-104
September 2014

PLANT MATERIALS TECHNICAL NOTE

ROCKY MOUNTAIN BEEPLANT
Cleome serrulata Pursh

A Native Annual Forb for Conservation Use in Montana and Wyoming

Susan R. Winslow, Agronomist, NRCS Plant Materials Center, Bridger, Montana

Rocky Mountain beeplant

General Description

Rocky Mountain beeplant is an annual, tap-rooted, colonizing native wildflower. It grows to a mature height of 2 to 5 feet tall. Rocky Mountain beeplant has many common names including pink bee-plant, bee spiderflower, toothed spider-flower, skunk weed, stink weed, stinking-clover, and Navajo spinach. *Cleome serrulata* [synonym *Peritoma serrulata* (Pursh) DC.], formerly a member of the Caper Family (*Capparaceae*), is presently classified in the Cleome Family (*Cleomaceae*). Genetic studies indicate *Cleomaceae* is closely related to the Mustard Family (*Brassicaceae*). Erect, smooth stems branch from the upper nodes growing into a tall, loosely formed, slightly stinky-smelling plant. Compound leaves are arranged alternately along the stem and consist of three, dark green, narrow leaflets approximately ½- to 3-inches long with minutely-toothed margins. Each of the numerous, small pink flowers have 4 sepals, 4 petals, and 6 long, “spidery” stamens curving backward as the distinctive green anthers open and dehisce pollen. The nectar-rich flowers are formed at the end of the stem in large, round showy clusters which have a fuzzy appearance. The anthesis of new flowers occurs 1 to 3 hours after sunset with no flowers opening in the daylight. Flowering begins at the bottom and proceeds up the inflorescence resulting in an extended bloom period with floral initiation and seed pod development occurring simultaneously. Season of bloom is mid- to -late summer. Rocky Mountain beeplant flowers are self and insect pollinated. The fruit is a slender, drooping, pod-like capsule that is 1 to 3 inches long and resembles legume and mustard seed pods. Mature seeds are large and dark brown to blackish in color, while non-viable seeds are pale gray and much smaller. The number of chromosomes are $2n$=34, 60.

Rocky Mountain beeplant flower with developing seed pods

Adaptation or Range

Rocky Mountain beeplant is native to the western, central, and northern U.S. as well as the southern prairie provinces of Canada. It was introduced as early as the 1930's in other areas of the country. Rocky Mountain beeplant is found in the moist areas of disturbed sites such as roadsides, ditch banks, coulee edges, barren rangeland, and dormant farm and pasture land. It occurs mostly on sandy sites and can be found on well-drained medium textured soils in low elevation valleys, dry prairies, open woodlands, and mountain foothills. Associated species include western wheatgrass *Pascopyrum smithii*, bluebunch wheatgrass *Pseudoroegneria spicata*, prairie Junegrass *Koeleria macrantha*, Sandberg bluegrass *Poa secunda*, common gaillardia *Gaillardia aristata*, big sagebrush *Artemisia tridentata*, and prairie coneflower *Ratibida columnifera*.

Rocky Mountain beeplant is tolerant to drought, and medium levels of calcium carbonate. It grows in a range of soil pH levels and in full sun or light shade. Rocky Mountain beeplant was collected by Lewis and Clark's Expedition in 1804 near the Vermillion River in South Dakota.

In Montana, Rocky Mountain beeplant is adapted to a wide range of soil types and precipitation zones at elevations of 2,500 feet to 5,200 feet. It is present as an ephemeral annual component on many ecological sites in Major Land Resource Areas (MLRAs) 32, 43B, 44, 46, 52, 53A, 54, 58A, and 60B. Rocky Mountain beeplant is known to inhabit at least 43 of the 56 counties in Montana.

In Wyoming, Rocky Mountain beeplant is adapted to a wide range of soil types and precipitation zones at elevations of 4,000 feet to 7,200 feet. It is present as an ephemeral annual component on many ecological sites in MLRAs 32, 34A, 43B, 58B, and 67A. Rocky Mountain beeplant is known to inhabit 21 of the 23 counties in Wyoming and very likely is found in MLRAs 48, 60A, 60B, 61, 62, and 64.

Conservation Uses

Rocky Mountain beeplant attracts many different insects when in bloom and is a good mid- to late-season flowering species for pollinator habitat improvement plantings. It is a short-lived showy ornamental plant suitable for use in water-efficient (Xeriscape™) gardens and is resistant to wildlife browsing due to the disagreeable taste and odor of its leaves. This native wildflower can be used as a forb component in reclamation of drastically disturbed lands, range renovation, and numerous conservation practices, such as pollinator habitat, conservation cover, range and critical area plantings, and restoration and management of rare and declining habitat. The seeds are a good food source for birds. It can be included in many seeding mixtures for creating and enhancing habitat for upland game birds. Rocky Mountain beeplant is rated as “poor” forage for livestock and wildlife and may cause nitrate poisoning if consumed in large quantities.

Cultural Uses

Rocky Mountain beeplant has historically been used by humans as a nutritious food source, a medicinal treatment for many ailments, and as a dye for coloring fabric and pottery. All parts of the plant can be eaten raw, cooked, or dried. Drinking an infusion of the plant relieves stomachache and reduces fever. Applied as a compress it soothes sore eyes. A yellow-green dye is made by boiling the leaves and a black dye is made by boiling the woody stems for an extended period of time.

Honey bee foraging on Rocky Mountain beeplant

Ease of Establishment

Rocky Mountain beeplant is easy to establish by direct seeding. Seedling vigor is good with nearly all plants reaching maturity and setting seed the year of establishment.

Planting Rates (all recommended amounts based on pure live seed PLS)

Rocky Mountain beeplant has approximately 64,500 seeds per pound. As a guideline, at a seeding rate of 1 pound per acre, there would be approximately 1.5 seeds per square foot. The full stand drill seeding rate, based on approximately 25 seeds per linear or square foot is 16.8 pounds PLS per acre, but it would seldom be seeded in a pure stand. It is recommended in native seed mixtures at a rate of ¼- to ½-pound PLS per acre. The broadcast seeding rate is double the drill rate and is recommended only when the large seed is adequately covered with soil. The critical area drill seeding rate is double the non-critical area drill rate, while the critical area broadcast rate is double the non-critical broadcast rate, and quadruple the non-critical area drill rate. Wildland collected and field produced seed is commercially available and cost is dependent upon supply and demand.

Stand Establishment

For best results, seed should be planted into a firm, weed-free seedbed in early spring or as a dormant seeding in late fall after the last killing frost. It is recommended seeding be done with a drill to ensure a uniform seeding depth of ¼- to ½-inch. Seeding a forb component in alternate rows, or cross-planting, with the grass component may ensure better forb establishment. After one growing season, Rocky Mountain beeplant is likely to reseed in relatively low numbers.

Rocky Mountain beeplant in test plot near Pinedale, Wyoming

Seed Production

Seed production fields should be established in rows of 25 PLS per linear foot. Between-row spacing is dependent on the type of planting and cultivation equipment used, and ranges from 24 to 36 inches. Allow adequate between-row space for mechanical weed control. At 24-inch row spacing, the recommended seeding rate is 8.4 pounds PLS per acre and at 30- and 36-inch row spacing, the seeding rate is 6.8 and 5.6 pounds PLS per acre respectively. There are presently no herbicides specifically labeled for controlling weeds in seed production fields of Rocky Mountain beeplant. Seed harvest can be accomplished by direct combining when the pod-like fruit capsule is brown in color but before it splits and shatters the seed. A single plant may produce up to 26,000 seeds. Indeterminate ripening requires that harvesting be timed properly in order to optimize seed yield. Seed viability is high and seed longevity is maximized by storage under moderate temperatures and low humidity.

Limitations

A variety of insects can cause substantial damage to foliage, capsules, and seed under favorable environmental conditions, such as increased soil moisture—this is due to lower concentrations of the compound methyglucosinolate (glucocapparin). Rocky Mountain beeplant is not considered a weed but under favorable conditions may re-seed and persist at low densities for years.

Additional Information

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USDA NRCS

United States Department of Agriculture
Natural Resources Conservation Service
Plant Materials Program

'Kaneb'
Purple Prairie Clover
Dalea purpurea Vent.

A Conservation Plant Release by USDA NRCS Manhattan Plant Materials Center, Manhattan, KS

Photo by R. Alan Shadow, East Texas PMC

'Kaneb' purple prairie clover (*Dalea purpurea* Vent.) is a cultivar released in 1975 in cooperation with the Kansas Agricultural Experiment Station.

Description
Purple prairie clover is a member of the legume family which is native to North America and is perennial and herbaceous. The plant has an erect type growth habit that typically grows from 12 to 24 inches tall. It is recognized by its alternate, pinnately compound leaves and multiple stems that arise from a woody crown. The inflorescence is a terminal spike 1 to 1.5 inches long and cylindrical in shape. The first flowers to bloom are located at the base of the spike with the circle of flowers moving upward along the spike as new buds bloom and old flowers fade. The flower petals, which are rose-purple with projecting gold-orange anthers, are small and simple compared to other typical legume flowers. Pollination is accomplished by a host of native insects from bumblebees to beetles. The fruit is a one seeded legume pod enclosed in a persistent calyx. The legume seed is yellowish-green to yellow and is 1/16 to 1/8 inch long. The plant is deep rooted with a 6 foot tap root that has 3 to 7 lateral roots located within a foot of the soils surface. These lateral roots travel horizontally 12 to 18 inches away from the plant and then proceed vertically into the soil.

Source
The germplasm source was originally collected in a native grassland area in 1948 in Riley County, Kansas. Testing of the accessions collected indicated that Kaneb was superior in stand, height, and overall vigor. Kaneb was also tested at Plant Materials Centers in North Dakota and New Mexico.

Conservation Uses
Purple prairie clover is used for native prairie restoration and re-vegetation of natural areas. It produces excellent forage quality for livestock, but its overall production is not very high. It can cause bloat in cattle, but is high in protein which increases its forage quality.

Area of Adaptation and Use
Kaneb has potential for use in Kansas, Nebraska, northern Oklahoma, Texas panhandle, northeastern New Mexico, eastern Colorado and southwestern Wyoming. It is a relatively drought tolerant species and tends to disappear under intense livestock grazing pressure. It grows on a wide range of soil types from clay loams to loamy sands. It prefers well drained, moderately alkaline calcareous soils.

Establishment and Management for Conservation Plantings
This species is easily established from seed; however germination can be low depending on the level of dormancy expressed by the seed unit. The easiest solution to this problem is to provide the seed units with a scarification process that will break the physical dormancy and allow germination to proceed. Purple prairie clover seed should be planted on a tilled, weed free, firm soil surface. The seedbed should be firm enough to plant at a reliable ¼ to ½ inch level depth. Seed should be inoculated prior to seeding with Type F inoculant to facilitate nodulation of the root system. A drill equipped with a legume box will provide good seed-to-soil contact and enhance the likelihood of successful stand establishment. Weed control during establishment of native legumes produces a healthier final plant stand. Mowing at a height that will not damage purple prairie clover seedlings is one method of reducing weed competition.

Ecological Considerations
Purple prairie clover does not spread aggressively by seed or vegetatively. Grasshoppers and small rodents in moderate numbers can cause damage especially to new seedling stands. While containing high protein levels and good overall forage quality, if eaten in large quantities, purple prairie clover can cause bloat problems for cattle.

Seed and Plant Production
Seed of Kaneb purple prairie clover is harvested with a standard combine, dried and then processed with a fanning mill. To determine seed production potential of purple prairie clover the weight of seeds per plant were

measured and the numbers of seeds per plant were counted. Purple prairie clover was determined to produce approximately 275,000 seeds per pound. Five year averages of seed yields at Manhattan Plant Materials Center (PMC) were 122 pounds per acre. Purity of harvested, processed seed is typically 99 percent or better with a germination range of 36 to 83 percent (including germination plus hard seed). A long term seed storage study conducted at Manhattan PMC indicated that Kaneb can be stored successfully under cool dry conditions for up to 26 years and still retain good germination percentages. Kaneb's initial germination was 81 percent and after 26 years of storage the germination was still 77 percent. There was however, a much lower percentage of hard seed in the latter test results when compared to the initial test results.

Availability

For conservation use: Kaneb is generally available from a variety of commercial seed vendors. However, Certified Class seed is for the most part not available commercially.

For seed or plant increase: Breeder and Foundation Class seed can be obtained from the Manhattan Plant Materials Center. There is no Registered Class of seed recognized for this variety.

For more information, contact:
Manhattan Plant Materials Center
3800 South 20th Street
Manhattan, KS 66502
(785) 539-8761 FAX (785) 539-2034
http://www.plant-materials.nrcs.usda.gov

Citation

Release Brochure for Kaneb purple prairie clover (Dalea purpurea). USDA-Natural Resources Conservation Service, Manhattan PMC. Manhattan, KS 66502. Published [March 2013]

For additional information about this and other plants, please contact your local USDA Service Center, NRCS field office, or Conservation District <http://www.nrcs.usda.gov/>, and visit the PLANTS Web site <http://plants.usda.gov> or the Plant Materials Program Web site <http://www.plant-materials.nrcs.usda.gov>

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Plant Fact Sheet

PRAIRIE SANDREED
Calamovilfa longifolia (Hook.) Scribn.

Plant Symbol = CALO

Contributed by: USDA NRCS Bismarck, North Dakota and Manhattan, Kansas Plant Materials Centers PM Program

© Mike Haddock Kansas Wildflowers and Grasses

Alternate Names

Sand reed, prairie sandgrass, and big sandgrass

Uses

Grazing/rangeland/hayland: Prairie sandreed is a native, sod forming, warm-season grass commonly found on sandy rangeland sites throughout the Central and Northern Plains. This grass species is considered a key species in grazing programs because of its abundance, yield potential and distribution of forage production during the growing season. Prairie sandreed begins growth earlier in the spring than most other warm-season grass species, thus it provides forage for early livestock grazing.

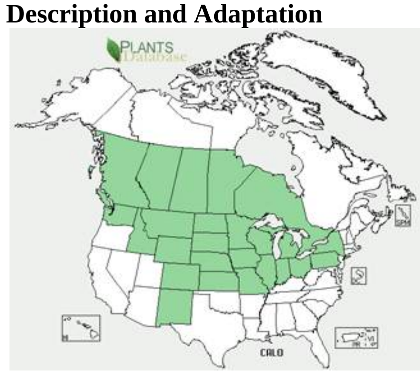
Wildlife Value: Prairie sandreed provides fair forage for grazing and browsing wildlife in early spring and summer. The plants forage value increases in importance in late fall and winter as the plant cures well on the stem and provides upright and accessible forage. Seeds are used by songbirds and small rodents.

Erosion Control: The rhizomatous growth habit and extensive fibrous root system of this species makes it an excellent stabilizer of sandy sites.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Description and Adaptation



Prairie Sandreed distribution from USDA-NRCS PLANTS Database.

Prairie sandreed is a tall, coarse, stemmy, open, sod forming grass found on sandy soil sites in typically low precipitation zones. Its coarsely fibrous root system augmented by scaly, spreading rhizomes produces an effective sand binding species. Its culms are 3 to 5 feet tall, arising singularly and are attached to its stout spreading rhizomes. Leaves are pale green to straw colored. Leaf blades are rigid, flat to rolled, hairless, 12 inches long or longer and tapered to a drawn out tip. The ligule is short and hairy and the collar is hairy inside. Inflorescence is a panicle 6 to 13 inches long, semi-open and wider in the middle. Spikelets are pale, shiny and one flowered. The lemmas are awnless and densely hairy at the base. It flowers from August to September and like most grasses is wind pollinated.

Prairie sandreed is drought tolerant and adapted to an average annual precipitation of from 10 to 20 inches. It is predominantly found growing in clumps or colonies on coarse, sandy soil types. It will grow on soils that are somewhat alkaline, but it does not tolerate salt. It also is intolerant of high water tables and early spring flooding. Prairie sandreed occurs naturally in mixed native stands with sand bluestem *Andropogon hallii*, little bluestem *Schizachyrium scoparium*, and sand lovegrass *Eragrostis trichoides* on sandy range sites. Several shrubs, including yucca, *Yucca glauca*, and sand sage, *Artimesia filifolia*, and a variety of forbs occur intermixed on these sites. It has been found growing on blow out sites in the Nebraska Sandhills.

For updated distribution, please consult the Plant Profile page3 for this species on the PLANTS Web site.

Establishment

Propagation of *Calamovilfa longifolia* can be accomplished by seed and vegetative means. Planting of prairie sandreed should be accomplished with a drill equipped with depth bands to control depth of seeding. Seed should be planted at a depth of 1 inch on coarse textured soils and ½ inch or less on medium to fine textured soils. Seedbed preparation should provide a weed free, firm surface on which to plant. Seedling vigor of this species is only fair and stands develop rather slowly. Seeding rate will vary by region and may be influenced by degree of processing provided by the seed vendor.

Management

Forage production of ND-95 at Pierre, SD was reported at 5,279 pounds per acre. June and August defoliations of prairie sandreed produced the greatest forage yields over a three year period. Generally concentrations of crude protein decreased with increased maturity of the forage. Dry matter digestibility also declined with advanced maturity of the plant. Prairie sandreed responds positively to early spring burns.

