

SITE-SPECIFIC QUALITY ASSURANCE & QUALITY CONTROL AUDIT

Permit Closure Type – Final



PERMIT CLOSURE REPORT – RANGELAND

Location ID 331413

Location Name DOW-65N63W/28SWNE

Report Date

31 May 2023

Soil Sage has conducted a thorough data audit as part of our Quality Assurance and Quality Control (QA/QC) protocols. The audit revealed this site has gone through a land use change.

Initial Job Assignment

Client	CIVITAS Resources
Work Assignment	CPW Centennial Valley State Wildlife Area Reclamation Report
Date	April 26, 2023

Quality Assurance & Quality Control Audit

Auditor	Soil Sage
Audit Date	05/02/2023

Audit Methodology

The following source materials were consulted during the QA and QC audit process:

- ✓ Site Permit Closures provided by CIVITAS Resources
- ✓ Colorado Oil & Gas Information System – COGIS Database
- ✓ On-site Evaluation and Proprietary Soil Sage Drone Imagery data collection
- ✓ Review of legacy imagery for site location and facility parameters

All pertinent data, imagery, and materials are included at the end of this report.

Site Description

Name	DOW-65N63W/28SWNE		
Location ID	331413		
Operator / #	BONANZA CREEK ENERGY OPERATING COMPANY LLC / 8960		
Field	WATTENBERG 90750		
County, State	WELD		
Lat/Long	40.372030 / -104.437750		
	Planned Location	X	As Drilled
Facility Status	CL	Location	SWNE 28 5N63W
Facility Status Date	06/24/2019	Access Road	Oil and Gas Access
Facility Entities	X	Tank Battery	Pits
	X	Wells	X Off-Location Flowlines (Form 44)
		Domestic Taps	X On-Location Flowlines (Form 42)
Equipment Remaining on Site	X	None	Debris or Non-Oil & Gas
	List of Equipment:		
Environment Incidents & Remediation		None	X Spill or Release (Form 19)
	X	Remediation (Form 27/27A)	
Inspection Corrective Actions (CA)s	<p>Corrective Actions (CA)s were detected during the QA & QC Audit.</p> <p>CA Overall Status: 1 of 1 CAs have not been completed</p> <p>Originating Field Inspection Doc # & Date: 697504610 & 04/28/2023</p> <ul style="list-style-type: none"> See "Field Inspection Form" section of this report below for details. <p>Complete COGCC Inspection Search Results: Link</p>		
Sundry Notice (Form 4)	Form 4s exist for Related Facilities – See individual scout card data for report details.		
On Location Flowlines (Form 42)	Form 42s exist for Related Facilities – See individual scout card data for report details.		
Off-Location Flowlines (Form 44)	No Form 44s were detected during the QA & QC Audit.		
Site Investigation and Remediation Workplan (Form 27/27A)	<p>Remediation Project #: 8826</p> <p>Form 27A Supplemental Docs # & Date: 200420236 & 10/27/2015</p> <ul style="list-style-type: none"> Purpose: Operator requested No Further Action following approved remediation activities (Doc # 400758956 on 12/24/2014). No Further Action Request Approved: 10/27/2015 by Rick Allison Correspondence Doc # & Date: 2315718 Final Resolution: Case Resolved on 10/27/2015 		

	<p>Form 27 Initial Doc# & Date: 2313479 & 11/21/2014</p> <ul style="list-style-type: none"> ○ Purpose: A Form 19 (Doc # 400639217) was submitted on 07/03/2014. Approximately 810 cubic yards of impacted soil and approximately 1,270 bbls of groundwater were removed during excavation activities. The excavation was backfilled with clean soil. Excavation activities and soil and groundwater analytical results are summarized. ○ Operator Comments: The Bonanza Creek production facility remains at the site. The excavation area was backfilled with clean soil and restored to its pre-release grade. As the release occurred within the footprint of the tank battery facility, reclamation is not necessary.
Spill or Release (Form 19)	<p>Spill or Release FACILITY ID: 437971</p> <ul style="list-style-type: none"> ○ Status & Date: 07/03/2014 ○ Lat/Long: 40.373052 / -104.437189 <p>Form 19 Resolving Doc # & Date: 400758956 & 12/24/2014</p> <ul style="list-style-type: none"> ○ Date Closed: 12/24/2014 ○ Request for Closure: Work is proceeding under an approved Form 27 Remediation Workplan. ○ Remediation Project #: 8826 (see Site Investigation and Remediation Workplan section of this report below for details). <p>Form 19 Initial Doc # & Date: 400639217 & 07/04/2014</p> <ul style="list-style-type: none"> ○ Date of Discovery: 07/02/2014 ○ Spill Type: Recent Spill ○ Reference Location Facility ID & Type: Tank Battery at 331413 ○ Operator: BONANZA CREEK ENERGY OPERATING COMPANY LLC ○ Operator Comments – A separator dumphine failed resulting in a release of oil, approximately 5 bbls The well site was shut in, liquids were removed by a vac truck and impacted soil is currently being excavated.
Field Inspection Form (Form INSP)	<p>Form INSP Doc # & Date: 697504610 & 04/28/2023</p> <ul style="list-style-type: none"> ○ Status Summary: Follow Up Inspection Required, Corrective Action Response Requested ○ Inspected Facilities: Well DOW #32-38, access road, and Off-Site Tank Battery ○ Inspection Status: RI – Reclamation Inspection (Final) ○ Inspection Date & Inspector: 04/20/2023 by Chris Binschus

	<ul style="list-style-type: none"> ○ Complaint #: 403379491 ○ Nature of Complaint: CPW (landowner) had concerns about failed reclamation that was previously performed by BONANZA CREEK approximately three years ago. ○ Comments: The well location and offsite tank battery consisted mostly of weeds with little perennial vegetation that is not reflective of reference areas. Bare soil was more prevalent along the main access road. Refer to the attached photos. Due to the lack of desirable vegetation establishment, COGCC is requiring soil sampling. Operator shall take samples along portions of the failed reclamation and background reference samples for comparison. Operator shall take discrete samples at six (6) inches intervals to a minimum depth of two (2) feet. See COGCC Comments Section for details on analytics. Note- Operator may need to install temporary fencing to facilitate on-going grazing operations. ○ Corrective Action: Comply with Rule 1004 to conduct additional reclamation. For soil samples, submit results via Form 4 Sundry Notice to the attention of Chris Binschus no later than two weeks after receiving results. Soil samples shall be overlaid on an aerial map depicting where soil sample locations and reference samples were taken. ○ CA Dates: 04/20/2023 ○ Overall Final Reclamation: Fail ○ Attachments: Inspection Photos Doc # 697504614
COGIS Tank Facilities Information (Scout Card)	<p>No Tank Battery Documents were detected in the QA/QC Audit.</p> <p>However, this off-site Tank Battery for is referenced in the Final Reclamation Inspection listed above in the “Field Inspection Form” section of this report.</p> <p>Note: The Tank Battery is also the site of the oil spill as referenced in the Spill or Release section of this report above (lat/long coordinates: 40.373052 / -104.437189).</p>
COGIS Well Information (Scout Card)	<p>Well Name: DOW #32-28</p> <p>API#: 05-123-20656</p> <p>FACILITY ID: 261886</p> <ul style="list-style-type: none"> ○ Status & Date: PA & 06/24/2019 ○ Lat/Long As Drilled: 40.372030 / -104.437750 ○ Form 6 Subsequent Doc # & Date: 402089957 & 08/11/2020 ○ Form 42 Doc # & Date: 402463321 & 08/10/2020

	<p>Purpose: Flowlines Abandoned on 07/01/2014</p> <ul style="list-style-type: none"> ○ Form 4 Doc # & Date: 402066711 & 12/06/2019 <p>Purpose: Notice of continued Temporary Abandoned Status</p>
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COGCC Abbreviations: [Location & Facility Status Codes](#), [Inspection Types & Statuses](#) and [COGCC Help](#).

Audit Key Findings – Designation Land Use Observations

PREVIOUS LAND USE	CURRENT LAND USE
<p>Reference Imagery for Infrastructure:</p> <p>Landsat/Copernicus 2013</p>	<p>Remotely Sensed Imagery:</p> <p>05/02/2023</p>
<p>Designation:</p> <p>Oil and Gas Facility</p>	<p>Designation:</p> <p>Rangeland</p>

The following imagery sources were reviewed during this audit:

EarthExplorer, DRCOG 2002 - 2014, NAIP Imagery 2011, 2013, 2015, 2017, 2019, 2021, ESRI Maxar and Remotely Sensed Imagery Sep 2022

Closure Information

Landowner Colorado Parks and Wildlife (CPW) filed a complaint on 04/20/2023 stating concerns about failed reclamation activities at the Centennial Valley State Wildlife Area performed by operator BONANZA CREEK ENERGY OPERATING COMPANY LLC approximately three years ago. In response, COGCC Reclamation Specialist Chris Binschus performed a Reclamation Inspection of the area that failed and identified a Corrective Action (CA) requiring the operator to perform soil sampling.

The inspection for this Location (331413) includes plugged and abandoned Well DOW #32-28, access road, and the off-site Tank Battery. The inspection noted these areas consisted mostly of weeds with little perennial vegetation that is not reflective of reference areas. Bare soil was more prevalent along the main access road.

Our post-inspection audit revealed an oil release due to a failed separator dumpline near the off-site tank battery (Lat/Long: 40.373052 / -104.437189). The release was discovered on 07/02/2014 and reported under Spill or Release 437971 (case closed on 12/24/2014) and remediated under a remediation workplan RPN 8826 (case resolved 10/27/2015).

Site Photos

Site Investigation and Photos Date

05/02/2023

Cardinal directional photos of the site



North



East



South



West

ATTACHMENTS

Maps and Figures

Location Maps

CPW Overview Soil and Vegetation Locations
CPW Overview Observation Locations
CPW Overview Roads and Reclamation Extents
CPW Overview Reference Extents

Area Maps

Previous Infrastructure Overview
Current Site Overview
Elevation & Contours
Slope
Hydrology
NDVI Composite
NDVI

Reports

Reclamation Report
Soil Analytics
Reference Soil and Vegetation
Observations

Background Information

Natural Resources Conservation Service (NRCS) Map Unit Description

Reference Soil and Ecological Description

SITE-SPECIFIC RECLAMATION PLAN



Permit Closure Type – Final

Failed Reclamation Inspection

Site Description

Name	DOW-65N63W/28SWNE
Location ID	331413
Operator / #	BONANZA CREEK ENERGY OPERATING COMPANY LLC / 8960
Field	WATTENBERG / 90750
County, State	WELD, CO

Report Date

31 May 2023

Site Evaluation

Investigator: Soil Sage

Investigation Date: 2-4 May 2023

Reference Soil Information: This site is comprised within one soil type, Map Unit 10 - Ellicott-Ellicott sandy-skeletal complex, 0 to 3 percent slopes, sandy texture surface and at depth. These soils are formed from noncalcareous, stratified sandy alluvium. Landform is drainageways, flood plains on intermittent streams. Excessively drained with a very low available water holding capacity. Depth ranges from 0 – 10 inches, the pH is 6.5 and the organic matter is 0.35%.

