



# 2014 Rim Drive Rehabilitation Revegetation Annual Report





**ON THIS PAGE**

Revegetation crew member salvages rare plants prior to an emergency road stabilization project.  
Photograph by: Jen Beck

**ON THE COVER**

Revegetation crew members collect seed for restoration of areas to be impacted by the Rim Drive Rehabilitation Project.  
Photograph by: Melody Frederic

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# **2014 Rim Drive Rehabilitation Revegetation**

## **Annual Report**

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## **Abstract**

Crater Lake National Park's Rim Drive Rehabilitation Revegetation project is intended to mitigate impacts to the rim environment from the Federal Highway Administration-sponsored Rim Drive Rehabilitation project. This major construction project will correct many deficiencies present along the Park's historic Rim Drive. Through surveying for and controlling invasive plant species, salvaging and reestablishing rare plant populations disturbed by the construction project, and restoring disturbed areas using site-specific native plants and seed it is hoped that long-term impacts from this construction project to the Park's natural resources will be minimized. During the 2014 field season, the project area was surveyed for invasive plant species and over 18,000 invasive plants were removed including two new-to-the Park weedy species. Almost 600 rare and sensitive plants including the Crater Lake rockcress, pumice grapefern, Mt. Shasta arnica, and whitebark pine were salvaged from areas that will be disturbed by construction activities. Salvaged plants from three sites were cared for at a holdover facility and monitored for health and survival. Rare plant survival rates ranged from 89.2 – 90.5%, but this estimate includes plants that were struggling at the time of last assessment. Rare plants from one of the plant salvage locations were transplanted back into their habitat in October 2014; these plants will continue to be monitored to assess the efficacy of reestablishing these rare species. Revegetation prescriptions were refined during the 2014 season and seeds were collected from five distinct seed zones representing the floral diversity of the project area. Forty-five seed accessions were delivered to the Corvallis Plant Materials Center for propagation of plants for revegetation and creation of customized seed mixes for each restoration site. Seed collection protocols were developed for each species targeted for use in revegetation to inform future restoration efforts.

## **Acknowledgments**

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# Introduction

The Federal Highway Administration (FHWA)-sponsored Rim Drive Rehabilitation project is a multi-year endeavor to enhance and improve Crater Lake National Park's (CRLA) historic and scenic Rim Drive and its associated pullouts and parking areas. The 29.4 mile long Rim Drive is a popular Park road and destination; it provides seasonal access to the caldera rim with its many trailheads and scenic vistas of Crater Lake and the surrounding Cascade Range. Rim Drive is listed on the National Register of Historic Places and has been nominated as a cultural landscape. Rim Drive was completed in 1941, and occasional repairs have occurred in the years since its construction. However, major reconstruction is now needed as existing roadway materials have exceeded their lifespan, and the roadbed and associated masonry features have deteriorated due to erodible soils and years of harsh weather.

The current phase of this project will commence in 2015 and affect 5.9 miles of West Rim Drive, portions of East Rim Drive (e.g., North Junction to Cleetwood Cove; Grotto Cove), and the Rim Village parking lot. In addition to impacting roadways and road shoulders, numerous pullouts, parking areas, and parking lots will be modified. These modifications include obliterating unofficial pullouts (Figure 1), shrinking the footprint of excessively large parking areas, and installing landscaping islands in high visitor use areas. Additionally, road work will displace the world's largest known population of the Crater Lake rockcress (*Boechea horizontalis*), a rare plant that is a Species of Concern on the federal endangered species list, and a candidate species for listing as threatened or endangered by the state of Oregon.

Due to the substantial impacts pending for soils and vegetation, FHWA has funded efforts to restore affected areas through revegetation, rare plant salvage and transplant, and invasive vegetation management. The Rim Drive Rehabilitation Revegetation (RDRR) project is tasked with:

1. Developing revegetation prescriptions for areas to be restored
2. Surveying for and controlling non-native, invasive plant species within the project area
3. Salvaging, transplanting, and monitoring rare plants impacted by the project
4. Collecting native plant seeds and materials for revegetation efforts



**Figure 1.** One of the pullouts slated for obliteration and restoration along West Rim Drive. Photo by Jen Beck.

5. Restoring affected areas through site preparation, planting, and seeding
6. Monitoring restored areas for revegetation efficacy and augmenting restoration actions as necessary

Restoration of areas disturbed by the Rim Drive Rehabilitation project is necessary to jumpstart natural succession of vegetation communities and will help protect the rim environment from erosion and invasion by non-native plant species. Through using site-specific, native genotypes in revegetation efforts, the biodiversity and genetic integrity of the rim vegetation community is maintained. Additionally, as Rim Drive is a popular Park road, revegetation will yield aesthetic benefits to Park visitors by reducing the appearance of bare, disturbed ground throughout the project area. The types of areas slated for restoration by the RDRR project are listed in Table 1.

**Table 1.** RDRR restoration areas by location.

<b>General Location</b>	<b>Type of Site/Location</b>	<b>Number to Restore</b>
West Rim Drive	Obliterated pullout	15
West Rim Drive	Reduced footprint of parking area (Lightning Springs, Last Snow)	2
West Rim Drive	Rare plant population reestablishment (Watchman)	1
West Rim Drive	Landscaping islands (Watchman Overlook)	2
East Rim Drive	Obliterated pullout	9
East Rim Drive	Roadway realignment (Pumice Point)	1
East Rim Drive	Landscaping islands (Cleewood Cove parking lot)	1
East Rim Drive	Rare plant population reestablishment (Grotto Cove)	1

Three Biological Science Technicians were devoted to the RDRR project in 2014; season length was from June 9 – September 25. In addition to working in areas to be directly impacted by the Rim Drive Rehabilitation project, the RDRR program also surveyed areas that will be used for staging of project materials and equipment for invasive plant species. Staging areas include Roundtop Quarry, Anderson Quarry, and Pole Bridge Creek Quarry. The FHWA-sponsored Rockfall Mitigation project was implemented during the 2014 season; this impacted RDRR operations by accelerating rare plant salvage in two locations. Additionally, the FHWA-sponsored Pavement Preservation project occurred during the 2014 season. This project applied a chip-seal treatment to most Park roads, including ones near Rim Drive (North Entrance Road; Munson Valley Road; Pinnacles Road; and Cloudcap Spur Road). The North Junction parking area and the intersection of Pinnacles Road with East Rim Drive were used to stage gravel “chips” used in this project. The base materials used in this project were sourced from a local gravel pit where many non-native, invasive plant species were observed to be growing in 2014.

Efforts made by the RDRR program in 2014 can be organized into three components: (1) revegetation; (2) invasive vegetation management; and (3) rare plant salvage and reestablishment. Revegetation includes refining site-specific restoration prescriptions for each area to be disturbed; refining seed zone definitions; and collecting seed and plant materials for revegetation. Invasive

vegetation management includes surveying project areas for invasive plant species, and controlling any invasive plant species found. Rare plant salvage and reestablishment consists of a thorough pre-disturbance inventory of each rare plant population; salvaging all possible rare plants from a site; caring for salvaged plants at a holdover facility; transplanting rare plants back into their habitat once the road construction is complete; and monitoring rare plants at various points during the holdover, transplant, and reestablishment periods.

## Methods

Methods for each component of the RDRR program are discussed separately.

### Revegetation

Revegetation prescriptions were developed for each area slated for restoration starting in 2012. The 2013 and 2014 RDRR crews continued with prescription development; prescriptions will need to be further refined based on available seed and propagated plants for restoration. Each of the 31 sites to be restored (Appendix A) has a unique revegetation prescription derived by making visits to each site and recording the dominant plant species with an ocular estimate of each species' relative cover value (Appendix B). The number of plants and amount of seed to be used in revegetation efforts at each of the 31 sites is outlined in Gregory et al. (2015).

In 2014, a "vulnerability index" was developed for each of the 31 sites to be restored to provide an estimate of restoration difficulty. The vulnerability index compiled information on snowmelt timing, general soil conditions (amount of organic matter, water retention, and small mammal predation risk); soil hardness (presence of rocks); wind exposure; and canopy cover. These five factors were rated at each site, with final scores averaged into composite scores that were then assigned a letter grade of A-D, with "A" indicating good revegetation potential and "D" indicating harsh or challenging site conditions for revegetation. This information is included in Appendix B, and will be refined by future RDRR crews.

Since CRLA does not have the infrastructure or staff to support plant propagation, an interagency agreement was developed by the DSC allowing the Natural Resource Conservation Service (NRCS) Corvallis Plant Materials Center (PMC) to assist with plant propagation and seed cleaning. The project area was delineated into seed zones, with each seed zone serving as a distinct area where seeds and propagated plants could be sourced and moved without compromising genetic integrity. In defining seed zones, sites with similar vegetation communities were grouped together - these groupings corresponded to similarities in site location and elevation. Five seed zones (Figure 2) were defined for the current phase of the RDRR project:

- South West Rim Drive ( South WRD)
- Central West Rim Drive (Central WRD)
- North West Rim Drive (North WRD)
- Northwest East Rim Drive (NW ERD)

- Northeast East Rim Drive (NE ERD)

Once seed zones were delineated, a discrete revegetation species list for the project was developed. In order to develop a cost-effective agreement and work plan between CRLA and the Corvallis PMC, it was determined that using eight to ten plant species (accessions) per seed zone (Table 2) would be adequate for revegetation efforts.



**Figure 2.** Distribution of RDRR sites by seed zone within the current project footprint. Map by Elena Thomas.

**Table 2.** Rim Drive Rehabilitation Revegetation project target species listed by seed zones. S = seed collection and C = vegetative cutting. Maximum allotted accessions for 2014 is 48.

Scientific Name	South WRD	Central WRD	North WRD	NW ERD	NE ERD
<i>Achnatherum occidentale</i>	S	S	S		S
<i>Aconogonon davisiae</i> var. <i>davisiae</i>		S	S	S	
<i>Arctostaphylos nevadensis</i>					C
<i>Arctostaphylos patula</i>					C
<i>Arnica viscosa</i>			S		
<i>Boechera horizontalis</i>		S			S
<i>Bromus carinatus</i> var. <i>carinatus</i>	S				S
<i>Carex breweri</i>			S	S	
<i>Carex halliana</i>	S				S
<i>Carex pachycarpa</i>	S				
<i>Castilleja applegatei</i>		S			
<i>Castilleja arachnoidea</i>				S	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	S	S	S	S	S
<i>Ericameria greenei</i>	S	S	S		
<i>Ericameria nauseosa</i> var. <i>speciosa</i>					S
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	S	S	S		
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>		S	S	S	
<i>Holodiscus microphyllus</i> var. <i>glabrescens</i>	S				
<i>Juncus parryi</i>				S	
<i>Leutkea pectinata</i>				S	
<i>Lupinus andersonii</i>	S				
<i>Lupinus lepidus</i> var. <i>lobbii</i>				S	S
<i>Penstemon davidsonii</i> var. <i>davidsonii</i>		S	S		
<i>Phacelia hastata</i> ssp. <i>compacta</i>					S
<i>Phlox diffusa</i>	S	S	S		

The 2014 seed collection efforts added to seeds collected during the 2013 season. The seed collection process commenced in 2014 by observing and documenting the phenology of each targeted species at each revegetation site within each seed zone. Notes were taken on plant phenology, seed maturity, and collection techniques; these were compiled into a seed collection protocol for each species (Appendix B) that will be refined in subsequent years. When seeds were mature, they were collected by hand into double-bagged paper bags (small lunch bag size or large grocery bag size, depending on amount of seed available). One exception to this was seed collection for *Boechera* species – these seeds were collected into glassine envelopes, which were collectively stored within a single paper bag. Another exception was made for lupine (*L. andersonii* and *L. lepidus* var. *lobbii*) seeds: inflorescences were bagged as seeds were maturing using blossom bags or nylon stockings (Figure 3) to capture seeds as they dehisced from the fruit pod; seeds were then collected into paper bags.

Only one species in a discrete seed zone was collected into each bag; bags were labelled with species code, date, and seed zone. After collection, seeds were dried in their bags at a storage facility (unit #6 of CRLA's nine-stall building – Figure 4) inside 30-gallon plastic storage totes secured with window screen at the top to both allow ventilation and reduce chances of predation. Some seeds were collected with vegetative material attached to allow continued maturation of seeds; these were placed in smaller plastic bins lined with newsprint and placed within larger 30-gallon plastic bins secured with window screen at the top.



**Figure 3.** Blossom bags were placed over lupine inflorescences to catch seeds as they matured. Photo by Melody Frederic.

Voucher specimens were collected from each species to be used in revegetation efforts. Voucher specimens were collected, pressed, mounted, and stored using the CRLA Botany program Working Herbarium Standard Operating Procedures.



**Figure 4.** Seed drying and storage facility. Photo by Elena Thomas.

Prior to sending seed to the Corvallis PMC, all seeds from a single species with a discrete seed zone were combined into large paper bags; each bag was labeled with species code, year of collection, and seed zone. The 2014 seed collection was delivered to the Corvallis PMC on September 25, with an additional shipment of seeds sent on October 27.

### **Invasive Vegetation Management**

Crater Lake National Park has assigned all of its 65 non-native species a management priority of Low, Medium, High, or Watch. All high priority species are actively targeted for control efforts; medium priority species are targeted as time and resources allow. Low priority species are usually not targeted for management, either because populations of these species are not aggressively spreading or populations are beyond control. Watch species are those that have been documented within the Park, but have not been observed in some time (> 10 years) and are believed to be eradicated from within Park boundaries. If any watch species are found within the Park, they receive



a management priority of high. These priorities may change depending upon situation and location. For example, most of the Rim Drive environment is relatively pristine and lacking non-native members. In this case, medium or low priority species may be treated in this area to protect the integrity of the vegetation communities adjacent to Rim Drive. Additionally, many rare plant species are found immediately adjacent to or nearby Rim Drive. Low priority species may be controlled if they threaten rare plant populations.

The control strategies for invasive plants found within the RDRR project area are containment (preventing new infestations and spread); reduction (reducing the size and extent of existing infestations); and eradication (extirpating the invasive species from the Park). Since Rim Drive contains few invasive plants, invasive plant populations along Rim Drive and project staging areas often have reduction or eradication strategies. The strategy at Rim Village is containment, reduction, or eradication as this location has a persistent invasive plant problem.

In 2014, the entire project area was surveyed for non-native, invasive plant species. Roadsides (four meters extending outward from the pavement edge) within the project area were surveyed once by foot. Additional surveys were made from a slow-moving vehicle throughout the season. Project staging areas (Roundtop Quarry, Anderson Quarry, and Pole Bridge Creek Quarry) were surveyed at least three times by foot in their entirety, including access roads and around piles of materials.

Presently control of invasive species at CRLA is largely limited to manual methods. Most invasive plants are hand-pulled or severed from the root below the ground surface using a digging knife. For rhizomatous species, care is taken to extract as much of the root mass as possible during control operations.

When invasive plants are encountered, data are recorded including scientific name, UTM coordinates (Zone 10, NAD83 datum), total number of plants present, area that plants occupy, and treatment applied to population. All plant parts capable of reproduction are bagged, removed from the site, and disposed of in the trash compactor at Park headquarters where they are hauled (in a closed truck) to the Dry Creek Landfill in White City, Oregon for burial. Vegetative parts incapable of reproduction are left to desiccate on site unless they present logistical or aesthetic problems for Park visitors, employees, and partners.

Any new-to-CRLA non-native plant species encountered are collected as voucher specimens for the Park's herbarium. Additionally, non-native plants encountered in previously undocumented locations are collected for the Park's herbarium. Extra specimens may be collected for use in the CRLA Botany program's Working Herbarium.

### **Rare Plant Salvage and Reestablishment**

In the process of rehabilitating Rim Drive and implementing the Rockfall Mitigation project, several rare plant populations growing adjacent to Rim Drive will be impacted. To mitigate impacts to the Park's rare plants, the RDRR program is charged with collecting baseline information on pre-disturbance rare plant populations; collecting seed from rare plants for propagation and revegetation; salvaging rare plants and caring for and monitoring them at a holdover facility; transplanting

salvaged plants back into their habitat post-disturbance; conducting supplemental planting of propagated rare plants; and monitoring reestablished populations to inform management. These items are discussed separately below. Two factors accelerated rare plant salvage work in 2014: (1) the failure of a section of East Rim Drive in the Grotto Cove area over the 2013-2014 winter (Figure 5), necessitating emergency stabilization and repair of the roadway; and (2) the Rockfall Mitigation work at the Watchman, which due to a misunderstanding was not communicated to the CRLA Botany program until a few days before project implementation.



**Figure 5.** East Rim Drive at Grotto Cove prior to emergency stabilization and repair in 2014. Photo by Jen Beck.

### **Baseline Information**

In 2013, the entire project area was surveyed for rare plants on foot; surveys included areas within four meters of pavement edge on West Rim Drive and two meters of pavement edge on East Rim Drive. In this effort, two new locations were discovered for Mt. Shasta arnica (*Arnica viscosa*). Previously known populations of rare plants within the project area included the Watchman Crater Lake rockcress population, the Grotto Cove Crater Lake rockcress and pumice grapefern (*Botrychium pumicola* – an Oregon state listed threatened species) populations, and the Skell Head Crater Lake rockcress population.

In 2014, efforts were focused on rare plants in immediate peril: the Watchman Crater Lake rockcress population was threatened by Rockfall Mitigation project work, and the Grotto Cove Crater Lake rockcress and pumice grapefern population threatened by emergency stabilization work on East Rim Drive through the Grotto Cove area.

A thorough pre-disturbance census of rare plants in these two areas was conducted prior to any salvage activities. For each census, the general rare plant population area was searched for rare plants and those found were marked with pink pin flags (Figure 6). Each plant was georeferenced with a GPS unit and noted as being either “mature” (with this season’s inflorescence present) or “immature” (rosette of basal leaves only with no signs of an inflorescence stalk); some plants at the Watchman were not differentiated as mature or immature due to a miscommunication between the project lead and field staff. Census activities at Grotto Cove were performed on June 2 and June 11, 2014; census activities at the Watchman (Figure 4) were conducted on July 23, 24, 28, 29, and August 5, 2014. Plants at Grotto Cove were marked using Garmin GPS units with approximately 2 m accuracy; plants at the Watchman site were georeferenced using a Trimble sub-meter accuracy GPS unit. Maps were created of each pre-disturbance rare plant population using ArcGIS.

### **Rare Plant Seed Collection**

Seeds were collected from Crater Lake rockcress plants in the Watchman and Grotto Cove areas in 2013 and 2014. As previously mentioned, these seeds were collected directly into glassine envelopes and allowed to dry. The early nature of road work in 2014 precluded any *in situ* seed collection of rare plants at the Grotto Cove site; seeds were collected from salvaged plants as they ripened at the holdover facility. Seeds were collected from the Watchman



**Figure 6.** Crater Lake rockcress census along West Rim Drive at the Watchman. Photo by Kathryn Williams.

Crater Lake rockcress plants as they ripened; some plants were salvaged early and seeds that continued to ripen were collected when ready at the holdover facility. Spores of the pumice grapefern were collected in 2013 and 2014 and stored in a plastic petri dish at the Botany office. No Mt. Shasta arnica seeds were collected in 2013 or 2014 due to herbivory of flowering stems. Crater Lake rockcress seeds were dried and stored in the previously mentioned storage facility, and shipped to the Corvallis PMC on September 25, 2014.