Pests and Potential Problems

Grasshopper infestations can damage seedlings. Gophers have been known to undercut and utilize the forage. Leaf rust, *Puccinia amphigena,* was identified as a potential anti-quality factor in the forage production of prairie sandreed. Prairie sandreed plants with origins in the dryer sections of the Great Plains become increasingly susceptible to rust as they are moved eastward into higher precipitation zones.

Environmental Concerns

Prairie sandreed does not pose any known negative concerns to the environment. It can form dense colonies on coarse textured soils where it is well adapted. This attribute is often looked at as a positive trait for increasing ground cover which reduces both wind and water erosion on these sites.

Control

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method.

Cultivars, Improved, and Selected Materials (and area of origin)

'Goshen' prairie sandreed was cooperatively named and released in 1976 by the Soil Conservation Service Plant Materials Center, Bridger, Montana and the Montana and Wyoming Agriculture Experiment Stations. The original germplasm was collected in 1959 near Torrington, Wyoming. It was released without selection and tested under the experimental designation WY-17 and P-15588.

'Pronghorn' prairie sandreed was cooperatively released in 1988 by the USDA-ARS, University of Nebraska and the USDA-SCS Manhattan Plant Materials Center, Manhattan, KS. An assembly of 48 accessions was collected in 1968 from Kansas, Nebraska, and South Dakota and established in a field space plant nursery at Manhattan, Kansas. The top ranked accessions from the nursery were provided to L.C. Newell, ARS Agronomist, for further evaluation for vigor, forage production and rust tolerance. Evaluation trials comparing Goshen and Pronghorn revealed that Pronghorn produced stands and forage amounts equivalent to Goshen, but was significantly superior with respect to leaf rust resistance.

ND-95 (Bowman) was selected at the USDA-SCS Plant Materials center, Bismarck, North Dakota. ND-95 is an informal release of materials collected in 1956 from southwestern North Dakota (Bowman County). Seed production is average for the species. Forage production is comparable to Goshen, in the northern U.S., but ND-95 has demonstrated improved performance in parts of Canada. Its dense, wiry root mass makes it well adapted for stabilizing sandy soil.

Koch Germplasm prairie sandreed was released by USDA-NRCS Rose Lake Plant Materials Center and the Michigan Association of Conservation Districts in 2007. Original germplasm was collected from native stands in costal zones along Lakes Michigan and Huron and subjected to three cycles of recurrent phenotypic selection for upright growth habit, seed production, and general vigor.

Prepared By Richard Wynia and Wayne Duckwitz

Citation

Wynia, R. and Duckwitz, W. 2006, Plant fact sheet for Prairie Sandreed (*Calamovilfa longifolia*). USDA-Natural Resources Conservation Service, Manhattan, KS 66502 and Bismarck, ND 58504

Published June, 2006

Edited: 13Apr2011erg;30Jul2007jsp.

For more information about this and other plants, please contact your local NRCS field office or Conservation District <http://www.nrcs.usda.gov/>, and visit the PLANTS Web site <http://plants.usda.gov> or the Plant Materials Program Web site <http://plant-materials.nrcs.usda.gov>

United States Department of Agriculture

Natural Resources Conservation Service

Plant Guide

LITTLE BLUESTEM

Schizachyrium scoparium (Michx.) Nash

Plant Symbol = SCSC

Alternate Names
Common Names: povertygrass, broom bluestem, broom beardgrass, prairie beardgrass, small feathergrass
Scientific Names: Andropogon scoparius

Description
General: Little bluestem is a tufted (sometimes with short rhizomes), warm-season (C_4), perennial grass broadly distributed and native to the U.S. and Canada. Because of this broad distribution, little bluestem exhibits significant ecotypic variation. Plants vary in height, color, length of leaves, flowering, and clump diameter (USDA, 1983; Uchytil, 1989). It grows from 1 to 3 feet tall with culms slightly flattened. The blades are folded, sometimes rolled inward, and smooth to hairy. They are 2 to 12 inches long, 1.5-6 mm wide, pointed with sheaths keeled and usually smooth. The ligule is a fringed membrane 0.5-2.5 mm long. The culms terminate in a single raceme 1-3 inches long. The pediceled spikelets are 3-6 mm long with pedicels flattened. The awns of the fertile lemmas are 9-16 mm long, bent and twisted. The anthers are 2-4 mm long (Sedivec and Barker, 1997). Seed averages 225,000 to 250,000 bearded seeds per pound (Uchytil, 1989).

Distribution: Little bluestem is found throughout the lower provinces of Canada and all states of the U.S., except Nevada and Washington. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Habitat: This midgrass is a tallgrass prairie increaser and mixed prairie decreaser. Little bluestem typically occurs on dry upland sites, especially on ridges, hilltops, and steep slopes. It also occurs on limey subirrigated sites and in prairie fens. It is found in areas receiving 10 to 40 inches of mean annual precipitation and plant hardiness zones 3 to 9.

Adaptation
Little bluestem is adapted to soils ranging from sandy to clay-loam in texture. It begins growth in late spring after cool-season species have already developed (Uchytil, 1989). It has been observed that little bluestem phenology follows a well-defined pattern. Periods of active growth as well as stage of maturity are directly related to the length of the growing season (Miller, 1967; USDA, 1983).

Uses
Pasture/rangeland/prairie restoration: This species provides fair to good forage while young. It is rated fair for cattle and horses, but is usually too coarse for sheep and goats. Ungrazed wolf plants with seed stalks often give the false impression of non-use for the plant community. Shorter plants between the wolf plants have usually been grazed quite extensively. Crude protein is 12 to 14 percent in May, dropping off considerably in July through September to less than 4 percent (Sedivec and Barker, 1997). Little bluestem has been used extensively in prairie restoration projects primarily because of its adaptation to a diversity of sites, drought tolerance, growth habit, and wildlife appeal.

Erosion control: Little bluestem has moderate drought tolerance and broad adaptation to diverse sites. It can form mats from short rhizomes on wetter sites although this species is usually thought of as a bunchgrass (clumps) on dry, upland sites. It is deep-rooted, and somewhat slow to establish from seed.

Wildlife: Little bluestem is one of the best grasses for nesting and roosting habitat. The clump type of growth habit and many fine leaves at the base provide excellent nesting sites. The seeds are consumed by small mammals and birds, including upland game birds, rosy finches and juncos, as well as chipping, field, and tree sparrows. The seeds are of high value especially as a food source for birds that spend the winter on grasslands, such as prairie chickens and sharp-tailed grouse (Jones, 1963). Meadowlarks nest in areas where little bluestem grows. The dusky skipper butterfly caterpillars overwinter in tube tents above the base of the clumps (Knopf et al., 1997).

Landscaping: Little bluestem is becoming more popular for home landscaping because it is a colorful and easy-care addition. New varieties are being developed that don't lodge (falling over at the base) and are more disease resistant. New growth can be bluish, maturing to a reddish-gold color. The seed develops to a fluffy silver-white. The plumes are showy when seed has matured which adds interest to a cut arrangement. Frost accents the plants and the reddish tint provides color during the winter (Mahr, 2007). This is a prairie grass for the garden that is truly exceptional in mass plantings. Use in full sun.

Ethnobotany: Some tribes used little bluestem switches in ceremonial sweat lodges. The Lakota word means "small red grass". Dried leaves and stems were rubbed into soft fiber for moccasin lining and insulation (Johnson and Larson, 1999).

Status
Please consult the PLANTS web site (http://plants.usda.gov) and your State Department of Natural Resources for this plant's current status (e. g. threatened or endangered species, state noxious status, and wetland indicator values).

Weediness: This plant may become weedy or invasive in some regions or habitats and may displace more desirable vegetation if not properly managed. The seed is light and fluffy, and may spread to the surrounding areas, especially in a garden or landscape setting. Seed is generally dispersed a short distance from the parent plants. The maximum dispersal is only 5 to 6 feet and seedling vigor is weak (Uchytil, 1989). Consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use. Weed information is also available from the PLANTS Web site at http://plants.usda.gov/. Consult the Related Web Sites on the Plant Profile for this species for further information.

Management
Little bluestem begins growth later in the spring after the cool-season species have already developed. It tolerates glyphosate when dormant, and other herbicides as labeled for grasses. Weed control can be accomplished by mowing, especially the first year when the planted grass is short. It is minimally affected by fire if burned dormant and changes little in frequency of occurrence due to fire. Little bluestem is relatively resistant to fire under moist conditions. The growing points (apical meristem) are slightly more than an inch above the soil surface (Uchytil, 1989). Little bluestem in the immature growth phase is considered a nutritional, palatable grass for all classes of livestock in June and early July in studies in North and South Dakota. Palatability is lower than many other native warm-season grasses, especially when seed stalks are present. Proper grazing management is critical to improve grazing efficiency. Little bluestem is an increaser under season long grazing systems. Higher stock densities such as rotational grazing systems will achieve greater use of more plants. Recommended stubble height of 3 to 4 inches is required to assure stand longevity. Although not usually recommended for hay production, little bluestem can make fair to good hay when part of a native hayland mixture (Sedivec et al., 2008). It is a popular species to include in prairie restoration seedings because of its wide adaptation and high wildlife value. Plants will sometimes die from the center out in the clump if the plants become too dry. Burning at the opportune time can help to reduce the population of cool-season competing vegetation, as well as woody species.

Pests and Potential Problems
A leaf spot disease was found to be widespread in a little bluestem nursery established at Mandan, North Dakota, from plants collected in North Dakota, South Dakota, and Minnesota. *Phyllosticta andropogonivora* was consistently isolated from leaves showing leaf spot symptoms. The fungus was also isolated from native prairie plants. The fungus was pathogenic to little bluestem, big bluestem (*Andropogon gerardii*), and sand bluestem (*Andropogon halli*) (Krupinsky and Tober, 1990).

Environmental Concerns
This grass is primarily a bunchgrass that will spread some by seed. The seed is light and fluffy and it will move to adjacent areas. Bare soil may allow seed to germinate, but it is usually not a problem. Random plants in a natural landscape are usually not considered undesirable because it is a native species.

Control
Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Seeds and Plant Production
Seed into a firm seedbed in early spring for best results. Seed as a solid stand (8 inches or less row spacing) at approximately 4.5 lb/acre (eastern ND rate), or 30 seeds per linear foot of row, or 2.5 lb/acre for 24-inch rows. Glyphosate may be used for weed control immediately

after seeding to kill everything green and growing. Other herbicide weed control options are also available. Consult with the local extension service or Land Grant University for assistance with recommendations on herbicides and application rate. Always read and follow the label directions when applying herbicides. Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U.S. government and does not imply its approval to the exclusion of other products that may also be suitable.

Seed is best harvested from the plant using a commercial stripper at 600 to 800 rpm at the hard dough or mature seed stage. This is because of the light, fluffy seed, and the uneven maturity. Straight combining is another method of harvest when most of the seed has matured. Average dockage of combined seed is 60 percent. Seed should be air dried for a couple of days. Seed for the bin should be dried to 12 percent or less, and sacked seed should be 15 percent or less. Average yield is 200 to 300 lb/acre irrigated and 75 to 150 lb/acre dryland. Processing the seed is fairly difficult because of the fuzziness of individual spikelets. It should be debearded first. A hammermill works well with a 3/16-inch screen at 550 rpm, and then a debearder at 200 rpm for 45 to 60 minutes. Scalping or final cleaning may be done using a 4-screen fanning mill. Post-harvest management requires rotary mowing, rototilling, or cultivating between rows in the fall or spring; or burning on a regular basis in early spring (Smith et al., 1989).

Plants may be grown in the greenhouse using standard greenhouse procedures. Deeper containers (4 inches or more) are recommended because perennial grasses develop extensive root systems. A critical factor in growing little bluestem is day length. A study in North Dakota required 18 hours of artificial light each day for continued growth of seedling little bluestem plants (USDA, 1983) during the winter months.

Little bluestem has high genetic diversity.

Cultivars, Improved, and Selected Materials (and area of origin)

'The Blues', 'Prairie Blues', 'Blue Heaven', 'Carousel', and several other varieties have been developed for landscaping and ornamental use. Sources for conservation planting showing the year of release, and origin include the following:

STN-176 Germplasm*	2015	TX
STN-461 Germplasm*	2015	TX
Ozark Germplasm	2010	MO
Suther Germplasm	2008	NC
Prairie View Indiana Germplasm	2005	IN
OK Select Germplasm	2003	OK
Spirit Ecovar (Canada)	2003	SK,MB
Southlow Michigan Germplasm	2001	MI
Itasca Germplasm	2001	ND,SD,MN
Taylor Ecovar (Canada)	2000	MB,SK
Southern Iowa Germplasm	1999	IA
Northern Iowa Germplasm	1999	IA
Northern Missouri Germplasm	1999	IA
Central Iowa Germplasm	1997	IA
Badlands Ecotype	1996	ND,SD
'Cimmaron'	1979	KS,OK
'Camper'	1973	NE,KS
'Blaze'	1967	NE,KS
'Aldous'	1966	KS
'Pastura'	1964	NM

*Carrizo Blend is a commercial post-harvest blend of STN-176 Germplasm and STN-461 Germplasm. The blend should contain no more than 50 ± 10% of each of the two germplasms.

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Citation

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United States Department of Agriculture

NRCS Natural Resources Conservation Service

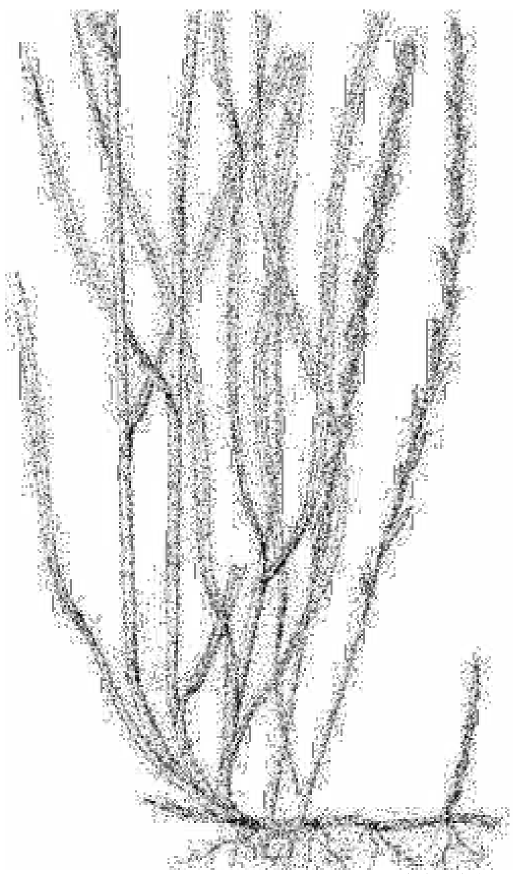
Plant Guide

INTERMEDIATE WHEATGRASS

Thinopyrum intermedium (Host) Barkworth & D.R. Dewey

plant symbol = THIN6

Contributed By: USDA, NRCS, Idaho State Office



Hitchcock (1950)

Alternate Names

Intermediate wheatgrass*: Agropyron intermedium*, *Elytrigia intermedia*

Pubescent wheatgrass: *Agropyron trichophorum*, *Thinopyrum intermedium* ssp. *barbulatum*

Uses

Grazing/pastureland/hayland: This is an introduced species used for hay and pasture in the northern Great Plains, west to central Washington, and south into Colorado, Kansas, and northern New Mexico and Arizona.

It produces good hay yields, both in monoculture and in mixtures with alfalfa (*Medicago* spp.), where its stiff stems tend to keep alfalfa from lodging.

Intermediate wheatgrass has fairly slow re-growth following clipping and is best adapted to single crop-haying situations (where rainfall patterns or limited irrigation prevents multiple cuttings in a season). Intermediate wheatgrass responds very well to irrigation with initial production nearing the level of orchardgrass (*Dactylis glomerata*) and meadow brome (*Bromus biebersteinii*) and exceeding smooth brome (*Bromus inermis*) under full irrigation. Meadow brome and orchardgrass have much better regrowth characteristics and will normally produce more than intermediate wheatgrass for hay production in multiple cutting situations.

Intermediate wheatgrass responds very well to limited irrigation. It is able to tolerate droughty conditions when irrigation ceases as long as about 12-14 inches or more total annual moisture is provided. It provides excellent spring, early summer, and fall pasture, but must be carefully managed to ensure maintenance of the stand and high production.

Intermediate wheatgrass is palatable to all classes of livestock and wildlife. It is a preferred feed for cattle, sheep, horses, deer, antelope, and elk in spring, early summer and fall. It is considered a desirable feed for cattle, sheep, horses, and elk in summer and winter.

Erosion control/reclamation: Intermediate wheatgrass is well adapted to the stabilization of disturbed soils. This grass can be used in critical and urban areas where irrigation water is limited and to stabilize ditchbanks, dikes, and roadsides. This grass can also be use to build soils because of its heavy root production. Levels as high as 7000 pounds (dry weight) per acre of root production in the upper 8 inches of soil have been measured in five-year-old stands.

