

Champoeg Prairie Restoration 2018 Annual Report



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Report for Oregon Parks and Recreation
Department

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PREFACE

IAE is a non-profit organization whose mission is conservation of native ecosystems through restoration, research and education. IAE provides services to public and private agencies and individuals through development and communication of information on ecosystems, species, and effective management strategies. Restoration of habitats, with a concentration on rare and invasive species, is a primary focus. IAE conducts its work through partnerships with a diverse group of agencies, organizations and the private sector. IAE aims to link its community with native habitats through education and outreach.



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Cover photograph: Showy tarweed flowering with tufted hairgrass at Champoeg Prairie May 18, 2018. (Photo: Andy Neill)

All photos in this report are by Andy Neill unless otherwise noted.

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TABLE OF CONTENTS

PREFACE	1
ACKNOWLEDGMENTS	2
SUGGESTED CITATION	2
TABLE OF CONTENTS	3
1. EXECUTIVE SUMMARY	4
2. INTRODUCTION	4
3. GOALS AND OBJECTIVES	8
4. 2018 RESTORATION ACTIVITIES	8
4.1. Weed treatments.....	11
4.2. Seeding.....	13
4.3. Cultural Harvest Area	15
5. RECOMMENDATIONS	16
6. REFERENCES	18
APPENDICES	19
Appendix A. Summary of Champoeg Prairie restoration actions (2013-2018).....	19
Appendix B. Forb diversity block seed mix species and seeding rates (2014-2015).....	23
Appendix C. Forb diversity block planting (2014).....	25
Appendix D. Native seed mixes and broadcast rates (October 2017).....	26

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1. EXECUTIVE SUMMARY

The Institute for Applied Ecology (IAE) has been involved in restoration of Champoeg Prairie, a 45-acre former agricultural field at Champoeg State Heritage Area, since 2013. In 2014, IAE developed and began implementation of the Champoeg Prairie Restoration Plan (IAE 2014) for Oregon Parks and Recreation Department. The goal of restoration efforts at Champoeg Prairie is to create upland and wet prairie habitats with diverse plant communities. This report summarizes prairie conditions and management actions in 2018. The objectives of restoration of Champoeg Prairie include controlling high priority invasive species, improving forb diversity increasing abundance of culturally significant species, and implementing periodic prescribed burns as part of prairie management. In 2018, weed management included mowing, hand weeding, and broadcast and spot spray herbicide applications. Some of the treated or disturbed areas of the prairie were seeded with native forbs, grasses, sedges and rushes. Native prairie species, including culturally important food and fiber plants, were planted in a portion of Champoeg Prairie. It is hoped that this portion of Champoeg Prairie will be a place for local tribal members to harvest traditional food and fiber plants and share knowledge of these plants, harvesting techniques, and the cultural significance of the Champoeg area. The creation of this harvest area was celebrated by a cultural event hosted by IAE, Oregon Parks and Recreation Department (OPRD), and the Confederated Tribes of the Grand Ronde (CTGR) where attendees planted culturally important food plants, ate traditionally prepared foods, and learned about tool and basket making techniques.

2. INTRODUCTION

Champoeg State Heritage Area (Champoeg) is a popular recreational destination in the mid-Willamette Valley, noted for its historical importance and natural resource values. It is owned and operated by the Oregon Parks and Recreation Department (OPRD). The 622-acre park consists of a variety of habitat types including creeks, oak woodlands, ash-forested wetlands, wet meadows, upland forest, riparian forest and active agricultural fields. Camping, biking, walking, disc golf and bird watching are some of the more popular recreational activities at the park. The park is located near Newberg, Oregon and is situated along the southern bank of the Willamette River in Marion County (Figure 1). Portions of the park and the entire Champoeg Prairie restoration unit are located within the Champoeg Conservation Opportunity Area (COA), as indicated on the Willamette Valley Synthesis Map (TNC 2014).

Historically, the park was an important trade, gathering, and food harvesting location for local tribes. The word Champoeg likely derives from a Kalapuyan word for the native prairie species *yampa* (*Perideridia oregana*), which is an important edible root for local tribes that was likely abundant in the Champoeg Prairie. Other food and fiber plants that were likely gathered at Champoeg include two species of camas (*Camassia quamash* and *C. leichtlinii*), soft rush (*Juncus effusus*), and hazelnut (*Corylus cornuta*). In addition to being an important harvest location, the prairie was a known location for trading

Champoeg Prairie

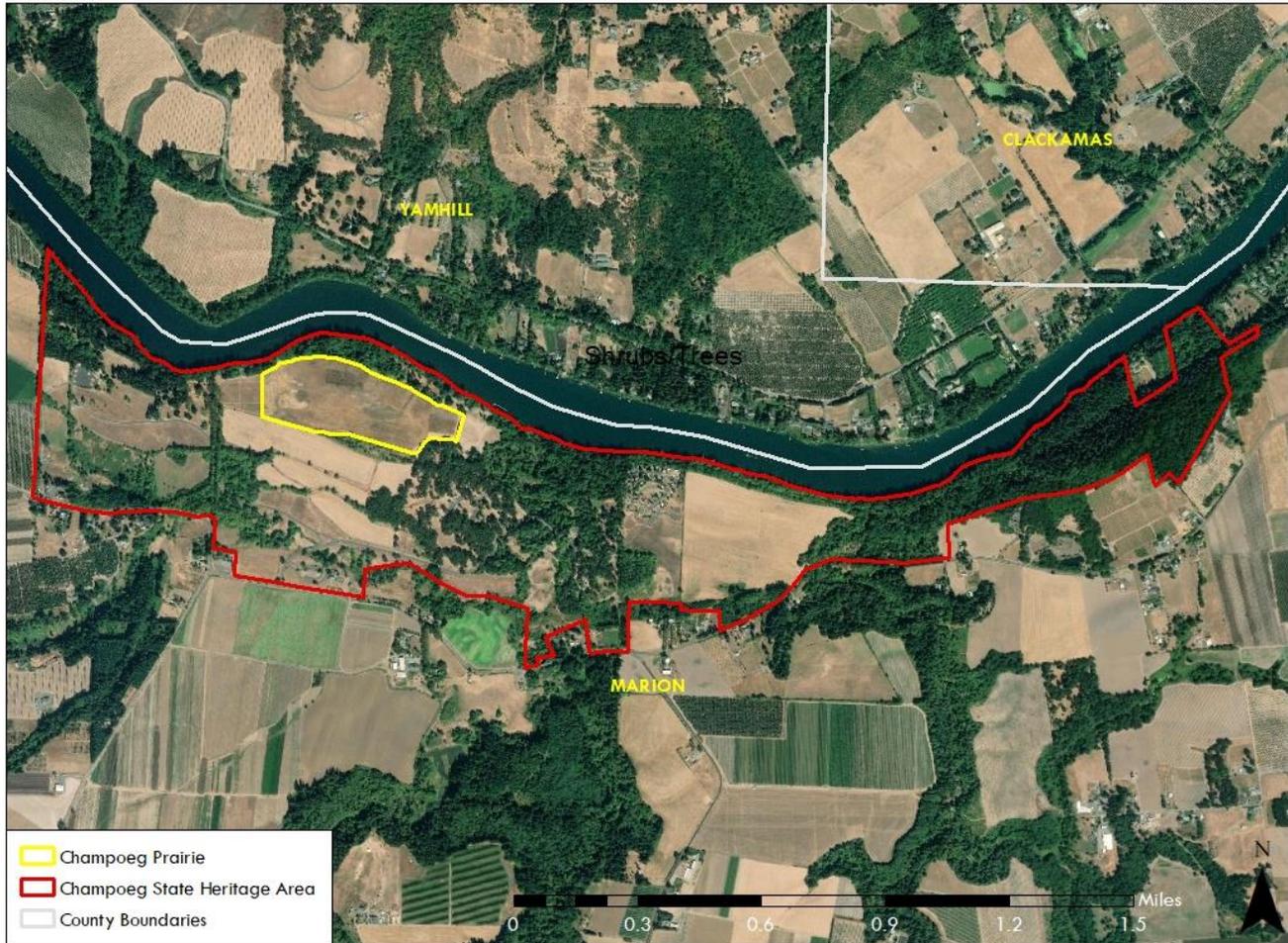
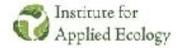


