Restoration plan for Jackson Meadow in the OSU McDonald-Dunn Research Forest

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Institute for Applied Ecology

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PREFACE

IAE is a non-profit organization whose mission is the 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: Jackson Meadow site as viewed from a drone, June 2022. Photo by Scott Harris.

SUGGESTED CITATION

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1. INTRODUCTION

Jackson Meadow is a 27-acre site located in the Oregon State University (OSU) McDonald-Dunn Research Forest just north of Corvallis, Oregon (Figure 1). The site can be characterized by two distinct topographical landforms: an upland area composed of a mixed forest, and a bench with remnant prairie habitat (both xeric and mesic) being encroached by woody vegetation. There are three riparian corridors that drain south through the site toward Jackson Creek. Most of the site is composed of a mixture of McAlpin, Dupee, Witzel, Ritner, and Philomath soil series (Appendix 1).

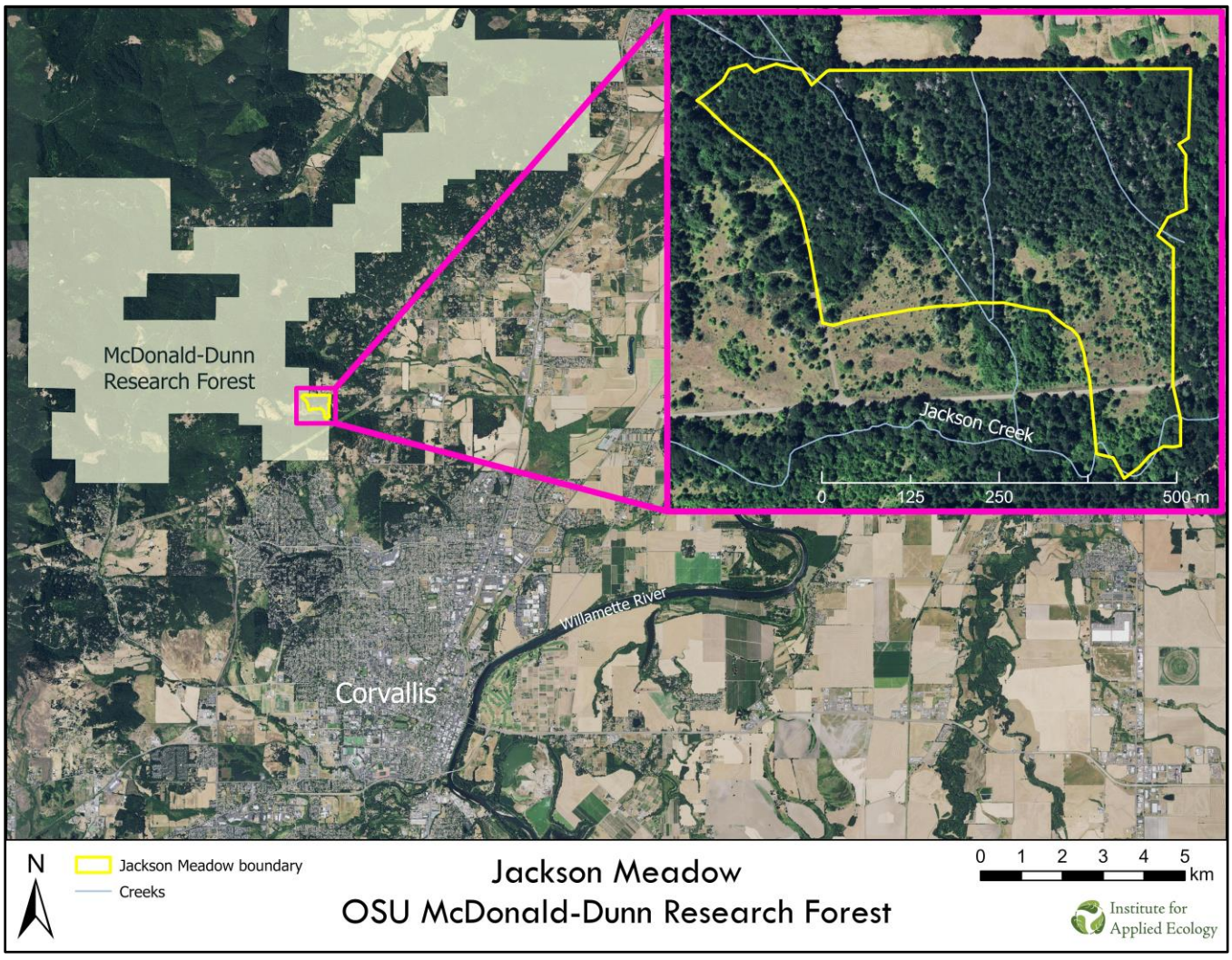

Figure 1. Location of Jackson Meadow in the Oregon State University McDonald-Dunn Research Forest north of Corvallis, Oregon.

Prior to European settlement, Jackson Meadow was likely a mix of oak woodland, savanna, and prairie habitat, typical of much of the Willamette Valley and surrounding foothills at the time. These ecosystems were maintained for thousands of years by the indigenous Kalapuya people. The Kalapuya deliberately used fire to reduce non-oak woody vegetation and maintain open habitat composed of native bunchgrasses and forbs, which provided food and other important resources (Boyd 1999). In the absence of frequent disturbance, these ecosystems naturally transition toward conifer-dominated forests. Following Euro-American settlement, fire suppression, land conversion, and the establishment of non-native species have contributed to the loss and modification of native oak-prairie habitat. Today, these landscapes are critically imperiled, with <10% of original habitat remaining (Noss et al. 1995).

In the mid-1800s, homesteaders began occupying the foothills surrounding Corvallis, including much of what is today the McDonald-Dunn Forest (Jackson 1980). These settlers modified the landscape by suppressing fires, harvesting timber, grazing livestock, and converting prairies for agricultural use. This particular site was home to the Jackson Place homestead, which was sold to OSU from the Jackson Estate in 1938 (Jackson 1980). The property has remnants of a historical fruit orchard (Tipton and Lebow 2009), still evident today by the abundance of large apple and pear trees present in the meadow to the immediate south of the project area.

OSU's McDonald-Dunn Forest Plan estimated that approximately 72% of the McDonald-Dunn Forest was covered by native oak-prairie vegetation in 1850. As of 2005, that amount was less than 3% (OSU College of Forestry 2005). In that plan, the authors identified the restoration potential of remnant oak-prairie habitat across the McDonald-Dunn Forest, with Jackson Place considered among the top priorities. In 2007, the Legacy Oaks and Prairie Tasks Forces inventoried the forest and determined that Jackson Place contained a "*Tier 1*" grove of Oregon white oaks (*Quercus garryana*) with many high-priority trees to be released from conifer competition, as well as several remnant prairie "hotspots" (Legacy Oaks and Prairie Task Forces 2008).

In general, the remnant prairies at Jackson Meadow host relatively low diversity but contain patches with reasonable native cover of resilient species, including California oatgrass (*Danthonia californica*), western buttercup (*Ranunculus occidentalis*), and wild strawberry (*Fragaria virginiana*; Salix Associates 2008). These meadows suffer from woody encroachment and are invaded by non-native species, including false brome (*Brachypodium sylvaticum*), common velvetgrass (*Holcus lanatus*), tall oatgrass (*Arrhenatherum elatius*), and common hawthorn (*Crataegus monogyna*). Prior to 2022, the adjacent forested upland included a canopy dominated by Douglas-fir (*Pseudotsuga menziesii*) and an understory dominated by false brome. These conditions, along with an easily accessible and public-facing location, make Jackson Meadow an excellent candidate for restoration, while offering opportunities for education and outreach (Legacy Oaks and Prairie Task Forces 2008).

In 2021, OSU's College of Forestry began partnering with the Institute for Applied Ecology (IAE) to develop and implement an oak-prairie restoration project for Jackson Meadow. The 67-year-old Douglas-fir stand in the upland was scheduled to be harvested in 2022 to release 419 Oregon white oak trees for wildlife and aesthetics and reduce fuel loads along the forest boundaries (OSU Research Forests 2022). This created an opportunity to conduct a full-scale restoration of the site, including the remnant meadows in the bench adjacent to the harvested upland. IAE developed a restoration proposal that also included a research component to monitor changes in site condition over the project's duration (using relevé plots, described in Section 3) and contribute to a regional network restoration experiment ("RestoreNet," described in Section 5.2).

2. PURPOSE AND OBJECTIVES

In the Willamette Valley, oak-prairie habitats are critically important. Oregon white oaks provide many ecosystem services such as cavity nesting sites for birds and small mammals, structural support for epiphytic plants, and critical food sources for many wildlife species. Remnant prairies are biological hotspots that enhance diversity across larger ecological landscapes, provide important edge and open-space habitat for wildlife, and contain abundant native plant species that serve as important cultural resources. Due to their importance for many strategy species (many of which are threatened and endangered), oak woodlands and prairies are listed as habitats of conservation concern by the Oregon Department of Fish and Wildlife (Oregon Conservation Strategy 2016).

Part of the mission of the OSU Research Forest is to actively restore, manage, and maintain remnant habitats across its landscapes, which includes the oak savannas, woodlands, and prairies scattered across the McDonald-Dunn Research Forest. The McDonald-Dunn Forest Plan outlines the conservation and restoration strategy for these areas, including projects that improve and restore the broader ecological and cultural functions of oak-prairie habitats at specific sites, like Jackson Meadow (OSU College of Forestry 2006). These projects require the development of detailed, site-specific restoration plans.

The purpose of this restoration plan is to provide a framework for restoring oak-prairie habitat at Jackson Meadow. This project has the following objectives:

1. Release stand-grown oaks from competition with Douglas-fir and transition the upland area from a closed-canopy forest to oak savanna-woodland.
2. Decrease woody encroachment in the remnant prairie meadows.
3. Reduce the abundance of non-native species.
4. Increase the abundance and diversity of native species.
5. Monitor site changes over time and adapt practices based on data and observations.

In summer 2022, OSU completed the oak-release timber harvest at Jackson Meadow. A post-harvest cleanup process began in early 2023 and will be followed by several years of chemical fallow treatments before introducing native plant materials (described in Section 5).

3. PRE-HARVEST BASELINE CONDITIONS

3.1. Plant community

To better understand baseline site conditions and monitor site changes throughout the project, IAE established four permanent relevé plots in June 2022 (relevé plots are a monitoring technique used to assess vegetation diversity and abundance). These plots are stratified by soil type and topographical landform, with two plots in the bench and two in the upland (Figure 2). We used GIS aerial imagery to select plot locations that were representative of distinct topo-edaphic conditions. The northwest corner of each relevé plot is monumented, with 20-m edges running east-south-west-north (true), creating a 20-m x 20-m square plot.