Wildlife: Strips of intermediate wheatgrass left ungrazed provide good nesting cover for game birds and migratory waterfowl.

Status

Consult the PLANTS Web site and your State Department of Natural Resources for status, such as state noxious status and wetland indicator values.

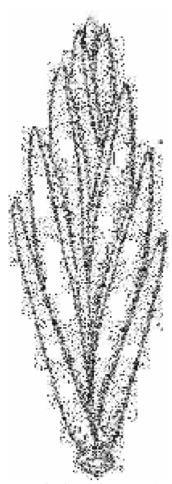
Description

General: Grass Family (Poaceae). As one of the common names implies, the spikes, spikelets, glumes, lemmas, and leaves of what once was considered pubescent wheatgrass are densely covered with hairs, whereas intermediate wheatgrass has vegetative structures which are for the most part smooth, but may have ciliate hairs on the leaf margins. The previously recognized separate species of intermediate and pubescent wheatgrass are now recognized as one species, *Thinopyrum intermedium*.

Intermediate wheatgrass grows to 3 to 4 feet tall. It is a long-lived, cool season grass with short rhizomes and a deep feeding root system. The seed spikes may be up to 4 to 8 inches long. Leaves are 4-8 mm wide and green to blue-green in color and sometimes drooping. The lemmas, paleas, and glumes are smooth to pubescent. The glumes are acute to blunt, generally five nerved, and awnless to awn tipped. There are usually fewer than seven florets. Commercial seed of Intermediate wheatgrass often contains both pubescent and glabrous forms.

Distribution

Intermediate wheatgrass is a perennial grass introduced in 1932 from Europe and Asia. Included in this group is a form that was known as pubescent wheatgrass (*Agropyron trichophorum*), which was introduced in 1934 from Europe and Asia and considered slightly more drought tolerant and winter hardy. For current U.S. distribution, please consult the Plant Profile page for this species on the PLANTS Web site.



Hitchcock (1950)

Adaptation

Intermediate wheatgrass is adapted to areas with 12 to 14 inches of annual rainfall or greater. The pubescent form can tolerate slightly more droughty conditions to 11 or 12 inches of rainfall. It performs best between 3500 and 9000 feet elevation. It can be seeded at lower elevations, but moisture requirements are greater. It is not as drought tolerant as crested wheatgrass (*Agropyron desertorum* and *A. cristatum)*, Siberian wheatgrass (*Agropyron fragile)* or Russian wildrye (*Psathyrostachys juncea*).

The glabrous form of Intermediate wheatgrass prefers well drained loamy to clayey textured soils. It will tolerate slightly acidic to mildly saline conditions, is cold tolerant, can withstand moderate periodic flooding in the spring, and is very tolerant of fire. The pubescent form performs best on loamy to sandy to shallow soils and can tolerate lower fertility, more alkaline soils, higher elevations, and drier conditions than the glabrous form. It performs poorly on wet, poorly drained, and moderately saline to alkaline soils with prolonged inundation.

Establishment

Planting: It should be seeded with a drill at a depth of 1/2 inch or less on medium to fine textured soils and no more than 1 inch deep on coarse textured soils. Recommended seeding rate is 8 pounds Pure Live Seed (PLS) per acre or 15 PLS seeds per square foot.

A firm weed free seedbed enhances stand establishment. It is compatible with other species, particularly alfalfa (*Medicago* spp.). In a mixture with alfalfa, stand longevity and productivity is often enhanced. If used as a component of a mix, adjust seeding rates to percent of mix desired. The best dryland results are obtained from seeding in very early spring on heavy to medium textured soils and in late fall (dormant) on medium to light textured soils. Irrigated lands should be seeded in spring through summer. Late summer (August - mid September) seedings are not recommended unless irrigation is available.

For mine lands, roadsides, and other harsh critical areas, the seeding rate should be increased to 16 pounds PLS per acre or 30 PLS seeds per square foot.

Intermediate wheatgrass establishes fairly quickly. Establishment is quicker than meadow brome or smooth brome varieties. Seedling vigor is good to excellent. Under favorable conditions intermediate wheatgrass provides good weed suppression. It makes good spring growth, fair summer growth, and good fall growth, if moisture is available. Light, frequent irrigation is beneficial for stand establishment.

Protect a new seeding until it is fully established and the plants are able to withstand pulling by grazing animals without being uprooted. It is beneficial to cut at least one hay crop prior to grazing.

Stands may require weed control measures during establishment. Application of 2,4-D should not be made until plants have reached the four to six leaf stage (be sure to read and follow label directions). Mow weeds at or prior to their bloom stage. Grasshoppers and other insects may also damage new stands and pesticides may be needed for control.

Management
Intermediate wheatgrass is highly palatable to livestock and wildlife. Livestock and wildlife will graze it throughout the growing season, but it is most preferred as forage in spring, early summer, and fall. A healthy, productive stand will not withstand heavy continuous grazing. Stands of intermediate wheatgrass are not as susceptible to spring and fall freezing as smooth brome, meadow brome, or orchardgrass.

Rush intermediate wheatgrass
Loren St. John
USDA-NRCS, Aberdeen, Idaho

Ten to twelve inches of new growth should be attained in spring before grazing is allowed on established stands. A six-inch stubble height should be maintained following grazing or mowing and going into winter. In pasture tests, stands consistently out-yield other grass-legume mixtures. For this reason, stocking rates can be set higher than other grasses. Care should be taken to allow proper rest of at least 21 to 28 days between grazing periods under irrigated and high moisture situations.
When planted with a legume, harvest hay at optimum stage for the legume. This will allow the grass to be harvested prior to flowering and result in very high quality hay. Harvest pure stands of intermediate wheatgrass for hay when plants start to flower.

Apply nitrogen as needed to maintain vigorous growth. Irrigated seedings and those in higher rainfall zones (18 inches +) will respond well to annual applications of 40 or more pounds of available nitrogen per acre during the establishment year and 70 to 90 pounds per acre each fall after establishment. A balance of nitrogen and phosphate fertilizer needs to be considered in order to maintain a legume component in a mixture. A soil test is recommended.

Forage production can be restored and stands may benefit from ripping if sodbound conditions occur. Care should be taken to avoid excessive tillage because stands may be damaged.

Environmental Concerns
Intermediate is long-lived (50+ years), spreads slowly vegetatively, and very little via seed distribution. It is not considered a "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. Research indicates that most seedings do not spread from original planting sites. It is known to coexist with native plants. On favorable sites where it is best adapted, it can maintain dominance and exist as a monoculture. There is no documentation that it crosses with native species.

Seed Production
Seed production of intermediate wheatgrass is generally not difficult. If fields are maintained in rows and adequate fertility levels are maintained, seed can be produced for 7 to 10 years. Row spacing of 36 inches dryland (areas with a minimum of 14 inches annual precipitation) and 24 to 36 inches irrigated are recommended. Intermediate wheatgrass is rhizomatous and to maintain seed production it should be maintained in row culture. Cultivation is required to maintain rows.

Average production of 250 to 350 pounds per acre can be expected under dryland conditions. Average production of 450 to 550 pounds per acre can be expected under irrigated conditions. Seed yields drop significantly after about four years of production. Harvesting is best completed by swathing, followed by combining of the cured rows. The seed heads will shatter when mature and if direct combining is desired the stand should be harvested when the top of seed heads just begin to shatter. Harvested seed must be dried to 12 percent moisture before storing in bins and to 15 percent before storing in sacks. Seed is generally harvested in mid to late August.

Cultivars, Improved and Selected Materials (and area of origin)
Certified seed of many cultivars in the following discussion are available through the appropriate state Crop Improvement Associations or from commercial sources.

'Amur' intermediate wheatgrass was selected from seed originally obtained from China by the Pullman PMC and transferred to the Los Lunas PMC, New Mexico and released by the PMC, New Mexico AES and University Park in 1952. It was selected for leafiness, vigorous growth, strong seedling vigor, and good seed production. It is a slow sod former. It was originally released for revegetation of disturbed lands and for pasture seedings at higher elevations. Introgression has occurred resulting in a high percentage of pubescent types over the years. Certified seed stock is no longer available. It has been replaced by other varieties, which are more widely adapted and/or better producers. It is not readily utilized in the northern U.S.

'Chief' intermediate wheatgrass was selected from seed originating in Russia by the Agriculture Canada Research Station in Saskatoon, Saskatchewan and was released in 1961. It was selected for high seed yield and forage quality. Its intended uses are as a grass component in grass-alfalfa hay mixtures and for short-term pasture that remains productive for about five years under heavy grazing pressure. Certified seed is available and Agriculture Canada maintains Breeder seed.

'Clarke' intermediate wheatgrass was selected from seed originating in Russia by the Agriculture Canada Research Station and was released in 1980. It was selected for drought tolerance, winter hardiness and high seed yields. It's intended uses are for hay and pasture either dryland or irrigated in the northern Great Plains of Canada and the U.S. Certified seed is available and Agriculture Canada maintains Breeder seed.

'Greenar' intermediate wheatgrass was selected from seed originating in Russia by Pullman PMC and was released by Idaho-Oregon-Washington AES and the PMC as P-2327 in 1945. Aberdeen and Pullman Plant Materials Centers named it in 1956. It was selected for vigor, moderate sod formation, leafy, broad-leafed, late maturing, and high production. Its intended use is for hay and pasture. Certified seed is no longer available.

'Greenleaf' pubescent wheatgrass was selected from seed originating from unknown European or Asian sources. Commercial seed sources in Washington and North Dakota were utilized by the Agriculture Canada Research Station to develop this cultivar and it was released in 1966. It has higher forage yields than 'Topar' and improved seedling vigor over 'Mandan 759'. It was intended for use as a winter hardy plant for pasture and hay production. Stands will not maintain high productivity under continuous heavy grazing. Certified seed is available and Agriculture Canada maintains Breeder seed.

'Luna' pubescent wheatgrass was selected from seed originating in Russia and Turkey by the Los Lunas PMC and was released by the New Mexico AES and PMC in 1963. It was selected for excellent seedling vigor, fast establishment and good forage production. Luna is one of the most broadly adapted pubescent wheatgrasses available and performs well from the central to northern Great Plains to the northern Rockies and Sierra Nevada regions. Certified seed is available and Breeder seed is maintained by the Meeker PMC.

'Manska' pubescent wheatgrass was selected from seed originating in Russia by the Great Plains Research Laboratory. It traces to 11 separate commercial lots of 'Mandan 759' intermediate wheatgrass (no longer available). It was selected for improved vigor, resistance to leaf spot, high forage and seed production, and nutritional quality. High nutritional value is the primary advantage of 'Manska' over other pubescent wheatgrass cultivars. ARS, Bismarck PMC, University of Nebraska and North Dakota AES, released it in 1992. It is intended for use in grass alfalfa hay mixes and for pasture. Certified seed is available and the Great Plains Research Laboratory maintains Breeder seed.

'Oahe' intermediate wheatgrass was selected from seed originating in Russia by South Dakota AES, Brookings, South Dakota and was released in 1961. Named after the Oahe Dam on the Missouri River, it is an abbreviation for the Sioux word meaning "Big House." It was selected for its uniformly bluish-green color, drought tolerance, vigor, rhizomatous traits and high seed yields. Oahe is adapted for hay, pasture and conservation purposes. Certified seed is available and South Dakota State University maintains Breeder seed.

'Reliant' intermediate wheatgrass was selected from sources adapted to the Northern Great Plains region. It was developed by the Northern Great Plains Research Laboratory and released by ARS, North Dakota AES and Bismarck PMC in 1991. It was selected for resistance to leaf spot, improved vigor, forage, seed production, forage quality and winter survival. It is of medium height, late maturing and adapted for hay, pasture and conservation purposes. Persistence and sustained productivity under hayland management in mixes with alfalfa are the primary advantages of 'Reliant' over other intermediate wheatgrass cultivars. Certified seed is available and the Great Plains Research Laboratory maintains Breeder seed.

'Rush' intermediate wheatgrass was selected from seed originating from sources in Germany. It was selected by the Aberdeen PMC and released by the Idaho AES and Aberdeen PMC in 1994. It was selected for superior seedling emergence and vigor compared to other intermediate wheatgrasses, good spring recovery, good rate of spread by rhizomes, uniform seedheads, wide leaves, high forage production, and high seed production. It has the largest seed of intermediate wheatgrasses, averaging 66,000 seeds per pound. It is adapted for soil erosion control, roadside stabilization, mine spoil stabilization, hayland, and pastureland both dry and irrigated, and forage for livestock and wildlife. It is not adapted to hay mixtures with alfalfa. Certified seed is available and Breeder seed is maintained by Aberdeen PMC.

'Slate' intermediate wheatgrass was selected from seed originating from a derivative of 'Amur' and another experimental accession. It was developed by the Nebraska AES and ARS and was released in 1969. It was selected for strong rhizomatous spread, erect form, broad flat leaves, and slate green color. It is adapted for use in the central Great Plains region. Certified seed is available and Breeder seed is maintained by Nebraska AES and ARS.

'Tegmar' intermediate wheatgrass was selected from seed originating in Turkey. It was developed by Pullman PMC and was released by Idaho-Washington AES and Aberdeen and Pullman PMCs in 1968. It was selected for long life, late maturing, vigorous seedlings, rapidly developing rhizomes, drought tolerance and dwarf growth form. It is generally about half the height of other intermediate wheatgrasses. Intended for use in erosion control, roadside and ditch stabilization, dam stabilization and grassed waterways. Certified seed is available and Breeder seed is maintained by Aberdeen PMC

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Prepared By

Daniel G. Ogle, Plant Materials Specialist
USDA, NRCS, Idaho State Office, Boise, Idaho

Loren St. John, Manager
USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Dr. Kevin B. Jensen, USDA-ARS, Forage and Range Research Laboratory, Utah State University, Logan, Utah

Species Coordinator

Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho.

Edited 18sep00 jsp; 18sept02 lsj; 24jan03 kbj; 03feb03 dgo

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site <http://plants.usda.gov>.

Plant Fact Sheet

SALTGRASS

Distichlis spicata (L.) Greene

Plant Symbol = DISP

Contributed by: USDA NRCS East Texas Plant Material Center

Larry Allain, USDI GS NWRC @ PLANTS

Alternate Names

spikegrass, common saltgrass, inland saltgrass, seashore saltgrass, alkali saltgrass,

Uses

Landscaping and Wildlife: *Distichlis spicata* is an abundant grass found throughout the coastal wetlands along the Gulf of Mexico. It has been used successfully in coastal wetland restoration projects as a pioneering species. It is also valuable for the reclamation of inland, high salinity areas, such as salt water spills associated with oil production sites.

Ducks have been known to feed on the seed, and geese will graze it in the fall, especially if it has been recently burned. It is also an important food source for the larvae of the Wandering Skipper Butterfly and the Florida Salt Marsh Vole.

Forage: Saltgrass is grazed by livestock, though it is not as favorable as other species. It is best used in early spring and winter months when other grasses are dry and less palatable. It is most palatable in its early growth stages.

Ethnobotanical: It is reported that Native Americans collected the salts extruded from the leaves of this plant, and used them to flavor foods. Saltgrass is also used in modern pharmaceuticals to treat respiratory allergies.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description and Adaptation

Saltgrass is a low growing, rhizomatous, sometimes stoloniferous, warm season, perennial grass**.** The leaves are short, paired, sharply pointed, and erect giving this grass a spiky appearance. The leaf sheaths overlap tightly on the stem, adding to the scaly appearance associated with the rhizomes. Saltgrass will grow from 6 to 18 inches in height, and produces both male and female plants. New plants often produce a star like pattern on bare ground as rhizomes radiate away from the mother plant. Saltgrass is capable of creating dense stands under favorable conditions. It generally produces few seed heads compared to the number of stems, and the seed heads are typically pale green in color. Salt crystals are usually present on the leaf blades in highly saline areas.

Saltgrass is commonly found in the salt marshes and flats along the Atlantic, Pacific, and Gulf coast; however, various subspecies are distributed much further inland, and may be found in nearly every state. It is very tolerant of saline and droughty conditions and favors fine to medium textured soil. It will tolerate a pH range between 6.4 and 10.5, and requires full sun for optimum growth. Prolonged water inundation will kill this species; however, it will tolerate brief flooding. It commonly grows in areas where water levels fluctuate between 2 inches above and 6 inches below soil level.

Establishment

Saltgrass may be established from seed; however, germination percentages can be low. It is most commonly propagated by vegetative means. Containerized material and rhizomes will grow readily, and are more reliable than direct seeding. This is especially true if the area of interest receives tidal influence. Rhizomes may be easily pulled from sandy areas, and cut into short lengths. It is imperative that this material be kept moist and away from excessive heat to maintain viability. Each length of rhizome should contain at least 2 nodes to insure production and establishment. Nodes are swollen areas on the rhizome, and may be located by following the above ground stems back to the rhizome. Once planted, these short lengths of rhizome will appear to die back. However, with continued watering and care, new shoots will appear from the nodes and stems in about 10 days. Rhizomes may be planted directly to the location of interest or into containers at a depth of 1 to 2 inches for later use.