### **Rare Plant Salvage, Holdover, and Monitoring**

Thirty-seven plants were salvaged from the Grotto Cove site prior to emergency stabilization of the roadway: 31 Crater Lake rockcress plants; 1 whitebark pine (*Pinus albicaulis* – a Candidate species for listing under the federal Endangered Species Act) cache of 4 seedlings; 1 pumice grapefern; and 1 Lemmon’s rockcress (*Boechea lemmonii*) because it occurs relatively infrequently in the Park. Grotto Cove plant salvage occurred from June 2 – June 16, 2014, with three additional Crater Lake rockcress plants salvaged on October 6, 2014. Five hundred fifty Crater Lake rockcress plants were salvaged from the Watchman location (Figure 7) on July 24, 28, 29 (plants within the 2014 Rockfall Mitigation project zone); and August 21, 27, and September 15, 2014 (plants not impacted by the 2014 Rockfall Mitigation project). Three Mt. Shasta arnica plants were salvaged from



**Figure 7.** Salvaged Crater Lake rockcress plants from West Rim Drive at the Watchman. Photo by Kathryn Williams.

the Watchman and Last Snow sites on October 7, 2014. Rare plants were salvaged during summer 2014 due to the uncertainty of the road construction schedule in 2015.

All plants except the pumice grapefern were gently excavated, with the objective of keeping as much of the surrounding soil intact around the root system (to retain local soil microflora and fauna), and placed into small pots (5 x 6") for immature plants and larger pots (6 x 7") for mature or larger plants. Once in its pot, each plant was marked with a unique aluminum tag mounted on a wire inserted next to the plant that served as its unique ID. If more than one plant was included in a pot and associated with a unique ID, this was noted. At Grotto Cove, plants were identified by whether they were found growing on the west or east sides of the road. The Watchman site was divided into five plant salvage zones (Table 3) and notes were taken on which zone salvaged plants originated from. It was noted if Mt. Shasta arnica plants originated from the Watchman or Last Snow locations.

**Table 3.** Watchman Crater Lake rockcress salvage zones and their associated information.

Watchman Salvage Zone	# Plants Salvaged	Side of Road	Site Description	UTM Coordinates of Zone Center
Rockfall	140	East	Narrow, rocky ditch between cliffs and road	0567059; 4754888
South Pullout	182	West	Flat pullout with sand spurry	0566978; 4754825
North Pullout	23	West	Flat; plants found in southern 15' of pullout; NW end of population	0567040; 4754891
North Slope	162	West	Area between the north and south pullouts; slope up to 65%	0567023; 4754872
East Slope	43	East	Slope to 40%	0566946; 4754777

The early June salvage time at Grotto Cove allowed for naturally moist soils, which facilitated salvage operations; plant salvage at the Watchman was much more difficult due to dry, rocky soils. Prior to plant removal, small pumice stones were placed in the bottom of each pot to promote drainage. If plants were growing together, they were retained in one pot so as to not damage root systems. Salvaged plants were staged in the shade until plant salvage operations were completed for the day. Then salvaged plants were secured in a vehicle and transported to a holding facility (Figure 8) established at the Ball Diamond, a staging area located near Park headquarters. The holding facility consisted of shade cloth placed and secured over lengths of rebar, and delineated



**Figure 8.** Plant holding facility at Park headquarters. Photo by Elena Thomas.

from the rest of the staging area by orange plastic fencing. Plants were immediately watered upon arriving at the holdover facility.

The pumice grapefern required a different salvage technique, which was determined based on conversations with revegetation specialists at the DSC and the Natural Resources Conservation Service (NRCS). The pumice grapefern has a complicated life history, in that it has a subterranean phase in which it is completely dependent upon mycorrhizal associates and its associated vegetation community for photosynthate (Camacho and Liston 2001; Winter and Friedman 2007). Due to its complicated relationship with and dependence on its mycorrhizal partners and community associates, plant salvage focused on retaining the soil environment surrounding the pumice grapefern individual.

Prior to salvaging the pumice grapefern, the soil surrounding the plant was moist but not soggy. The pumice grapefern and its associated soil was carefully excavated and immediately placed in a gallon-sized Ziploc-style plastic bag (Figure 9). The air was gently pressed out of the plastic bag and the bag was sealed. This bag was then placed inside a second gallon-sized plastic bag, which was also pressed of air and sealed. The soil adjacent to where the pumice grapefern was growing was then excavated and placed in a 2 x 3' plastic tub and sealed with a tight-fitting lid (Figure 9). The pumice grapefern was transported back to the CRLA Botany office, where it was placed in a refrigerator (temperature remained at ~ 40°F) for four months, with biweekly checks made for mold or signs of decay. The plastic tub containing the soil that had surrounded the pumice grapefern was kept in the Warehouse at Park headquarters (a facility that stays cool and dry) for four months, with biweekly checks made for mold or signs of decay.



**Figure 9.** Left: The pumice grapefern was salvaged and placed in a plastic bag for cold storage. Photo by Melody Frederic. Right: Its associated soil was retained and stored until transplant. Photo by Jen Beck.

Salvaged plants were watered and cared for on a weekly basis at the holdover facility. During periods of abnormally cold temperatures (including snow and periods of frost/freeze), plants were covered with frost cloth until temperatures warmed above freezing. Salvaged plants were monitored weekly for health, phenology, and survival.

### **Grotto Cove Rare Plant Transplant**

Salvaged rare plants were transplanted back into the Grotto Cove location on October 6, 2014. Since salvaged plants originated from within four meters of the roadside at this location and future road maintenance is likely within the road prism, plants were transplanted close to their original locations but placed outside of the road prism. Plants located on the east side of East Rim Drive remained on the east side of the road, but were shifted to suitable habitat south of their original location. Since the terrain on the west side of East Rim Drive dropped precipitously into the Crater Lake caldera, plants originating on the west side of the road were transplanted due east to the east side of East Rim Drive, immediately north of the other transplanted population. Plants to be transplanted were staged in the shade until ready to plant (Figure 10). Each transplanted plant was mapped, photographed, and marked with a unique ID tag (Figure 10), and data were collected on the plant's health and condition at time of transplant. Each plant was watered immediately after being transplanted.



**Figure 10.** Left: Grotto Cove rare plants prior to transplant. Right: Crater Lake rockcress immediately after transplant at Grotto Cove. Photos by Jen Beck.

## **Results**

Results are presented separately for each component of the RDRR project.

### **Revegetation**

Forty-five seed accessions were collected, dried, and processed in 2014. Seeds were delivered to the Corvallis PMC in the fall of 2014; as of this writing seeds are still being cleaned, tested, and germinated. The annual report from the Corvallis PMC should be received by the Park in May 2015. The final Rim Drive Rehabilitation Revegetation Plan (Gregory et al. 2015) contains specific revegetation prescriptions (number of plants per species per site), and seed mix prescriptions will be developed based on final amounts of available seed per species per zone.

Seed collection occurred from July 17 to October 7, 2014. Seed ripeness varied per species throughout each seed zone (Table 4). It was challenging to collect seed from late-ripening species (*E. greenii*, *E. nauseosus* var. *speciosa*, *E. pyrolifolium* var. *coryphaeum*, and *H. microphyllum* var.

*glabrescens*) both due to seeds becoming ripe as the field season was ending, and because storms occurred more frequently in mid-late September and limited collecting opportunities.

**Table 4.** Rim Drive Rehabilitation Revegetation project seed collection dates by seed zone.

Scientific Name	South WRD	Central WRD	North WRD	NW ERD	NE ERD
<i>Achnatherum occidentale</i>	7/30 – 9/02	8/04 – 9/10	8/11 – 8/27		7/21 – 9/02
<i>Aconogonon davisiae</i> var. <i>davisiae</i>		8/04 – 9/11	8/14 – 9/17	8/07 – 9/03	
<i>Arctostaphylos nevadensis</i>					n/a**
<i>Arctostaphylos patula</i>					n/a**
<i>Arnica viscosa</i>			n/a*		
<i>Boechera horizontalis</i>		7/31 – 9/17			7/17 – 7/31
<i>Bromus carinatus</i> var. <i>carinatus</i>	7/30 – 9/11				8/04 – 8/11
<i>Carex breweri</i>			8/04 – 9/08	8/04 – 9/03	
<i>Carex halliana</i>	8/11 – 9/17				8/11 – 8/20
<i>Carex pachycarpa</i>	7/30 – 8/21				
<i>Castilleja applegatei</i>		9/10			
<i>Castilleja arachnoidea</i>				9/03 - 9/17	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	7/30 – 9/02	8/04 – 9/15	8/11 – 9/08	8/21 – 9/02	7/21 – 9/02
<i>Ericameria greenei</i>	9/15 – 10/07	9/17 – 10/07	9/17		
<i>Ericameria nauseosa</i> var. <i>speciosa</i>					9/17 – 10/07
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	8/12 – 9/17	8/18 – 9/17	8/11 – 9/17		
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>		9/17	9/17	9/17	
<i>Holodiscus microphyllus</i> var. <i>glabrescens</i>	9/22				
<i>Juncus parryi</i>				8/04 – 8/28	
<i>Leutkea pectinata</i>				8/20 – 8/28	
<i>Lupinus andersonii</i>	7/30 – 8/19				
<i>Lupinus lepidus</i> var. <i>lobbii</i>				8/11 – 9/02	7/21 – 9/02
<i>Penstemon davidsonii</i> var. <i>davidsonii</i>		8/18 – 9/10	8/26 – 9/08		
<i>Phacelia hastata</i> ssp. <i>compacta</i>					7/30 – 8/11
<i>Phlox diffusa</i>	8/07 – 8/20	8/04 – 9/10	8/11 – 9/03		

\*insect damage – no seed set

\*\*plant to be propagated via cuttings – no seeds to be collected

The easiest plants from which to collect seeds include those from the grass (Poaceae) and sedge (Cyperaceae – Figure 11) families, although *B. carinatus* var. *carinatus* plants had to be carefully checked for presence of smut prior to commencing seed collection. *B. horizontalis*, *E. pyrolifolium* var. *coryphaeum*, *E. marifolium* var. *marifolium*, and *P. hastata* ssp. *compacta* were fairly easy plants from which to collect seed. Collecting seeds from *L. andersonii* and *L. lepidus* var. *lobbii* was the most time intensive, as inflorescences had to be bagged to capture mature seeds and revisited to collect captured seeds. *A. davisiae* var. *davisiae* plants were also time intensive to collect seeds from, as seeds had to be removed from the terminal ends of leaf axils. No seeds were collected from *A. viscosa* in 2014 due to herbivory of flowering stems. Mature capsules of *C. applegatei* var.

*aplegatei* and *C. arachnoidea* were highly susceptible to insect predation and needed to be carefully checked for entry holes prior to seed collection. Seeds from *J. parryi*, *L. pectinata*, and *P. davidsonii* var. *davidsonii* were very small and typically collecting entire mature inflorescences was the most efficient way to ensure seed collection. *P. diffusa* seeds were also time-consuming to collect and mature seeds often “jumped” out of their capsules. Not many *P. diffusa* seeds were collected in 2014.



**Figure 11.** Collecting seed from *Carex pachycarpa*. Photo by Melody Frederic.

### Invasive Vegetation Management

A total of 18,237 invasive plants were removed from project areas during the 2014 season. Invasive plants were encountered most frequently at Rim Village and along West Rim Drive. An increase in invasive plants was encountered in 2014 compared with 2013 (Table 5); this may be due to a greater effort expended on invasive plant survey and control in 2014, and the fact that some invasive plant populations were missed in 2013 (Table 4). Some areas experienced a marked decrease in invasive plant species (e.g., sheep sorrel – *Rumex acetosella* at several locations); other areas experienced an increase in the number of invasive plants encountered in 2014 (e.g, Anderson Quarry). A map of invasive plant locations is displayed in Figure 13.

**Table 5.** Abundance (number of plants encountered) of invasive plant species within the RDRR project area for 2014 and 2013. Asterisks indicate invasive plant populations missed during a particular survey year.

IVM Region	Species	2014 Abundance	2013 Abundance
Anderson Quarry	<i>Barbarea vulgaris</i>	259	91
Pole Bridge Creek Quarry	<i>Hypericum perforatum</i>	2	10
	<i>Lepidium campestre</i>	1	0
	<i>Spergularia rubra</i>	0	63
	<i>Taraxacum officinale</i>	41	8
East Rim Drive	<i>Hypericum perforatum</i>	35	1
	<i>Hypochaeris radicata</i>	1	0
	<i>Polygonum aviculare</i> ssp. <i>depressum</i>	325	*
	<i>Rumex acetosella</i>	2	240
	<i>Spergularia rubra</i>	10	0
West Rim Drive	<i>Barbarea vulgaris</i>	3	64
	<i>Hypericum perforatum</i>	0	2
	<i>Phleum pratense</i>	0	9



IVM Region	Species	2014 Abundance	2013 Abundance
	<i>Plantago lanceolata</i>	0	1
	<i>Rumex acetosella</i>	319	785
	<i>Spergularia rubra</i>	1,939	*
	<i>Taraxacum officinale</i>	3	3
Rim Village	<i>Barbarea vulgaris</i>	1,084	14
	<i>Hypericum perforatum</i>	15	0
	<i>Lepidium campestre</i>	5	0
	<i>Matricaria discoidea</i>	38	0
	<i>Plantago major</i>	120	105
	<i>Rumex acetosella</i>	4,557	12,708
	<i>Spergularia rubra</i>	6,868	51
	<i>Taraxacum officinale</i>	1,099	701
	<i>Trifolium repens</i>	633	39
	Total	18,237	14,929

\*Missed during 2013 invasive plant surveys

Two new-to-the-Park weedy species were encountered within the project area in 2014: pineapple weed (*Matricaria discoidea*) and field pepperweed (*Lepidium campestre*). At Roundtop quarry, a site which has no history of invasive plant infestations, the above-ground portion of a velvet grass (*Holcus lanatus*) plant in seed was found attached to the undercarriage of large piece of construction equipment. Roundtop quarry was used as a project staging area for the 2014 Rockfall Mitigation project and was subjected to a substantial amount of ground disturbance to improve its access road and staging area (Figure 12). At Rim Village, the common dandelion (*Taraxacum officinale*),



**Figure 12.** Ground disturbance at Roundtop quarry from the 2014 Rockfall Mitigation project. Photo by Kathryn Williams.

# Crater Lake National Park

2014 IVM - Rim Drive Rehabilitation Revegetation

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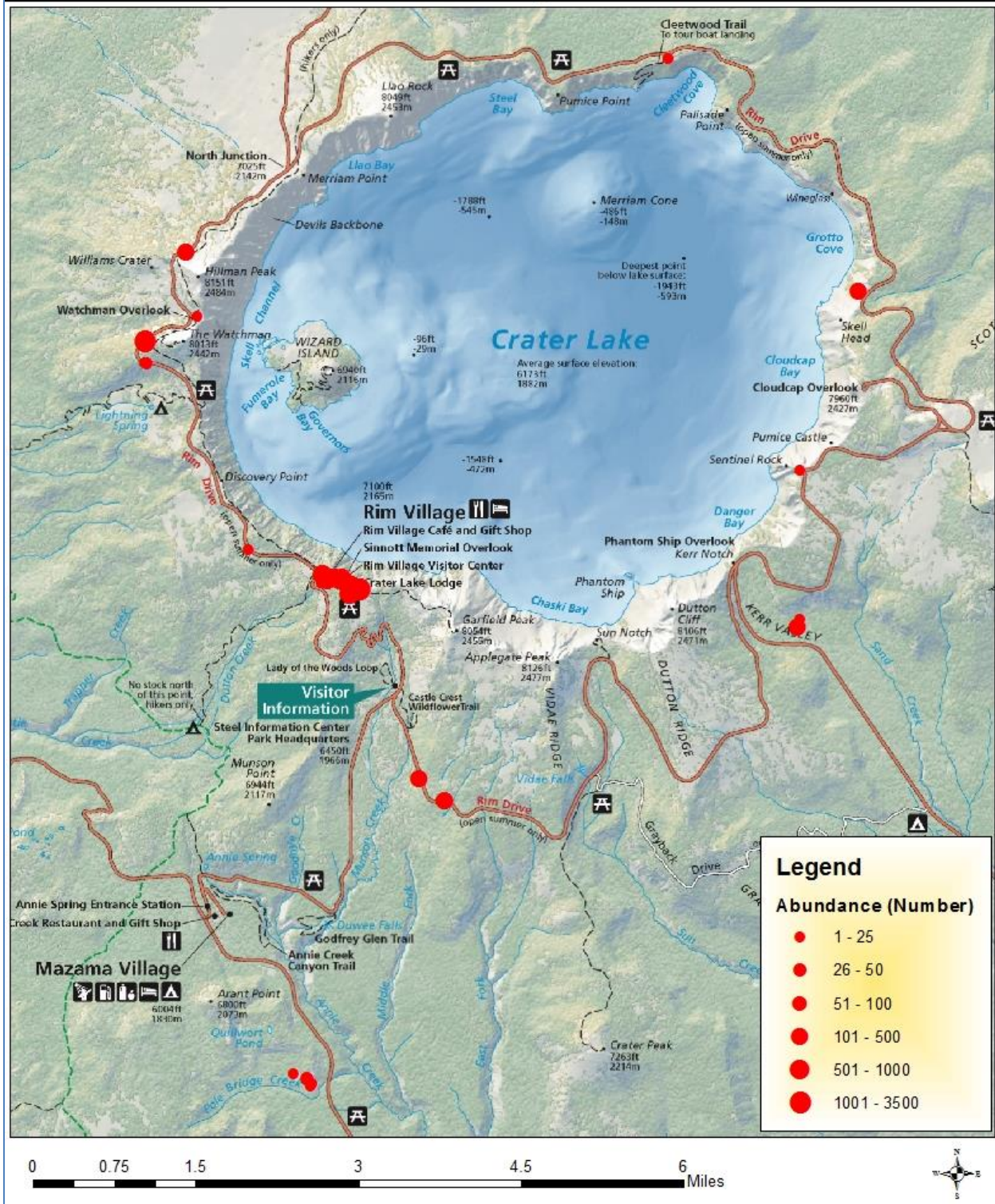


Figure 13. Invasive plant locations for the RDRR project and staging areas in 2014. Map by Jen Beck.

common plantain (*Plantago major*), pineapple weed, and St. John's wort (*Hypericum perforatum*) populations were treated in their entirety with all observed individuals removed. However, the remaining species (yellow rocket – *Barbarea vulgaris*, sheep sorrel, and white clover – *Trifolium repens*) were treated as time allowed, and at the culmination of the field season there were multiple untreated populations still present. The sheep sorrel population was treated in its entirety, but had partially resprouted by the end of the season.

## Rare Plant Salvage and Reestablishment

Results for rare plant salvage and reestablishment are presented separately by topic.

### Baseline Information

The census of the Watchman Crater Lake rockcress population yielded a total of 1,927 individuals, making this the world's largest known population of this species. This population was mapped (Figure 15) and data were collected on individual Crater Lake rockcress plants such as whether plants were reproductively mature (with flowering stem) or immature (lacking flowering stem). The maturity of some plants was not documented due to a miscommunication. Of the 1,927 plants, 38.6% were mature (743 plants); 44.1% were immature (850 plants); and 17.3% of plants were of undocumented maturity (334 plants). The population grows in a combination of shallow, compacted rocky soils on relatively flat ground (e.g., "Rockfall" and "Pullout" salvage zones), and steep, loosely consolidated rocky soils (e.g., all "Slope" salvage zones). It is believed that all Crater Lake rockcress plants will be displaced by the Rim Drive Rehabilitation project. Plant species associated with the Watchman Crater Lake rockcress population include *P. davidsonii* var. *davidsonii*, *E. marifolium* var. *marifolium*, *E. elymoides* ssp. *elymoides*, and *P. hastata* ssp. *compacta*.

