



Pacific Crest Well Pipeline Revegetation Project

2017 Annual Report





ON THIS PAGE

The project area along Highway 62 during construction.
Photo by Carrie Wyler.

ON THE COVER

Pre-construction picture of the area to be disturbed by the new pipeline on Highway 62.
Photo by Jen Hooke.

Pacific Crest Well Pipeline Revegetation Project

2017 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 an approximately 2.3 acre area 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 vegetative restoration of this impacted area, with a project length of three years. In the first year of the project, restoration efforts consisted of site assessment, monitoring, and mapping; native seed collection, cleaning and storage; plant salvaging from the construction area, and care for these plants; and Invasive Vegetation Management. Results of these efforts consisted of salvaging 144 containers of plants, collection and storage of 2,426 grams of native seed, Invasive Vegetation Management surveys which investigated 39 historic noxious weed population sites and documented and treated 29 current population sites; and creation of a framework to guide efforts in the final two years of the project. Due to delays in the construction schedule that precluded project completion, no planting, seeding, or transplanting was accomplished this season.

Acknowledgments

The Crater Lake National Park Maintenance Division provided funding to support this work. Chris Wayne provided assistance with GIS mapping and documentation. The Crater Lake National Park Invasive Vegetation Management crew (Sarah Hall, Michael Hernandez, Delacey Randall, Lindsay Crouch, Katie Ripstein, Eddie Silahua, and Rachel Wheatley) 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 summer of 2017, construction commenced for creation of a well pumping infrastructure, an underground pipeline connecting the PCW to existing water supply lines, and an underground utility (electrical power, pump control communication) conduit for the newly converted well.

As of November 1, 2017, construction work has created 2.32 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 (Plants) to achieve the following tasks:

- Survey for and control non-native, invasive plant species within project area to prevent introduction and spread.
- Develop a revegetation plan for seed collection, site repair, broadcast seeding, and planting.
- Collect native seeds and plant materials from adjacent wildlands.
- Dry, clean, process, and store collected plant materials.
- Prepare seed mixes for broadcast seeding.
- Rehabilitate disturbed soils through adding native organic materials such as Park-sourced compost and woody debris.
- Propagate native herbaceous and shrubby plants for restoration plantings.
- Broadcast seed of native grasses, forbs, sedges, and shrubs.
- 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 has been budgeted to span three years: 2017-2019. In the first year of the project, all construction activities were scheduled to be completed, but were ongoing at the onset of the winter snow pack. Restoration efforts for 2017 focused on two distinct components: revegetation (planning, native seed

collection and processing, salvaging plant materials), and invasive vegetation management (IVM). These components will be discussed separately in the Methods and Results sections.

Methods

Revegetation

Revegetation efforts of the project target disturbed areas surrounding the wellhead and expanded Pacific Crest Trail parking lot, the run of pipeline/conduit trenching alongside Highway 62, 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 which will be utilized as a service road.

Initial assessment divided the planned disturbance sites into two habitats and plant community structures: the south facing, minimally shaded roadside along Highway 62 and PCT parking lot (referred to as Upper); and the cooler, higher canopy cover shaded areas in the gulch near Annie Spring and the Mazama storage tanks access road (referred to as Lower). Profiles were developed for these areas, documenting pre-disturbance dominant plant species and relative vegetation cover, site environmental characteristics and snow melt-out dates, and establishing reference photo-points. These zones were established for the purpose of maintaining distinct collections of salvaged plants and native seed, as well as for setting restoration goal expectations (Appendices A and B).

Plant Salvage

Established, mature perennial plants (assorted grasses, sedges, forbs, shrubs and mosses) growing in areas of planned heavy disturbance were targeted for salvage. When re-planted in the disturbed area, these plants act as seed sources and as nurse plants. Due to time and storage space constraints, clumps with multiple plants that could be transplanted together were favored over single plants. Selected plants were extracted from the ground by cutting a perimeter around the plant with a shovel, and then prying the soil plug up. Taking care to avoid excessive root disturbance, the removed plugs were then placed into pots. Once in a pot, the edges of transferred plugs were tamped down to conform to the pot, in an effort to settle the roots, eliminate drainage channels, and create a 2” reservoir for watering purposes (Figure 1). The plants were then watered to further settle and moisten the roots.