Management
Saltgrass responds favorably to burning. Burnings should be done once every 2 years between the months of September and February. For best results, burn when water levels are one inch above the soil surface level to avoid damaging the rhizomes and stolons. Grazing should not be allowed on newly burned areas until at least four inches of re-growth appears. Saltgrass will respond to fertilization; however, it is rarely needed in reclamation plantings to be successful.

Pests and Potential Problems
Saltgass is an alternate host for Red Rust.

Environmental Concerns
Weediness: Saltgrass protects itself from over-grazing by growing low to the ground, and may become aggressive in inland areas where more desirable species are grazed too heavily. Please consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use. Weed information is also available from the PLANTS Web site at plants.usda.gov. Please consult the Related Web Sites on the Plant Profile for this species for further information.

Control
Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective

Cultivars, Improved, and Selected Materials (and area of origin)
LK517f saltgrass is a source identified release of saltgrass from the Lockford, California Plant Materials Center.

Prepared By:
R. Alan Shadow, USDA NRCS East Texas Plant Materials Center, Nacogdoches, Texas

Species Coordinator:
R. Alan Shadow, USDA NRCS East Texas Plant Materials Center, Nacogdoches, Texas

Edited: 070912 jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

United States Department of Agriculture
Natural Resources Conservation Service

Plant Guide

INDIAN RICEGRASS

Achnatherum hymenoides (Roem. & Schult.) Barkworth

Plant Symbol = ACHY

Contributed by: USDA NRCS Idaho Plant Materials Program and USDA Agricultural Research Service, Forage and Range Research Laboratory, Logan, Utah

'Nezpar' Indian ricegrass. Photo by Dan Ogle, USDA-NRCS (retired).

Alternate Names

Common Alternate Names: Indian mountain-ricegrass, Indian millet, wye, silky mountain rice, sandgrass

Scientific Alternate Names: Oryzopsis hymenoides, Stipa hymenoides

Uses

Grazing: Indian ricegrass is one of the most important native forage grasses on western desert and semi-desert rangelands (Forest Service, 1937). Indian ricegrass is used by domestic cattle, sheep and horses and is highly palatable during most of the year with the exception of late spring when seed heads are forming. It provides valuable forage for cattle in winter especially in salt desert communities and it supplies a source of green feed for domestic livestock early in the spring before most other native grasses have started to produce new growth (Tirmenstein, 1999). It is not typically used as hay.

Erosion control/reclamation: Indian ricegrass is drought tolerant and has a fibrous root system, which makes it desirable for erosion control and reclamation in areas receiving 8 to 14 inches annual precipitation in many arid and semiarid areas in the western United States. However, it is not highly effective in controlling sand movement on dunes (Tirmenstein, 1999). It is one of the first species to establish on cut-and-fill slopes. It does not compete well with aggressive introduced grasses during the establishment period but is very compatible with less aggressive native species.

Wildlife: Indian ricegrass is highly palatable to wildlife. It is preferred forage for elk in all seasons and for deer and antelope in spring, late fall, and winter (Tirmenstein, 1999). Indian ricegrass provides poor cover for big game but fair to good cover for birds and small mammals. The seed of Indian ricegrass is readily eaten by many species of birds and rabbits. Desert rodents (mice, ground squirrels, prairie dogs and rats) also utilize Indian ricegrass for food and cover (Tirmenstein, 1999).

Other uses/values: Indian ricegrass can be used in low rainfall locations for horticultural value and in dry floral arrangements because of the large-seeded panicle (Tirmenstein, 1999). A company in Montana markets an all-purpose baking flour and flour blend of Indian ricegrass as a gluten-free food product (Amazing Grains, 2013).

Status

Indian ricegrass is listed as endangered in the state of Minnesota. Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Description

General: Grass Family (Poaceae). Indian ricegrass is a cool season, native bunchgrass which grows 30-50 cm tall. The sheath is open and auricles are absent. The ligule is membranous, acute and 6 mm long. The leaves are 1-2 mm wide and 15-25 cm long and usually tightly rolled, giving the plant a slightly wiry appearance. The inflorescence is a wide spreading panicle with a single flower at the end of each hair-like branch. The glumes are 3 to 5 nerved, 6-8 mm long and papery. The lemmas are about 3 mm long, densely pilose and the awn is nearly straight and 3-6 mm long (Majerus, 2009; Skinner, 2010).

Seeds are round to elongated, black or brown, and covered with a fringe of short, dense, white callus hairs.

Johnson and Rogler (1943) reported the chromosome count for Indian ricegrass as 2n=48. Indian ricegrass is recognized as highly polymorphic (Robertson, 1976) and that most forms are ecotypes since variation from site to site is more marked than variation among plants within a site. Jones and Nielson (1989) found that under mesic conditions, the anthers may be exerted permitting cross pollination. But under hot, stressful conditions, pollination occurs before the flower opens, a condition known as ecological cleistogamy. They concluded that Indian ricegrass is self-pollinated and the mode of reproduction can be induced by extreme environments. Indian ricegrass can form natural hybrids with other members of the Stipeae, usually referred to as *Achnatherum x bloomeri* (Barkworth, et al., 2007).

A seed zone map has been developed for Indian ricegrass in the Southwestern United States which distinguished genetic variation between cooler and warmer regions and separating more northern, higher elevation areas from more southern, lower elevation areas into 12 seed zones (Johnson, et al., 2012). The seed zone map was developed to guide and broaden germplasm collection and utilization of Indian ricegrass for restoration.

Ethnobotany
Indian ricegrass was a widely known food plant of Indian tribes in the Southwest and Great Basin (Forest Service, 1937). There is documented use of Indian ricegrass by many western tribes including the Apache, Gosiute, Havasupai, Hopi, Kawaiisu, Navajo, Paiute, and Zuni Indian tribes of western North America (University of Michigan, 2013). The major uses were as ground seed used to make bread, mush, pones and dumplings and hay for horses. The starch and sugar content of Indian ricegrass seed is not as high as commonly cultivated grains but does yield approximately 120 calories per ounce (Benfer, 2013).

A study to evaluate the baking qualities of 'Nezpar' Indian ricegrass seed was reported by Stearns and Booth (1980). Nezpar seed showed a good test weight, high milling yield, and high flour protein content. The flour was a cream color and displayed a "sharp feel" more like that of hard wheat flour than of soft wheat flour. Nezpar flour showed a poor baking response as the bread dough became weaker and the loaf volume decreased as the percentage of Nezpar flour was added to standard hard red wheat bread flour. The cookie spread of Nezpar flour was less than cookie spread for soft wheat flour and the study concluded that the poor baking qualities of Nezpar eliminated its consideration for use in domestic bakery goods.

Adaptation
Indian ricegrass is very winter hardy and has a broad climatic adaptation. It can be found at elevations from 3,300 to 9,500 feet above sea level. It grows best in areas that receive 8-14 inches annual precipitation but has been observed to establish and reproduce from seeding in areas with as low as 6 inches annual precipitation. It prefers sandy, coarse textured soils and can also be found on sands, fine sandy loams, silt loams, clay loams, gravelly, rocky and shale soil textures (Ogle, et al., 2011a).

It does not tolerate poorly drained soils, extended periods of inundation, winter flooding, or shading. It is tolerant of weakly saline and sodic soil conditions but prefers neutral soil conditions. Response to fire is variable with reports of slight to moderate damage to generally killed by fire. Indian ricegrass regenerates by seed after fire (Tirmenstein, 1999).

Distribution: Indian ricegrass is widely distributed throughout the western United States. It occurs east of the Cascade Range from British Columbia south to southern California and northeastern Mexico and east to Alberta, the Dakotas and Texas. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Habitat: Indian ricegrass is found in salt desert shrub communities, sagebrush steppe, short and mixed grass prairie and in pinyon-juniper and ponderosa pine forest communities. It is commonly associated with needleandthread (*Hesperostipa comata*), Thurber's needlegrass (*Achnatherum thurberianum*), sideoats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), wheatgrasses (Triticeae), Sandberg bluegrass (*Poa secunda*), bottlebrush squirreltail (*Elymus elymoides*), big sagebrush (*Artemisia tridentata*), black sagebrush (*Artemisia nova*), winterfat (*Krascheninnikovia lanata*) and shadscale (*Atriplex confertifolia*) (Tirmenstein, 1999).

Establishment
The major factor limiting use of Indian ricegrass is the high percentage of dormant seed. Two types of dormancy have been identified: 1) morphological seed dormancy associated with the hard seed coat, and 2) embryo dormancy (Booth, et al., 1980). Research has shown that mechanical scarification of the seed improves germination of dormant seed (Jones and Nielson, 1992). Scianna, et al., (2012) found a combination of modest seed coat stratification with sandpaper plus a 6-10 month moist chilling period at approximately 38-40° F resulted in the highest germination of Indian ricegrass seeds. Dormant field planting in fall (after soil temperatures reach 40° F or less) with light seed coat scarification is the preferred method for establishment of Indian ricegrass. However, commercial seed is rarely scarified. A practical method to overcome seed coat dormancy is by dormant planting

seed that has been properly stored for 4-6 years (Booth et al., 1980).

Embryo dormancy can be overcome by use of Gibberlic acid, kinetin, thiorea, and hydrogen peroxide but are only slightly effective and not very practical (Robertson, 1976). As with seed coat dormancy, fall planting seed that has been properly stored for 4-6 years is the most practical method to overcome embryo dormancy in Indian ricegrass (Booth et al., 1980) but older seed may not emerge from seeding depths as well as younger seed.

The recommended seeding rate for Indian ricegrass is 8 pounds Pure Live Seed (PLS) per acre or approximately 30 PLS seeds per square foot (Ogle, et al., 2011a). There are approximately 161,920 seeds per pound (PLANTS database, 2013). For erosion control or reclamation plantings, the seeding rate should be doubled. If used as a component of a mix, adjust to percent of mix desired. It should be seeded with a drill at a depth of ½-1 inch on medium to fine-textured soils and 1-3 inches on coarse-textured soils into a clean, firm, and weed-free seedbed. A deeper planting depth places the seed in contact with soil with increased moisture content which aids in seed stratification and makes the seed less likely to be dug up by digging rodents. When planting seed mixes that include species that require shallower planting depths (0-¼ inch), two separate seeding operations may be necessary. Plant Indian ricegrass first at the deeper planting depth and then plant the other components of the seed mix at the shallower depth.

Management
Stands may require weed control measures during establishment. Broadleaf herbicides should not be applied until plants have reached the 4-6 leaf stage. Mowing when weeds are beginning to bloom will help reduce weed seed development. Grasshoppers or other insects may damage new stands and used of pesticides may be required. All herbicides and insecticides should be applied according to the label.

Indian ricegrass establishes slowly and new seedings should not be grazed before the late summer or fall of the second growing season. New stands should be producing some seed before light grazing should be allowed (Ogle, et al., 2011b). Once established, Indian ricegrass benefits from moderate grazing during winter and early spring. Livestock should be removed while there still is enough growing season moisture to allow recovery, growth, and production of seed. Stands will deteriorate under heavy spring grazing.

The third and fourth year after establishment is critical to stand survival because reproduction is dependent on seed production. Seed must be available in the seed bank to replenish the stand as older plants begin to die. Grazing management with rest or deferment scheduled every 2 to 3 years is recommended to maintain Indian ricegrass. By the eighth or ninth year following establishment, the seed bank should be adequate, with a wide variation of low dormancy to hard seed to ensure long–term stand persistence with proper grazing management.

Pests and Potential Problems
Grasshoppers, jack rabbits, and rodents may damage stands. There are no known serious disease problems in Indian ricegrass.

Environmental Concerns
Indian ricegrass is a native bunchgrass that reproduces only by seed and is not considered to be weedy or invasive. Although it is not considered weedy or invasive, Indian ricegrass can spread into adjoining vegetation under ideal climatic conditions. Most seedings do not spread from the original planting. Although Indian ricegrass is mostly self-pollinating, it occasionally cross-pollinates with other native needlegrass species. These natural crosses generally produce sterile hybrids.

Seed and Plant Production
Using seed that is at least 4-6 years old that has been stored under cool and dry conditions is recommended for producing seedlings for transplanting. Moist-stratify seed at 38-40° F for 30 days prior to planting in the greenhouse. Plant stratified seed into planting containers and grow seedlings for approximately 60 to 90 days with typical greenhouse conditions and irrigation before transplanting to field. If seed is younger than 4-6 years of age, modest seed scarification with sandpaper plus a 6-10 month moist stratification may be required prior to planting seed (Scianna, et al., 2012).

Field seed production of Indian ricegrass has been very successful under cultivated conditions. Row spacing varies from 24 to 36 inches when irrigated and 36 inches under dryland conditions (14 to 16+ inches annual precipitation) are recommended. The recommended seeding rate for seed production in 36 inch row spacing is 3.5 pounds PLS/ac (Cornforth et al., 2001). Cultivation will be needed for weed control and to maintain row culture. Herbicides are used primarily for broadleaf weed control.

Seed production of Indian ricegrass is most productive and persistent on coarse-textured soils. Planting should be accomplished in late fall as a dormant seeding to overcome seed dormancy. Field should be clean, weed-free and firm and seed should be planted to a depth of 1-3 inches on coarse-textured soils and ½-1 inch deep on fine-textured soils.

Seed fields are productive for about five years. Field moisture during the fall, soil fertility, and plant regrowth in the fall determine the yield the following growing season.

Seed harvest can be accomplished by either direct combining or by windrowing followed by combining when seed is in the hard-dough stage. Seed is generally harvested in mid to late July. Wind can shatter ripe seed readily so close inspection is necessary to determine optimum harvest date. Windrowing followed by combining helps to ensure more complete threshing but windrows are also prone to seed loss from wind storms. Seed yields range from about 100 pounds per ac for dryland production to about 200 pounds per ac from irrigated fields (Cornforth, et al., 2001). Seed needs to be dried immediately after harvest to 12 percent moisture content if stored in bins, or to 15 percent if stored in sacks.

The Aberdeen Plant Materials Center uses a two-screen scalper to begin the seed cleaning process. The scalper removes larger inert matter. Once the seed has been scalped it is run through a debearder which removes the copious amounts of fuzz (fringe of short, dense, white callus hairs on the seed). The seed is then processed through a three-screen clipper and a disc or indent cleaner to complete the seed cleaning process.

Cultivars, Improved, and Selected Materials (and area of origin)

'Nezpar' was originally collected in 1935 from a site south of White Bird, Idaho by the Washington Plant Materials Center. It was selected from 152 accessions for its vegetative characteristics and low seed dormancy and released by the Aberdeen, Idaho Plant Materials Center and the Idaho Agricultural Experiment Station in 1978 (Booth, et al., 1980). It is adapted to the Northwest and Intermountain regions where precipitation averages 8 inches or above. It has survived in plantings with 6 inches annual rainfall. It prefers gravelly to loamy to sandy soils. It is noted for its large erect plant type, robust stems, abundant leaves, medium to small dark nearly hairless elongated seeds (< 50 percent dormant seeds), and good to excellent seedling vigor. Certified seed is available, and Aberdeen Plant Materials Center maintains Breeder and Foundation seed.

'Paloma' was collected in 1957 west of Pueblo, Colorado at about 5000 feet elevation on medium textured soils. It was selected by New Mexico PMC and released cooperatively by the PMC and New Mexico Agricultural Experiment Station in 1974 (Alderson and Sharp, 1994). It is adapted to the Southwestern Regions of the Western United States. It is considered very drought tolerant, has good seedling vigor, forage, seed yields, and is long lived. Paloma has good regrowth and spring recovery. It is considered the best Indian ricegrass cultivar for the Southwestern Regions of the Western United States. Certified seed is available, and Los Lunas, New Mexico Plant Materials Center maintains Breeder seed.

'Rimrock' was collected in 1960 from a native site averaging 10 to 14 inches of precipitation, north of Billings, Montana, at about 3600 feet elevation on sandy soils. The Montana Plant Materials Center; ARS, Logan, Utah; and the Montana and Wyoming Agricultural Experiment Stations released Rimrock in 1996, primarily because of its ability to retain mature seed better than Nezpar or Paloma. Its more acute angle of glumes helps retain seed longer and protects it from seed shatter caused by wind and/or rain. Certified seed is available, and Bridger PMC maintains breeder seed (Jones, et al., 1998).

Ribstone was released in 2003 as a genetically manipulated selected class germplasm. It was selected from an accession collected in 1993 near Taber, Alberta, Canada. At the time of collection, the accession was noted as featuring an acute glume pair-angle, a trait previously associated with seed retention in the cultivar Rimrock. Based on several plot planting evaluations conducted in Utah, 10 of the original plants from the parent accession were visually selected for acute glume-pair angle. Seed from the 10 plants was bulked and used to establish a Generation 1 (G1) field. Prechilled germination of Ribstone was also compared to Rimrock with nearly doubled results for Ribstone. The intended area of use of Ribstone is the southeastern portion of Alberta extending into Saskatchewan and Montana. G1 seed is maintained by the USDA ARS Forage and Range Research Laboratory and G2 and G3 generations are available to seed growers by Ducks Unlimited-Canada and the Utah Crop Improvement Association. G4 seed is eligible for Certification but sale of Ribstone seed beyond G4 is expressly prohibited to limit genetic drift (Jones, et al., 2004).

