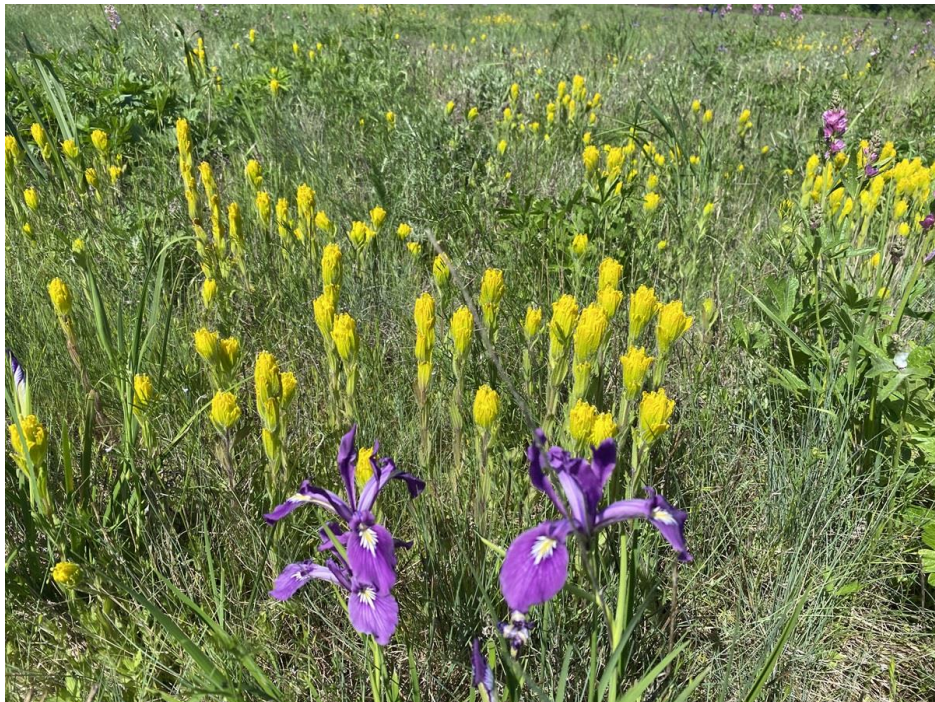


Herbert Farm and Natural Area Restoration – 2023 Annual Report



1/19/2024

Report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife

Report prepared by Sara Alaica and Andrew Esterson
Institute for Applied Ecology



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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ACKNOWLEDGMENTS

A key to the overall success of restoration work at Herbert Farm has been the collaboration between IAE and its funders and restoration partners, several of which have contributed important on-the-ground actions and project support. Funding was provided by the Oregon Department of Fish and Wildlife (ODFW) through Grant Agreement Number 107-22, and we thank ODFW's Willamette Wildlife Mitigation Program staff, Laura Tesler and Owen Cass for their help administering the grant and providing support. Additional funding for plant materials came from the Plants for People Phase III (Oregon Watershed Enhancement Board grant #221-3007-19001) and the City of Corvallis. Restoration activities were coordinated or conducted by staff from the Parks and Recreation Department of the City of Corvallis, Jude Geist and Emily Day, as well as IAE staff: Aynesley Wilson, Evan Lasley, Zade Clark-Henry, Tyler Roberts, Paul Reed, Isaac Gromacki, and Jeni Nugent. Plant materials support came from Mara Friddle. Photos in this report were taken by Sara Alaica, unless otherwise stated.

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Cover photograph: Golden paintbrush (*Castilleja levisecta*) and Oregon iris (*Iris tenax*) at Herbert Farm Natural Area, May 15, 2023.

Suggested citation

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Herbert Farm and Natural Area Restoration – 2023 Annual Report

REPORT FOR THE WILLAMETTE WILDLIFE MITIGATION PROGRAM,
OREGON DEPARTMENT OF FISH AND WILDLIFE

1. EXECUTIVE SUMMARY

Herbert Farm and Natural Area, a 221-acre property near Corvallis in Benton County, Oregon, is owned by the City of Corvallis, and has a conservation easement held by Oregon Department of Fish and Wildlife through the Willamette Wildlife Mitigation Program. Since 2013, the Institute for Applied Ecology (IAE), with assistance and funding from several agencies, has restored formerly farmed areas to natural habitats. In spring 2023, contractors conducted herbicide spot sprays, while IAE staff flame weeded small patches in the Phase II area. During the summer, IAE ecologists mapped the locations of over a dozen weed species across the site and in fall 2023, ODFW mowed the prairies. Volunteers and IAE staff planted over 1,400 Nelson's checkermallow (*Sidalcea nelsoniana*; listed as threatened by the state of Oregon) plugs in the Phase II prairie in December.

2. INTRODUCTION

Herbert Farm and Natural Area (HFNA) is a 221-acre property located south of Corvallis in Benton County, Oregon (Figure 1). The property is owned and administered by the Parks and Recreation Department of the City of Corvallis (City) and has a conservation easement with Oregon Department of Fish and Wildlife (ODFW) through the Willamette Wildlife Mitigation Program (WWMP), which is funded by the Bonneville Power Administration (BPA).

The City developed a management plan for HFNA to guide restoration and management over a 10-year period (2011-2021, City of Corvallis 2011). The Institute for Applied Ecology (IAE) developed habitat restoration plans with guidance from the management plan and collaboration with restoration partners including the City, ODFW, BPA, and the U.S. Fish and Wildlife Service (USFWS) for two phases of habitat restoration at HFNA (Menke et al. 2013, Moore 2017a). Restoration of Phase I, 84 acres north-west of Matt Creek, and Phase II, 130 acres east of Muddy and Matt creeks, began in 2013 and 2015, respectively (Figure 1).

Despite previous agricultural use, the property retained areas of high-quality native prairie, oak savanna, and riparian forest (Figure 2). In addition, two federally listed plant species were present, including Kincaid's lupine (*Lupinus oregonus*; delisted in 2023) and Nelson's checkermallow (*Sidalcea nelsoniana*; delisted in 2023). Peacock larkspur (*Delphinium pavonaceum*; listed as endangered by the state of Oregon) and several rare species were also present (Institute for Applied Ecology 2013).

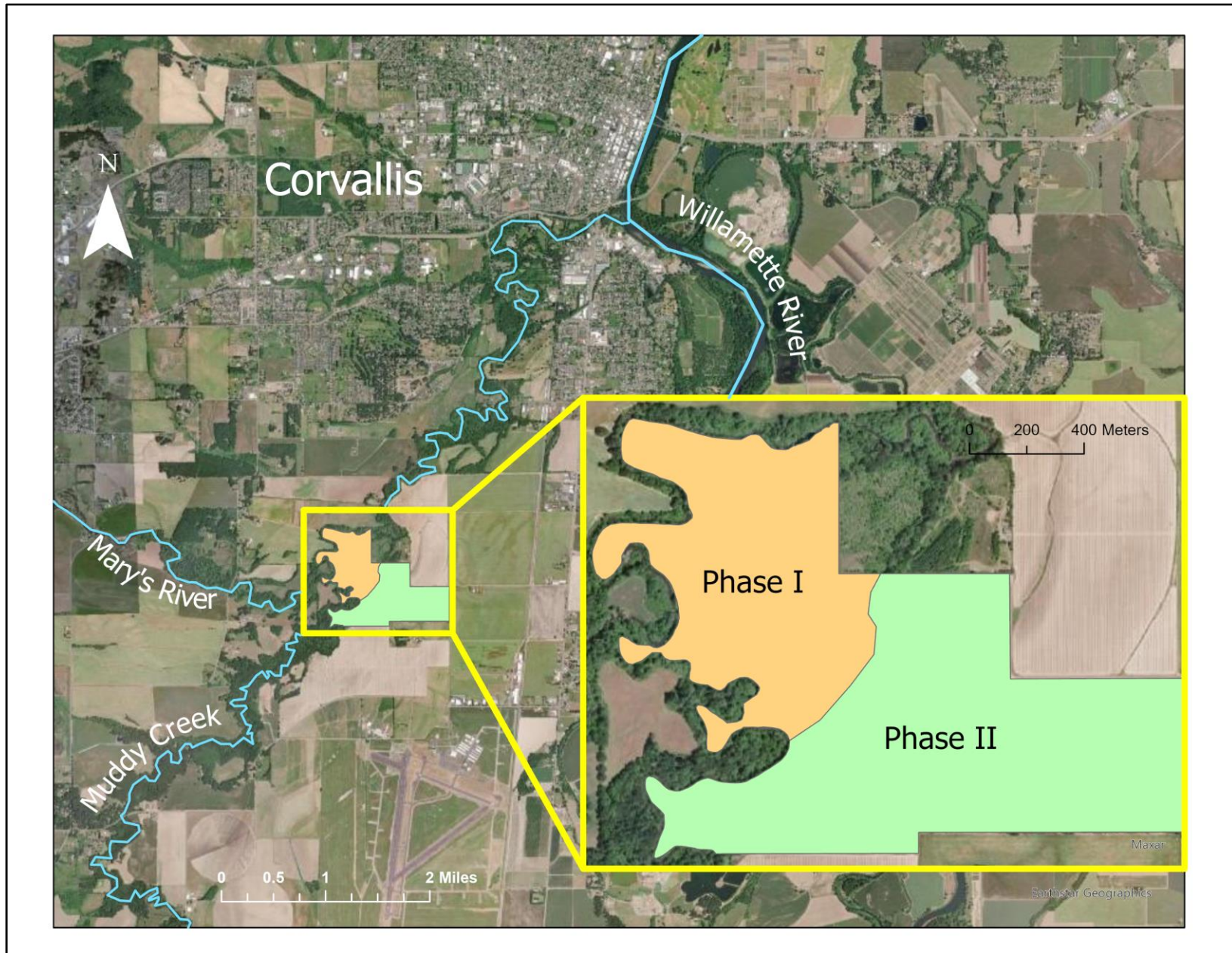


Figure 1. Herbert Farm and Natural Area location, southwest of Corvallis, Benton County, Oregon.

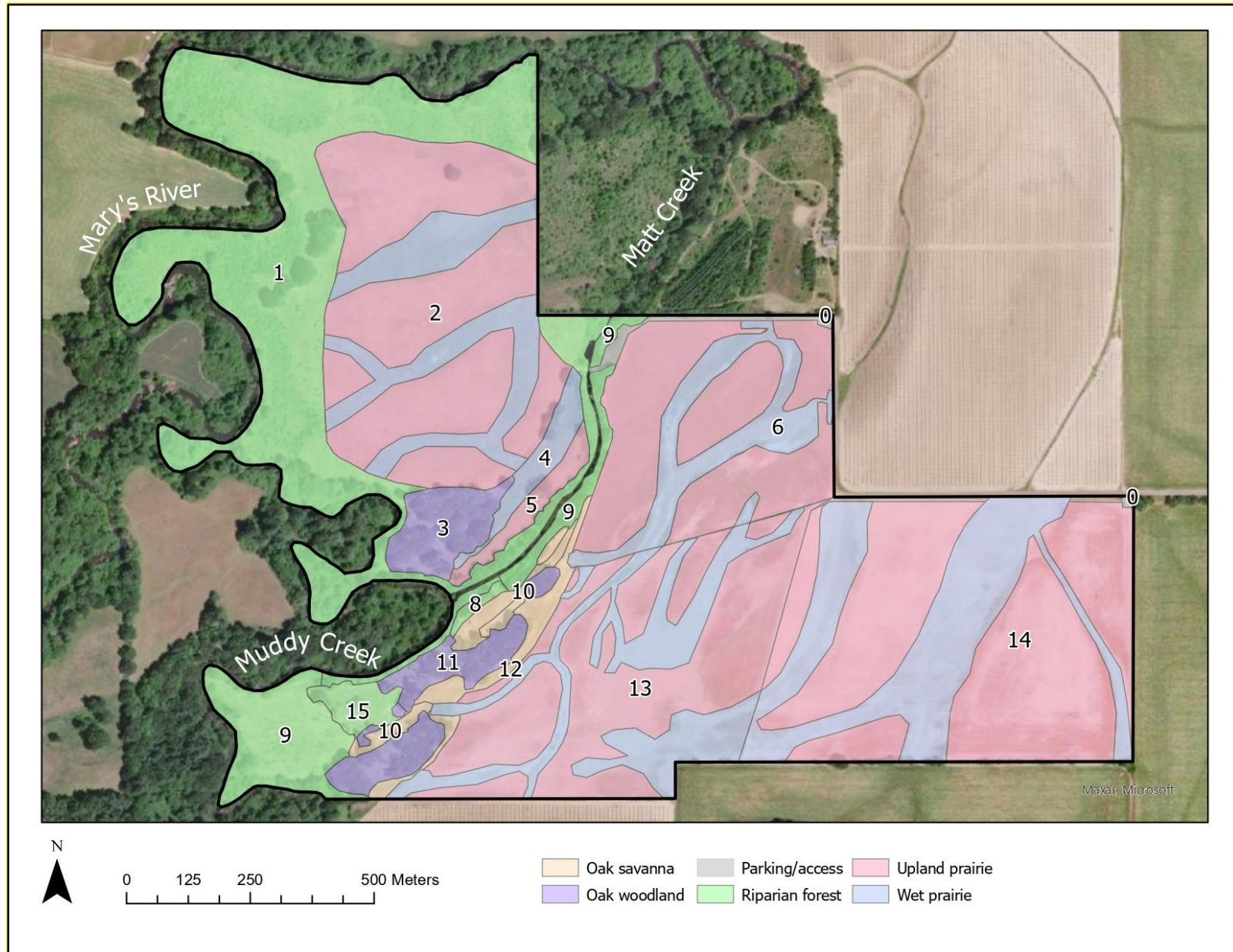


Figure 2. Current habitats at Herbert Farm and Natural Area in 2023 with map codes for individual areas that are referred to in Tables 1 and 2 and the text.

HFNA is also an important site for streaked horned larks (*Eremophila alpestris strigata*), a threatened species which is found at the nearby Corvallis Municipal Airport. Restoration east of Matt Creek focused in part on creating habitat for streaked horned larks. An Endangered Species Conservation Recovery Implementation grant (funded by USFWS) was implemented in 2016-2017 to compare restoration treatments for creating streaked horned lark habitat and to monitor the population at HFNA (Moore 2017b).

