



Site Description

The PDC Energy, Inc. (PDC) Phelps 12-32NHZ well pad was field investigated by a Duraroot, LLC (Duraroot) Certified Professional Soil Scientist (CPSS) on June 19, 2020. The Phelps 12-32NHZ well pad and associated access road are located in the SE ¼ of the NE ¼ in Section 32, Township 1N, Range 66W in Weld County, Colorado (Figure 1). The approximate disturbance area of the Phelps 12-32NHZ well pad and associated access road is 4.8 acres. These wells are active and interim reclamation on this location has been initiated (March 2020). Based on visual observation at the time of the assessment native, desirable vegetative cover is establishing on the reclaimed areas of the location. It should be mentioned that the location was seeded this spring and has not completed a full growing season at the time of the investigation. Weedy species cover is also high. PDC will commence reclamation maintenance on this location this fall (2020).

Site Soils and Vegetation

During the field investigation, Duraroot collected one (1) composite soil sample from three (3) separate areas exhibiting limited reclamation success (Figure 1). Soil samples were collected from surface soils (0 to 6 inches) across the reclaimed portion of the Phelps 12-32NHZ well pad area to determine why germination was limited on portions of the well pad and if soil physicochemical properties could be limiting healthy, native vegetative cover. Surface soil was sampled and analyzed to evaluate current soil physicochemical properties for reclamation maintenance planning (Table 1).

Table 1. Soil chemical and physical parameters from collected soil samples. Parameters in red may interfere with reclamation success.

Depth (inches)	pH (s.u.)	EC (dS/m)	SAR	NO ₃ -N	N	P	K	Lime	Organic Matter	Sand	Silt	Clay	Texture
				lb/acre	ppm			%					
Phelps 12-32NHZ Well Pad													
0 to 6	7.9	0.35	0.90	5.0	3.0	25	79	6.0	0.50	78	9.0	13	Sandy Loam

Soil sample results for the Phelps 12-32NHZ well pad indicate that soil pH, electrical conductivity (EC), and sodium adsorption ratio (SAR) are suitable for reclamation. Soil texture consists of a sandy loam with 78 percent sand content. Coarse soil textures (elevated sand content) have limited water and nutrient retention capabilities. Soil nitrogen (N) and potassium (K) levels are less than optimal and may limit seedling establishment. Furthermore, soil organic matter content is low (0.50 percent) and may impair seedling establishment. There are no other soil physicochemical properties that should limit reclamation success.

Current landuse of the well pad location and adjacent area is native rangeland. The location was seeded in March 2020 to a native grass seed mix. Field observations indicate that grasses have germinated and are establishing (Figure 2). Various weedy, undesirable species were observed as well that could interfere with reclamation success (Figure 3). Weedy, undesirable species included field bindweed (*Convolvulus arvensis*), cheatgrass (*Bromus tectorum*), kochia (*Kochia scoparia*), and lambsquarters (*Chenopodium album*). Field bindweed and cheatgrass are classified as List C Species on the Colorado Noxious Weed list.

Field bindweed is a deep-rooted perennial that spreads from an extensive rootstock and from seed (ACWD, 2020). Most parts of the bindweed roots and rhizomes can produce buds that create new roots and shoots. To successfully manage bindweed, containment and persistence in controlling existing plants are necessary in order to exhaust the root system and deplete the soil seed bank. Cheatgrass is an annual grass species with an aggressive nature to inhabit native rangeland and disturbed areas and become invasive (Beck, 2012). Cheatgrass offers little nutritional value to livestock and is highly flammable, altering the timing and occurrence of range fires that negatively impact other desirable species. In order to



successfully establish a healthy stand of native range grasses a site-specific Integrated Weed Management Plan (IWMP) should be diligently enforced to manage undesirable species. A site-specific IWMP will address various options for weedy species control including chemical, mechanical, and biological methods. Field bindweed and cheatgrass are extremely difficult species to control and will require time and several methods, including herbicide use and mowing (ACWD, 2020; Beck, 2013). PDC will initiate weed management on this location during 2020. Herbicide treatments for these observed species have been provided below.

Finally, prairie dogs (*Cynomys ludovicianus*) are present on the reclaimed portion of the Phelps 12-32NHZ well pad and will most likely interfere with native species establishment (Figure 2). Based on field observations and former aerial imagery of this location, prairie dog populations exist on the western and northern perimeter of the Phelps 12-32NHZ well pad. Historical imagery (circa October 2013) shows that prairie dog habitat existed within the location boundary prior to well pad construction. These populations may re-inhabit the reclaimed portion of the well pad making desirable vegetation establishment more difficult.

Site Reclamation Summary

Achieving successful vegetative cover on the interim portions of the Phelps 12-32NHZ well pad and access road will require several components that address weed control, prairie dog population management, and inter-seeding sparsely vegetated areas to promote healthy, native species cover. Recommendations for more successful reclamation are following.