Figure 1. Champoeg State Heritage Area (outlined in red) with the location of Champoeg Prairie restoration project area (outlined in yellow).

among tribes because of the open prairie and river access and crossing (Hussey 1967). During pioneer settlement, the Champoeg Prairie, in particular, was noted as the first place upstream from Willamette Falls where travelers could access the Willamette River easily due to the prairie that extended almost all the way to the river’s edge. For this reason, part of Champoeg Prairie was the location of the historic town of Champoeg, which was destroyed in the flood of 1861. Today, Champoeg is an important site for cultural and historic resource protection.

The Champoeg Prairie restoration unit is a 45-acre former agricultural field situated along the southern bank of the Willamette River (Figure 1). Restoration of this prairie is important because of the rarity of prairie habitats and associated plants and animals in the Willamette Valley Ecoregion. Much of the wet and upland prairie habitat has been lost due to conversion to agriculture, urban expansion, and encroachment by trees and shrubs. Prior to European settlement in the Willamette Valley, open prairie habitats were maintained by periodic fires, including those intentionally set by native tribes that had long

lived in the area. Early accounts of the area suggest that the restoration unit has been in agricultural use since the 1850s, or possibly earlier (Hussey 1967).

Habitat restoration efforts began at Champoeg Prairie when OPRD stopped leasing the field to local farmers for agriculture in 2005 and began converting the field to native wet and upland prairie. OPRD kept the field in chemical fallow during the 2005 and 2006 growing seasons. In 2007, the 45-acre field was seeded using a no-till drill with five native grasses: tufted hairgrass (*Deschampsia cespitosa*), blue wildrye (*Elymus glaucus*), Roemer's fescue (*Festuca roemeri*), California brome (*Bromus carinatus*), and California oatgrass (*Danthonia californica*). By 2013, Champoeg Prairie was dominated by tufted hairgrass with minor components of blue wildrye, Roemer's fescue, and California brome (Figure 2). In 2013, the Institute for Applied Ecology (IAE) became involved in restoration of Champoeg Prairie and in 2014 developed an adaptive management plan for OPRD to guide restoration of the prairie to achieve restoration goals and objectives (IAE 2014). Since then, IAE has been implementing the management plan and refining the techniques, tools, and timing outlined in the management plan to create prairie habitats with a diversity of native forbs and grasses. For a full treatment and task schedule for Champoeg Prairie since IAE's involvement began in 2014, see Appendix A.



Figure 2. Tufted hairgrass dominating the field in October 2013 (Photo: Peter Moore).

To increase forb diversity in Champoeg Prairie, four forb diversity blocks (Figure 3) were established in 2014 by first spraying rows in the grass with herbicide then seeding and planting the treated blocks with native forbs, sedges and rushes in fall 2014 and seeding again in fall 2015 (see Appendix B for a list of seeded species and Appendix C for a list of planted species). Many of the seeded and planted forbs were observed flowering in 2018, indicating successful establishment of these species. The forb diversity blocks have increased native plant diversity, plant community heterogeneity across the site, and habitat stability. This has led to increased diversity and abundance of pollinators and other animals that use the site. Included in the seed mix and planting scheme were culturally significant plants that once established could be harvested by local tribes.

Champoeg Prairie Restoration Project



Figure 3. Overview of the 45-acre Champoeg prairie restoration project area and plant establishment areas.

Restoration activities in 2016 and 2017 focused on reduction of weeds using mowing and herbicides, a prescribed burn in fall 2017, and broadcast seeding of native forbs and grasses to burned portions of the prairie including areas outside forb diversity blocks. The prescribed burn of Champoeg Prairie was completed on September 27, 2017 as a training exercise for a fire crew from the Confederated Tribes of the Grand Ronde (CTGR) Natural Resources Department (Figure 4). The prescribed burn was considered a success and about 90% of the prairie burned. However, the western and central sandy areas did not have enough vegetation to carry a flame during the burn and were instead mowed by OPRD staff after the burn. Following the burn a diverse seed mix that included native forbs, grasses and sedges was broadcast over approximately 15 acres, contributing to over 18 acres with native forb introduction at Champoeg Prairie.



Figure 4. Confederated Tribes of Grand Ronde crew members igniting the fire along a wet line (left). The central sandy area did not carry a flame (center). The burned thatch exposed soil for broadcasting native seed (right) on September 27, 2017.