Salvaged plants were housed in the Park’s South Yard for the growing season. To shield these plants from the relatively hotter and drier environment than they were salvaged from, they were placed in a shade house improvised from empty raised-bed planter frames with a layer of erosion control fabric stretched over the top (Figure 1). The plants were monitored regularly and watered as needed. For overwintering, the plants were relocated to the Ball Diamond, placed in a tight group, and mulch was packed around the perimeter to protect roots against exposure to severe cold and desiccation (Figure 1).



Figure 1. Salvaging plants (top left); salvaged plants being stored in empty seed increase bed frame (top right); erosion control fabric stretched over frame to provide shade and cooler temperatures for plants salvaged from a higher elevation (bottom left); and grouping the salvaged plants together for winter storage. Mulch has been packed around the perimeter to provide insulation for root systems (bottom right). Photos by Carrie Wyler.

Native Seed Collection

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, actual disturbed area has reached 2.32 acres at the time of writing this report.

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 over most of the project area restricted fruitful collection to roadsides and forest openings. Three seed mixes were created to account for differing broadcast seeding rates and seed processing requirements, as well as to maximize collection efficiency. These mixes consist of a grass, sedge, and rush mix; a forb and shrub mix; and a lupine (*Lupinus*) species mix. Seeds were

collected according to the CRLA Botany Program's established Seed Collection Protocols (Beck et al. 2017). This seed was then dried and cleaned according to the CRLA Botany Program's established Seed Cleaning and Short Term Storage Preparation Protocol (on file in Botany office).

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

Scientific Name	Leaf	Bud	Flower	Fruit	Seed
<i>Achnatherum occidentale</i>	7/07		7/07		8/03—9/11
<i>Anaphalis margaritacea</i>			7/07		9/26
<i>Arctostaphylos nevadensis</i> (cuttings)					8/03
<i>Boechera howellii</i>					8/17—9/26
<i>Bromus carinatus</i> var. <i>carinatus</i>			7/07		8/08
<i>Calyptridium umbellatum</i>			7/07		8/08
<i>Carex breweri</i>					8/03—9/11
<i>Carex halliana</i>					8/08—9/28
<i>Carex inops</i> ssp. <i>inops</i>				7/07	8/03—9/11
<i>Carex pachycarpa</i>				7/07	8/03—9/11
<i>Castilleja</i> sp.				7/07	8/17
<i>Ceanothus prostratus</i>					9/26
<i>Elymus elymoides</i> ssp. <i>elymoides</i>				7/07	8/03—9/26
<i>Elymus glaucus</i> ssp. <i>glaucus</i>					8/17—9/11
<i>Ericameria greenei</i>					9/14—9/28
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>			7/07		9/11
<i>Eriogonum marifolium</i> var. <i>marifolium</i>			7/07		9/11
<i>Hieracium albiflorum</i>					8/03—9/11
<i>Juncus parryi</i>					8/24—9/11
<i>Lupinus andersonii</i>				7/07	8/03—9/11
<i>Lupinus lepidus</i> var. <i>lobbii</i>			7/07		8/03—9/26
<i>Luzula hitchcockii</i>					8/03
<i>Nothocalais alpestris</i>					7/07—8/03
<i>Penstemon davidsonii</i> var. <i>davidsonii</i>					8/08—8/24
<i>Phacelia mutabilis</i>			7/07		8/08—9/11

Invasive Vegetation Management

Given the project area location, IVM stands as a critical component of a successful vegetation restoration effort. 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 Pacific Crest Trailhead is a staging area for horses and pack-stock and the PCT is a popular trail through the Park. The Annie Spring Trail is another well-used trail. Mazama Village and Campground are located near the PCW pipeline corridor, and both areas have well-established populations of invasive plants. The 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 weed populations is likely.