Soil chemical properties within the rooting zone to 50 inches is described in the Soil Properties – USDA Soil Properties section of this report.

Current Land Use in Reference Area: Range land

Observations

The Northern section is intermixed leased grazing land and “native” ecosystem along the South Platte River. The reclaimed areas have residual gravel and excessive applications of manure which have impacted the recovery of the sites.

Weed pressure has occurred along the roads and patchy areas at each site.

Debris remains along the roads and sites in the form of silt fencing, waddles and oil and gas operational equipment. Reference the observation document for specifics.

Site Soils

During the field investigation, Soil Sage collected soil samples every six inches from 0 – 24 inches within the site and reference locations within the map unit. These soils were analyzed to establish current soil physicochemical properties for reclamation planning. See spreadsheet attachment Table 1 for site

specific soil characterizations and associated reference soils. Reference USDA Soils and Ecological Site Description for historical properties.

Recommendations

Data of Sampling – 2-4 May 2023

Vegetation

Spring vegetation characteristics were present, newly emerging grasses and weeds are the primary vegetation during the site visit.

Ecological Site observations serve as the baseline vegetation cover.

Table represents the present cover observations.

Sample Number	Bare Ground	Grass	Forbs	Shrubs	Litter	Weeds	Field Notes
7	30	5	5	0	40	20	

Weeds

Weed Summary Reference

Common Name	Weed List Type	Percent Cover (%)
Canada Thistle	List B	5
Tansy Mustard	Common	15

Weed Inventory Criteria

- Each site is accessed for noxious weeds and common weeds
- Data are aggregated using point locations coupled with percent cover assessments and area measurements as needed
- Governance - Colorado Department of Agriculture - Colorado Noxious Weeds List, effective October 2020
- List A - Designated for eradication, List B - Designed to stop the continued spread, List C - Facilitate more integrated effective weed management, Watch List - Determined to pose a potential threat to ag and natural productivity.
- Common - designates weeds that do not fall within the Colorado Department of Agriculture lists
- Other - designates other identified weeds at the site

Site Characteristics

Hydrology

Hydrology – Stream Orders 1 – 6 are present - dominant streams are orders are 1, 2 and 3. Order 3 are present in locations that have the potential for soil erosion represented by gullying and riling that follow the elevation gradient from high to low within the current reclaim extent. These could be major runoff areas for gullying and soil erosion with heavy precipitation events.

Ponding - potential ponding can occur where water follows the elevation gradients in low lying area.

Reference Hydrology and Elevation and Contour Maps

Soil/Erosion

Exposed soils have low susceptibility to water erosion and are in the high susceptible group for wind erosion due to ecosystem dynamics and vegetative cover.

Summary Acreage Table

Description	Acres
Total Disturbance Extent	0.93
○ Reclaim Extent	0.50
○ Road	0.54
○ Reference Extent	0.25

Total Disturbance Extent includes Well pad and Tank Battery, not the Road.

Reclaim Extent includes Well Pad and Tank Battery Reclaim Extents.

Reference areas are shared and are available in the North Reference Document and Site Overview Reference Map

Site Recommendation and Re-Evaluation

North Side

Road: 12 inches remove and replace

Pad: 6 inches remove and replace

Replacement Soil

Texture: Sandy Loam

Organic Matter: 1%

pH: 7.0 - 8.3

Nitrate N: less than 50 ppm

Sodium: less than 150 ppm

Chloride Cl: less than 100 ppm

Sulfate S: less than 100 ppm

Soil tests must be submitted to Luke Kelly (lkelly@civiresources.com) AND Sam Streeter (sam@soilsage.com) for approval prior to use on the project. Certified Weed Free Straw must be used, and evidence must be supplied to Luke Kelly and Sam Streeter. Soil Sage will be performing inspections during reclamation activities and after work is complete to ensure success. On-site access must be coordinated with Colorado Parks and Wildlife (CPW) before work commences. Schedule of reclamation activities (approximate) must be submitted before reclamation starts and any changes to the schedule must be communicated via email to Luke Kelly and Sam Streeter.

Seed Mix

Vegetation Seed Mix

Additional reclamation procedures are recommended at this time.

Sandy Bottomland - Salt Meadow Ecosystems CPW Mix

Common Name	Scientific Name	#PLS/Acre	% of Mix
Alkali Sacaton	<i>Puccinellia distans</i>	4	26.7
Western Wheatgrass	<i>Pascopyrum smithii</i>	4	26.7
Switchgrass	<i>Spartina pectinata</i>	3	20.0
Prairie Cordgrass	<i>Spartina pectinata</i>	2	13.3
Needle and Thread	<i>Hesperostipa comata ssp. comata</i>	2	13.3
Total Mix		15	100.0

NOTE: The seed mix is based on the soil type and landscape position. The surrounding area has similar soil properties, and this seed mix is subject to change based on land use type.

Soil Amendments

New soil specifications are outlined above with NPK and OM recommendations.

Pre-Reclamation Activities and Notes:

- There are active and abandoned midstream assets in both the northern and southern parts of the reclamation area.
- Remove silt fencing, waddles and remaining oil and gas operational equipment.

Reclaim Area Protocol

Time Frame	Activity	Specifications	Site Totals
Prior to Reclamation Activities	Pre-Reclamation	Remove trash, silt fencing, waddles, and oil and gas operational equipment	Refer to the observation document for the area
Spring 2023	Remove and Replace Soil	Texture: Sandy Loam Organic Matter: 1% pH: 7.0 - 8.3 Nitrate N: less than 50 ppm Sodium: less than 150 ppm Chloride Cl: less than 100 ppm Sulfate S: less than 100 ppm	0.50 Acres
	Rip	Deep rip to 18 inches, do not rip below 18 inches. Evidence of seasonably high-water table found as shallow as 18 inches. Do not interact with this layer	
	Disc	Disc the site to a depth of 6.0-inches using a disk and harrow, field cultivator, vibrashank, or another alternative suitable to site conditions	
	Seed	CPW Mix	15 LBS/acre
	Straw	Spread certified weed free straw	2 Tons/acre
	Crimp	Crimp Straw	
Monitoring	Continuous	Site should be monitored post reclamation to ensure success	
Weed Management		Due to the seed bank of cheatgrass, thistle and kochia monthly monitoring is recommended with appropriate herbicide control	

Site Photos – Soil 7

Lat/Long: 40.372007 / -104.437765

Nearest Facility #: 331413

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Soil Picture 1	Soil Picture 2 Vegetation at Soil Location





Site Photos – Vegetation 7





Lat/Long: 40.372106 / -104.437794

Nearest Facility #: 331413

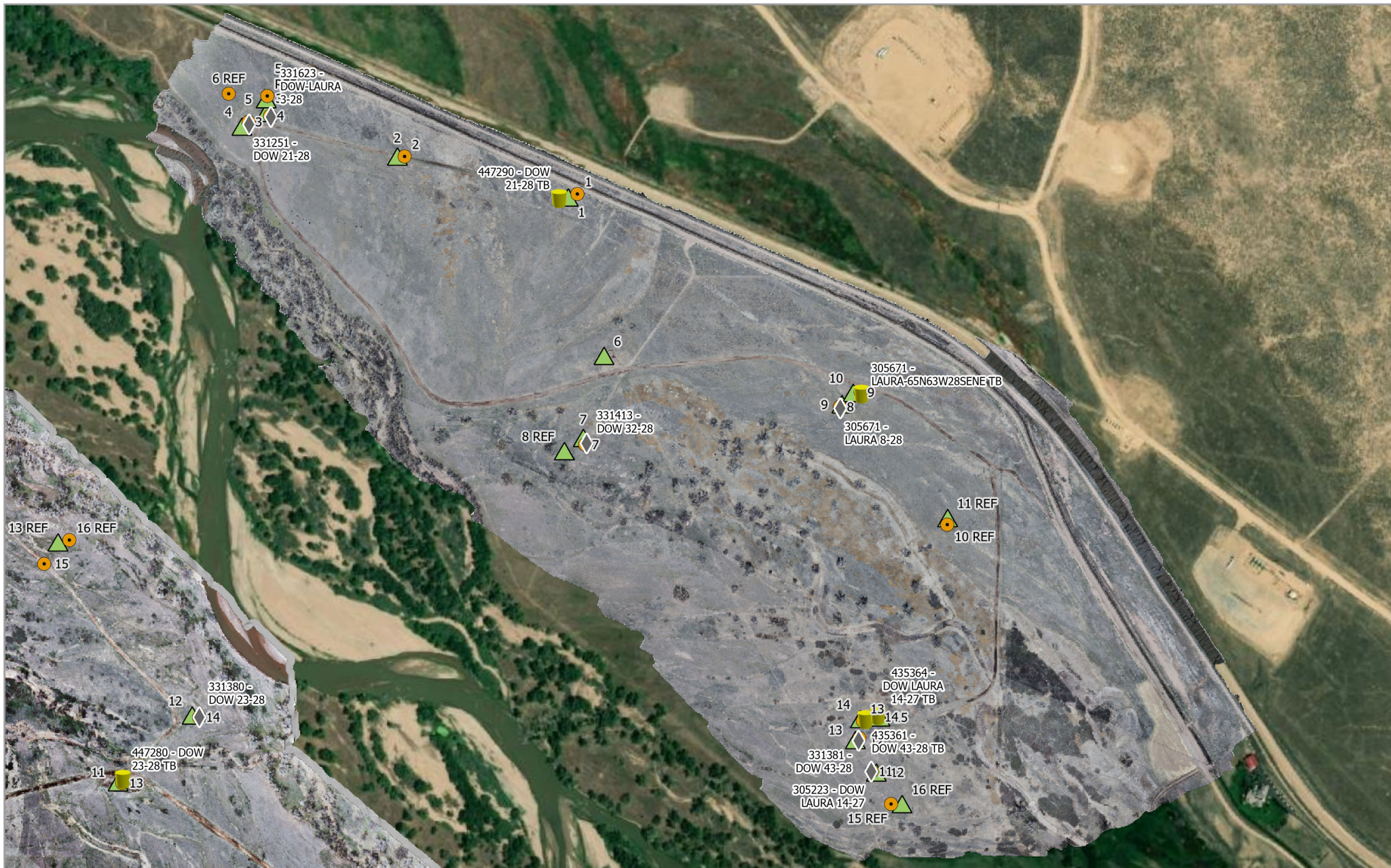
Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Veg	Veg - North
	