PDC will implement an IWMP this season to initiate weedy species control. IWMPs address various options for weedy species control including chemical, mechanical, and biological methods. An IWMP will provide the best opportunity to establish a healthy stand of native grasses for Interim reclamation. The IWMP will specifically address field bindweed and cheatgrass cover on-site.

Field bindweed is an extremely difficult species to control and requires several methods, including herbicide use and mowing (ACWD, 2020). To successfully manage field bindweed, containment and persistence in controlling existing stands are necessary in order to exhaust the root system and deplete the soil seed bank. These species need to be continually stressed, forcing plants to exhaust root nutrient stores and eventually die. Weedy species will out-compete planted natives for resources and impair reclamation success. The following IWM practices are recommended to provide the most effective weed control:

2020

1. If vegetation is tall enough to interfere with herbicide application, the location will initially be mowed. Mowing will reduce residue cover and improve herbicide efficacy. Mowing should occur in early to mid-August.
2. The location will be sprayed 7 to 10 days (at a minimum) after mowing with a pre-emergent herbicide (i.e., Esplanade). Pre-emergent herbicides assist in the prevention of new seedling development (cheatgrass) in the fall from the available seed bank produced during the summer growing months.
3. Simultaneously spray the location with a selective **broadleaf** herbicide that is specific for field bindweed (i.e., Dicamba, 2,4-D, Milestone®). Herbicide application will occur in late August to early September. Spraying field bindweed in the fall prior to dormancy will assist in stressing the plants as they prepare to transmit resources to the roots for dormancy and over-wintering.
4. The location will be monitored through October/ early November and hand sprayed with the same selective herbicide as needed.

INTERIM RECLAMATION PLAN

PDC ENERGY – PHELPS 12-32NHZ WELL PAD



2021

1. Duraroot recommends three (3) additional herbicide applications during 2021 using the same selective broadleaf herbicide used in 2020. Spraying should occur:
 - a. in the early spring at pre-flower, bud growth stage;
 - b. during the summer growing season; and
 - c. in the fall prior to inter-seeding.
2. Monitoring should continue on a monthly basis during the 2021 growing season to validate treatment effectiveness and maximize weed management efforts.
3. Inter-seed the location with a desirable, native grass seed mix suitable for soil conditions in the fall if native vegetative cover has not improved. It is recommended that the location be inter-seeded during ideal seeding windows, September 15 through November 15 (dormant), to increase germination success.

Application timing and rates for herbicides should follow the manufacturer's recommendations. All herbicide applications should be approved by property owners prior to application and should be applied by a qualified and certified herbicide applicator. Mowing may be implemented if species begin to flower to prevent seed head production of undesirable species.

Prairie dog management is limited due to the potential of harming other species in the process. Any prairie dog management should occur between November 15, 2020, and March 30, 2021, to avoid harming other species potentially on location. Prairie dog management includes applying rodenticide to control/ reduce populations. Rodenticide use should be conducted by a competent person familiar with the risks of using these products. The location should be monitored every 2 to 4 days during treatment to ensure proper disposal of carcasses to avoid injury to other species. Continued maintenance of prairie dog populations is recommended to preserve seeded vegetation.

References:

- Adams County Weed Department (ACWD). 2020. Fact Sheet 6. Field bindweed Identification and Management. <http://adams.colostate.edu/ag/fieldbindweed.htm> (verified 20 June 2020).
- Beck, G. 2012. Cheatgrass and Wildfire. Colorado State University Extension, Fact Sheet No. 6.310. Available at <https://extension.colostate.edu/docs/pubs/natres/06310.pdf> (verified 20 June 2020).



 1:1200 0 50 100 ft	 Duraroot, LLC 4626 WCR 65 Keenesburg, CO 80643	 PDC Energy 4000 Burlington Avenue Evans, CO 80620	Title: Phelps 12-32NHZ Well Pad Interim Reclamation Area Soil Sample Locations	
			Project: Phelps 12-32NHZ Well Pad	Figure: Figure 1
			Location: Weld County, Colorado	
			Date: 7/02/2020	





Figure 2. Soil surface conditions of the Phelps 12-32NHZ well pad at the time of the assessment highlighting vegetation establishment and prairie dog populations (viewing west).



Figure 3. Close up of bindweed on the Phelps 12-32NHZ well pad at the time of the assessment.

Table 2. Weed management recommendations for the Phelps 12-32NHZ Well Pad.