IVM measures taken have included conducting area surveys (Figure 2) and controlling invasive plant species, both before and during construction. See the 2017 IVM Annual Report (Hall et al. 2018) for detailed methodology on invasive plant survey and control. Historic invasive plant populations were investigated using the IVM program's GIS database, and newly discovered populations were added to the database. Manual removal and, when permitted, chemical control was used to control the invasive



Figure 2. Surveying for invasive plant species along the area to be disturbed. Photo by Carrie Wyler.

plant populations. A new Invasive Vegetation Management Plan Environmental Assessment was finalized in July of 2017. This enabled the Botany program to utilize herbicide application as a control method Park-wide; prior to this herbicide application had been limited to a once/year treatment of roadside St. John's wort (*Hypericum perforatum*). Chemical treatment methods will likely be vital assets in managing future noxious weed populations in the project area.

Results

Revegetation

The areas disturbed by construction and in need of restoration were mapped and entered into a GIS database (Figure 3). The contractors did not finish construction, so no site preparation, planting, seeding, or transplanting of salvaged plants were accomplished this season.



Figure 3. Map outlining the areas disturbed by PCW infrastructure development, as of November 1st, 2017. Map by Scott Heisler.

Plant Salvage

A total of 60 one gallon pots from the Upper zone and 81 one gallon pots from the Lower zone were salvaged, and most pots contained multiple plants. Three 9 1/4" x 20" Dynaflat propagation trays of mosses were also salvaged from the Upper zone.

Native Seed Collection

A total of 2,426g of rough cleaned seed was collected: 1,431g of the grass/sedge/rush mix, 390g of the forb and shrub mix, and 605g of the Lupine mix. This seed is stored in the Botany program's seed storage freezer for application in the fall of 2018 (Figure 4).



Figure 4. Seed was dried, cleaned (left), and overwintered in a freezer for next season's use (right). Photos by Carrie Wyler.

Invasive Vegetation Management

The entire project area was surveyed for invasive plant species, including 39 historic populations of invasive plants in the project area that were revisited. Twenty-nine populations of invasive plant species were encountered, treated, and mapped in 2017 (Figure 5). The most commonly encountered invasive plants in the project area in 2017 were St. John's wort (31 plants); smooth brome (*Bromus inermis* – 3,767 plants); sheep sorrel (*Rumex acetosella* – 744 plants); and dandelion (*Taraxacum officinale* – 159 plants) for a total of 4,701 plants treated.