We took four photo points at each plot monument, one in each true cardinal direction (Appendix 2). Within each relevé plot, IAE inventoried all species present and recorded cover values using Braun-Blanquet cover classes (Braun-Blanquet 1932). Cover classes include “rare” (a single occurrence), “trace” (< 1% cover, mean = 0.1%), “1” (1-5%, mean = 2.5%), “2” (5-25%, mean = 15.0%), “3” (25-50%,

mean = 37.5%), "4" (50-75%, mean = 62.5%), and "5" (75-100%, mean = 87.5%). IAE will annually repeat photo points and estimate cover in these plots.

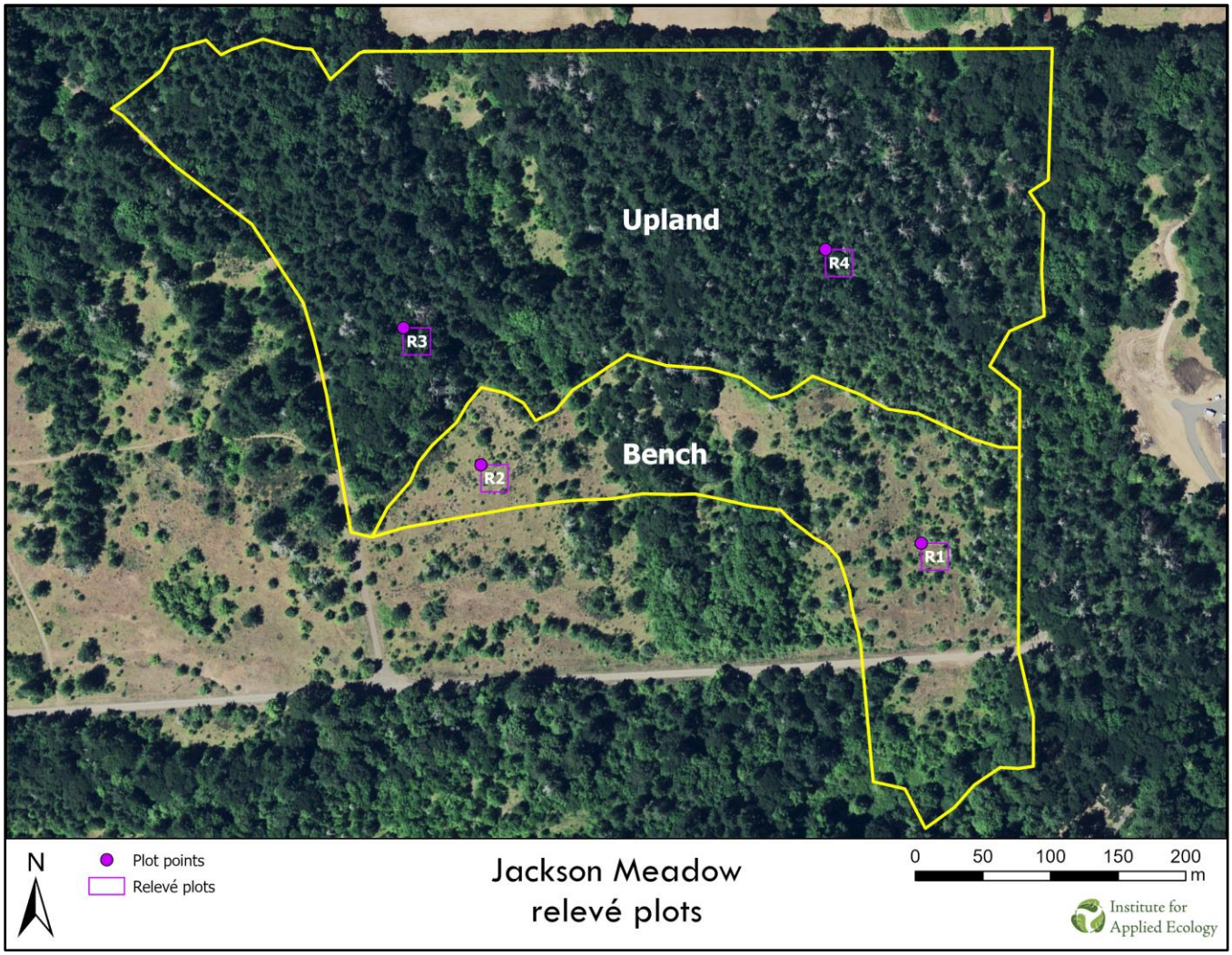

Figure 2. Location of the four relevé plots at Jackson Meadow, with two in the bench meadows (R1, R2) and two in the forested upland (R3, R4). Plots are 20-m x 20-m. Four photo points are taken at each northwest corner plot monument, facing each of the four cardinal directions.

During pre-harvest baseline monitoring in June 2022, we identified 81 unique plant species across all four relevé plots. The two bench plots had greater non-native than native richness, whereas the two upland plots had greater native than non-native richness (Table 1). On average, the two bench plots had greater total plant species richness than the upland plots.

Table 1. Species richness in the four relevé plots at Jackson Meadow, June 2022.

Relevé plot	Native grasses	Non-native grasses	Native forbs	Non-native forbs	Native ferns	Native woodies	Non-native woodies	Total native	Total non-native	Overall richness
R1 (bench)	3	8	9	17	0	10	3	22	28	50
R2 (bench)	1	8	10	11	0	6	2	17	21	38
R3 (upland)	2	1	5	1	2	10	3	19	5	24
R4 (upland)	2	4	8	4	2	15	4	27	12	39

By absolute cover, the most abundant species were false brome (62.5%), common pear (*Pyrus sp.;* 37.5%), and Queen Anne's lace (*Daucus carota*; 37.5%) in plot R1; false brome (87.5%) and common velvetgrass (37.5%) in plot R2; false brome (87.5%) and bigleaf maple (*Acer macrophyllum*; 62.5%) in plot R3; and false brome (62.5%), Douglas-fir (37.5%), and Pacific blackberry (*Rubus ursinus;* 37.5%) in plot R4. Appendix 3 provides species lists for each plot ranked by cover.

When relativized across vegetation cover types, the two bench (meadow) relevé plots had <25% relative cover by natives and >50% relative cover by non-native grasses and forbs, while the two upland (forested) relevé plots were each >50% relative cover by native woody species, but also had strong non-native grass components (>25% relative cover; Figure 3). Note that Douglas-fir was the second most and most abundant native woody species in plots R3 and R4, respectively, in 2022 (Appendix 3), but this species was the primary target of the oak-release timber harvest. Thus, the relative cover of native woody vegetation will inherently decline in these two plots during subsequent monitoring. Figure 4 provides representative example photos for the bench (meadow) and upland (forested) areas.

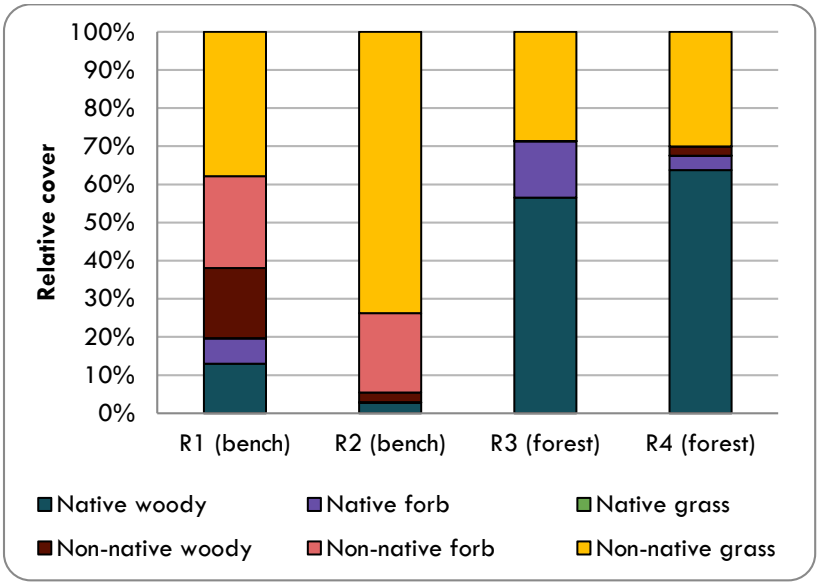

Figure 3. Relative abundance of vegetation cover types, based on summed Braun-Blanquet cover class means in relevé plots at Jackson Meadow, June 2022.

Figure 4. (Left) Meadow area in the bench dominated by non-native grasses, such as common velvetgrass (*Holcus lanatus*) and false brome (*Brachypodium sylvaticum*), experiencing woody encroachment from common hawthorn (*Crataegus monogyna*). (Right) Forested area in the upland with a unique growth-form bigleaf maple (*Acer macrophyllum*) being crowded by Douglas-fir (*Pseudotsuga menziesii*). The understory is dense with false brome. Photos taken in July 2022.

3.2. Bird community

Prior to timber harvest, we also surveyed the breeding bird community. Breeding bird surveys used standard fixed radius (50-m) bird point count protocols (Ralph et al. 1995). Surveys were conducted by an observer experienced in identifying regional birds by sight and sound. We conducted one bird count the bench (at the R1 relevé plot location) and one in the forest (at R3) on June 15, 2023. Surveys were conducted within the first 4.5 hours following sunrise. Incidental observations on this day were also recorded between 8 and 10 am.

We observed 26 bird species shown in Table 2.

Table 2. Bird species observed at Jackson Meadow on June 15, 2022, prior to harvest.

Common name	Species name	Bench (R1)	Forest (R3)	Incidental
American robin	*Turdus migratorius*	X	X	
Anna's hummingbird	*Calypte anna*	X		
Bewick's wren	*Thryomanes bewickii*	X	X	
black-capped chickadee	*Poecile atricapillus*		X	
black-headed grosbeak	*Pheucticus melanocephalus*	X	X	
black-throated gray warbler	*Setophaga nigrescens*	X	X	
dark-eyed junco	*Junco hyemalis*	X	X	
evening grosbeak	*Coccothraustes vespertinus*	X		
mourning dove	*Zenaida macroura*	X		
northern flicker	*Colaptes auratus*	X		
orange-crowned warbler	*Vermivora celata*	X		
red-breasted nuthatch	*Sitta canadensis*	X		
spotted towhee	*Pipilo maculatu*	X	X	
turkey vulture	*Cathartes aura*	X		
western wood-pewee	*Contopus sordidulus*		X	
Wilson's Warbler	*Cardellina pusilla*	X		
American Goldfinch	*Spinus tristis*			X
California Scrub-Jay	*Aphelocoma californica*			X
chestnut-backed chickadee	*Poecile rufescens*			X
Pacific Wren	*Troglodytes pacificus*			X
Pacific-slope Flycatcher	*Empidonax difficilis*			X
Pileated Woodpecker	*Dryocopus pileatus*			X
Purple Finch	*Haemorhous purpureus*			X
Red-tailed Hawk	*Buteo jamaicensis*			X
Rufous Hummingbird	*Selasphorus rufus*			X
Steller's Jay	*Cyanocitta stelleri*			X

4. POST-HARVEST ASSESSMENT

OSU completed logging operations at the site between September – October 2022 and removed thousands of trees (mostly conifers) while retaining more than 1,000 others (Figure 5), including oaks and other hardwoods, wildlife snags, riparian trees, and large diameter Douglas-fir. IAE visited the site post-harvest to assess on-the-ground conditions, map habitat types, and determine appropriate management

units for restoration. Many mature overtopped oaks were released from conifer competition, as were other native hardwoods such as bigleaf maple and Pacific madrone (*Arbutus menziesii*; Figure 6). Logging operations caused considerable ground disturbance in some areas and resulted in a substantial amount of stumps and woody debris across the site (Figure 7). Some of this debris was gathered into approximately 78 burn piles (Figure 5), most of which have been burned as of February 2023. In April 2023, IAE observed a handful of retained trees across the site that appear to have fallen on their own over the course of the winter, likely due to windstorms and the loss of other protective trees.