The rare plants at Grotto Cove were also mapped prior to any plant salvage activities (Figure 16). Since several plant species were found at this location, the maps do not differentiate Crater Lake rockcress individuals by maturity stage. However, these data were recorded. Thirty-one Crater Lake rockcress plants (contained within 27 pots) were salvaged including 16 from the west side of the road (West Grotto Cove – Figure 14) and 15 from the east side of the road (East Grotto Cove). At West Grotto Cove, 9 Crater Lake rockcress individuals were mature (56.2%) and 7 were immature (43.8%). At East Grotto Cove, 13 Crater Lake rockcress individuals were mature (86.7%) and 2 were immature (13.3%).

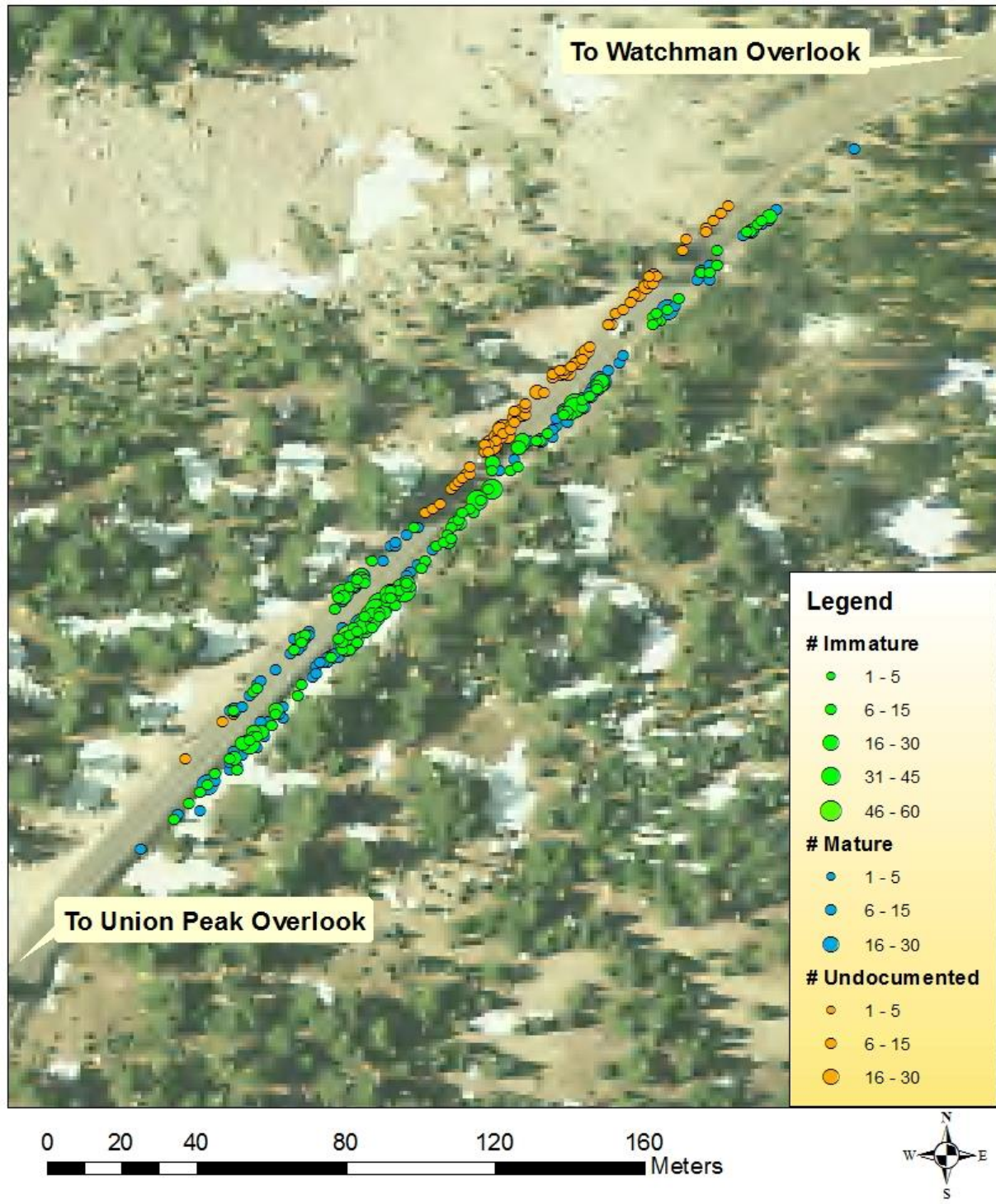


**Figure 14.** West Grotto Cove prior to plant salvage; rare plants are marked with pink flags. Photo by Jen Beck.

# Crater Lake National Park

## 2014 Watchman Crater Lake Rockcress Population

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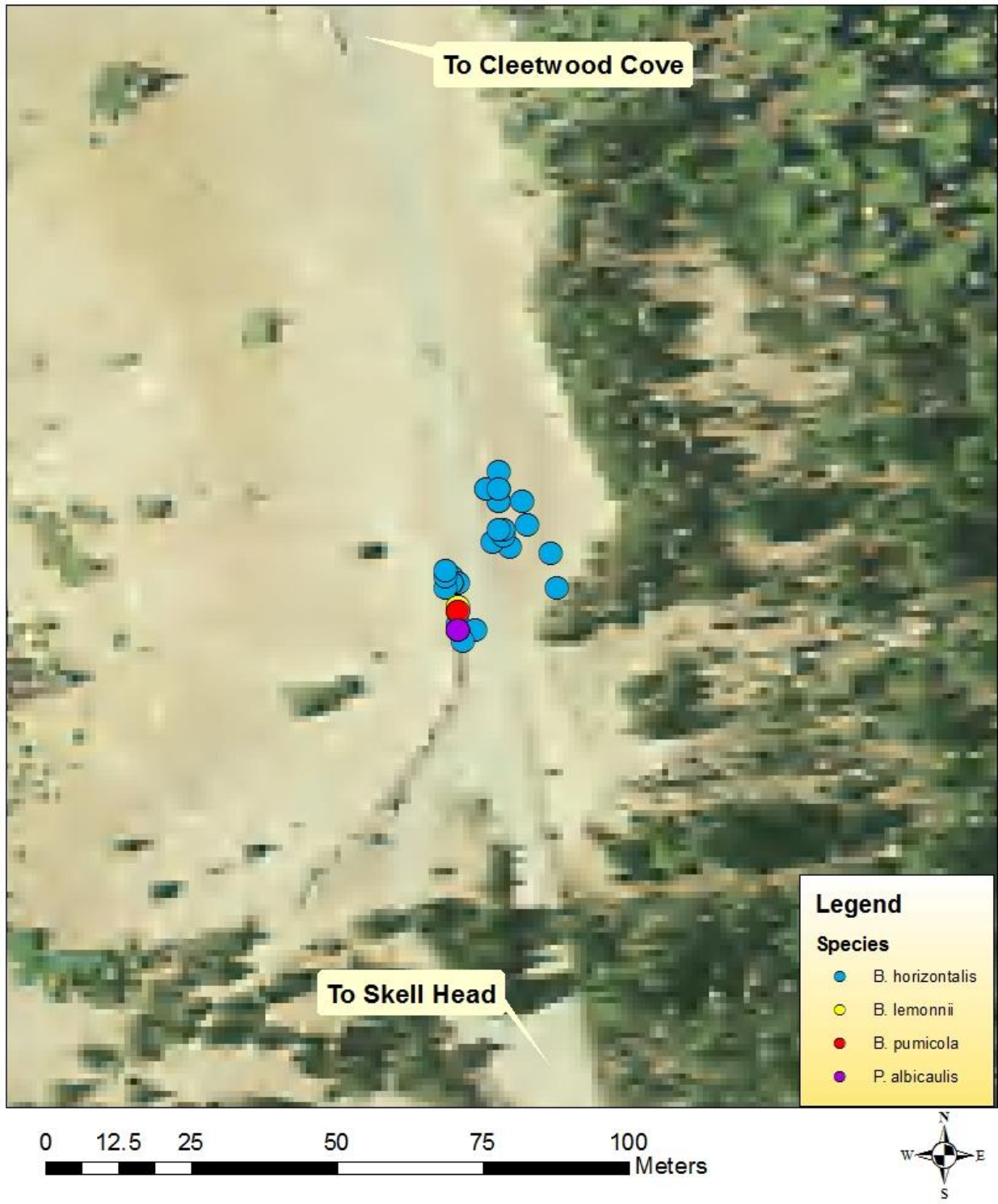


**Figure 15.** Pre-disturbance distribution of the 2014 Watchman Crater Lake rockcress population at 1,927 individuals. Plants are differentiated by whether they were flowering (mature) or not (immature); some plants did not have maturity stage recorded (undocumented). Map by Jen Beck.

# Crater Lake National Park

## 2014 Grotto Cove Rare Plant Population

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**Figure 16.** Pre-disturbance distribution of the 2014 Grotto Cove rare plant population at 37 individuals. Plants are differentiated by species. Map by Jen Beck.

### ***Rare Plant Salvage, Holdover, and Monitoring***

The Crater Lake rockcress plants salvaged from the Watchman site experienced an overall survival rate of 90.5%; however this should be considered an optimistic estimate, as many of the plants were noted as being “stressed” or with “no visible green showing” as of the last assessment on September 23, 2014. Salvaged Crater Lake rockcress survival rates by salvage zone are presented in Table 6.

**Table 6.** Survival rates of salvaged Watchman Crater Lake rockcress plants per salvage zone as of September 23, 2014.

<b>Salvage Zone</b>	<b># Plants Salvaged</b>	<b># Alive</b>	<b>% Alive</b>
Rockfall	140	105	75.0
South Pullout	182	175	96.2
North Pullout	23	22	95.7
North Slope	162	154	95.1
East Slope	43	42	97.7
<b>All</b>	<b>550</b>	<b>498</b>	<b>90.5</b>

The plants salvaged from Grotto Cove experienced good (89.2%) survival, with mortality of two of the four whitebark pine seedlings, one mature Crater Lake rockcress, and one immature Crater Lake rockcress. All the plants that died were salvaged on June 11, 2014. One whitebark pine seedling died during the week of July 17, 2014, with the second seedling dying during the week of August 6, 2014. The immature Crater Lake rockcress that died was housed in a pot with two other Crater Lake rockcress individuals (they had been growing from the same point and were kept together during salvage); this plant died right before transplant during the week of September 23, 2014 but its pot-mates survived. The mature Crater Lake rockcress died during the week of August 21, 2014. The survival rate for the whitebark pine seedlings was 50%; the survival rate for the Crater Lake rockcress was 93.5%. The Lemmon’s rockcress and pumice grapefern survived the salvage and holdover processes.

The three Mt. Shasta arnica plants from the Watchman and Last Snow sites were salvaged too late in the season (October 7, 2014) to assess how they fared the holdover process.

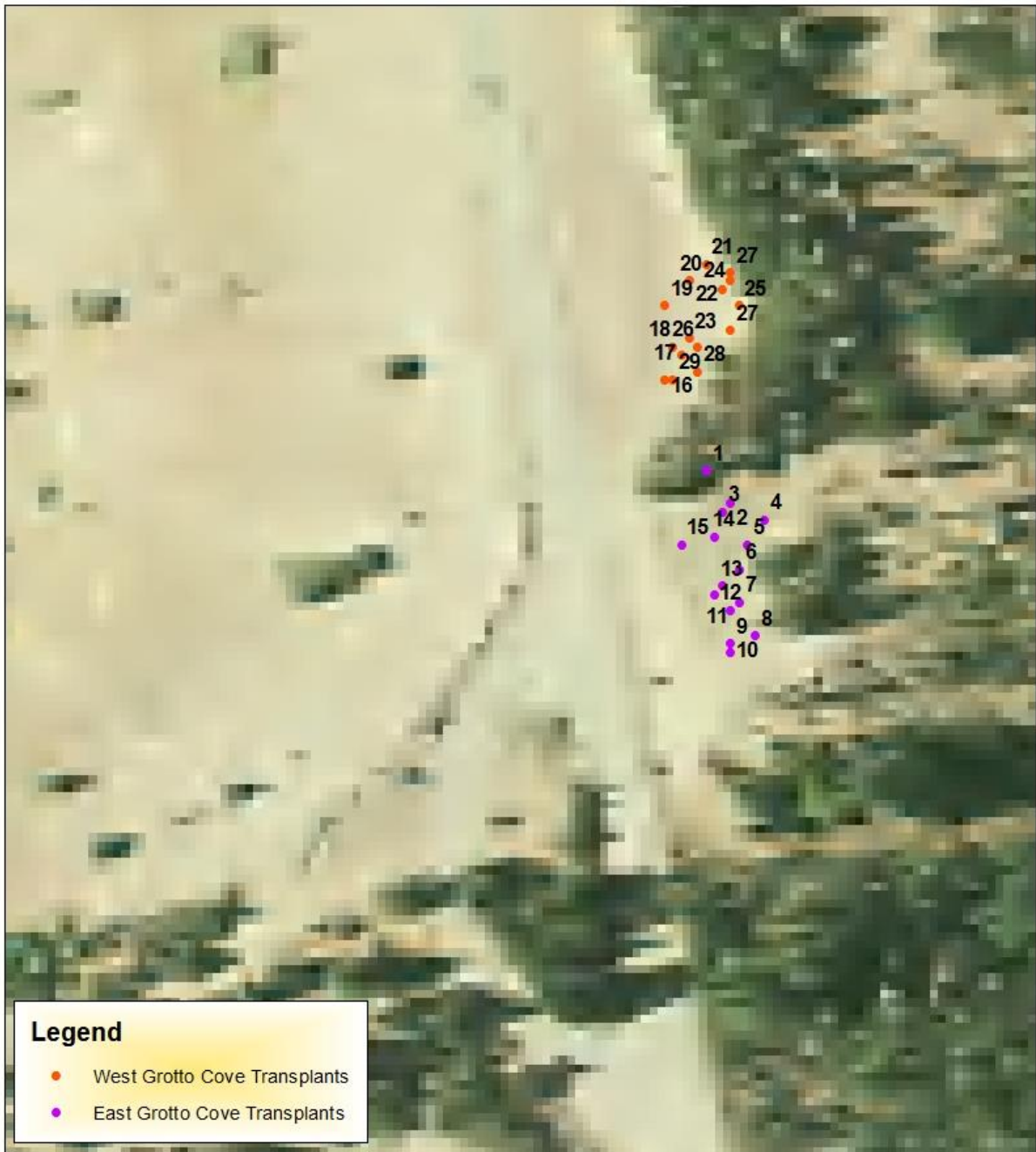
### ***Grotto Cove Rare Plant Transplant***

All 37 rare plants were transplanted back to the Grotto Cove site on October 6, 2014. Even the two dead Crater Lake rockcress plants were transplanted back into their habitat; this was done in case they have the ability to sprout from their caudex. All plants were placed outside of the road prism in an attempt to protect them from future road maintenance-related disturbance (Figure 17). Each plant was tagged, mapped, photographed, and data were collected on their condition. All plants except the dead ones appeared healthy at time of transplant (Figure 18); some Crater Lake rockcress plants had even continued flowering and fruiting while in the holdover facility. The pumice grapefern survived its months spent in cold storage; it was a bit wilted in appearance but still green and alive (Figure 18). The pumice grapefern was planted with as much of its associated soil as was practical. All transplanted plants will be assessed for survival and damage during the 2015 field season.

# Crater Lake National Park

## Grotto Cove Rare Plant Transplant 2014

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0 12.5 25 50 Meters



**Figure 17.** Transplanted locations of the 2014 Grotto Cove rare plants. Plants were placed outside the road prism. Map by Jen Beck.



**Figure 18.** Left: Transplanted Crater Lake rockcress. Right: Transplanted pumice grapefern. Photos by Jen Beck.

## Discussion

The baseline data collected and work performed by the 2014 and 2013 RDRR crews have laid a solid foundation to guide and enhance the following years of work. Road construction commences in June 2015 and revegetation work will begin in fall 2015 with seeding of sites that have been reconstructed. Seeding will continue into 2016 and beyond and be augmented with planting; the majority of planting efforts are scheduled for fall 2016. Specific suggestions and recommendations for the 2015 field season and beyond are made for each major focus area of the RDRR project.

## Revegetation

The information contained within the Revegetation Prescriptions (Appendix B) and Seed Collection Protocol (Appendix C) includes specific details on phenology and seed collection techniques to guide seed collection in 2015. These appendices also contain suggestions on what species need additional focus in 2015 (e.g., *A. davisiae* var. *davisiae* and *P. diffusa*) and good sites for seed collection. Additional feedback from the Corvallis PMC staff on the 2013 and 2014 seed collections should be received in May 2015 and will further refine and direct 2015 seed collection efforts.

The revegetation prescriptions (Appendix B) will need to be further refined based on the Revegetation Plan that provides area estimates (square footage) for each disturbance site and numbers of plants by species to be planted at each site. The 2015 RDRR crew will need to carefully align the Revegetation Prescriptions with the Revegetation Plan to ensure that enough seed of each species is being collected per seed zone. The 2015 RDRR crew should continue to document information on seed maturity, seed collection techniques, and good locations for seed collection to ensure this information is available to subsequent crews.

The Revegetation Specialists at the Denver Service Center have expressed that the absolute top priority of the 2015 RDRR season needs to be seed collection. As much seed as possible needs to be collected in 2015, as this will serve as the bulk of plant materials used for restoration.



## **Invasive Vegetation Management**

Steady progress has been made in reducing invasive plant species within the project area, and vigilant and expanded surveys should continue to capture new and previously missed infestations. Known infestations of invasive plants should continue to be treated in 2015. Treatment of invasive plant infestations occurring near rare plant populations (e.g., Diamond Lake Overlook; Watchman; and Skell Head) should receive the highest priority. Additionally, the entire project area needs to be surveyed at least twice in 2015 as it will experience increased construction traffic and disturbance.

Since a contaminated source of gravel “chips” was used in the 2014 Pavement Preservation project, RDRR project areas that were directly affected by or are adjacent to affected roadways and staging areas need to be surveyed multiple times during the 2015 season. This includes Pole Bridge Creek Quarry; Roundtop Quarry; the Ball Diamond; Cloudcap Spur Road and its intersection with East Rim Drive; the intersection of East Rim Drive and Pinnacles Road; the Grotto Cove emergency stabilization project area; the North Junction parking area; the intersections of West and East Rim Drives with Munson Valley Road; and the intersection of West Rim Drive with the North Entrance Road.

RDRR project areas impacted by the 2014 Rockfall Mitigation project will also need to be surveyed at least twice during the 2015 season due to extreme ground disturbance made by this project. This includes the Wizard Island Overlook and Watchman Cut on West Rim Drive; and the Sun Grade, Dutton Cliffs, and Anderson Point section of East Rim Drive.

## **Rare Plant Salvage and Reestablishment**

Rare plant salvage activities should be complete for this phase of the Rim Drive Rehabilitation project. The salvaged rare plants that remain in the holdover facility include the Watchman Crater Lake rockcress plants and the three Mt. Shasta arnica plants. These plants will need to be cared for and monitored during the 2015 growing season beginning at snowmelt.

The Watchman Crater Lake rockcress and Mt. Shasta arnica plants will be transplanted back into their habit once reconstruction is finished. Timing of transplant is dependent on the construction schedule, and may occur in the fall of 2015 or the fall of 2016. Plants will continue to be monitored during holdover and transplant so that we can gauge the efficacy of salvage, holdover, and transplant actions on these rare plant species.

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# Appendix A

## Rim Drive Rehabilitation Revegetation Project: Master Revegetation List for 100% Plans

**Table A1.** Comprehensive list of all sites needing revegetation under the Rim Drive Rehabilitation Revegetation project.

