



**PAWNEE 16-13H**

**LOCATION ID # 420186**

**Reclamation Plan**

# SITE-SPECIFIC RECLAMATION PLAN

## Site Description



<b>Operator/#</b>	8 NORTH LLC / 10575	<b>County / State</b>	Weld, CO
<b>API#</b>	05-123-32493	<b>Field</b>	Pawnee Buttes
<b>Location ID</b>	420186		Field # 67680
<b>Well Name</b>	Pawnee 16-13H	<b>Lat/Long</b>	40.835220 / -103.992170
<b>Facility Status/ID</b>	CL	<b>Location</b>	NWSW 16 10N59W 6
<b>Status Date</b>	3/23/2021	<b>Reclaim Extent Acres</b>	2.46
<b>Overburden Extent Acres</b>	2.07	<b>Total Reclaim Extent Acres</b>	5
<b>Additional soils cubic yards</b>	1900		

## Report Date

26 July 2021

## Site Evaluation

*Investigator:* Lone Tree Services (LTS)

*Investigation Date:*

*Site Notes:* This site was evaluated on 30 Jun 2021 for pH analysis. No additional soil properties were analyzed.

*Reference soils:* This site is comprised of tree soil types with two of them being the predominant types. The Kim-Mitchell complex, 0 to 6 percent slopes has a loam to clay loam texture at depth. These soils are formed from calcareous loamy alluvium. Landform is Alluvial fans, plains. Well drained with high available water holding capacity, organic matter 0.61 % and pH 7.9

Second soil type is Epping silt loam, 0 to 9 percent slopes, silt loam throughout the profile. These soils are formed from calcareous loamy residuum weathered from siltstone. Landform is plains Well drained with very low water holding capacity, organic matter 0.75 % and pH 7.6.

*Site Description:* This is a Loamy Plain and Shallow Siltstone ecological site. The Loamy Plain occurs on upland positions on plains with mixed grass prairie site dominated by warm-season tallgrasses with an understory of warm-season shortgrass. Cool-season mid grasses are secondary. A variety of forbs and shrubs occur on the site. The Shallow Siltstone occurs in uplands on level to moderately sloping plains. It is a cool-season midgrass rhizomatous and warm-season shortgrass co-dominant site. Forbs and shrubs are a minor components.

*Current Land Use:* Short grass prairie ecosystem – Pawnee National Grasslands.

*Observations:* The site has exposed siltstone and the overburden area has recovered with vegetation.

## Site Soils

Soils were not sampled for reclamation properties only pH (Appendix B - LTS Analysis Pawnee 16-13H 8 Jul 2021). The following properties are representatives of the native conditions based on NRCS Soil Survey Data.

Soil Properties	Map Unit 27	Map Unit 31
pH	7.6	7.9
EC (mmhos/cm)	0.0	0.6
SAR	0.0	0.0
CEC	9.7	12.8
CaCO3 (%)	9	10
OM (%)	0.75	0.61
Particle Size (%Sand-%Silt-%Clay)	29-54-17	38-38-25
Surface Texture	Silt Loam	Loam
Available Water Holding Capacity (cm/cm)	0.17	0.17
Drainage Class	Well Drained	Well Drained
Parent Material	Calcareous loamy residuum weathered from siltstone	Calcareous loamy alluvium

There are no other soil physicochemical properties that should limit reclamation success.

To improve soil health, maintain soil microbial activity, and increase soil stability, LTS has provided a native seed mix recommendation to improve soil conditions and provide sufficient vegetative cover (Table 2). The selected seed mix is intended to improve the soil system by balancing the legumes and grass for quick establishment that will improve soil productivity and stability as the soil surface reaches 80% revegetation percentages. This seed mix is only recommended and does not reflect any requests from the landowner.

**Reclamation Objective:** Restore vegetation with 70% grasses and 30% legumes to increase diversity in the vegetative cover, reduce bare ground and erosion, and provide natural weed suppressant.

Table 2. Recommended seed mix for vegetative cover.