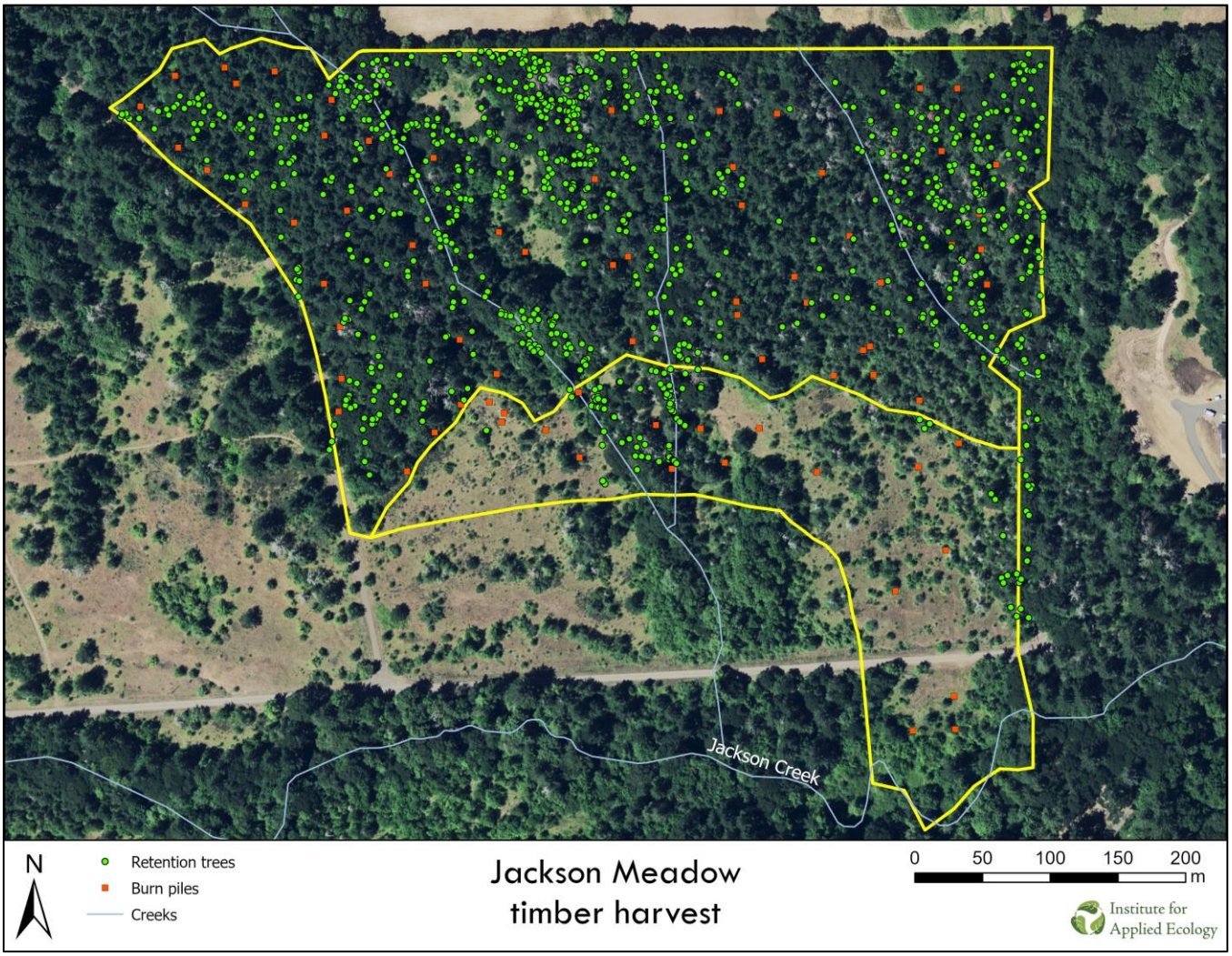

Figure 5. Map showing the trees marked for retention before harvest as well as the location of burn piles following harvest. Most of the marked trees were retained during harvest. Retained trees varied in size and species, from approximately 5" diameter Oregon white oaks (*Quercus garryana*) to >60" diameter Douglas-fir (*Pseudotsuga menziesii*). Most burn piles were approximately 10-m in diameter.

Figure 6. A relatively dense stand in the southwest corner of the site with mature Oregon white oaks (*Quercus garryana*; foreground) and Pacific madrone (*Arbutus menziesii*; background center) after being released from conifer competition. Photo taken in February 2023.

Figure 7. Tree stumps and woody debris litter the site following timber harvest operations. Photo taken in February 2023.

4.1. Habitat types and management units

The timber harvest considerably altered Jackson Meadow. While the upland area was almost entirely forested pre-harvest, it now consists of a mosaic of heterogenous tree densities and open spaces. Although ultimate habitat conditions will not be realized until restoration activities are complete, some areas within the upland could now be characterized as oak woodlands based on their tree densities, other areas could be considered oak savannas, and others still, where nearly all trees were removed, appear to be on a trajectory of becoming open prairie habitat (Figure 8). Many trees were retained along the three primary riparian stream corridors. Meanwhile, meadow habitat in the bench became more representative of open prairie habitat as timber harvest reduced the abundance of encroaching woody vegetation.

Following riparian corridors, the upland/bench delineation, and roads along the perimeters, the site can be divided into seven management units (Figure 8). The upland region is composed of units A (6 acres), B (5 acres), C (6 acres), and D (3 acres), while the bench is composed of units E (2 acres), F (4 acres), and G (1.5 acres). Separating the upland and bench areas is a dirt spur (road) created for logging operations, which OSU plans to retain long term.

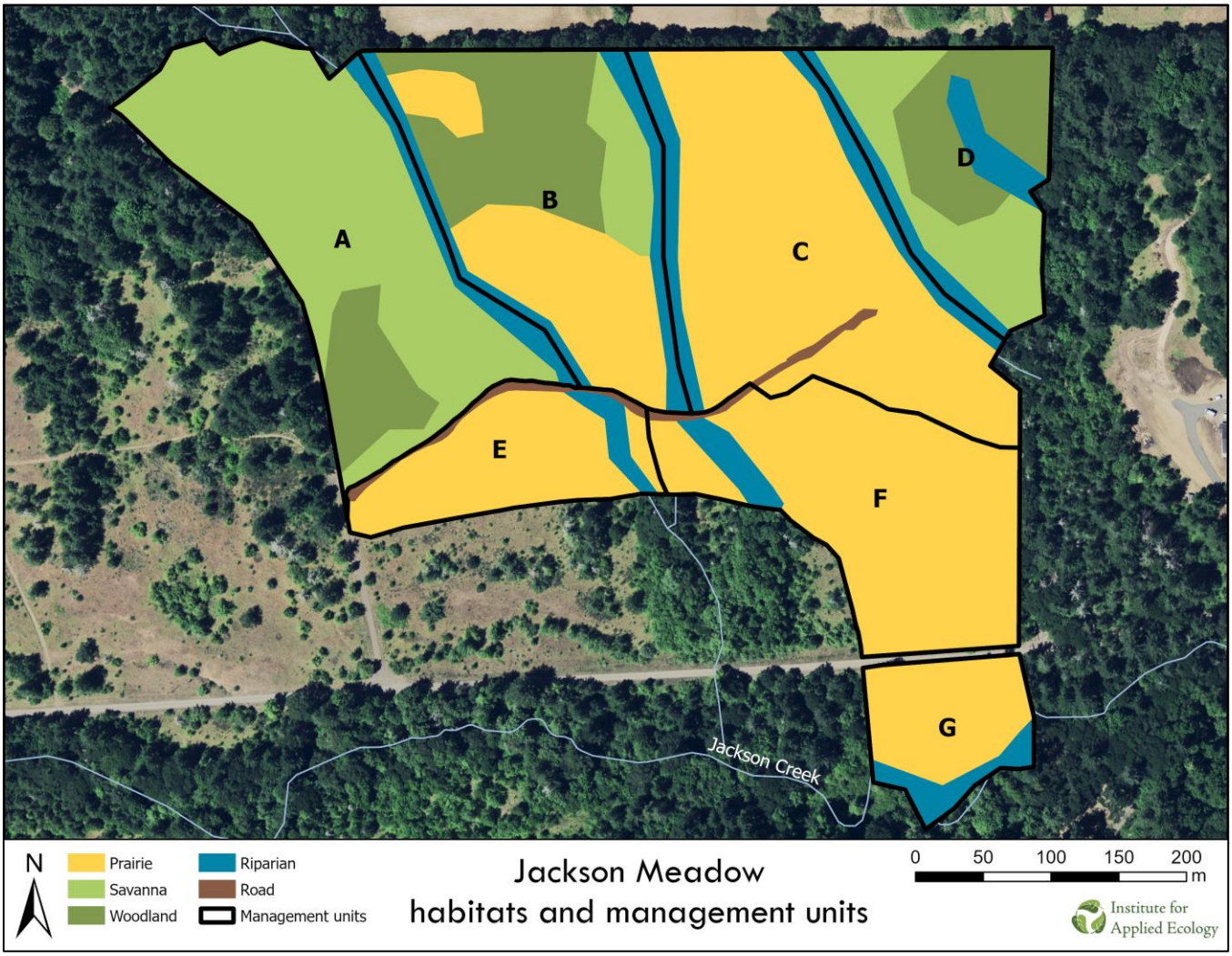

Figure 8. Map of post-harvest habitat types and proposed management units. Boundaries are approximate and do not exactly match true conditions on the ground. Letters indicate management units.

Unit A is the northwest corner of the site. This unit has some of the largest Oregon white oak and madrone trees in the entire site (Figure 9A). The unit is topographically complex: the southern woodland sits atop a hill and the entire unit drops off relatively steeply toward the riparian corridor to its east. The central and northern portions of this unit have relatively open savanna-like canopies. This unit has mostly Witzel and Ritner soils along with lesser extents of Philomath, Dupee, and Dixonville (Appendix 1). The Witzel and Philomath soils are shallow and well drained (suitable for xeric species), the Ritner and Dixonville soils are moderately deep and well drained (suitable for wider range of species), and the Dupee soil is deep to very deep and poorly to moderately drained (suitable for mesic species).

