



Reclamation Plan

Horseshoe 1 Well Pad

Washington County, Colorado

Prepared for:
St. Croix Exploration Company

Prepared by:
Duraroot, LLC

Date:
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BASELINE INVENTORY

HORSESHOE 1 – WELL PAD LOCATION



Site Description

Topsoil depths across the proposed St. Croix Exploration Company (St. Croix) Horseshoe 1 well pad location were evaluated and determined by a Duraroot Certified Professional Soil Scientist (CPSS) on July 16, 2021. The proposed Horseshoe 1 well pad is located in the NE ¼ of the NE ¼ of Section 27, Township 3S, Range 49W in Washington County, Colorado (Figure 1). The approximate disturbance area of the facility is 4.3 acres which will be reduced to 0.60 acres during interim reclamation. The pre-disturbance land use is irrigated crop.

During the field investigation, Duraroot collected three (3) soil cores from the proposed location to establish current soil physicochemical properties (Tables 1 and 2). Soil cores were collected from within the Valent sand soil series. Soil samples for each delineated horizon were submitted to Ward Laboratories, Inc, (Kearney, NE) for the following agronomic soil properties: saturated paste pH, electrical conductivity (EC), and sodium adsorption ratio (SAR); soil organic matter content (SOM); nitrate-nitrogen (NO₃-N), phosphorus (Olsen-P), and potassium (K); zinc (Zn), iron (Fe), manganese (Mn), and copper (Cu); percent lime (CaCO₃); and soil texture. A summary of the soil physicochemical properties is as follows:

- **Soil pH:** Soil pH ranges from 6.8 to 8.5 in the Horseshoe 1 well pad soil samples. Soil pH ranges from neutral to strongly alkaline in the Horseshoe 1 well pad soils. Soil pH should not impair crop growth at the Horseshoe 1 well pad.
- **Soil EC:** Soil EC ranges from 0.78 to 3.5 dS/m in the Horseshoe 1 well pad soil samples. Soil EC ranges from non-saline to very slightly saline in the Horseshoe 1 well pad soil samples. Soil EC on the Horseshoe 1 well pad should not a impair crop growth.
- **Soil SAR:** Soil SAR ranges from 1.2 to 8.2 in the Horseshoe 1 well pad soil samples. Soils at the Horseshoe 1 well pad are not sodic. Soil SAR on the Horseshoe 1 well pad should not a impair crop growth.
- **Soil Texture:** Soil sample results indicate the location has very coarse soil textures. Soil texture at the Horseshoe 1 well pad was measured as sand with greater than 90 percent sand content. Soil texture is consistent across the location. Coarse soil textures have low water and nutrient retention and may impair crop growth.
- **Soil Organic Matter:** SOM measured in the Horseshoe 1 well pad soils ranges from 0.40 to 1.8 percent. SOM is suitable (> 0.50 percent) for crop production in topsoil (A) horizon soils and in the recommended salvage depth of 12 inches at the location.
- **Soil Fertility (N-P-K):** Soil nitrogen (NO₃-N) measured in the Horseshoe 1 well pad soils ranges from 8.0 to 330 pounds per acre. Soil phosphorus (Olsen-P) levels in the Horseshoe 1 well pad soils range from 6.7 to 87 ppm. Soil potassium (K) levels in the Horseshoe 1 well pad soils range from 279 to 755 ppm. Soil N, P, and K levels are primarily elevated in the Horseshoe 1 well pad soils and suitable for crop growth. Soil micro-nutrients (Zn, Fe, Mn, and Cu) measured at the location are suitable for crop growth.

Appropriate site preparation procedures, soil amendments, revegetation species, and a site-specific Integrated Weed Management Plan (IWMP) should help expedite reclamation success at the Horseshoe 1 well pad location. A site-specific reclamation plan is provided on Pages 4 and 5.

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Figure 1. Aerial image of the proposed Horseshoe 1 well pad with soil sample locations.

Table 1. Approximate location coordinates for the individual Horseshoe 1 well pad location soil samples.

Sample ID	Latitude	Longitude
SS1	39.76837	-102.84343
SS2	39.76865	-102.84285
SS3	39.76907	-102.84275

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Table 2. Soil physicochemical data for the Horseshoe 1 well pad location. Parameters shown in red may interfere with reclamation success.

Depth (inches)	pH (s.u.)	EC (dS/m)	SAR	N-NO ₃	N	P	K	Zn	Fe	Mn	Cu	SOM	Lime	Saturation	Sand	Silt	Clay	Texture
				lb/acre	(ppm)						%							
SS1																		
0 to 6	7.7	0.80	1.2	9.0	5.3	87	480	9.2	16	5.2	21	1.8	0.10	37	92	4.0	4.0	Sand
6 to 12	7.9	0.78	4.0	8.0	4.2	34	703	7.0	59	2.6	7.2	0.70	0.10	29	93	3.0	4.0	Sand
SS2																		
0 to 8	7.4	2.7	3.7	165	69	39	512	7.0	17	4.7	8.4	1.3	0.10	33	94	2.0	4.0	Sand
8 to 18	8.1	2.7	7.5	165	55	22	521	1.1	47	1.1	1.2	0.60	0.10	29	95	1.0	4.0	Sand
18 to 24	6.8	2.2	7.1	23	38	6.7	279	0.69	23	4.9	0.56	0.50	0.10	26	94	2.0	4.0	Sand
SS3																		
0 to 13	7.5	3.5	6.8	330	85	83	755	7.3	31	19	12	1.1	0.10	36	94	2.0	4.0	Sand
13 to 24	8.5	1.6	8.2	22	11	11	467	0.75	45	38	2.1	0.40	0.10	26	94	1.0	5.0	Sand

Notes:

1. Soil samples were submitted to Ward Laboratories, Inc, (Kearney, NE) for laboratory analysis.
2. Soil analytical results were established using a saturated paste extract.