<b>Shallow Siltstone Ecosystem</b>				
	<b>Common Name</b>	<b>Scientific Name</b>	<b>#PLS/Acre</b>	<b>% of Mix</b>
	Blue Grama	<i>Bouteloua gracilis</i>	3	10.68
	Western Wheatgrass	<i>Pascopyrum smithii</i>	5	17.79
<b>Grasses</b>	Little Bluestem	<i>Schizachyrium Nees</i>	2	7.12
	Sideoats Grama	<i>Bouteloua curtipendula</i>	3	10.68
	Green Needlegrass	<i>Nassella viridula</i>	2	7.12
	Slender Wheatgrass	<i>Elymus trachycaulus</i>	6	21.35
				0.00
	Purple Prairie Clover	<i>Dalea purpurea</i>	1	3.56
<b>Forbs/Legumes</b>	Scarlet Globemallow	<i>Sphaeralcea coccinea</i>	5	17.79
	Buckwheat	<i>Eriogonum spp.</i>	1	3.56
	Fourwing Saltbrush	<i>Atriplex canescens</i>	0.1	0.36
<b>Total</b>			<b>28.1</b>	<b>100</b>

## **Grade Reconstruction**

Move overburden soils onto pad location, regrade both sections equivalent to surrounding contour lines (appendix B), avoid compaction as best as possible.

## **Decompaction**

Site conditions represent variation on Silt Loam to Loam texture, compaction was observed within the pad site at a depth of 1 inches, however this area will be filled with the over burden soils. Compaction mitigation is required if reclamation processes cause additional compaction; deep-rip subsurface soils, prior to any replacement topsoil re-application or seed application, to a maximum depth of 18-inches using a parabolic ripper or equivalent agricultural equipment to reduce soil compaction and improve drainage. The shanks on the back of a grader or dozer should NOT be used to reduce soil compaction.

## **Top Soil**

Due soil movement from the overburden site to the reclaimed pad site, the overburden site will also be reclaimed. The addition of a Loamy soil to both areas is equal to 5 acres. The amount of additional top soil is 1900 cubic yards. This will be 3 inches deep of top soil for the seed bed preparation.

## **Soil Amendments**

It is recommended that an application of compost 150 cubic yards is applied to increase organic matter content and retain moisture during germination. A light application of UREA (20-20-20) fertilizer is recommended to increase germination success at an application rate of 100 lbs/acre = 20.0 lbs N/acre. These recommendations will increase the chance of germination and species proliferation.

## **Microbial Amendments**

Apply the selected key beneficial microbial consortium to treat soil functions, specifically targeted to improve productivity, increase plant germination and growth, and improve ecosystem resiliency. Application rate 32 oz/acre. Delivery solution is water.

## **Seedbed Preparation**

Disc the site to a depth of 4.0 to 6.0-inches to create a seedbed conducive to seedling establishment (disk and harrow, field cultivator, vibra-shank, or other alternative suitable to site conditions).

## **Seeding**

Seeding should be conducted using a drill seeder capable of direct seed placement into medium textured soils and the seed mix provided in Table 2. Seed depth is critical for most native grass species. It is recommended that the seed be placed no deeper than ½-inch below ground surface. The recommended seed mix should be seeded at a rate of 28 lbs per acre.

Seeding should occur within ideal seeding windows for greatest success. In Colorado, this is after September 15 for late fall, dormant seeding (preferred) and from spring thaw to June 1, for spring seeding. If reclamation is completed outside of the ideal seeding season, a cover crop should be seeded to provide quick vegetation establishment and more immediate ground cover and protection.

## **Site Observations**

### **Site Photos**

Refer to Appendix A

## Weed Management

Invasive Weed Inventory:

Invasive weeds are present at this site. Weed suppression is recommended prior to seeding. Noxious weeds are listed in Table 3.

**Table 3. Colorado Noxious Weeds by List Type**

List A	List B	List C	Watchlist	Other
None present at time of observation				

**Table 4. Weed Management Recommendations**

Common Name	Scientific Name	Chemical/Product	Rate per Acre	Application
None	None	None	None	None

**\* With this recommendation less than 30 gallons of mixture per acre should be applied.**

***NOTE: All equipment should be cleaned to minimize transportation of weed seeds to other reclamation sites.***

Total application rate for site:

None at this time

The recommendation for this site would be to monitor for weed encroachment due to reclamation processes. Perform the earthwork and seeding in the fall. Monitoring is required to ascertain additional weed pressure by species upon which time, a site-specific Integrated Weed Management Plan (IWMP) should be developed. Noxious, undesirable weedy species include (i.e., cheatgrass, thistle, field bindweed, etc.). Herbicides appropriate for the identified weedy species could be applied to eradicate any problematic species. Application timing and rates for herbicides should follow the manufacturer’s recommendations. At a minimum, weed management during the first two (2) seasons following reclamation should be diligent to improve establishment of seeded grasses and to prevent weedy species infestation.