3. GOALS AND OBJECTIVES

The goal of this project is to assist OPRD in implementing the Champoeg Prairie Restoration Plan to create diverse wet and upland prairie habitat in the 45-acre prairie at Champoeg State Heritage Area. Restoration activities are being completed to achieve the following objectives:

- 1) Control high priority invasive species such as mullein (*Verbascum thapsus*), thistles (*Cirsium arvense* and *C. vulgare*), and non-native grasses;
- 2) Improve forb diversity at Champoeg Prairie by seeding and planting appropriate native species;
- 3) Increase abundance of culturally significant species; and
- 4) Implement periodic prescribed burns as part of prairie management.

4. 2018 RESTORATION ACTIVITIES

Restoration activities in 2018 focused on reduction of priority weeds, confirming compliance for future restoration activities, and establishment of an area in Champoeg Prairie that could eventually be used by local tribes to harvest culturally significant food and fiber plants (Table 1).

High priority weeds were targeted during the 2018 growing season with herbicide spot treatments using backpack sprayers and broadcast treatments completed by IAE staff and a contractor each using a boom sprayer pulled behind an ATV. Broadleaf weeds and annual grasses at the west end of the prairie and the broadleaf weeds in the central swale were controlled with broadcast herbicide applications. Spot spray herbicide applications in the rest of the prairie, including the four forb diversity blocks were completed to control high priority weeds that include common mullein, Canada and bull thistle, and non-native grasses, such as rattail fescue (*Vulpia myuros*) and velvetgrass (*Holcus lanatus*).

The preference is to have the prairie burned every three years, but in the absence of prescribed burning OPRD staff mowed ~30 acres of the prairie over the course of several days in September and October (Figure 5). Mowing reduced thatch, dispersed seed of flowering plants, made fall planting easier, and will facilitate locating and targeting of priority weeds during spot spray herbicide applications.

In 2017 we worked with the Champoeg park manager and OPRD archaeologist to ensure cultural compliance with the State Historical Preservation Office (SHPO) to perform the prescribed burn. In 2018, maps of proposed planting and planting methods submitted by the OPRD archaeologist were approved by SHPO. The approval from SHPO to perform ground disturbing activities established boundaries for restoration activities that disturb the soil, including, planting, hand weeding, and use of a no-till seed drill (Figure 6). This approval is significant since many native prairie plants do not establish well when broadcasting seed is the only method of introduction.



Figure 5. Oregon Parks and Recreation Department staff mowing Champoeg Prairie in September, 2018.

In order to harvest cultural foods within the proposed Cultural Harvest Area, we have begun planning the eventual phasing out chemical herbicide use. The area selected for this purpose has traditionally had a lower abundance of weeds and has required less herbicides to control weeds in general. Moving forward weed control in this area will be done by hand and chemical herbicides will not be used. All of the planting that occurred in 2018 took place inside this area.

Champoeg Prairie Restoration Project



Figure 6. Plant establishment areas and methods approved by the State Historical Preservation Office for Champoeg Prairie.

Table 1. 2018 restoration activities at Champoeg Prairie.

Date	Task
2/15/2018	Met with Nancy Nelson, OPRD Archaeologist, and John Mullen, Park Manager, to discuss State Historical Preservation Office report and future planting areas at Champoeg.
3/1/2018	Met with Dr. Paige Parry's ecology class from George Fox University to talk about prairie ecology and restoration at Champoeg Prairie.
3/23/2018	Meeting with Andrea Berkley, OPRD Natural Resource Specialist and John Mullen, Park Manager, to discuss restoration plans at Champoeg and other possible OPRD projects.
4/19/2018	Meeting with OPRD and CTGR to begin planning for October 13, 2018 cultural and planting event.
4/23/2018	Broadcast spray of Garlon 3A (triclopyr) by contractor to ~8 acres at west end of prairie targeting broadleaf weeds.
4/26/2018	IAE staff directed contract crew to spot spray tansy ragwort, thistles and mullein across ~35 acres starting at the west end of Champoeg Prairie with Milestone (aminopyralid).
5/17/2018	IAE staff spot sprayed tansy ragwort and thistles at east end of the prairie with Gly-Star (glyphosate).
5/18/2018	IAE staff spot sprayed tansy ragwort and thistles at east end and central area of Champoeg Prairie with Gly-Star (glyphosate).
6/5/2018	Site visit with IAE staff to discuss successes and challenges of prairie restoration in Champoeg Prairie.
6/7/2018	Meeting with staff from IAE, OPRD and CTGR to discuss fall (October 13, 2018) cultural and planting event and soil sampling.
7/16/2018	IAE staff collected soil samples from four pits and 6-8" deep. The four samples were mixed for a total of one quart in a Ziploc bag. The soil sample was submitted the same day to Pacific Agricultural Laboratory in Sherwood, OR. Cut tops of tansy ragwort, common mullein, St. Johnswort, and hairy evening primrose and hauled off site.
9/28/2018	IAE staff coordinated a contractor to broadcast spray Plateau (imazapic) to 11 acres at west end of prairie. OPRD staff were mowing from the east end of meadow with a tractor pulling a mower with a six-foot wide deck.
10/2/2018	Staff from IAE, OPRD and CTGR Natural Resources Department presented work completed at Champoeg Prairie through partnership between the three organizations to the Legislative Commission on Indian Services (LCIS) at the state capitol building in Salem.
10/13/2018	IAE staff hosted a cultural event with CTGR to kick-off planting in a part of the Champoeg Prairie that will eventually become a harvest area for culturally important plants. In addition to cultural events provided by CTGR, attendees planted camas and yampa provided by CTGR. Many people attended the event and about 40 volunteers assisted with planting during the event.
10/16/2018	Broadcast native forbs and grasses to bare ground exposed by the OPRD mower and spot spray treatments to the eastern 15 acres of Champoeg Prairie.
10/27/2018	Twenty-four volunteers assisted IAE and CTGR staff to plant ~6,000 bareroot plants and bulbs in the cultural harvest area at Champoeg Prairie.
11/19/2018	IAE staff broadcast spray of 2.8 acres of central sandy area with Rodeo (glyphosate) to prepare the area for shrub and tree planting in January 2019. IAE staff also did a broadcast spray to the ~2 acre central swale with Garlon 3A (triclopyr) to promote sedges and rushes that were seeded in fall 2017 and 2018.