The USFWS Partners for Fish and Wildlife Program constructed berms in 2016 to flood two swales and promote bare ground and sparse vegetation for streaked horned lark habitat (Moore 2017c). Separate projects (funded by the Federal Aviation Administration and managed by City of Corvallis, Precision Approach and Ecological Assessment and Restoration Services of AECOM and IAE) fallowed 23 acres of former farmland for three years (2018-2020) to attract streaked horned larks and mitigate for impacts to the species during runway improvements at Corvallis Municipal Airport. This project, with additional funding from City of Salem and USFWS, included monitoring of streaked horned larks and testing of decoys and a sound attraction system at HFNA (Lapinski and Bahm 2018).

Restoration was conducted and coordinated by IAE using operations and maintenance funding from the WWMP, as well as several other grants including three Plants for People grants (funded by the Oregon Watershed Enhancement Board) and three State Wildlife Grants (funded by USFWS through the Center for Natural Lands Management [CNLM]). Other partner agencies, including the USFWS Partners for Fish and Wildlife Program, ODFW, the City, and Confederated Tribes of Grand Ronde (CTGR) contributed in-kind efforts.

Since active restoration efforts began in 2012, all former-agricultural fields have transitioned into prairie habitat. Threatened and endangered species have been augmented with plantings and seedings, and riparian areas have been revegetated with trees and shrubs. In the forest, conifers were felled and girdled to open the canopy. For a complete list of restoration actions conducted to date see Appendix 1.

3. GOALS AND OBJECTIVES

The City's overall mission for HFNA includes maintaining and restoring the site's ecological attributes, managing agriculture to be compatible with natural and cultural resources, encouraging recreation while protecting rare species and their habitat, and supporting education projects (City of Corvallis 2011).

The City's restoration goals (City of Corvallis 2011) include:

- Conserve, protect, and enhance natural functioning habitats of HFNA, in particular the prairie, oak savanna, oak woodland, and riparian corridors.
- Manage HFNA agricultural lands in a sustainable manner that affords protection and restoration of natural habitat functions.

Management Plan restoration objectives (City of Corvallis 2011):

- Restore prairie structure, diversity, and plant community composition by reducing encroachment of woody vegetation, controlling non-native invasive plant species, and increasing native plant and animal species abundance.
- Enhance oak savanna habitat by improving stand composition and structure and expanding the presence of rare and native plant and animal species.
- Improve health and vigor of upland forest and oak woodland.

- Increase native plant abundance, vigor, and diversity of riparian corridors and buffers, increase stream bank shading and reduce erosion.

This report summarizes restoration work completed at HFNA in 2023. It also summarizes actions achieved under other grants and in-kind actions by partner agencies to recognize the multiple contributions to restoration at HFNA. The current habitat conditions at HFNA are shown in Figure 2, with map codes provided for interpretation of tables and the text. Previous years' restoration actions are summarized in Appendix 1 and described in previous reports (Moore 2017c, 2018, 2019, 2020, Moore & Currin 2021, 2022, Alaica et al. 2023).

4. 2023 RESTORATION ACTIONS

Restoration actions conducted at HFNA are shown in Figure 4, with detailed descriptions in the text. For a breakdown of actions by habitat unit, see Appendix 1.

4.1. Vegetation management

4.1.1 Spot spraying

Herbicide treatments began on April 14, when staff from IAE targeted young shoots of reed canarygrass (*Phalaris arundinacea*) in the riparian areas with glyphosate. Reed canarygrass is an aggressive, noxious weed that has been present at HFNA since restoration began and requires ongoing maintenance to keep it from spreading more widely (Figure 3).

Throughout May and June, crews from R. Franco Restoration spot sprayed HFNA, focusing primarily on class B noxious perennial weeds such as Canada thistle (*Cirsium arvense*), field bindweed (*Convolvulus arvensis*), and woody species that are encroaching into the prairies such as Himalayan blackberry (*Rubus armeniacus*). A map of targeted weeds can be found in section 5.1 Weed mapping.

In the fall, IAE staff spot sprayed invasive woody species with triclopyr, particularly in the planting areas where Himalayan blackberry outcompetes other native shrubs (Figure 3).



Figure 3. (l-r) Yellowing on reed canarygrass (*Phalaris arundinacea*) in the wet prairie; dead Himalayan blackberry (*Rubus armeniacus*) amongst planted shrubs.

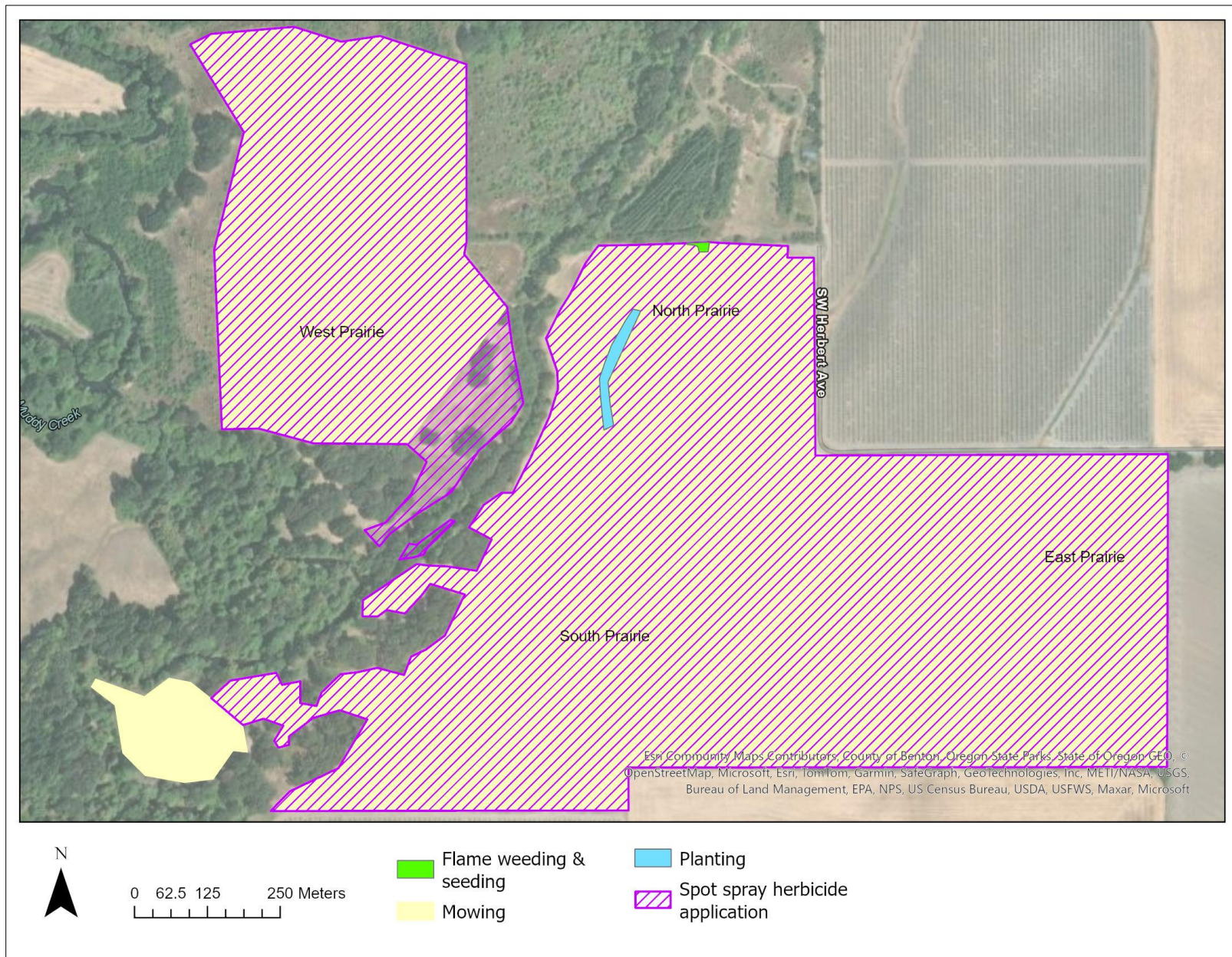


Figure 4. Restoration actions completed at Herbert Farm Natural Area in 2023.

4.1.2 Mowing

On June 19, crews from R. Franco Restoration mowed around the perimeter of HFNA to maintain an access path and mowed down vegetation between the riparian plantings (Figure 5). Thick vegetation competes with plantings for soil moisture at this stage of establishment, but once canopy closure is achieved, low light conditions will reduce competing vegetation.

From August 28 to September 1, ODFW mowed each of the four prairies, leaving patches of unmowed vegetation to serve as refugia and provide an opportunity for native annuals such as tarweed (*Madia* spp.) to seed (Figure 5).



Figure 5. (l-r) R. Franco Restoration mowed down vegetation between riparian plantings; Oregon Department of Fish and Wildlife (ODFW) completed a patchy mow in the prairies.

4.1.3 Flame weeding

HFNA is experiencing the early stages of rattail fescue (*Vulpia myuros*) invasion. This annual grass is native to Eurasia and is highly invasive in Mediterranean climates such as Oregon. This is due to its early germination: it begins growing as early as March, outcompeting later-establishing native grasses. Targeting this species with herbicide is largely ineffective both because it sprouts during spring rainy season, and its thin blades have little surface area to uptake chemicals.

In early spring, IAE staff used propane torches (referred to as flame weeding) to burn patches where rattail fescue has created monocultures (Figure 6). Flame weeding successfully prevented the rattail fescue from seeding in 2023, and because of the slow, high heat method used, we hypothesize that the seed bank may have been negatively affected. Laboratory tests done on seed viability found that buried rattail fescue seeds died if soil temperatures reached 155°F (Howard 2006). IAE staff seeded the flame weeded patches in the fall, with more details in section 4.2.1. Seed.



Figure 6. (l-r) Tyler Roberts flame weeding; results of flame weeding rattail fescue (*Vulpia myuros*).

4.2. Planting

4.2.1. Seed

On October 31, IAE staff broadcast seeded the 0.05-acre patch where rattail fescue was flame weeded (see 4.1.3 Flame weeding). Staff seeded 0.5 lbs of a grass seed mix using belly bags. The species list can be found in Table 1.

Table 1. Native seed mix broadcast at Herbert Farm and Natural Area in October 2023.

Scientific name	Common Name	Duration	Growth habit	Percent of mix (%)
<i>Agrostis exarata</i>	spike bentgrass	Perennial	grass	12
<i>Beckmannia syzigachne</i>	American sloughgrass	Annual	grass	4
<i>Bromus sitchensis</i>	Alaska brome	perennial	grass	12
<i>Carex densa</i>	dense sedge	perennial	sedge	5
<i>Carex tumulicola</i>	splitawn sedge	perennial	sedge	1
<i>Carex unilateralis</i>	lateral sedge	perennial	sedge	3
<i>Danthonia californica</i>	California oatgrass	perennial	grass	20
<i>Deschampsia cespitosa</i>	tufted hairgrass	perennial	grass	10
<i>Elymus glaucus</i>	blue wildrye	perennial	grass	11
<i>Festuca roemerii</i>	Roemer’s fescue	Perennial	grass	0
<i>Hordeum brachyantherum</i>	meadow barley	perennial	grass	10
<i>Juncus bufonius</i>	toad rush	annual	rush	4
<i>Juncus occidentalis</i>	poverty rush	perennial	rush	4
<i>Koeleria macrantha</i>	pine Junegrass	perennial	grass	2
<i>Poa secunda</i>	pine bluegrass	perennial	grass	2

4.2.2. Plugs

On December 7, 16 volunteers, an eight-person AmeriCorps team, and five IAE staff members planted 1,470 Nelson’s checkermallow plugs in north prairie (Figure 7). The plugs were planted next to an existing Nelson’s checkermallow population introduced as plugs in 2020. The 2020 Nelson’s checkermallow plugs are now mature, well-established individuals, suggesting that conditions at this location are well-suited for the species.



Figure 7. (l-r) Americorps crew with plugs at Herbert Farm and Natural Area; volunteers planting Nelson’s checkermallow (*Sidalcea nelsoniana*). Photos by Emily Day.

5. MONITORING

5.1 Weed mapping

Throughout 2023, IAE staff collected GPS points for weed species across HFNA. As HFNA transitions out of the active restoration stage, the goal was to provide land managers quantitative data for ongoing management of the site.

In the north prairie, woody weeds such as oneseed hawthorn (*Crataegus monogyna*) and Himalayan blackberry (*Rubus bifrons*) are of highest concern, as they can slowly transition the prairie from early successional habitat into shrub and forestland (Figure 8). Priority weed species in west prairie are common sheep sorrel (*Rumex acetosella*), common St. Johnswort (*Hypericum perforatum*), pineapple weed (*Matricaria discoidea*), and stinking chamomile (*Anthemis cotula*) (Figure 9). Prickly lettuce (*Lactuca serriola*) is a priority in north prairie; bull thistle (*Cirsium vulgare*) and common velvetgrass (*Holcus lanatus*) in south prairie; and field bindweed (*Convolvulus arvensis*) and common sheep sorrel in east prairie (Figure 9).

Finally, the riparian area suffers from common wetland weeds, including Himalayan blackberry and reed canarygrass (Figure 10).