ID#	Name	Lt/Rt	Page	Type	Obliteration	Seed Zone	Location
SWRD1	1+04; 3+64	Lt	D.4	Pullout to obliterate	2	South WRD	Near Rim Village
SWRD2	1+45; 4+11	Rt	D.4	Pullout to obliterate	4	South WRD	Near Rim Village
SWRD3	11+28; 13+50	Lt	D.5	Pullout to obliterate	1	South WRD	North of weather station
SWRD4	23+23; 24+08	Lt	D.5	Pullout to obliterate	2	South WRD	North of weather station
SWRD5	48+41; 53+53	Rt	D.7	Pullout to obliterate	2	South WRD	South of Discovery Point
SWRD6	117+43; 120+51	Lt	D.12, E.4	Shrink parking area	2, 4	South WRD	Lightning Springs Trailhead
CWRD1	131+34; 132+91	Lt	D.13	Pullout to obliterate	1	Central WRD	North of Lightning Springs
CWRD2	143+20; 146+02	Lt	D.13	Pullout to obliterate	2	Central WRD	Union Peak Grade
CWRD3	160+65; 175+02	Lt/Rt	D.15	Rare Plant Reestablishment	n/a	Central WRD	Watchman Grade
CWRD4	168+75; 169+50	Lt	D.15	Pullout to obliterate	4	Central WRD	Watchman Grade
CWRD5	200+25; 205+52	Rt	D.17, I.5	Landscape strip/islands	2, 4	Central WRD	Watchman Overlook
CWRD6	200+20; 201+08	Rt	D.17	Landscape islands	4	Central WRD	Watchman Overlook
CWRD7	213+89; 215+25	Lt	D.18	Pullout to obliterate	2	Central WRD	Hillman Peak
CWRD8	216+10; 217+29	Lt	D.18	Pullout to obliterate	1	Central WRD	Hillman Peak
NWRD1	259+20; 264+53	Rt	D.21, E.6	Shrink pullout	3	North WRD	Last Snow
NWRD2	259+57; 264+14	Rt	D.21, E.6	Pullout to obliterate	2, 4	North WRD	Last Snow
NWRD3	269+48; 273+17	Lt	D.22	Pullout to obliterate	1	North WRD	Devil's Backbone
NWRD4	279+35; 281+13	Lt	D.22, D.23	Pullout to obliterate	1	North WRD	Devil's Backbone
NWRD5	297+18; 299+72	Lt	D.24, E.7	Pullout to obliterate	1	North WRD	Glacial Valleys
NWRD6	297+27; 299+24	Rt	D.24, E.7	Pullout to obliterate	1	North WRD	Glacial Valleys
NWERD1	503+51; 507+03	Rt	D.26	Pullout to obliterate	3	NW ERD	North Junction
NWERD2	503+93; 508+38	Lt	D.26	Pullout to obliterate	2	NW ERD	North Junction
NWERD3	560+75; 564+21	Lt	D.28	Pullout to obliterate	3	NW ERD	Llao Rock
NWERD4	566+91; 568+50	Lt	D.28	Pullout to obliterate	2	NW ERD	Llao Rock
NWERD5	588+42; 594+25	Lt	D.29	Pullout to obliterate	2	NW ERD	Grouse Hill
NWERD6	603+35; 606+35	Lt	D.29/30	Pullout to obliterate	1	NW ERD	Grouse Hill
NEERD1	696+21; 698+71	Rt	D.34	Road Realignment	4	NE ERD	Pumice Point
NEERD2	731+89; 735+23	Lt	D.35/36	Pullout to obliterate	3	NE ERD	Cleetwood Cove
NEERD3	Cleetwood Cove	n/a	I.9	Landscape islands	n/a	NE ERD	Cleetwood Cove Parking Lot
NEERD4	739+31; 750+02	Lt	D.36	Pullout to obliterate	1	NE ERD	Cleetwood Cove
NEERD5	742+38; 744+94	Rt	D.36	Pullout to obliterate	3	NE ERD	Cleetwood Cove

# Appendix B

## Revegetation Prescriptions for all Rim Drive Rehabilitation Revegetation Sites

<b>Seed Zone: South WRD</b>		<b>ID: SWRD1</b>	<b>Mileage = 0.02</b>
<b>Beginning Station: 1+04</b>		<b>Ending Station: 3+64</b>	<b>Left Side</b>
<b>Location:</b> Near Rim Village			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	5	
<i>Bromus carinatus var. carinatus</i>	California brome	10	
<i>Carex pachycarpa</i>	Many-ribbed sedge	15	
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail	15	
<i>Ericameria greenei</i>	Greene's goldenweed	30	
<i>Lupinus andersonii</i>	Anderson's lupine	15	
<i>Phlox diffusa</i>	Spreading phlox	10	
Total Cover:		100	
<b>Associated species:</b> <i>Castilleja applegatei</i> , <i>Eucephalus ledophyllus</i> , <i>Veratrum viride</i> , <i>Nothocalais alpestris</i> , <i>Calyptridium umbellatum</i> , <i>Carex inops ssp. inops</i>			
<b>UTM (Zone 10, NAD 83):</b>	0569488 E	4751412 N	
<b>Total Vegetative Cover:</b> 70%		<b>Elevation:</b> 7135'	
<b>Soil:</b> Deep (> 4") ashy sandy loam/ ashy loamy sand; minimal litter; Scattered < 2 inch rocks			
<b>Comments:</b> Asphalt eyebrows to 1 meter from pullout edge.			
<b>Slope:</b> 8%	<b>Aspect:</b> SW	<b>Snowmelt out:</b> 6/17 – no snow = 0	
<b>General soil:</b> low-mod water retention; mod gopher potential; low-mod organics = 2			
<b>Soil "hardness," presence of rocks:</b> -soft pumice soil with small pumice rocks = 0			
<b>Wind exposure:</b> mod-high = 2		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> 0 at site but woody debris, litter & duff in nearby forest stands			
<b>2014 Phenology notes:</b>			
7/23 – in fruit: BROCAR, CARPAC, PHLDIF; in bud: ACHOCC, ERIGRE Note: some BROCAR with smut			
7/30 – in fruit: ACHOCC, ELYELY; collected seed from CARPAC, LUPAND; also placed 6 nylons over LUPAND pods			
8/7 – collected ACHOCC, BROCAR, CARPAC, ELYELY, LUPAND			
8/12 – collected ACHOCC, BROCAR, CARPAC, ELYELY, LUPAND (removed all 6 nylons from LUPAND)			

<b>Seed Zone: South WRD</b>		<b>ID: SWRD2</b>	<b>Mileage = 0.03</b>
<b>Beginning Station: 1+45</b>		<b>Ending Station: 4+11</b>	<b>Right Side</b>
<b>Location:</b> Near Rim Village			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Bromus carinatus var. carinatus</i>	California brome	10	
<i>Carex pachycarpa</i>	Many-ribbed carex	10	
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail	10	
<i>Ericameria greenei</i>	Greene's goldenweed	25	
<i>Lupinus andersonii</i>	Anderson's lupine	15	
<i>Phlox diffusa</i>	Spreading phlox	30	
	Total Cover:	100	
<b>Associated species:</b> <i>Aconogonon davisiae</i> , <i>Eucephalus ledophyllus</i> , <i>Veratrum viride</i> , <i>Nothocalais alpenstris</i> , <i>Agoseris aurantiaca</i> , <i>Achnatherum occidentale</i>			
<b>UTM (NAD 83):</b>	0569496 E	4751420 N	
<b>Total Vegetative Cover:</b> 70%		<b>Elevation:</b> 7139'	
<b>Soil:</b> Deep (> 4 inches) ashy sandy loam/ashy loamy sand; very little litter; scattered < 1.0 inch pebbles			
<b>Comments:</b> Old asphalt sloughing 6 feet down into ditch.			
<b>Slope:</b> 8%	<b>Aspect:</b> SW	<b>Snowmelt out:</b> 6/17 – no snow = 0	
<b>General soil:</b> low-mod water retention; mod gopher potential; low-mod organics = 2			
<b>Soil "hardness," presence of rocks:</b> soft pumice soil with small pumice rocks = 0			
<b>Wind exposure:</b> mod-high = 2		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> 0 at site but woody debris, forest floor litter debris in nearby forest stands			
<b>2014 Phenology notes:</b>			
7/23 – in fruit: <b>LUPAND, CARPAC, PHLDIF</b> ; in bud: <b>ERIGRE</b> Note: Placed stockings over 12 LUPAND			
7/30 – collected seed from <b>ACHOCC, CARPAC, ELYELY, LUPAND</b> ; also placed 22 nylons on LUPAND pods			
8/7 – collected seed from PHLDIP, CARPAC			
8/12 – collected ACHOCC, BROCAR, CARPAC, ELYELY, LUPAND (removed 32 nylons from LUPAND; unable to find 2 nylons)			

<b>Seed Zone: South WRD</b>		<b>ID: SWRD3</b>	<b>Mileage: 0.21</b>
<b>Beginning Station: 11+28</b>		<b>Ending Station: 13+50</b>	<b>Left side</b>
<b>Location:</b> North of weather station			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Bromus carinatus</i> var. <i>carinatus</i>	California brome	10	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	10	
<i>Ericameria greenei</i>	Greene's goldenweed	40	
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat	5	
<i>Holodiscus microphyllus</i> var. <i>glabrenscens</i>	Sticky oceanspray	20	
<i>Lupinus andersonii</i>	Anderson's lupine	5	
<i>Phlox diffusa</i>	Spreading phlox	10	
	Total Cover:	100	
<b>Associated species:</b> <i>Carex breweri</i> , <i>Calyptridium umbellatum</i> , <i>Eriogonum umbellatum</i> var. <i>polyanthum</i> , <i>Phacelia hastata</i> ssp. <i>compacta</i> , <i>Agoseris aurantiaca</i> , <i>Achnatherum occidentale</i> , <i>Carex halliana</i>			
<b>UTM (NAD 83):</b>	0569251 E	4751590 N	
<b>Total Vegetative Cover:</b> 70%		<b>Elevation:</b> 7082'	
<b>Soil:</b> Deep (> 4 inches) ashy sandy loam / ashy loamy sand; little litter development; mixed gravel and pumice on surface			
<b>Comments:</b> none			
<b>Slope:</b> 34%	<b>Aspect:</b> SW	<b>Snow meltout:</b> 6/17 - no snow = 0	
<b>General soil:</b> low-mod water retention; mod gopher potential; low-mod organics = 2			
<b>Soil "hardness,"presence of rocks:</b> slope with small to large rock rubble with 5% large boulders = 2			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> 0 on site but small woody debris, forest ground litter, decayed dead & down in forests nearby			
<b>2014 Phenology notes:</b>			
7/23 –in fruit: BROCAR, ERIMAR, PHLDIF, LUPAND			
7/30 – in fruit: BROCAR, ELYELY; collected seed from BROCAR, ELYELY			

<b>Seed Zone: South WRD</b>		<b>ID: SWRD4</b>	<b>Mileage = 0.44</b>
<b>Beginning Station: 23+23</b>		<b>Ending Station: 24+08</b>	<b>Left Side</b>
<b>Location:</b> North of weather station			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Carex halliana</i>	Oregon sedge	5	
<i>Carex pachycarpa</i>	Many-ribbed sedge	30	
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail	20	
<i>Ericameria greenei</i>	Greene's goldenweed	30	
<i>Eriogonum marifolium var. marifolium</i>	Mountain buckwheat	15	
	Total Cover:	100	
<b>Associated species:</b> <i>Phacelia hastata ssp. compacta</i> , <i>Boechera howellii</i> , <i>Arctostaphylos nevadensis</i> , <i>Calyptidium umbellatum</i>			
<b>UTM (NAD 83):</b>	0568907 E	4751648 N	
<b>Total Vegetative Cover:</b> 50%		<b>Elevation:</b> 7082'	
<b>Soil:</b> Deep (> 4 inches) ashy sandy loam / ashy loamy sand; mixed gravel on surface.			
<b>Comments:</b> none			
<b>Slope:</b> 60%	<b>Aspect:</b> SE	<b>Snow meltout:</b> 6/17 – no snow = 0	
<b>General soil:</b> low water retention; low gopher potential; low organics = 2			
<b>Soil "hardness," presence of rocks:</b> most of site large rock rubble to boulder-sized = 3			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover :</b> 0 = 3	
<b>Ameliorating microsite features:</b> 0 on site but debris should be available from nearby forest stands			
<b>2014 Phenology notes:</b>			
7/23 – in fruit: ERIMAR, CARPAC			
7/30 – in fruit: ELYELY; collected seed from CARPAC, ELYELY			
8/12 – collected ACHOCC, CARPAC, ELYELY, ERIMAR			

<b>Seed Zone: South WRD</b>		<b>ID: SWRD5</b>	<b>Mileage = 0.92</b>
<b>Beginning Station: 48+41</b>		<b>Ending Station: 53+53</b>	<b>Right side</b>
<b>Location:</b> South of Discovery Point			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	30	
<i>Bromus carinatus var. carinatus</i>	California brome	10	
<i>Carex halliana</i>	Oregon sedge	10	
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail	15	
<i>Ericameria greenei</i>	Greene's goldenweed	20	
<i>Eriogonum marifolium var. marifolium</i>	Mountain buckwheat	10	
<i>Phlox diffusa</i>	Spreading phlox	5	
	Total Cover:	100	
<b>Associated species:</b> <i>Carex inops ssp. inops</i> , <i>Eriogonum pyrolifolium var. coryphaeum</i> , <i>Aconogonon davisiae var. davisiae</i> , <i>Calyptridium umbellatum</i> , <i>Viola sp.</i> , <i>Luzula hitchcockii</i> , <i>Carex pachycarpa</i>			
<b>UTM (NAD 83):</b>	0568460 E	4752120 N	
<b>Total Vegetative Cover:</b> 50%		<b>Elevation:</b> 7105'	
<b>Soil:</b> Deep (> 4 inches) ashy sandy loam / ashy loamy sand with mixed native gravel on surface			
<b>Comments:</b> Asphalt into meadow at 3 meters from road.			
<b>Slope:</b> 20%	<b>Aspect:</b> NE	<b>Snow meltout:</b> 6/17 – no snow = 0	
<b>General soil:</b> low water retention; mod-high gopher potential; low-mod organics = 2			
<b>Soil "hardness," presence of rocks:</b> few scattered large rocks = 1			
<b>Wind exposure:</b> mod-high = 2		<b>Canopy cover:</b> < 5% = 2	
<b>Ameliorating microsite features:</b> little on site but downed woody debris, forest floor litter in nearby forest stands			
<b>2014 Phenology notes:</b>			
7/16 - in fruit: ERIMAR			
7/23 –in fruit: CARHAL, PHLDIF			
7/30 – in fruit: ELYELY, BROCAR, ACHOCC, ACODAV			
8/11 – collected from BROCAR, ELYELY, CARPAC, CARHAL, ACHOCC			
8/19 & 8/21 (Noname pullout) – collected ACHOCC, BROCAR, ELYELY, ERIMAR, CARPAC, CARHAL			
9/2 (Noname pullout) – collected ACHOCC, BROCAR, CARHAL, ELYELY, ERIMAR			
9/15 (Noname pullout) – collected ERIGRE, ERIMAR			
9/22 (pullout just north of Discovery Point) – collected HOLMIC (seeds just beginning to mature)			



<b>Seed Zone: South WRD</b>		<b>ID: SWRD6</b>	<b>Mileage = 2.22</b>
<b>Beginning Station: 117+43</b>		<b>Ending Station: 120+51</b>	<b>Left Side</b>
<b>Location:</b> Lightning Springs Trailhead Parking			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	15	
<i>Carex halliana</i>	Oregon sedge	10	
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail	20	
<i>Ericameria greenei</i>	Greene's goldenweed	25	
<i>Eriogonum marifolium var. marifolium</i>	Mountain buckwheat	10	
<i>Lupinus andersonii</i>	Anderson's lupine	10	
<i>Phlox diffusa</i>	Spreading phlox	10	
	Total Cover:	100	
<b>Associated species:</b> <i>Carex inops ssp. inops*</i> , <i>Arctostaphylos nevadensis</i> , <i>Dicentra formosa</i> , <i>Epilobium angustifolium</i> , <i>Eriogonum pyrolifolium var. coryphaeum</i> , <i>Lupinus lepidus var. lobbii</i> , <i>Calyptridium umbellatum</i>			
<b>UTM (NAD 83):</b>	0567716 E	4753847 N	
<b>Total Vegetative Cover:</b> 70%		<b>Elevation:</b> 7184'	
<b>Soil:</b> Deep (> 4 inches) ashy sandy loam / ashy loamy sand			
<b>Comments:</b> *Lots of smut on <i>C. inops</i> population			
<b>Slope:</b> 30%	<b>Aspect:</b> SW	<b>Snow meltout:</b> 6/17 – heavy snow on west edge; 6/30 snow still present; 7/2 – no snow = 1	
<b>General soil:</b> low-mod water retention; low gopher potential; low-mod organics =2			
<b>Soil "hardness," presence of rocks:</b> 10% small-large rocks, a few boulders = 1			
<b>Wind exposure:</b> mod = 2		<b>Canopy cover:</b> 5% = 2	
<b>Ameliorating microsite features</b> – very little on site but small woody debris, forest floor litter, duff layer at trailhead sign and bordering forest stand			
<b>2014 Phenology notes:</b>			
8/12 – collected ACHOCC, BROCAR, CARHAL, CARPAC, ELYELY, LUPAND			
8/18 – collected CARHAL, CARPAC, BROCAR			

<b>Seed Zone: Central WRD</b>		<b>ID: CWRD1</b>	<b>Mileage = 2.49</b>
<b>Beginning Station: 131+34</b>		<b>Ending Station: 132+91</b>	<b>Left Side</b>
<b>Location:</b> North of Lightning Springs			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	15	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	30	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	15	
<i>Ericameria greenei</i>	Greene's goldenweed	5	
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat	20	
<i>Phlox diffusa</i>	Spreading phlox	15	
	Total Cover:	100	
<b>Associated species:</b> <i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i> , <i>Carex pachycarpa</i> , <i>Calyptridium umbellatum</i> , <i>Arctostaphylos nevadensis</i>			
<b>UTM (NAD 83):</b>	0567557 E	4754208 N	
<b>Total Vegetative Cover:</b> 50%		<b>Elevation:</b> 7246'	
<b>Soil:</b> Deep (> 4 inches) ashy sandy loam / ashy loamy sand with mixed native gravel on surface			
<b>Comments:</b> none			
<b>Slope:</b> 42%	<b>Aspect:</b> SW	<b>Snow meltout:</b> 6/17 – heavy snow on 2/3; 7/2 – PO with 50% snow cover; 7/16 – no snow = 2	
<b>General soil:</b> low water retention; high gopher potential; low organics = 3			
<b>Soil "hardness," presence of rocks:</b> – 20% small to large rock rubble = 1			
<b>Wind exposure:</b> mod = 2		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> little on site but woody debris, forest floor litter, decaying dead & down in nearby forest stands; some ACODAV debris will be available			
<b>2014 Phenology notes:</b>			
7/22 –in fruit: ERIMAR, PHLDIF			
7/30 –in fruit: ACODAV			
8/18 – collected ERIMAR, ACODAV, ELYELY, ACHOCC, PHLDIF			
9/15 – collected ELYELY			