RECLAMATION PLAN

HORSESHOE 1 – WELL PAD LOCATION



(1) Decompaction

Following construction and grading, deep-rip the Horseshoe 1 well pad soils prior to topsoil replacement to maximum depth possible (minimum depth of 18 inches) using a parabolic ripper or equivalent equipment to reduce post-construction soil compaction and improve drainage and crop growth. The shanks on the back of a grader or dozer should **NOT** be used to reduce soil compaction as this method is ineffective.

(2) Soil Amendments and Fertilizer

Soil amendment application is recommended to improve soil structure on the Horseshoe 1 well pad due to elevated sand content greater than 90 percent. It is recommended to apply cornstalks at a rate of 3.0 to 5.0 tons per acre. The cornstalks should be applied and incorporated into topsoil resources to a depth of 3.0 to 4.0 inches during seedbed preparation activities. Nitrogen (N) application is recommended to accompany cornstalk application to offset N-immobilization during biodegradation. Apply nitrogen at the rate of 75 pounds per acre. Nitrogen should be applied and incorporated into topsoil resources to a depth of 4.0 to 6.0 inches during seedbed preparation activities.

(3) Seedbed Preparation

Disc the site to a depth of 4.0 to 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, incorporate soil amendments, and create a firm seedbed conducive to seedling establishment.

(4) Seeding

If re-establishment of the crop will not occur within 45 days of reclamation activities, cover crop establishment is recommended. An annual cover crop will protect the soil from wind and water erosion, increase soil stabilization, improve soil structure, suppress weed establishment, initiate soil microbial and biologic function, and improve overall reclamation success.

Seed the location using a cover crop of oats (*Avena sativa*) or barley (*Hordeum vulgare*). Seeding should be conducted using a drill seeder capable of direct seed placement into coarse textured soils. Seed depth is critical. It is recommended that the seed be placed no deeper than ½-inch below ground surface. The recommended seeding rate is 60 pounds per acre, which will provide approximately 20 pure live seeds (PLS) per square foot. The cover crop should also include a mycorrhizal inoculum at the rate of 5.0 pounds per acre.

(5) Weed Management

A site-specific IWMP should be implemented once weedy species can be identified. The site could be mowed prior to flowering and seed head production of weedy species. Mowing will reduce competition with desirable species and allow greater opportunity for reclamation success. At a minimum, weed management during the first two (2) seasons following reclamation should be diligent to improve crop establishment and to prevent weedy species infestation.

RECLAMATION PLAN

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Table 3. Reclamation prescription for the Horseshoe 1 well pad.

	ACTION	SPECIFICATION	PURPOSE
RECLAMATION	Compaction Relief	Deep rip soil to a minimum depth of 18 inches using a parabolic ripper or equivalent equipment. Ripping should occur prior to topsoil re-application.	Ripping will reduce soil compaction and improve drainage and leaching of salts from the root zone.
	Soil Amendments	Apply 3.0 to 5.0 tons per acre cornstalks.	Cornstalks will improve soil structure of sandy soils.
	Fertilizer	Apply: <ul style="list-style-type: none"> • Nitrogen = 75 pounds per acre 	Fertilizer application will offset nitrogen immobilization during biodegradation of cornstalks.
	Seedbed Preparation	Disc the site to a depth of 4.0 to 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, incorporate soil amendments, and enhance seed to soil contact.
	Seeding	When re-establishment of the crop will not occur within 45 days of reclamation activities plant a cover crop. Drill seed into the soil surface no deeper than ½-inch using a cover crop of either oats or barley at a rate of 60 pounds per acre. Seed mix should include mycorrhizal inoculum at the rate of 5.0 pounds per acre.	Drill seeding enhances seed to soil contact. A cover crop will stabilize soil resources until planted and will initiate soil microbial and nutrient cycling processes.
	Weed Management	Establish and maintain a site-specific IWMP.	Weedy species will compete with the planted crop for important resources required for germination and seedling establishment.

FACILITY PHOTOS

HORSESHOE 1 – WELL PAD LOCATION



Photo 1. Photo point for the Horseshoe 1 well pad, July 16, 2021.

Location: N 39.76837 W 102.84343

Direction: North



Photo 2. Photo point for the Horseshoe 1 well pad, July 16, 2021.

Location: N 39.76837 W 102.84343

Direction: East



Photo 3. Photo point for the Horseshoe 1 well pad, July 16, 2021.

Location: N 39.76837 W 102.84343

Direction: South



Photo 4. Photo point for the Horseshoe 1 well pad, July 16, 2021.

Location: N 39.76837 W 102.84343

Direction: West