Veg - East	Veg - South

	
<p>Veg – West</p>	<p>Canada Thistle – <i>Cirsium arvense</i> – Colorado List B Noxious Weed</p>
	
<p>Grass</p>	<p>Tansy Mustard – <i>Descurainia pinata</i> – Common Weed</p>

	
Tansy Mustard – <i>Descurainia pinata</i> – Common Weed	

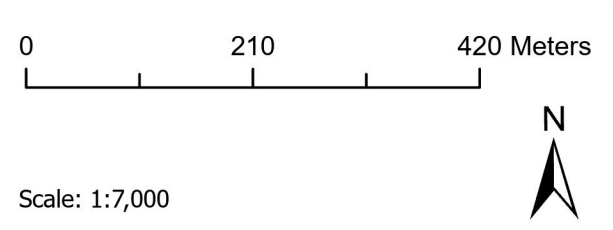


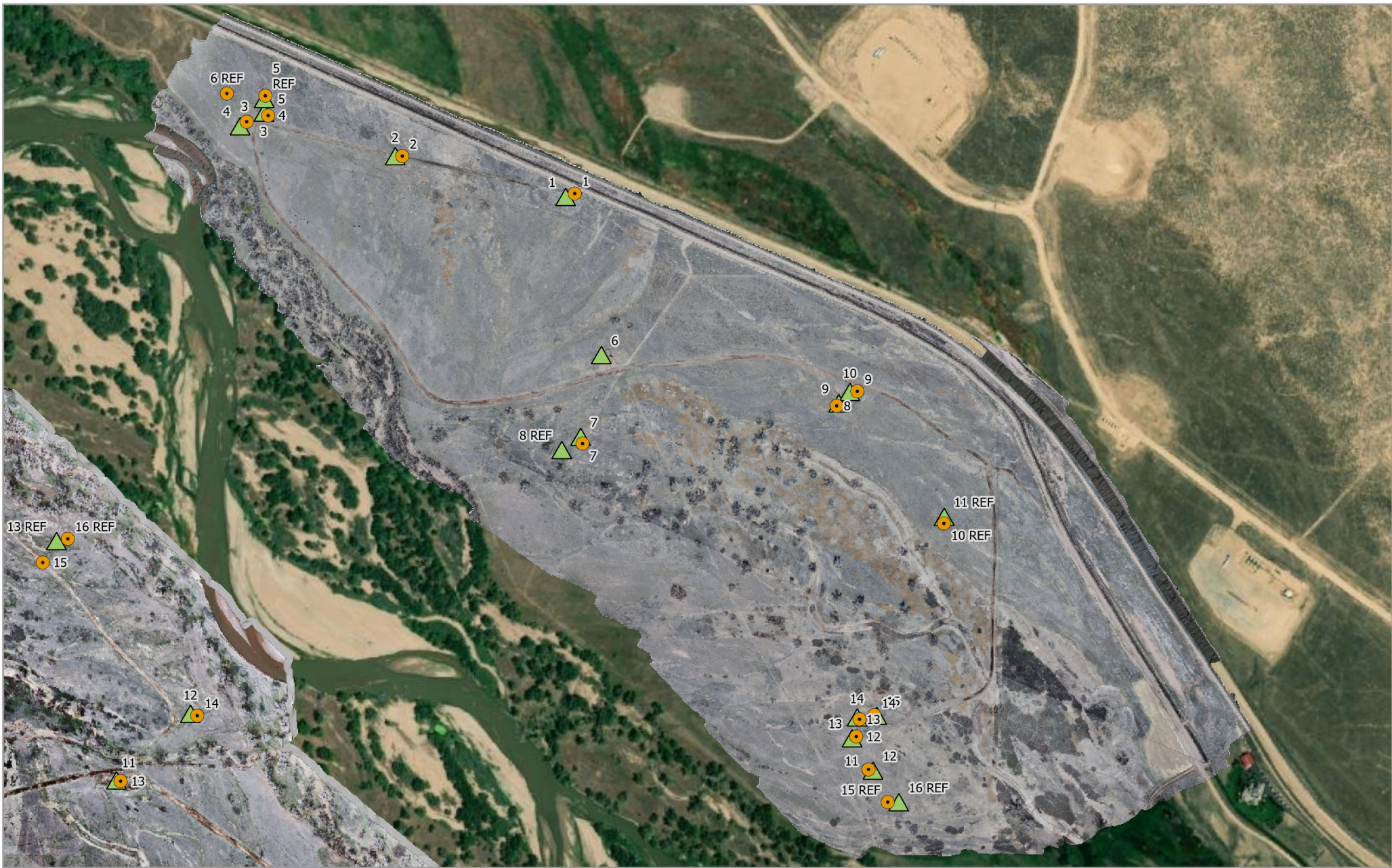
CIV - CPW North Side **Map Extent - Overview Soil & Veg Points**

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 29 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Legend

- Well
- Tank Battery
- Soils
- Veg



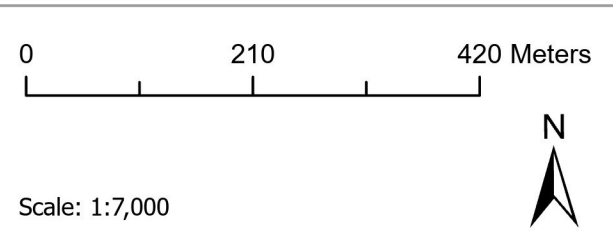


CIV - CPW North Side **Map Extent - Overview Soil & Veg Points**

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 29 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Legend

- Soils
- ▲ Veg



Service Credits - Maxar



CIV - CPW North Side **Map Extent - Overview Observation** **Points**

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 29 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Legend

- Well
- Tank Battery
- Observations

0 210 420 Meters

Scale: 1:7,000



Service Credits - Maxar



CIV - CPW North Side
Map Extent - Overview Observation
Points

Imagery: RS Orthomosaic & DSM
Imagery Date: 2 May 2023
Map Date: 29 May 2023
Datum: WGS 1984 UTM Zone 13N
POC: Soil Sage

Legend

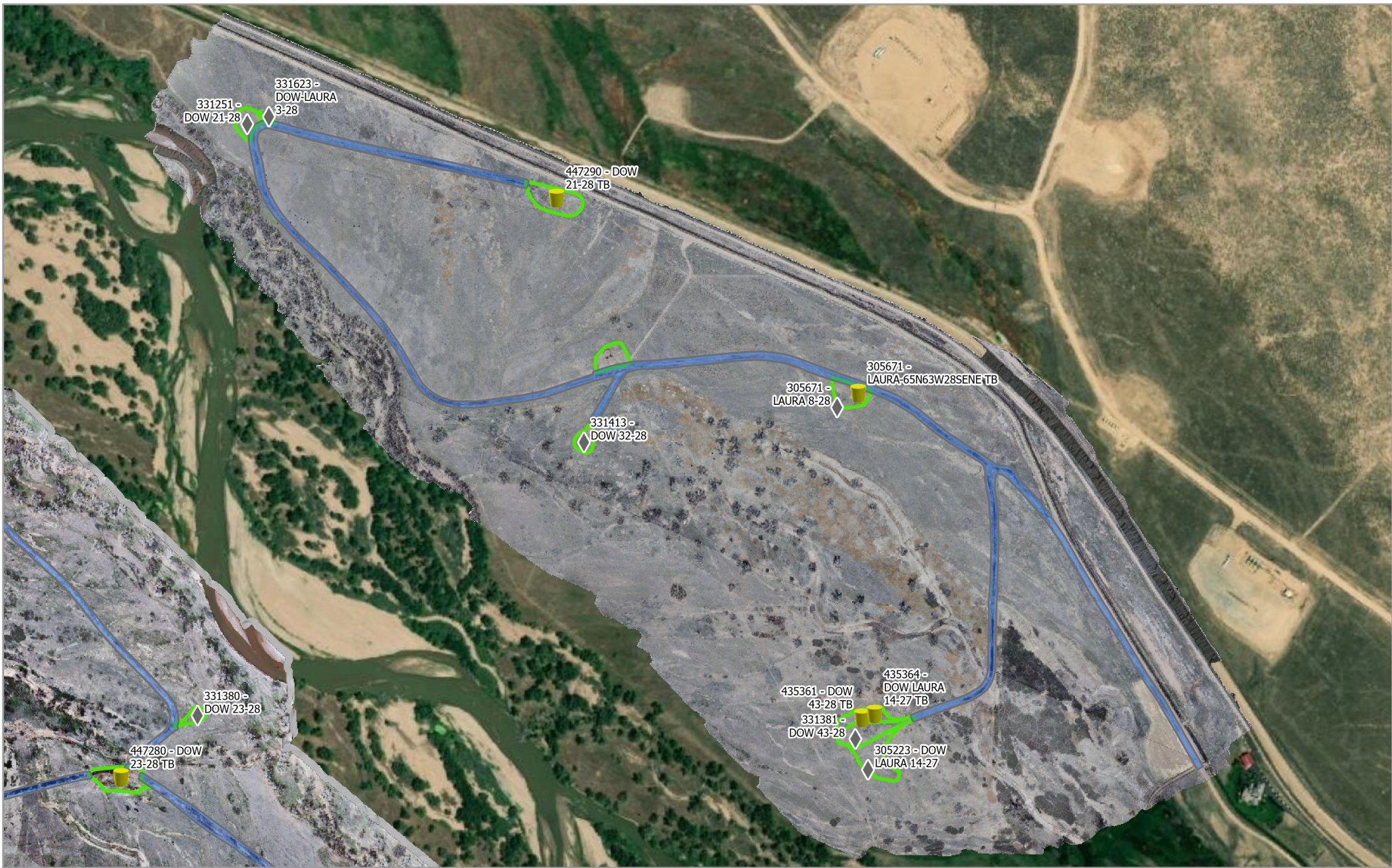
 Observations

0 210 420 Meters

Scale: 1:7,000



Service Credits - Maxar



CIV - CPW North Side **Map Extent - Overview Reclaim & Road** **Reclaim Extent**

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 31 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Legend

