



Pacific Crest Well Pipeline Revegetation Project

2019 Annual Report





ON THIS PAGE

Seeding pots as part of plant propagation for the Pacific Crest Well Pipeline project.
Photo by Carrie Wyler

ON THE COVER

Post-construction project area along Highway 62.
Photo by Scott Heisler

Pacific Crest Well Pipeline Revegetation Project

2019 Annual Report

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This annual report series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by a subject matter expert who was not directly involved in the collection, analysis, or reporting of the data.

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Abstract

In 2017, Crater Lake National Park converted an existing exploratory groundwater well into a supplemental potable water source, the Pacific Crest Well. Development of pumping infrastructure and a transport pipeline created approximately 2.3 acres of bare-ground disturbance alongside a popular Park entrance road and regional transportation corridor. The Crater Lake National Park Botany program received funding to carry out restoration of this impacted area, with a project length of four years. In the third year (2019) of the project, restoration efforts consisted of continued site monitoring; care of plants propagated during the 2018 field season; native seed collection, cleaning, and storage; and invasive vegetation management. Results of these efforts consisted of collecting 1,414 grams of native seed; care of 3,235 containerized plants; and invasive vegetation management surveys which investigated 150 historic invasive plant populations and treated 27 current populations. Due to continued delays in the construction schedule, large sections of the project area remain excluded from restoration efforts and will be restored when possible.

Acknowledgments

The Crater Lake National Park Maintenance division provided funding to support this work. The Crater Lake National Park Revegetation crew (Melody Frederic, Carson Ralls, and Benjamin Wright) assisted with native seed collection. The Crater Lake National Park Invasive Vegetation Management crew (Delacey Randall, Elena Olsen, Hamilton Hasty, Sarah Hogan, Matthew Jelinske, and Vance McNees) assisted with invasive plant survey and control.

Introduction

Crater Lake National Park's (CRLA) Annie Spring Supplemental Potable Water Plan (ASSPWP) was originally drafted in 2015 in response to the need for a reliable, adequate, long-term source of potable water to support the Park's developed areas (NPS 2016). In May of 2017, a water call was placed on the park's primary potable water source, Annie Spring, expediting the ASSPWP-proposed conversion of an existing exploratory well into a new potable water source, the Pacific Crest Well (PCW). In the summer of 2017, construction commenced for the creation of well infrastructure which include an underground pipeline connecting the PCW to existing water supply lines and an underground utility (electrical power, pump control communication) conduit.

In total, the project created approximately 2.3 acres of bare, heavily disturbed ground alongside portions of Oregon State Highway 62 and Munson Valley Road in the vicinity surrounding CRLA's Annie Spring entrance station. In anticipation of this disturbance, CRLA's Botany program petitioned for and received funding to mitigate the impact on native vegetation communities, and to restore the scenic beauty of this high profile roadside viewshed. The funds support salary and supply costs for a seasonal Biological Science Technician to achieve the following tasks:

- Survey for and control invasive plant species within the project area to prevent introduction and spread
- Help develop a revegetation plan that addresses site repair goals
- Collect native seeds and plant materials from adjacent wildlands for restoration efforts
- Dry, clean, process, and store collected plant materials
- Prepare and distribute seed mixes using broadcast seeding methods
- Rehabilitate disturbed soils through adding native organic materials such as Park-sourced compost and woody debris
- Help propagate native herbaceous and shrubby plants for restoration plantings
- Monitor efficacy of restoration efforts and augment seeding/planting as needed to restore barren areas
- Produce annual reports of efforts and findings

In order to ensure the success of revegetation and invasive plant survey & control efforts, the project was budgeted to span three years: 2017-2019. In the first year of the project, all construction activities were scheduled to be completed, but primary construction work was not concluded until September 2018. Installation of an underground electrical line is planned, and continuing disturbance to limited sections of the project area is anticipated from this activity, which will push the project into its fourth year in 2020. Restoration efforts in 2019 focused on two distinct

components: revegetation (restoration site monitoring, propagated plant care, and native seed collection/processing), and invasive vegetation management (IVM). These components will be discussed separately in the methods and results sections.