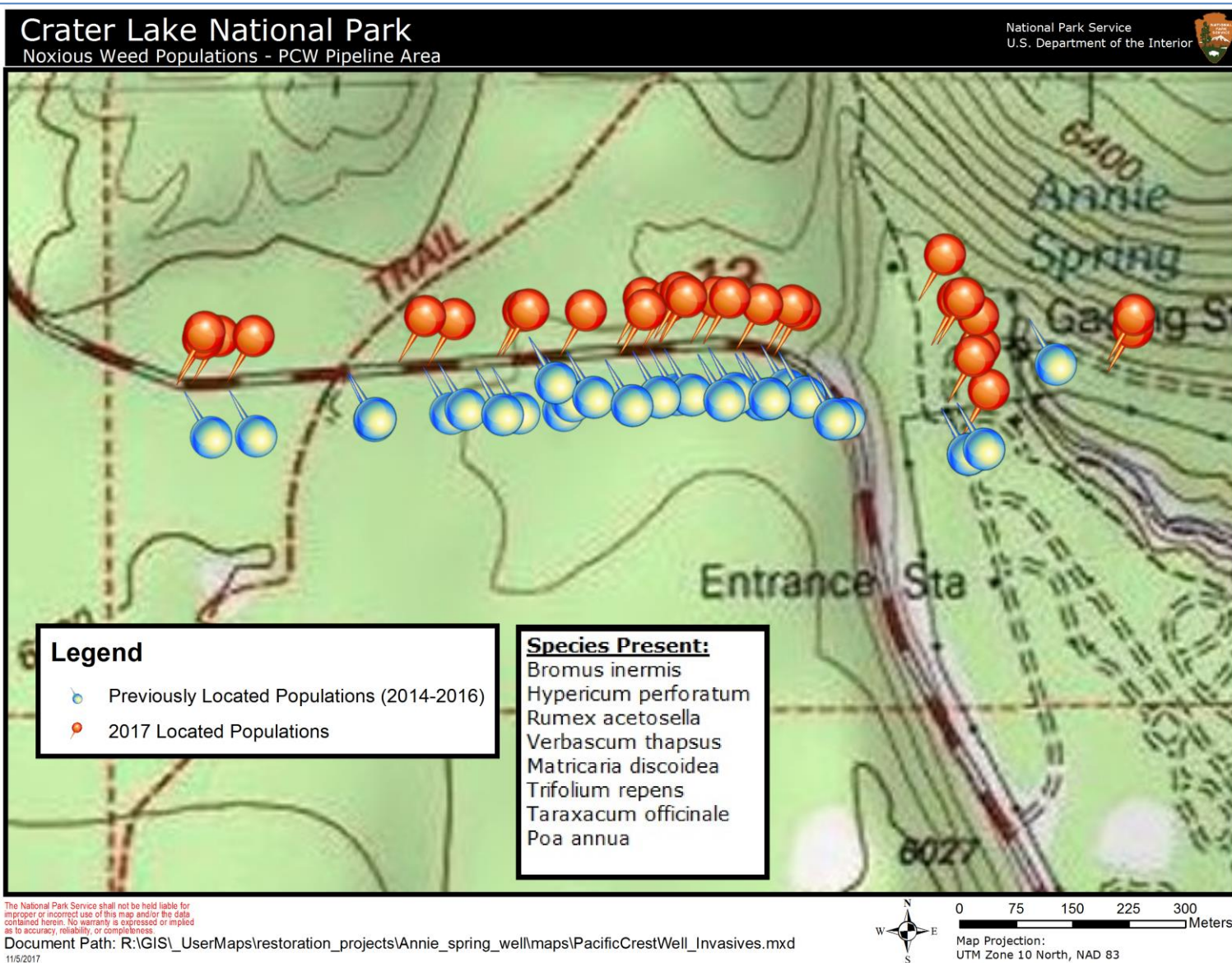


Figure 5. Map showing sites of known invasive plant populations in the project area. Map by Scott Heisler.

Discussion

It is rather unfortunate that due to construction delays, the disturbed areas in this project remain unseeded, as many of the collected species' seeds must overwinter in the soil to germinate. Seeding and outplanting of the salvaged plants will occur in the fall of 2018. IVM in these bare areas will require regular surveying to identify new invasive plant populations before they establish strong root systems or set seed. The areas being used as service roads should receive attention in IVM efforts, and notice should be given that utility vehicles must be cleaned and inspected before using these roads as per standard Park policy.

The amount of collected native seed and salvaged plants falls far short of ideal levels for the size of the project area. Factors contributing to this shortfall are the unplanned drastic increase in actualized disturbed area size, limited native seed collection areas, limited storage area for the salvaged plants, and limited funding available for this project. To address the shortfall of plant materials, it is recommended that seed collection efforts are continued in 2018 and 2019, and that additional collection areas are located. Additional collection areas may be located in meadows and openings along the Pacific Crest Trail, and from extending the collection area further alongside Highway 62.

If staffing allows next spring, initiating experimental propagation of grass and sedge species early in the season is recommended so as to have some plant plugs available this fall for revegetation efforts. Since plant propagation is a new activity for the CRLA Ecological Restoration program, careful record keeping and documentation of protocols will be essential to track and monitor propagation success.

Continued monitoring (Appendices A and B) of disturbance areas and the revegetation methods utilized will be essential over the next several years to ensure that recovery and vegetative succession are jumpstarted and proceeding as desired.