- ◆ Well
- 🛢 Tank Battery
- 🟩 Reclaim Extent
- 🟦 Road Reclaim

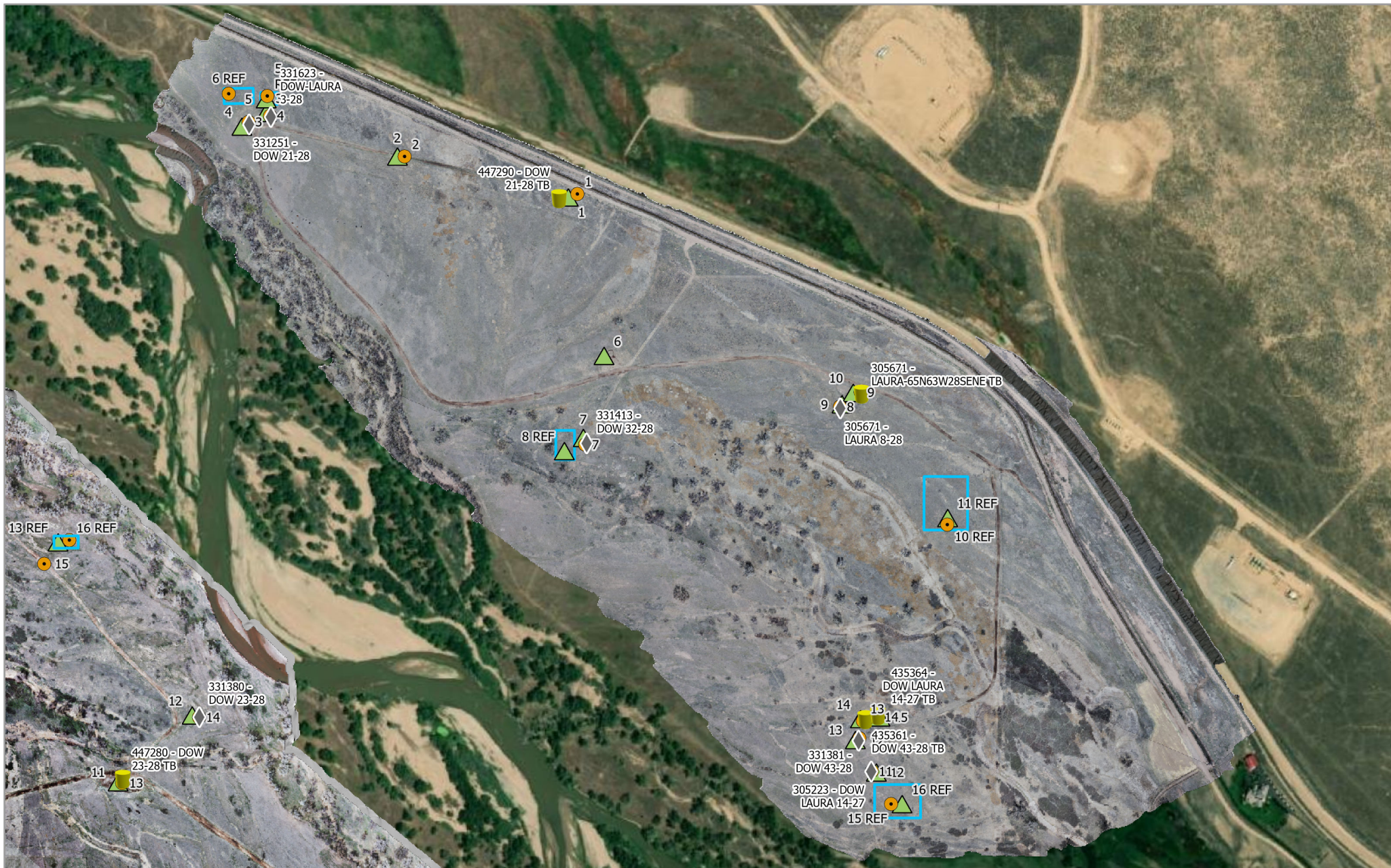
0 210 420 Meters

Reclaim Extent: 3.1 surface Acres
 Road: 7 surface Acres including buffer

Scale: 1:7,000



Service Credits - Maxar



Service Credits - Maxar

CIV - CPW North Side Map Extent - Overview Reference Extent

Imagery: RS Orthomosaic & DSM
Imagery Date: 2 May 2023
Map Date: 29 May 2023
Datum: WGS 1984 UTM Zone 13N
POC: Soil Sage

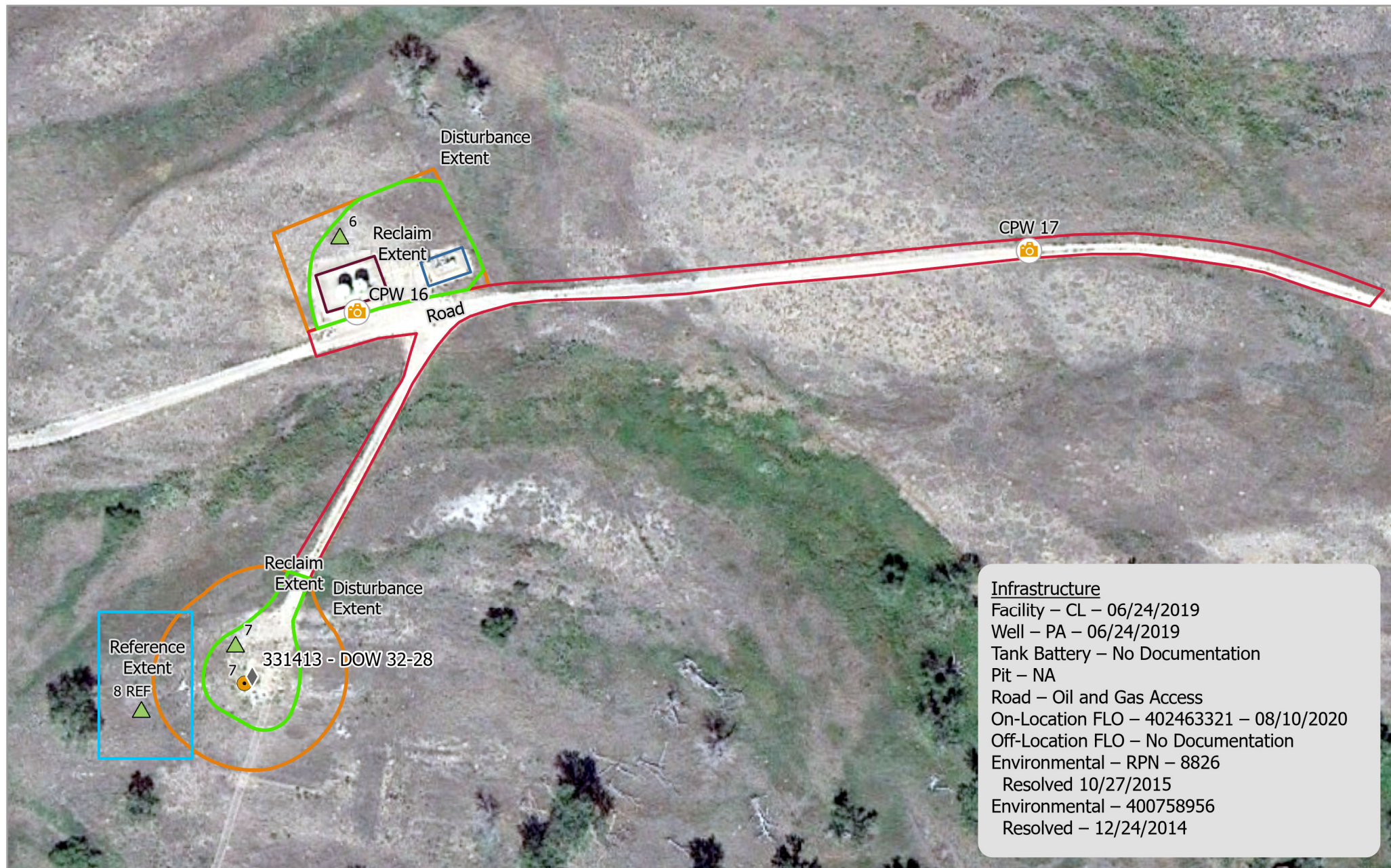
Legend

- ◆ Well
- Tank Battery
- Soils
- ▲ Veg
- Reference Extent

0 210 420 Meters

Scale: 1:7,000

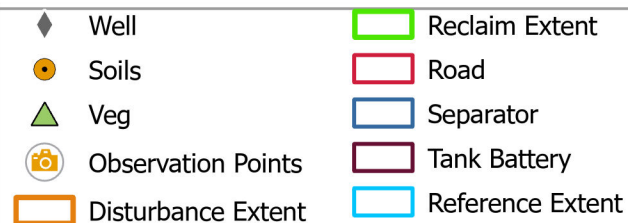




Service Credits -

CIV - 331413 - DOW 32-28 **Map Extent - Landsat/Copernicus 2013**

Imagery: Landsat/Copernicus
 Imagery Date: 6 Sep 2013
 Map Date: 16 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