4.1. Weed treatments

Until 2018 weed treatments have varied based on the specific needs of three distinct areas within the Champoeg Prairie. These areas include 1) sandy areas at the west end and center of the prairie, 2) the four forb diversity blocks, and 3) the rest of the prairie that is dominated by native grasses (Figure 3). Priority weeds targeted with broadcast and spot spray herbicide applications in all areas include mullein, tansy ragwort (*Jacobaea vulgaris*, Figure 7), Canada and bull thistles (*Cirsium arvense* and *C. vulgare*), Himalayan blackberry (*Rubus bifrons*), rattail fescue, velvetgrass, and reed canarygrass (*Phalaris arundinacea*). However, in 2017 following the



Figure 7. Tansy ragwort flowering with cinnabar moth caterpillar at Champoeg prairie on July 16, 2018.

prescribed burn and adequate control of non-native forbs, native forb seed was broadcast to additional areas outside of the original four forb diversity blocks making broadcast herbicide treatments to control broadleaf weeds unnecessary (Figure 3). Instead, multiple spot spray treatments throughout this area and most of the prairie were completed in 2018 to control priority weeds. The prescribed burn in 2017 effectively reduced thatch and aboveground vegetation which made spot treatments to non-native forbs, such as thistles, mullein and tansy ragwort, much more efficient and effective. The residual effects of aminopyralid and clopyralid enhanced weed control by limiting establishment of weeds from seed maintained in the soil seedbank.

A two-acre portion of Champoeg Prairie was designated in 2018 as a Cultural Harvest Area, or an area that will be managed as prairie habitat but with a higher density of culturally significant plants (Figure 6). It is hoped that this area will become a location for tribes to harvest these plants. This planting area is being established through a partnership with Confederated Tribes of the Grand Ronde and funded by an Oregon Watershed Enhancement Board (OWEB) grant. Because many of the plants in the harvest area will be food plants, herbicides began to be phased out 2018. Fortunately, this area has had a low abundance of weeds throughout the restoration process and herbicide applications have been limited in this area. Starting in 2019 this harvest area will be managed by pulling target weeds by hand. To facilitate the establishment of the Cultural Harvest Area and ensure the safety of food that could be harvested, soil samples were collected and analyzed for herbicide residues. Test results indicated that low concentrations of some common herbicide residues were present, but that these levels were well below USDA food safety standards. However, future testing of plant materials grown in the area and concentration thresholds will have to be established prior to consumption.

Tansy ragwort is a common agricultural weed throughout the Willamette Valley that likely was already present or transported to Champoeg Prairie by equipment or as windblown seed (Figure 7). There was



Figure 8. Tansy ragwort burning as part of the prescribed burn on September 27, 2017.

an unexpected outbreak of tansy ragwort in 2017 the prescribed burn in the fall of 2017 (Figure 8) and targeted herbicide spot and broadcast spray applications in 2018 appear to have reduced the abundance of this weed (Neill 2017).

Sandy areas of the prairie have been dominated by non-native grasses and broadleaf weeds since the areas were sprayed and left fallow prior to IAE's involvement in the project. Sandy areas include ~11 acres at the west end of the prairie and central sandy area that is ~2.8 acres (Figure 3). Priority weeds present in these areas include mullein, thistles, and annual grasses. Common horsetail (*Equisetum arvense*) is also present in this area but

control of this species has not been attempted. The sandy areas were included in the spot spray applications that targeted priority broadleaf weeds. The western sandy area also received a broadcast herbicide application of Garlon 3A (triclopyr) in the spring to control broadleaf weeds and a fall broadcast application of Plateau (imazapic) to inhibit germination of annual grasses. The triclopyr application appears to be successful and the grasses seeded in 2017 appear to have established enough to survive the herbicide applications. However, it appears that the concentration of the imazapic broadcast application was too low or the soil porosity was too great to maintain a high enough concentration to affect the germinating annual grasses and another application at a higher concentration might be required in 2019 to control annual grasses.

The hairy evening primrose (*Oenothera villosa*) (Figure 9) that densely occupied portions of the sandy area at the west end of the prairie has been controlled by broadcast herbicide applications in 2017 and 2018. Isolated plants and small patches can still be found in the prairie and should be monitored to prevent future outbreaks. Although hairy evening primrose is native, this species can form dense patches and prevent establishment of desired native prairie species.

The ~2.8-acre central sandy area has proven to be a difficult area for controlling



Figure 9. Hairy evening primrose (*Oenothera villosa*) flower (left) and basal rosette (right) that invaded the western end of Champoeg Prairie

problem weeds and establishing native grasses (Figure 3). In 2016, it was decided to implement an alternate plan to establish native shrubs and trees in this area that was described in the Champoeg Prairie Management plan (IAE 2014). Once established, trees and shrubs will out-compete annual weeds and provide habitat for shrub dwelling animals. Originally, the outplanting of the trees and shrubs was scheduled for February of 2017, but this was delayed while compliance with archaeological regulations was resolved. This delay allowed for another year of weed control in the central sandy area (Table 1). In October 2017, this area received an herbicide treatment of Arsenal (imazapyr), a broad-spectrum herbicide with pre-emergent qualities that effectively reduced survival of germinating weed seed but would not affect planting. In fall 2018, this area received a broadcast application of glyphosate to control remaining weeds. These treatments appear to be successful and the area is ready for a target planting date in early 2019. A grant from the Marion Soil and Water Conservation District was awarded to IAE to conduct herbicide treatments and to purchase and plant shrubs and trees in this area.

The 2-acre central swale of Champoeg Prairie that was seeded with sedges and rushes in 2017 (Figure 3, Appendix D) received broadcast herbicide treatment of Garlon 3A (triclopyr) in fall 2018 to control broadleaf weeds and prepare the area for a second seeding sedges and rushes in fall 2018.

4.2. Seeding

The forb diversity blocks (Figure 3) were established in 2014 with an initial seeding and planting, followed by an additional seeding in 2015 using belly seeders (Appendices A). Forb establishment following seeding and planting in 2014 and 2015 varies among the four forb diversity blocks. Species with established populations in the forb diversity blocks include perennials such as Oregon sunshine (*Eriophyllum lanatum*), common selfheal (*Prunella vulgaris*), common yarrow (*Achillea millefolium*), barestem biscuitroot (*Lomatium nudicaule*), checkermallow (*Sidalcea campestris* and *S. malviflora* ssp. *virgata*), slender cinquefoil (*Potentilla gracilis*), river lupine (*Lupinus rivularis*) and tall camas (*Camassia leichtlinii*), as well as annuals such as fare-well-to spring (*Clarkia amoena*), American bird's-foot trefoil (*Acmispon americanus*), denseflower willowherb (*Epilobium densiflorum*), showy tarweed (*Madia elegans*), and globe gilia (*Gilia capitata*). Establishment of some species continue to be varied across the forb diversity blocks. For example, American bird's-foot trefoil continues to grow densely in forb diversity block D but sparsely in the other three blocks despite similar seeding rates (Appendix B). Conversely, river lupine grew in large dense patches in forb diversity block A while only a few plants established in the other blocks (Neill 2017). The robustness of river lupine plants in forb diversity block A occurred in 2015 and 2016 but this species was reduced to a few plants in 2017. In 2018, river lupine appears to be having a resurgence but will not likely be fully expressed as flowering plants until 2019.