Literature Cited

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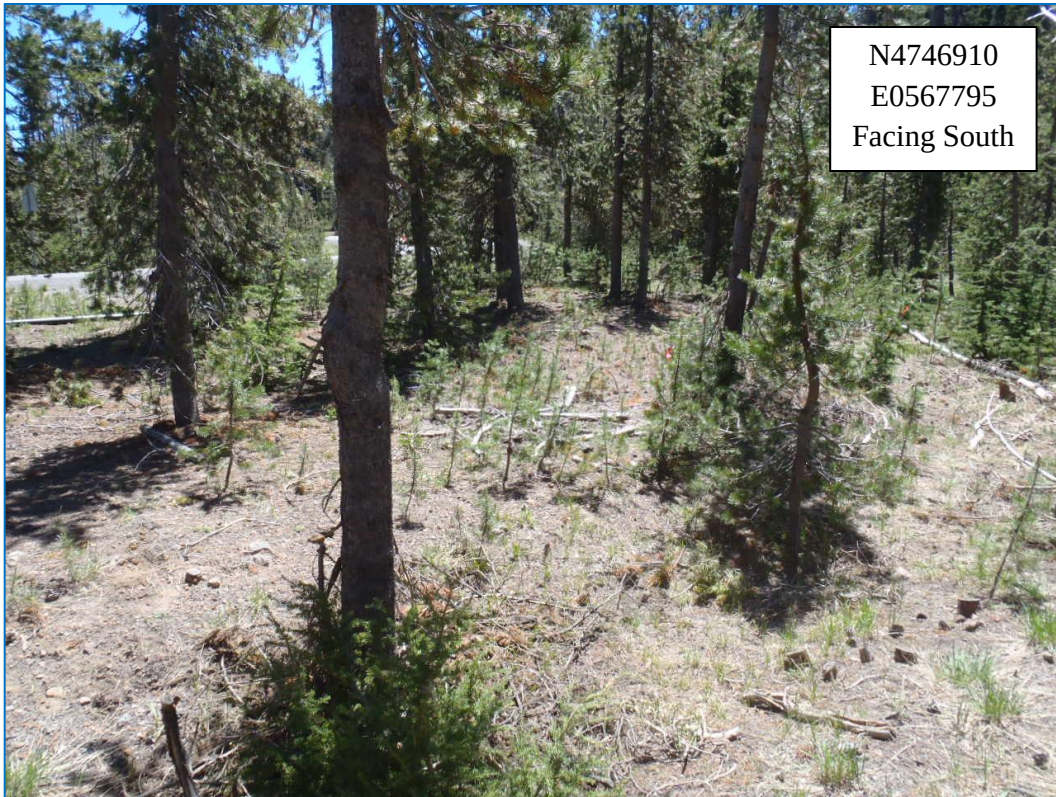
Appendix A

Site Restoration Summary and Monitoring Framework – Lower zone

Seed Zone: Lower Munson Valley Road	ID: ASPW Lower	Planned or unplanned site: Planned
Side of Road: West		
Location: Annie Springs Pumphouse (behind the water tanks) to the old road, including disturbed areas along road to water storage tanks.		
Site Description: Lower section of the pipeline running from the Mazama water storage tanks to the Annie Springs pumphouse.		
Pre-Disturbance Site Information		
Plant Species	Common Name	Relative % Cover
<i>Carex</i> sp.	Sedges	35
Grasses		15
<i>Lupinus lepidus</i> var. <i>lobbii</i>	Low mountain lupine	5
Conifers		40
Forbs		5
	Total Relative Cover:	100%
Associated species:		
UTM (Zone 10, NAD 83):	Beginning: E 0567836 End: E 0567738	Beginning: N 4746917 End: N 4746899
Total Vegetative Cover: 40%		Elevation: 6,037'
Slope: 0-10°	Aspect: East/Southeast	Snowmelt out: late June
Soil “hardness,” presence of rocks: very rocky		
General Soil description: Average compactness, some looser areas		
Ameliorating microsite features: natural litter and duff, branches		
Wind exposure: Low	Canopy cover (overall): 25-40%	
Area: 25,726 ft² (approx. 0.6 acres)		
Comments: 68 one gallon pots of plants were salvaged from the site on 7/7/17. Species salvaged included <i>Carex pachycarpa</i> , <i>Carex halliana</i> , <i>Elymus elymoides</i> ssp. <i>elymoides</i> , <i>Achnatherum occidentale</i> , <i>Juncus parryi</i> , <i>Aster</i> species, <i>Gayophytum diffusum</i> , <i>Carex inops</i> , and other unknown forbs.		