Lone Tree Services

	Operational Order	ACTION	SPECIFICATION	PURPOSE
ENVIRONMENTAL	0	Stormwater BMPs and Erosion Control	Not Applicable	Not Applicable
	1	Contamination Prevention	Clean all equipment prior to work at site and after	Reduction in transportation of weed species between reclamation sites
WEED CONTROL & PREVENTION	0	Mowing	Mow the field to a height between 4 and 6 inches. Spraying of herbicide should happen between 1-3 weeks after mowing if applied.	Reduce height of weeds to have better herbicide penetration into the canopy, and have greater efficiency.
	4	Integrated Weed Management Plan (IWMP)	Active weed management for weeds present in Table 3. Weed management recommendation in Table 4  Follow up weed control on regular schedule.	Noxious weed control prior to seed bed preparation will reduce weed propagation. Subsequent treatment for seed bank and reemergence.
	3	Overburden	Place the overburden soil on the pad location – regrade	
	3	Compaction Relief	Compaction present with the pad location. Implement decompaction protocol.	Soil Decompaction for seed bed prep
	3	Top Soil	Apply 1900 cubic yards of Loamy top soil	Apply after overburden has been placed on reclaim pad and overburden site
	3	Seedbed Preparation	Disc the site to a depth of 6.0-inches using a disk and harrow, field cultivator, vibra-shank, or other alternative suitable to site conditions	Discing will break up soil clods and enhance seed to soil contact.
	3	Soil Amendments	Apply compost at 150 cubic yards	Increase SOM to facilitate water retention for Germination
	3	Microbial Inoculants	Application Rate – 32 oz/acre	Improve germination and soil available water. Improve soil system functions that improve soil health.
	3	Fertilizer	Urea (20-20-20) – 100lb/acre	UREA provides plant available nitrogen for germination and growth.
	3	Seeding ( <i>see preferred seeding dates</i> )	If reclamation occurs > 30-days prior to preferred seeding dates, drill seed into the soil surface no deeper than ½-inch using the recommended temporary seed mix and rate in Table 2.	Drill seeding enhances seed to soil contact.
	3	Crimp Hay	Apply Hay and crimp after seeding	Reduces soil erosion by wind, retains moisture, and soil stabilization.

**APPENDIX A – Site Photos**

Date 30 June 2020

Photo locations correspond with the site map.



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Picture 1: Pawnee



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Picture 2: South on the East boundary



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Picture 3: South



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Picture 4: West



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Picture 4: West

## Appendix B



**Lone Tree Service  
Environmental  
Data Analysis for Pawnee 16-13H  
Report Date: 2 July 2021**

**Updated 8 July 2021**

Lone Tree first performed a unmanned aerial systems flight to obtain recent high resolution imagery. From this imagery we were able to ascertain the original extent of the pad area, and the area where overburden was placed when the well pad was built. From this imagery we were able to ascertain that the area between the pad and the valley to the Northeast was the location of the overburden. The bank on the Southwest side is the original height of the terrain from before the well pad was constructed. The areas between these locations are transition zones between the two. Lone Tree then proceeded to take multiple soil samples from three distinct areas, Native soil, Pad Boundary, and Overburden (overview map).

The Natives samples represent the baseline surface, or topsoil that is naturally found in this area. One sample was taken in the area that was disturbed on the upper bank and then was reseeded (reference N5). Samples were taken from the overburden area to the Northeast. Table 1 outlines the variation across the landscape coupled with GPS reference maps.

### **Table 1 Summary**

The native samples have an average pH of 8.39 (N=4). The native soils located within the Badland soil formation have an average pH of 8.89 (N=2). NOTE: Sample ID's N6 and PB 2 have a similar elevations, which correlates to the findings within the pad boundary.

The pad boundary samples have an average pH of 8.90 (N=4).

The overburden samples have an average pH of 8.67 (N=5).

The data shows a strong correlation between the soils pH from the badland landform to both the pad boundary and the overburden. These soils are slightly higher in pH (0.5 difference) than the native conditions.

These data depict a strong correlation to elevation and pH, the lower the elevation the higher the pH. These pH values reflect the environmental and soil development conditions that are present in the Pawnee National Grasslands.

In addition, these data indicate the soils in the overburden extent reflect a pH value of 8.67, which is 0.03 difference from the average native pH of 8.64.



## **Map Summary**

These maps correlate the data spatially for visual representation.

Overview map – Remotely sensed data collected on 30 Jun 2021 with soil sample locations.