Unit B sits between two riparian corridors in the north-central portion of the site (Figure 9B). Toward the northern end of unit B is a young oak woodland characterized by small diameter, dense trees. The northwest corner of unit B has a small remnant prairie patch that predated timber harvest. The southern half of the unit had most of its trees cleared, providing open canopy conditions for future prairie habitat. The young oak woodland and remnant prairie patch are mostly Witzel and Philomath soils (shallow and

well drained), while the riparian edges and cleared southern half of the unit are mostly Dupee and McAlpin soils (very deep and moderately drained; Appendix 1).

Unit C sits between two riparian corridors, to the east of unit B. Most of the trees in this unit were harvested. Those that remain in the center of the unit are extremely small in diameter, providing ample open canopy conditions for future prairie habitat (Figure 9C). Most of this unit has McAlpin soil, and a small extent has Dupee soil (deep and moderately drained; Appendix 1).

Unit D is the northeast corner of the site. This unit is characterized by a relatively dense woodland with a small stream seeping from the ground (Figure 9D). The seep has an abundance of teasel (*Dipsacus fullonum*) and Italian arum (*Arum italicum*). The southeastern corner of this unit has perhaps the highest concentration of blackberry (both *Rubus armeniacus* and *R. ursinus*) in the site. The entirety of this unit is McAlpin soil (very deep and moderately drained; Appendix 1).

Unit E is the southwest corner of the site and is the first in the remnant meadow bench area (Figure 9E). The meadow extends south of this unit outside the project boundary where it becomes part of the historical Jackson Place orchard. The meadow is largely upland prairie habitat and suffers from hawthorn and conifer encroachment and has an abundance of false brome and common velvetgrass. The riparian stream separating upland units A and B flows south through the eastern edge of unit E. This unit has approximately half Philomath soil (shallow and well drained) and half McAlpin soil (very deep and moderately drained; Appendix 1).

Unit F is the southeast corner of the site (north of Road 612) and is the larger of the two remnant meadows in the bench area. Many small trees and shrubs were removed during harvest, increasing open space (Figure 9F). Wet prairie habitat prevails toward the southern and western edges of the unit whereas the prairie becomes increasingly upland toward the northeast. Patches of native species such as California oatgrass and self-heal (*Prunella vulgaris*) can be found along the southern edge. The unit has a mix of McAlpin and Dupee soils (deep and moderately drained; Appendix 1).

Unit G is a small area to the south of Road 612 and immediately adjacent to Jackson Creek. The center of the unit has a remnant wet meadow with trees having been cleared along the perimeter during harvest. There is a substantial amount of blackberry and shrubby vegetation throughout the unit. The unit has a mix of McAlpin and Dupee soils (deep and moderately drained; Appendix 1).

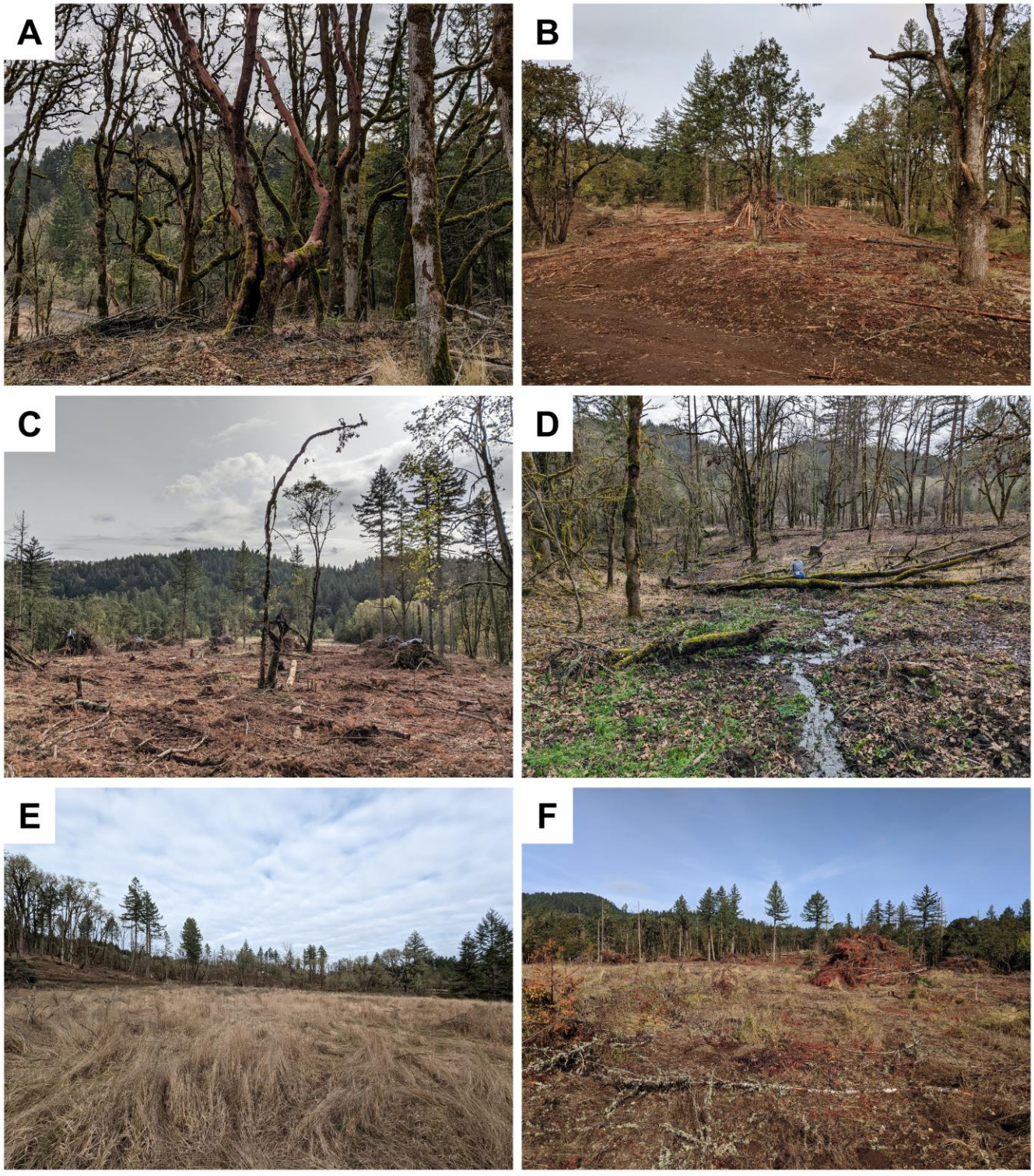

Figure 9. Example photos for six of the seven management units. (A) a large madrone (*Arbutus menziesii*) amid an Oregon white oak (*Quercus garryana*) stand in unit A; (B) looking north up unit B from the dirt spur; (C) a thin Oregon white oak that was retained amid widespread tree harvest in unit C; (D) a seep emerging from the ground in unit D; (E) looking northeast across the meadow in unit E; (F) looking north across the meadow in unit F. Unit G not shown. Photos taken in February 2023.

5. RESTORATION STRATEGY

The goal of restoration at Jackson Meadow is to create a mosaic of native prairie, oak savanna, woodland, and riparian habitat across the site. The first step toward achieving this goal was the large-scale Douglas-fir harvest conducted by OSU in 2022. The remaining phases of work are described in full detail in section 5.1. Concurrently with the proposed restoration activities, IAE will also implement an experiment that will be part of a larger regional network called "RestoreNet" (described in section 5.2). In this experiment, IAE will test whether different management practices (soil disking and manipulating the length of chemical fallow treatments) alter the trajectory of the plant community during the restoration process.

It is important to recognize that restoration is a dynamic process with each site responding to actions differently depending on factors such as soils, topography, and past land use. Thus, a key element of the Jackson Meadow restoration strategy will be the use of adaptive management practices. Management units, treatment timing, and techniques may deviate from the original plan based on annual monitoring data and observations. All management decisions will receive final approval by OSU.

5.1. Proposed activities

5.1.1. Reduce woody encroachment in the meadows

Much of the woody vegetation in bench management units E and F were removed or destroyed during timber harvest operations. After harvest, IAE began removing the remaining hawthorn, rose (*Rosa sp.*), and other woody species from these units using chainsaws and hand mowers. The meadow immediately south of management unit E (in the Jackson Place orchard) has a particularly high abundance of hawthorn which could act as a source for future encroachment within the project area. In December 2022, IAE and an AmeriCorps crew began targeting this meadow for woody removal, reducing the hawthorn seed source and thus its potential for future expansion into the project area. We hauled cut material to within the project boundary, where it can be masticated as described in section 5.1.3. IAE also limbed Douglas-fir along the perimeter of unit E to increase openness and establish connectivity between previously isolated portions of the meadow (Figure 10).

Figure 10. The southeastern corner of management unit E before (left) and after (right) cutting common hawthorn (*Crataegus monogyna*) and limbing Douglas-fir (*Pseudotsuga menziesii*) to establish a corridor between meadow patches. Photos taken in February 2023.

5.1.2. Burn debris piles

Following timber harvest, there were approximately 78 slash piles of substantial size (at least 10-m in diameter) across the site. These piles can act as a source of weeds, as plants growing under the cover of woody material may be less exposed to herbicide treatments. Therefore, burning these piles in a timely manner will be critical before progressing to further restoration activities. As of February 2023, OSU had burned half of the piles. Progress has been challenged by wet winter conditions and the requirement for easterly winds to gain burn authorization. The remaining piles will be burned during the fall 2023 burn season. Where piles were burned, remaining charcoal (Figure 11) may alter soil conditions. IAE recorded the locations of all burn piles to examine whether future plant communities and weed outbreaks differ in these spots because of burning.

Figure 11. Example of a residual burn pile with charcoal logs in management unit A. Photo taken in February 2023.

5.1.3. Mastication and mowing

As previously stated, downed woody debris litters the site following timber harvest operations (Figure 7). Even with the larger debris being gathered into burn piles, there is still a lot of material on the ground which is not conducive for typical prairie restoration practices. This is a larger problem in the upland area but will still be a challenge in the bench meadow units because of all the small trees and shrubs that were

destroyed when equipment drove through. Additionally, the meadows contain abundant grass thatch from previous growing seasons that could impede herbicide applications. Before any widespread chemical treatments occur, it is imperative for a mastication machine to mulch the entire project area. This will help expose bare soil, flush out weeds, and make the ground easier to navigate during herbicide application, mowing, and seeding. OSU will hire a subcontractor to complete mastication once the site dries enough (targeting spring 2023).

Mastication will likely result in a lot of mulch and wood chips across the site. This smaller material should break down faster than larger logs and limbs, but it may not decompose completely by the time we seed with native species. If this is the case, dense patches of wood chips may prohibit native seed germination. Mixing the wood chips directly into the soil during or after mastication (e.g., with a rotovator) would be ideal, as this would increase the contact between the wood chips and microorganisms in the soil that are responsible for breaking down that material. Advanced Land Management is one option for a local contractor with the ability to masticate and rotovate. Alternatively, if there are just a few dense patches of wood chips, it could be worth trying to spread the material thin using a rake or other tools if feasible. Commercially available products such as Earthfort's Soil ProVide® Inoculum could also be applied to such patches to speed up the decomposition process.