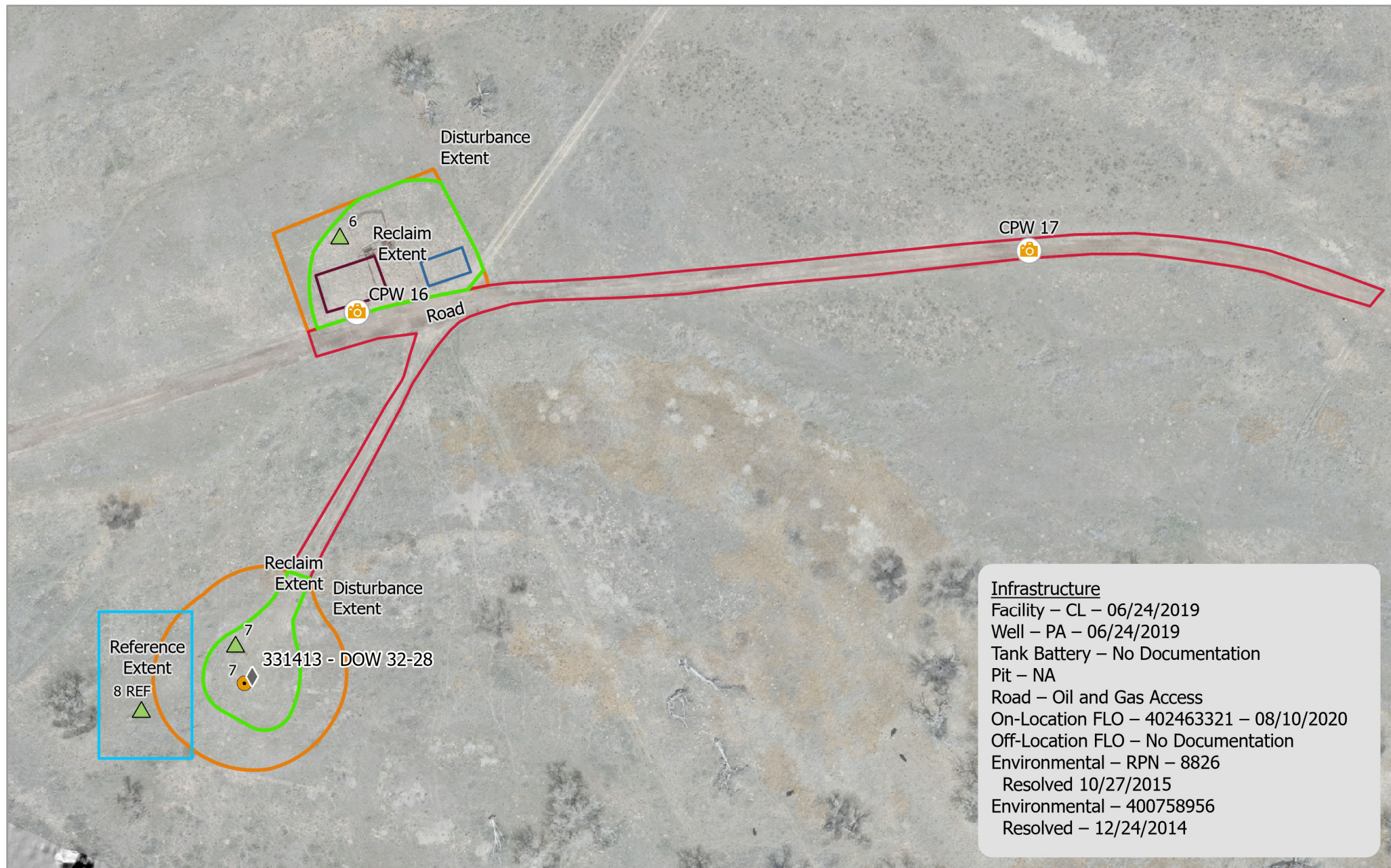


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Scale: 1:1,400

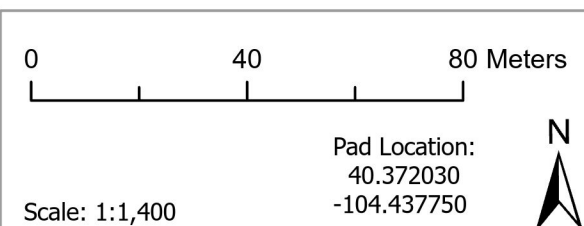
Pad Location:
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 -104.437750

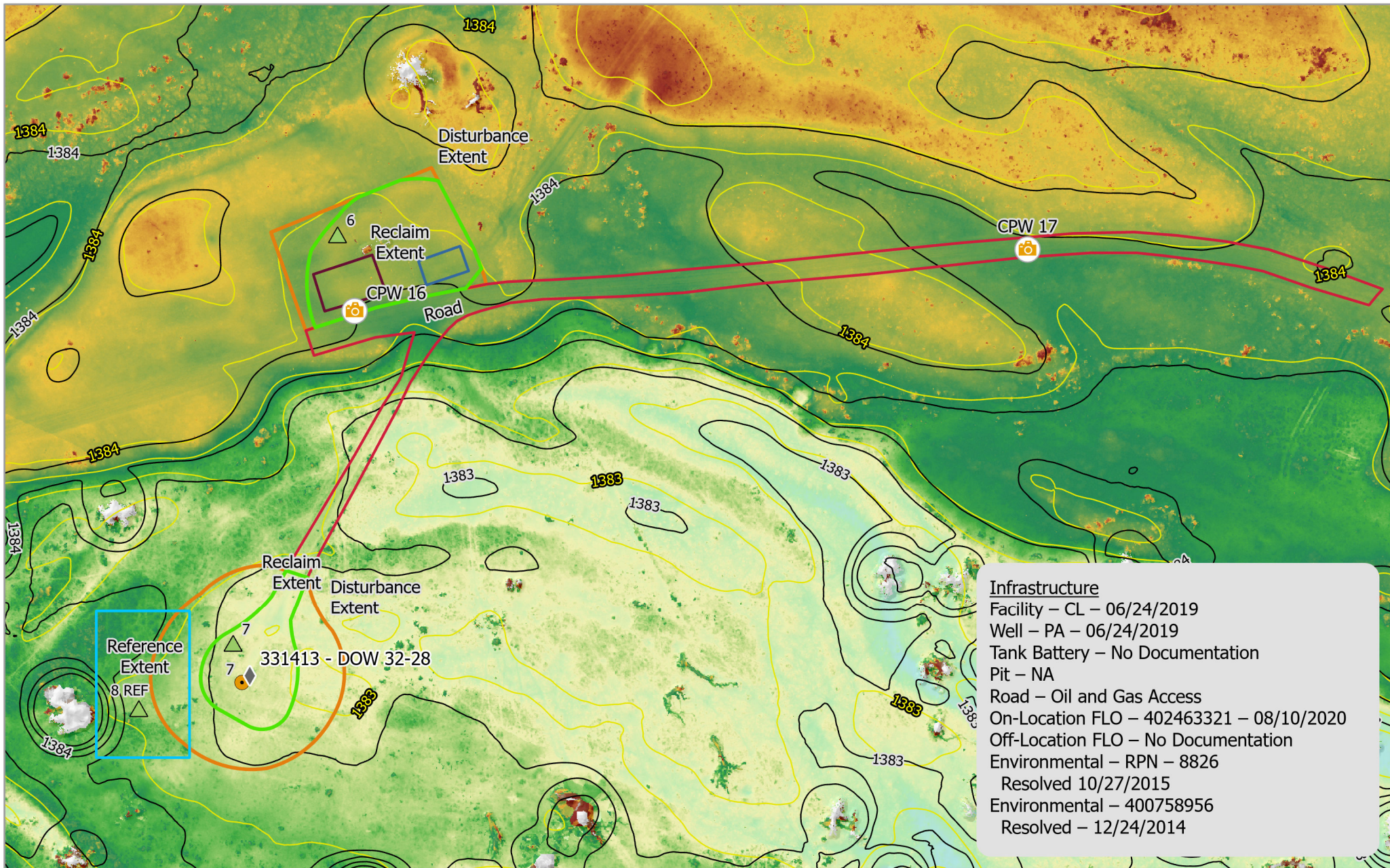




CIV - 331413 - DOW 32-28 Map Extent - Overview

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 16 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage





CIV - 331413 - DOW 32-28 Map Extent - Elevation & Contours

Imagery: RS DSM, USGS
 Imagery Date: 2 May 2023, 2013
 Map Date: 16 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

- | | |
|--------------------------|--------------------|
| ◆ Well | Disturbance Extent |
| ● Soils | Reclaim Extent |
| ▲ Veg | Road |
| 📷 Observation Points | Separator |
| ~ 0.25 m Contours (2023) | Tank Battery |
| ~ 0.25 m Contours (2013) | Reference Extent |