Elevation Contour Map – reflects the elevation gradient across the pad coupled with the GPS'd locations of each soil sample and the contour gradients

pH Heat Map – reflects the pH gradient across the landscape with only slight variation of higher pH at lower elevations.

Slope Map – reflects the slope gradient with higher slopes on the Eastern boundary of the pad extent and along the western boundary where the overburden extent created the berm during production.

Cut Fill Map – reflects the amount of material needed to fill the pad extent and the amount of material present in the overburden extent. The defect is approximately 6500 cubic meters. **NOTE:** This is an estimate and does not reflect the return of the landscape gradient.

## **Conclusion**

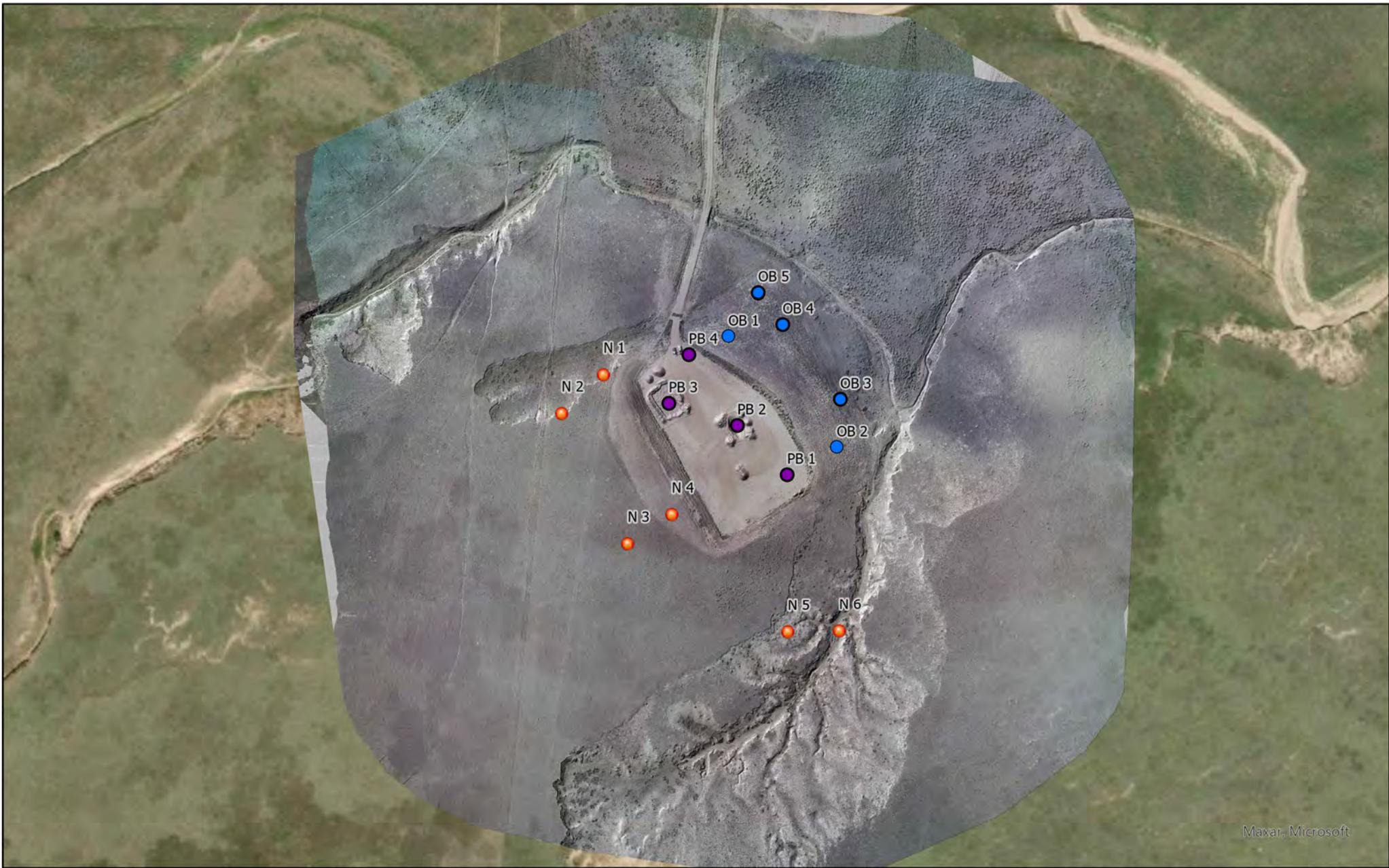
These analysis indicate that current conditions are representative of the site and surround area. The pad location is within a low lying area on top of bedrock composed of calcareous silt stone, which is similar to the land feature to the south, which has a landform designation as Badland. The pad contains residual road base and gravel that are incorporated into the bedrock with little or no formed soil . Sites where the above ground storage tank and the well head have been excavated beneath the level on the pad and to a depth below to pad greater than 15 feet. These location are not representative of the area to be reclaimed and should not be looked at to ascertain any reclamation success.