Many of the annual forbs that were broadcast seeded in fall 2017 following the prescribed burn flowered in 2018 (Appendix D). In particular, the tarweed species were observed flowering in all the seeded areas and included dense patches of showy tarweed. The perennial species that were seeded were also observed growing including Oregon sunshine, common selfheal, and meadow checkermallow. The fall mowing completed by OPRD will help disperse seed and reduce thatch that could otherwise inhibit growth of perennials being established from seed.

The weed treatments in 2017 and 2018 and the mowed portion of Champoeg Prairie provided an opportunity to increase diversity by broadcasting seed on exposed soil. In fall 2018 native seed mixes

were broadcast to increase diversity in the main forb, central sedge and rush, and eastern grassy areas (Figure 3). A diverse seed mix including annual and perennial forbs, grasses and sedges (Table 2) was broadcast with belly seeders to small patches of bare soil in the main forb area (Figure 3), sedges and rushes (Table 3) were broadcast on the central 2.5-acre sedge and rush area (Figure 3), and a pre-made grass mix (Table 4) was broadcast on a ~1.5 acre area at the east end of Champoeg Prairie that has received multiple weed treatments to control rattail fescue (Figure 3, Neill 2017).

Table 2. Native seed mix broadcast to open areas in Champoeg Prairie 2018.

Scientific Name	Common Name	Lbs/acre
<i>Achillea millefolium</i>	common yarrow	0.09
<i>Camassia leichtlinii</i> var. <i>suksdorfii</i>	tall camas	1.83
<i>Carex tumulicola</i>	splitawn sedge	0.00
<i>Collinsia grandiflora</i>	large-flowered blue-eyed Mary	0.45
<i>Collomia grandiflora</i>	large-flowered collomia	1.61
<i>Danthonia californica</i>	California oatgrass	2.89
<i>Eriophyllum lanatum</i>	woolly sunflower	0.11
<i>Festuca roemerii</i>	Roemer's fescue	1.05
<i>Gilia capitata</i>	bluehead gilia	0.19
<i>Perideridia gairdneri</i>	Gairdner's yampa	0.15
<i>Potentilla gracilis</i>	slender cinquefoil	0.14
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	common selfheal	0.49

Table 3. Native sedges and rushes broadcast to the central 2.5-acre sedge and rush area in fall 2018.

Scientific Name	Common Name	Lbs/acre
<i>Carex unilateralis</i>	one-sided sedge	0.26
<i>Carex densa</i>	dense sedge	0.07
<i>Juncus effusus</i>	soft rush	0.02
<i>Carex pachystachya</i>	chamisso sedge	0.14
<i>Carex scoparia</i>	pointed-broom sedge	0.15
<i>Carex stipata</i>	saw-beaked sedge	0.17
<i>Carex tumulicola</i>	splitawn sedge	0.81
<i>Carex feta</i>	green-sheath sedge	0.18
<i>Eleocharis ovata</i>	ovoid spikerush	0.13
<i>Juncus occidentalis</i>	poverty rush	0.01
<i>Juncus bufonius</i>	toad rush	0.02
<i>Scirpus microcarpus</i>	small fruited bulrush	0.11
<i>Schoenoplectus tabernaemontani</i>	softstem bulrush	0.44

Table 4. Native grass mix broadcast to the east end of Champoeg Prairie.

Scientific Name	Common Name	Lbs/acre
<i>Festuca roemerii</i>	Roemer's fescue	
<i>Hordeum brachyantherum</i>	meadow barley	
<i>Danthonia californica</i>	California oatgrass	17.18
<i>Elymus glaucus</i>	blue wildrye	
<i>Deschampsia cespitosa</i>	tufted hairgrass	

4.3. Cultural Harvest Area

On Saturday October 13th, IAE, OPRD and CTGR staff partnered to host a tribal cultural event at Champoeg Prairie. The event was part of the Plants for People Project, funded by OWEB, celebrating the establishment of a Cultural Harvest Area at Champoeg Prairie (Moore and Neill 2017). Volunteers, tribal members, and staff from IAE, OPRD, and CTGR planted ~1,300 tall camas (*Camassia leichtlinii*) bulbs and ~800 yampa (*Perideridia gairdneri*) roots in a location where local tribes will eventually be able to come together annually to collect first foods and share their traditions (Figure 10).



Figure 10. Volunteers watching IAE Restoration Ecologist Andy Neill demonstrate planting techniques for camas and yampa in the Cultural Harvest Area at Champoeg Prairie October 13, 2018.

In addition to planting, attendees from CTGR and passersby enjoyed cultural demonstrations that included a camas oven, basketry, handmade tools and prairie ecology. The oven would have been used to cook camas over the course of two days but instead it cooked carrots and potatoes for this event (Figure 11). The hole for the oven was dug the night before and lined with carefully selected rocks. On the morning of the event, a fire was started in the oven and kept burning until the rocks were red hot. The remaining wood and ashes were removed and cattails doused with water lined the oven. Instead of camas, carrots and potatoes were placed in the bed of wet cattails and covered with more cattails, handkerchiefs, soil and four cap stones that had been heated by the fire. The vegetables cooked for a few hours then dug up and



Figure 11. Serving potatoes and carrots from the camas oven on October 13, 2017. (Photo: Peter Moore)

revealed to curious onlookers. The potatoes and carrots were part of lunch and served with salmon that was cooked using traditional methods over an open fire. This event and the partnership between IAE, OPRD and CTGR were highlighted when members of each organization presented as a group to the Legislative Commission on Indian Services (LCIS), which is composed of tribal government leaders from Oregon tribes and Oregon senators and Representatives, later that fall.