Methods

Revegetation

Revegetation efforts targeted disturbed areas surrounding the wellhead and expanded Pacific Crest Trail parking lot, the length of pipeline/conduit trenching alongside Highway 62 (Figure 1), the area alongside the existing Mazama storage tanks access road, and the run of pipeline/conduit trenching from the Mazama storage tank access road to the Mazama booster pump under the Annie Creek bridge on Munson Valley Road. These areas notably exclude the run of pipeline/conduit trenching connecting the Mazama storage tank access road area to the Highway 62 roadside area, as this stretch follows an old highway grade that will be utilized as a service road. The project area is highlighted in Figure 2.

A revegetation plan was developed in 2017 containing revegetation prescriptions and site documentation for the two main habitats and plant communities observed within the project area. The area was divided into two zones: an upper zone dominated primarily by grasses, sedges, and forbs; and a lower zone that was more densely forested. This documentation was created to provide guidelines for restoration efforts and to serve as a baseline from which to monitor the progress of these efforts. This documentation was updated in 2019 (Appendix A).



Figure 1. Disturbed areas along Highway 62 have been slowly revegetating since 2017. This area will be further impacted by installation of an underground electrical conduit. Photo by Scott Heisler.



Figure 2. Areas disturbed by the PCT Well Pipeline are highlighted in yellow and total 2.3 acres. Map by Scott Heisler.

Plant Propagation

Two rounds of plant propagation (Figure 3) have been conducted to source containerized native plants for use in this project’s rehabilitation efforts: one in spring 2018, and another in fall 2018. The plants are housed at the Botany program’s nursery facility located at the Ball Diamond area, and were cared for throughout the 2019 growing season according to the program’s established native plant nursery protocols (on file on the Botany server). For overwintering, all of the pots were placed in a tight group, and mulch was packed around the perimeter to protect roots from exposure to severe cold and desiccation (Figure 4).



Figure 3. Plants growing for restoration at the Ball Diamond. Photo by Jen Hooke.



Figure 4. Preparing plants for overwintering by insulating the perimeter with mulch. Photo by Carrie Wyler.

Native Seed Collection and Processing

Seed collection targets were initially set at 15 lbs./acre (6.8 kg/acre), with a disturbed area size of around 1.1 acres based on the project's 2015 environmental assessment (NPS 2016). As previously stated, the actual disturbed area has encompassed 2.3 acres. Native seed was collected from all grasses, sedges, rushes, forbs, and shrubs that were encountered within one mile of the project area (Table 1). The dense forest canopy cover and depauperate understory found in the lower project area restricted fruitful collection to roadsides and forest openings (Figure 5). Seeds were collected according to the Botany program's established Seed Collection Protocols (Beck et al. 2017). This seed was then dried and cleaned (Figure 5) according to the Botany program's Seed Cleaning and Short-Term Storage Protocol (on file on the Botany server). Limited collections of individual species were maintained during collection and processing for use in plant propagation. The remaining seed was combined for use in future broadcast seeding.



Figure 5. Depauperate understory area (left). Cleaning seed (right). Photos by Scott Heisler.

Table 1. List of plant species from which seed was collected with observed 2019 plant phenology.