Star Lake was released in 2005 as selected class germplasm that was genetically manipulated. The parent collection was made in McKinley County, New Mexico near the town of Torreon. The cleaned seed collection yielded three seed morphologies differing in size and shape: small elongate (later named Star Lake), large globose, and jumbo globose. The lemma and palea thickness of Star Lake seed was thinnest of the 3 seed morphs (increased lemma and palea thickness has been correlated with increased seed dormancy). Seed of Star Lake and 29 other accessions from southern Utah, northern New Mexico and northern Arizona were then evaluated and harvested from plots and germinated with cold-moist prechill but without scarification. Star Lake was highest in germination. The intended area of use of Star Lake is eastern Utah, western Colorado, northern Arizona and northern New Mexico. Seed of G2 is maintained by the USDA ARS Forage and Range Research Laboratory and is made available to seed growers for production of G3-5 seed by the Utah Crop Improvement Association (Jones and Nielson, 2005).

White River was released in 2006 as a selected class germplasm that was genetically manipulated. The original collection was made near Rangley, Colorado. It also has small seed morphology like Star Lake germplasm (less seed dormancy). It was established in plots in Utah with other collections and had the highest seed yield of 25 accessions and second highest germination of 59 accessions tested. Following field testing in Wyoming, a nursery was established and the best performing accessions in terms of seed yield and germination (32 accessions) were bulked to form White River germplasm. It is intended for use in central and eastern Nevada, central, southern, and eastern Utah, western Colorado, southern Wyoming, southern Idaho, eastern Oregon and southeastern Washington. G2 seed is maintained by the USDA ARS Forage and Range Laboratory and G3 seed is produced by the Uncompahgre Plateau Project in Utah and made available to commercial seed growers through the Utah Crop Improvement Association for production of G4 and G5 seed (Jones et al., 2010).

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Prepared By:
Daniel G. Ogle, USDA, NRCS, Boise, Idaho
Loren St. John, USDA, NRCS Aberdeen, Idaho
Dr. Thomas A. Jones, USDA, ARS, Forage and Range Research Laboratory, Utah State University, Logan, Utah

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For more information about this and other plants, please contact your local NRCS field office or Conservation District at http://www.nrcs.usda.gov/ and visit the PLANTS Web site at http://plants.usda.gov/ or the Plant Materials Program Web site http://plant-materials.nrcs.usda.gov.

United States Department of Agriculture
Natural Resources Conservation Service
Plant Materials Program

‘Lodorm’ Green Needlegrass
Nassella viridula

A Conservation Plant Release by USDA NRCS Plant Materials Center, Bismarck, North Dakota

‘Lodorm’ green needlegrass [*Nassella viridula* (Trin.) Barkworth] was released in 1969 by the Montana, North Dakota, and South Dakota Agricultural Experiment Stations, along with the Plant Science Research Division of the Agricultural Research Service (ARS), Mandan, North Dakota. It is recommended for use in pasture and range seedings in the Northern Great Plains.

This cool-season midgrass is an important native species in the Northern Great Plains. Lodorm originates from a bulk collection made in a native stand north of Bismarck, North Dakota, in 1935. It was selected for low seed dormancy after harvest.

USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions.* 3 vols. Charles Scribner's Sons, New York. Vol. 1: 176.

Description
Green needlegrass is a cool-season (C_3) perennial bunchgrass native to the Central and Northern Great Plains region. Green needlegrass grows to a height of 18-36 inches. The seed head is a compacted panicle. The awns are curved, sharply bent in the middle, and about one inch long. The leaves are often rolled, thread-like, 4-12 inches long, glabrous, with prominent veins above. The ligule is a ring of hairs, and the sheath is hairy at the margins.

Ligule and Sheath

Clarke, S.E., Campbell, J.A., and Shevnek, W. 1950. *The Identification of Certain Native and Naturalized Grasses by Their Vegetative Characters*. Canada Department of Agriculture Publication No. 762.

Conservation Uses
Lodorm green needlegrass is well suited for use in mixtures for range seeding, critical area establishment, mined land revegetation, wildlife habitat, and other plantings where the establishment of native vegetation is the objective. Lodorm has rapid recovery growth. It starts growth relatively early and remains green until late in the season. This species is nutritious and palatable, but decreases under heavy grazing use. The awns are not troublesome to livestock as with some other needlegrasses. Green needlegrass is frequently included in seedings of mixed midgrasses, but due partly to its hard seed coat, it may be slow to germinate and become established.

Area of Adaptation and Use
This species has moderately deep, fibrous roots which in favorable situations may extend to a depth of 10 feet or more. On medium-textured soils, green needlegrass grows with western wheatgrass, needleandthread, and blue grama. On fine-textured soils, needleandthread drops out, and on even finer soils, blue grama decreases leaving green needlegrass and western wheatgrass as dominants. Green needlegrass naturally occurs on bottomlands, flat benches, and overflow areas along streams. The primary area of adaptation of Lodorm is the Northern Great Plains and Upper Midwest.

Establishment
High dormancy is a characteristic of this grass. Germinability improves for several years after harvest. Seedlings are slow in developing. Once established, they have good vigor. Green needlegrass has approximately 181,000 seeds/lb. A full seeding rate of 6 PLS lb/ac (25 pure live seeds/ft^2) for western North Dakota is recommended. For eastern North Dakota, a seeding rate of 7.5 PLS lb/acre is recommended. This is equivalent to

30 pure live seeds/ft^2. Seed into a clean, weed-free seedbed. Firm the seedbed with a packer or harrow if necessary. The seedbed should be firm enough to allow the seed to be planted only ½ to ¾ inch deep. The seeding equipment should provide proper seed depth, uniform seeding rate, and good seed to soil contact. Apply no fertilizer the year of establishment unless a soil test indicates a severe deficiency of nitrogen and phosphorus.

Management
Seed dormancy in this species is inversely related to maturity. Seed ripening progresses from top to bottom. Seed in the lower panicle branches is still immature when that in the upper branches has ripened and started to shatter. Differences of a few days in harvest can make large differences in seed dormancy. Seed harvest must be timed carefully to avoid excesses in both shattering and immaturity. It is seldom possible to get more than 50 percent of the seeds. Pure stands of green needlegrass in native grasslands are uncommon. Mixtures of Lodorm green needlegrass with other grasses and alfalfa are recommended for forage plantings and for pasture. In new plantings, reduce weed competition by mowing at a height that will not affect the young seedlings. Protect from grazing until established.

Performance
As a cool-season grass, green needlegrass growth begins in the spring and continues into the fall when moisture conditions are favorable. In a study conducted by the Bismarck Plant Materials Center and North Dakota State University at Hettinger, North Dakota, the date of peak forage production of green needlegrass was in mid-August. In an earlier study at the same location, the five-year average for forage production of Lodorm was almost 700 lb/acre, on a fine sandy loam soil. In a similar study at Fort Pierre, South Dakota, the five-year average forage production was approximately 1,100 lb/acre, on a clay soil. Crude protein is good during the early growing season. The study at Hettinger indicated a range from 19 percent (April 26), 14 percent (June 1), 7 percent (July 1) to 5 percent (August 24).

Seed Production
Seed yields from green needlegrass vary from about 125 lb/acre on dryland to 250 lb/acre for irrigated fields. Seed ripening is intermittent on each seed head and shattering begins as soon as the first seed is ripe. Seed ripens from late June to mid-July. If the seed is harvested with a grass seed stripper, more than one pass can be made through the field. Native stands of green needlegrass produce profitable seed harvest only in years of favorable precipitation. Once the seed is harvested, it needs to be processed to remove the awns.

Availability
For conservation use: Certified seed is available from various commercial vendors. Contact your local USDA NRCS field office or the Bismarck Plant Materials Center for a list of vendors.

For seed increase: Foundation seed of Lodorm is available for seed increase from the USDA NRCS Plant Materials Center, Bismarck, North Dakota.

For more information, contact:
USDA-NRCS Plant Materials Center
3308 University Drive
Bismarck, ND 58504
Phone: (701) 250-4330
Fax: (701) 250-4334
http://Plant-Materials.nrcs.usda.gov

Citation
Release brochure for Lodorm green needlegrass (*Nassella viridula*). USDA Natural Resources Conservation Service, Plant Materials Center, Bismarck, North Dakota 58504. Published July 2005, revised August 2012.

For additional information about this and other plants, please contact your local USDA Service Center, NRCS field office (www.nrcs.usda.gov) or Conservation District and visit the PLANTS Web site (www.plants.usda.gov) or the Plant Materials Program Web site (www.plant-materials.nrcs.usda.gov).

United States Department of Agriculture
Natural Resources Conservation Service

Plant Fact Sheet

FOURWING SALTBUSH

Atriplex canescens (Pursh) Nutt.

Plant Symbol = ATCA2

Contributed by: USDA NRCS Idaho Plant Materials Program

Fourwing saltbush. Photo by Steven Perkins @ USDA-NRCS PLANTS Database

Alternate Names
Chamise, chamize, chamiso, white greasewood, saltsage, fourwing shadscale, bushy atriplex

Uses
Fourwing saltbush is highly palatable browse for most livestock and big game. Protein, fat and carbohydrate levels of fourwing saltbush have been compared to those of alfalfa. It is utilized primarily in the winter at which time it is high in carotene and digestible protein averages near 8%. Fourwing saltbush provides excellent season long browse for deer. It is a good browse plant for bighorn sheep, antelope, and elk in fall and winter. It is also a food source and excellent cover for upland birds, rabbits, songbirds, and small mammals.

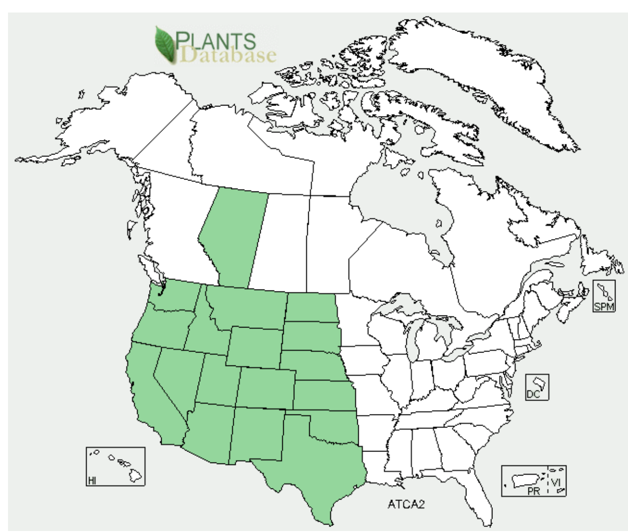
Fourwing saltbush makes an excellent vegetative barrier. It is especially useful on saline-sodic soils. It has excellent drought tolerance and has been planted in highway medians and on road shoulders, slopes, and other disturbed areas near roadways. Its root system provides excellent erosion control. Fourwing saltbush is used extensively for reclamation of disturbed sites (mine lands, drill pads, exploration holes, etc,).

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Description and Adaptation
Fourwing saltbush can be deciduous or evergreen, depending on climate. Its much-branched stems are stout with whitish bark. Mature plants range from 1 to 8 ft in height, depending on ecotype, the soil, and climate. Its leaves are simple, and ½ to 2 inches long. Its root system can reach depths of up to 20 ft when soil depth allows.

Fourwing saltbush is mostly dioecious, with male and female flowers on separate plants. Fourwing saltbush plants can also have male and female parts in one flower. Male flowers are red to yellow and form dense spikes at the ends of the branches. The female flowers are axillary and nondescript. The seed is contained in a winged utricle that turns a dull yellow when ripe and may remain attached to the plant throughout winter.

Fourwing saltbush is one of the most widely distributed and important native shrubs on rangelands in the western United States. It can be found from the Pacific Coast to the Missouri River, from Mexico to southern Alberta. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.



Fourwing saltbush distribution from USDA-NRCS PLANTS Database.

Fourwing saltbush is adapted to most soils but is best suited to deep, well drained; loamy to sandy to gravely soils. It is very tolerant of saline and somewhat tolerant of sodic soil conditions. Fourwing saltbush also has high tolerance to boron. It does not tolerate high water tables or late winter inundation. It is extremely drought tolerant and has fair shade tolerance. It is not especially tolerant of fire, but may resprout to some degree if fire intensity is not too severe. Its ability to tolerate extreme cold conditions varies with ecotype. Fourwing saltbush occurs most commonly in salt-desert scrub communities in the desert areas of western North America in areas that receive 200 to 360 mm (8 to 14 in) of annual precipitation. It can be found from sea level in Texas to over 2,400 m (8,000 ft) in Wyoming.

Establishment
An adapted cultivar/release or local seed source should be used to ensure the ecotype is compatible with the site. On moist fine soils, seed should be planted ½ inch deep. On sandy to coarse gravely soils, plant up to ¾ inch deep. Seeding rates of 0.25 to 0.50 lbs PLS (pure live seed) per acre is recommended for rangeland seeding mixtures (3 to 7 percent of the seeding mix). De-winged seed is preferred as seed flow through a drill and planting depth can be controlled more easily. There is no prechilling requirement for fourwing saltbush seed. Seedling vigor is generally outstanding and depending on ecotype.

Management
Animals should be removed from new plantings for at least two growing seasons or until plants are well established and reproducing. Irrigation may be needed for transplants on harsh sites to ensure establishment. Young seedings are not tolerant of excessive insect, rabbit, and rodent damage and plantings may require control measures if severe damage appears.

In established plantings, deferred rotation grazing is recommended for fourwing saltbush. Plants can be grazed from late spring through winter, but plant health is best maintained if used primarily as a winter browse. Fourwing saltbush tolerates browsing very well, but will decrease in abundance under continuous close browsing (>40-50% of annual growth). Damaged plants generally recover if rested, but production will be reduced until fully recovered. Fourwing saltbush can cause bloat and scours in spring if it is the primary dietary source.

Environmental Concerns
Fourwing saltbush is native to western North America It is not considered "weedy", but can spread into adjoining vegetative communities under ideal conditions.

Cultivars, Improved, and Selected Materials (and area of origin)
'Marana' fourwing saltbush was released in 1979 by the NRCS Lockeford Plant Materials Center. It originated from plants near El Cajon, California and was selected for ease of establishment and drought resistance. It is best adapted to areas in the southwest including southern New Mexico, southern Arizona and southern to central California.

'Rincon' fourwing saltbush was selected by the Forest Service, Shrub Science Laboratory in Provo, Utah and released with the NRCS Plant Materials Center, Meeker, Colorado in 1983. The original seed was collected near Canjilon, New Mexico at 7,800 feet elevation. Rincon is an erect, leafy form with early green-up. It is best adapted to the southwest areas of Utah, Nevada, western Colorado, New Mexico and central Arizona.

'Santa Rita' fourwing saltbush was cooperatively released by the NRCS Plant Materials Center, Tucson, Arizona, ARS, and University of Arizona in 1987. It is best adapted to areas in the southwest including southern New Mexico, southern Arizona and southern to central California.

'Wytana' fourwing saltbush was released by the NRCS Plant Materials Center, Bridger, Montana in 1976. Wytana is a natural cross between fourwing saltbush and Gardner saltbush. It is a short, herbaceous type that is best adapted to the Great Plains and mountain foothills of Idaho, Montana and Wyoming.

Prepared By:
Derek Tilley, USDA NRCS Plant Materials Center, Aberdeen, ID

Loren St. John, USDA NRCS Plant Materials Center, Aberdeen, ID

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PLANTING GUIDE

Elymus canadensis L.

Common Name:
Canada wildrye

Accession Numbers/Releases:
9062275 – Zone 1, Northern Iowa Germplasm
9062276 – Zone 2, Central Iowa Germplasm
9062277 – Zone 3, Southern Iowa Germplasm

Manual of Grasses of the United States
A. S. Hitchcock

Description:

A cool-season native perennial bunchgrass, which is mildly rhizomatous. Leaves may be glaucous (greenish color which appears to be somewhat powdered with a whitish bloom), stems are erect, tufted, and generally one to 1.5 meters tall. Sheaths may be glabrous and the amount of hair found on them is variable. Leaf blades are flattened or curled inwards near the tips and are generally rough to the touch. Leaf width is one to two centimeters. Where the leaf blade joins the sheath, an earlike lobe extends from the leaf margins to clasp the stem. The seedhead is usually drooping or nodding and is 10 to 25 centimeters long. Spikelets are commonly found in threes and fours; they spread away from the stem at the base of the seedhead. Glumes are narrow and also rough to the touch. Awns are two to three centimeters long and must be removed before it will flow satisfactorily through a drill. *Elymus canadensis* has a chromosome count of 23 and is a tetraploid 2n=4x=28.

Purpose: Revegetate roadsides in the state of Iowa along with providing hay and forage production as this species is palatable and nutritious to all classes of livestock. Canada wildrye was an important part of prairie pastures. Its stout creeping habit has potential for stabilizing sand or critical areas, it may prove useful for wildlife food and cover and prairie restoration.