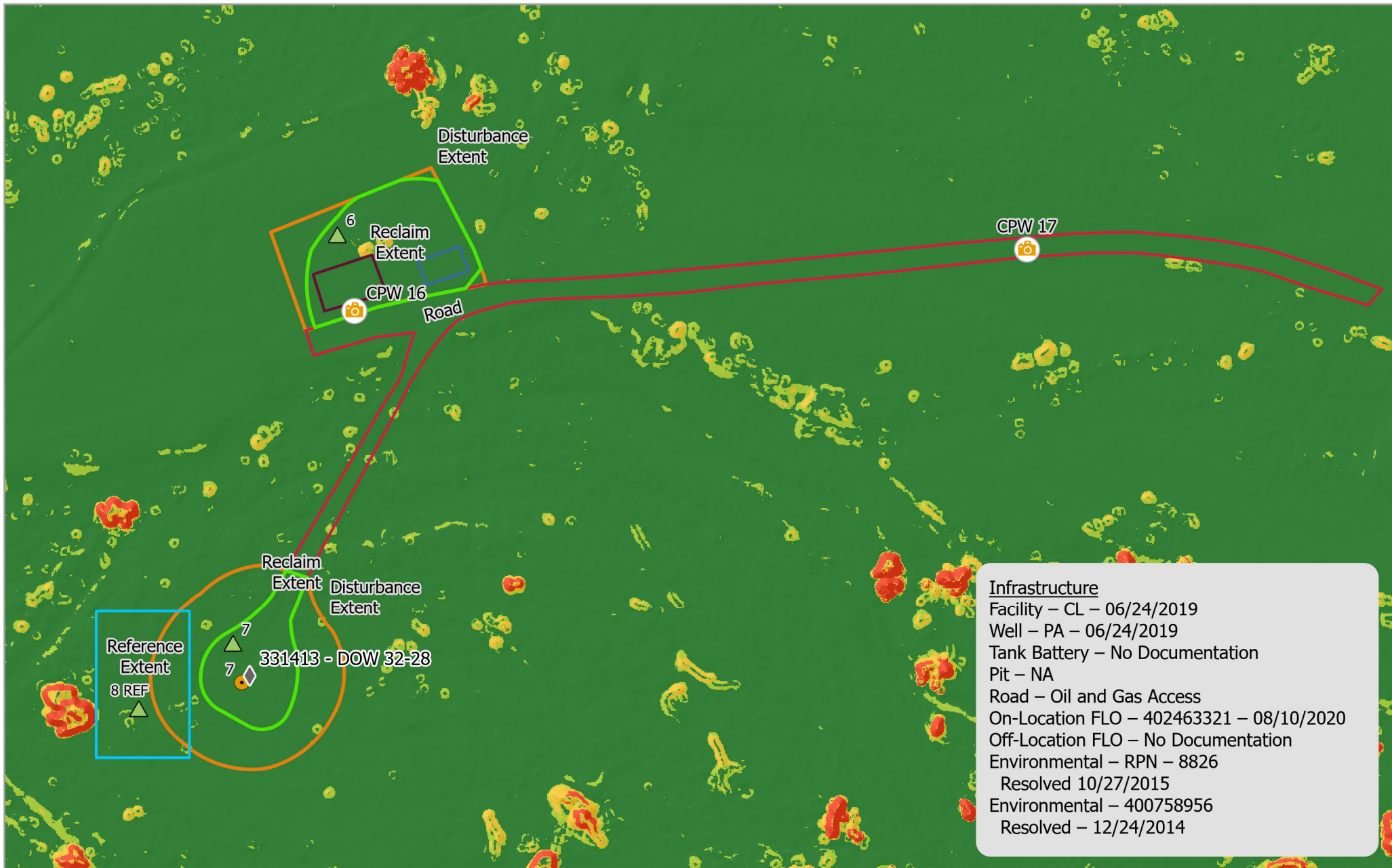
Elevation
Meters
1404
1369

0 40 80 Meters

Scale: 1:1,400

Pad Location:
40.372030
-104.437750

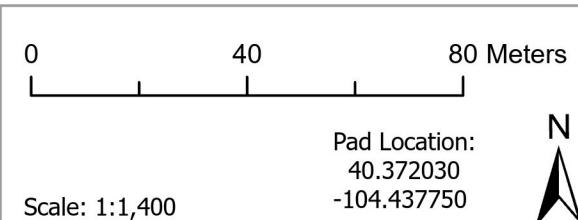
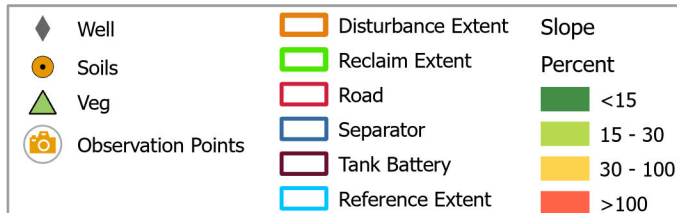


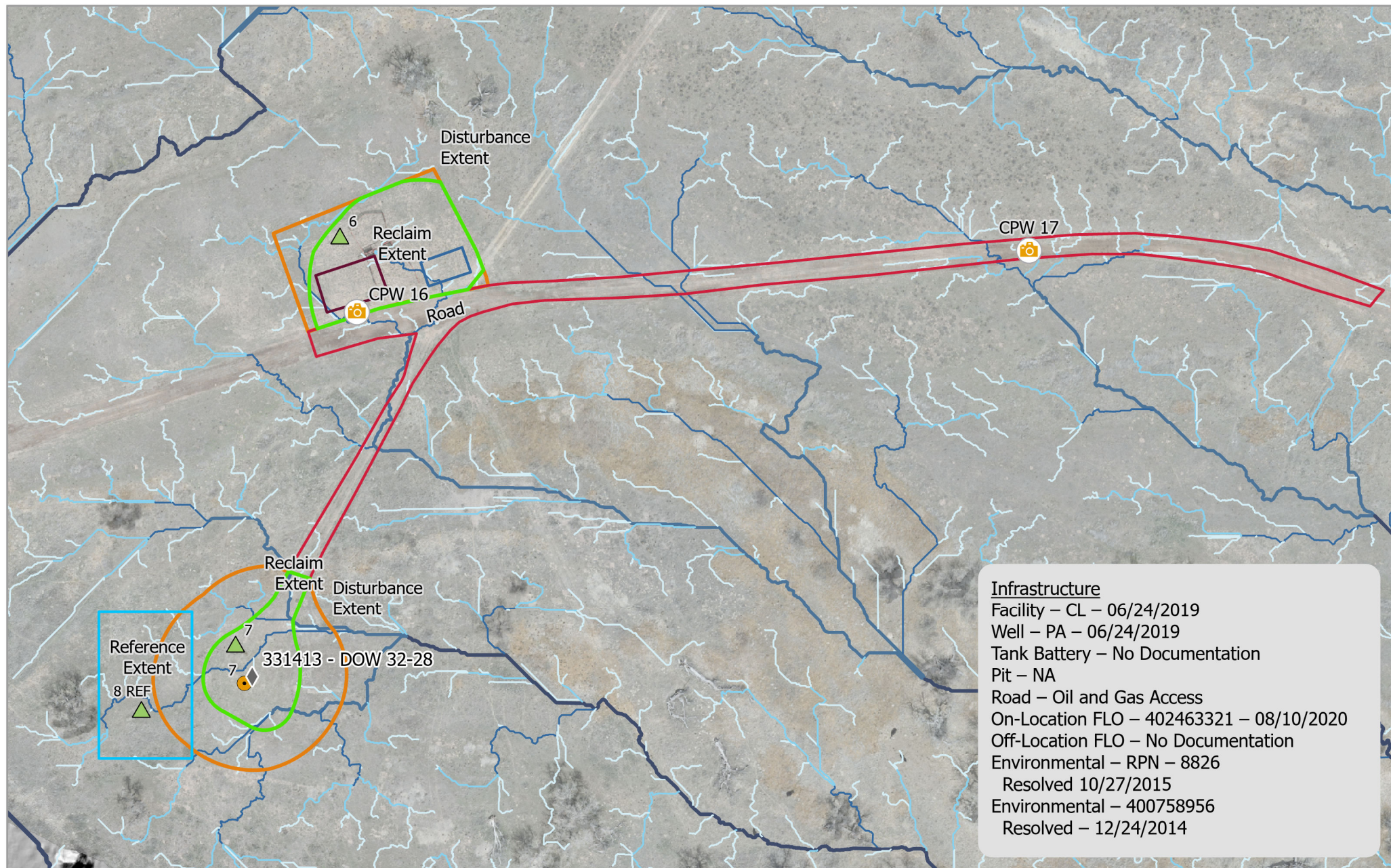


Infrastructure
 Facility – CL – 06/24/2019
 Well – PA – 06/24/2019
 Tank Battery – No Documentation
 Pit – NA
 Road – Oil and Gas Access
 On-Location FLO – 402463321 – 08/10/2020
 Off-Location FLO – No Documentation
 Environmental – RPN – 8826
 Resolved 10/27/2015
 Environmental – 400758956
 Resolved – 12/24/2014

CIV - 331413 - DOW 32-28 Map Extent - Slope

Imagery: RS DSM
 Imagery Date: 2 May 2023
 Map Date: 16 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage





Service Credits -

CIV - 331413 - DOW 32-28 Map Extent - Hydrology

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 16 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

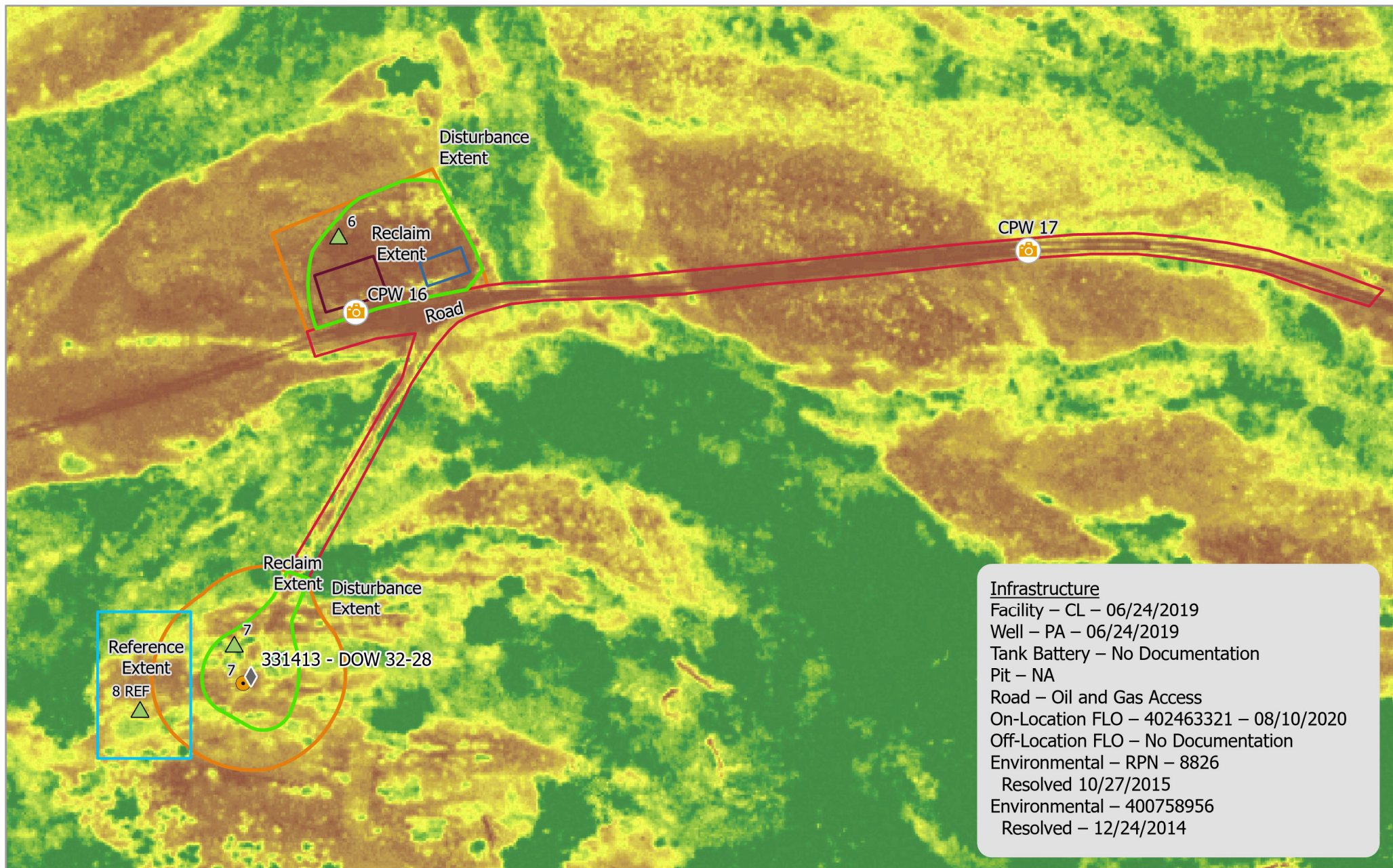


0 40 80 Meters

Scale: 1:1,400

Pad Location:
 40.372030
 -104.437750





CIV - 331413 - DOW 32-28 Map Extent - NAIP NDVI Composite

Imagery: USDA NAIP
 Imagery Date: 2011-2021
 Map Date: 16 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