Lone tree recommends preserving 6-8 inches from the overburden surface to be used as the material on the final grade for vegetation reestablishment.

Pawnee 16-13H pH Analytical Data

Table 1

Location	Sample ID	Depth	Elevation (m) (meters)	Elevation (Δ m) (Δ meters)	pH (1:2) Average	Temp (degree C) Average	RAW pH - Temp Data			
							run 1	Temp 1	run 2	Temp 2
Native - Edge of Drainage & SGP	N1	0-6	1541.68	2.87	8.48	20.5	8.48	20.3	8.48	20.7
Native - Edge of Drainage & SGP	N2	0-10	1542.98	1.57	8.44	20.5	8.39	20.3	8.48	20.7
Native - Shortgrass Prairie (SGP) (Highest Elevation Δ)	N3	2-10	1544.55	0	8.19	20.5	8.17	20.3	8.2	20.7
Native - Disturbed - Reseeded - Grazed	N4	2-6	1543.1	1.45	8.45	20.5	8.44	20.3	8.45	20.7
Average pH for this area										
Native - Badland	N5	0-2	1538.31	6.24	8.65	20.5	8.64	20.3	8.66	20.6
Native - Badland (similar elevations)	N6	0-2	1534.2	10.35	9.13	20.5	9.14	20.3	9.11	20.6
Average pH for this area										
Pad Boundary - Pad Surface w/road base	PB 1	0-1	1537.94	6.61	9.05	20.3	9.05	20.1	9.05	20.5
Pad Boundary - Base of capped well (similar elevations)	PB 2	composite	1535.4	9.15	8.71	20.3	8.72	20.1	8.69	20.5
Pad Boundary - AST	PB 3	composite	1537.35	7.2	9.02	20.3	9.02	20.1	9.01	20.5
Pad Boundary - Pad Surface w/road base	PB 4	0-1	1537.91	6.64	8.83	20.4	8.83	20.2	8.82	20.5
Average pH for this area										
Overburden	OB 1	0-12	1538.71	5.84	8.73	20.7	8.73	20.5	8.72	20.9
Overburden	OB 2	0-12	1537.61	6.94	8.72	20.7	8.73	20.5	8.71	20.9
Overburden	OB 3	0-9	1535.12	9.43	8.47	20.7	8.48	20.4	8.46	20.9
Overburden	OB 4	0-12	1536.7	7.85	8.73	20.7	8.74	20.4	8.71	20.9
Overburden	OB 5	0-9	1536.83	7.72	8.71	20.7	8.71	20.4	8.7	20.9
Average pH for this area										



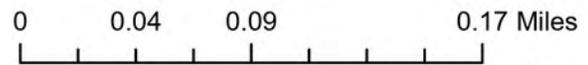
Maxar, Microsoft

**XOG - Location 420186 - Pawnee 16-13H**  
**Map Extent - Overview**

Imagery: RS Orthomosaic  
 Imagery Date: 30 Jul 2021  
 Map Data: 2 Jul 2021  
 Datum: NAD\_1983\_UTM\_Zone\_13N  
 POC: Lone Tree Services