<b>Seed Zone: Central WRD</b>		<b>ID: CWRD2</b>	<b>Mileage = 2.71</b>
<b>Beginning Station: 143+00</b>		<b>Ending Station: 146+02</b>	<b>Left Side</b>
<b>Location:</b> Union Peak Grade			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	10	
<i>Castilleja applegatei</i>	Applegate's paintbrush	5	
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail	15	
<i>Penstemon davidsonii var. davidsonii</i>	Davidson's penstemon	70	
Total Cover:		100	
<b>Associated species:</b> <i>Boechera howellii</i> , <i>Carex pachycarpa</i> , <i>Eucephalus ledophyllus</i> , <i>Hieracium albiflorum</i> , <i>Phacelia hastata ssp. compacta</i> , <i>Calyptridium umbellatum</i> , <i>Carex inops ssp. inops</i> , <i>Juncus parryi</i>			
<b>UTM (Zone 10, NAD 83):</b>	0567265 E	4754429 N	
<b>Total Vegetative Cover:</b> 70%		<b>Elevation:</b> 7320'	
<b>Soil:</b> Ashy loamy sand with talus and an .01 inch "O" horizon			
<b>Comments:</b> Asphalt eyebrows to 1 meter from pullout edge.			
<b>Slope:</b> 62%	<b>Aspect:</b> S	<b>Snowmelt out:</b> 6/17 – heavy snow drifts along PO edge, PO 2/3 clear; 7/2 – no snow =1	
<b>General soil:</b> low-mod water retention; low gopher potential; mod-high organics = 1			
<b>Soil "hardness," presence of rocks:</b> 60% large rock rubble with some boulders = 3			
<b>Wind exposure:</b> mod-high = 2		<b>Canopy cover:</b> 5% = 2	
<b>Ameliorating microsite features:</b> small woody debris, forest floor litter, decaying dead & down available in bordering forest			
<b>2014 Phenology notes:</b>			
7/22 – in fruit: ERIMAR, PHLDIF			
7/30 –in fruit: ACODAV			
8/18 – collected ERIMAR, ACODAV, ELYELY, ACHOCC, PHLDIF			
9/15 – collected ELYELY			

<b>Seed Zone: Central WRD</b>		<b>ID: CWRD3</b>	<b>Mileage = X.XX</b>
<b>Beginning Station: 160+65</b>		<b>Ending Station: 175+02</b>	<b>Left and Right Sides</b>
<b>Location:</b> Watchman Grade			
<b>Plant Species</b>	<b>Common Name</b>		<b>Relative % Cover</b>
<i>Boechera horizontalis</i>	Crater Lake Rockcress		100
Total Cover:			100
<b>Associated species:</b> <i>Acogonon davisiae</i> ssp. <i>davisiae</i> , <i>Anaphalis margaritacea</i> , <i>Juncus parryi</i> , <i>Elymus elymoides</i> ssp. <i>elymoides</i> , <i>Penstemon davidsonii</i> , <i>Eriogonum marifolium</i> var. <i>marifolium</i> , <i>Leutkea pectinata</i>			
<b>UTM (Zone 10, NAD 83):</b>	0567006 E	4754834 N	
<b>Total Vegetative Cover:</b> 70%			<b>Elevation:</b> 7XXX'
<b>Soil:</b> Ashy, loamy sand with gravel and rocks			
<b>Comments:</b> Steep shoulders will make transplanting difficult.			
<b>Slope:</b> X%	<b>Aspect:</b> W		<b>Snowmelt out:</b> 2 (need date)
<b>General soil:</b> low-mod water retention, low-mod organics = 2			
<b>Soil "hardness," presence of rocks:</b> > 50% rocks and gravel = 3			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> 0 at site but woody debris, litter & duff in nearby forest stands			
<b>Comments:</b> Seed collected in 2013 and 2014 (limited). Plants that could be salvaged were removed in July/August 2014.			

<b>Seed Zone: Central WRD</b>		<b>ID: CWRD4</b>	<b>Mileage = X.XX</b>
<b>Beginning Station: 168+75</b>		<b>Ending Station: 169+50</b>	<b>Left Side</b>
<b>Location:</b> Watchman Grade			
<b>Plant Species</b>	<b>Common Name</b>		<b>Relative % Cover</b>
<i>Boechea horizontalis</i>	Crater Lake Rockcress		100
Total Cover:			100
<b>Associated species:</b> <i>Acogonon davisiae</i> ssp. <i>davisiae</i> , <i>Anaphalis margaritacea</i> , <i>Juncus parryi</i> , <i>Elymus elymoides</i> ssp. <i>elymoides</i> , <i>Penstemon davidsonii</i> , <i>Eriogonum marifolium</i> var. <i>marifolium</i> , <i>Leutkea pectinata</i>			
<b>UTM (Zone 10, NAD 83):</b>	0XXXXXX E	475XXXX N	
<b>Total Vegetative Cover:</b> 70%			<b>Elevation:</b> 7XXX'
<b>Soil:</b> Ashy, loamy sand with gravel and rocks			
<b>Comments:</b> Steep shoulders will make transplanting difficult.			
<b>Slope:</b> X%	<b>Aspect:</b> W		<b>Snowmelt out:</b> 2 (need date)
<b>General soil:</b> low-mod water retention, low-mod organics = 2			
<b>Soil "hardness," presence of rocks:</b> > 50% rocks and gravel = 3			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> 0 at site but woody debris, litter & duff in nearby forest stands			
Comments:			

<b>Seed Zone: Central WRD</b>		<b>ID: CWRD5</b>	<b>Mileage: X.XX</b>
<b>Beginning Station: 200+25</b>		<b>Ending Station: 205+52</b>	<b>Right Side</b>
<b>Location:</b> Watchman Overlook			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass		
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower		
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail		
<i>Ericameria greenei</i>	Greene's goldenweed		
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat		
<i>Phlox diffusa</i>	Spreading phlox		
	Total Cover:		
<b>Associated species:</b> <i>Anemone occidentalis</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i> , <i>Penstemon davidsonii</i> var. <i>davidsonii</i>			
<b>UTM (NAD 83):</b>	567768 E	4755162 N	
<b>Total Vegetative Cover:</b> 50%		Elevation: 7593'	
<b>Soil:</b> Deep (> 4 inches) ashy sandy loam / ashy loamy sand			
<b>Comments:</b> Relative cover is based on hillslope to north of parking.			
<b>Slope:</b> n/a	<b>Aspect:</b> W	<b>Snow meltout:</b> 6/17 – light snow cover on 70%; 6/30 – no snow	
<b>General soil:</b> low water retention; low gopher potential?; low organics			
<b>Soil "hardness," presence of rocks:</b> n/a			
<b>Wind exposure:</b> mod-high		<b>Canopy cover:</b> 0	
<b>Ameliorating microsite features:</b> 0 on site			
<b>2014 Phenology notes:</b>			
7/22 – in fruit: ACODAV; ERIMAR			
7/30 – in fruit: ELYELY			
8/19 – collected ACHOCC, ACODAV, ELYELY, ERIMAR, PHLDIF			
9/17 – collected ERIMAR, ERIPYR			

<b>Seed Zone: Central WRD</b>		<b>ID: CWRD6</b>	<b>Mileage: X.XX</b>
<b>Beginning Station: 200+20</b>		<b>Ending Station: 201+08</b>	<b>Right Side</b>
<b>Location:</b> Watchman Overlook			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass		
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower		
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail		
<i>Ericameria greenei</i>	Greene's goldenweed		
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat		
<i>Phlox diffusa</i>	Spreading phlox		
	Total Cover:		
<b>Associated species:</b> <i>Anemone occidentalis</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i> , <i>Penstemon davidsonii</i> var. <i>davidsonii</i>			
<b>UTM (NAD 83):</b>	567768 E	4755162 N	
<b>Total Vegetative Cover:</b> 50%		<b>Elevation:</b> 7593'	
<b>Soil:</b> Deep (> 4 inches) ashy sandy loam / ashy loamy sand			
<b>Comments:</b> Relative cover is based on hillslope to north of parking.			
<b>Slope:</b> n/a	<b>Aspect:</b> W	<b>Snow meltout:</b> 6/17 – light snow cover on 70%; 6/30 – no snow	
<b>General soil:</b> low water retention; low gopher potential?; low organics			
<b>Soil "hardness," presence of rocks:</b> n/a			
<b>Wind exposure:</b> mod-high		<b>Canopy cover:</b> 0	
<b>Ameliorating microsite features:</b> 0 on site			
<b>2014 Phenology notes:</b>			
7/22 – in fruit: ACODAV; ERIMAR			
7/30 – in fruit: ELYELY			
8/19 – collected ACHOCC, ACODAV, ELYELY, ERIMAR, PHLDIF			
9/17 – collected ERIMAR, ERIPYR			

<b>Seed Zone: Central WRD</b>		<b>ID: CWRD7</b>	<b>Mileage = 4.05</b>
<b>Beginning Station: 213 + 89.2</b>		<b>Ending Station: 215 + 24.9</b>	<b>Left Side</b>
<b>Location:</b> Hillman			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	50	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	10	
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat	20	
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks	5	
<i>Phlox diffusa</i>	Spreading phlox	15	
	Total Cover:	100	
<b>Associated species:</b> <i>Phacelia hastata</i> ssp. <i>compacta</i> , <i>Viola</i> sp., <i>Eucephalus ledophyllus</i>			
<b>UTM (NAD 83):</b>	0567483 E	4755530 N	
<b>Total Vegetative Cover:</b> 30%		<b>Elevation:</b> 7612'	
<b>Soil:</b> Bouldery with > 4 inch deep ashy sandy loam/ashy loamy sand			
<b>Comments:</b> Asphalt eyebrows between two pullouts sloughing 1 meter from road.			
<b>Slope:</b> 60%	<b>Aspect:</b> W	<b>Snow meltout:</b> 6/17 – PO is mostly clear; 7/2 – PO and 50% of slope clear of snow; 7/16 no snow = 3	
<b>General soil:</b> low water retention; mod gopher potential; low organics = 3			
<b>Soil “hardness,” presence of rocks:</b> 10% gravel, 50% small to large rocks; 5% boulders = 2			
<b>Wind exposure:</b> mod to high = 2		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> moderate presence of ACODAV to provide plant debris; possible material in near- vicinity forest stands			
<b>2014 Phenology Notes:</b>			
7/22 – in fruit: ACODAV; ERIMAR			
7/30 – in fruit: ELYELY			
8/19 – collected ACHOCC, ACODAV, ELYELY, ERIMAR, PHLDIF			
9/17 – collected ERIMAR, ERIPYR			



<b>Seed Zone: Central WRD</b>		<b>ID: CWRD8</b>	<b>Mileage = 4.09</b>
<b>Beginning Station: 216 + 10</b>		<b>Ending Station: 217 + 29</b>	<b>Left Side</b>
<b>Location:</b> Hillman			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	5	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	50	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	10	
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat	15	
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks	10	
<i>Phlox diffusa</i>	Spreading phlox	10	
	Total Cover:	100	
<b>Associated species:</b> <i>Carex phaeocephala</i> , <i>Juncus parryi</i> , <i>Boechera howellii</i> , <i>Carex pachycarpa</i> , <i>Eucephalus ledophyllus</i> , <i>Lupinus andersonii</i> , <i>Calyptidium umbellatum</i>			
<b>UTM (NAD 83):</b>	0567449 E	4755581 N	
<b>Total Vegetative Cover:</b> 40%		<b>Elevation:</b> 7614'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand with 0.1 inch litter, in part since some mountain hemlock is adjacent to pullout			
<b>Comments:</b> Some mountain hemlock adjacent to pullout.			
<b>Slope:</b> 35%	<b>Aspect:</b> W	<b>Snow meltout:</b> 6/17 – most of PO is clear; 7/2 – PO clear; 7/16 – 20% snow pack left on north slope = 3	
<b>General soil:</b> mod water retention; mod gopher potential; mod organics = 1			
<b>Soil “hardness,” presence of rocks:</b> 5% small/large/boulder cover = 1			
<b>Wind exposure:</b> mod-high = 2		<b>Canopy cover:</b> <5% = 2	
<b>Ameliorating microsite features:</b> small amount of useable woody debris in bordering forest; moderate numbers of ACODAV to provide plant debris			
<b>2014 Phenology Notes:</b>			
7/22 – in fruit: ACODAV; ERIMAR			
8/19 – collected ACHOCC, ACODAV, ELYELY, ERIMAR, PHLDIF			
9/11 – collected ACODAV			
9/17 – collected ERIMAR, ERIPYR			

<b>Seed Zone: North WRD</b>		<b>ID: NWRD1</b>	<b>Mileage = 4.92</b>
<b>Beginning Station: 259 + 20</b>		<b>Ending Station: 264 + 53</b>	<b>Right Side</b>
<b>Location:</b> Last Snow			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	30	
<i>Carex breweri</i>	Brewer's sedge	30	
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks	30	
<i>Penstemon davidsonii</i> var. <i>davidsonii</i>	David's penstemon	10	
	Total Cover:	100	
<b>Associated species:</b> <i>Arnica nevadensis</i> , <i>Boechera howellii</i> , <i>Calyptidium umbellatum</i> , <i>Cardamine</i> sp., <i>Elymus elymoides</i> ssp. <i>elymoides</i>			
<b>UTM (NAD 83):</b>	0568003 E	4756563 N	
<b>Total Vegetative Cover:</b> 50% in talus		<b>Elevation:</b> 7491'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand with talus parent material.			
<b>Comments:</b> One Shasta arnica ( <i>Arnica viscosa</i> ) four meters downslope of pullout			
<b>Slope:</b> 45%	<b>Aspect:</b> NW	<b>Snow meltout:</b> 6/17 – full snow coverage; 7/7 – slopes still with snow pack, but pack is receding; 7/17 – no snow = 3	
<b>General soil:</b> low water retention; low to mod gopher potential; low organics = 3			
<b>Soil "hardness," presence of rocks:</b> > 50% small to large gravel/rock rubble = 3			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> <5% = 2	
<b>Ameliorating microsite features:</b> some ACODAV present for plant debris; could possibly bring in woody debris, forest floor litter from forest stands north of Last Snow pullout			
<b>2014 Phenology Notes:</b>			
7/30 – in fruit: ERIPYR, CARBRE, PENDAV, ACODAV			
8/18 – collected CARBRE, ELYELY			
8/25 – PENDAV appear to be poorly pollinated, not many seed capsules developing			
8/26 (Diamond Lake Overlook) – collected ACODAV, CARBRE, ELYELY, ERIMAR, PENDAV, PHLDIF			
9/3 (Diamond Lake Overlook) – collected PENDAV, PHLDIF			
9/8 (Diamond Lake Overlook) – collected PENDAV			

<b>Seed Zone: North WRD</b>		<b>ID: NWRD2</b>	<b>Mileage = 4.93</b>
<b>Beginning Station: 259 + 57</b>		<b>Ending Station: 264 + 14</b>	<b>Left Side</b>
<b>Location:</b> Last snow			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	30	
<i>Carex breweri</i>	Brewer's carex	30	
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks	30	
<i>Penstemon davidsonii</i> var. <i>davidsonii</i>	David's penstemon	10	
	Total Cover:	100	
<b>Associated species:</b> <i>Carex pachycarpa</i> , <i>Juncus parryi</i> , <i>Arnica nevadensis</i> , <i>Boechera howellii</i> , <i>Calyptridium umbellatum</i> , <i>Epilobium hornemannii</i> var. <i>hornmannii</i> , <i>Sedum</i> sp., <i>Nothocalais alpentriss</i> , <i>Lupinus Lepidus</i> var. <i>lobbii</i>			
<b>UTM (NAD 83):</b>	0568020 E	4756539 N	
<b>Total Vegetative Cover:</b> Little		<b>Elevation:</b> 7485'	
<b>Soil:</b> Depth varies; 1.0 to 4 inches deep mixed in with large rock fall.			
<b>Comments:</b> One Shasta arnica ( <i>Arnica viscosa</i> ) in project area. Heavy rockfall area, last snow play area = lots of trampling.			
<b>Slope:</b> 1%	<b>Aspect:</b> NW	<b>Snow meltout:</b> 6/17 – full snow coverage; 7/30 – one small patch of snow on rock face remaining	
<b>General soil:</b> low water retention; low-mod gopher potential; low organics = 3			
<b>Soil "hardness," presence of rocks:</b> > 80% small to large rock rubble = 3			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> 0 on site; could possibly bring in woody debris, forest floor litter from forest stands north of Last Snow pullout			
<b>2014 Phenology Notes:</b>			
8/4 – collected CARBRE from 4 plants			
8/14 – collected ACODAV (with veg matter to test drying technique)			
8/18 – collected CARBRE, ELYELY; checked ARNVIS, flowers still have not developed and some buds dead due to unknown insect; PENDAV capsule noted with larval worm inside			
8/27 – collected CARBRE			
9/8 – collected ACODAV, CARBRE			

<b>Seed Zone: North WRD</b>		<b>ID: NWRD3</b>	<b>Mileage = 5.10</b>
<b>Beginning Station: 269 + 48</b>		<b>Ending Station: 273 + 17</b>	<b>Left Side</b>
<b>Location:</b> Devil's Backbone			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	50	
<i>Carex breweri</i>	Brewer's sedge	10	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	30	
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat	5	
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks	5	
	Total Cover:	100	
<b>Associated species:</b> <i>Calyptridium umbellatum</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i>			
<b>UTM (NAD 83):</b>	0568238 E	4756702 N	
<b>Total Vegetative Cover:</b> 40%		<b>Elevation:</b> 7421'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand with broken talus			
<b>Comments:</b> Lots of tire tracks in ash soils; Much old asphalt downslope.			
<b>Slope:</b> 42%	<b>Aspect:</b> NW	<b>Snow meltout:</b> 6/17 – full snow coverage; 7/30 – no snow	
<b>General soil:</b> low water retention; high gopher potential; low organics = 3			
<b>Soil "hardness," presence of rocks:</b> 5% small to large rocks; 20% gravel-sized rocks = 1			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> some ACODAV present for plant debris; nearby forest stands might provide woody debris/forest floor litter			
<b>2014 Phenology Notes:</b>			
7/30 –in fruit: ERIMAR			
8/19 – collected ACHOCC, ACODAV, CARBRE, ELYELY, ERIMAR			
8/27 – collected ACHOCC, ELYELY, ERIMAR			
9/8 – collected ACODAV, CARBRE, ELYELY, ERIMAR			

<b>Seed Zone: North WRD</b>		<b>ID: NWRD4</b>	<b>Mileage = 5.29</b>
<b>Beginning Station: 279 + 35</b>		<b>Ending Station: 281 + 13</b>	<b>Left Side</b>
<b>Location:</b> Devil's Backbone			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	30	
<i>Carex breweri</i>	Brewer's sedge	15	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	15	
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat	20	
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks	20	
	Total Cover:	100	
<b>Associated species:</b> <i>Boechera howellii</i> , <i>Castilleja arachnoidea</i> , <i>Festuca</i> sp., <i>Trisetum spicatum</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i> , <i>Calyptridium umbellatum</i>			
<b>UTM (NAD 83):</b>	0568471 E	4756834 N	
<b>Total Vegetative Cover:</b> 50%		<b>Elevation:</b> 7406'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand			
<b>Comments:</b> none			
<b>Slope:</b> 35%	<b>Aspect:</b> N	<b>Snow meltout:</b> 6/17 –full snow coverage; 7/16 - most of slope still with snowpack but pullout clear = 3	
<b>General soil:</b> low water retention; high gopher potential; low organics = 3			
<b>Soil "hardness," presence of rocks:</b> 10% small gravel; 5% small-large rocks =1			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> some ACODAV present for plant debris; nearby forest stands might provide woody debris/forest floor litter			
<b>2014 Phenology Notes:</b>			
7/30 – in fruit: ERIMAR			
8/11 – in fruit: ACODAV, collected ELYELY, ERIMAR, PHLDIF (note: good site for ACODAV & CARBRE)			
8/19 – collected ACHOCC, ACODAV, CARBRE, ELYELY, ERIMAR			
8/27 – collected ACHOCC, ACODAV, ELYELY, ERIMAR			
9/8 – collected ACODAV, CARBRE, ELYELY, ERIMAR			
9/17 – collected ACODAV, ERIPYR			