- | | |
|----------------------|--------------------|
| ◆ Well | Disturbance Extent |
| ● Soils | Reclaim Extent |
| ▲ Veg | Road |
| 📷 Observation Points | Separator |
| | Tank Battery |
| | Reference Extent |

0 40 80 Meters

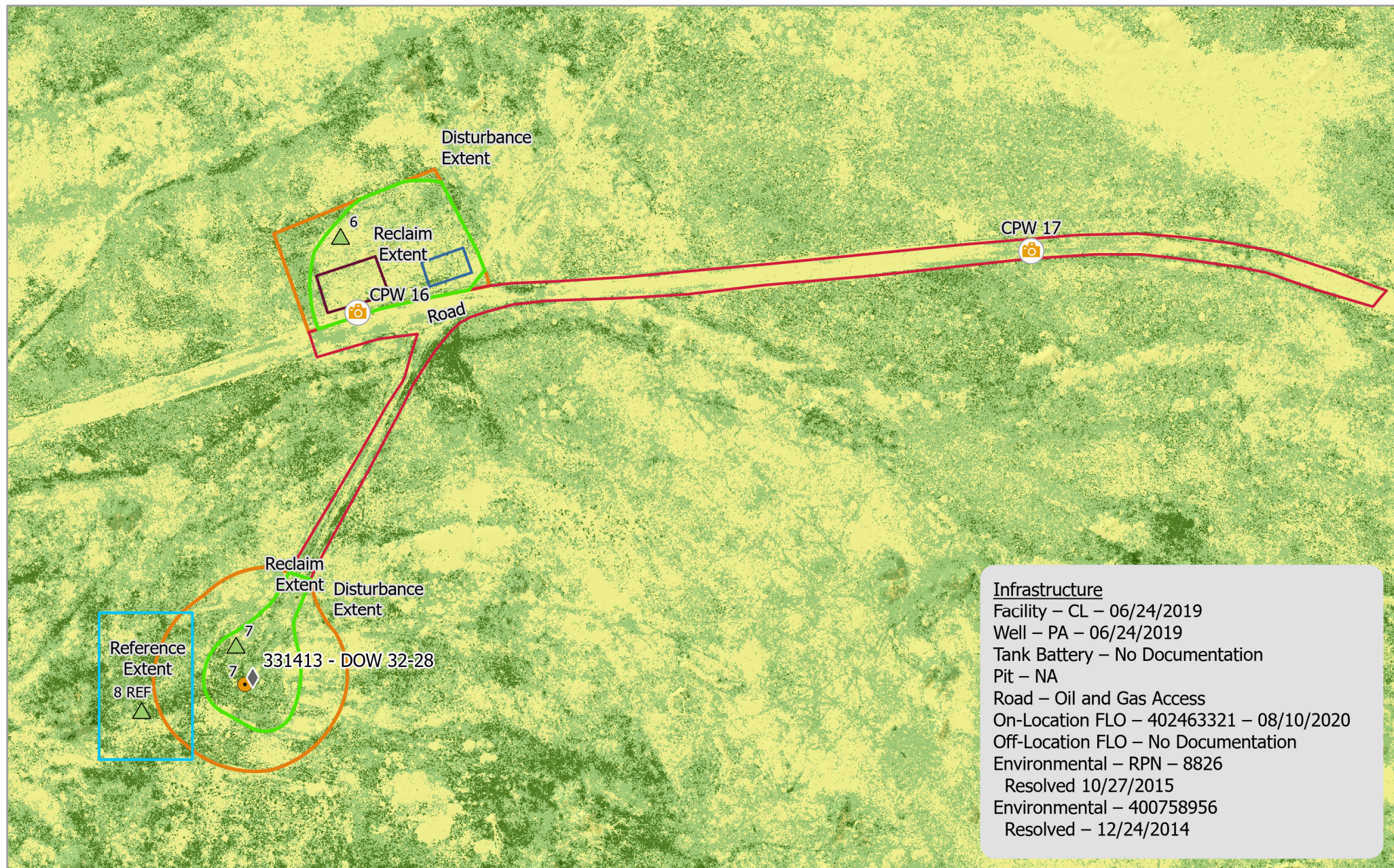
Scale: 1:1,400

Pad Location:
 40.372030
 -104.437750



Service Credits - Esri, USDA Farm Service Agency

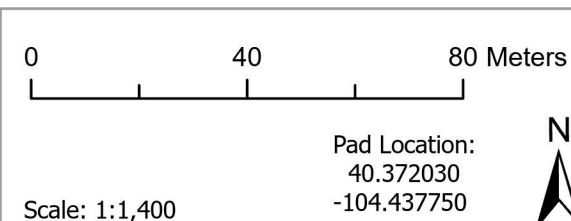
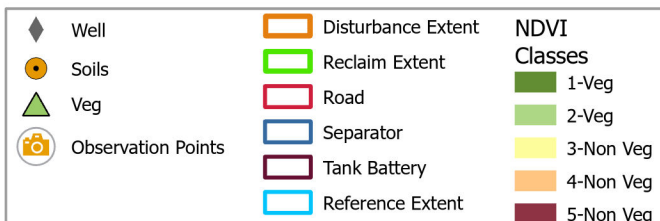




Service Credits -

CIV - 331413 - DOW 32-28 Map Extent - NDVI

Imagery: RS Multispectral
 Imagery Date: 2 May 2023
 Map Date: 16 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage



CPW Soil and Vegetation

North Side Reference



Site Soils

These soils were analyzed to establish current soil physicochemical properties.

Soil Analytical Spreadsheet

Map Unit(s) – 10

The CPW_North_SoilData_17MAY2023 - contains 4 soil references.

Overview of the 0-12 inches

- Soil texture is a Sandy Loam/Loamy Sand with intermixed Sandy Clay Loam
- pH 7.5
- ECe 1.1
- Organic Matter % - 1.5
- SAR 1.4
- N-P-K – 6-38-199
- Nitrate-N Lbs/A = 11
- Sodium – 105 ppm
- Chloride – 18 ppm
- Sulfate – 64 ppm

NOTE: The native soils have elevated sodium levels in 2 of the 4 samples in the top 12 inches which has a direct correlation to the higher ECe and SAR values.

Vegetation Analysis

Ecological Site observations serve as the baseline vegetation cover.

Table represents the present cover observations.

During the time of sampling the site contained bare ground no vegetation analysis performed.

Sample Number	Bare Ground	Grass	Forbs	Shrubs	Litter	Weeds	Field Notes
8	5	20	0	0	65	10	
11	20	15	5	0	50	10	
16	10	20	0	0	60	10	

Site Average for Vegetative Cover and Total Percent Cover based on field sampling.

Grasses	Forbs	Total Percent Cover	Site Target Recovery (80%)
18	5	23	18

Weeds

Weed Summary Reference based on 2-4 May 2023 Monitoring

Common Name	Weed List Type	Percent Cover (%)
Field Bindweed	List C Noxious	10
Tansy Mustard	Common Weed	10



Site Photos – Soil 5

Lat/Long: 40.376311 / -104.442836

Nearest Facility #: 331623 and 331251

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Soil Picture 1	Soil Picture 2 Vegetation at Soil Location



Site Photos – Soil 6

Lat/Long: 40.376343 / -104.443456

Nearest Facility #: 331623 and 331251

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Soil Picture 1	Soil Picture 2 Vegetation at Soil Location
	

Site Photos – Soil 10

Lat/Long: 40.370999 / -104.431953

Nearest Facility #: 305671, 331381 and 305223

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Soil Picture 1	Soil Picture 2 Vegetation at Soil Location



Site Photos – Soil 15

Lat/Long: 40.367564 / -104.432884

Nearest Facility #: 305223

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Soil Picture 1	Soil Picture 2 Vegetation at Soil Location





Site Photos – Vegetation 8

Lat/Long: 40.371947 / -104.438097

Nearest Facility #: 331413

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Veg	Veg - North
	
Veg - East	Veg - South

	
<p>Veg – West</p>	<p>Grass ssp.</p>
	
<p>Field Bindweed – <i>Convolvulus arvensis</i> – Colorado List C Noxious Weed</p>	

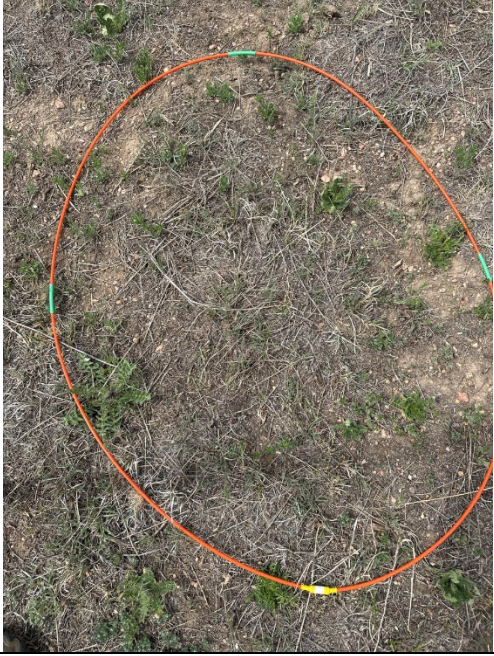



Site Photos – Vegetation 11





Lat/Long: 40.371095 / -104.431946

Nearest Facility #:

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Veg	Veg - North
	
Veg - East	Veg - South

	
<p>Veg – West</p>	<p>Tansy Mustard – <i>Descurainia pinata</i> – Common Weed</p>
	
<p>Grass ssp.</p>	<p>Tansy Mustard – <i>Descurainia pinata</i> – Common Weed</p>

CPW Site Observations



North

Reference the Observation overview map

Observation 12 – ROAD - North

40.375215 / -104.43867

 A photograph showing a dirt road in a field. The road is covered with dark brown soil and patches of green vegetation. The surrounding area is filled with tall, dry, yellowish-brown grass. The sky is overcast.	 A photograph showing a dirt road in a field, similar to the one in the left image. In the distance, a small black vehicle is visible on the road. The surrounding area is filled with tall, dry, yellowish-brown grass. The sky is blue with some clouds.
<p>Distinctive start of the manure application, 4-6 inches manure and compaction.</p>	