Scientific Name	Leaf	Bud	Flower	Fruit	Seed
<i>Achnatherum occidentale</i>	6/10	6/17	7/08	*	8/05
<i>Anaphalis margaritacea</i>	6/10	7/01	7/22	8/05	8/26
<i>Boechera howellii</i>	*	*	6/10	7/01	8/05
<i>Bromus carinatus</i> var. <i>carinatus</i>	6/10	6/24	7/08	8/05	8/26
<i>Calyptridium umbellatum</i>	*	*	*	6/10	7/08
<i>Carex halliana</i>	*	*	6/10	7/01	8/05
<i>Carex pachycarpa</i>	*	*	6/10	7/01	8/05
<i>Chamaenerion angustifolium</i> var. <i>canescens</i>	*	*	*	8/26	9/27
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	6/10	6/17	6/24	7/08	8/05
<i>Elymus glaucus</i> ssp. <i>glaucus</i>	6/10	6/17	7/01	7/29	8/05
<i>Ericameria greenei</i>	6/10	7/1	8/19	8/26	9/15
<i>Juncus parryi</i>	*	6/10	6/24	7/08	8/05
<i>Lupinus andersonii</i>	*	*	6/10	7/08	8/05
<i>Lupinus lepidus</i> var. <i>lobbii</i>	*	*	6/17	7/01	7/29
<i>Nothocalais alpestris</i>	*	*	6/10	6/24	7/22
<i>Penstemon rydbergii</i> var. <i>oreocharis</i>	*	*	6/10	7/01	8/26
<i>Phacelia hastata</i> var. <i>hastata</i>	*	6/10	6/24	7/29	8/19

* Data unavailable for that phenological phase.

Invasive Vegetation Management

Given the project area location, IVM stands as a critical component of a successful revegetation effort (Figure 6). Highway 62 serves as both a portal into the Park, as well as a thoroughfare for vehicles crossing between the Rogue and Klamath basins. The PCT trailhead is a staging area for horses and pack-stock and the PCT is a popular trail through the Park. Mazama Village and Campground are located near the PCW pipeline corridor, and both areas have well-established populations of invasive plants. The heavy usage received by this area increases the risk for introduction of invasive plant seeds coming from outside the Park; combined with the high levels of disturbance found in the PCW pipeline corridor, establishment of new invasive plant populations is likely.

IVM measures taken include conducting area surveys and controlling invasive plant species, both before and during construction. See the 2019 IVM Annual Report (Randall et al. 2020) for detailed methodology on invasive plant survey and control. Historic invasive plant populations were investigated using the IVM program's geodatabase, which maintains invasive plant records from 2003—present, and newly discovered populations were added to the geodatabase.

Results

Revegetation

Revegetation efforts in 2019 were focused on care of previously propagated containerized plants awaiting outplanting (Figure 7), and continued collection of plant materials. All restoration sites were monitored in 2019; updated site monitoring documentation is included in Appendix A.



Figure 6. Roadside St. John's wort growing in the project area. Photo by Elena Olsen.



Figure 7. Thinning germinated seedlings to promote plant vigor and size. Photos by Carrie Wyler.

Plant Propagation

In total, 3,235 living containerized plants were cared for during the 2019 field season (Table 2). These plants experienced modest growth during the 2019 growing season at the Ball Diamond plant nursery. These plants were not outplanted in fall 2019, given the anticipated disturbances from continued construction in the project area. It is hoped outplanting will occur in fall 2020.

Table 2. Native plant inventory from the Ball Diamond nursery to be used in the PCT Well Pipeline revegetation project.

Common Name	Scientific Name	Living Containerized Plants (#)
Needlegrass	<i>Achnatherum occidentale</i>	448
Howell's flatseed rockcress	<i>Boechera howellii</i>	333
California brome	<i>Bromus carinatus</i> var. <i>carinatus</i>	486
Many-rib sedge	<i>Carex pachycarpa</i>	294
Common squirreltail	<i>Elymus elymoides</i> var. <i>elymoides</i>	400
Forb mix	n/a	294
Graminoid mix	n/a	980
Total		3,235

Native Seed Collection and Processing

A total of 1,414 g of rough-cleaned native seed was collected during the 2019 field season, as outlined in Table 3. The total amount of seed in storage is also detailed in Table 3. This seed was dried and cleaned at the Park and is stored in the Botany program’s seed storage freezer (Figure 8). This will be available for broadcast seeding upon completion of construction. Additional seed collection efforts will not be made during the 2020 field season. After disturbed areas are planted and seeded in fall 2020, the area will be monitored for recovery and restoration success. Additional seed may be collected (summer 2021-22) to fill in poorly recovering sites as needed, although there are presently no funds to support this work.