**Sample Points Descriptions**

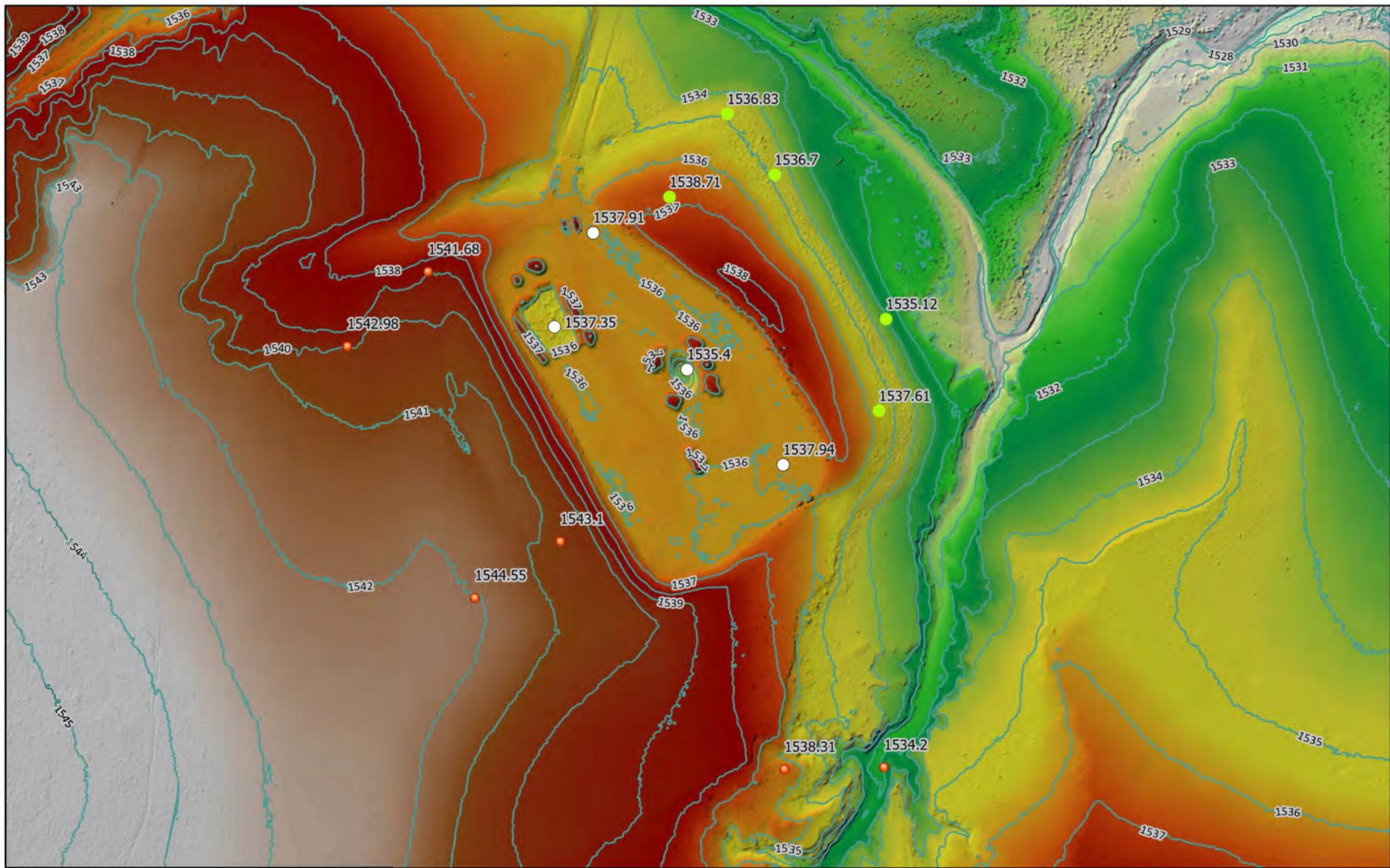
- Overburden Points
- Pad Boundary Points
- Native Soil Points



Scale: 1:4,450

Well Location  
 40.835220  
 -103.992170





**XOG - 420186 - Pawnee 16-13H**  
**Map Extent - Elevation**

Imagery: RS DSM  
 Imagery Date: 30 Jul 2021  
 Map Data: 2 Jul 2021  
 Datum: NAD\_1983\_UTM\_Zone\_13N  
 POC: Lone Tree Services

**Legend**

- Pad Boundary
- Overburden
- Native
- Contours

0 0.02 0.04 0.08 Miles



Scale: 1:2,300

Well Location  
 40.835220  
 -103.992170





**XOG - 420186 - Pawnee 16-13H**  
**Map Extent - pH Heat Map**

Imagery: RS Orthomosaic  
 Imagery Date: 30 Jul 2021  
 Map Data: 2 Jul 2021  
 Datum: NAD\_1983\_UTM\_Zone\_13N  
 POC: Lone Tree Services