Following mastication, IAE will have a better sense of areas that could use targeted mowing treatments, such as where blackberry patches are most dense. A combination of mowing and herbicide treatments are an effective way to reduce blackberry cover. Mowing with brush cutters in the steep riparian ravines may be critical if herbicide cannot be sprayed where there is standing or flowing water.

5.1.4. Chemical fallow

Typical restoration of degraded prairie-oak habitat includes several years of continuous herbicide applications to kill all ground vegetation and create bare soil conditions in which to plant (known as a chemical fallow treatment). Maintaining fallow for several years is the best opportunity to reduce the weed seed bank at the site. Chemical prescriptions depend upon the primary weeds and vegetation present. At Jackson Meadow, false brome is by far the most abundant herbaceous species. Other problematic and widespread weeds include tall oatgrass, blackberry, and oxeye daisy (*Leucanthemum vulgare*), so a non-selective herbicide such as glyphosate, in combination with a pre-emergent, will likely be the most appropriate for broadcast application.

Beginning in spring 2023, contractors will spray the entire site two to three times per year (typically in spring, summer, and during fall green up) for three years. An ATV-mounted boom sprayer may be navigable in units C, E, and F (during drier periods), but a backpack spray crew will likely be necessary in other management units and around riparian corridors because of the topography and density of trees. If possible, the crew should also target Jackson Place orchard to the immediate south and west of units E and F, respectively, where a dense understory of false brome poses a major threat of invading the project area. A long-term pre-emergent such as imazapic should be used during the first treatment, while a shorter term pre-emergent such as metsulfuron-methyl is recommended during spring treatments in subsequent years.

Ideally, the first herbicide treatment would occur approximately one month after mastication to allow weeds to flush after removing woody debris and thatch. However, if mastication cannot occur before mid-May 2023, the first herbicide treatment should occur no later late-May 2023, to ensure that the current growth of false brome and other weeds do not produce another year of seed.

5.1.5. Revegetation

SEED

Once the site has been fallow for three years, IAE will sow a mixture of native grass and forb seed purchased from local native seed producers. Given the variety of habitats across the site (Figure 8), there will be at least three seed mixes developed: an upland prairie mix, a woodland/savanna mix, and a wet prairie/riparian mix. Species selection will be tailored to specific site conditions and there will likely be substantial overlap in composition across the mixes. Good starting points for species compositions include the diverse prairie, woodland, and wet prairie premade mixes by Heritage Seedlings & Liners, Inc., a reputable native seed producer in the Willamette Valley. A general target seeding rate in fallow conditions is 10-15 lbs/acre, which will typically put enough seed on the ground to allow the native plant community to be competitive with weeds long term. October is typically the best month to seed native prairie species, as this allows early species the chance to germinate with the return of fall rains and provides enough time for later species to receive necessary cold stratification through the winter months. Having a second year of seeding is also beneficial to help fill in gaps that may have been missed or seeded lightly during the first year. Typically, seeding rates can be cut in half for the second year. Where appropriate, drill seeding is preferable to broadcast seeding as it improves seed-to-soil contact and results in less seed exposure to predation or being washed away. Units C and F may be possible for drill seeding given the relatively flat ground and lack of major tree stumps. Unit E also meets these criteria but may be too small to be worth navigating with a drill. In all other units and along riparian corridors, edges, and around trees, shrubs, and stumps, IAE will broadcast seed using belly bags.

Strategic seeding could help control the outbreak of weeds entering the site. For example, the woodland to the west of Road 610 (west of the project boundary) has an extremely dense understory of false brome. Seed is likely to spread across the road and invade the project area. However, planting a dense stand of native bunchgrass such as Roemer's fescue (*Festuca roemeri*) along the western edge of the site could provide a barrier that outcompetes false brome seed spilling over from the adjacent stand. Depending on conditions, it may be beneficial to seed these barriers before the three years of chemical fallow are complete, in which case the barriers would then be excluded from future broad-spectrum fallow applications. Conveniently, however, Roemer's fescue is resistant to grass-specific herbicides such as fluazifop-P-butyl, meaning any false brome infestations in these barriers could still be treated using grass-specific herbicide applications.

As part of a research forest, this site could also provide an opportunity to experiment with future climate-adapted seed sources. The Willamette Valley Native Plant Partnership has convened a climate change committee working group to develop a protocol for when, where, and how to use plant materials from outside the Willamette Valley to increase the resiliency of restoration projects in the face of rising temperatures and shifting precipitation patterns in our region. There are many challenges and risks associated with such practices, but the risk of inaction could be even greater if it means widespread localized species extinctions. If a protocol is developed and vetted before seeding at Jackson Meadow is complete, it may be worth incorporating some native seed sourced from further south (e.g., the Umpqua and Rogue River valleys) to the seed mixes sown at this site.

PLUGS, BULBS, AND BAREROOTS

To complement seeding, planting plugs, bulbs, and bareroots is a useful way to increase diversity across the site, particularly after the first year of seeding when one can assess which species, functional groups, or phenology may be lacking from the community. Some native perennials have a tough time establishing

from seed because they can take several years to grow large enough to compete with fast-growing weeds. When this is the case, putting a more robust stage of that plant in the ground may improve establishment.

We recommend assessing conditions after the first year of seeding to determine which native perennial species should be supplemented with these types of plant materials. SevenOaks Native Nursery grows dozens of herbaceous perennial species for transplanting that could do well at Jackson Meadow but might otherwise establish poorly from seed or for whom seed availability is limited, including broad-leaved shooting star (*Dodecatheon hendersonii*), Columbia lily (*Lilium columbianum*), harvest brodiaea (*Brodiaea elegans*), narrow-leaved mule's ears (*Wyethia angustifolia*), Puget balsamroot (*Balsamorhiza deltoidea*), Tolmie's mariposa lily (*Calochortus tolmiei*), or white hyacinth (*Triteleia hyacinthina*). Dense population patches should be planted for each species, rather than spreading individuals out across the site, to ensure that successful pollination and reproduction can occur.

SHRUBS

Lastly, the oak woodland and riparian areas should be supplemented with native shrubs to add an additional dimension to those habitats aside from just herbaceous species and trees. Shrubs can provide a place for wildlife to hide, make nests, and forage for foods such as berries and seeds. When deciding where to enhance a native shrub layer, care should be taken to minimize the risk of shrubs encroaching upon open prairie habitat. For this reason, planting small patches along the riparian corridors in the upland area is preferred. Like with plugs, bulbs, and bare roots, it would be best to plant shrubs after the first year of seeding to avoid hindering seeding efforts.

Prior to restoration treatments in June 2022, the two upland relevé plots contained the native shrubs beaked hazelnut (*Corylus cornuta*), common snowberry (*Symphoricarpus albus*), orange honeysuckle (*Lonicera ciliosa*), osoberry (*Oemleria cerasiformis*), Pacific blackberry (*Rubus ursinus*), poison oak (*Toxicodendron diversilobum*), and western serviceberry (*Amelanchier alnifolia*; Appendix 3). Some of these species such as common snowberry, osoberry, and western serviceberry, as well as others such as narrow-leaved buckbrush (*Ceanothus cuneatus*), oceanspray (*Holodiscus discolor*), Pacific ninebark (*Physocarpus capitatus*), red elderberry (*Sambucus racemosa*), and salmonberry (*Rubus spectabilis*), would serve well in accomplishing goals for a shrub component at this site. All these species are available for purchase from SevenOaks Native Nursery.

THREATENED AND ENDANGERED SPECIES INTRODUCTIONS

If habitat conditions are conducive to threatened and endangered Willamette Valley species, OSU should consider introducing plant species such as Kincaid's lupine (*Lupinus oreganus*), Willamette daisy (*Erigeron decumbens*), Bradshaw's lomatium (*Lomatium bradshawii*), Nelson's checkermallow (*Sidalcea nelsoniana*), or golden paintbrush (*Castilleja levisecta*). In partnership with the U.S. Fish and Wildlife Service, IAE has been growing or contracting seed amplification fields for all five of these species over the past several years. If appropriate, seed of these species could be provided for introduction at Jackson Meadow at no cost to OSU.

Finally, if Kincaid's lupine and/or golden paintbrush are introduced to the site and successfully establish, OSU should consider working with the U.S. Fish and Wildlife Service to introduce the federally threatened Fender's blue butterfly (*Icaricia icarioides fenderi*) and/or the endangered Taylor's checkerspot butterfly (*Euphydryas editha taylori*). The Fender's blue butterfly relies upon the Kincaid's lupine as its host plant while the Taylor's checkerspot butterfly historically relied upon native paintbrush

species as its primary hosts (although today primary utilize the English plantain [*Plantago lanceolata*]). Both butterfly species have existing populations at nearby sites in Benton County and were likely present across the historical oak-prairie habitats in the McDonald-Dunn Forest. If the site is deemed suitable for introduction, native butterfly nectar species should be incorporated into the plant materials plan, including dwarf checkermallow (*Sidalcea malviflora ssp. virgata*), giant blue-eyed Mary (*Collinsia grandiflora*), Oregon sunshine (*Eriophyllum lanatum*), rosy plectritis (*Plectritis congesta*), Tolmie's mariposa lily, and wild strawberry (*Fragaria virginianica*).

5.1.6. Spot sprays

In between broadcast herbicide applications and once native seed is on the ground, spot spray treatments should be conducted to deal with problematic weed outbreaks. IAE plans to visit the site regularly to monitor weed problems and respond rapidly. By targeting specific species, or a suite of species (e.g., perennial grasses), we can tailor chemical prescriptions to be most appropriate for a given situation. For example, fluazifop-P-butyl sprays in the spring may be most beneficial for dealing with patches of false brome. Triclopyr spot sprays will be common in the late summer when target woody vegetation includes blackberry, hawthorn, scotch broom, and rose.

5.2. RestoreNet experiment

Across a regional network, experimental studies provide great insight regarding how unique site factors affect restoration treatments and how implementation techniques affect restoration results. RestoreNet is a regional, collaborative, experimental network open to all restoration practitioners and hosted by IAE. The RestoreNet experimental design was developed collaboratively by practitioners and researchers to be robust, relevant to ecological theory, and able to address real-world restoration questions. Each RestoreNet site is a replicate of the experiment that addresses critical questions and restoration challenges unique to each site, while contributing to a regional network to apply information learned across broader scales. RestoreNet aims to improve restoration outcomes by 1) increasing knowledge of the factors that affect native plant establishment and, ultimately, restoration outcomes; 2) reducing restoration costs; 3) addressing questions important to ecological theory, including topics related to species life history traits and plant communities; and 4) engaging practitioners in the research process to improve research questions and dissemination of useful results.