Figure 8. Seed in storage in the Botany freezer. Photo by Scott Heisler.

Table 3. Native seed collected during the 2019 field season, and total amounts of seed in storage.

Common Name	Scientific Name/Mix	2019 Seed Collected (g)	Total Seed in Storage (g)
Needlegrass	<i>Achnatherum occidentale</i>	199	208
Howell’s flatseed rockcress	<i>Boechera howellii</i>	6	10
California brome	<i>Bromus carinatus</i> var. <i>carinatus</i>	73	97
Pussypaws	<i>Calyptidium umbellatum</i>	7	7
Hall’s sedge	<i>Carex halliana</i>	119	119
Many-rib sedge	<i>Carex pachycarpa</i>	150	202
Fireweed	<i>Chamerion angustifolium</i>	25	25
Common squirreltail	<i>Elymus elymoides</i> ssp. <i>elymoides</i>	590	905
Blue wildrye	<i>Elymus glaucus</i> ssp. <i>glaucus</i>	12	25
Greene’s goldenweed	<i>Ericameria greenei</i>	79	79
Parry’s rush	<i>Juncus parryi</i>	6	6
Anderson’s lupine	<i>Lupinus andersonii</i>	35	35
Prostrate lupine	<i>Lupinus lepidus</i> var. <i>lobbii</i>	9	9
Rydberg’s penstemon	<i>Penstemon rydbergii</i> var. <i>oreocharis</i>	24	24
Compact phacelia	<i>Phacelia hastata</i> var. <i>compacta</i>	2	2
Asteraceae mix	n/a	78	78
Forb mix	n/a	0	346
Graminoid mix	n/a	0	1353
Lupine mix	n/a	0	605
Total		1,414	4,135

Invasive Vegetation Management

The entire project area was surveyed for invasive plant species, including 150 historic populations. Twenty-seven populations of invasive plant species were encountered, mapped, and treated in 2019 (Figure 9). Populations of two invasive plant species new to the project area were discovered alongside the installed pipeline on Highway 62: red fescue (*Festuca rubra*), and colonial bentgrass (*Agrostis capillaris*) (Figure 10). The most commonly encountered invasive plant species in the project area were colonial bentgrass (219 plants); smooth brome (*Bromus inermis* – 123 plants); sheep sorrel (*Rumex acetosella* – 536 plants); and dandelion (*Taraxacum officinale* – 157 plants), with a total of 1,103 plants treated. Other invasive plant species encountered included bull thistle (*Cirsium vulgare*), red fescue (*Festuca rubra*), St. John’s wort (*Hypericum perforatum*), timothy (*Phleum pratense*), narrowleaf plantain (*Plantago lanceolata*), and red sandspurry (*Spergularia rubra*).