Source: Seed of these three accessions 9062275, 9062276, and 9062277 were collected from native stands located in the northern (Zone 1), central (Zone 2), and southern (Zone 3) counties in the state of Iowa.

Establishment: (For Seed Production): Stratify seed in cold moist condition for 60 days if planting in spring or summer. Prepare a clean weed-free seedbed by disking and harrowing or chemical weed control. Firm the seedbed by cultipacking. Seedbed should be firm enough to allow the seed to be planted 1/4 - 1/2 inch deep. Use a no-till grass drill with double disc openers, depth bands, packer wheels, seed agitators and a positive feed mechanism capable of handling and applying the seed in a uniform manner. Plants are largely self-pollinated. Canada wildrye grows well on many kinds of soil and is especially well adapted to sandy soils. Growth starts early and often continues through the summer if moisture and temperature are favorable. Growth may resume in the fall after a period of summer dormancy. Grass maturity may be reached in July.

The seedlings are very vigorous; therefore, new plantings can be established quickly. This makes Canada wildrye especially useful in mixtures with other grasses, many of which do not produce ground cover rapidly. The seed of wildrye is usually high in quality. It is ordinarily ready for harvest from July in the South to August in the northern part of the region. Since the seed do not shatter readily, harvesting may be extended over a period of several weeks.

Fertilizer: Apply no fertilizer the establishment year unless soil test indicates severe deficiency of less than 15 PPM of phosphorus and or less than 90 PPM of potassium. Use no nitrogen during the establishment year as this can encourage weed competition. On established stands apply nitrogen at 40 to 60 pounds per acre.

Seeding Rates: (For Seed Production): Seeding rates for Canada wildrye should be about 30 to 40 pure live seeds (PLS) per linear foot or row in 30 inch rows. There are approximately 115,000 clean debearded seeds in one pound of Canada wildrye.

For solid stand production, drill 15 pounds of PLS per acre.

Seeding Dates: Spring (April to May), late summer (August to September) or dormant seeding (November to March). The seed of Canada wildrye needs cold stratification for maximum germination if seeded in spring and summer.

Management: Reduce weed competition by mowing or cultivating between the rows of Canada wildrye. For broadleaf weed control usage of a post broadleaf herbicide can provide control and will encourage a good stand. Use label recommendations for application. Remove dead plant material in spring for faster green-up by shredding. Burning of straw will weaken the plants unless done before is has broken dormancy.

Note: Herbicide products may not be registered on this grass species in your state. NRCS does not endorse the use of any product.

See NRCS Iowa prescribed Burning Practice Code 338 on burning criteria. Burning may be appropriate where plant vigor declines in native plant species or where invader species threaten a native stand.

Availability of Plant Materials: Breeders' material is being produced in limited supply by the Plant Materials Center, located at Elsberry, Missouri.

Source identified seed will be released to interested commercial seed growers. A list of commercial growers can be obtained from the Elsberry Plant materials Center of the Iowa Crop Improvement Association – The Iowa Seed Directory.

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Plant Guide

BLANKETFLOWER

Gaillardia aristata Pursh

Plant Symbol = GAAR

Contributed by: USDA NRCS Bridger Plant Materials Center, Montana

Gaillardia aristata Susan R. Winslow, Bridger Plant Materials Center

Alternate Names

Indian blanketflower, common gaillardia, gaillardia, brown-eyed Susan

Uses

Blanketflower is a native perennial wildflower useful for adding species diversity in native plant seed mixes for rehabilitation of disturbed sites. It can be used in producing native wildflower sod for restoration of native plant colonies (Airhart, 1988). Blanketflower is suitable for use as an ornamental wildflower in low maintenance or naturalistic landscapes. It has utility as a cover and food source for pollinators, wildlife, and livestock.

Status

Please consult the PLANTS Web site (USDA-NRCS, 2011) and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Description

General: Blanketflower *Gaillardia aristata* is a native, herbaceous perennial in the Aster family. *Gaillardia* was named in honor of Gaillard de Marentonneau, an 18th century French patron of botany (Bailey, 1929). The name *aristata* is derived from, *arist*, Latin for bristle, in reference to the hairy stems and leaves, and the awn-like bristles on the single-seeded fruit (achene). The blanketflower inflorescence is said to resemble the colorful, intricate patterns woven into blankets made by Native Americans (Kimball and Lesica, 2005). Blanketflower is found in grasslands, woodlands, and montane meadows. Its natural range extends from southern Canada on both sides of the Rocky Mountains, south to Utah, Colorado, and South Dakota (Strickler, 1993).

Taxonomy: Blanketflower is tap rooted, with one or commonly several, erect stems from the base (Hitchcock et al., 1955). The pubescent plant grows to a height of 26 inches with rough-hairy, lance-shaped, alternate leaves, 6 inches long, 1 inch wide, entire to coarsely-toothed, or rarely pinnately divided (Hermann, 1966). The flower heads are radiate, showy, solitary to few, with an outer series of ray flowers and an inner group of disk flowers. There are typically 13, sterile, 0.6 to 1.4 inches long, ligulate (strap-shaped), yellow ray flowers with purple bases (eFloras, 2011). The number and shape of the ray flowers is variable, as is the number of lobes in a ray (Robbins, 1908). A normal flower head has a large number of ligulate and tubular-shaped rays, with the latter shape being four-lobed. A few flower heads have all tubular rays. The purple, perfect (both stamens and pistil) disk flowers are 0.3 to 0.35 inch long, with long hairs at the top (Lesica, 2002). The overall appearance of the central disk flowers are said to resemble big, brown eyes, hence the alternative common name, brown-eyed Susan (Talk About Wildlife, 2011). The receptacle is convex to subglobose, with chaffy or sometimes soft, spine-like bristles that do not individually subtend the disk flowers (Hitchcock and Cronquist, 1973). The fruit is a one-seeded, gray-brown achene, 0.12 to 0.16 inch long, with densely ascending hairs, a short pappus crown 0.3 to 0.4 inch long, and awns approximately two times as long as the fruit body (Jepson Manual, 2011). The chromosome number for blanketflower is $2n = 34$ (Taylor and Brockman, 1966).

Distribution: The native range of blanketflower extends from south-central Canada to southern Colorado, east to the Dakotas and west to the Cascade Mountains of Washington and the Blue Mountains of Oregon (Marlowe and Hufford, 2007). For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Habitat: Blanketflower prefers dry, open spaces in prairies, mountain foothills, and along roadsides and railroad rights-of-way (Vance et al., 1999). It is a mid-successional species capable of growing in dense populations on disturbed sites (Taylor, 1992). Blanketflower is adapted to a wide range of well-drained soils and is drought tolerant. It grows well on dry to mesic, well-drained sites in areas receiving 10 to 30 inches of annual precipitation. Plant growth and development is dependent on site location, with a wide range of dates in emergence and floral initiation.

Adaptation

In Montana, presence of blanketflower has been documented in all 56 counties (Booth and Wright, 1959), including nine types of riparian plant communities (Hansen et al., 1995). It is an important component of several habitat types in western Montana (Hermann, 1966). Blanketflower is present in the mountain and foothill environments of more than half of the 23 counties in Wyoming (Rocky Mountain Herbarium, 2011). It does well on a variety of soil types, including loams to rocky to gravelly-sandy textures; and tolerates a soil pH range from slightly acidic to mildly alkaline (USDA-NRCS, 2003). Blanketflower attains optimum growth in full sun, beginning in early spring until seed set in late summer (Mueggler and Stewart, 1980). It occurs at elevations from 1,300 to 9,000 feet.

Establishment

Blanketflower may be grown from seed or division of vegetative parts. The seed does not require cold stratification treatment to break dormancy. For range plantings, seed should be planted into a firm, weed-free seedbed, preferably with a mechanical drill that will ensure uniform seed placement depth of ¼- to ½-inch. There are approximately 220,700 seeds in one pound of blanketflower. The full seeding rate is 5 pounds pure live seed per acre, but it would seldom be seeded as a pure stand. It is recommended that blanketflower be included as a component of a native seed mixture at a rate not to exceed ½ to 1 pound pure live seed per acre. When used in a mix, adjust the seeding rate to the desired percentage of mix. Spring seeding is preferred over late summer or dormant, fall planting dates.

Management

Blanketflower is tolerant to drought and requires supplemental moisture only during extended hot, dry conditions. Periodic mowing during the establishment year is one option for weed suppression.

Pests and Potential Problems

Blanketflower has no serious insect or disease problems. Root rot may be a problem in poorly drained soils, especially during extended periods of heavy rain. Powdery mildew may be present at times of elevated humidity, but usually does not have a long-term negative impact on the plants. The species generally is susceptible to aster yellows and fungal leaf spot disease (Missouri Botanical Garden, 2011). Gaillardia is slightly susceptible to oat blue dwarf virus (Brunt et al., 1996).

Environmental Concerns

Blanketflower plants tend to be moderately long-lived and may re-seed in abundance. A skin rash or irritation may develop following contact with juice or sap from the foliage (eNature, 2011).

Ecological Considerations

As global demand increases for drinking and irrigation water, there is concern over the excessive use of high water-consuming plants in residential and commercial landscapes (Proctor, 1996). Blanketflower is an attractive, showy, native wildflower that is tolerant of drought conditions within its range of adaptation (Curtis and Curtis, 1989). It is recommended for use as an ornamental specimen plant or a mass display in low watering zones of Xeriscape™ and waterwise gardens (Knopf, 1991). It may be irrigated using non-potable water with salinity levels up to 5.4 decisiemens per meter with minimal impact to the visual aesthetics of the plant (Niu et al., 2007). Blanketflower is considered deer-resistant due to the mature plant's unpalatable and rough-textured stems and leaves (Parkinson, 2003). Whitetail deer may lightly browse blanketflower to supplement dietary needs at different times of the year (Atwood, 1941). Low volatility of the leaf chemistry combined with high moisture content suggests blanketflower has low flammability and may be resistant to wildfire (Dennis, 2008). Percentage canopy cover of blanketflower, however, more than doubled following a wildfire (Antos et al., 1983). More than 30 hybrid varieties of several species of blanketflower have been developed for use in the commercial floriculture industry with the majority having landscape application in the southern regions of the United States. (Hammond, 2007).

Blanketflower in landscape garden

A wide variety of pollinators and beneficial insects rely on blanketflower as a food source of pollen and nectar, and for resting and cover. It is a common nectar source for the adult stage of the butterfly, Edwards fritillary *Speyeria edwards* (Opler, 2008). A cryptic moth, *Schinia masoni*, is color-camouflaged to mimic the yellow ray flowers and purplish-brown disk flowers of blanketflower as protection against predators (Ferner, 1981). Blanketflower is an indicator plant associated with the upland, dry prairie habitats of the Dakota skipper *Hesperia dacotae* Skinner (Cochrane and Delphey, 2002), a butterfly species petitioned as a candidate for listing under the Endangered Species Act (USDI-USFWS, 2008). In western North America, the widely distributed soft-winged flower beetle *Listrus senilis* is recognized as a crucial pollinator of blanketflower (Mawdsley, 2003). Blanketflower is a component of several northern grassland ecosystems where the breakdown of organic matter by functionally-important insects increased soil fertility and improved soil water-holding capacity and water infiltration (Hewitt and Burleson, 1976).

Honey bees visiting blanketflower

Indian tribes of North America long recognized the medicinal qualities of blanketflower and used it to treat many ailments (University of Michigan, 2011). The Blackfeet used infusions of roots and leaves to relieve upset stomachs and to treat saddle sores on horses (Larson and Johnson, 1999). Kiowas picked the flowers for good luck (Johnson and Larson, 1999). Blanketflower was one of the voucher specimens collected by Captain Meriwether Lewis along the Blackfoot River on July 7, 1806 (Phillips, 2003). Cancer studies on major plant groups determined blanketflower contained the sesquiterpene lactone agent, gaillardin, a tumor-killing (antineoplastic) compound (Lewis and Elvin-Lewis, 1977). There is evidence blanketflower contains substances with antibacterial properties (Harris, 1949). A skin rash or irritation may develop following contact with juice or sap from the foliage (Ferner, 1981).

The tender, young plant growth and insect-rich blooms of blanketflower are a potential food source for young and adult upland game birds, such as sage-grouse and sharp-tail grouse. Forage palatability of blanketflower is rated poor to fair for domestic livestock during early stages of growth. It is a mid-summer maturing species in sagebrush plant communities (Pitt and Wikeem, 1990). Blanketflower can be an indicator of range readiness, as it will begin to bloom when more desirable forage plants have reached the stage of growth where they are ready for grazing (WACD, 1987). Blanketflower was a highly selected forb by California bighorn sheep and comprised 2 percent of late-summer diet (Wikeem and Pitt, 1979). Gayton (2003) indicated grazing regime or local site conditions greatly influence re-growth in blanketflower. Its response to grazing and other disturbances can be indicators of successional trend and ecological integrity (Mueggler, 1983). Light grazing by domestic sheep did not noticeably affect the abundance of plants (Daubenmire, 1970). Tyrer et al. (2007) suggest early germination and establishment, and resistance to allelopathic chemicals, give *Gaillardia aristata* seedlings a considerable advantage over later germinating Russian knapweed *Acroptilon repens* (a noxious weed) seedlings. Callaway et al. (2004) found the biomass of spotted knapweed *Centaurea stoebe* ssp. *micranthos* (another noxious weed) was lower when grown in competition with *Gaillardia aristata*. Plant communities rich in perennial forb species such as blanketflower, may be more resistant to noxious weed invasion (Maron and Marler, 2007) and indigenous, deep-rooted, forb functional groups (of which *Gaillardia* is a member) capture soil moisture and nutrients making them less available for weed establishment (Pokorny, 2005).

Blanketflower seedheads

Seed and Plant Production

Blanketflower lends itself to agronomic seeding methods when planted at the appropriate time and rate (Norcini, 2006). Seed production fields should be established in rows at 25 pure live seeds per lineal foot of row. Between-row spacing is dependent on the type of planting and cultivation equipment, and ranges from 24 to 36 inches. Adequate between-row space should be provided to perform mechanical cultivation. At 24-inch row spacing, the recommended seeding rate is 2.5 pounds pure live seed per acre, and at 30- and 36-inch row spacing, the seeding rate is 2.2 and 1.9 pounds pure live seed per acre, respectively. There are presently no herbicides specifically labeled to control weeds in seed production fields of this species. Preliminary results in a wildflower seed production herbicide trial indicated effective weed control with the use of pendimethalin and a mix of pendimethalin and trifluralin (Wiese, 2009). Seed harvest can be accomplished by direct combining when the seeds have just begun to shatter from the radiate flowerhead. Immediately after combining, spread out harvested material to dry and prevent mold.

Meriwether Germplasm blanketflower seed production field, at the Bridger Plant Materials Center

Due to the persistent hairy pappus, and poor seed flow, this species is fairly difficult to clean. Seeds are moderately viable and longevity can be expected for several years when stored at favorable temperatures and low humidity. Meriwether Germplasm blanketflower yielded approximately 150 bulk pounds of seed per acre in experimental irrigated plots at the Bridger Plant Materials Center on an average harvest date of July 29. Seed production is expected to be much higher when grown under conventional agronomic conditions.

Blanketflower seed with bristly pappus

Cultivars, Improved, and Selected Materials (and area of origin)

Meriwether Germplasm Selected Class blanketflower was released in 2011 by the Bridger Plant Materials Center in cooperation with the agricultural experiment stations of Montana State University and the University of Wyoming. Meriwether Germplasm is a composite of seed collections from 14 Montana counties and one county in Wyoming.

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Prepared By

Susan R. Winslow
USDA-NRCS Plant Materials Center
Bridger, Montana

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For more information about this and other plants, please contact your local NRCS field office or Conservation District at http://www.nrcs.usda.gov/ and visit the PLANTS Web site at http://plants.usda.gov/ or the Plant Materials Program Web site http://plant-materials.nrcs.usda.gov.

United States Department of Agriculture

Natural Resources Conservation Service **Plant Guide**

Black-eyed Susan

Rudbeckia hirta L.

Plant Symbol = RUHI2

Common Names: brown eyed Susan, bristly coneflower, hairy coneflower, gloriosa daisy

Scientific Names: *Rudbeckia hirta* L. var. *hirta*

Figure 1. Black-eyed Susan in bloom. Photo credit: Larry Allain, US Geological Survey.

Description

General: Black-eyed Susan is a native, warm season forb in the Asteraceae family (Fig.1). Black-eyed Susan may be annual, biennial, or a short-lived perennial. The plant grows from a taproot which produces many stiff, coarse, upright pubescent stems 1 to 3 feet (0.3 to 0.9 m) tall (Tyrl et al., 2008). The alternately arranged basal leaves are up to 3 inches (7.5 cm) wide and 4 inches (10 cm) long and have either entire or slightly toothed margins. Each stem produces a solitary bloom up to 2.5 inches (6 cm) in diameter with eight to twenty yellow ray flowers around a flattish cone like structure (Ajilvsi, 2003). Black-eyed Susan blooms from summer through early fall (Ladybird Johnson Wildflower Center, 2019). The seeds or achenes are four sided, elliptical shaped, less than 5/64 inch (2 mm) long with no appendages or pappus (Tyrl et al., 2008).