<b>Seed Zone: North WRD</b>		<b>ID: NWRD5</b>	<b>Mileage: X.XX</b>
<b>Beginning Station: 297 + 18</b>		<b>Ending Station: 299 + 72</b>	<b>Right Side</b>
<b>Location:</b> Glacial Valleys			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower		
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail		
<i>Ericameria greenei</i>	Greene's goldenweed		
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat		
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks		
<i>Penstemon davidsonii</i> var. <i>davidsonii</i>	David's penstemon		
<i>Phlox diffusa</i>	Spreading phlox		
	Total Cover:		
<b>Associated species:</b> <i>Castilleja arachnoidea</i> , <i>Anemone occidentalis</i> , <i>Polygonum shastense</i> , <i>Raillardella argentea</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i>			
<b>UTM (NAD 83):</b>	568893 E	4757074 N	
<b>Total Vegetative Cover:</b> 40%		<b>Elevation:</b> 7320'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand			
<b>Comments:</b> Percent cover / species list is taken from upslope to the SE of "Grandmother" tree (CRLA-12-NJ001)			
<b>Slope:</b> 12%	<b>Aspect:</b> NW	<b>Snow meltout:</b> 6/17 – light to moderate snowpack over most of area; 6/30 – area snow-free	
<b>General soil:</b> low water retention; mod-high gopher potential; low organics			
<b>Soil "hardness," presence of rocks:</b> soft pumice only			
<b>Wind exposure:</b> high		<b>Canopy cover:</b> <10%	
<b>Ameliorating microsite features:</b> small amounts of woody debris, forest floor litter from PINALB stands; some ACODAV to provide plant debris			
<b>Comments:</b>			

<b>Seed Zone: North WRD</b>		<b>ID: NWRD6</b>	<b>Mileage: X.XX</b>
<b>Beginning Station: 297 + 27</b>		<b>Ending Station: 299 + 24</b>	<b>Right Side</b>
<b>Location:</b> Glacial Valleys			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower		
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail		
<i>Ericameria greenei</i>	Greene's goldenweed		
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Mountain buckwheat		
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks		
<i>Penstemon davidsonii</i> var. <i>davidsonii</i>	David's penstemon		
<i>Phlox diffusa</i>	Spreading phlox		
	Total Cover:		
<b>Associated species:</b> <i>Castilleja arachnoidea</i> , <i>Anemone occidentalis</i> , <i>Polygonum shastense</i> , <i>Raillardella argentea</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i>			
<b>UTM (NAD 83):</b>	568893 E	4757074 N	
<b>Total Vegetative Cover:</b> 40%		<b>Elevation:</b> 7320'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand			
<b>Comments:</b> Percent cover / species list is taken from upslope to the SE of "Grandmother" tree (CRLA-12-NJ001)			
<b>Slope:</b> 12%	<b>Aspect:</b> NW	<b>Snow meltout:</b> 6/17 – light to moderate snowpack over most of area; 6/30 – area snow-free	
<b>General soil:</b> low water retention; mod-high gopher potential; low organics			
<b>Soil "hardness," presence of rocks:</b> soft pumice only			
<b>Wind exposure:</b> high		<b>Canopy cover:</b> <10%	
<b>Ameliorating microsite features:</b> small amounts of woody debris, forest floor litter from PINALB stands; some ACODAV to provide plant debris			
<b>Comments:</b>			

<b>Seed Zone: NW ERD</b>		<b>ID: NWERD1</b>	<b>Mileage = 0.07</b>
<b>Beginning Station: 503 + 51</b>		<b>Ending Station: 507 + 03</b>	<b>Right Side</b>
<b>Location:</b> North Junction			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	25	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	20	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	25	
<i>Ericameria greenei</i>	Greene's goldenweed	15	
<i>Phlox diffusa</i>	Spreading phlox	15	
	Total Cover:	100	
<b>Associated species:</b> <i>Lupinus andersonii</i> , <i>Phacelia hastata</i> ssp. <i>compacta</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i> , <i>Lupinus andersonii</i> , <i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>			
<b>UTM (NAD 83):</b>	0569318 E	4757461 N	
<b>Total Vegetative Cover:</b> <50%		<b>Elevation:</b> 7298'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand and scattered pumice			
<b>Comments:</b> none			
<b>Slope:</b> 10%	<b>Aspect:</b> NE	<b>Snow meltout:</b> 6/17 – light snowpack cover over ~80%; 7/8 – snow free = 1	
<b>General soil:</b> low water retention; high gopher potential; low organics = 3			
<b>Soil "hardness," presence of rocks:</b> 5-6 placed boulders; 5% small to large rocks = 1			
<b>Wind exposure:</b> high = 3		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> strong numbers of ACODAV for plant debris; possible materials available from upslope forest stands on lake-side of Rim Drive			
<b>2014 Phenology Notes:</b>			
7/22 – in fruit: PHLDIF; ACODAV appear unhealthy; flowers slow to develop and are fading			
7/30 – in fruit: ACHOCC, ACODAV			
8/11 – collected ACHOCC, PHLDIF (note: not a good site to collect ACODAV)			
8/26 – collected ACHOCC, ELYELY, ERIMAR, PHLDIF			
9/8 – ERIGRE maturing but with green achenes; noted maggot/worm in fl/fr			
9/17 – collected ERIGRE			



<b>Seed Zone: North WRD</b>		<b>ID: NWERD2</b>	<b>Mileage = 0.07</b>
<b>Beginning Station: 503 + 93</b>		<b>Ending Station: 508 + 38</b>	<b>Left Side</b>
<b>Location:</b> North Junction			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	30	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	40	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	30	
		Total Cover:	100
<b>Associated species:</b> <i>Lupinus andersonii</i> , <i>Phacelia hastata</i> ssp. <i>compacta</i> , <i>Raillardella argentea</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i> , <i>Eriogonum marifolium</i> var. <i>marifolium</i> , <i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i> , <i>Phlox diffusa</i>			
<b>UTM (NAD 83):</b>	0569339 E	4757466 N	
<b>Total Vegetative Cover:</b> 30%		<b>Elevation:</b> 7300'	
<b>Soil:</b> : > 4 inch deep ashy sandy loam/ashy loamy sand			
<b>Comments:</b> none			
<b>Slope:</b> 45%	<b>Aspect:</b> NW	<b>Snow meltout:</b> 6/17 – light snow pack cover over ~ 80%; 6/30 – snow-free = 0	
<b>General soil:</b> low water retention; high gopher potential; low organics =3			
<b>Soil “hardness,” presence of rocks:</b> 5% small to boulder-sized rocks = 1			
<b>Wind exposure:</b> high = 3		<b>Canopy cover:</b> 0 = 3	
<b>Ameliorating microsite features:</b> moderate numbers of ACODAV for plant debris; possible materials available from upslope forest stands			
<b>2014 Phenology Notes:</b>			
7/22 –ACODAV appear unhealthy; flowers slow to develop and are fading			
7/30 – in fruit: ACODAV, ACHOCC, ELYELY			
8/11 – collected ACHOCC, ELYELY			
8/26 – collected ACHOCC, ELYELY, ERIMAR			

<b>Seed Zone: NW ERD</b>		<b>ID: NWERD3</b>	<b>Mileage = 1.15</b>
<b>Beginning Station: 560 + 75</b>		<b>Ending Station: 564 + 21</b>	<b>Left Side</b>
<b>Location:</b> Llao Rock			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>		20	
<i>Carex breweri</i>	Brewer's sedge	10	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	10	
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks	40	
<i>Juncus parryi</i>	Parry's rush	10	
<i>Lupinus lepidus</i> var. <i>lobbii</i>	Low mountain lupine	10	
	Total Cover:	100	
<b>Associated species:</b> <i>Achnatherum occidentale</i> , <i>Eremogone pumicola</i> , <i>Calyptridium umbellatum</i> , <i>Castilleja arachnoidea</i>			
<b>UTM (NAD 83):</b>	0570019 E	4758915 N	
<b>Total Vegetative Cover:</b> 40 %		<b>Elevation:</b> 7370'	
<b>Soil:</b> : > 4 inch deep ashy sandy loam/ashy loamy sand			
<b>Comments:</b> none			
<b>Slope:</b> 7%	<b>Aspect:</b> NW	<b>Snow meltout:</b> 6/17 – moderate snow cover over ~ 75%; 7/8 – about 20% snow remaining; 7/16 - no snow = 3	
<b>General soil:</b> mod water retention; mod gopher potential; mod- high organics = 1			
<b>Soil "hardness," presence of rocks:</b> soft pumice = 0			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> <5% = 2	
<b>Ameliorating microsite features:</b> good amounts of woody debris, forest floor litter in bordering forest stands; some ACODAV present for plant debris			
<b>2014 Phenology Notes:</b>			
7/22 – in fruit: JUNPAR			
8/14 – placed 6 bags on LUPLEP & placed pink flag by ACODAV potential			
8/21 – collected ELYELY; collected ACODAV and CARBRE between two paved pullouts behind Llao Rock			
8/25 – collected 6 LUPLEP bags; between this pullout and south, collected ACODAV, CARBRE, ELYELY, JUNPAR, LUPLEP			
9/2 – collected ELYELY, LUPLEP			

<b>Seed Zone: NW ERD</b>		<b>ID: NWERD4</b>	<b>Mileage = 1.27</b>
<b>Beginning Station: 566 + 91</b>		<b>Ending Station: 568 + 50</b>	<b>Left Side</b>
<b>Location:</b> Llao Pullout			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	30	
<i>Carex breweri</i>	Brewer's sedge	10	
<i>Castilleja arachnoidea</i>	Cobwebby paintbrush	5	
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Squirreltail	20	
<i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i>	Dirty socks	30	
<i>Lupinus lepidus</i> var. <i>lobbii</i>	Low mountain lupine	5	
	Total Cover:	100	
<b>Associated species:</b> <i>Eremongone pumicola</i> , <i>Boechera howellii</i> , <i>Carex</i> sp., <i>Achnatherum occidentale</i> , <i>Juncus parryi</i>			
<b>UTM (NAD 83):</b>	0570136 E	4758993 N	
<b>Total Vegetative Cover:</b> <50%		<b>Elevation:</b> 7365'	
<b>Soil:</b> Darker ashy soil near an island of trees			
<b>Comments:</b> none			
<b>Slope:</b> 15%	<b>Aspect:</b> N	<b>Snow meltout:</b> 6/17 – moderate snowpack over ~75%; 7/16 – no snow = 3	
<b>General soil:</b> low-mod water retention; mod-high gopher potential; mod organics = 2			
<b>Soil "hardness," presence of rocks:</b> soft pumice = 0			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> <10% =2	
<b>Ameliorating microsite features:</b> good amounts of woody debris, forest floor litter in bordering forest stands; some ACODAV present for plant debris			
<b>2014 Phenology Notes:</b>			
7/30 in fruit: CARBRE, ACODAV, LUPLEP, CASARA; bagged 2 LUPLEP			
8/4 – collected CARBRE, bagged 1 LUPLEP			
8/7 – collected ACODAV, CARBRE; bagged 6 LUPLEP @ 570057 x 4758904			
8/12 – collected ACODAV (few), CARBRE, LUPLEP (removed 8/4 LUPLEP bag)			
8/20 – removed all remaining LUPLEP bags; collected LUPLEP, CARBRE; ELYELY still not mature for collecting			
9/3 – collected ACODAV, CARBRE			
9/17 – collected CASARA, ERIPYR			

<b>Seed Zone: NW ERD</b>		<b>ID: NWERD5</b>	<b>Mileage = 1.67</b>
<b>Beginning Station: 588 + 42</b>		<b>Ending Station: 594 + 25</b>	<b>Left Side</b>
<b>Location:</b> Grouse Hill			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Aconogonon davisiae</i> var. <i>davisiae</i>	Fleeceflower	25	
<i>Juncus parryi</i>	Parry's rush	10	
<i>Luetkea pectinata</i>	Partridge foot	60	
<i>Lupinus lepidus</i> var. <i>lobbii</i>	Low mountain lupine	5	
	Total Cover:	100	
<b>Associated species:</b> <i>Ericameria greenei</i> , <i>Boechera howellii</i>			
<b>UTM (NAD 83):</b>	0570793 E	4759208 N	
<b>Total Vegetative Cover:</b> 40		<b>Elevation:</b> 7224'	
<b>Soil:</b> : > 4 inch deep ashy sandy loam/ashy loamy sand with pumice			
<b>Comments:</b> In this pullout, there is 5 to 6 feet of pavement, 6 feet of gravel and chipseal/tar, 6 feet of soil with gravel/tar, and 3 to 4 inches of gravel & chipseal/tar.			
<b>Slope:</b> 20%	<b>Aspect:</b> N	<b>Snow meltout:</b> 6/17 – moderate snow cover over ~ 75%; 7/16 – no	
<b>General soil:</b> low water retention; low gopher potential; low organics = 2			
<b>Soil “hardness,” presence of rocks:</b> 30% small to medium rocks; 30% gravel = 2			
<b>Wind exposure:</b> low = 0		<b>Canopy cover:</b> <5% = 2	
<b>Ameliorating microsite features:</b> some woody debris, forest floor litter available from bordering forest; some ACODAV present for plant debris			
<b>2014 Phenology Notes:</b>			
7/22 – in fruit: ACODAV, LUPLEP			
7/30 - in fruit: JUNPAR			
8/4 – collected JUNPAR; noted that some capsule had a white “bag” from unk parasite attached, we avoided those plants; bagged 12 LUPLEP			
8/11 – collected JUNPAR, LUPLEP (removed a bag from LUPLEP			
8/20 – removed all LUPLEP bags; collected JUNPAR, ACODAV, LEUPEC, ELYELY			
8/28 – collected CARBRE, ELYELY, JUNPAR, LEUPEC, LUPLEP			

<b>Seed Zone: NW ERD</b>		<b>ID: NWERD6</b>	<b>Mileage = 1.96</b>
<b>Beginning Station:</b>		<b>Ending Station:</b>	<b>Left Side</b>
<b>603 + 35</b>		<b>606 + 35</b>	
<b>Location:</b> Grouse Hill			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Juncus parryi</i>	Parry's sedge	20	
<i>Luetkea pectinata</i>	Partridge foot	80	
	Total Cover:	100	
<b>Associated species:</b> <i>Eriogonum marifolium</i> var. <i>marifolium</i> , <i>Eriogonum pyrolifolium</i> var. <i>coryphaeum</i> , <i>Veratrum viridae</i> , <i>Lupinus lepidus</i> var. <i>lobbii</i> , <i>Aconogonon davisiae</i> var. <i>davisiae</i> , <i>Elymus elymoides</i> ssp. <i>elymoides</i>			
<b>UTM (NAD 83):</b>	0571167	4759013	
<b>Total Vegetative Cover:</b> 70%		<b>Elevation:</b> 7188'	
<b>Soil:</b> : > 4 inch deep ashy sandy loam/ashy loamy sand with some needle litter			
<b>Comments:</b> none			
<b>Slope:</b> 10%	<b>Aspect:</b> N	<b>Snow meltout:</b> 6/17 – moderate snow cover over ~ 75%; 7/16 - no snow = 3	
<b>General soil:</b> mod-high water retention; low gopher potential; mod organics = 1			
<b>Soil "hardness," presence of rocks:</b> 50% gravel on surface; 5% small rocks = 1			
<b>Wind exposure:</b> low = 0		<b>Canopy cover:</b> <5% = 2	
<b>Ameliorating microsite features:</b> some woody debris, forest floor litter available from bordering forest; some ACODAV present for plant debris			
<b>2014 Phenology Notes:</b>			
7/22 – In fruit: ACODAV; JUNPAR			
8/4 – in fruit: LEUPEC			
8/7 – collected JUNPAR			
8/20 – collected JUNPAR, LUPLEP, LEUPEC			
8/25 – collected LEUPEC			
8/28 – collected CARBRE, JUNPAR, LEUPEC, LUPLEP			

<b>Seed Zone: NE ERD</b>		<b>ID: NEERD1</b>	<b>Mileage = X.XX</b>
<b>Beginning Station:</b>		<b>Ending Station:</b>	<b>Right Side</b>
696 + 21		698 + 71	
<b>Location:</b> Pumice Point			
<b>Plant Species</b>	<b>Common Name</b>		<b>Relative % Cover</b>
<i>Arctostaphylos nevadensis</i>			20
<i>Carex halliana</i>			80
	Total Cover:		100
<b>Associated species:</b>			
<b>UTM (NAD 83):</b>	057XXXX	475XXXX	
<b>Total Vegetative Cover:</b> 70%		<b>Elevation:</b> XXXX'	
<b>Soil:</b> :			
<b>Comments:</b> none			
<b>Slope:</b>	<b>Aspect:</b> S	<b>Snow meltout:</b>	
<b>General soil:</b>			
<b>Soil "hardness," presence of rocks:</b>			
<b>Wind exposure:</b>		<b>Canopy cover:</b>	
<b>Ameliorating microsite features:</b>			
<b>Phenology Notes:</b>			

<b>Seed Zone: NE ERD</b>		<b>ID: NEERD2</b>	<b>Mileage = 4.39</b>
<b>Beginning Station:</b>		<b>Ending Station:</b>	<b>Left Side</b>
731 + 89		735 + 23	
<b>Location:</b> Cleetwood Cove			
<b>Plant Species</b>	<b>Common Name</b>		<b>Relative % Cover</b>
<i>Achnatherum occidentale</i>	California needlegrass		15
<i>Arctostaphylos nevadensis</i>	Pinemat manzanita		50
<i>Arctostaphylos patula</i>	Green leaf manzanita		25
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail		10
	Total Cover:		100
<b>Associated trace species:</b> <i>Lupinus andersonii</i> , <i>Ribes sp.</i> , <i>Lupinus lepidus var. lobbii</i> , <i>Carex inops ssp. inops</i> , <i>Carex halliana</i>			
<b>UTM (NAD 83):</b>	0574584	4758955	
<b>Total Vegetative Cover:</b> 70%		<b>Elevation:</b> 6875'	
<b>Soil:</b> 0.5 to 1.0 inch deep litter layer over ashy sandy loam			
<b>Comments:</b> North of pullout is forested, therefore, little collection options next to pullout; suspect that the <i>Ribes</i> is <i>R. viscosissimum</i> .			
<b>Slope:</b> 14%	<b>Aspect:</b> S	<b>Snow meltout:</b> 6/17 – no snow = 0	
<b>General soil:</b> mod water retention; low gopher potential; mod-high organics = 0			
<b>Soil “hardness,” presence of rocks:</b> soft pumice soil = 0			
<b>Wind exposure:</b> mod = 1		<b>Canopy cover:</b> 80% = 0	
<b>Ameliorating microsite features:</b> small woody debris, forest floor litter from bordering forest			
<b>2014 Phenology Notes:</b>			
7/2 – in fruit: <b>ARCNEV, ARCPAT</b>			
7/21 – in seed: <b>ACHOCC</b> (collected); beginning to seed: <b>ELYELY</b>			
7/30 –collected ACHOCC			
8/4 – collected ELYELY			
9/2 (Pumice Point) – collected ACHOCC, ELYELY, LUPLEP			
9/17 – collected ERINAU			