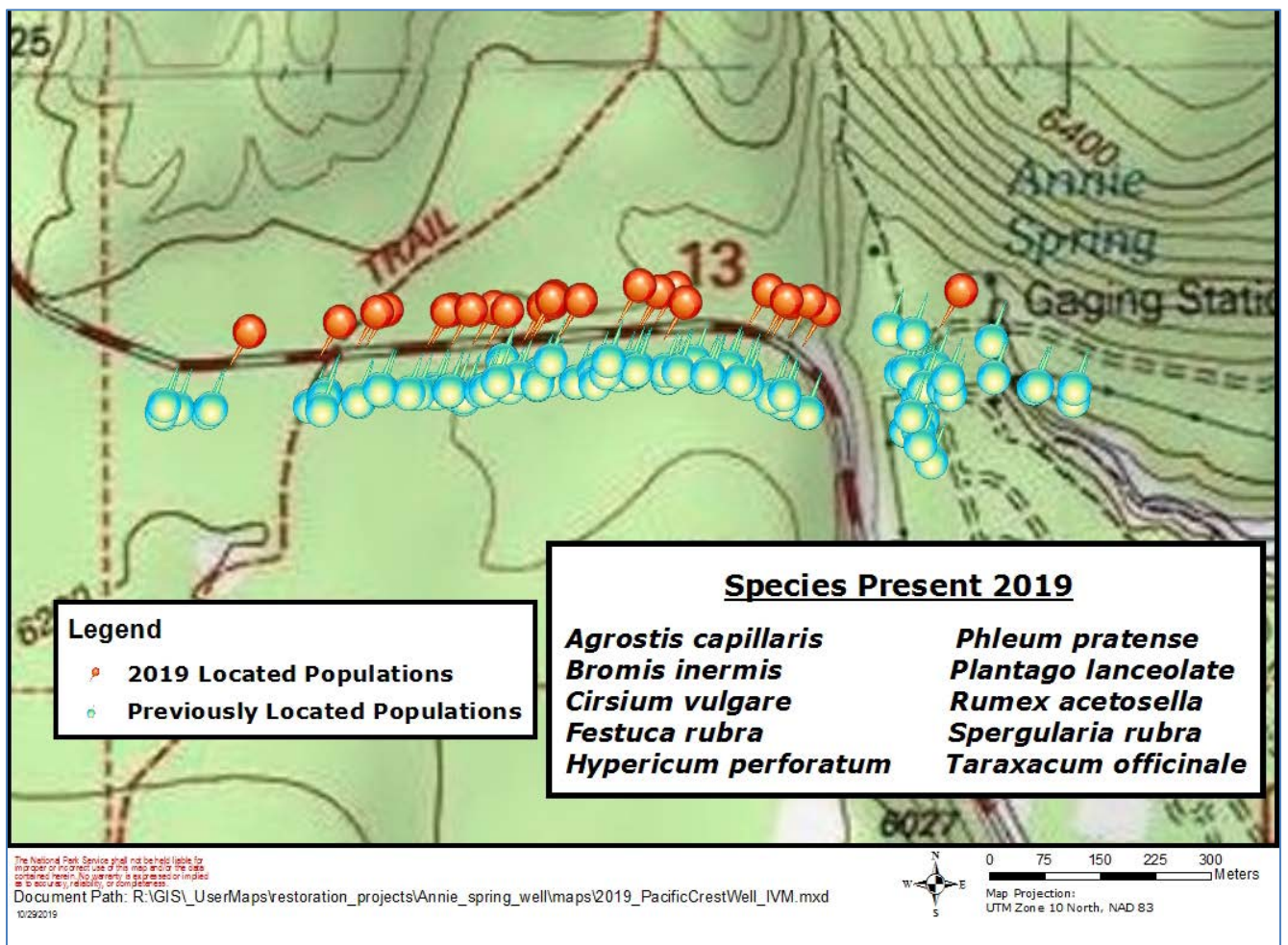


Figure 9. Invasive plant populations treated in 2019. Map by Scott Heisler.



Figure 10. Two new-to-the-project-area invasive plant species encountered in 2019: colonial bentgrass (left) and red fescue (right). Photos by Scott Heisler.

Discussion

Continuing delays in project completion have resulted in extensive areas persisting for a third year without any rehabilitative action. The delay has resulted from an extended negotiation period regarding right of way with the power utility company; these negotiations are planned to be completed and the power cables installed during the 2020 field season.

The containerized plants grown for this project will ideally be outplanted in fall 2020 if the power cables are installed as planned. Given the uncertain timetable for final completion of construction, it is possible that these plants will ultimately have spent over three growing seasons in containers before outplanting. The plants will need to be evaluated in summer 2020 to assess if division or increasing pot size is needed to prevent root binding and promote vigor.