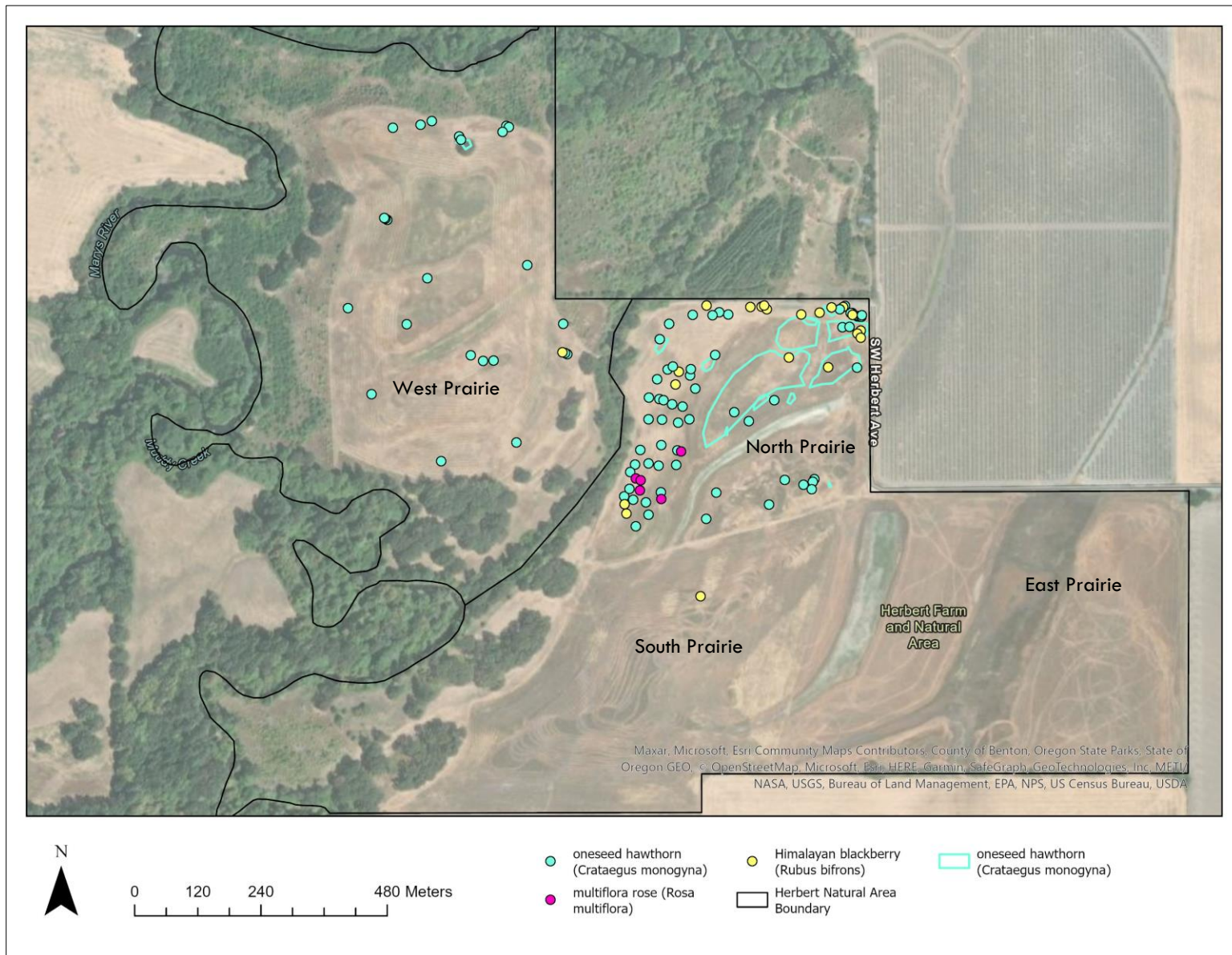


Figure 8. Woody non-native species in prairies at Herbert Farm Natural Area.

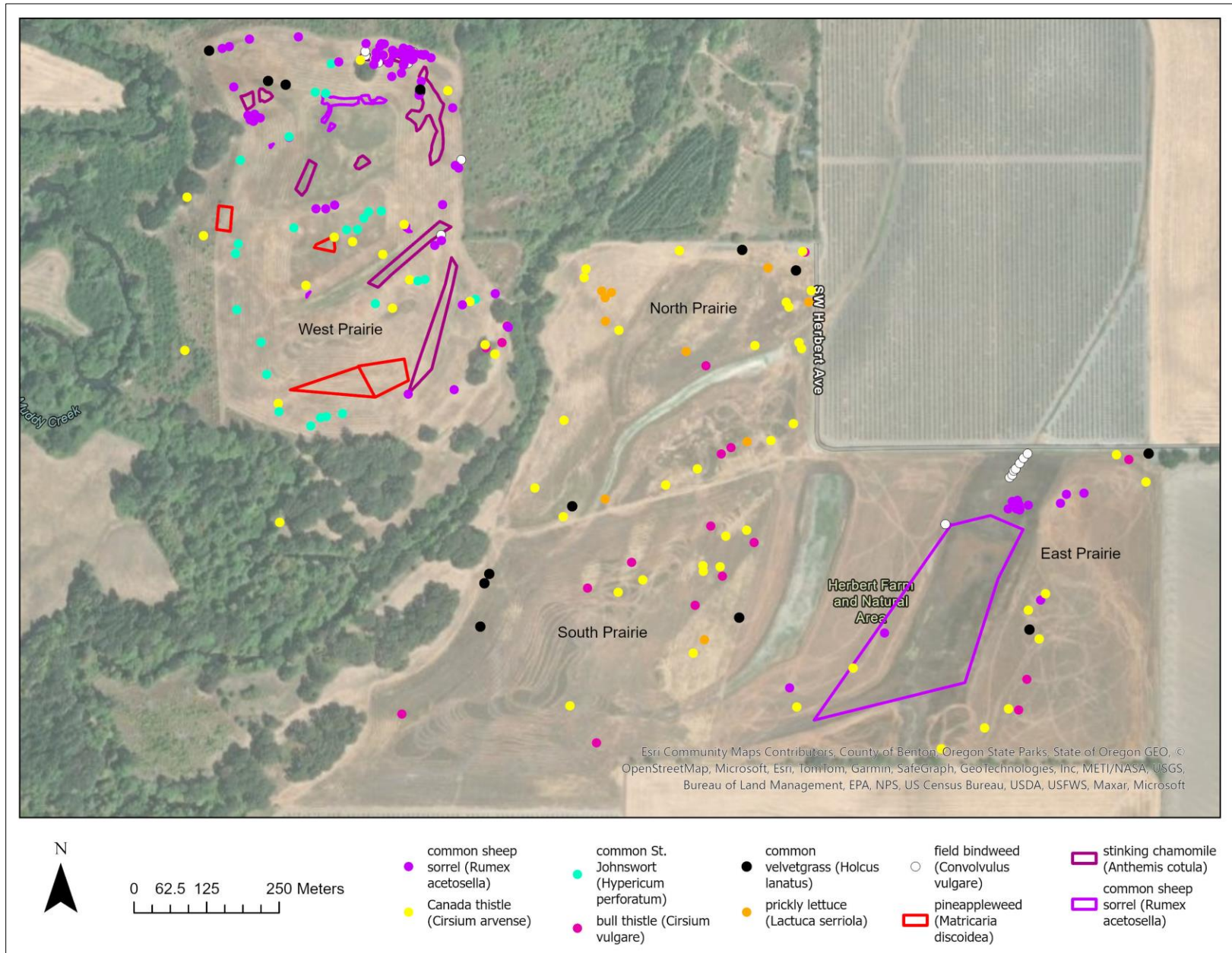


Figure 9. Prairie weed species at Herbert Farm Natural Area.

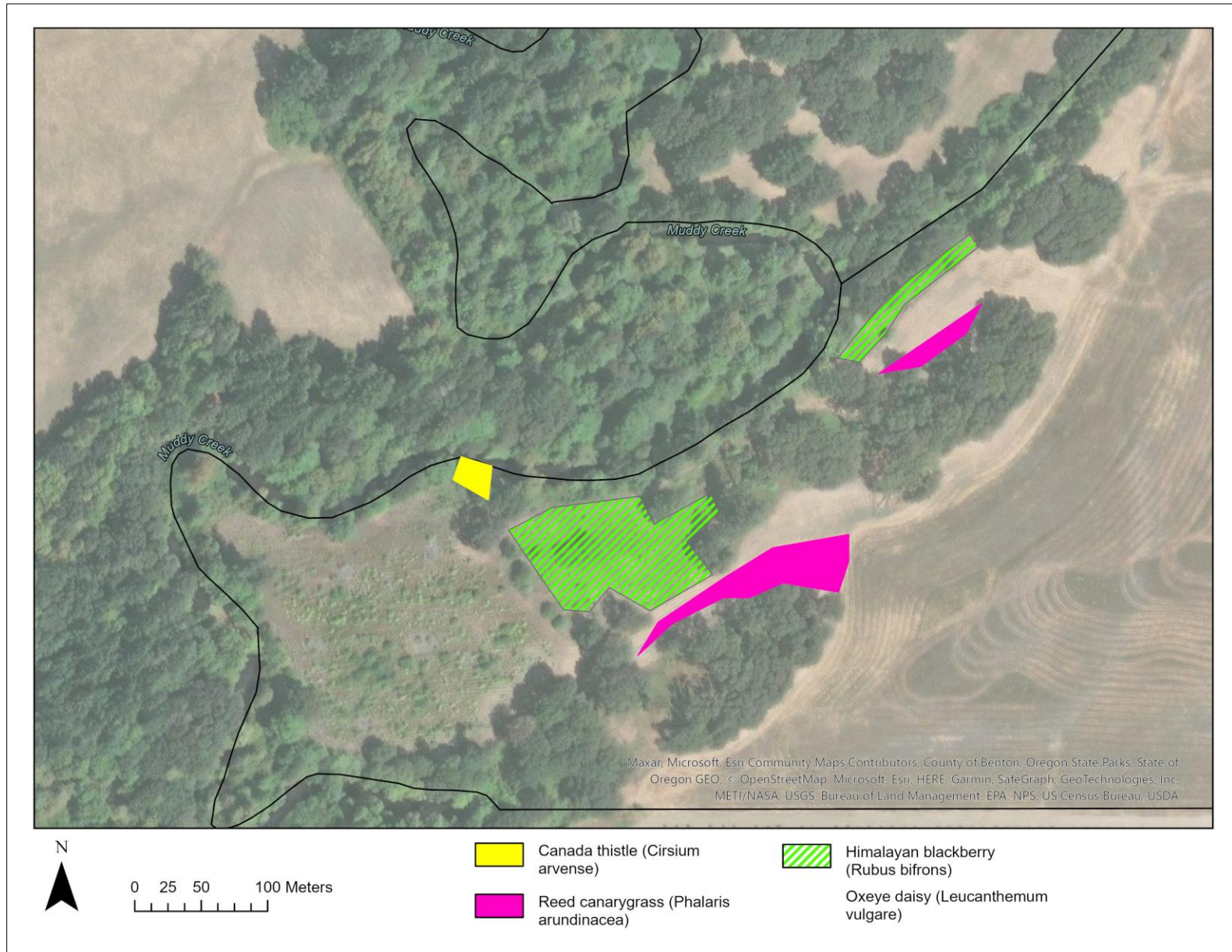


Figure 10. Weed species distribution in the riparian area of Herbert Farm Natural Area.

5.2 Vegetation monitoring

From June 26-29, IAE staff conducted follow-up monitoring on the Phase I restoration area to track progress on prairie vegetation communities and riparian planting survival rates.

5.2.1 Prairie vegetation community surveys

For the prairie surveys, IAE staff randomly selected points within the Phase I prairies, then estimated percent cover of all plant species, bare ground, moss, and litter within a 2 x 2 m plot (Table 2). Any species with less than 0.5% cover was recorded as trace. The full monitoring protocol can be found in Appendix 3.

Table 2. Vegetation cover in monitored plots in Phase I prairies at Herbert Farm Natural Area in 2013, 2017, and 2023.

Area	Map Code	# of Plots	Year	Percent (%) Vegetative Cover (Absolute)			
				Native	Exotic	Shrub/Tree	Thatch/Litter
Upland (2 acres)	5	5	2013	33.4	51.6	9.4	9.8
			2017	21.5	66.7	16.1	17
			2023	9	30	21	50
Wet prairie (2 acres)	4	5	2013	15.3	79.7	1.6	8
			2017	47.9	57.1	0	5.6
			2023	27	21	6	50
Upland Prairie and wet swales (37 acres)	2	15	2013	0	89.7	0	1
			2017	83.2	10.4	0	13.4
			2023	29	17	0	57

Generally, the Phase I prairies saw a decrease in native vegetative cover since 2017 (Figure 11). The high native plant cover in that year was likely due to the culmination of three years of seeding in 2014, 2015, and 2016, and the prescribed burn in the upland prairie in September 2016 (Moore 2017). Unlike what we have seen in many Willamette Valley prairies, it does not appear that introduced species have replaced the native vegetation. There has generally been a decline in exotic vegetative cover since restoration began (Figure 11). Instead, the data suggest that litter and thatch buildup, likely from a lack of fire on the landscape, is reducing habitat availability.

Since fire has not been available on the landscape, contractors have been mowing the prairies, which has successfully prevented shrubs and trees from establishing (Figure 11). The upland prairie closest to the

river (Figure 2, map code 5) has seen the most woody encroachment, with a 30% increase since 2017 (Table 2).