<b>Seed Zone: NE ERD</b>		<b>ID: NEERD3</b>	<b>Mileage = 4.52</b>
<b>Cleetwood Cove Parking Lot</b>		<b>Planting Islands - Interior</b>	
<b>Location:</b> Cleetwood Cove Parking Lot			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass		
<i>Bromus carinatus var. carinatus</i>	California brome		
<i>Carex halliana</i>	Oregon sedge		
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail		
	Total Cover:		
<b>Associated species:</b> <i>Calyptridium umbellatum</i> , <i>Juncus parryi</i> , <i>Monardella odoratissima</i> , <i>Carex inops ssp. inops</i> , <i>Lupinus lepidus var. lobbii</i>			
<b>UTM (NAD 83):</b>	0574762	4759082	
<b>Total Vegetative Cover:</b> 60%		<b>Elevation:</b> 6856'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand			
<b>Comments:</b> none			
<b>Slope:</b> 17%	<b>Aspect:</b> W	<b>Snow meltout:</b> 6/17 – no snow = 0	
<b>General soil:</b> mod water retention; mod gopher potential; mod-high organics = 1			
<b>Soil "hardness," presence of rocks:</b> pumice soil with 50% small pumice rocks = 1			
<b>Wind exposure:</b> low = 0		<b>Canopy cover:</b> 15%	
<b>Ameliorating microsite features:</b> small woody debris, forest floor litter available in nearby forest stands			
<b>2014 Phenology Notes:</b>			
7/30 - in fruit: CARHAL, ACHOCC, ELYELY, BROCAR; collected ACHOCC			
8/4 – in fruit: LUPLEP; collected BROCAR from 6 plants			
8/11 – collected BROCAR, CARHAL, ACHOCC, ELYELY			
8/20 – collected ACHOCC, CARHAL			
Note: Good collection site for LUPLEP for NE ERD at Steel Bay 572373 x 4759006; placed 36 bags 8/4 and removed all 8/20			



<b>Seed Zone: NE ERD</b>		<b>ID: NEERD4</b>	<b>Mileage = 4.53</b>
<b>Beginning Station:</b>		<b>Ending Station:</b>	<b>Left Side</b>
<b>Location:</b> Cleetwood Cove			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	20	
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail	20	
<i>Ericameria nauseosa var. speciosa</i>	Rubber rabbitbrush	20	
<i>Lupinus lepidus var. lobbii</i>	Low mountain lupine	20	
<i>Phacelia hastata ssp. compacta</i>	Mountain phacelia	20	
	Total Cover:	100	
<b>Associated species:</b> <i>Eriogonum nudum, Hulsea nana, Phlox diffusa</i>			
<b>UTM (NAD 83):</b>	0575060	4759093	
<b>Total Vegetative Cover:</b> 10%		<b>Elevation:</b> 6888'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand			
<b>Comments:</b> Steep slopes for collecting seeds and pumice.			
<b>Slope:</b> 38%	<b>Aspect:</b> SE	<b>Snow meltout:</b> 6/17 – no snow = 0	
<b>General soil:</b> low water retention; high gopher potential; low organics =3			
<b>Soil “hardness,” presence of rocks:</b> >90% pumice rock, <5% rock rubble = 0			
<b>Wind exposure:</b> mod-high = 2		<b>Canopy cover:</b> <1% = 3	
<b>Ameliorating microsite features:</b> small woody debris, forest floor litter available in upslope forest stands			
<b>2014 Phenology Notes:</b>			
7/9 –in fruit: LUPLEP			
7/16 – in fruit: ACHOCC, ELYELY, PHAHAS			
7/21 – collected ACHOCC			
7/30 – in fruit: LUPLEP; collected ACHOCC, ELYELY, PHAHAS; placed 9 bags on LUPLEP			
8/4 –collected ACHOCC, ELYELY, PHAHAS			
8/11 –collected ELYELY, PHAHAS, LUPLEP (pulled all 9 bags from LUPLEP)			
9/17 – collected ERINAU			

<b>Seed Zone: NE ERD</b>		<b>ID: NEERD5</b>	<b>Mileage = 4.53</b>
<b>Beginning Station:</b>		<b>Ending Station:</b>	<b>Right Side</b>
<b>742 + 38</b>		<b>744 + 94</b>	
Location: Cleetwood Cove			
<b>Plant Species</b>	<b>Common Name</b>	<b>Relative % Cover</b>	
<i>Achnatherum occidentale</i>	California needlegrass	10	
<i>Arctostaphylos nevadensis</i>	Pinemat manzanita	35	
<i>Arctostaphylos patula</i>	Green leaf manzanita	35	
<i>Elymus elymoides ssp. elymoides</i>	Squirreltail	10	
<i>Ericameria nauseosa var. speciosa</i>	Rubber rabbitbrush	5	
<i>Lupinus lepidus var. lobbii</i>	Low mountain lupine	5	
	Total Cover:	100	
<b>Associated species:</b> <i>Polygonum nudum</i> , <i>Penstemon davidsonii var. davidsonii</i>			
<b>UTM (NAD 83):</b>	574785 E	4758994 N	
<b>Total Vegetative Cover:</b> <50%		<b>Elevation:</b> 6864'	
<b>Soil:</b> > 4 inch deep ashy sandy loam/ashy loamy sand			
<b>Comments:</b> none			
<b>Slope:</b> 15%	<b>Aspect:</b> SE	<b>Snow meltout:</b> 6/17 – no snow	
<b>General soil:</b> mod water retention; mod gopher potential; mod organics			
<b>Soil “hardness,” presence of rocks:</b> 20% small to large rock rubble, a few boulders			
<b>Wind exposure:</b> mod-high		<b>Canopy cover:</b> <5%	
<b>Ameliorating microsite features:</b>			
<b>2014 Phenology Notes:</b>			
7/2 – in fruit: ARCNEV, ARCPAT			
7/16 – beginning to seed: ELYELY, ACHOCC			
7/21 – in seed: ACHOCC (collected seed)			
9/17 – collected ERINAU			

## Appendix C

### Seed Collection Protocol for the Rim Drive Rehabilitation Revegetation Project

*Note: Life history and seed information has in most cases been borrowed from:*

Baldwin, B.G., D.H. Goldman, D.J. Keil, R. Patterson, T.J. Rosatti, and D.H. Wilken, editors. 2012. *The Jepson Manual: vascular plants of California*, second edition. University of California Press, Berkeley, California, USA.

**Species: *Achnatherum occidentale* (ACHOCC); Needlegrass**

**Family: Poaceae**

#### Life History and Seed Information:

Plant is a perennial bunchgrass. Fruit is a caryopsis; spikelet with glumes > floret (except awn); one floret per spikelet; floret 5.5-7.5 mm.

Identification Tips: Two subspecies of *Achnatherum occidentale* occur in CRLA: *californicum* and *pubescens*.

Per Zika (pg. 73) the two taxa occur in similar habitats and ranges and are distinguished “by minor differences in the length of the hairs at the summit of the lemma.” Distinguishing between the two subspecies was not critical to the RDRR project.

Phenology and Seed Ripeness: Seeds are ready to collect when inflorescences begin to turn from a green to a straw color and awns bend out (Figures C1, C2). In 2014, seeds were collected from July 21<sup>st</sup> into early September.

Seed Collection Techniques: Seeds are easily removed by running fingers up the inflorescence. Use only slight pressure to ensure gathering only seeds that are ripe enough to be collected.

Plans for Propagation: This species is to be re-established in South WRD, Central WRD, North WRD, and NE ERD and is targeted for propagation by sowing.



**Figure C1.** ACHOCC inflorescences with bent awns. Photo by Melody Frederic.



**Figure C2.** ACHOCC inflorescences and seeds with bent awns. Photos by Melody Frederic.

**Species:** *Aconogonon davisiae* var. *davisiae* (ACODAVDAV); Newberry's fleecflower

**Family:** Polygonaceae



**Figure C3.** ACODAVDAV with developing seeds. Photo by Melody Frederic.

Life History and Seed Information: Plant is perennial from a woody caudex (Figure C3). Fruit is an achene, 4-4.5 mm, obovoid, brown, and shiny (Figure C4). Seed is single and attached to ovary wall at a single point.

Phenology and Seed Ripeness: As seeds begin to develop, the terminal leaves of the plant often begin to enclose the fruit. In general (but certainly not always), green plants contain immature seeds (Figure 3) and, as seeds mature, plants begin to turn red. Seeds are fully mature when they turn from green to light brown (Figure C4). However, according to Corvallis Plant Materials Center (PMC) personnel, color doesn't matter as much as the seed's hardness; green seeds that are hard and doughy or powdery inside (i.e., with no liquid) should be viable and collectable. In 2014, seeds were ready for collection beginning in early August through late September, depending on location within a seed zone.

Seed Collection Techniques: In general, the best time to collect is when a given population (e.g., in a meadow or along a roadside) is at least 50% red. Collect from plants that are not completely green but have, at the least, some red color. Feel the terminal ends of upper leaf axils for the presence of small, hard seeds. If seeds are felt, they can be collected either by opening the terminal leaves and

removing them or by rolling the terminal end around with your fingers to loosen the seeds and then letting them fall into your palm. While the seeds are in your palm, check for and remove any insects that might be present before placing seeds in your bag. (Note: Although various insect species appear to be associated with this plant, we found no insects that impacted the seeds.) A plant that has seeds in its upper leaf axil also should have its lower, lateral leaves checked for seeds. In 2014, if seeds were still green and tightly attached, stems and leaves were removed along with the terminal end in hopes that the seeds would develop into full maturity; however, the seeds appeared to shrivel.

Additional Observations from 2014: This is a time-consuming plant from which to collect; nonetheless, it is an important component. Seed production varies greatly from one plant to another in a given population and from one population to another. Collection efforts were more successful in the North WRD and NW ERD seeds zones; the Central WRD seed zone will need to be focused on in 2015.

Plans for Propagation: This species is to be re-established in Central WRD, North WRD, and NW ERD and are targeted for plug production; containers will range from 4-6" diameter. This species is selected for germination trials and propagation protocol development. On August 7, 2014 Corvallis PMC personnel obtained cuttings from the NW ERD seed zone to experiment with the possibility of propagating this species through vegetative material.



**Figure C4.** ACODAVDAV seeds at maturity. Photos by Melody Frederic.

**Species: *Arctostaphylos nevadensis* (ARCNEV); Pinemat manzanita**

**Family: Ericaceae**



**Figure C5.** ARCNEV in flower. Photo by Melody Frederic.

Life History and Seed Information: Plant is a spreading to decumbent perennial shrub (Figure C5). Fruit is a drupe, 6-8 mm wide, +/- spheric, glabrous; stones +/- separable.

Phenology and Seed Ripeness: This species will be propagated by cuttings. Corvallis PMC personnel will collect cuttings in 2015 and 2016.

Plans for Propagation: This species is to be re-established in NE ERD and is targeted for propagation by cuttings contained in D40 containers.

**Species: *Arctostaphylos patula* (ARCPAT); Green leaf manzanita**

**Family: Ericaceae**



**Figure C6.** ARCPAT in bloom. Photo by Melody Frederic.

Life History and Seed Information: Plant is a perennial shrub (Figure C6). Fruit is a drupe, 7-10 mm wide, glabrous, dark chestnut-brown.

Phenology and Seed Ripeness: This species will be propagated by cuttings. Corvallis PMC personnel will collect cuttings in 2015 and 2016.

Plans for Propagation: This species is to be re-established in NE ERD and is targeted for propagation contained in D40 containers.

**Species: *Arnica viscosa* (ARNVIS); Mt. Shasta arnica**

**Family: Asteraceae**



**Figure C7.** *Arnica viscosa* by Last Snow pullout. Photo by Melody Frederic.

Life History and Seed Information: Plant is perennial from woody, scaly caudex (Figure C7, C8). Fruit is an achene, +/- cylindric, 5-6.6 mm, stalked-glandular; pappus is short-barbed to subplumose, gen white (brownish).

Phenology and Seed Ripeness: In 2014, we were unable to collect from this species as no flowers were available. All plants had stems gnawed off and buds infested by an unknown insect. However, in 2013 a small number of seeds were collected from late August to about mid-September; these seeds are now at the Corvallis PMC.

Seed Collection Techniques: Seeds were collected in 2013 by pulling pappus with achenes attached from seed heads.

Plans for Propagation: This species is to be re-established in North WRD and is targeted for plug production; containers will range from 4-6" diameter. This species also is selected for germination trials and propagation protocol development.



**Figure C8.** *Arica viscosa* plant on Wizard Island. Photo by Jen Beck.

**Species: *Boechea horizontalis* (BOEHOR); Crater Lake rockcress**

**Family: Brassicaceae**



**Figure C9.** The Crater Lake rockcress. Photo by Melody Frederic.

Life History and Seed Information: Plant is perennial from woody caudex (Figure C9). Fruit is a silique, straight or slightly curved with horizontal orientation extending from stem, glabrous, generally around 3 cm in length. Seeds are about 1 mm, round with narrow wing +/- all around perimeter.

Identification Tips: Plant is distinguished from other *Boechea* spp. by the horizontal orientation of siliques extending from stem; flowers are deep purple with no white flowers.

Phenology and Seed Ripeness: In 2014, seeds were harvested starting July 17<sup>th</sup> from BOEHOR plants salvaged from Grotto Cove. Watchman plants were ready for collection from July 31<sup>st</sup> and early-mid September. Seeds are ready for harvest when siliques are dry, thin, and light brown to straw colored (Figure C10).

Seed Collection Techniques: Slide small glassine envelopes under siliques and gently rub the fruiting pod; seeds will slip out easily if they are ripe.

Plans for Propagation: This species is to be re-established in Central WRD via plug production; containers will range from 4-6" diameter. This species is selected for germination trials and propagation protocol development.



**Figure C10.** BOEHOR seeds at maturity. Photo by Melody Frederic.



**Species: *Bromus carinatus* var. *carinatus* (BROCARCAR); California brome**

**Family: Poaceae**



**Figure C11.** BROCARCAR near Rim Village. Photo by Melody Frederic.

Life History and Seed Information: Plant is a perennial bunchgrass (Figure C11). Fruit is caryopsis; spikelet is strongly compressed with glumes keel-like. Florets 7-11; lemma body 12-17 mm; keel-like; awn 3-15 mm (Figure C12).

Phenology and Seed Ripeness: Seed heads turn from green to a reddish brown and become firm and hard as seeds ripen. Seeds are fully mature when they become straw-colored; however, seeds can be collected prior to this stage as long as they are not green. In 2014, seeds were ready for collection between July 30<sup>th</sup> and early September.

Seed Collection Techniques: Run fingers from the bottom of the inflorescence to the top using light pressure; seeds that are mature enough will pop into pinched fingers. Take a good look at seeds before harvesting as this species is highly susceptible to smut.

Plans for Propagation: This species is to be re-established in North WRD and NE ERD seed zones and is targeted for seed collection and propagation by sowing.



**Figure C12.** Left: Inflorescence with mature seeds. Right: Mature BROCARCAR seeds. Photos by Melody Frederic.

**Species: *Carex brewerii* (CARBRE); Brewer's sedge**

**Family: Cyperaceae**



**Figure C13.** *Carex brewerii*. Photo by Melody Frederic.

Life History and Seed Information: Plant is perennial with rhizomes (Figures C13, C14). Perigynia 10-40 per spikelet, ascending to spreading, 4-7 mm, 2.1-4.8 mm wide, very flat, thin, golden-brown, a bristle-like axis within. Fruit 1.7-2.3 mm, 0.8-1 mm wide, << smaller than perigynium body, 3-sided (Figure C14).

Phenology and Seed Ripeness: Seeds are ripening when white anthers are gone and the entire inflorescence is brown. The head will feel soft as the seeds mature; at full maturity, the head will be somewhat brittle.

Seed Collection Techniques: Fully mature seeds will crumble easily into the hand or bag. However, if the head is brown but still soft, seeds still can be collected by cutting stems; collecting the heads with the stems allow seeds to continue receiving nutrients and to develop into maturity according to Corvallis PMC personnel. In 2014, seeds were ready for collection from early August through mid-September.

Plans for Propagation: This species is to be re-established in North WRD and NW ERD. This species is targeted for plug production; containers will range from 4-6" diameter. This species is selected for germination trials and propagation protocol development.



**Figure C14.** Left: CARBRE in flower. Right: Immature CARBRE seeds with a developing perigynium. Photos by Melody Frederic.

**Species: *Carex halliana* (CARHAL); Oregon sedge**

**Family: Cyperaceae**



**Figure C15.** *Carex halliana*. Photo by Melody Frederic.

Life History and Seed Information: Plant is perennial with rhizomes (Figure C15). Perigynia 20-40 per spikelet, 3.6-5mm, 1.7-2.3 mm wide, thick-walled, strongly many-ribbed, green to gold, beak 1-1.7 mm, teeth erect, 0.2-0.5 mm. Fruit 1.9-2.5 mm, 1.3-1.8 mm wide (Figure C16).

Phenology and Seed Ripeness: Seeds are fully ripe when the female spikes, which occur below the male spike(s), turn brown; however, per Corvallis PMC personnel, seeds can be collected while seeds are still green (see techniques for collecting below). In 2014, seeds were beginning to turn brown in late August-early September.

Seed Collection Techniques: Seeds can be collected before they turn brown as long they no longer contain any liquid and are solid or doughy. Check by cutting open or crushing a seed. Collect the inflorescences along with the stem and leaves so that nutrients continue to be provided to the seeds as they develop.

Using this technique, seeds were collected during mid-August in 2014. Because of the amount of vegetation collected with the seeds, plants were spread out in large bins to allow for adequate drying and then dried plants were stored in paper bags.

Plans for Propagation: This species is to be re-established in South WRD and NE ERD. This species is targeted for plug production; plug containers will range from 4-6" diameter. This species is selected for germination trials and propagation protocol development.



**Figure C16.** CARHAL spikelets with mature perigynia. Photo by Melody Frederic.

**Species: *Carex pachycarpa* (CARPAC); Many-ribbed sedge**

**Family: Cyperaceae**



**Figure C17.** *Carex pachycarpa*.  
Photo by Melody Frederic.

Life History and Seed Information: Plant is perennial and cespitose (Figure C17). Inflorescence is dense, triangular, and sometimes elongate (Figure C18). Perigynium appressed-ascending, 3.5-6.3 mm, 1.5-2.5 mm wide, body ovate to wide-ovate, planoconvex, green to light brown, flat margin including wing 0.2-0.5 mm wide, veins on back > 8, on front generally > 3, beak tip cylindrical and entire for < 0.4 mm, gold (Figure C18). Fruit 1.7-2.7 mm, 1.1-1.7 mm side, stalk 0.4-0.8 mm.

Identification Tips: *C. stramineiformis* looks similar to *C. pachycarpa*. However, *C. stramineiformis* perigynia have a broad flat “potato chip” shape while *C. pachycarpa* perigynia are not broad and are planoconvex (flat on one side and rounded on the other).

Phenology and Seed Ripeness: Seeds are ready for collecting when the inflorescence turns brown and brittle. In 2014, seeds were ready for collection between late July and late August.

Seed Collection Techniques: Seeds are easily collected by rubbing the inflorescence and allowing the seeds to fall in the hand or bag. According to Corvallis PMC personnel, seeds also can be collected while seeds are maturing if stems are cut with the seed heads to provide nutrients that allow seeds to continue maturing.

Plans for Propagation: This species is to be re-established in South WRD and is targeted for plug production; containers will range from 4-6” diameter. This species is selected for germination trials and propagation protocol development.



**Figure C18.** Left: CARPAC spikelets with mature perigynia. Right: CARPAC perigynia. Photos by Melody Frederic.

**Species:** *Castilleja applegatei* var. *applegatei* (CASAPPAPP); Applegate’s Paintbrush

**Family:** Orobanchaceae



**Figure C19.** *Castilleja applegatei* var. *applegatei*. Photo by Jen Beck.

Life History and Seed Information: Plant is a perennial forb (Figures C19, C20). Fruit is a loculicidal capsule, +/- ovoid, and +/- asymmetrical. Seeds are brownish, attached to capsule walls at base, 1 – 1.5 mm.

Phenology and Seed Ripeness: Seeds ripen shortly after calyx bracts senesce; ripeness can be detected by capsules turning pale brown and becoming dry and papery. In 2014, seeds were ready for collection in early- to mid –September. Seeds are ready to collect when you hear them rattle around inside the capsule and the capsule septa easily dehisce when prompted by your thumbnail.