During the Jackson Meadow project planning phase, IAE and OSU agreed that the project could serve as a valuable addition to the greater RestoreNet study. As a result, IAE will implement two RestoreNet sites during the restoration process at Jackson Meadow. Each site will feature a 2x3 factorial split plot design (Figure 12). To address whether ground disturbance activities affect restoration results, the first factor will involve soil preparation (disked/not disked). We expect that disking the soil will encourage germination of weeds from the seedbank, making subsequent herbicide treatments more effective and potentially reducing the time needed for chemical fallow. To address how long the site should be treated, the second factor will be the duration of chemical fallow, with three treatments: 1) one year of chemical fallow; 2) two years of chemical fallow; and 3) three years of chemical fallow. We expect that increasing the length of time under chemical fallow will improve establishment of sown seeds, but that this variable may interact with the effect of soil disking, potentially allowing for an equivalent effectiveness with reduced time under fallow. The third (split) factor will be seeding rate. We will have one of the split plots be the base seeding rate applied across Jackson Meadow, and the other split plot will be double that rate. We

expect that increasing seeding rate will increase germination success, but if that is not true then cost savings can be accrued by purchasing less seed.

In spring 2023, IAE will establish one RestoreNet site in the bench and one in the upland, each being 7.5-m x 7.5-m and divided into six macroplots (one for each of the crossed treatment combinations; Figure 12). There will be two plots within each macroplot (to incorporate the split factor). Within each plot, we will survey plant responses with 1-m x 1-m quadrats each spring and estimate percent cover of each vascular plant species, total basal area of all plants, and percent cover of moss and lichen, plant litter and thatch, bare ground, and rock. Changes in the plant community over time will inform our interpretation of how implementation techniques affect restoration results.

Little is known about how restoration treatments such as chemical fallow affect soil properties or microbial processes. If budgeting allows, IAE hopes to collect two soil samples per RestoreNet macroplot (one per quadrat) in spring 2023 and 2025 for analysis by OSU's Soil Health Lab to measure pre- and post-treatment metrics including soil pH, organic matter, total carbon and nitrogen, phosphorus, and microbial respiration. Doing so may reveal differences between upland and bench soils, giving insight into how soil properties and processes affect plant communities and are affected by herbicide and disking practices.

We will select RestoreNet site locations following mastication. Before chemical fallow treatments begin, we will flag out the two RestoreNet sites so that the macroplots can be treated appropriately. Approximately two to four weeks before the first herbicide application, we will disk the appropriate macroplots using a small cultivator or rototiller. We will then treat the macroplots with herbicide for the length of time determined by their fallow treatment, using the prescriptions described above in Section 5.1.4. If the spring 2023 mastication treatment is not complete by the timing of the first herbicide application, we will delay the first disking treatment to fall 2023 once the rains return.

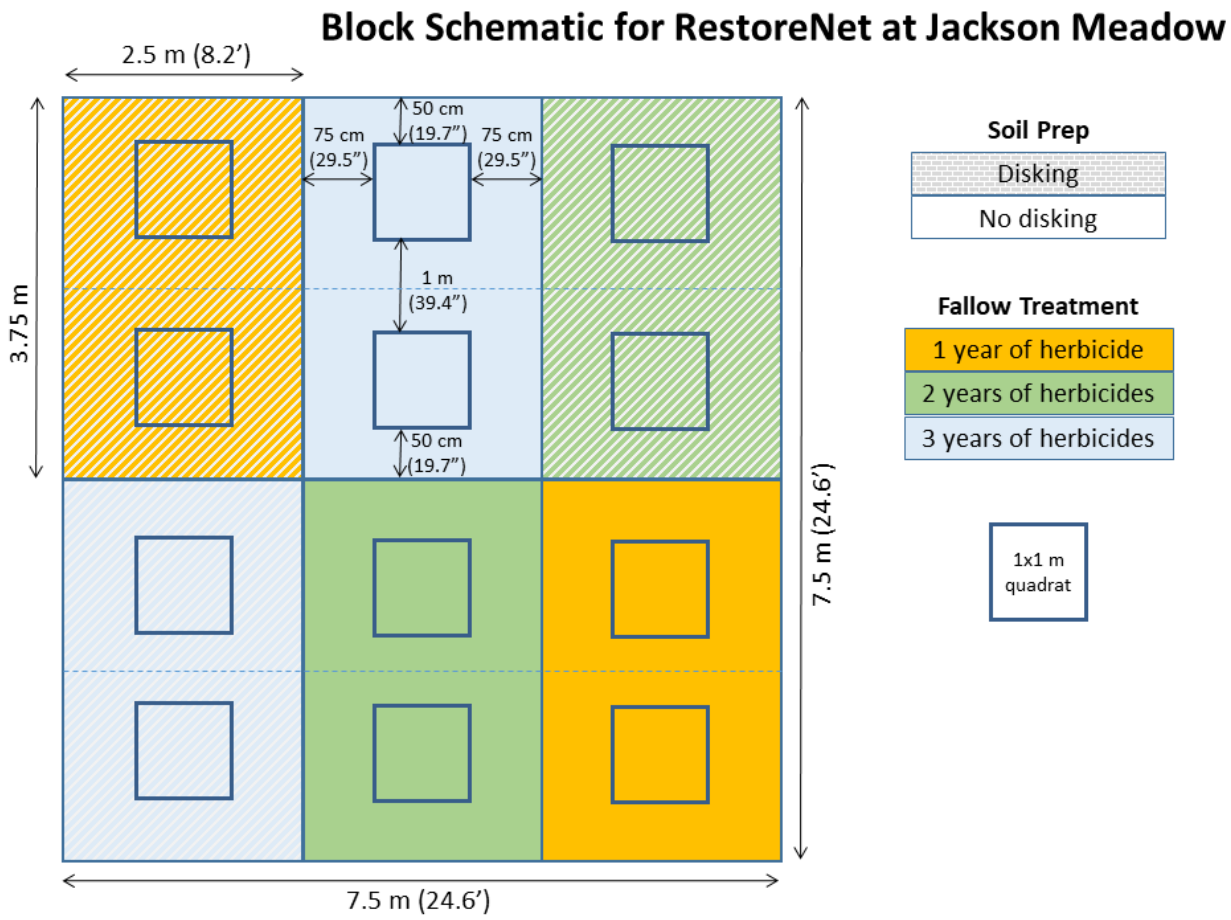

Figure 12. Schematic design outlining the RestoreNet experimental design at Jackson Meadow. The 2x3 factorial split plot will include treatments for soil preparation (disking = hatched pattern, no disking = solid pattern), length of chemical fallow (yellow = 1 year, green = 2 years, blue = 3 years), and seeding rate (above and below dashed horizontal lines).

6. MONITORING

Monitoring is an important component of the restoration plan for Jackson Meadow. IAE will use observations and data from monitoring efforts to adjust restoration plan treatments, prescriptions, and timing to achieve the most desirable outcomes. Each June between 2023-2026, IAE will continue to collect vegetation cover data and take photo points in the four relevé plots and will collect cover data from the two RestoreNet plots. These data and photo points will be analyzed annually to track the change in conditions through time and determine whether additional actions should be taken. Additionally, IAE will make site visits at least once per season to locate and map invasive species, track their phenology to determine when to act, assess the efficacy of restoration treatments, and evaluate native species establishment (after seed is sown).

7. TIMELINE

The proposed restoration and monitoring activities will take place between winter 2023 to fall 2026, as summarized in a timeline in Table 3.

Table 3. Jackson Meadow restoration plan and timeline.

Year	Season	Action	Notes	Units	Personnel
2023	Winter	Woody removal	Continue removing hawthorn, limbing Douglas-fir through existing meadows.	E, F	IAE
2023	Winter	Burn debris piles	Continue burning debris piles.	All	OSU
2023	Early spring	Mastication	Masticate woody debris and grass thatch across entire site.	All	Contractor
2023	Spring	RestoreNet	Establish two RestoreNet plots.	C, F	IAE
2023	Spring	Monitoring	Collect vegetation cover data in relevé and RestoreNet plots. Collect soil cores from RestoreNet plots and send to OSU's Soil Health Lab for analysis.	A, C, E, F	IAE
2023	Spring	RestoreNet	Disk RestoreNet plots if mastication is complete.	C, F	IAE
2023	Spring	Broadcast herbicide	Broad spectrum plus pre-emergent.	All	Contractor
2023	Summer	Broadcast herbicide	Broad spectrum plus pre-emergent.	All	Contractor
2023	Late summer	Mow	Target blackberry patches in hard-to-reach riparian corridors.	All	IAE
2023	Fall	Burn debris piles	Finish burning debris piles.	All	OSU
2023	Fall	RestoreNet	Disk RestoreNet plots if this action was not completed in spring 2023.	C, F	IAE
2023	Fall	Broadcast herbicide	Broad spectrum plus pre-emergent.	All	Contractor
2024	Winter	Woody removal	If necessary.	E, F	IAE
2024	Early spring	Mow	If thatch remains, mowing will expedite decomposition and improve efficacy of herbicide applications.	All	IAE/ Contractor
2024	Spring	Monitoring	Collect vegetation cover data in relevé and RestoreNet plots.	A, C, E, F	IAE
2024	Spring	Broadcast herbicide	Broad spectrum plus pre-emergent.	All	Contractor
2024	Late spring	Spot spray	If necessary, broad spectrum or grass specific to target false brome.	All	IAE
2024	Summer	Broadcast herbicide	Broad spectrum.	All	Contractor
2024	Late summer	Mow	Target blackberry patches in hard-to-reach riparian corridors.	All	IAE

Year	Season	Action	Notes	Units	Personnel
2024	Fall	Broadcast herbicide	Broad spectrum.	All	Contractor
2024	Fall	Seed	Consider seeding dense buffers of Roemer's fescue along roadside-adjacent perimeters.	A, E, F, G	IAE
2025	Spring	Monitoring	Collect vegetation cover data in relevé and RestoreNet plots. Collect soil cores from RestoreNet plots and send to OSU's Soil Health Lab for analysis.	A, C, E, F	IAE
2025	Spring	Broadcast herbicide	Broad spectrum plus pre-emergent. Avoid any buffers that may have been seeded in fall 2024.	All	Contractor
2025	Late spring	Spot spray	Grass specific to target false brome, especially any buffer zones that may have been seeded in fall 2024.	All	IAE
2025	Summer	Broadcast herbicide	Broad spectrum.	All	Contractor
2025	Late summer	Mow	Target blackberry patches in hard-to-reach riparian corridors.	All	IAE
2025	Fall	Broadcast herbicide	Broad spectrum.	All	Contractor
2025	Fall	Seed	Sow at least three separate seed mixes: upland prairie, woodland/savanna, and wet prairie/riparian.	All	IAE
2026	Spring	Spot spray	Spot spray for weeds as needed.	All	IAE
2026	Summer	Spot spray	Spot spray for weeds as needed.	All	IAE
2026	Fall	Spot spray	Spot spray for weeds as needed.	All	IAE
2026	Fall	Seed	Second year seeding in areas that were missed or seeded lightly.	All	IAE
2026	Fall	Planting	Plant plugs, bulbs, bare roots, and shrubs.	All	IAE

8. MAINTENANCE

Prairie-oak ecosystems are characterized by early successional habitat and have historically required regular disturbance to prevent conifer encroachment. Moreover, the widespread distribution of invasive species in our region today adds a layer of complexity to the management of these ecosystems. As a result, once the restoration phase is complete, regular maintenance will be necessary to achieve the long-term sustainability of prairie-oak habitat at Jackson Meadow (Table 4).