Continued monitoring of disturbance areas and revegetation methods utilized will be essential over the next several years to ensure that recovery and vegetative succession are jumpstarted and proceeding as desired. No seed collection is scheduled for the 2020 field season; if additional revegetation is deemed necessary then seed collection should occur in the summer of 2021.

Maintaining IVM in the project area, especially in areas of continued construction disturbance, will be essential to identify new invasive plant populations and treat them before they become established or set seed. The areas being used as service roads should receive attention in annual IVM efforts, and notice should be given that utility vehicles must be cleaned and inspected before using these roads as per standard Park operating procedures.

In 2019 a distinct social trail emerged from the PCT trailhead parking area paralleling Highway 62 towards Mazama Village. At this time the social trail is narrow, but any revegetation efforts should be focused outside of this corridor as it appears to be a popular travel route for PCT hikers. This social trail should be monitored to ensure that hikers aren't causing soil erosion by cutting down the steep slope towards Mazama Village.

Literature Cited

Beck, J.S., A.H. Fraser, C.S. Wyler, M.C. Frederic, and K.M. Williams. 2017. Rim Drive Rehabilitation Revegetation Project 2016 Annual Report. Crater Lake National Park, Crater Lake, Oregon.

D.R.A. Randall, E.L. Olsen, J.S. Hooke, H.L. Hasty, S.E. Hogan, V.J. McNees, and M.W. Jelinske. 2020. Invasive Vegetation Management: 2019 Annual Report. National Park Service, Crater Lake National Park, Crater Lake, Oregon.

National Park Service (NPS). 2016. Augment Annie Springs Water Supply Environmental Assessment. On file at Crater Lake National Park. National Park Service, Washington, District of Columbia.

Appendix A

Full site summary reports are on file on the Botany server at:

R:\BOTANY\Ecological Restoration\Restoration Projects\Annie Springs Well\Site documentation

Restoration Monitoring 2019: Lower section

Date: 8/12/19	Recorder(s): CW, SH	Time Since Restoration: 1 year*
Site ID/Name: PCT well lower, near south entrance station		
Survivorship from planting/seeding (High/Med/Low): Medium		
Repeat Photography Photopoints (UTM Zone 10, NAD83)		
1	UTME: 0567840	UTMN: 4746917
2 (facing North)	UTME: 0567768	UTMN: 4746882
3 (facing West)	UTME: 0567768	UTMN: 4746882
Regeneration Assessment		
Total Vegetation Cover: 5%		
Species Cover (As a percentage of the total vegetation):		
Species	Common Name	Relative % Cover
Grasses/Sedges/Rushes	Graminoids	78
<i>Lupinus lepidus</i> var. <i>lobbii</i> / <i>Lupinus andersonii</i>	Prostrate lupine/ Anderson's lupine	2
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat	1
Conifers (seedlings)	Seedling conifers	10
<i>Calyptridium umbellatum</i>	Pussypaws	7
<i>Gayophytum diffusum</i> ssp. <i>parviflorum</i>	Nuttall's groundsmoke	2
	TOTAL	100%
Site Notes: (note erosion, tire tracks, etc.)		
Invasive Plant Assessment		
Invasive Plant Species	# Present at Restoration	# Present 2019
none	0	0
General Comments/ Additional Site Needs and Recommendations:		
<p>*Only salvaged plants were replanted and approximately 70 grams cleaned seed mix was distributed on the edges of the site. Area wasn't fully planted or seeded because a truck will need to be driven into the area to place cabling in the vaults.</p> <p>-Salvaged plants that were replanted are doing well, not many seedlings coming up.</p>		