**Legend**

**pH Distribution**



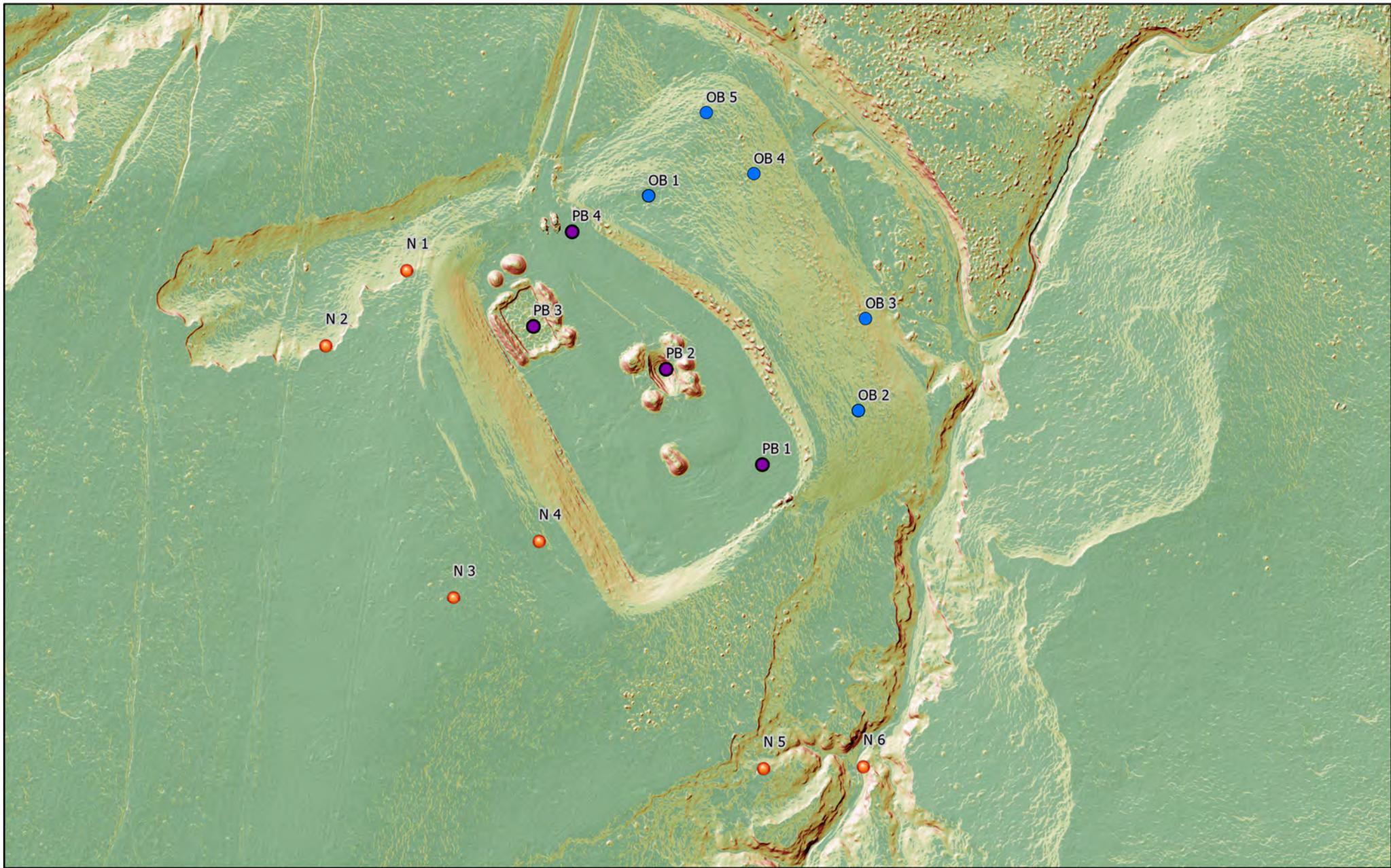
0 0.02 0.04 0.08 Miles



Scale: 1:2,300

Well Location  
 40.835220  
 -103.992170



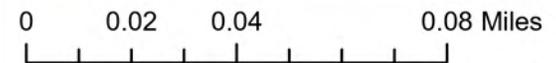


**XOG - 420186 - Pawnee 16-13H**  
**Map Extent - Slope**

Imagery: RS DSM Slope  
 Imagery Date: 30 Jul 2021  
 Map Data: 2 Jul 2021  
 Datum: NAD\_1983\_UTM\_Zone\_13N  
 POC: Lone Tree Services