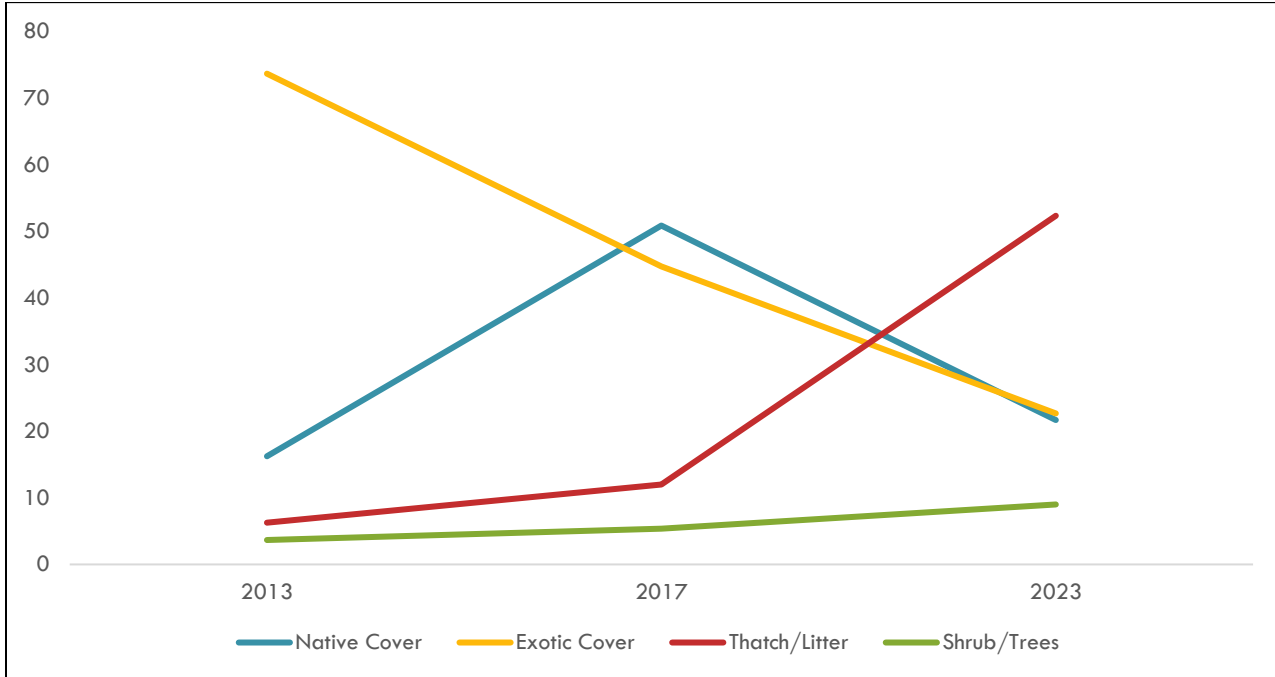


Figure 11. Average percent cover of native and exotic vegetation, thatch, shrubs, and trees in the Phase I prairies at Herbert Farm Natural Area.

5.2.2 Riparian plantings

There were two elements to the riparian surveys: a 5 x 5 m plot, and a 50 m transect. In each 5 x 5 m plot, staff estimated absolute percent cover of all rooted trees and shrubs, invasive plants, litter, and bare ground (Table 3). Staff then followed the northernmost transect for 50 m and counted and identified each surviving tree or shrub along the planting row (Table 4). Both surveys were done in high density and low-density planting areas. The full monitoring protocol can be found in Appendix 3.

Table 3. Percent cover for vegetative species in random 5 x 5 m plots at Herbert Farm Natural Area.

Density	Year	Native tree cover (%)	Native shrub cover (%)	Invasive cover (%)	Canopy cover (%)
High density	2013	1.02	0.63	10.19	23
	2016	3.56	5.57	3.68	7.1
	2023	32.88	43.36	8.85	82.27
Low density	2013	0.77	0.01	3.66	7.78
	2016	2.33	0.4	0.57	1.76
	2023	4.42	4.91	0.28	36.53

Table 4. Trees and shrubs per meter along 50 m transects at Herbert Farm Natural Area.

Density	Year	Shrubs per meter	Trees per meter	Species per meter
High density	2016	0.41	0.21	0.14
	2023	0.35	0.22	0.17
Low density	2016	0.12	0.26	0.09
	2023	0.08	0.22	0.09

In both high-density and low-density planting areas, tree, shrubs, and canopy covered increased at HFNA since 2013 (Figure 12). However, the rate of change was exponentially faster in high-density planting areas, with almost full canopy closure (82%) achieved in 10 years. This contrasts with the low-density plantings that have an average of 35% canopy closure in the same period.

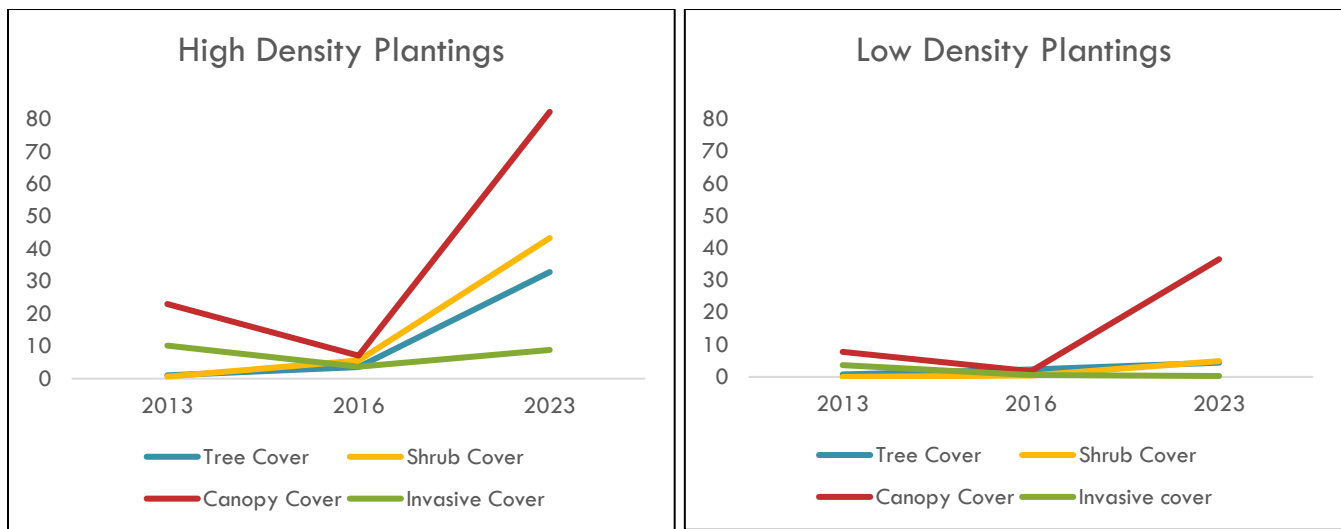


Figure 12. Percent cover of native trees, shrubs, canopy, and invasive species in both high-density and low-density planting plots.

One of the arguments made for investing the additional funds in high-density plantings was to reduce the need for chemical management of invasive species. Ten years later, this approach seems to have been successful. The high-density planting areas are now impenetrable and are not sprayed, yet invasive species only average 10% cover in the plots. The high canopy cover will likely restrict their expansion or eventually shade them out completely.

5.3 Streaked horned lark

Bob Altman monitored streaked horned larks from May-August 2023 (Altman 2023). Altman detected 30 males, 18 females, and 10 unidentified streaked horned larks. Altman notes that the streaked horned lark population appears to have reached its peak in 2020 and 2021 and has declined ever since (Figure 13). This timing correlates with the eastern fields transitioning from fallow to vegetated through 2021 and 2022, culminating in a well-established prairie. Most sightings at HFNA were in the east prairie

(Figure 14). To protect streaked horned larks, we caution against developing any trails or park infrastructure in the eastern portion of HFNA.

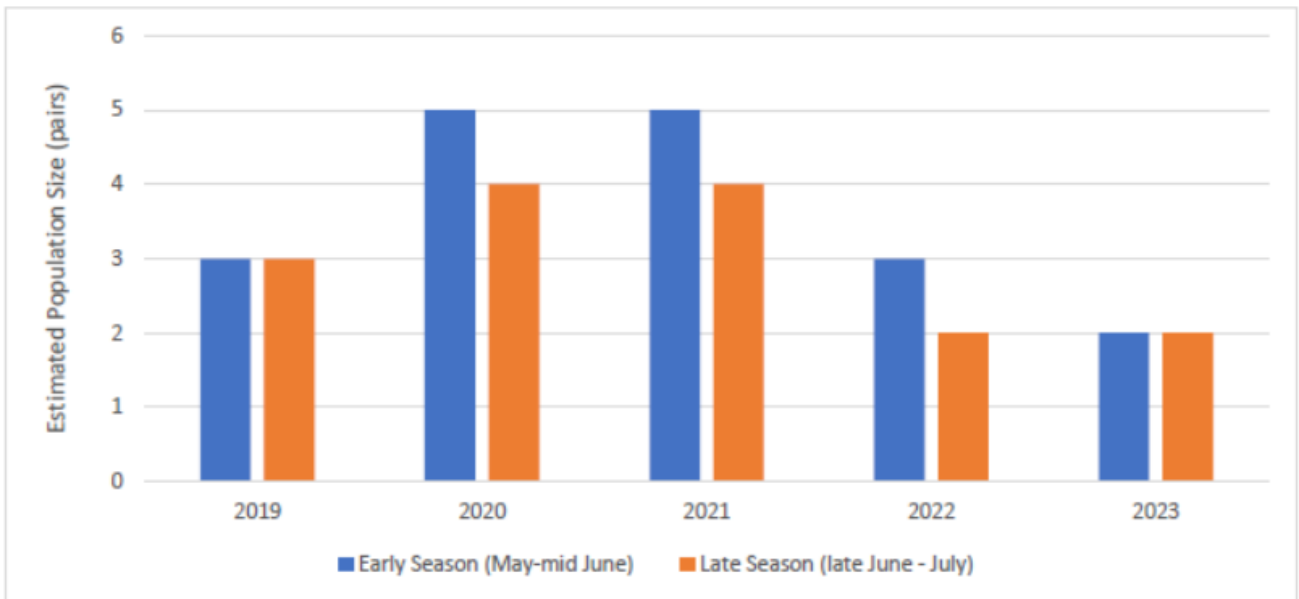


Figure 13. Estimated population sizes of streaked horned larks at Herbert Farm, 2019-2023 (Altman 2023)



Figure 14. Location of georeferenced streaked horned larks at Herbert Farm and Natural Area. Red: males; blue: females; yellow: unknown

6. OUTREACH

Sara Alaica led two public tours of HFNA on June 10 and 14 (Figure 15). Over two dozen members of the Salem and Eugene Native Plant Societies joined IAE board members and staff to enjoy the summer wildflowers and learn about the important work being done on behalf of wildlife and threatened and endangered plant species at HFNA.

On April 19, Sara also presented “Reviving the Wetlands at Herbert Farm,” in the “Growing Local Wetlands Webinar Series” from the Willamette watershed. A full video of the presentation can be found on YouTube: <https://www.youtube.com/watch?v=b6dR-iG9mc4>



Figure 15. (l-r) Members of the Salem Native Plant Society at Herbert Farm (left) enjoyed seeing large-flowered collomia (*Collomia grandiflora*) (center) and Oregon sunshine (*Eriophyllum lanatum*) (right). Photos by Evan Lasley.

7. PHOTO POINTS AND AERIAL VIEWS

Photographs were taken at 18 photo points (Appendix 2) on June 1, 2023 for comparison with photos taken prior to or during restoration.

These photographs help illustrate changes that occurred during restoration. For example, the Phase I prairie transitioned from a ryegrass field in 2013 to a well-established native prairie in 2023 (Figure 16). Restored riparian areas show a similar trajectory from fallow grassland to partially closed canopy within high-density plantings in 2023 (Figure 17). A full set of photos are on file at IAE and available upon request.

These restoration progressions are also illustrated by Google Earth photographs (Figure 18, Figure 19, Figure 20 and Figure 21) with changes described in the captions.

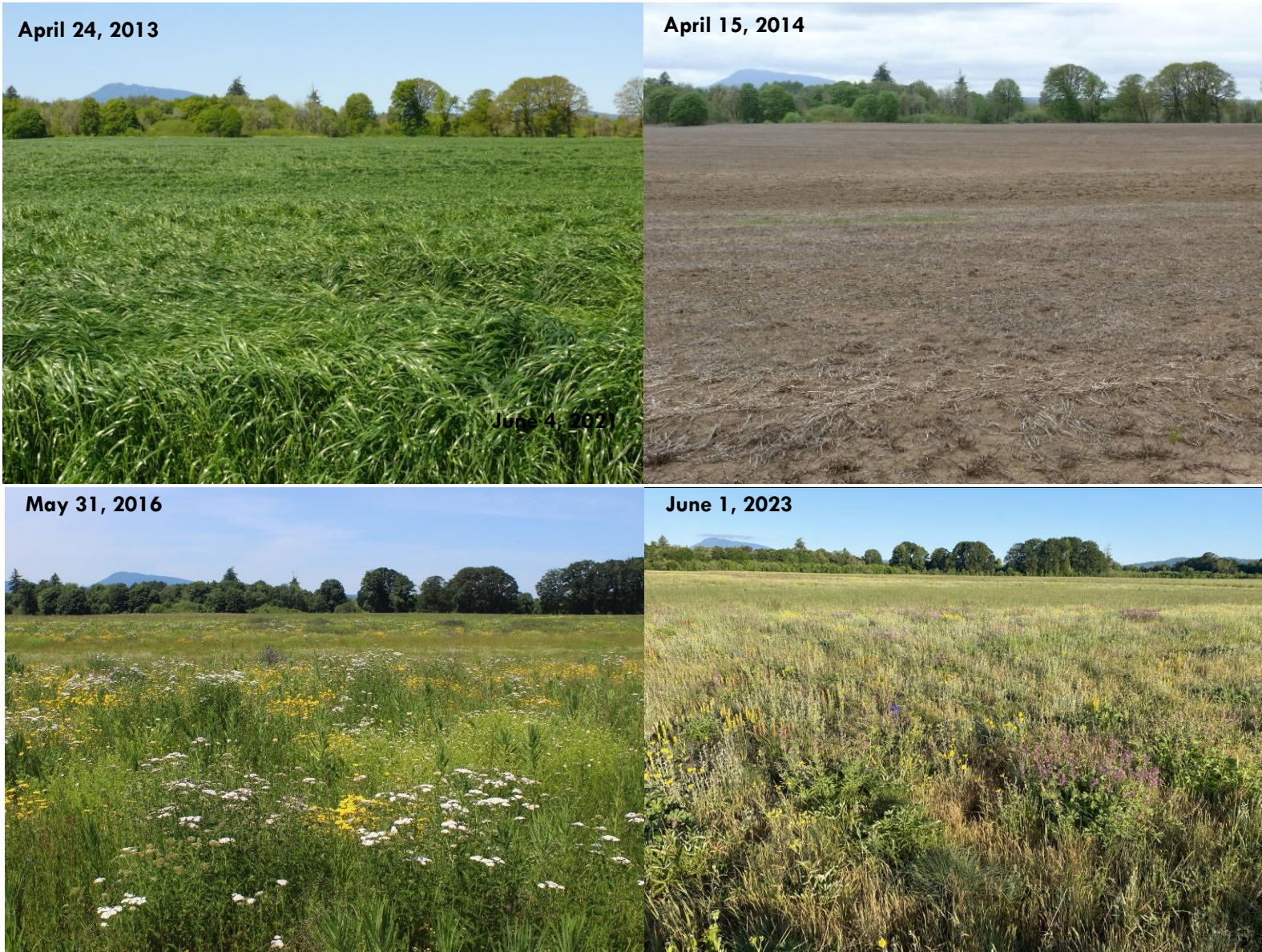


Figure 16. Photo point 1: Progression of upland prairie restoration at Herbert Farm and Natural Area, showing the ryegrass (*Lolium* sp.) field prior to restoration in 2013 (top left); during site preparation (top right); after second year of seeding native forbs and grasses, including common madia (*Madia elegans*, not yet flowering), woolly sunflower (*Eriophyllum lanatum*) and common yarrow (*Achillea millefolium*; bottom left); and well-established prairie checkermallow (*Sidalcea campestris*) and golden paintbrush (*Castilleja levisecta*) in 2023 (bottom right).