Common Name	Scientific Name	Colorado Designation	Preferred Management	Recommended Herbicides	Recommended Application Timing	Photo of Species
Downy Brome (Cheatgrass)	<i>Bromus tectorum</i>	<p>List C – Downy brome is an annual that reproduces solely by seed. The fall seed crop has greater reproductive success than spring. Seeds can be dispersed long distances by wind, machinery, contaminated hay, animals, and straw. Seeds can remain viable for more than two to three years in the soil.</p>	<p>To control downy brome cultural and chemical controls should be implemented to contain and eliminate seed sources to reduce competition with desirable species and deplete the seed bank.</p> <p>Non-selective herbicides should be used on young seedlings when non-target plants are present. Due to fall germination and the potential for multiple germinations throughout the year, herbicide application timing is critical. Herbicides approved for use on cheatgrass are usually best applied in fall or early winter before soils are frozen.</p> <p>Selective herbicides should be used when native desirable species have established. Herbicides should be used in conjunction with mechanical methods (tillage) to effectively deplete the seed bank.</p> <p>Mowing –Repeated mowing every 2 to 3 weeks during spring and summer may be as effective as an application of glyphosate. However, mowing just a single time has not been found to be effective in preventing seed production since plants often rapidly regrow and still produce seed.</p> <p>Collect, bag, and dispose of or destroy flowers and seeds; seeds can mature and germinate if left.</p>	<p>1. Pseudomonas fluorescens D7 – bio-herbicide under the trade name D7® by Verdesian Life Sciences, LLC, Cary, NC.</p> <p>2. Imazapic – roadsides and non-crop areas</p> <p>3. Glyphosate – Non-selective; Foliar application only</p> <p>4. Rimsulfuron – roadsides and bare ground sites but not for rangeland</p>	<p>1. Pseudomonas fluorescens D7 – Applied to soil in fall with cool temperatures, overcast skies, and rain.</p> <p>2. Imazapic – Fall, prior to cheatgrass emergence, or spring before cheatgrass reaches 2” tall.</p> <p>3. Glyphosate – Early spring, after cheatgrass emerges and before native perennial seedlings emerge. Has a narrow application window.</p> <p>4. Rimsulfuron – Apply in late fall on emerged seedlings for best results.</p>	

Common Name	Scientific Name	Colorado Designation	Preferred Management	Recommended Herbicides	Recommended Application Timing	Photo of Species
Field Bindweed	<i>Convolvulus arvensis</i>	<p>List C -</p> <p>A non-native, deep-rooted perennial that spreads from an extensive rootstock and from seed. Most parts of the bindweed roots and rhizomes can produce buds that create new roots and shoots. Field bindweed is one of the most persistent and difficult-to-control weeds.</p>	<p>To successfully manage bindweed, containment and persistence in controlling existing plants are necessary in order to exhaust the root system and deplete the soil seed bank. Control of field bindweed isn't easy, and it can't be accomplished with a single treatment or in a single season.</p> <p>Effective control requires prevention of seed production, reduction of stored carbohydrates by deep tillage of the root system, competition for light from other plants, and constant vigilance in removing top growth. Application of herbicides, which reduce bindweed growth and kill germinating seedlings, can also be part of an integrated pest management program. It is important to control new infestations when they are small, because spot control is the least expensive and the most effective strategy.</p>	<p>1. Dicamba</p> <p>2. 2,4-D</p> <p>3. Glyphosate - Non-selective; Applied to actively growing plants.</p>	<p>More than one application will have to be made during the summer growing season.</p> <p>Fall application will exhaust the root system as the plant prepares for overwintering.</p>	

Ag Testing - Consulting

Account No. : 23042

Soil Analysis Report

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DURAROOT
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KEENESBURG

CO 80643

Invoice No. : 1319015
Date Received : 06/26/2020
Date Reported : 06/30/2020

Results For : PDC 4024500
Location : PHELPS

Lab No. : 67093 Depth : 0 - 6
ID : PHELPS

1:1 Soil pH	8.2
Soluble Salts 1:1, mmho/cm	0.11
Excess Lime Rating	NONE
Organic Matter LOI, %	0.5
Nitrate-N KCl, ppm N	3.0
Nitrate-N, lbs N / Acre	5
Phosphorus M3, ppm P	25
Potassium NH ₄ OAc, ppm K	79
Sulfate M-3, ppm S	2.4
Calcium NH ₄ OAc, ppm Ca	1569
Magnesium NH ₄ OAc, ppm Mg	198
Sodium NH ₄ OAc, ppm Na	29
Calcium Carbonate, %	6.0

Sum of Cations, me/100g	% Saturation				
	H	K	Ca	Mg	Na
9.8	0	2	80	17	1

Saturated Soil Paste Analysis (SAR)

Saturation, %	31
Sat Paste pH	7.9
Sat Paste E _{Ce} , mmho/cm	0.35
HCO ₃ , ppm	149
Cl, ppm	11
Ca, ppm	39
Mg, ppm	8
Na, ppm	23
S, ppm	7.8
Sodium Adsorption Ratio	0.9

Soil Texture	Sand, %	Silt, %	Clay, %
Sandy Loam	78	9	13

Reviewed By : Nick Ward

7/1/2020

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