A regular maintenance plan should include annual weed treatments via hand pulling or herbicide application. To prevent woody encroachment, prairie habitat should be mowed every other year. In the oak woodlands and savannas, a tradeoff may occur between the need to control conifer and non-native (e.g., common hawthorn) woody establishment and the desire to allow natural oak recruitment. As a result, we recommend targeted cutting and spot spraying every few years rather than regularly mowing in these habitat types.

The primary disturbance that these ecosystems have evolved with is fire. Once established, the native plant community should thrive with occasional fire, as this helps clear thatch and return nutrients and carbon to the soil. While we recognize that executing a prescribed burn can be challenging, we recommend trying to burn the site every three to five years. Maintaining the dirt spur that intersects the site will help facilitate prescribed burns by providing fire crews with easy access.

Finally, native plant materials should be added to the site any time a disturbance exposes significant bare ground. Seeding should follow every prescribed burn, while seeding or planting plugs, bulbs, and bare roots is recommended whenever other treatments (e.g., spot sprays or mowing) cause enough of a disturbance to expose bare soil. If the native community is already established, a lower seeding rate (4-8 lbs/acre) may be appropriate.

Table 4. Long-term maintenance plan after the restoration phase is complete.

Season	Frequency	Action	Notes
January - March	Biennially	Cut encroaching trees and shrubs	Use brush cutters and hand tools to reduce undesirable woody encroachment in oak woodland and savanna habitats.
March - June	Annually	Spot spray and hand pulling	Target weedy herbaceous vegetation such as false brome across entire site.
August - October	Annually	Spot spray	Spot spray triclopyr to target blackberry.
September - October	Biennially	Mow	Mow prairies to reduce woody encroachment and remove thatch.
September - October	3-5 years	Prescribed burn	If possible (in lieu of mowing).
October - November	As needed	Seed and plant	Seed and plant natives following prescribed burns and when bare soil has been exposed from other treatments.

9. REFERENCES

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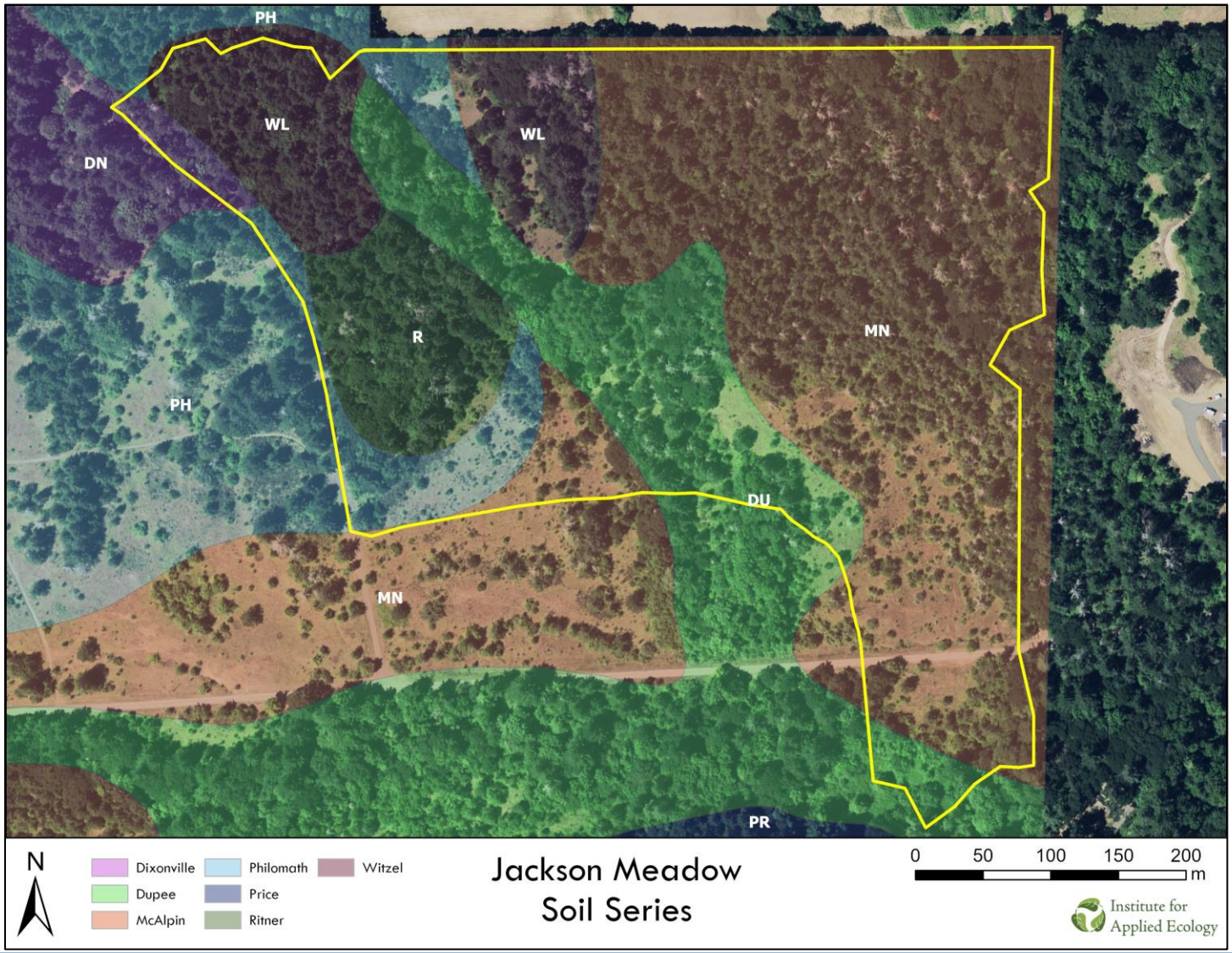
APPENDICES

Appendix 1. Soil series map



Appendix 2. Photo points

Table 5. Latitude and longitude of photo points. See Figure 2 for mapped locations.

Photo point	Location	Latitude	Longitude
Relevé 1	Bench (meadow)	44.614524	-123.288059
Relevé 2	Bench (meadow)	44.614894	-123.290985
Relevé 3	Upland (forest)	44.615542	-123.2915
Relevé 4	Upland (forest)	44.615912	-123.288695

Relevé 1 photo points (Clockwise from top left: looking North, East, South, and West).




Relevé 2 photo points (Clockwise from top left: looking North, East, South, and West).




Relevé 3 photo points (Clockwise from top left: looking North, East, South, and West).




Relevé 4 photo points (Clockwise from top left: looking North, East, South, and West).




Appendix 3. Species lists for relevé plots

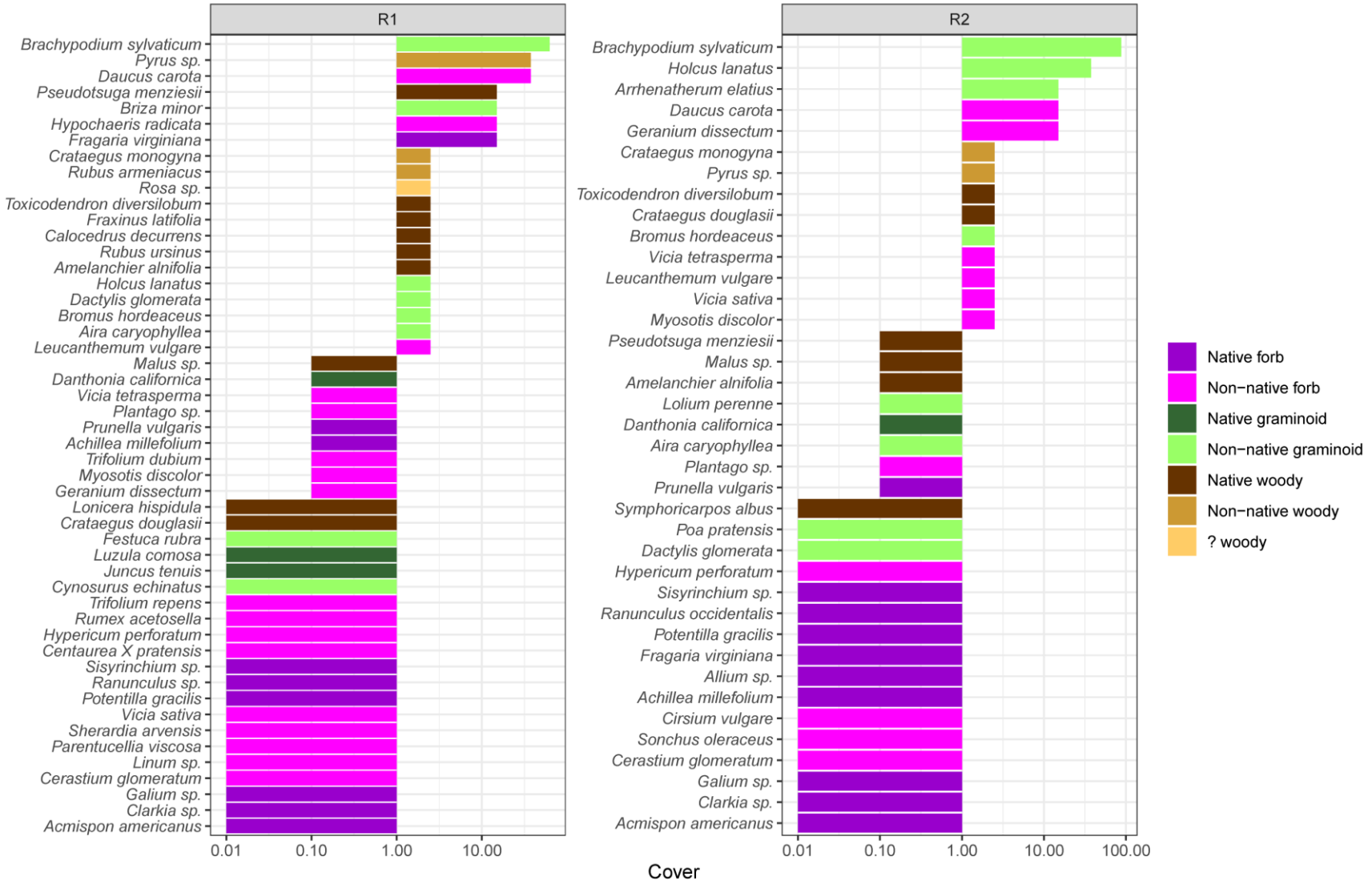


Figure 13. Species in the two bench (meadow) relevé plots (R1 and R2) in June 2022 ranked by absolute cover. Cover is the percent cover on a log scale. Cover by species was estimated with Braun-Blanquet cover classes.