Figure 17. Photo point 7: Progression of riparian tree and shrub restoration at Herbert Farm and Natural Area, showing: fallow grassland after one year of site preparation (top left); during the first year of establishing riparian trees and shrubs (top right), two years after planting (bottom left); and canopy closure in 2023 (bottom right).

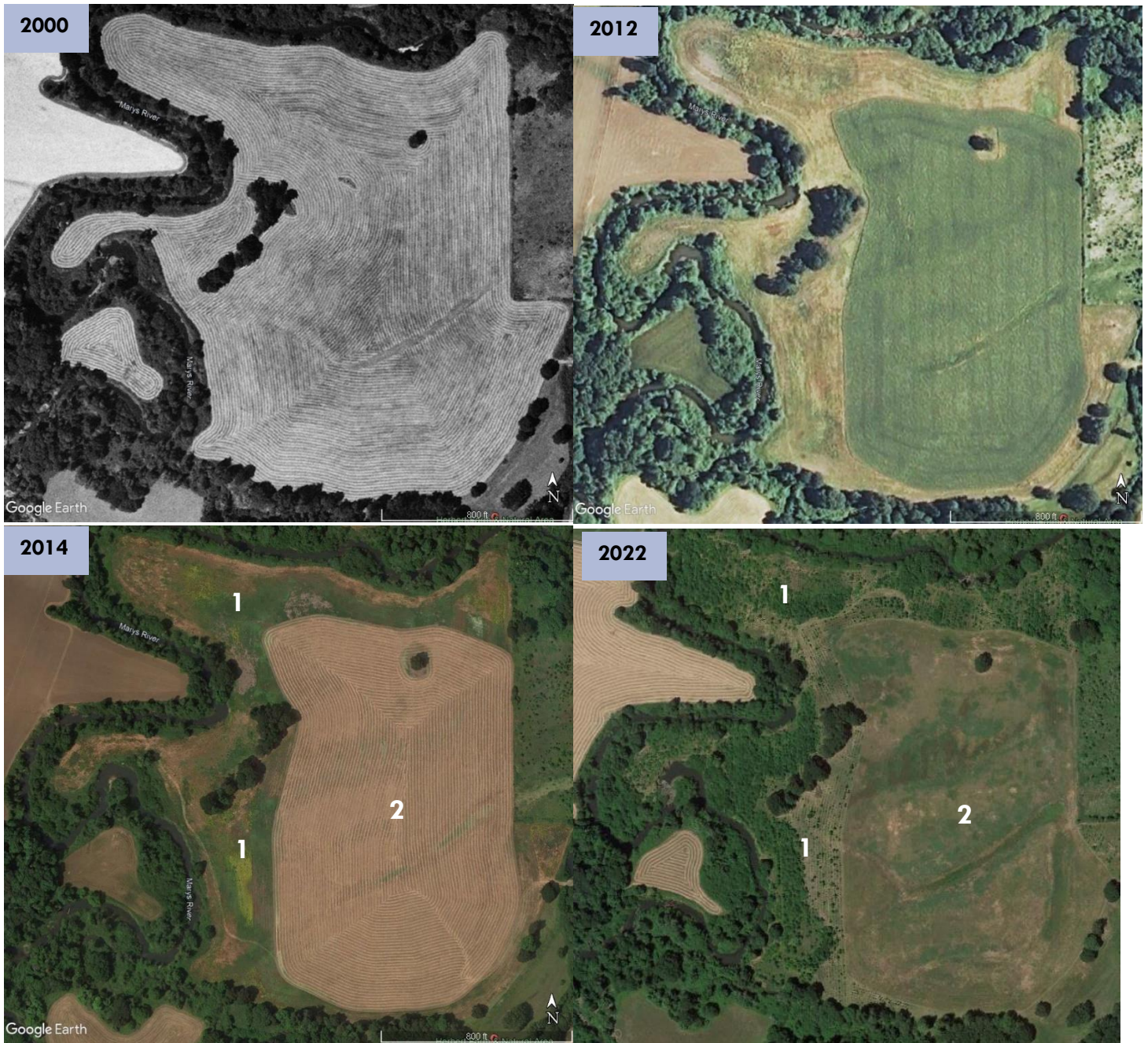


Figure 18. A Google Earth view of Phase I areas in 2000 (upper left), at the time when the City of Corvallis acquired the property, most of which was actively farmed; 2012 (upper right), when farming was restricted to the central 37-acre field and the outer 28-acre portion was fallow grassland; 2014 (lower left) during site preparation before riparian planting (map code 1); and 2022 (lower right) after riparian (map code 1) and prairie restoration (map code 2).



Figure 19. Google Earth view of Phase I riparian plantings (map code 1) in July 2022, showing canopy closure in low-lying parts of the high-density planting areas to the center-left and wider spacing between rows in the low-density plantings to the right.



Figure 20. Google Earth view of Phase II riparian plantings in July 2022 showing early stages of establishment of trees and shrubs. The first plantings were in 2017-2018 (map code 9) and are visible as horizontal lines with scattered larger trees visible as green blobs. The most recent plantings were in 2020-2021 (map codes 8, 15) and now lines between rows are visible as parallel diagonal lines. Other restoration units are labelled including oak savanna (map codes 10, 12), oak woodland (map code 11) and upland prairie (map code 13).



Figure 21. Google Earth view of Phase II restoration areas in 2012 (left), when most of the area was farmed and after restoration in 2022 (right).

8. MANAGEMENT RECOMMENDATIONS/NEXT STEPS

8.1 Manage non-native species

As the 2023 monitoring surveys reveal, managing non-native species over the long-term is an effective strategy for reducing cover, limiting woody encroachment, and preventing new invasions.

Recommendations for 2024

- In spring and fall, spot spray weeds across the site, in particular Canada thistle, Himalayan blackberry, reed canarygrass, and oneseed hawthorn
- In summer, mow between rows in riparian and low-density planting areas (Figure 2, map code 1, 8 and 15)
- Mow all prairies after August 15
- Update existing non-native species distribution map

8.2 Conduct prescribed burn

Some of the oldest restored areas of HFNA have built up more than 50% thatch cover that fills in bare ground, limiting natural seed establishment. A prescribed fire would open bare ground and allow for additional seeding to supplement the plant community.

Recommendations for 2024

- Contract EcoStudies Institute to write HFNA burn plan
- Contract EcoStudies Institute to burn 37 acres of West Prairie (Figure 2, map code 2)

8.3 Increase native species diversity

The 2023 vegetation surveys show that native diversity in Phase I is decreasing. Seeding post-burn, as well as planting bulbs and roots that are difficult to establish from seed will help augment native populations. Also, given that we were able to plant 1,400 plugs in 1 hour at the 2023 fall planting event, the scope of the Nelson's checkermallow planting can be increased to 4,000 additional plugs in the Phase II prairie.

Recommendations for 2024

- Plant 4,000 Nelson's checkermallow plugs in North Prairie to continue augmenting population (Figure 2, map code 6)
- Add additional native seed to Phase I post-burn fields
- Plant a mix of 2,000 bulb and root species such as common camas (*Camassia quamash*) and cat's ears (*Calochortus tolmiei*) that are difficult to establish from seed.

8.4 Create regular volunteer work force

Over 13 volunteers attended the 2023 planting event at Herbert Farm, despite the rain and the event being rescheduled last minute. Given the interest, the accessibility of the site to the public, and the winding down of WWMP funding, creating a volunteer Herbert Farm Crew to hand weed and manage the site would increase management capacity of the site.

Recommendations for 2024

- Run regular weeding/management events at Herbert Farm to create a regular volunteer work crew to get consistent community engagement and support
- Focus efforts on hand weeding around threatened and endangered species such as Phase I populations of Nelson’s checkermallow, golden paintbrush (*Castilleja levisecta*), and Kincaid’s lupine.
- Create a monitoring program for new weed invasions and endangered species trends

8.5 Begin post-WWMP planning

The work recommended in the Phase II restoration plan (2017-2023) is now complete, and the management plan (2011-2021) no longer reflects the on-the-ground conditions at the site.

Recommendations for 2024

- Write 10-year management plan to guide invasive species control and conservation of native, threatened and endangered species.
- Outline any planned development of the site, such as trails or visitor structures, and how best to mitigate the impacts on habitat and wildlife.
- Seek alternate funding sources for continuing conservation work at HFNA

9. REFERENCES

- Alaica, S, P. Moore and A. Esterson. 2023. Herbert Farm and Natural Area restoration – 2022 annual report. Unpublished report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, OR.
- Altman, B. 2022. Streaked horned lark monitoring at Herbert Farm and Natural Area, 2022. Report for Institute for Applied Ecology. Avifauna Northwest. 3 pp.
- City of Corvallis. 2011. Herbert Farm and Natural Area Management Plan. Parks and Recreation Department, City of Corvallis, Oregon. 135 pp.
- Institute for Applied Ecology. 2013. City of Corvallis Herbert Farm and Natural Area Restoration Plan. 45 pp., plus appendices.
- Lapinski, M.K. and M.A. Bahm. 2018. Investigating the potential of using playback and decoys to attract streaked horned lark to unoccupied habitats. Progress Report for U.S. Fish and Wildlife Service. Institute for Applied Ecology, Corvallis, Oregon. vi + 17 pp.
- Menke, C., P. Moore and M. Gisler. 2013. Herbert Farm and Natural Area Restoration Plan Phase I: 2013-2017. Prepared for the City of Corvallis and Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, Oregon. 45 pp. + appendices.
- Moore, P. 2017a. Herbert Farm and Natural Area Restoration Plan; Phase II: 2017-2023. Prepared for the City of Corvallis and Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, Oregon. 58 pp. + appendices.
- Moore, P. 2017b. Evaluating streaked horned lark habitat creation and population response at Herbert Farm. Final report to US Fish and Wildlife Service; Grant Agreement #F14AP00668. Institute for Applied Ecology, Corvallis, Oregon. 30pp.

Moore, P. 2017c. Herbert Farm Restoration Summary 2016/17. Report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, OR. 24 pp.

Moore, P. 2018. Herbert Farm Restoration Summary July-December 2017. Report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, OR. 15 pp.

Moore, P. 2019. Herbert Farm and Natural Area restoration – 2018 annual report. Unpublished report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, OR. 36 pp.

Moore, P. 2020. Herbert Farm and Natural Area restoration – 2019 annual report. Unpublished report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, OR. 42 pp.

Moore, P. and R. Currin. 2021. Herbert Farm and Natural Area restoration – 2020 annual report. Unpublished report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, OR. 45 pp.

Moore, P. and R. Currin. 2022. Herbert Farm and Natural Area restoration – 2021 annual report. Unpublished report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, OR. 38 pp.

Howard, J. 2006. *Vulpia myuros*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <https://www.fs.usda.gov/database/feis/plants/graminoid/vulmyu/all.html>

Wiebush, M. 2022. 2022 City of Corvallis HCP Effectiveness Monitoring. Unpublished report for the City of Corvallis. Institute for Applied Ecology, Corvallis, OR. 29 pp.

APPENDICES

Appendix 1. Summary of restoration actions at Herbert Farm and Natural Area conducted from 2012-2023

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2012	Agriculture, fallow grassland, woodland, upland and wet prairies	1, 2, 3, 4, 5	84	X	X	X	X	A meeting of partner groups was held on site to discuss plans for restoration.
2012	Agriculture, fallow grassland, woodland, upland and wet prairies	1, 2, 3, 4, 5	84	X				A draft restoration plan was prepared for Phase I areas.
2012	Grassland and prairie areas	1, 3, 4, 5, 9, 12	40		X			Fallow grassland, some field edges, oak woodland and prairies were mowed with a tractor, as part of the annual mowing maintenance.
2012	Agriculture	2, 6, 7, 13, 14	84		X			Areas farmed in annual ryegrass under an annual agreement with a local farmer.
2013	Agriculture, fallow grassland, woodland, upland and wet prairies	1, 2, 3, 4, 5	83	X	X	X	X	Phase I restoration plan was finalized.
2013	Agriculture, fallow grassland, woodland, upland and wet prairies	1, 2, 3, 4, 5	83	X				Surveys of baseline vegetation, threatened species and weed distribution were conducted.
2013	Fallow grassland - site preparation for riparian forest	1	22	X				Two broadcast herbicide (Aquamaster) treatments >100 feet from Marys River and three spot spray (Aquamaster & Transline) treatments <100 feet from water.
2013	Riparian shrub-scrub - site preparation for riparian forest	1, 3	7	X				The weedy sections of riparian border, vegetated primarily with blackberry and reed canarygrass, were mowed with a skid steer in summer and regrowth was spot sprayed (Opensight & Rodeo) in the fall.
2013	Wet prairie	4	2	X				Broadcast and spot spray herbicide (Rodeo).