Seed Collection Techniques: Since seeds “jump” out of capsules and are readily lost, collecting generally is easier by clipping or cutting the entire inflorescence. However, in 2014, this species was highly susceptible to insect predation, especially within the capsules where seeds are developing.

Therefore, it is recommended to collect only fully mature seeds as this will avoid infecting other seed collections in our drying facility. Only collect seeds from capsules that have no insect holes.

Plans for Propagation: This species is to be re-established at only one site (the Union Peak grade site 143+20 to 146+02 in Central WRD) and is targeted for seed collection and propagation by sowing.



**Figure C20.** CASAPP in bloom. Photo by Melody Frederic.

**Species: *Castilleja arachnoidea* (CASARA); Cobwebby Paintbrush**

**Family: Orobanchaceae**



**Figure C21.** CASARA along West Rim Drive. Photo by Melody Frederic.

Life History and Seed Information: Plant is a perennial forb (Figure C21). Fruit is loculicidal capsule, +/- ovoid, and +/- asymmetrical, 8-12 mm. Seeds (Figure C22) are brownish, attached to capsule walls at base, +/- 1 mm.

Phenology and Seed Ripeness: Seeds ripen shortly after calyx bracts senesce; ripeness can be detected by capsules turning pale brown and becoming dry and papery. In 2014, seeds were ready for collection in mid-September. Seeds are ready to collect when you hear them rattle around inside the capsule and the capsule septa easily dehisce when prompted by your thumbnail.

Seed Collection Techniques: Since seeds “jump” out of capsules and are readily lost, collecting generally is easier by clipping or cutting the entire inflorescence. However, in 2014 we found this species is highly susceptible to insect predation, especially within the capsules where seeds are developing. Therefore, we recommend collecting only the fully mature seeds as this will avoid infecting other seed collections in our drying facility. Only collect seeds from capsules that have no insect holes.

Plans for Propagation: This species is to be re-established in NW ERD and is targeted for plug production; containers will range from 4-6” diameter.



**Figure C22.** Immature CASARA fruits and seeds with inflorescence. Photo by Melody Frederic.

**Species: *Elymus elymoides* ssp. *elymoides* (ELYELYELY); Bottlebrush squirreltail**

**Family: Poaceae**



**Figure C23.** *Elymus elymoides* ssp. *elymoides*. Photo by Melody Frederic.

Life History and Seed Information: Plant is a perennial bunchgrass (Figure C23). Fruit is a caryopsis (Figure C24). Inflorescence has 2 spikelets per node; spikelet 12-20 mm. Glumes 35-85 mm, lowest floret generally sterile. Fertile florets 1+, lemma awn 25-75 mm.

Phenology and Seed Ripeness: Seeds are ready to collect when the inflorescences bush out like a squirrel's tail and exhibit a pale, almost white, straw color. In 2014, seeds were ready for collection from July 21 through late September. This species exhibited the widest range of availability than any other species collected for the RDRR project. It tended to become collectable sooner and peak sooner in the South WRD and NE ERD seed zones than in the other three zones.

Seed Collection Techniques: Even though inflorescence is open and full, collect only when seeds come off the plant easily into the hand. Gently run thumb and fingers from the bottom of the stem up and let the ripe seeds collect in your hand. Because of the bushy inflorescences, this is a bulky seed to collect. When collecting from many plants, use a large grocery-size bag. Occasionally tamp down the seeds by pushing down with your hand enclosed in a small lunch-size bag; this will prevent the seeds from sticking to your hand and sleeve while packing down the seeds.

Plans for Propagation: This species is to be re-established in all five seed zones and is targeted for seed collection and propagation by sowing.



**Figure C24.** Mature ELYELYELY seeds with inflorescence. Photos by Melody Frederic.

**Species: *Ericameria greenei* (ERIGRE); Greene's goldenweed**

**Family: Asteraceae**



**Figure C25.** *Ericameria greenei*. Photo by Melody Frederic.

Life History and Seed Information: Plant is a perennial shrub (Figure C25). Fruit is an achene, 6-7 mm, narrowly oblong, +/- glabrous to densely appressed-soft-hairy; pappus = disk corollas, white to light brown.

Identification Tips: *E. greenei* and *E. bloomerii* look similar. However, *E. greenei* has stems and leaves that are stipitate-glandular while *E. bloomerii* has stems and leaves that are glabrous, tomentose, or gland-dotted (sessile or in pits).

Phenology and Seed Ripeness: Seeds are ready to collect after flowers fade, pappus appears, and achenes turn from green to brown. In 2014, seeds were ready for collection starting around mid-September.

Seed Collection Techniques: Seeds were collected by pulling pappus with achene attached from seed heads and placing in bags. This plant is highly susceptible to insect infestation that is noticeable by small black specks. This is one of the latest-maturing species on the RDRR species list.

Plans for Propagation: This species is to be re-established in South WRD, Central WRD, and North WRD and is targeted in these three seed zones for propagation by cuttings contained in D40 containers.



Species: *Eriogonum marifolium* var. *marifolium* (ERIMARMAR); Sierra Eriogonum

Family: Polygonaceae



**Figure C26.** Left: Male ERIMARMAR plant. Center: Female ERIMARMAR plant. Right: Closeup of ERIMARMAR inflorescence containing mature seeds. Photos by Melody Frederic.

Life History and Seed Information: Plant is a dioecious perennial subshrub (Figure C26). Fruit is an achene, 3.5-5 mm, with slightly hairy tip, brown to black. Seed is single and attached to ovary wall at a single point. Male and female plants have different flowers: male perianth is 1-2 mm and dull yellow; female perianth is 4-7 mm and bright yellow to red.

Identification Tips: *Eriogonum marifolium* var. *marifolium* and *Eriogonum umbellatum* var. *polyanthum* are similar in appearance. However, *Eriogonum umbellatum* var. *polyanthum* is bisexual while *Eriogonum marifolium* var. *marifolium* is dioecious.

Phenology and Seed Ripeness: As flowers continue to develop, females begin to show a reddish hue to their yellow petals while the male plants remain completely yellow. Seeds are ready to harvest once flowers turn a pale orange or red color and feel dry and papery; a mature seed will be black (Figure C27). In 2014, seeds were ready for collection from about mid-August to early-September.

Seed Collection Techniques: Crumble flower heads directly into paper bags or cup your hand at the base of the umbel and gently pull up to have seeds fall into your hand.

Plans for Propagation: This species is to be re-established in South WRD, Central WRD, North WRD, and NW EDR and is targeted for plug production; containers will range from 4-6" diameter.



**Figure C27.** Mature ERIMARMAR seed. Photo by Melody Frederic.

**Species: *Ericameria nauseosa* var. *speciosa* (ERINAUSPE); Showy rubber rabbitbrush**

**Family: Asteraceae**



**Figure C28.** ERINAUSPE shrub.  
Photo by Melody Frederic.

Life History and Seed Information: Plant is a perennial shrub (Figure C28). Fruit is an achene, 3-8 mm, generally hairy; pappus = disk corollas, white to light brown.

Identification Tips: This species is collected only in the NE ERD seed zone. A similar species, *Ericameria greenei*, occurs interspersed with *E. nauseosa* in some areas within this seed zone. *E. nauseosa* can be distinguished by its narrow silver-green leaves; *E. greenei* has leaves that are slightly broader and a deeper green color. *E. nauseosa* is a taller shrub (2-28 dm); *E. greenei* is a shorter shrub (1-3 dm).

Phenology and Seed Ripeness: Seeds are ready to collect after flowers fade, pappus appears, and achenes turn from green to brown. In 2014, seeds were ready for collection starting around mid-September.

Seed Collection Techniques: Seeds were collected by pulling pappus with achene attached from seed heads and placing in bags.

Plans for Propagation: This species is to be re-established in NE ERD and is targeted for propagation by cuttings contained in D40 containers.

**Species: *Eriogonum pyrolifolium* var. *coryphaeum* (ERIPYRCOR); Alpine Buckwheat**

**Family: Polygonaceae**



**Figure C29.** ERIPYRCOR plant.  
Photo by Melody Frederic.

Life History and Seed Information: Plant is a perennial forb from a thick woody caudex (Figure C29). Fruit is an achene, 4-5 mm with a hairy tip, brown to black. Seed is single and attached to ovary wall at a single point.

Identification Tips: Two variations of *Eriogonum pyrolifolium* occur in CRLA: var. *coryphaeum* and var. *pyrolifolium*. ERIPYRCOR has leaf blades densely lanate to tomentose abaxially, mostly glabrous adaxially; ERIPYRPYR has leaf blades glabrous on both surfaces.

Phenology and Seed Ripeness: Flowers are initially white. As ovaries develop, some petals turn red; a small lump can be felt where ovaries exist. Seeds are ready to harvest once flowers have dried and turned a pale salmon color (Figure C30). The ovaries can no longer be felt, and the flower heads pull off plant with no

resistance. Seeds of this plant are late to mature. In 2014, seeds were ready for collection beginning in mid-September.

Seed Collection Techniques: Gently pull flower heads and place into paper bags.

Plans for Propagation: This species is to be re-established Central WRD, North WRD, and NW ERD. This species is targeted for plug production; containers will range from 4-6" diameter.



**Figure C30.** Left, Center: Developing ERIPYRCOR seed and inflorescence. Right: ERIPYRCOR plant at seed maturity stage with dry, salmon-colored petals. Photos by Melody Frederic.

**Species:** *Holodiscus microphyllus* var. *glabrescens* (HOLMICGLA); Bush ocean spray

**Family:** Rosaceae



Life History and Seed Information: Plant is a perennial shrub (Figure C31). Fruits are achenes, 5, 1-1.5 mm, hairy, often with sessile glands (Figure C32).

Phenology and Seed Ripeness: Seeds are maturing when inflorescences turn brown, look bristly, and feel dry to the touch. In 2014, seeds were starting to mature in late September.

Seed Collection Techniques: Crumble dry achenes into a paper bag; also, the entire inflorescence can be collected.

Plans for Propagation: This species is to be re-established in South WRD and is targeted for propagation by cuttings contained in D40 containers.

**Figure C31.** HOLMICGLA shrub.  
Photo by Melody Frederic.



**Figure C32.** Left: Inflorescences turning dry, bristly, and brown. Right: Each flower head contains 5 hairy achenes. Photos by Melody Frederic.

Species: *Juncus parryi* (JUNPAR); Parry's rush

Family: Juncaceae



**Figure C33.** JUNPAR plant. Photo by Melody Frederic.

Life History and Seed Information: Plant is perennial and densely caespitose (Figure C33). Fruit is a loculicidal capsule, gen > perianth, 3-angled; tip acute. Seeds are 2 mm, ovate; appendages > seed body.

Phenology and Seed Ripeness: Capsule has to be cut or squeezed open to determine status of seeds. Unripe seeds are a sickly yellow; ripe seeds are amber to bronze in color (Figure C34). In 2014, seeds were ready for collection between August 4 and early September.

Seed Collection Techniques: Since seeds are so small, cutting stems with capsules attached when the seeds are at or nearing maturity is the best method. The stems continue to provide

nutrients, allowing seeds to reach full maturity. Place stems with capsules in plastic bins. Allow to dry for at least two weeks. Seeds will drop to the bottom of the bins and can then be collected and stored in Ziplock® baggies. Seeds are so small, they appear to be reddish “dust.” Checking under a scope will confirm the presence of seeds in the bin bottom.

Plans for Propagation: This species is to be re-established in NW ERD is targeted for plug production; containers will range from 4-6” diameter.



**Figure C34.** Left: JUNPAR flower. Center Left: Inflorescence with mature seeds. Center Right: Immature Seeds. Right: Maturing seeds. Photos by Melody Frederic.

**Species: *Leutkea pectinata* (LEUPEC); Partridge foot**

**Family: Rosaceae**



**Figure C35.** *Leutkea pectinata*. Photo by Melody Frederic.

Life History and Seed Information: Plant is perennial, +/- prostrate subshrub (Figure C35). Fruits are follicles, 4-6, +/- 4 mm, leathery, dehiscent along both sutures. Seeds are > 1, +/- fusiform, flat, smooth (Figure C36).

Phenology and Seed Ripeness: Seeds are ready to collect when capsules on stems turn a rosy-rusty color (Figure C36) and are ready to dehisce. Seeds are small. In 2014, seeds were ready for collection beginning in mid-August through late August.

Seed Collection Techniques: Seeds within dehiscent capsules can be poured into the hand or bag. However, because the seeds are so small, we recommend collecting the entire seed stem just prior to capsules dehiscing.

Plans for Propagation: This species is to be re-established in NW ERD and is targeted for plug production; containers will range from 4-6" diameter.



**Figure C36.** Left: Mature LEUPEC inflorescences with rusty-red color. Right: Mature seeds and capsule debris. Photos by Melody Frederic.

**Species: *Lupinus andersonii* (LUPAND); Anderson's Lupine**

**Family: Fabaceae**



**Figure C37.** *Lupinus andersonii*.  
Photo by Melody Frederic.

Life History and Seed Information: Plant is a perennial forb (Figure C37). Fruit is a dehiscent, oblong legume, 2-4.5 cm, and silky. Seeds are 4-6 per pod, 4-6 mm, and mottled tan or brown (Figure C38).

Phenology and Seed Ripeness: Seeds are ripe when legume pods turn light brown, and seeds inside feel hard and solid. In 2014, seeds were ready for collection beginning in early August.

Seed Collection Techniques: Once seeds ripen, their pods burst open, immediately scattering seeds out into the soil. We experimented with placing nylon stockings over developing seed pods (see photo below). We also collected developing seed pods with stems and leaves attached; these we placed in small plastic bins lined with newsprint and allowed the plant material to dry. Both techniques provided mature seeds; however, bag placement had a more successful yield but was more labor intensive as they required exact location

information and a return trip to retrieve the bags and seeds.

Additional Information: The nylon stockings blended in well and were not very noticeable, if at all, to the public. However, this made them more difficult to re-locate.

Plans for Propagation: This species is to be re-established in South WRD and is targeted for seed collection and propagation by sowing.



**Figure C38.** Left: Bagged LUPAND inflorescence for capturing seeds. Right: Mature LUPAND seeds. Photos by Melody Frederic.

**Species: *Lupinus lepidus* var. *lobbii* (LUPLEPLOB); Prostrate lupine**

**Family: Fabaceae**



**Figure C39.** *Lupinus lepidus* var. *lobbii*.  
Photo by Melody Frederic.

Life History and Seed Information: Plant is an herbaceous, matted perennial forb (Figure C39). Fruit is a dehiscent, somewhat oblong legume, 1-2 cm, and hairy. Seeds are 2-4 per pod, 2-4 mm, and +/- tan or green to brown (Figure C40).

Identification information: Two varieties of *Lupinus lepidus* occur in CRLA: var. *lobbii* and var. *sellulus*. The inflorescence of LUPLEPLOB is more or less head-like, 2-8 cm, and the plant is < 1 dm in height. LUPLEPSEL has more elongate inflorescences, 4.5-11 cm, and the plant is 1.2-3.5 dm in height.

Phenology and Seed Ripeness: Seeds are ripe when legume pods turn light brown, and seeds inside feel hard and solid. In 2014, seeds were ready for collection from early August through mid-September.

Seeds in the NW ERD seed zone matured sooner than the seeds in the NE ERD seed zone.

Seed Collection Techniques:

Once seeds ripen, their pods burst open, immediately scattering seeds out into the soil. We experimented with placing white seed bags over developing seed pods (Figure C40). We also collected developing seed pods with stems and leaves attached; these we placed in small plastic bins lined with

newsprint and allow the plant material to dry. Both techniques provided mature seeds; however, bag placement had a more successful yield but was more labor intensive as it required exact location information and a return trip to retrieve the bags and seeds.

Additional Information: Because the white bags were noticeable to the public, we placed a few tags stating “Crater Lake National Park Research—Please Do Not Remove” among the bagged plants (see photo below). We hole-punched the tags and secured them into the soil using landscape anchor pins.

Plans for Propagation: This species is to be re-established in NW ERD and NE ERD and is targeted for seed collection and propagation by sowing.



**Figure C40.** Left: Bagged LUPLEPLOB inflorescences. Right: Mature LUPLEPLOB seeds. Photo by Melody Frederic.



**Species: *Penstemon davidsonii* var. *davidsonii* (PENDAVDAV); Davidson’s Penstemon**

**Family: Plantaginaceae**



**Figure C41.** *Penstemon davidsonii* var. *davidsonii*. Photo by Melody Frederic.

Life History and Seed Information:

Plant is a mat-forming perennial subshrub (Figure C41). Fruit is a septicidal capsule (Figure C42). Seeds are many and small.

Phenology and Seed Ripeness: Seeds are mature when capsules become dry and turn from green to a rich chestnut brown color; seeds can be heard “rattling” inside capsules. In 2014, seeds were collected from mid-August to early September.

Seed Collection Techniques: Seeds within dehiscent capsules can be poured into the hand or bag. However,

because the seeds are so small, it is recommended to collect the entire inflorescence stem just prior to capsules dehiscing.

Plans for Propagation: This species is to be re-established in Central WRD and North WRD and is targeted for plug production; containers will range from 4-6” diameter. This species is selected for germination trials and propagation protocol development.



**Figure C42.** Mature PENDAVDAV seed capsules. Photo by Melody Frederic.

**Species: *Phacelia hastata* ssp. *compacta* (PHAHASCOM); Timberline phacelia**

**Family: Boraginaceae**



**Figure C43.** *Phacelia hastata* ssp. *compacta*.  
Photo by Melody Frederic.

Life History and Seed Information: Plant is a perennial forb (Figure C43). Fruit is a loculicidal capsule, 2-4 mm, ovoid, stiff-hairy. Seed are 1-3, 1.5-2.5 mm, pitted in vertical rows.

Phenology and Seed Ripeness: Seeds are ready to harvest when they change from white to black. Seed heads become brown, prickly, dry, and pull easily from the plant. In 2014, seeds were ready for collection between late July and mid-August.

Seed Collection Techniques: Collect the entire seed head only when it can be easily pulled away from the plant.

Plans for Propagation: This species is to be re-established in NE ERD and is targeted for plug

production; containers will range from 4-6" diameter. This species is selected for germination trials and propagation protocol development.



**Figure C44.** Mature (black) and immature (beige-brown) PHAHASCOM seeds with inflorescence and capsule debris. Photo by Melody Frederic.

Species: *Phlox diffusa* (PHLDIF); Spreading phlox

Family: Polemoniaceae



Figure C45. *Phlox diffusa*. Photo by Melody Frederic.

Life History and Seed Information: Plant is a matted, perennial forb (Figure C45). Fruit is a capsule; occurs singularly at the terminal end of stems and contains one seed.

Phenology and Seed Ripeness: While developing, seeds are “hidden” inside fruit capsules at the end of stems. Seeds are ripe when the terminal stem leaves open to reveal the seed capsule, which has turned from green to light brown (Figure C46). In 2014, seeds were ready for collection between early-August and early- to mid-September.

Seed Collection Techniques: Collect the seeds when they are no longer “hidden” but are perched at the terminal end of stems. Ripe or near-ripe seeds tend to be “jumpy;” therefore, gently secure the seed capsule between your thumb and index finger before pinching the seed capsule from the terminal end of the stem.

Additional information: This is a time-consuming plant from which to collect; however, it is an important component in the South and Central WRD seed zones and a minor component in the North WRD zone. It was collected in small numbers in 2014 and will need to be focused on in 2015. Because the seeds mature over time on any given plant and within any given population, it is recommended to return on a regular basis throughout the season to areas where good PHLDIF coverage occurs.

Plans for Propagation: This species is to be re-established in South WRD, Central WRD, and North WRD is targeted for seed collection and propagation by sowing.



Figure C44. Left: Mature PHLDIF capsules. Right: Mature PHLDIF seeds. Photos by Melody Frederic.

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 2015

**National Park Service**  
**U.S. Department of the Interior**



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