Distribution: The *Rudbeckia* genus contains approximately 23 species in North America. *Rudbeckia hirta* is found throughout the United States (USDA NRCS, 2019). Within *Rudbeckia hirta*, there are four botanical varieties. *Rudbeckia hirta* var. *floridana* is found in Florida. *Rudbeckia hirta* var. *angustifolia* occurs in Texas and the southeastern US to North Carolina. *Rudbeckia hirta* var. *hirta* occurs in the eastern half of the US. *Rudbeckia hirta* var. *pulcherrina* is most widespread and found in all the continental US except Nevada and Arizona (USDA NRCS, 2019). For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Habitat: Black-eyed Susan is found in fields, pastures, prairies, open woodlands, along railroad tracks, roadsides, and abandoned areas (Ajilvsgi, 2003; Illinois Wildflowers, 2019). Associated plants include leadplant (*Amorpha canescens*), sawtooth sunflower (*Helianthus grosseserratus*), stiff sunflower (*Helianthus rigidus*), rattlesnake master (*Eryngium yuccifolium*), eastern red cedar (*Juniperus virginiana*), dewberry (*Rubus* sp.), chokecherry (*Prunus virginiana*), and flowering spurge (*Euphorbia corollate*) in tall grass prairie sites in Missouri and Illinois (Hurd and Christensen, 1975; Johnson and Anderson, 1986).

Adaptation

Black-eyed Susan is an early successional species adapted to clay, loam, and sandy soils (Tyrl et al., 2008). This forb prefers acidic soils less than 6.8 pH and grows well in full sun with slightly moist to moderately dry soil conditions (Ladybird Johnson Wildflower Center, 2019; Illinois Wildflowers, 2019).

Uses

Black-eyed Susan has poor to fair value for livestock (Tyrl et al., 2008). Dyksterhuis (1948) reported cattle grazed black-eyed Susan lightly in late April, heavily in May, and lightly in June, but was not grazed any other time.

Wildlife and pollinator insects use black-eyed Susan. White-tailed deer (*Odocoileus virginianus*) graze on the basal leaves in winter (Miller and Miller, 1999). Little Carpenter bees (*Ceratina* sp.), Leaf Cutting bees (*Megachile* sp.), and Green Metallic bees (*Agapostemon* sp.) collect pollen and nectar (Fig.2). Coneflower Miner bees (*Andrena rudbeckiae*) prefer *Rudbeckia* flowers (Illinois Wildflowers, 2019). Black-eyed Susan is a larval host for Silvery Checkerspot (*Chlosyne nycteis*) and Bordered Patch (*Chlosyne lacinia*) butterfly caterpillars and adult butterflies are attracted to the plant (Ladybird Johnson Wildflower Center, 2019). Bobwhite quail (*Colinus* sp.), wild turkey (*Meleagris gallopavo*), and songbirds eat its seeds (Tyrl et al., 2008).

Figure 2. Black-eyed Susan is a pollen and nectar source for bees and butterflies.

Ethnobotany
Native American Indian tribes utilized the entire black-eyed Susan plant. Yellow and green dyes were produced from the blooms (Ajilvsi, 2003). Derivatives from roots, stems, leaves, and florets were used to treat various ailments (Tyrl et al., 2008). The Cherokee prepared a leaf wash to heal swelling caused by worms. Sores were bathed with root infusions and earaches treated with root oozes. The Iroquois used root infusions to treat children with worms and a root decoction for heart medicine. The Potawatomi treated colds with root infusions (Moerman, 2015).

Figure **3**. A butterfly draws nectar from a black-eyed Susan bloom.

Status
Threatened or Endangered: Rudbeckia hirta is not threatened or endangered (US Fish and Wildlife Service, 2019).

Wetland Indicator: *Rudbeckia hirta* is a facultative upland (FACU) plant in the Northcentral and Northeast, Eastern Mountains and Piedmont, Atlantic and Gulf Coastal Plain, Midwest, Great Plains, Arid West, and Western Mountains, Valleys, and Coast regions of the United States. Facultative upland plants usually occur in non-wetlands but may also occur in wetlands (US Army Corps of Engineers, 2018).

Weedy or Invasive: This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not effectively managed. Please consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use.

Please consult the PLANTS Web site (http://plants.usda.gov/) and your state's Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Planting Guidelines
Plant black-eyed Susan is planted with a no-till drill, conventional drill equipped with a small seed or wildflower seed box, or broadcast seeding. Prepare a weed free seedbed using light tillage, herbicide applications for conventional and broadcast planting. Lightly disk or harrow to loosen the soil surface then roll or cultipack prior to seeding. A firm seedbed is needed as seedling emergence is poor in a fluffy seedbed (Grabowski, 2001). Use a seeding rate of 0.8 pure live seed (PLS) lb/acre when drill planting on 20 inch or less row spacing; 0.7 PLS lb/acre when drill planting on 21 to 40 inch row spacing; and 1 PLS lb/acre when broadcast seeding. Seed black-eyed Susan in mid-September through April (USDA NRCS, 2018). Place the seed ¼ inch (6mm) deep and leave the drill planter furrows open (Grabowski, 2001). Seed should be placed close to the soil surface then rolled or cultipacked after broadcast seeding to ensure good seed-to-soil contact.

Management
Clip wilted blooms of black-eyed Susan to promote blooming and/or reduce self-seeding (Missouri Botanical Garden, 2019). Black-eyed Susan eventually declines without soil disturbance. Disk the site every two to three years to control perennial weeds and promote black-eyed Susan germination (Burgess et al., 2010). Black-eyed Susan increased on pastures in fair or poor condition but was not observed in pastures in good or excellent condition (Dyksterhuis, 1948). Therefore, monitoring grazing and improving pasture condition are ways to control black-eyed Susan.

Pests and Potential Problems
Pests include aphids (*Aphididae* sp.) which suck plant sap and produce a sticky honeydew. Diseases include downy mildew (*Sclerospora* sp.) which attacks seedlings and produces light yellow spots on foliage, powdery mildew (*Erysiphe* sp.) that

produces a white growth on leaves, and white smut (*Entyloma* sp.) that causes light spots on leaves. Destroy plant material affected by white smut (Gilman and Howe, 1999).

Environmental Concerns
Black-eyed Susan is considered a desirable plant within its native range and has no known detrimental effects on the environment.

Control
Black-eyed Susan can be controlled by mechanical means such as mowing or applying a broad-spectrum herbicide. Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Control measures appear in this document only to provide specific information.

Seeds and Plant Production
Prepare a weed free seedbed using tillage and/or herbicide application. Prior to planting, the seedbed must be firmed and accumulated moisture for improved establishment success. Direct sow using a no-till drill, conventional drill with small seed or wildflower box, or broadcast seed. Refer to *Planting Guidelines* for appropriate seeding rate based on row spacing and seeding method, and plant in mid-September through April (USDA NRCS, 2018). When broadcast seeding, mix the seed with a carrier such as cat litter or coarse sand to improve seed distribution and help prevent planting at too high a rate. Roll or cultipack the planting site to ensure good seed-to-soil contact after planting. Black-eyed seedlings emerge in fall, overwinter as rosettes, and begin rapid spring growth. Apply 20-30 lb/acre N in the spring to aid plant growth and development. Avoid cultivating plants in rows as they do not tolerate root disturbance or soil deposited on them from the field cultivator (Grabowski, 2005).

Figure 4. Signs of maturing Rudbeckia seed heads include dried ray flowers and a brown, woolly appearance.

Sometimes fall planted seeds germinate the following spring. Spring germination causes the plants to flower sporadically and reduces seed harvest. If this occurs, leave the plants to mature, produce seed, and then mow to improve the stand. Harvest seed the following year (Grabowski, 2001).

Harvest seed in mid-summer using a combine equipped with a slow speed fan. Black-eyed Susan ripens indeterminately; therefore, seed harvest should be completed when most of the seed heads are mature. Harvest seed soon after the seed heads are brown and woolly in appearance but before shattering (Figure 3). Air dry and scalp the harvested material. Use a seed cleaner with air adjustments and separation screens to remove chaff and unfilled seed. Recommended screen sizes are 1/16 or 1/18 round hole for top screens and 36 x 36 or 6 x 36 wire mesh screen for the bottom to remove fine material and sand (Grabowski, 2005).

Figure 5. *Rudbeckia hirta* seeds are small and four sided. Photo credit: Steve Hurst, ARS Systematic Botany and Mycology Laboratory, hosted by the USDA-NRCS PLANTS Database.

Cleaned seed (Fig. 4) yields range from 20 to 30 lb/acre at the USDA NRCS Jamie L. Whitten Plant Materials Center in Coffeeville, MS (MSPMC). Seed purity varied from 57% to 82% and seed germination ranged from 22% to 90%. Seeds remained viable up to five years in controlled storage conditions of 55°F and 45% relative humidity (Grabowski, 2001). Phillips (1985) mentions the seeds have no prolonged dormancy and Andersen (1968) notes they require no pretreatment for germination.

Start black-eyed Susan transplants in the greenhouse. Direct sow into individual planting tray cells filled with sterile growing media. After sowing, cover the seeds with a thin layer of growing media and lightly water. Place the trays in a greenhouse set at 65°F-70°F daytime temperature and 55°F nighttime temperature (Butler and Frieswyk, 2001). Seed should germinate and emerge in approximately two weeks after planting. Thin to obtain one vigorous seedling. Keep growing media moist but not overwater because the plants are vulnerable to damping off or rot if overwatered (Phillips, 1985). Grow the transplants in the greenhouse until they develop a firm, fibrous root plug. Then move the plant trays to a shade house and harden off for one to two weeks before transplanting outside.

Cultivars, Improved, and Selected Materials (and area of origin)

Black-eyed Susan seed and plants are available commercially. Cultivars should be selected based on local climate, resistance to local pests, and intended use. Consult with your local land grant university, local agricultural or horticultural extension agent, or local USDA NRCS office for recommendations on adapted cultivars for use in your area**.**

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For more information about this and other plants, please contact your local NRCS field office or Conservation District at http://www.nrcs.usda.gov/ and visit the PLANTS Web site at http://plants.usda.gov/ or the Plant Materials Program web site: http://plant-materials.nrcs.usda.gov.

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NATURAL RESOURCES CONSERVATION SERVICE
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PLANT MATERIALS TECHNICAL NOTE

SUNFLOWER
Helianthus L.

Native Sunflowers for Conservation Use in Montana and Wyoming

Susan R. Winslow, Agronomist, NRCS Plant Materials Center, Bridger, Montana

Common sunflower

General Description

There are many members of the Aster Family (Asteraceae) casually referred to as sunflowers because of their showy, yellow flowers. True sunflowers belong to the genus *Helianthus* and are divided in two groups, those growing under cultivation or in the wild. Cultivated varieties are hybrids of the native annual, common sunflower, and are used as food or ornamental crops. In the wild, annual and perennial sunflowers grow in a wide variety of shapes and sizes in diverse environments across the United States and Canada. There are 52 *Helianthus* sunflower species native to North America—14 annuals and 38 perennials.

Wild sunflowers are warm-season plants with active growth periods from mid-summer to early fall. They produce several small-headed yellow inflorescences per stalk with each head composed (the Aster Family was formerly called the Composite Family) of two different types of florets—an outer ring of yellow ray flowers (sterile bracts) surrounding numerous very small brown disk flowers (fertile florets that produce seed). A distinguishing characteristic in *Helianthus* is two awn-like appendages (pappi) borne at the end of the disk flowers that easily detach or fall off at maturity. The achene-like fruit of a sunflower is called a cypsela and contained within is a single seed.

Sunflowers are difficult to identify due to ecologic adaptability (plasticity) and multiple sets of chromosomes (polyploidy) with $2n$ = 34, 51, 68, or 102, resulting in inter-specific hybridization. Of the six species in Montana and seven species in Wyoming, one annual and three perennials have utility in restoration and conservation seeding projects.

Common sunflower *Helianthus annuus*, also called annual sunflower, is a showy annual found in open disturbed areas, and along roadsides, ditches, and field edges in dry to moderately moist soils. It grows 1 to 6 feet tall with stout, coarse, and branching stems. The rough leaves are arranged alternately along the stem, broadly heart-shaped at the base, and 2 to 10 inches long. The flowers are borne at the end of a branched stem. The orange-yellow ray flowers are 1 to 2 inches long and the reddish brown disk is up to 2 inches across. The number of chromosomes is $2n = 34$ (diploid). Common sunflower readily hybridizes with other annual and perennial sunflowers, including prairie sunflower *Helianthus petiolaris* and Jerusalem artichoke *Helianthus tuberosus.*

Maximilian sunflower *Helianthus maximiliani* is a tall and robust perennial, with short rhizomes and fibrous roots adapted to deep clay loam to sandy loam soils. It grows 3 to 8 feet tall with single or loosely clustered, stout, white-hairy stems. The leaves are arranged alternately along the stem, 3 to 6 inches long, 0.4 to 1 inch wide, lance-shaped with somewhat wavy margins to a sharp tip, and often rigidly folded downward in a trough shape. The deep yellow ray flowers are 1 to 1½ inches long and the yellowish-brown disk is up to 1 inch across. The number of chromosomes is $2n = 34$ (diploid). Hybrids of Maximilian sunflower and common sunflower are sterile. Maximilian sunflower will hybridize with stiff sunflower and Jerusalem artichoke (also native to Montana and Wyoming) as shown in plant breeding trials conducted by Cox et al. (2010).


Common sunflower (*left*) and Maximilian sunflower (*right*)

Stiff sunflower *Helianthus pauciflorus,* also called rigid sunflower, is an erect, single stemmed, strongly rhizomatous perennial adapted to upland range sites with silty, shallow, or thin soil. It grows 1 to 4 feet tall in dense colonies and is often found on sandy sites. The single stems are commonly reddish and branched above in the inflorescence. The stiff, dark green leaves are mostly arranged opposite along the stem, lance to oval in shape, 2 to 8 inches long with three prominent ribs, leathery textured, and rough on both sides with serrated to entire margins. The yellow ray flowers are up to 1.5 inches long and the dark brown disk is up to 1 inch across. The number of chromosomes is $2n = 102$ (hexaploid). Stiff sunflower readily hybridizes with many sunflowers, including Jerusalem artichoke. The hybrid, cheerful sunflower *Helianthus* x *laetiflorus,* is commonly cultivated.

Littleflower sunflower *Helianthus pumilus,* also called dwarf sunflower, is a perennial found growing naturally on dry, rocky sites in the plains and mountains of central and southeastern Wyoming and central Colorado, and is adapted to many sites including those found in Montana. It grows 1 to 3 feet tall and plants are rough and hairy throughout. There are 5 to 7 pairs of ashy-green leaves arranged opposite along the stem, each leaf 1.5 to 6 inches long by 0.4 to 2 inches wide. The rounded yellow ray flowers are generally less than 1 inch long with glandular dots on the lower surface and the yellow or light brownish disk is approximately 0.5 inch across. The number of chromosomes is 2*n* = 34 (diploid).

Stiff sunflower (*left*) and Littleflower sunflower (*right*)

Adaptation or Range

Sunflowers are common in the United States and Canada, ranging south from Saskatchewan to Texas and east from the Great Basin to the Great Plains. Littleflower sunflower is considered an endemic species in Wyoming and Colorado. Sunflowers are very adaptable and grow on a wide variety of soils and habitat types. They require full sun, are moderately resistant to drought, and all but common sunflower are tolerant, when dormant, of wildfire. The foliage is a palatable source of food for livestock and wildlife. In general, the perennial sunflowers may be found growing in association with big bluestem *Andropogon gerardii,* little bluestem *Schizachryium scoparium*, switchgrass *Panicum virgatum*, yellow Indiangrass *Sorghastrum nutans*, purple prairieclover *Dalea purpurea*, scurfpea *Pediomelum* and *Psoralidium*, and dotted blazing star *Liatris punctata.*

In Montana, common sunflower is adapted to a wide range of soil types and precipitation zones at elevations of 2,300 feet to 5,000 feet. It is present as an ephemeral annual component on many ecological sites and is likely found in all of the Major Land Resource Areas (MLRAs). Common sunflower is known to inhabit at least 37 of the 56 counties in Montana.

In Wyoming, common sunflower is found growing on a wide range of soil types and precipitation zones at elevations of 3,200 feet to 6,600 feet. It is present as an ephemeral annual component on many ecological sites and is likely found in all of the MLRAs, with the possible exception of 47. Common sunflower is known to inhabit at least 19 of the 23 counties in Wyoming.

In Montana, Maximilian sunflower grows well on deep upland soils and heavier lowland soils in areas receiving a minimum 10 inches of average annual precipitation at elevations of 2,200 feet to 4,000 feet. It is present as a long-lived perennial on ecological sites in MLRAs 52, 53A, 58A, and 60B. Maximilian sunflower is known to inhabit at least 15 of the 56 counties in Montana.