**Legend**

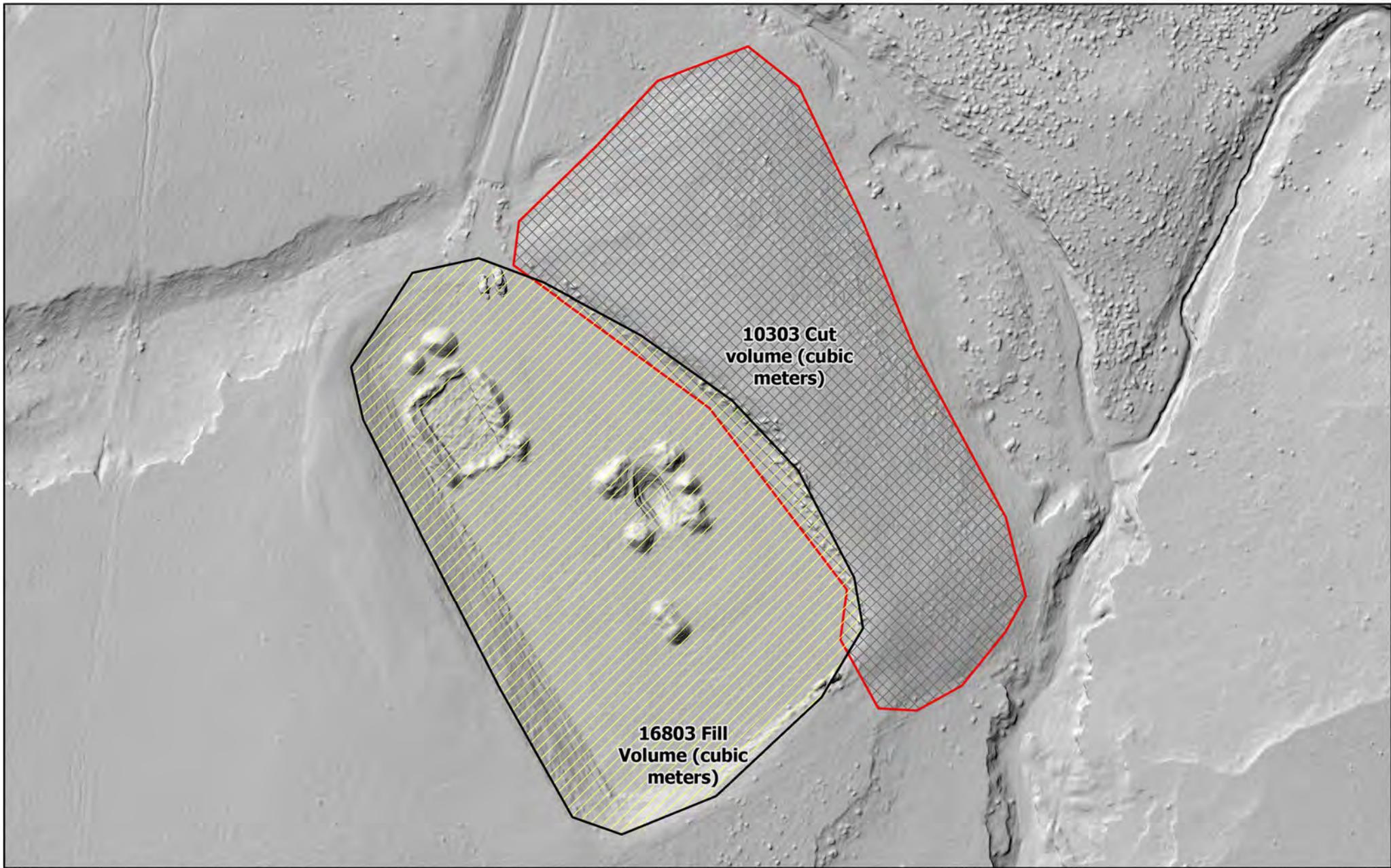
Slope	
	4.88 - 13.9
	14 - 28.9
	29 - 88.8
Percent	
	0.001 - 4.87



Scale: 1:2,300

Well Location  
 40.835220  
 -103.992170





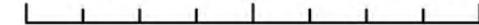
**XOG - 420186 - Pawnee 16-13H**  
**Map Extent - Cut/Fill**

Imagery: RS DSM Hillshade  
 Imagery Date: 30 Jul 2021  
 Map Data: 2 Jul 2021  
 Datum: NAD\_1983\_UTM\_Zone\_13N  
 POC: Lone Tree Services

**Legend**

-  Cut Volume
-  Fill Volume

0 0.01 0.03 0.06 Miles



Scale: 1:1,600

Well Location  
 40.835220  
 -103.992170