Two weeks later on October 27, staff from IAE and CTGR coordinated 24 volunteers to plant the remaining bulbs and bareroot perennial forbs and rushes in the Champoeg Prairie harvest area (Figure 12; Table 5). These plants were purchased with funds from the OWEB grant and planted in the cultural harvest area at Champoeg Prairie.



Figure 12. Panoramic view of Champoeg Prairie with volunteers planting culturally important plants in the Champoeg harvest area on October 27, 2018.

Table 5. Bulbs and bareroot plants planted in the harvest area at Champoeg Prairie in October 2018.

Scientific Name	Common Name	Cultural	Propagule	Count
<i>Allium amplexans</i>	narrowleaf onion	Food	Bulb	400
<i>Calochortus tolmiei</i>	cats-ear lily	Food	Bulb	600
<i>Camassia leichtlinii</i>	tall camas	Food	Bulb	1,000
<i>Fragaria virginiana</i>	strawberry	Food	Bareroot	1,400
<i>Geranium oreganum</i>	Oregon geranium	n/a	Bareroot	200
<i>Iris tenax</i>	toughleaf iris	Fiber	Bareroot	700
<i>Juncus effusus</i>	common rush	Fiber	Bareroot	550
<i>Lomatium nudicaule</i>	barestem biscuitroot	Food	Bareroot	350
<i>Perideridia gairdneri</i>	Gardner's yampah	Food	Bareroot	500
<i>Triteleia hyacinthina</i>	hyacinth brodiaea	Food	Bulb	500
<i>Wyethia angustifolia</i>	mule's ears	n/a	Bareroot	300

5. RECOMMENDATIONS

The overarching goal of this project is to create native upland and wet prairie with a diverse mix of forbs and grasses that will attract pollinators and other wildlife that rely on these habitats. To achieve this goal

at Champoeg State Heritage Area, we recommend the following restoration activities in 2019 and beyond:

- Update the Champoeg Prairie Restoration Plan to include establishment of native shrubs and trees in the central sandy areas and the cultural harvest area.
- Develop a harvest plan for the Cultural Harvest Area.
- Implement periodic prescribed burns (ideally every three years) to reduce thatch and promote native, fire adapted plant species.
- Restrict use of herbicides in the current Cultural Harvest Area and control weeds by hand.
- Slowly expand the Cultural Harvest Area by reducing the use of herbicides.
- Continue spot spray herbicide treatments to control target weed species including mullein, tansy ragwort, Canada and bull thistles, velvet grass, tall oatgrass and rattail fescue outside of the Cultural Harvest Area.
- Augment wet and upland prairie communities with native forbs, sedges and rushes after prescribed burns and herbicide treatments.
- Aggressively treat velvetgrass throughout meadow to prevent continued spread.
- Consider alternatives to controlling non-native annual grasses in the western sandy area. Options might include:
 - Establish native perennial grasses in the western sandy area and treat area with pre-emergent herbicide, such as Milestone (aminopyralid) or Arsenal (imazapyr).
 - As an experimental approach to combating annual grasses that have dominated sandy soils at the site we propose planting natives from seed that quickly establish and can dominate an area. For example, species in the pea (Fabaceae) family, such as riverbank lupine (*Lupinus rivularis*) and American bird's-foot trefoil can temporarily dominate an area and limit resources available for and prevent seed production of non-natives. This has been observed in the forb diversity blocks already. If needed, these natives could be controlled by mowing prior to flowering or seed maturation and the area subsequently seeded with a diverse mix of natives. Although this might temporarily increase nitrogen availability and soil organic matter to create conditions that could favor non-native species, it is expected that these conditions will be short lived in the sandy soils of the Champoeg Prairie.
- Consider introduction of threatened and endangered species such as golden paintbrush (*Castilleja levisecta*), Kincaid's lupine (*Lupinus oregonus*), Willamette daisy (*Erigeron decumbens*), Bradshaw's lomatium (*Lomatium bradshawii*) and Nelson's checkermallow (*Sidalcea nelsoniana*) to aid in the recovery efforts of these species in Oregon.

6. REFERENCES

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APPENDICES

Appendix A. Summary of Champoeg Prairie restoration actions (2013-2018).

Date	Activity	Notes
Aug-2013	Site visit	Site assessment and prairie inventory.
Nov-2013	Weed treatment	Broadcast spray of rattail fescue with Gly-Star (glyphosate).
Feb-2014	Site visit	Site visit to assess weed abundance and determine project boundaries
Apr-2014	Weed treatment	Broadcast spray of rattail fescue, other non-native grasses and mullein with Gly-Star (glyphosate).
May-2014	Weed treatment and photopoints	Broadcast spray of strips to establish four forb diversity blocks in the prairie for planting, spot spray of reed canarygrass and thistles, collect photopoints, collect seed bank samples and assess results of previous treatments.
Nov-2014	Weed treatment	Flame weeding of rattail fescue.
Nov-2014	Planting and seeding	Planting and seeding prairie species in the four forb diversity blocks.
May-2015	Weed treatment	Broadcast spray of rattail fescue with diquat and spot spray of thistles and reed canarygrass with Gly-Star (glyphosate).
Jul-2015	Weed treatment	Spot Spray of thistle and mullein with Stinger (clopyralid).
Jul-2015	Weed treatment	Spot Spray of thistle and mullein with Stinger (clopyralid).
Dec-2015	Planting and seeding	Broadcast seeding of the forb diversity blocks with belly seeders and planted ~110 milk weed into forb diversity block D.
Mar-2016	Site visit	Site assessment with Ryan Sparks, Park Manager and Bob Woodruff to discuss weed treatments and project goals.
Apr-2016	Weed treatment	Contractor crew broadcast spray sandy areas at west end and NE corner with AquaMaster (glyphosate).
Apr-2016	Weed treatment	Spot spray thistles and mullein with AquaMaster (glyphosate) and Stinger (clopyralid) in forb diversity blocks D and western half of forb diversity blocks C and B.
May-2016	Weed treatment	Spot sprayed thistles, tansy ragwort, and velvet grass in forb diversity blocks.
Jul-2016	Weed treatment	Spot sprayed thistles and mullein in forb diversity blocks and prairie.
Aug-2016	Site visit	Site visit to assess haying of field that excluded the four forb diversity blocks, flowering forbs, and weed abundances in the prairie.