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2013	Upland prairie	5	2	X				Nelson's checkermallow rhizomes were planted along the bank between the upland and wet prairies.
2013	Grassland and prairie areas	3, 5, 9, 12	16		X			Annual mowing maintenance.
2013	Agriculture - site preparation for prairie	2	37	X	X			Farming ceased after the 2013 harvest and pre-emergent herbicide was broadcast in the fall.
2014	Riparian shrub-scrub - site preparation for riparian forest	1, 3	29	X			X	Two broadcast (Rodeo and Rodeo/Escort) and spot spray herbicide treatments (Rodeo and Renovate). Selected portions of riparian margin were mowed with a skid steer. A native grass seed mix was prepared and broadcast in the fall.
2014	Former agriculture converted to upland prairie and wet prairie swales	2	37	X			X	Two broadcast herbicide (Rodeo and Rodeo/Escort) treatments. A seed mix of native forbs and Roemer's fescue was prepared and broadcast in the fall.
2014	Wet prairie	4	2	X				Two broadcast and spot spray herbicide treatments. Native seed was broadcast in the fall.
2014	Upland prairie	5	2	X				Seed of threatened species was collected for propagation.
2014	Agriculture - site preparation for prairie	6	25		X		X	Farming ceased after the 2014 harvest and the area was broadcast with herbicide in the fall.
2014	Restoration areas	1, 2, 3, 4, 5	83	X	X			IAE and the City hosted a visit by elders of the Confederated Tribes of Grand Ronde as part of the Plants for People project. Photo points were established for restoration monitoring.
2014	Grassland and prairie areas	3, 4, 5, 9, 12	18		X			Annual mowing maintenance.
2014 /2015	Agriculture, fallow grassland, riparian forest and shrub-scrub, woodland, upland and wet prairies	All zones		X			X	An archaeological survey was conducted to identify cultural resources. After consultation, Bonneville Power Administration gave permission for the use of ground-disturbing restoration techniques. Planning started for Phase II restoration.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2015	Former fallow grassland and shrub-scrub converted to riparian forest	1, 3	29	X	X		X	Trees and shrubs were planted in 22 acres of high density and 7 acres of low density plantings in March. Competition from weeds and grasses was reduced for the new seedlings by spot spraying and mowing (by hand and tractor) in summer and fall. Some hand watering in the low density plantings helped alleviate drought conditions. Tree survival was monitored.
2015	Upland prairie and wet prairie swales	2	37	X		X		Herbicide treatments included broadcast spraying (Select Max) of grasses over the whole prairie and sow thistle/prickly lettuce in the northern 13 acres (Stinger), and spot spraying (and dead-heading) of thistles throughout. Native forb and grass seed mixes for upland and wet swales were prepared and drilled in the fall.
2015	Upland and wet prairie	4, 5	4	X		X		Limited spot spraying of reed canarygrass and thistles occurred. A fire line was mowed around the upland prairie in anticipation of a prescribed burn, but the burn was not achieved. Native seed, including Nelson's checkermallow, was drilled in the wet prairie in the fall.
2015	Agriculture - site preparation for prairie	6	25	X				A broadcast herbicide (Rodeo) treatment was conducted in the fall.
2015	Fallow grassland and shrub-scrub - site preparation for riparian forest	9	4.5	X				Blackberry and reed canarygrass patches in the riparian edge were mowed with a skid steer. Weedy fallow grassland was treated by broadcasting and spot spraying herbicide (Rodeo, Habitat, Renovate).
2015	Streaked horned lark experiment	7	1	X	X		X	Farming ceased in October and experimental plots marked out for comparing combinations of herbicide, mowing and disking to create streaked horned lark habitat. Herbicide and harrow (in lieu of disking) treatments commenced in November.
2015	Grassland and prairie areas	3, 4, 5, 12	14		X			Annual mowing maintenance.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2016	Riparian forest	1	27	X			X	A second cohort of trees and shrubs were inter-planted to offset mortality from the first year. Ongoing spot spraying and mowing maintenance, including mowing high-density area twice. Tree survival was monitored. Additional spot spraying and dead-heading of thistles occurred in summer-fall.
2016	Riparian, woodland, upland and wet prairies	1, 2, 3, 4, 5	83	X				Surveys of riparian vegetation, threatened species and weed distribution were conducted for comparison with 2013 baseline.
2016	Upland prairie and wet prairie swales	2	37	X		X		The northern 13 acres was mowed to limit flowering of an infestation of stinking chamomile, prickly lettuce and sow thistle. Two spot spray treatments and dead-heading of thistles occurred in summer-fall in this zone. Supplementary seed of forb and grasses in upland and wet swale mixes was broadcast in the 13-acre area. Rushes were planted in the southern swales.
2016	Fir-dominated woodland	3	4		X			Douglas fir trees were girdled to release oaks from competition.
2016	Wet prairie	4	2	X				Limited spot spraying of reed canarygrass patches. Bulbs and bare root of native forbs were planted in the fall.
2016	Upland prairie	5	2	X	X	X	X	Seedling shrubs were spot sprayed, a fire line was mowed, and a prescribed burn conducted in late September. Emerging weeds and non-native grasses were treated by broadcasting herbicide (Rodeo). Seed of native forbs, including Kincaid's lupine and golden paintbrush, and grasses were drilled in October. Kincaid's lupine plugs were planted in spring and peacock larkspur plugs, and bulbs and bare root of other native forbs, were planted in fall.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2016	Former agriculture - site preparation for prairie	6	25	X		X	X	A survey of anadromous fish using two swales was conducted in February. Three broadcast and spot spray treatments targeted weedy forbs and regrowth of ryegrass. Berms were constructed to flood swales in the winter and create streaked horned lark habitat. Three seed mixes, including forbs of low stature, were drilled on 20 acres in the fall. Bulbs and bare root of native forbs were also planted.
2016	Fallow grassland and shrub-scrub - site preparation for riparian forest	9	4.5	X				Two broadcast (Rodeo/Renovate, Stinger) and three spot spray herbicide treatments were conducted through the year, and a graminoid seed mix was broadcast in the fall.
2016	Streaked horned lark experiment	7	1	X			X	Spring and fall treatments comparing combinations of herbicide, mowing and disking. The streaked horned lark population was monitored here and throughout Herbert Farm (April-August).
2016	Grassland and prairie areas	3, 4, 12	10		X			Annual mowing maintenance.
2017	Agriculture, fallow grassland, woodland, upland and wet prairies	6, 7, 8, 9, 10, 11, 12, 13, 14	130	X	X	X	X	Phase II restoration plan was finalized.
2017	Upland and wet prairies	2, 4, 5	41	X				Surveys of prairie vegetation were conducted for comparison with 2013 baseline. Photo points were repeated in all restoration areas.
2017	Riparian forest	1	27	X				Ongoing spot spraying and mowing maintenance occurred, and tree survival was monitored. Additional spot spraying and dead-heading of thistles occurred in summer-fall, and blackberry in the fall.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2017	Upland prairie and wet prairie swales	2	37	X		X		Spot spray treatments targeted thistles and velvet grass in spring and summer. A fire line was mowed in August and the whole prairie mowed high prior to a prescribed burn in September. In the fall, upland areas were drilled with a native forb/grass mix, including Kincaid's lupine and golden paintbrush in the southern zones. Wet swales were broadcast seeded. Bulbs and bare roots of native plants were also planted in the fall.
2017	Wet prairie	4	2	X				Spot spray treatments targeted reed canarygrass. Milkweed was planted in spring.
2017	Upland prairie	5	2	X	X	X	X	Kincaid's lupine plugs were planted in spring.
2017	Former agriculture - site preparation for prairie	6	24	X		X	X	The fall seeding was unsuccessful because of heavy flooding in the winter. Site preparation resumed with three broadcast (Rodeo) and spot spray herbicide treatments.
2017	Riparian forest	9	4.5	X				Trees and shrubs were planted in high density rows in February. Competition from weeds and grasses was reduced for the new seedlings by spot spraying and hand mowing in summer and fall.
2017	Streaked horned lark experiment	7	1	X			X	Spring and fall treatments comparing combinations of herbicide, mowing and disking. The streaked horned lark population was monitored here and throughout Herbert Farm (April-August).
2017	Agriculture - site preparation for prairie	14	23		X			Farming ceased after the 2017 harvest and the area was partially broadcast with herbicide in the winter as part of mitigation for airport runway development on streaked horned lark habitat. This area was managed by City staff from the airport.
2017	Grassland and prairie areas	3, 4, 12	18		X			Annual mowing maintenance.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2018	Riparian forest	1	27	X				Ongoing spot spraying and mowing maintenance occurred, and tree survival was monitored. Additional spot spraying and dead-heading of thistles occurred in summer-fall.
2018	Upland prairie and wet prairie swales	2	37	X			X	Spot spray treatments and mowing. Plant and seed Kincaid's lupine, plant Nelson's checkermallow, bare root materials, including camas and yampah.
2018	Wet prairie	4	2	X				Spot spray treatments.
2018	Upland prairie	5	2	X				Spot spray treatments.
2018	Former agriculture converted to upland prairie and wet prairie swales	6	25	X		X		Site preparation continued with three broadcasts (Rodeo, Rodeo/Escort, Rodeo) and one spot spray herbicide treatment. Two low density/low stature seed mixes of native forbs and Roemer's fescue were drilled or broadcast in the fall.
2018	Riparian forest	9	4.5	X				A second cohort of trees and shrubs were inter-planted in February to offset mortality from the first year. Ongoing spot spraying and mowing maintenance occurred, and tree survival was monitored.
2018	Riparian shrub-scrub - site preparation for riparian forest	8	0.5	X				Blackberry and reed canarygrass patches in the riparian edge were mowed with a skid steer.
2018	Oak woodland	11	6	X	X			Douglas fir trees were felled and removed to release oaks from competition. A woodland forb/grass seed mix was broadcast in the understory.
2018	Grassland - site preparation for prairie	10, 12	6	X				Grassland was broadcast with herbicide (Rodeo/Escort) in fall.
2018	Fallow grassland	7	1	X	X			The streaked horned lark habitat experiment ended in 2017 and this area became fallow grassland in 2018. The strips were mowed in late summer and treated with herbicide in fall as part of the larger prairie site preparation area (below).