2019 Photos: Lower Section



Restoration Monitoring 2019: Highway 62 Roadside

Date: 8/12/19	Recorder(s): CW, SH	Time Since Restoration: 1 year*
Site ID/Name: PCT well upper, Hwy 62 roadside		
Survivorship from planting/seeding (High/Med/Low): High		
Repeat Photography Photopoints (UTM Zone 10, NAD83)		
1 (end)	UTME: 0567494	UTMN: 4746900
2 (Facing East)(middle area)	UTME: 0567322	UTMN: 4746888
3 (Facing West)(middle area)	UTME: 0567322	UTMN: 4746888
4 (Facing East)	UTME: 0567049	UTMN: 4746873
5 (Facing West)	UTME: 0567036	UTMN: 4746867
6 (end)	UTME: 0566976	UTMN: 4746860
7 (area behind pullout)	UTME: 0566976	UTMN: 4746860
Regeneration Assessment		
Total Vegetation Cover: 5%		
Species Cover (As a percentage of the total vegetation):		
Species	Common Name	Relative % Cover
Grasses/Sedges/Rushes		35
<i>Lupinus lepidus</i> var. <i>lobbii</i> / <i>Lupinus andersonii</i>	Prostrate lupine/ Anderson's lupine	31
<i>Phacelia hastata</i> ssp. <i>compacta</i>	Compact phacelia	1
<i>Conifers</i> (seedlings)	Seedling conifers	5
<i>Gayophytum diffusum</i> ssp. <i>parviflorum</i>	Nuttall's groundsmoke	1
<i>Calyptidium umbellatum</i>	Pussypaws	20
<i>Anaphalis margaritacea</i>	Pearly everlasting	2
<i>Epliobium</i> species	Willowherb	5
	TOTAL	100%
Site Notes: (note erosion, tire tracks, etc.)		
Some tire tracks		
Invasive Plant Assessment		
Invasive Plant Species	# Present at Restoration	# Present 2019
<i>Bromus inermis</i>	Smooth brome	multiple
<i>Poa compressa</i>	Canada bluegrass	multiple
<i>Taraxacum officinale</i>	Common dandelion	multiple
<i>Plantago lanceolata</i>	English plantain	1
General Comments/ Additional Site Needs and Recommendations:		
<p>*Only salvaged plants were replanted and approximately 400 grams of rough-cleaned seed mix was distributed. Area wasn't fully planted or seeded because cable still needs to be pulled through the vaults in the ground in the future; therefore, large trucks will be driving on the area.</p>		

2019 Photos: Highway 62 Roadside



Point 5



Point 6



Point 7



Restoration Monitoring 2019: Trailhead Parking

Date: 8/12/19	Recorder(s): CW, SH	Time Since Restoration: 1 year*
Site ID/Name: PCT well upper, trailhead parking		
Survivorship from planting/seeding (High/Med/Low): Medium		
Repeat Photography Photopoints (UTM Zone 10, NAD83)		
8	UTME: 0566984	UTMN: 4746845
9	UTME: 0566980	UTMN: 4746797
10 (island)	UTME: 0566963	UTMN: 4746805
11	UTME: 0566954	UTMN: 4746814
Regeneration Assessment		
Total Vegetation Cover: 10%		
Species Cover (As a percentage of the total vegetation):		
Species	Common Name	Relative % Cover
Grasses/Sedges/Rushes	Graminoids	50
<i>Lupinus lepidus</i> var. <i>lobbii</i> / <i>Lupinus andersonii</i>	Prostrate lupine/ Anderson's lupine	15
<i>Phacelia hastata</i> ssp. <i>compacta</i>	Compact phacelia	1
Conifers (seedlings)	Seedling conifers	30
<i>Calyptridium umbellatum</i>	Pussypaws	3
<i>Epliobium</i> species	Willowherb	1
	TOTAL	100%
Site Notes: (note erosion, tire tracks, etc.)		
Invasive Plant Assessment		
Invasive Plant Species	# Present at Restoration	# Present 2019
none	0	0
General Comments/ Additional Site Needs and Recommendations:		
<p>*Only salvaged plants were replanted, and some rough cleaned seed mix was distributed. Area wasn't fully planted or seeded because we anticipated additional disturbance from electrical cabling project.</p>		

2019 Photos: Trailhead Parking



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