Date	Activity	Notes
Mar-2017	Site visit	Met Colby Drake, CTGR Silviculture and Fire Protection Manager, and John Mullen, Park Manager to discuss burn plan for fall 2017 prescribed burn. Also met with Dr. Paige Parry and her ecology class from George Fox to talk about prairie ecology and restoration at Champoeg.
Mar-2017	Weed treatment	Contractor broadcast spray of ~11 acres in west end, central sandy, and northeast corner of meadow with Rodeo (glyphosate). Spot spray of rattail fescue, mullein and Canada and bull thistles outside targeted broadcast spray areas with Rodeo (glyphosate) and Stinger (clopyralid).
Jul-2017	Weed treatment	Spot spray of thistles and mullein with mix of Garlon 3A (triclopyr) and Gly-Star (glyphosate) and thistles with stinger (clopyralid).
Jul-2017	Weed treatment	Spot spray of thistles, tansy ragwort, and Himalayan blackberry with Garlon 3A (triclopyr).
Sep-2017	Prescribed burn	Fire crew from Confederated Tribes of the Grand Ronde (CTGR) Natural Resources Department completed prescribed burn of the 45 acre prairie.
Oct-2017	Site visit	Met with staff from Marion Soil and Water Conservation District (MSWCD) to review grant proposal to plant central sandy area with shrubs and trees.
Oct-2017	Weed treatment	Contractor broadcast spray of west end of prairie with Rodeo (glyphosate), central sandy area with Arsenal (imazapyr), and northern edge with Crossbow (2,4-D + triclopyr) to prep areas for planting and seeding.
Oct-2017	Seeding	Broadcast native forb, sedge and rush seed across 14 acres in meadow with belly seeders (day 1).
Oct-2017	Seeding	Broadcast native forb, sedge and rush seed across 14 acres in meadow with belly seeders (day 2).
Dec-2017	Site visit	Site visit to assess burn, fall treatments, and seeding success.
Feb-2018	Site visit	Met with Nancy Nelson, OPRD Archaeologist, and John Mullen, Park Manager, to discuss State Historical Preservation Office report and future planting areas at Champoeg Prairie.
Mar-2018	Site visit	Met with Dr. Paige Parry's ecology class from George Fox University to talk about prairie ecology and restoration at Champoeg Prairie.
Mar-2018	Meeting	Meeting with Andrea Berkley, OPRD Natural Resource Specialist and John Mullen, Park Manager, to discuss restoration plans at Champoeg and other possible OPRD projects.

Date	Activity	Notes
Apr-2018	Meeting	Meeting with OPRD and CTGR to begin planning for October 13, 2018 cultural and planting event.
Apr-2018	Weed treatment	Broadcast spray of Garlon 3A (triclopyr) by contractor to ~8 acres at west end of prairie.
Apr-2018	Weed treatment	IAE staff directed contract crew to spot spray tansy ragwort, thistles and mullein across ~35 acres starting at the west end of Champoeg Prairie with Milestone (aminopyralid).
May-2018	Weed treatment	IAE staff spot sprayed tansy ragwort and thistles at east end of the prairie with Gly-Star (glyphosate).
May-2018	Weed treatment	IAE staff spot sprayed tansy ragwort and thistles at east end and central area of Champoeg Prairie with Gly-Star (glyphosate).
Jun-2018	Site visit	Site visit with IAE staff to discuss successes and challenges of prairie restoration in Champoeg Prairie.
Jun-2018	Meeting	Meeting with staff from IAE, OPRD and CTGR to discuss fall (October 13, 2018) cultural and planting event and soil sampling.
Jul-2018	Soil sampling	IAE staff collected soil samples from four pits and 6-8" deep. The four samples were mixed for a total of one quart in a Ziploc bag. The soil sample was submitted the same day to Pacific Agricultural Laboratory in Sherwood, OR. Cut tops of tansy ragwort, common mullein, St. Johnswort, and evening primrose and hauled off site.
Sep-2018	Weed treatment and Mowing	IAE staff coordinated a contractor to broadcast spray Plateau (imazapyr) to 11 acres at west end of prairie. OPRD staff were mowing from the east end of meadow with a tractor pulling a mower with a six-foot wide deck.
Oct-2018	Presentation	Staff from IAE, OPRD and CTGR Natural Resources Department presented work completed at Champoeg Prairie through partnership between the three organizations to the Legislative Commission on Indian Services (LCIS) at the state capitol building in Salem.
Oct-2018	Cultural event and planting	IAE staff hosted a cultural event with CTGR to kick-off planting in a part of the Champoeg Prairie that will eventually become a harvest area for culturally important plants. In addition to cultural events provided by CTGR, attendees planted camas and yampa provided by CTGR. Many people attended the event and about 40 volunteers assisted with planting during the event.
Oct-2018	Seeding	Broadcast native forbs and grasses to bare ground exposed by the OPRD mower and spot spray treatments to the eastern 15 acres of Champoeg Prairie.

Date	Activity	Notes
Oct-2018	Planting	Twenty-four volunteers assisted IAE and CTGR staff to plant ~6,000 bareroot plants and bulbs in the cultural harvest area at Champoeg Prairie.
Nov-2018	Weed treatment	IAE staff broadcast spray 2.8 acres of central sandy area with Rodeo (glyphosate) to prepare the area for shrub and tree planting in January 2019. IAE staff also did a broadcast spray to the ~2-acre central swale with Garlon 3A (triclopyr) to promote sedges and rushes that were seeded in fall 2017 and 2018.

Appendix B. Forb diversity block seed mix species and seeding rates (2014-2015).