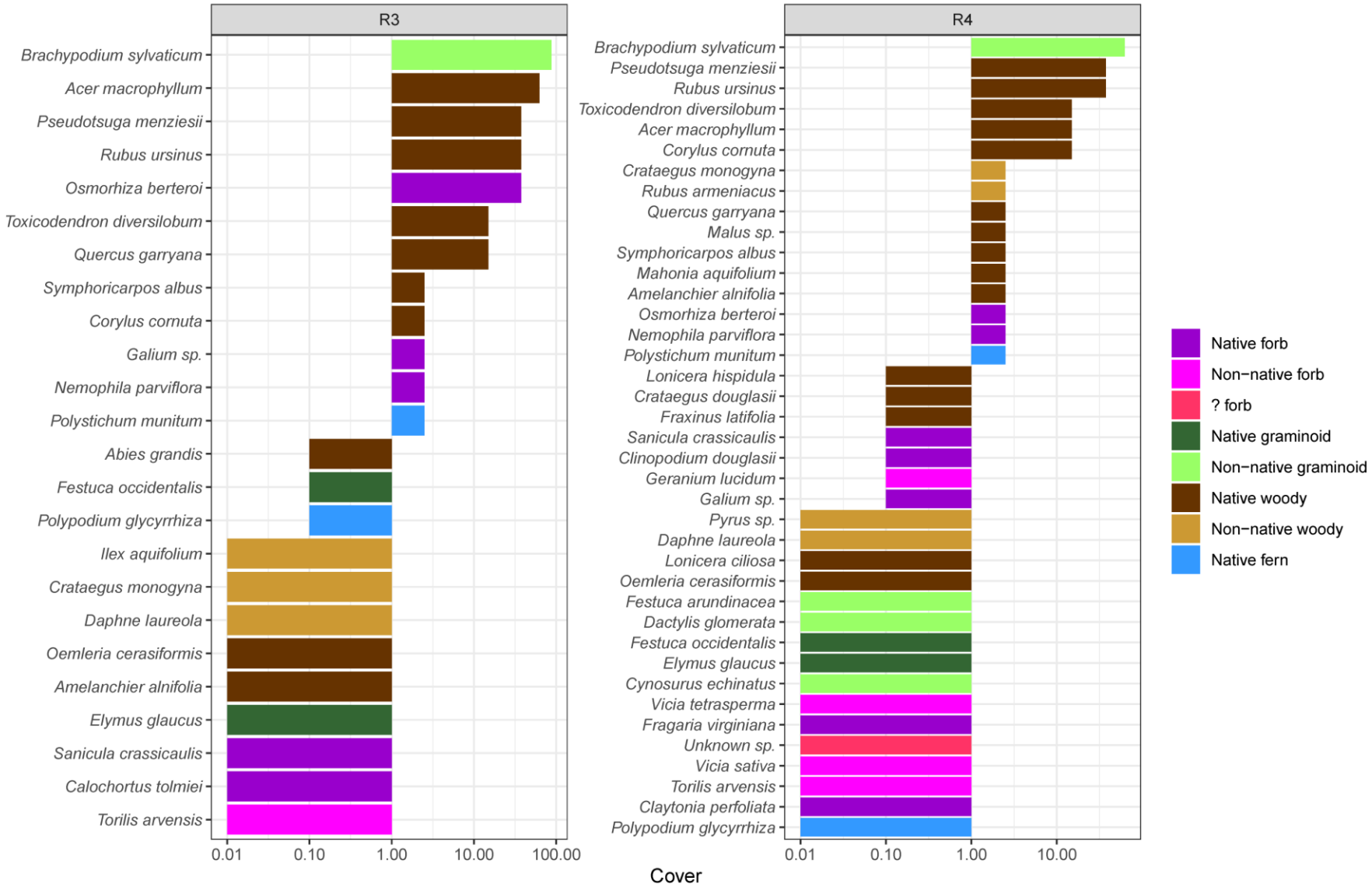


Figure 14. Species in the two upland (forested) relevé plots (R3 and R4) in June 2022 ranked by absolute cover. Cover is the percent cover on a log scale. Cover by species was estimated with Braun-Blanquet cover classes.

Appendix 4. Seed mixes by habitat type

Table 6. Heritage Seedlings & Liners, Inc. premade "Diverse Prairie Mix" (2022), as an example of some of the potential species that could be included in a prairie seed mix for this site.

DIVERSE PRAIRIE MIX			
Species	**Common name**	**Growth form**	**Duration**
Achnatherum lemmonii	Lemmon's needlegrass	Graminoid	Perennial
Carex tumulicola	Foothill sedge	Graminoid	Perennial
Elymus glaucus	Blue wildrye	Graminoid	Perennial
Elymus trachycaulus	Slender wheatgrass	Graminoid	Perennial
Festuca roemeri	Roemer's fescue	Graminoid	Perennial
Juncus tenuis	Path rush	Graminoid	Perennial
Koeleria macrantha	Prairie junegrass	Graminoid	Perennial
Luzula comosa	Pacific woodrush	Graminoid	Perennial
Poa secunda	Secund bluegrass	Graminoid	Perennial
Achillea millefolium	Yarrow	Forb	Perennial
Aquilegia formosa	Red columbine	Forb	Perennial
Asclepias speciosa	Showy milkweed	Forb	Perennial
Camassia leichtlinii	Great camas	Forb	Perennial
Clarkia amoena	Farewell to spring	Forb	Annual
Clarkia rhomboidea	Common clarkia	Forb	Annual
Collinsia grandiflora	Giant blue-eyed Mary	Forb	Annual
Eriophyllum lanatum	Oregon sunshine	Forb	Perennial
Gilia capitata	Bluehead gilia	Forb	Annual
Iris tenax	Oregon iris	Forb	Perennial
Ligusticum apiifolium	Celery-leaved licorice root	Forb	Perennial
Lomatium dissectum	Fernleaf biscuitroot	Forb	Perennial
Lomatium nudicaule	Barestem biscuitroot	Forb	Perennial
Lupinus latifolius	Broad-leaved lupine	Forb	Perennial
Madia elegans	Common madia	Forb	Annual
Potentilla gracilis	Slender cinquefoil	Forb	Perennial
Potentilla glandulosa	Sticky cinquefoil	Forb	Perennial
Prunella vulgaris var. lanceolata	Lance-leaved self-heal	Forb	Perennial
Ranunculus occidentalis	Western buttercup	Forb	Perennial
Rumex salicifolius	Willow dock	Forb	Perennial
Sidalcea campestris	Meadow checkermallow	Forb	Perennial
Sidalcea malviflora ssp. virgata	Rose checkermallow	Forb	Perennial
Symphyotrichum hallii	Hall's aster	Forb	Perennial

Table 7. Heritage Seedlings & Liners, Inc. premade "Oak Woodland Understory" mix (2022), as an example of some of the potential species that could be included in an oak woodland-savanna mix for this site.

WOODLAND MIX			
Species	**Common name**	**Growth form**	**Duration**
Bromus sitchensis	Alaska brome	Graminoid	Perennial
Elymus glaucus	Blue wildrye	Graminoid	Perennial
Artemisia douglasiana	Douglas' sagewort	Forb	Perennial
Achillea millefolium	Yarrow	Forb	Perennial
Aquilegia formosa	Red columbine	Forb	Perennial
Camassia leichtlinii	Great camas	Forb	Perennial
Collinsia grandiflora	Giant blue-eyed Mary	Forb	Annual
Geum macrophyllum	Largeleaf avens	Forb	Perennial
Heracleum maximum	Common cowparsnip	Forb	Perennial
Iris tenax	Oregon iris	Forb	Perennial
Ligusticum apiifolium	Celery-leaved licorice root	Forb	Perennial
Lomatium dissectum	Fernleaf biscuitroot	Forb	Perennial
Madia elegans	Common madia	Forb	Annual
Phacelia nemoralis var. oregonensis	Oregon phacelia	Forb	Perennial
Plagiobothrys nothofulvus	Rusty popcornflower	Forb	Annual
Plectritis congesta	Rosy plectritis	Forb	Annual
Potentilla glandulosa	Sticky cinquefoil	Forb	Perennial
Prunella vulgaris var. lanceolata	Lance-leaved self-heal	Forb	Perennial
Rupertia physodes	California tea	Forb	Perennial
Sanicula crassicaulis	Pacific snakeroot	Forb	Perennial
Solidago elongata	Narrow goldenrod	Forb	Perennial
Sidalcea campestris	Meadow checkermallow	Forb	Perennial
Thalictrum polycarpum	Meadowrue	Forb	Perennial

Table 8. Heritage Seedlings & Liners, Inc. premade "Wetland Prairie/Bioswale 2" mix (2022), as an example of some of the potential species that could be included in an oak woodland-savanna mix for this site.

WET PRAIRIE MIX			
Species	**Common name**	**Growth form**	**Duration**
Carex densa	Dense sedge	Graminoid	Perennial
Carex scoparia	Pointed broom sedge	Graminoid	Perennial
Carex pachystachya	Chamisso sedge	Graminoid	Perennial
Carex stipata	Awl-fruit sedge	Graminoid	Perennial
Carex unilateralis	Lateral sedge	Graminoid	Perennial
Danthonia californica	California oatgrass	Graminoid	Perennial
Deschampsia cespitosa	Tufted hairgrass	Graminoid	Perennial
Deschampsia elongata	Slender hairgrass	Graminoid	Perennial
Juncus ensifolius	Dagger-leaved rush	Graminoid	Perennial
Juncus tenuis	Path rush	Graminoid	Perennial
Artemisia douglasiana	Douglas' sagewort	Forb	Perennial
Allium amplectens	Slim-leaf onion	Forb	Perennial
Camassia quamash	Common camas	Forb	Perennial
Clarkia purpurea ssp. quadrivulnera	Small-flowered godetia	Forb	Annual
Epilobium densiflorum	Denseflower spikeprimrose	Forb	Annual
Eriophyllum lanatum	Oregon sunshine	Forb	Perennial
Geum macrophyllum	Largeleaf avens	Forb	Perennial
Heracleum maximum	Common cowparsnip	Forb	Perennial
Lomatium nudicaule	Barestem biscuitroot	Forb	Perennial
Lotus purshianus	American deervetch	Forb	Annual
Lupinus polyphyllus	Bigleaf lupine	Forb	Perennial
Microsteris gracilis	Slender phlox	Forb	Annual
Mimulus guttatus	Common monkeyflower	Forb	Annual
Perideridia oregana	Oregon yampah	Forb	Perennial
Plectritis congesta	Rosy plectritis	Forb	Annual
Ranunculus occidentalis	Western buttercup	Forb	Perennial
Ranunculus orthorhynchus	Straightbeak buttercup	Forb	Perennial
Rorippa curvisiliqua	Curvepod yellowcress	Forb	Annual
Rumex salicifolius	Willow dock	Forb	Perennial
Sanguisorba annua (occidentalis)	Annual burnet	Forb	Annual
Sidalcea campestris	Meadow checkermallow	Forb	Perennial
Sisyrinchium idahoense	Idaho blue-eyed grass	Forb	Perennial
Solidago elongata	Narrow goldenrod	Forb	Perennial
Veronica peregrina	Purslane speedwell	Forb	Annual