In a field planting near Jordan, Montana (MLRA 58A, 10 to 12 inches average annual precipitation, (Floweree and Lonna silt loam soils), when Maximilian sunflower was harvested in a fall-dormant state, it contained adequate levels of crude protein, energy, and minerals to maintain a moderate level of performance in most ruminant animals. When harvested in the active growing stage, it provided higher levels of energy and crude protein than dormant plants, but lower levels of minerals for moderate animal performance. Forage quality values are reported in Table 1.

In a 2014 field planting near Bozeman, Montana (MLRA 43A, 15 to 19 inches average annual precipitation on Sourdough loam soil), Medicine Creek Germplasm Maximilian sunflower had "good" establishment and excellent vigor**.** It grew to a flowering height of 2 to 3 feet the first year of the planting.

In Wyoming, Maximilian sunflower is adapted to deep upland soils and heavier lowland soils in areas receiving a minimum 14 inches of average annual precipitation at elevations of 3,500 feet to 6,000 feet. It is present as a long-lived perennial on ecological sites in MLRAs 58B, 60A, 60B, 61, 64, and 67A. Maximilian sunflower is known to inhabit at least 6 of the 23 counties in Wyoming.

In Montana, stiff sunflower grows well on medium- to coarse-textured soils on dry hillsides and ridge tops in areas receiving a minimum of 13 inches of average annual precipitation at elevations of 3,000 feet to 5,000 feet. It is present as a long-lived perennial on ecological sites in MLRAs 43B, 44, 52, 53A, 58A, and 60B. Stiff sunflower is known to inhabit at least 13 of the 56 counties in Montana.

In the field planting mentioned above near Jordan, Montana, when stiff sunflower was harvested in a fall-dormant state, it did not provide enough crude protein to maintain rumen function in livestock. Energy and mineral content of both active and dormant plants was adequate for low levels of animal performance but was lower than Maximilian sunflower. Forage quality values are reported in Table 1.

Table 1. Forage quality values for Maximilian and stiff sunflower harvested during active and dormant growth stages. Jordan, Montana, 2000-2001.

	Maximilian sunflower		**Stiff sunflower**	
	Active	**Dormant**	**Active**	**Dormant**
Dry matter %	19.6	79.0	28.0	67.8
Crude protein %	16.4	9.6	12.1	5.3
Acid detergent fiber %	29.9	33.7	29.6	34.5
Total digestive nutrients %	51.8	64.2	60.1	62.8
Net energy lactation MCal[†]	0.71	0.66	0.72	0.63
Net energy maintenance MCal	0.66	0.64	0.59	0.61
Net energy gain MCal	0.54	0.37	0.35	0.33
Sulfur %	0.54	0.21	0.18	0.12
Phosphorus %	0.39	0.24	0.21	0.17
Potassium %	3.94	1.68	2.77	2.45
Magnesium %	0.42	0.42	0.61	0.39
Sodium %	0.01	0.02	0.01	0.01
Calcium %	2.59	3.01	2.08	2.16
Iron PPM[‡]	992	227	933	105
Manganese PPM[‡]	106	87	99	68
Copper PPM	25	8	18	4
Zinc PPM	93	95	42	85

[†] Mega-calories per pound; [‡] Parts per million.

In Wyoming, stiff sunflower is adapted to medium- to coarse-textured soils on dry hillsides, ridge tops, and ravines in areas receiving a minimum of 13 inches of average annual precipitation at elevations of 3,700 feet to 5,000 feet. It is present as a long-lived perennial on ecological sites in MLRAs 58B, 60A, 60B, 62, and 67A. Stiff sunflower is known to inhabit at least 6 of the 23 counties in Wyoming.

In Montana, littleflower sunflower is not a component of native plant communities. It has been grown successfully on sites in Carbon and Custer Counties (MLRA 32 and 58A, respectively).

In Wyoming, littleflower sunflower is adapted to medium- to coarse-textured soils on gravelly and siltstone hills, sandy ridges, and stony knolls in areas receiving a minimum of 11 inches of average annual precipitation at elevations of 3,400 feet to 7,660 feet. It is present as a long-lived perennial on ecological sites in MLRAs 43B, 49, 58B, and 67A. Littleflower sunflower is known to inhabit at least 9 of the 23 counties in Wyoming.

Conservation Uses

Sunflowers are used as a forb component in the reclamation of drastically disturbed lands, range renovation projects, and numerous conservation practices, such as pollinator habitat, conservation cover, range and critical area plantings, and restoration and management of rare and declining habitats. The seeds are a very good food source for many species of birds and animals. Sunflowers can be included in many seeding mixtures for creating and enhancing habitat for upland game birds. Sunflower stalks are used for silage and feed for livestock and poultry. Maximilian and stiff sunflower are readily eaten and rarely found in pastures that are continually over-grazed. They are used in landscapes as border and screen plantings and in containers as showy ornamentals. Sunflowers are drought tolerant and suitable for use in water-efficient (Xeriscape™) gardens.

Cultural Uses

Common sunflower is an important crop grown globally for production of cut flowers, vegetable oil, fuel, commercial fiber, and seeds for snacks and bird food. Sunflowers have historically been used by humans as a nutritious food source, a medicinal treatment for many ailments, and as a dye for body paint and coloring basketry. Native Americans boiled and ate flower buds and raw seeds. Drinking an infusion of the plant alleviated rheumatism, soothed chest pain, and stimulated appetite. Purple, black, and yellow dyes were made by boiling different parts of the plant.

Honey bee foraging for nectar and pollen on littleflower sunflower

Ease of Establishment

Sunflowers are easy to establish by direct seeding. Seedling vigor is good in annual and perennial sunflowers with many plants flowering the year of establishment.

Medicine Creek Germplasm Maximilian sunflower seedling

Planting Rates (all recommended amounts based on pure live seed [PLS]).

As a guideline, full stand drill seeding rates are based on 12-inch wide row spacing as shown for four sunflowers in Table 2. Forbs are seldom seeded in a pure stand, and in native seed mixtures rates are adjusted as a percentage of the mix and in general are ¼ to ½ pound PLS per acre. Seeding rates vary by planting method (drill versus broadcast) and site condition (non-critical versus critical area), refer to Plant Materials Technical Note, MT-46 for more information (Majerus et al., 2013). Critical areas are highly disturbed, highly erodible, and/or have physical, chemical, or biological conditions that prevent establishment with normal practices. Seeding rates for four sunflowers as determined by planting method and site condition are shown in Table 3. Wildland collected and field-produced seed is commercially available and cost is dependent on supply and demand.

Table 2. Seeding rates for conservation plantings of four species of sunflower *Helianthus*.

Common Name	**Seeds/lb**†	**Seeding Date**	**Seeds/ft**‡	**Full Stand Rate**§	
			1 lb PLS/ac	***PLS/ft²***	***lb PLS/ac***
Common sunflower	53,000	spring/summer	1.2	10.0	8.2
Maximilian sunflower¶	250,000	spring/fall dormant	5.7	5.7	1.0
Stiff sunflower¶	85,000	spring/fall dormant	0.5	5.0	2.5
Littleflower sunflower	200,000	fall dormant	5.0	25	5.4

† Number of pure live seeds (PLS) per pound; ‡ number of PLS per linear or square foot at 1 pound PLS/acre seeding rate; § full stand drill seeding rate in PLS pounds per acre at 12-inch between rows; and ¶ USDA-NRCS North Dakota Field Office Technical Guide.

Table 3. Seeding rates for four species of sunflower *Helianthus* as determined by planting method and site condition.

Common Name	**Non-Critical Drilled**	**Non-Critical Broadcast**¶	**Critical Area Drilled**¶	**Critical Area Broadcast**‡
	lb PLS/ac	***lb PLS/ac***	***lb PLS/ac***	***lb PLS/ac***
Common sunflower	8.2	16.4	16.4	32.8
Maximilian sunflower	1.0	2.0	2.0	4.0
Stiff sunflower	2.5	5.0	5.0	10.0
Littleflower sunflower	5.4	10.8	10.8	21.6

¶ Multiply the non-critical drill rate times 2; ‡ multiply the non-critical drill rate times 4.

Stand Establishment

For best results, seed should be planted into a firm, weed-free seedbed in early spring after the soil has warmed up to at least 45° Fahrenheit or as a dormant seeding in late fall (see Table 2). It is recommended seeding be done with a drill that will ensure a uniform seeding depth. The seeding depth of common sunflower is ¼- to 1-inch, whereas the seeding depth of perennial sunflowers is ¼- to ½-inch. Seeding a forb component in alternate rows, or cross-planting (forb in one direction and grass in the other) may ensure better forb establishment. Common sunflower sets seed and will volunteer profusely the second year. It is considered competitive at high levels of establishment. Medicine Creek Germplasm and 'Prairie Gold' attained flowering heights of greater than 8 feet under irrigated conditions at the USDA-NRCS Plant Materials Center in Bridger, Montana. Medicine Creek began prolific flowering as early as mid-July, with seeds maturing in early September. Prairie Gold began prolific flowering in mid-August, but seeds did not ripen before the onset of freezing temperatures in late summer to early fall.

Prairie Gold (*left*) and Medicine Creek Germplasm (*right*), August 6, 2014, Bridger, Montana

Seed Production

Seed production specifications for four species of sunflower are shown in Table 4. Between-row spacing is dependent on the species and the type of planting and cultivation equipment used, and ranges from 24 to 42 inches. Sunflowers are sensitive to fertilizer salts. Direct combine when the back portion of the head turns brown. Maximilian sunflower can be mowed early in the season to keep plants shorter for ease of harvest.

Table 4. Seed production specifications for four species of sunflower *Helianthus*.

Common Name	**Row Spacing** *inches or feet*	**Seeding Rate** *PLS/ft²*	*lb PLS/ac*	**Irrigated Seed Yield** *lb PLS/ac*
Common sunflower	24 to 36 inches	25	10.3 to 6.8	100 to 200 (estimated)
Maximilian sunflower†	42 inches	10/linear feet	0.50	75 to 150
Stiff sunflower†	24 to 36 inches	15	3.8 to 2.6	75 to 150
Littleflower sunflower	24 to 36 inches	25	2.7 to 1.8	40 to 50 (bulk)

† Duckwitz, W., personal communication.

Limitations

Sunflowers are affected by many diseases, including but not limited to: bacterial infections from leaf spot *Pseudomonas*, head and stem rot *Erwinia,* and crown gall *Agrobacterium*; and fungal infections from rusts *Puccinia helianthi*, gray mold *Botrytis*, leaf spots *Alternaria*, and downy mildew *Plasmopara*. Seed crops are subject to shatter and are preyed upon by birds and insects such as the banded sunflower moth *Cochylis hospes*, seed maggot *Neotephritis finalis*, and headclipping weevil *Haplorhynchites aeneus*. Common sunflower is considered weedy and invasive.

Releases

There are hundreds of hybrid varieties of common sunflower for various uses.

There are two releases of Maximilian sunflower suitable for use in Montana and Wyoming. Prairie Gold (Kansas origin) was released in 1978 from the USDA-NRCS Plant Materials Center in Manhattan, Kansas, in cooperation with the Nebraska Agricultural Experiment Station. Prairie Gold is used in critical area reseedings and wildlife food plantings. Medicine Creek Germplasm (South Dakota origin) was released in 2000 from the USDA-NRCS Plant Materials Center in Bismarck, North Dakota, in cooperation with Agricultural Experiment Stations in North and South Dakota and Minnesota. Medicine Creek Germplasm is used in range and pasture seedings, wildlife habitat enhancement, prairie restoration and landscaping, hedge or screen plantings, and has potential for use in filter strips.

Bismarck Germplasm stiff sunflower was released in 2000 from the USDA-NRCS Plant Materials Center in Bismarck, North Dakota (North Dakota origin) in cooperation with Agricultural Experiment Stations in North and South Dakota and Minnesota. Bismarck Germplasm stiff sunflower is used in prairie restoration, native landscaping, and range improvement projects.

Medicine Creek Germplasm Maximilian sunflower first-year establishment

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United States Department of Agriculture

A Conservation Plant Released by the Natural Resources Conservation Service
Los Lunas Plant Materials Center, Los Lunas, NM

‘Salado’ alkali sacaton

Sporobolus airoides (Torr.) Torr.

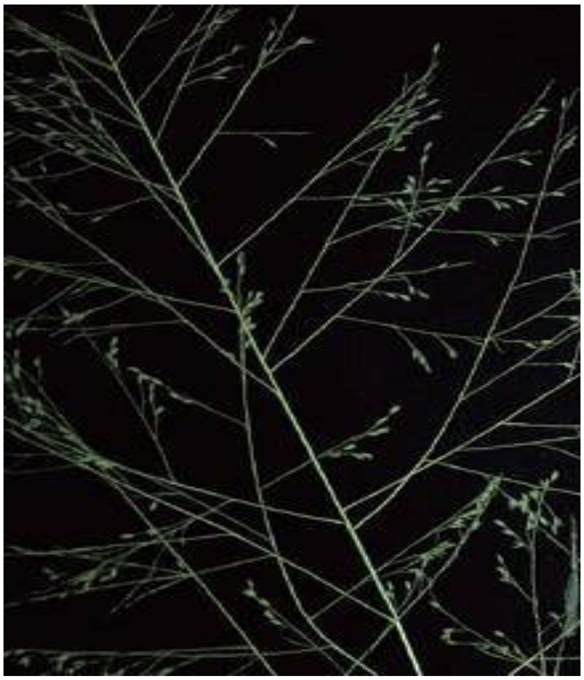

Photo courtesy of R. Mohlenbrock
USDA,NRCS,Wetland Sciences Institute
@PLANTS

‘Salado’ alkali sacaton (*Sporobolus airoides* (Torr.) Torr.) was released in January 1983 by the New Mexico State University Los Lunas Agricultural Science Center and the USDA-Natural Resources Conservation Service Los Lunas Plant Materials Center.

Salado alkali sacaton was selected as an improved cultivar in 1966 after comparing it with other accessions of alkali sacaton. Seed from the original collection was used to establish a seed increase field, and during the years between 1958 and 1966, was evaluated for seedling vigor, establishment, and forage and seed production.

Description

Salado alkali sacaton is a native, perennial, warm- season bunchgrass. The culms are erect, spreading 20 to 40 inches tall; sheaths pilose at the throat; ligule pilose, leaf blades elongate flat becoming involute, usually less than 0.2 in. wide. Often flexuous, the panicle is nearly half the entire height of the plant and at maturity, one-halfto two-thirds as wide. The stiff, slender branches and branchlets spread wildly, are naked at the base, and the spikelets aggregate along the upper one-half to two-thirds of the plant and are 0.75 inches long. The glume is about half as long and commonly falls toward maturity.

Source

Seed was collected in 1958 from a shallow upland range site at an elevation of 5,900 ft. located 7.5 miles south of Claunch, New Mexico. The average annual precipitation in this area is approximately 12 inches.

Conservation Uses

Salado alkali sacaton is a good source of forage or as pasture grass in lowlands and in alkali regions. It is useful for range improvement, mined land reclamations, highway revegetation, and forage production on most arid lands in the West.

Area of Adaptation and Use

Salado alkali sacaton is adapted at elevations of 1,600 to 8,200 ft. It is adapted to moderately alkaline soils of bottomlands and flats, on sandy plateaus and washes, and on light- to heavy- textured soils. It is common along drainage areas in arid and semi-arid regions.

Establishment and Management for Conservation Plantings

Salado alkali sacaton reproduces from seeds and tillers. The seeds remain viable for years and germinate without being scarified. Plant seeds in the spring when soil temperature is near 86°F and precipitation probabilities are the greatest. The plants can survive on 12 to 18 inches of precipitation per year.

Ecological Considerations

Alkali sacaton is considered a primary or secondary invader on saline soils. The plant intrudes directly on saline flats or follows a stage where “succulent” plants are dominant.

Seed and Plant Production

For successful establishment, sufficient moisture is needed within four weeks of seeding due to small seed size. Plant in rows 36-42 inches apart and at a rate of 0.25 to 0.50 pure live seed (PLS) lbs per acre. Excellent production can be expected the first five years, after which production appears erratic. Yields have ranged from 50 to 328 PLS lbs/ac. Multiple insecticide applications are beneficial for maximum seed production.

Availability
Breeder and foundation seed of Salado alkali sacaton is produced and maintained at the Los Lunas Plant Materials Center. Seed is available to certified growers through New Mexico State University Seed Certification.

For more information, contact:
Los Lunas Plant Materials Center
1036 Miller Road
Los Lunas, NM 87031
Tele: 505-865-7340
FAX: 505-865-5163
https://www.plant-materials.nrcs.usda.gov/nmpmc

Citation

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For additional information about this and other plants, please contact your local USDA Service Center, NRCS field office, or Conservation District <http://www.nrcs.usda.gov/>, and visit the PLANTS Web site <http://plants.usda.gov> or the Plant Materials Program Web site <http://www.plant-materials.nrcs.usda.gov>

United States Department of Agriculture

This is a joint release between New Mexico State University's Los Lunas Agricultural Science Center and the USDA Natural Resources Conservation Service Los Lunas Plant Materials Center.