Scientific Name	Common Name	Forb Diversity Block (acres) and Seeding Rates (Lbs/acre)							
		A (1.7)		B (1.4)		C (1.9)		D (1.6)	
		2014	2015	2014	2015	2014	2015	2014	2015
<i>Achillea millefolium</i>	common yarrow	0.15	n/a	0.14	n/a	0.10	n/a	0.11	n/a
<i>Carex unilateralis</i>	one-sided sedge	n/a	2.99	0.14	2.99	0.10	2.99	0.11	2.99
<i>Clarkia amoena</i> var. <i>lindleyi</i>	farewell-to-spring	0.19	0.36	0.41	0.36	0.30	0.36	0.33	0.36
<i>Clarkia purpurea</i> ssp. <i>quadrivulnera</i>	winecup clarkia	0.08	n/a	n/a	n/a	n/a	n/a	0.11	n/a
<i>Epilobium densiflorum</i>	denseflower willowherb	n/a	2.80	0.27	2.80	0.20	2.80	0.22	2.80
<i>Eriophyllum lanatum</i>	Oregon sunshine	0.31	4.19	0.54	4.19	0.40	4.19	0.44	4.19
<i>Gilia capitata</i>	globe gilia	n/a	0.48	n/a	0.48	n/a	0.48	n/a	0.48
<i>Grindelia integrifolia</i>	Puget Sound gumweed	n/a	n/a	0.68	n/a	0.50	n/a	0.55	n/a
<i>Juncus effusus</i>	soft rush	n/a	n/a	0.001	n/a	0.001	n/a	0.001	n/a
<i>Juncus tenuis</i>	poverty rush	n/a	0.06	0.01	0.06	0.01	0.06	0.01	0.06
<i>Lomatium nudicaule</i>	barestem biscuitroot	0.76	n/a	1.36	n/a	1.00	n/a	1.09	n/a
<i>Lomatium utriculatum</i>	spring gold	0.11	n/a	0.20	n/a	0.15	n/a	0.16	n/a
<i>Acmispon americanus</i>	American bird's-foot trefoil	0.23	n/a	0.41	n/a	0.30	n/a	0.33	n/a
<i>Lupinus latifolius</i>	broadleaf lupine	n/a	0.72	n/a	0.72	n/a	0.72	n/a	0.72
<i>Lupinus polyphyllus</i>	bigleaf lupine	n/a	n/a	2.04	n/a	1.50	n/a	1.64	n/a
<i>Lupinus rivularis</i>	river lupine	2.29	n/a	2.04	n/a	1.50	n/a	1.64	n/a
<i>Madia elegans</i>	showy tarweed	0.76	n/a	1.36	n/a	1.00	n/a	1.09	n/a
<i>Perideridia oregana</i>	Oregon yampah	n/a	n/a	0.27	n/a	0.20	n/a	0.22	n/a

Scientific Name	Common Name	Forb Diversity Block (acres) and Seeding Rates (Lbs/acre)							
		A (1.7)		B (1.4)		C (1.9)		D (1.6)	
		2014	2015	2014	2015	2014	2015	2014	2015
<i>Plectritis congesta</i>	rosy plectritis	n/a	0.24	n/a	0.24	n/a	0.24	n/a	0.24
<i>Potentilla gracilis</i>	slender cinquefoil	0.38	n/a	0.68	n/a	0.50	n/a	0.55	n/a
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	common selfheal	0.38	n/a	0.68	n/a	0.50	n/a	0.55	n/a
<i>Ranunculus occidentalis</i>	western buttercup	n/a	0.24	n/a	0.24	n/a	0.24	n/a	0.24
<i>Ranunculus orthorhynchus</i>	straight beaked buttercup	0.19	n/a	0.34	n/a	0.25	n/a	0.27	n/a
<i>Sidalcea virgata</i>	rose checkermallow	n/a	1.44	n/a	1.44	n/a	1.44	n/a	1.44
<i>Solidago lepida</i> var. <i>salebrosa</i>	western goldenrod	0.02	n/a	0.01	n/a	0.01	n/a	0.01	n/a

Appendix C. Forb diversity block planting (2014).

Scientific Name	Common Name	Propagule	Forb Diversity Block			
			A	B	C	D
<i>Brodiaea elegans</i>	elegant brodiaea	Bulbs	250	n/a	n/a	250
<i>Camassia leichtlinii</i>	large camas	Bulbs	n/a	3,766	3,766	3,468
<i>Camassia quamash</i>	small camas	Bulbs	n/a	2568	2568	2,365
<i>Dichelostemma congestum</i>	forktooth ookow	Bulbs	100	n/a	n/a	n/a
<i>Sidalcea campestris/</i> <i>virgata mixed</i>	meadow and rose checkermallow	Bareroot	6,000	2,896	2,896	2,707
<i>Triteleia hyacinthina</i>	white hyacinth	Bulbs	100	150	150	n/a
<i>Wyethia angustifolia</i>	narrowleaf mule's ears	Plugs	150	175	175	n/a

Appendix D. Native seed mixes and broadcast rates (October 2017)

Native forb, sedge, and rush species broadcast to ~ 15.3 acres

Scientific Name	Common Name	Lbs/acre
<i>Carex unilateralis</i>	one-sided sedge	0.22
<i>Clarkia amoena</i>	farewell to spring	0.10
<i>Clarkia purpurea</i> ssp. <i>quadrivulnera</i>	winecup clarkia	0.13
<i>Epilobium densiflorum</i>	denseflower willowherb	0.31
<i>Eriophyllum lanatum</i>	woolly sunflower	0.23
<i>Grindelia integrifolia</i>	Puget Sound gumweed	1.42
<i>Juncus occidentalis</i>	poverty rush	0.004
<i>Madia elegans</i>	showy tarweed	0.15
<i>Madia glomerata</i>	cluster tarweed	0.40
<i>Madia gracilis</i>	grassy tarweed	0.33
<i>Potentilla gracilis</i>	slender cinquefoil	0.25
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	common selfheal	0.67
<i>Rumex salicifolius</i>	willow dock	0.001
<i>Sidalcea campestris</i>	meadow checkermallow	0.38
<i>Solidago lepida</i> var. <i>salebrosa</i>	western goldenrod	0.03

Native sedges and rushes broadcast across 2 acres in the central swale.

Scientific Name	Common Name	Lbs/acre
<i>Carex densa</i>	dense sedge	0.19
<i>Carex pachystachya</i>	chamisso sedge	0.41
<i>Carex scoparia</i>	pointed-broom sedge	0.28
<i>Carex stipata</i>	saw-beaked sedge	0.69
<i>Carex unilateralis</i>	one-sided sedge	0.45
<i>Eleocharis palustris</i>	creeping spikerush	0.38
<i>Juncus bufonius</i>	toad rush	0.02
<i>Juncus effusus</i>	soft rush	0.02
<i>Juncus occidentalis</i>	poverty rush	0.02

Native grasses broadcast to a portion of the western sandy area (5.2 ac) and the northeastern corner of the prairie (0.7 ac).

Scientific Name	Common Name	Lbs/acre
<i>Achnatherum lemmonii</i>	Lemmon's needlegrass	2.53
<i>Bromus carinatus</i>	California brome	-
<i>Danthonia californica</i>	California oatgrass	1.86
<i>Elymus glaucus</i>	blue wildrye	8.39
<i>Festuca roemerii</i>	Roemer's fescue	5.74