Pre-Disturbance Photos:





Mid-Disturbance Photos



To be completed in Fall 2018

Site ID/Name:

Date(s) Planted and/or Seeded:

Actual Area Restored:

Planted species and seed dispersed:		
Species name	Number planted	Grams of seed dispersed
Total:		

Site Preparation Notes:

Photography Photopoints (UTM Zone 10, NAD83)		
Beginning (by water tanks)	UTME: 0567836	UTMN: 4746917
Middle	UTME: 0567795	UTMN: 4746910
End (at old forest road)	UTME: 0567738	UTMN: 4746899

Notes:

7/10/17- 81 pots of plants salvaged for restoration

Seed collected throughout the 2017 season

To be completed in Fall 2018

Post-planting photos:

To be completed in Fall 2018

Restoration Monitoring

[illegible]

To be completed in Fall 2018

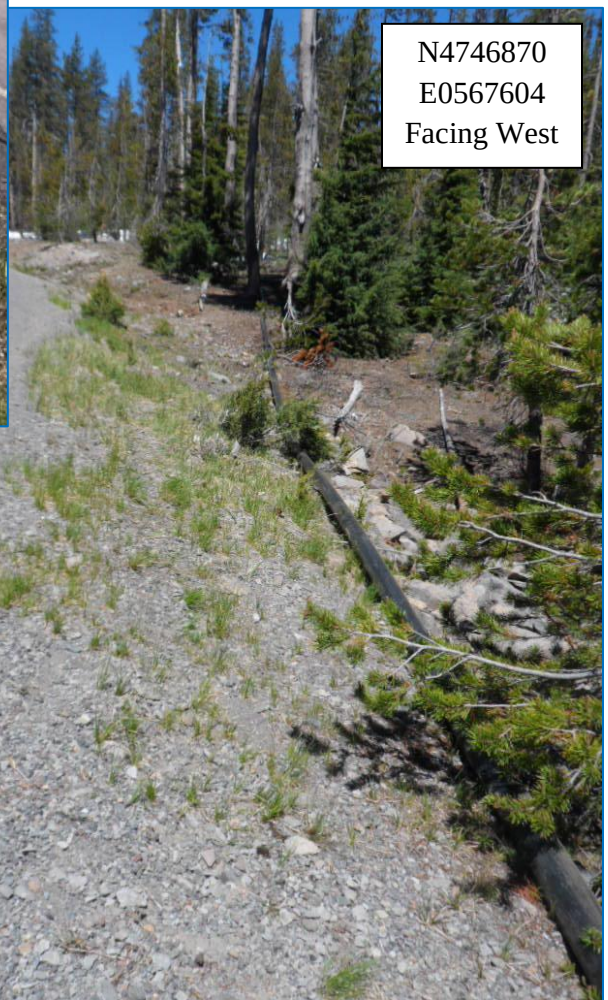
1 YEAR POST-RESTORATION PHOTOS:

Appendix B

Site Restoration Summary and Monitoring Framework – Lower zone

Seed Zone: Hwy 62 West (near PCT Trailhead)	ID: ASPW Upper	Planned or unplanned site: Planned
Side of Road: North		
Location: Near the PCT Trailhead across from the new well.		
Site Description: Upper section of the pipeline running from the PCT trailhead to where the road curves sharply and the guardrail begins.		
Pre-Disturbance Site Information		
Plant Species	Common Name	Relative % Cover
<i>Carex sp.</i>	Sedges	30
Grasses		15
<i>Lupinus andersonii</i>	Anderson’s lupine	15
Conifers		20
<i>Arctostaphylos nevadensis</i>	Pinemat manzanita	10
<i>Anaphalis margaritacea</i>	Pearly everlasting	5
<i>Calyptridium umbellatum</i>	Pussy paws	5
	Total Relative Cover:	100%
Associated species: <i>Eriogonum marifolium</i> var. <i>marifolium</i> , <i>Sanguisorbia occidentalis</i> , <i>Claytonia lanceolata</i> , <i>Microsteris gracilis</i> , <i>Anaphalis margaritacea</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i> , <i>Phacelia mutabilis</i> , <i>Nothocalais alpestris</i>		
UTM (Zone 10, NAD 83):	Beginning: E 0566967	Beginning: N 4746861
Total Vegetative Cover: 75%		Elevation: 6,196’
Slope: 0-15°	Aspect: South	Snowmelt out: mid-June
Soil “hardness,” presence of rocks: some gravel		
General Soil description: Average compactness with some gravel mixed in		
Ameliorating microsite features: natural litter and duff, branches		
Wind exposure: Low	Canopy cover (overall): varies. 0-25% depending on proximity to road	
Area: 64,874 ft ² (approx. 1.5 acres)		
Comments: 110 one gallon pots of plants were salvaged from this site on 6/22/17 and 7/6/17. Species included <i>Achnatherum occidentale</i> , <i>Carex inops</i> ssp. <i>inops</i> , <i>Carex halliana</i> , <i>Carex pachycarpa</i> , <i>Elymus elymoides</i> ssp. <i>elymoides</i> , <i>Juncus parryi</i> , <i>Phacelia hastata</i> ssp. <i>compacta</i> , <i>Anaphalis margaritacea</i> , mosses, <i>Epilobium spp.</i> , and other unknown forbs.		

Pre-Disturbance Photos:



Mid-Disturbance Photos:





Mid-Disturbance Photos (September 2017)



Mid-disturbance Photos (October 2017)



N4746861
E0566967 (start)
Facing E

Mid-Disturbance Photos: Well Area (October 2017)



To be completed in Fall 2018

Restoration Site Implementation

Site ID/Name:

Date(s) Planted and/or Seeded:

Actual Area Restored:

Planted species and seed dispersed:		
Species name	Number planted	Grams of seed dispersed
Total:		

Site Preparation Notes:

Photography Photopoints (UTM Zone 10, NAD83)		
Beginning (by W62 PCT trailhead)	UTME: 0566967	UTMN: 4746861
Middle	UTME: 0567303	UTMN: 4746887
End (at curve in road)	UTME: 0567549	UTMN: 4746894

Notes:

6/22/17- 60 pots of plants and 3 trays of moss salvaged for restoration

6/22/17- cuttings of manzanita taken for propagation

Seed collected throughout the 2017 season

To be completed in Fall 2018

Post-planting photos:

Looking North

Looking South

To be completed in Fall 2018

Restoration Monitoring

Date:	Recorder(s):	Time Since Disturbance:
Site ID/Name:		
Repeat Photography Photopoints (UTM Zone 10, NAD83) (take original pictures with)		
Beginning (looking North/East) (circle)	UTME:	UTMN:
End (looking South/West) (circle)	UTME:	UTMN:
Planting Assessment		
Planted Species	# Planted 2016	% Survival 2017
Seeding Assessment		
Seeded Species	Amount Sown (grams)	% Total Cover 2017
Site Notes: (note erosion, tiretracks, etc.)		
Invasive Plant Assessment		
Invasive Plant Species	# Present at Restoration	# Present 2017
Natural Recovery Assessment (excluding planted/seeded species)		
Plant Species	% Total Cover 2017	
Additional Site Needs and Recommendations:		

To be completed in Fall 2018

1 YEAR POST-RESTORATION PHOTOS:

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

April 2018

National Park Service
U.S. Department of the Interior



Crater Lake National Park

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