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2018	Agriculture - site preparation for prairie	13	61	X				Farming ceased after the 2018 harvest and the area was broadcast with pre-emergent herbicide (Rodeo/Plateau) in fall.
2018	Agriculture - site preparation for prairie	14	23		X			No treatments occurred during 2018.
2018	Grassland and prairie areas	3	18		X			Annual mowing maintenance by City was limited to Phase I oak woodland. Existing prairies were not mowed.
2019	Riparian forest	1	27	X				Ongoing spot spraying maintenance of riparian plantings in May and mowing in June. Other spot spraying and hand weeding in Sep-Oct. Tree survival was monitored in November.
2019	Upland prairie and wet prairie swales	2	37	X			X	Golden paintbrush was surveyed in May. Spot spray treatments in May-August and most of the prairie was mowed in August. 54 peacock larkspur were planted in October.
2019	Oak woodland	3	4	X				Thin-leaved peavine plots were monitored in May.
2019	Wet prairie	4	2	X				Spot spray treatments in August-September targeted reed canarygrass, thistles and encroaching shrub and tree seedlings. A fire line was mowed in late August in preparation for a prescribed burn which was deferred until 2020. Tall meadow-rue were planted in November.
2019	Upland prairie	5	2	X				Golden paintbrush was surveyed in May. Spot spray treatments in August targeted shrub and tree seedlings. A fire line was mowed in preparation for a prescribed burn which was deferred until 2020. Woodland strawberry was planted in November.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2019	Upland prairie and wet prairie swales	6	25	X		X	X	Three partial broadcast treatments with grass-specific herbicide (Poast, Select Max and Fusilade) in April, June and October, and glyphosate on 2-3 acres to maintain bare ground areas. Spot spraying broadleaf weeds in May, June and September and mowing in late August. Native seed mixes were drilled or broadcast seeded over 21 acres in Sep-Oct. Kincaid's lupine was also seeded.
2019	Riparian forest	9	4.5	X				Ongoing spot spraying in May and mowing maintenance of riparian plantings in June, with further spot spraying in July. Tree survival was monitored in November.
2019	Oak woodland	11	6	X				Limited spot spraying of blackberry and broadleaf weeds in July.
2019	Prairie and riparian site preparation	8, 10, 12, 15	6	X				Broadcast spray of Rodeo on 6 acres in April and June, Rodeo/Escort on 3.5 acres and Rodeo on 2.5 acres in October. Spot spraying of reed canarygrass, seedling shrubs and broadleaf weeds in August-September. Wood debris cleared. Native grass seed was broadcast over 2 acres of riparian site preparation area.
2019	Prairie site preparation	7, 13	61	X				Broadcast spray of Rodeo in June, partial spray of swales in August, and broadcast of Rodeo/Escort mix in October.
2019	Airport mitigation prairie site preparation	14	23	X	X			Partial broadcast herbicide spray in winter, mow and harrow in late May, partial broadcast in July. IAE start managing. Broadcast spray of Rodeo/Escort mix in October and a mow in late November over the whole field. A sound and decoy system and streaked horned lark monitoring program ran from April-August.
2020	Riparian forest	1	27	X				Ongoing spot spraying maintenance of riparian plantings in May and mowing in June. Other spot spray in October. A partner tour of all areas was held in August.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2020	Upland prairie and wet prairie swales	2	37	X			X	Golden paintbrush and Kincaid's lupine populations were surveyed in May. Infestation of vetch hand weeded or weed-whacked near these rare species. Spot spray treatments in May-June and October. Perimeter was mowed in June and whole prairie in October.
2020	Wet prairie	4	2	X	X		X	Prescribed burn planning meeting held in August, but burn was deferred to 2021. Spot spray treatments in August targeted reed canarygrass, thistles and encroaching shrub and tree seedlings. Mowed in October.
2020	Upland prairie	5	2	X			X	Golden paintbrush and Kincaid's lupine were surveyed in May. Spot spray treatments in August targeted shrub and tree seedlings. Mowed in October.
2020	Upland prairie and wet prairie swales	6	25	X		X	X	Two broadcast herbicide treatments (Rodeo) in one swale and a fallow area near road in June and October. Spot spraying broadleaf weeds in March, May, June, September, and October. Mow berms in June and 20 acres in October. Native seed mixes were drilled or broadcast seeded over 5 acres in October. Kincaid's lupine seed was sown in October. Bare root native plants were planted in February, Kincaid's lupine plugs planted in March-April, and Nelson's checkermallow and peacock larkspur were planted in November.
2020	Riparian forest	8, 9, 15	4.5	X				Plant trees and shrubs in new area. Line spray and spot spraying in May and mowing maintenance of riparian plantings in June. Further spot spray around perimeter in October. Tree survival was monitored in November.
2020	Oak woodland	11	5	X				Limited spot spraying of blackberry in October.
2020	Oak savanna	10, 12	4	X		X		Broadcast spray (Rodeo) in June and October. Spot spray in October. Native forb and grass seed was drilled and broadcast in October.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2020	Prairie site preparation	13	61	X		X		Streaked horned larks monitored April-August. Broadcast spray (Rodeo) all or partial areas in April, June, August, and October (Rodeo for seeding areas and Rodeo/Escort in fallow field). Native forbs and Roemer's fescue was seeded by no-till drill and hand broadcast swales in October.
2020	Airport mitigation prairie site preparation	14	23	X				Streaked horned larks monitored April-August. Broadcast spray all or partial areas in April, June, August (Rodeo) and October (Rodeo/Escort).
2021	Riparian forest	1	27	X				Ongoing spot spraying maintenance of riparian plantings in May and limited mowing in June. Other spot spray in September.
2021	Upland prairie and wet prairie swales	2	37	X			X	Spot spray treatments in May-June and September. Perimeter was mowed in June and the whole prairie in October.
2021	Oak woodland	3	4		X			Mowed in November to control shrub encroachment of open areas and camas field. 6 Douglas-fir trees re-girdled and 8 more girdled to release oaks.
2021	Wet prairie	4	2	X	X		X	Spot spray treatments in August targeted reed canarygrass, thistles and encroaching shrub and tree seedlings. A fire line was mowed, and a prescribed burn was conducted in September. Native forbs and grasses were sown with no-till drill and additional grasses hand broadcast in October. Camas and other bulb species were planted in November.
2021	Upland prairie	5	2	X	X		X	Spot spray treatments in August-September targeted shrub and tree seedlings. A fire line was mowed, and a prescribed burn was conducted in September. Post-burn glyphosate spray of upland. Native forbs and grasses were sown with no-till drill and additional grasses hand broadcast in October. Brodiaea bulbs and yampah roots were planted in November.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2021	Upland prairie and wet prairie swales	6	25	X		X	X	Spot spray periphery in March. Two broadcast herbicide treatments (Rodeo) in one swale in June and October. Spot spraying broadleaf weeds in May and grasses in June. Mow berms in June and 20 acres in September. Native seed was broadcast by hand and ATV over 5 acres in October.
2021	Riparian forest	8, 9, 15	6.6	X				Interplanting of trees and shrubs in January in new 2.1-acre riparian restoration area in January. Spot spraying of oxeye daisy in March. Line spray and spot spraying in May and mowing maintenance of riparian plantings in June.
2021	Oak savanna	10, 12	4	X	X	X		Spot spray in March. Broadcast spray patches of reed canarygrass in September. Mowed in September. Grass seed was drilled in October.
2021	Prairie	13	35	X		X	X	Streaked horned larks were monitored April-August. Broadcast spray grass-specific herbicide in April and June. Spot spraying broadleaf weeds in June. Mowed in September. Native grasses seeded by no-till drill in October.
2021	Prairie site preparation	13, 14	49	X	X	X	X	Streaked horned larks monitored April-August. Broadcast herbicide spray in May (Rodeo/Escort) and October (Rodeo). Native grasses and forbs were seeded by no-till drill on the uplands and ATV broadcast in swales in October. A native grass mix was drilled around the field perimeter. Camas planted in November. Damage by vehicle repaired and re-seeded in December.
2022	Riparian forest	1	27	X				Ongoing spot spraying (Rodeo/Vastlan) maintenance of riparian plantings in May and limited mowing in June.
2022	Upland prairie and wet prairie swales	2	37	X	X		X	Spot spray treatments (Transline/Vastlan) in May. Perimeter was mowed in June. HCP area was surveyed for threatened plant species, vegetation plots and weed mapping in May-June. Mowed in August.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2022	Oak woodland	3	4		X			Mowed in August.
2022	Wet prairie	4	2	X	X			HCP area was surveyed for threatened plant species, vegetation plots and weed mapping in May-June. Mowed in August.
2022	Upland prairie	5	2	X	X			HCP area was surveyed for threatened plant species, vegetation plots and weed mapping in May-June. Mowed in August.
2022	Upland prairie and wet prairie swales	6	25	X	X			Spot spray (Transline/Vastlan) periphery in April. Spot spray (Rodeo) broadleaf weeds and grasses in May. Mow berms and access road in June. HCP area was surveyed for threatened plant species, vegetation plots and weed mapping in May-June. Mowed in August. Wet swale sprayed out (Rodeo) and broadcast seeded in October.(
2022	Riparian forest	8, 9, 15	6.6	X				Line spray and spot spraying in May and mowing maintenance of riparian plantings in June. Spot spray in November.
2022	Oak savanna	10, 12	4	X	X			Spot spray (Garlon 3A) in April and May. Mowed in August. Spot sprayed perimeter (Garlon 3A) in November.
2022	Prairie	13	35	X			X	Streaked horned larks were monitored April-August. Spot spray broadleaf weeds in May. Mowed in August.
2022	Prairie	13, 14	49	X			X	Streaked horned larks monitored April-August. Spot spray (Transline/Vastlan) periphery in April-May. Spot spray grasses (Rodeo) in June. Mowed in August. Native grasses seeded by no-till drill in October.
2023	Riparian forest	1	27	X				Vegetation monitoring, photo points and spot spray of riparian plantings in June.

Herbert Farm and Natural Area restoration – 2023 annual report

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2023	Upland prairie and wet prairie swales	2	37	X			X	Vegetation monitoring, photo points and spot spray in June. Weed mapped in July. Perimeter mowed in June by contractors and patchily mowed by ODFW in September.
2023	Oak woodland	3	4	X				Spot sprayed and photo points in June.
2023	Wet prairie	4	2	X				Spot spray in May. Vegetation monitoring, photo points, and spot spray in June. Weed mapped in July.
2023	Upland prairie	5	2	X				Spot spray in May and June. Vegetation monitoring and photo points in June. Weed mapped in July.
2023	Upland prairie and wet prairie swales	6	25	X			X	Spot sprayed and photo points in June. Weed mapped in July. Patchy mow by ODFW in September.
2023	Riparian forest	8, 9, 15	6.6	X				Spot sprayed for reed canarygrass (<i>Phalaris arundinacea</i>) from April to June. Mowed and photo points in June. Spot sprayed for Himalayan blackberry (<i>Rubus armeniacus</i>) in July and August.
2023	Oak savanna	10, 12	4	X				Spot sprayed for reed canarygrass (<i>Phalaris arundinacea</i>) from April to June. Photo points in June. Mowed in July.
2023	Prairie	13	35	X			X	Spot sprayed and photo points in June. Weed mapped in July. ODFW mowed in September.

Herbert Farm and Natural Area restoration – 2023 annual report

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2023	Prairie	14	47	X			X	Weed mapped and flame weeded in April. Spot sprayed and photo points in June. Weed mapped again in July. ODFW mowed in September.

Appendix 2. Photo point locations at Herbert Farm and Natural Area

Photo point coordinates (projection is WGS 1984) and direction of one to four photographs taken at each point.

Photopoint number	Latitude	Longitude	Directions of photos (degrees)			
1	44.521444	-123.295944	186	284	346	84
2	44.520806	-123.295556	210	26	158	
3	44.519833	-123.296361	28	217	300	
4	44.520139	-123.298833	296	12	100	260
5	44.5205	-123.301167	24	75	105	190
6	44.521833	-123.301056	320	17	84	150
7	44.523167	-123.30175	90	120	165	240
RB1	44.523278	-123.300944	55			
RB2	44.523333	-123.300583	282	27	140	175
8	44.524139	-123.296167	180	225	285	326
9	44.524167	-123.300028	200	320	25	95
10	44.522139	-123.299861	346	335	15	80
11	44.516727	-123.299486	220	266	314	
12	44.516859	-123.300122	0	90	180	270
13	44.522015	-123.290778	210	255		
14	44.519009	-123.295266	25	80		
15	44.518323	-123.296837	0	90	180	270
16	44.517308	-123.298805	0	90	180	270
17	44.518403	-123.292639	0	90	180	270
18	44.519695	-123.285466	180	225	265	

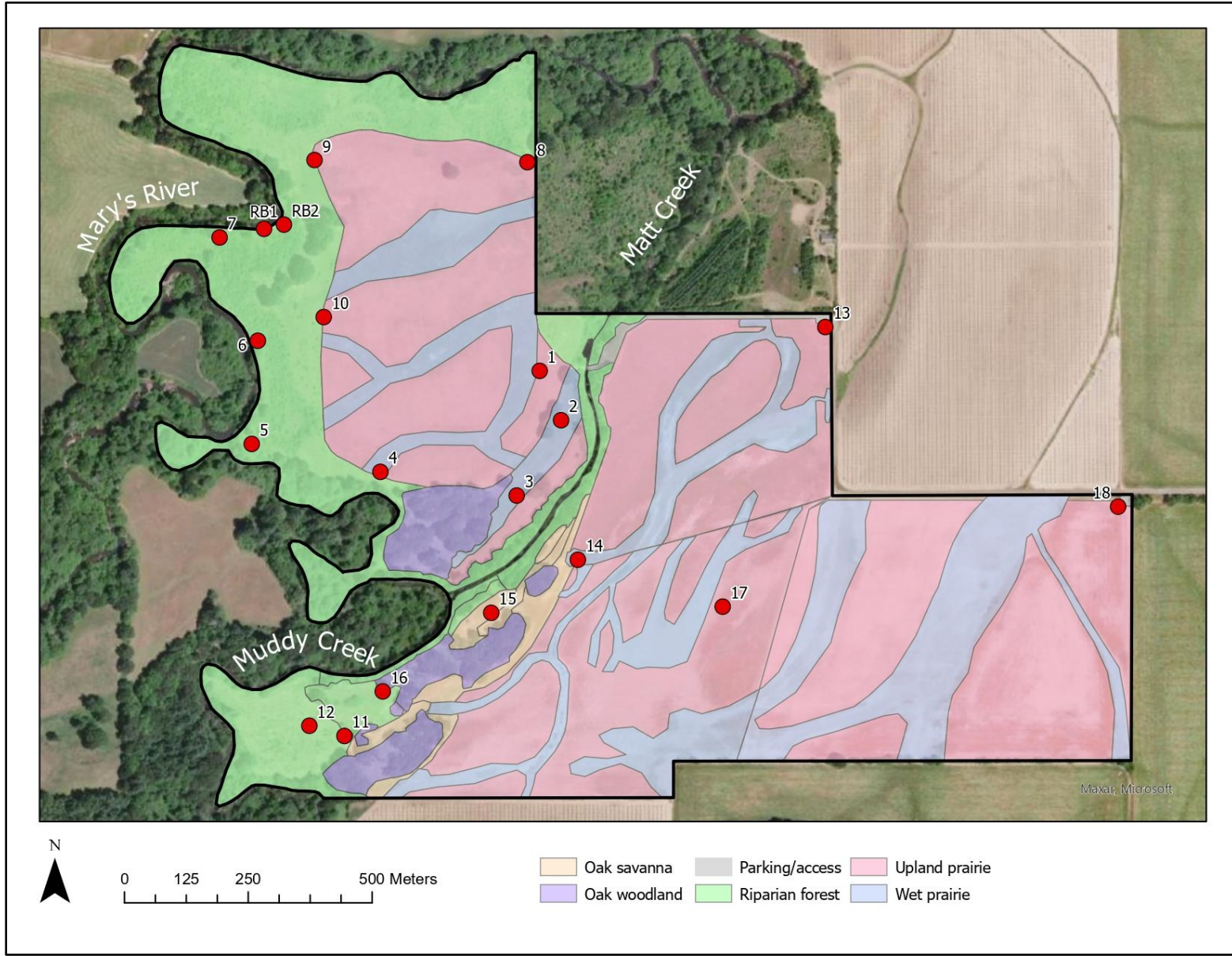


Photo point locations at Herbert Farm and Natural Area.

Appendix 3. Vegetation monitoring protocol

HERBERT FARM VEGETATION MONITORING - PROTOCOL

Objective

The objective of this project is to collect data to assess the effectiveness of restoration efforts in prairie and riparian areas at Herbert Farm. These data will be comparable to baseline data collected in 2013 before restoration efforts began, and data collected on restoration effectiveness in 2016 and 2017 and includes data on tree and shrub survival and plant community composition.

Data collected includes:

1. Plant community composition data and 25 2 x 2 m plots in prairie areas.
2. Cover of native tree and shrub species, a subset of invasive plant species, and total introduced species cover in 30 5 x 5 m plots in riparian restoration areas.
3. Survival data on trees and shrubs along 30 50m transects in riparian restoration areas.

Protocol

Prairie Vegetation Community surveys:

This part of the protocol is to collect data on prairie community composition in the restored prairie and the remnant wet and upland prairie areas. These data will be compared to data collected in previous years to determine the success of restoration activities. In 2023, we took 10 hours over two days to finish these surveys, or 22 person/hours. 10 of those person hours were done by a team of two and included teaching plant ID.

Equipment:

Tablet or smartphone with map of random survey points downloaded on ArcGIS Field Maps

1 30 meter tape

4 candy canes

Compass

Clipboard, pens and pencils, datasheets

Plant ID references

Ziplock bags and sharpies for collecting unknowns

1. At your field site, navigate to the selected random point. While approaching and setting up your plot, you want to be careful not to trample the area you will be surveying.
2. Place a candy cane at the northeast corner of your plot.
3. Use the compass and tape to measure out 2 meters south and place your second candy cane. Repeat to the west, north, and then east (back to the first candy cane.) You want to make sure that your plot is reasonably square and that the sides are each 2 meters long, but you do not want to spend too much time on this step.
4. Once your plot is set up, you will:
 - a. Estimate cover of bare ground, moss, litter, and basal area (should equal 100% cover). A really useful way to think about doing these estimates is to imagine a seed falling into your plot. What is it going to land on? Bare ground? Litter? Another plant? Your goal here is to evaluate how likely a seed is to reach the ground and be able to grow. To estimate basal area, imagine you have

mowed or clipped all the vegetation off at ground level. How much cover do the plant stems make up? Once you have all your estimates, add them up to check that they equal 100% cover.