Observation 13 - ROAD- North

40.375561 / -104.440652



Manure in the top 4 inches then compaction

Observation 14 - ROAD- North

40.374259 / -104.44192



Sand and manure with compaction

Observation 15 – ROAD - North

40.372523 / -104.439919



Top 6 inches is manure, sand with compaction

Observation 16 – ROAD, CORRAL, VEHICLE TRAFFIC - North

North of the 331413

40.372919 / -104.437395



Cheatgrass and gravel



Road



OK Corral on the footprint of the disturbance



Gravel and weds

Observation 17 - ROAD - North

40.39306 / -104.43523



6 inches of Sandy manure with compaction



Unincorporated manure

Observation 18 - DEBRIS - North

40.372523 / -104.433646



Trash – buried cable



Trash – buried cable

Observation 19 - ROAD - North

40.371765 / -104.431303



4inches of manure with compactions



Unincorporated manure

Observation 20 – ROAD and WADDLES- North

40.369642 / -104.431193



Manure, sand, and compaction



Unincorporated manure



Waddles



Waddles



Waddles

Observation 21 – ROAD- North

40.368321 / -104.433245



Gravel on access road



Gravel on access road

Observation 22 – TANK BATTERY - North

40.36859 / -104.433314

	
Cow feeding station	Hay
	
Hay on the tank battery location	

Observation 23 - ROAD - North

40.36854 / -104.43263



Weeds and 6 inches of gravel and rock and compaction on the access road

Weeds



Gravel and rocks

Observation 26 – ROAD - North

40.3717320 / -104.4313185



Trash – Straw Waddle



Trash – Straw Waddle





Site Photos – Vegetation 16

Lat/Long: 40.367575 / -104.432707

Nearest Facility #: 305223

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

					
Veg				Veg - North	
					
Veg - East				Veg - South	

	
<p>Veg – West</p>	<p>Grass ssp. and Field Bindweed – <i>Convolvulus arvensis</i> – Colorado List C Noxious Weed</p>
	
<p>Grass ssp. and Field Bindweed – <i>Convolvulus arvensis</i> – Colorado List C Noxious Weed</p>	<p>Grass ssp. and Field Bindweed – <i>Convolvulus arvensis</i> – Colorado List C Noxious Weed</p>

Soil Properties

USDA Soil Description

Reference Soil Information

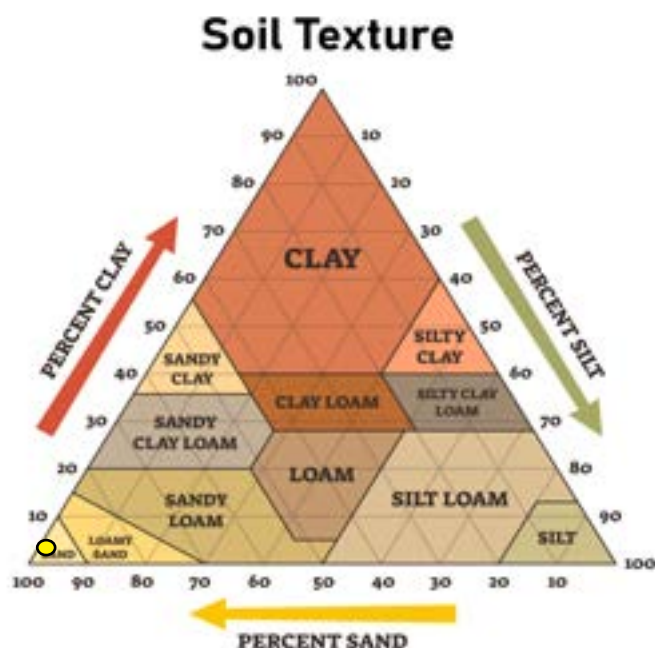
The location of the site is contained within one soil type, Ellicott-Ellicott sandy-skeletal complex.

Map Unit 10 Reference Soil information - Ellicott-Ellicott sandy-skeletal complex

This soil is formed from noncalcareous, stratified sandy alluvium. Landform is drainageways, flood plains on intermittent streams, with the Sandy Bottomland Ecological Site. Soils are excessively drained with a very low water holding capacity, and slope 0-3 percent.

Depth (in)	Physical			Chemical			
	Texture	Bulk Density	Partical Size Percent sand, silt, clay	pH	EC	SAR	OM%
0-10	Sand	1.65	95-3-2	6.5	0.1	0.0	0.35
10-20	Sand	1.64	95-4-1	7.0	0.1	0.0	0.25
20-30	Sand	1.63	95-4-1	7.2	0.1	0.0	0.25
30-40	Sand	1.63	95-4-1	7.6	0.1	0.0	0.25
40-50	Coarse Sand	1.66	95-4-1	7.6	0.1	0.0	0.25
50 +	Coard Sand	1.68	95-4-2	7.6	0.1	0.0	0.25

Soil Texture Triangle reflect the 0-10 in depth



Erosion Potential (10 inches)

- K Factor, Whole soil - .02. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.
- Wind Erodibility Group – 1. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

Soil Reference Information

There is a general relationship of soil bulk density to root growth based on soil texture. Bulk densities ideal for root growth are less than 1.60 g/cc for sandy textures, less than 1.40 g/cc for loamy textures, and less than 1.10 g/cc for clayey textures. Bulk densities that restrict root growth are greater than 1.80 g/cc for sandy textures, 1.65 g/cc for loamy textures, and 1.47 g/cc for clayey textures.

Vegetation

Reference vegetation – Sandy Bottomland Ecology

Climate

Average Annual Precipitation 14 to 17 inches annually - average 15 inches

Average Annual Air Temperature ranges from 48 to 52 degrees F

Drought conditions in effect

Long-term effects of these latest drought events have yet to be determined. Growth of native cool-season plants begin about April 1 and continue to mid-June. Native warm-season plants begin growth about May 1 and continue to about August 15. Regrowth of cool-season plants occur in September in most years, depending on moisture.

Reference dynamics

The Reference State is characterized by a dominance of warm-season tallgrasses (sand bluestem, prairie sandreed, and switchgrass). The Shrub State is dominated by sand sagebrush and a minor component of understory species (sand dropseed, Fendler threeawn). The Eroded State is characterized by annual forbs and grasses (sunflower, kochia, Russian thistle, cheatgrass) and early successional plants (sandhill muhly, sand dropseed, Fendler threeawn, and lemon scurfpea).

Drought has increased mortality of blue grama and other bunchgrasses significantly in some locales.

Principle dominants are sand bluestem, prairie sandreed, and switchgrass. Subdominant grasses include needle and thread, blue grama, little bluestem, and western wheatgrass. Significant forbs and shrubs are pacific peavine, evening primrose, prairie clovers, leadplant and western sandcherry. Cottonwoods may be present. The potential vegetation is about 70-85% grasses or grass-like plants, 8-15% forbs and 7-15% shrubs.

Carbon sequestration is greatly reduced.

Reference Vegetation – Sandy Bottomland Ecology

At Risk Plant Community

Key species from the Reference Plant Community, Sand bluestem, prairie sandreed, switchgrass, western sandcherry and leadplant have decreased in frequency and production. Blue grama and sand sagebrush have increased. Sand dropseed, Fendler threeawn, slimflower scurfpea, and Cuman ragweed (western ragweed) have also increased.

The risk of losing some of the tallgrass species, palatable forbs and shrubs. The reduction of tallgrass species, nitrogen-fixing forbs, key shrub component and increased warm-season shortgrass has altered the biotic integrity of this plant community. Nutrient cycle, water cycle and energy flow are at risk of becoming impaired.

Vegetation

Sandy Bottomland Ecosystem Vegetative Community Composition

Common Name	Scientific Name
Sand Bluestem	<i>Andropogon hallii</i>
Prairie Sandreed	<i>Calamovilfa longifolia</i>
Switchgrass	<i>Panicum virgatum</i>
Indiangrass	<i>Sorghastrum nutans</i>
Needle and Thread	<i>Hesperostipa comata</i> ssp. <i>comata</i>
Blue Grama	<i>Bouteloua gracilis</i>
Western Wheatgrass	<i>Pascopyrum smithii</i>
Little Bluestem	<i>Schizachyrium scoparium</i>
Sideoats Grama	<i>Bouteloua curtipendula</i>
Sand Dropseed	<i>Sporobolus cryptandrus</i>
Indian Ricegrass	<i>Achnatherum hymenoides</i>
Hairy Grama	<i>Bouteloua hirsuta</i>
Prairie Junegrass	<i>Koeleria macrantha</i>
Saltgrass	<i>Distichlis spicata</i>
Sixweeks Fescue	<i>Vulpia octoflora</i>
Sand Bluestem	<i>Andropogon hallii</i>
Switchgrass	<i>Panicum virgatum</i>
Indiangrass	<i>Sorghastrum nutans</i>
Manystem Pea	<i>Lathyrus polymorphus</i>
Dotted Blazing Star	<i>Liatris punctata</i>
Purple Prairie Clover	<i>Dalea purpurea</i> var. <i>purpurea</i>
Broadbeard Beardtongue	<i>Penstemon angustifolius</i>
Upright Prairie Coneflower	<i>Ratibida columnifera</i>
Scarlet Globemallow	<i>Sphaeralcea coccinea</i>
White Heath Aster	<i>Symphyotrichum ericoides</i> var. <i>ericoides</i>
Annual Buckwheat	<i>Eriogonum annuum</i>
White Sagebrush	<i>Artemisia ludoviciana</i>
Painted Milkvetch	<i>Atragalus ceramicus</i> var. <i>filifolius</i>

Change Detection

Normalized Difference Vegetation (NDVI)

Section will primarily focus on the NDVI imagery for vegetation reference and current analytics.

The composite NAIP NDVI imagery from 2010-2020, this data set does not contain the NDVI values to perform statistical analysis. The imagery foot print encompasses the site extent and a vegetation reference extent for vegetative analysis.

Remotely sensed data was gathered on 2 - 4 May 2023, which reflects the current vegetative cover statistics.

NDVI calculations used the Near Infrared from the multispectral sensors. The NDVI reflects the measurements from the plant's topmost layer of leaves, typically used during spring emergence into mid-season growth.