- i. Note: for a 2 x 2 meter plot, 1% is 20 x 20 cm.
 - b. Identify all plant species. For any species you can't identify in the field, collect specimens and/or take photos of important identifying characteristics and detailed notes for later ID. Make sure you can link specimens to the correct line in the datasheets. Uploading photos to iNaturalist for ID can be useful for confirming suspected ID or to suggest a starting point, but identification using a plant key is more reliable. However, time constraints may make keying-in species impractical, so make sure to balance the time you spend on plant ID with efficiency.
 - c. Estimate percent cover of all plant species (should be at least equal to basal area but can exceed 100% cover). For any species present with less than 0.5% cover, record their cover value as "T" (trace). Once you have finished your cover estimates, add them all up to make sure that they are equal to or greater than your estimate for basal area.
5. Once you finish collecting data, mark your plot as surveyed on the map ("yes"), collect your tape and candy canes and move on to the next plot.

Note: At the beginning of the day or week, have the crew do one or two plots together to calibrate cover estimates and to practice their plant ID together. After calibrating, it will be most efficient to have each crew member work on cover plots solo.

Note: The order that you do these steps depends on you. Some suggestions: For larger plots, focus on functional groups (e.g., identify all grasses, then all forbs). Identifying all species and then going back to estimate cover for each species is usually most efficient. Limit the time you spend on identifying unknown species. Remember that data analysis will be by functional group (e.g. annual grass, perennial forb, etc.) While IDing to species provides the most detailed data, IDing a species to functional group is the most important part of the data.

Riparian surveys

Riparian surveys are to collect data on the success of tree and shrub plantings, and to track introduced species abundance, including a subset of target weeds along the Mary's River. These data will be compared to previous years' data to determine the success of restoration efforts. There are two densities of plantings in the riparian area: high and low. In 2023, we used the same protocol to collect data in both the high and low density plantings. The current protocol works well in low density areas but we suggest developing a revised protocol in high density areas that is more practical for that habitat. In 2023 the survey took us 18 hours total, or 24 team/hours to survey all our riparian points. Because we only had one densiometer, one person floated between groups to take canopy measurements. Most plots were surveyed in teams of 1 or 2, but the last high density plots were done as a team of 4, two people to do the plot, and two people to do densiometer readings and transects. Transects and plots take approximately the same time to survey, and especially in dense areas, the majority of the survey time was spent bushwhacking to and setting up the plots.

Equipment:

Tablet or smartphone with map of random survey points downloaded

1 30 m tape

1 50 m tape

5 candy canes

Compass

Clipboard, pens and pencils, datasheets
Densimeter
Plant ID references
Ziplock bags and sharpies for collecting unknowns

5 x 5 m plots

1. At your field site, navigate to the selected random point. While approaching and setting up your plot, you want to be careful not to trample the area you will be surveying.
2. If your plot falls in an area that is not planted, move it to the nearest area with the correct planting density. Update the location of your point in the field map if you need to move a point to do a survey.
3. Place a candy cane at the northeast corner of your plot.
4. Use the compass and tape to measure out 5 meters south and place your second candy cane. Repeat to the west, north, and then east (back to the first candy cane.) You want to make sure that your plot is reasonably square and that the sides are each 5 meters long, but you do not want to spend too much time on this step.

Note: In the high density planting areas, these plots can be very difficult to set up. The tape is there to help you visualize the 5 x 5 m square, so if you can't run the tape around the whole plot, just do your best to make sure you can confidently identify the area you are surveying.

5. Take four densimeter readings at the center of the plot. Count and record the number of filled squares you see in the densimeter when you hold it chest height (~1.37 m, so if you are short, hold it a little higher than chest height, and if you are tall hold it a little lower than chest height).
Tip: if more than half the squares are filled, it can be easier to count the blue (sky) squares and subtract that number from 24 to get your filled squares.
Tip: the center of the plot is ~3.5m SW of the point in field maps. Densimeter readings can be taken at plots even if other data collection is not currently set up.
6. Record species and *absolute* percent cover of all trees and shrubs rooted in the 5 x 5 m plot. As with plant ID in the prairie vegetation plots, you will want to balance the amount of time you spend on ID with efficiency. If you have any unknowns, make sure to connect samples, photos, or descriptions to the appropriate data on your data sheet.
7. Record *absolute* cover by species for the invasive plants *Cytisus scoparius* (Scotch broom), *Rubus armeniacus* (Himalayan blackberry), *Brachypodium sylvaticum* (false brome), *Phalaris arundinacea* (reed canarygrass), *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), *Hypericum perforatum* (St. Johnswort), *Senecio jacobaea* (tansy ragwort), *Matricaria discoidea* (pineapple weed), and *Convolvulus arvensis* (field bindweed) rooted in the plot.
8. Record total *relative* cover of introduced plant species, litter, and bare ground. You do not need to identify any plants beyond "native" and "introduced." For relative cover, all cover measurements need to add up to 100%. One way to think about the relative cover of your plot is to imagine looking down directly at the plot and documenting what you would see first.
Tip: one way to make estimating the relative cover of introduced plants easier is to estimate the relative cover of native plants (because native plants were often the least abundant, they were the easiest to visualize percent cover of) and then subtract native plant cover from the total relative plant cover to get your introduced species cover.
9. Record any grazing and browsing observations (e.g. beaver activity). Any obvious emerald ash borer activity should also be documented.

50 m transects

10. 50 m transects run along the planted row nearest to the center of each riparian vegetation plot and follow the row of planted trees and shrubs in the direction in which there is the most space within the density zone of the relevant plot (Figure).
11. Count and identify each surviving tree or shrub on the transect to species. Any tree or shrub with canopy that intersects the line should be recorded on your data sheet. The goal of these data are to capture the species diversity along the line.
12. If your transect stops before 50 m, note how long it was. If your transect transitions between planting densities, note the meter mark where the planting density changed, and record the number of trees and shrubs for each species in two sets, one count for what was found in the low density portion of the transect and another count for what was found in the high density portion of the transect.
13. Record starting and ending vertices of a line feature at the beginning and the end of each transect or take a track of the transect (we did not do this in 2023, but it would be a good idea to do for future surveys).

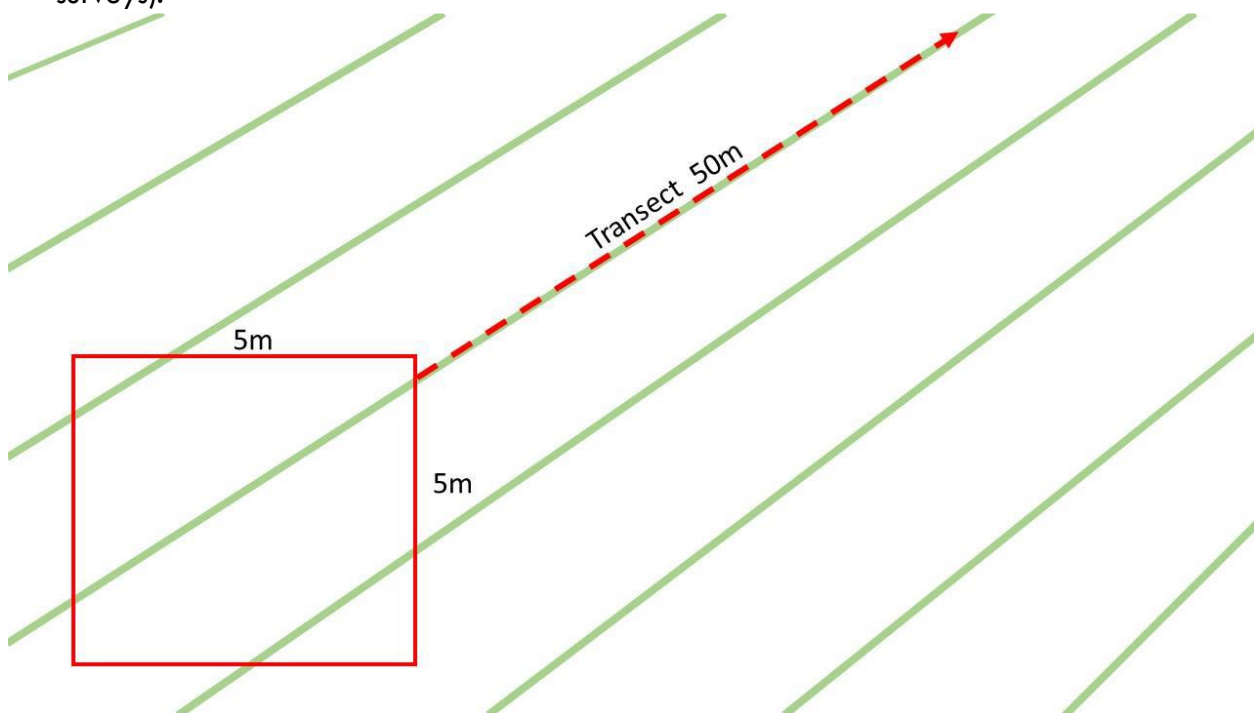


Figure 1. Diagram of transect placement relative to 5 x 5 m riparian monitoring plot.

14. Once you have finished both the 5 x 5 m plot and the 50 m transect, mark your plot as surveyed (“yes”) in the map.

Safety Notes:

For the riparian surveys, pay attention to your location in regard to the river. The banks are eroded and undercut in places, and the drop off can be difficult to see in thick vegetation. Poison oak is most abundant in the remnant upland prairie and the remnant forest areas at Herbert Farm. Take appropriate precautions when you encounter poison oak. In 2023, it was not abundant in planting areas in the riparian zone.

Field Notes

Fill out the following information throughout the fieldwork for the project. Also feel free to make notes throughout this protocol – such as parts of the protocol that need further detail or ways to improve this document.

Site _____ Date _____

Notetaker(s)

Logistic Notes

This will be notes on travel to the site, lodging, parking, etc.

Plot/Transect Locating Notes

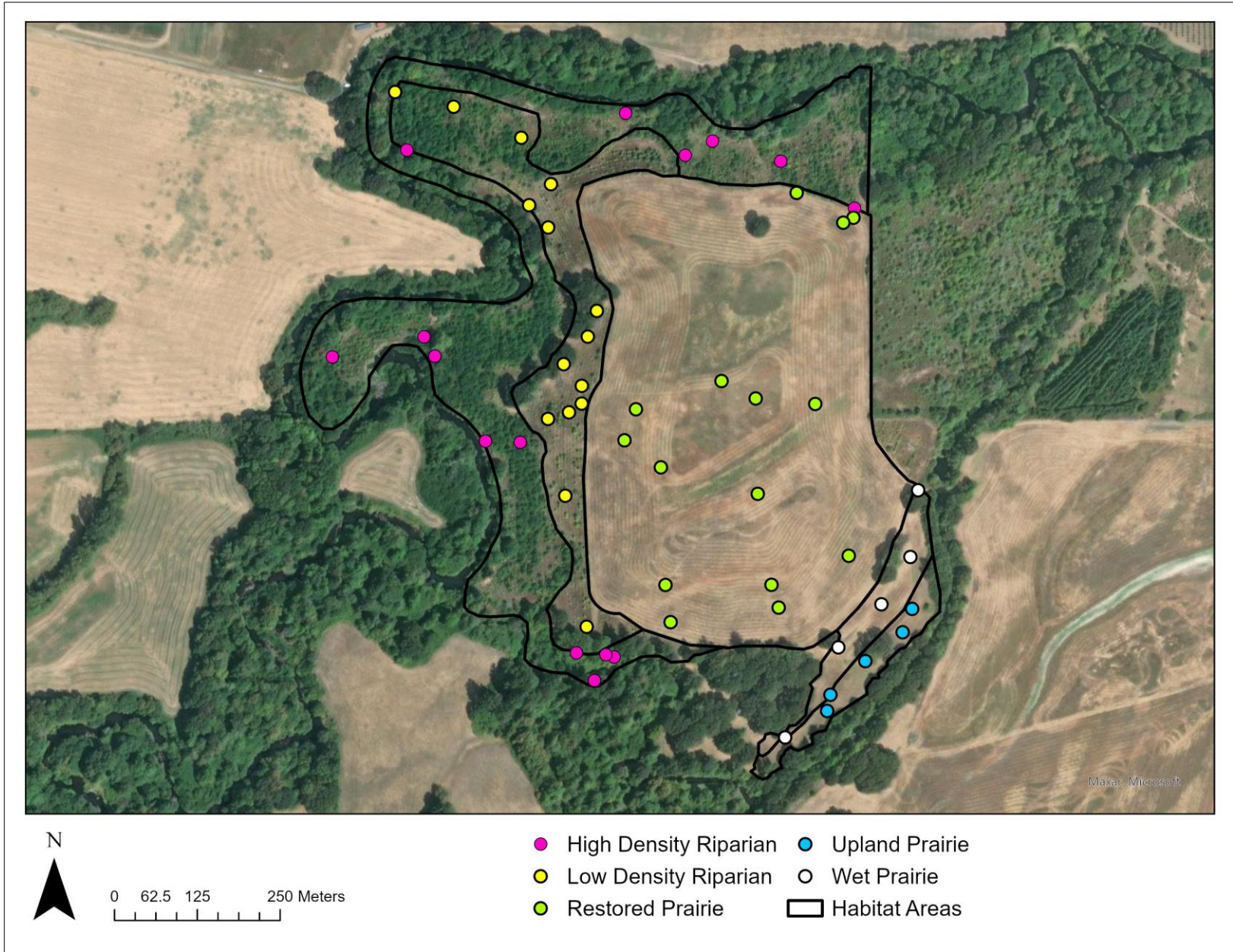
This will be notes on locating plot markers - such as updating tags, not being able to locate a plot, etc. Feel free to also leave these notes on the protocol as you see fit

Data Collection Notes

This will be notes on how data was collected – this could be additional unknown notes, further explanation on how a variable was recorded, any on the fly decisions that were made, etc.

Phenology Notes

This will be notes on the target species phenology – such as reporting that the species is at peak bloom, senesced, seeding, budding, etc.



Plot locations for 2023 Phase I monitoring.