Hobart Natural Area
Stewardship Plan

City of Sweet Home, Oregon

2014

Table of Contents

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Cover photos: Hobart Natural Area (photo by Rebecca Currin) and Bradshaw's lomatium flower (photo by Melissa Carr).

1.0 Background

1.1 Introduction

Hobart Natural Area (Hobart) is located within the city limits of Sweet Home, Oregon (Figures 1 and 2). This undeveloped 60-acre site contains approximately 15 acres of wetland (open wet prairie and ash swales), as well as about 45 acres of forested hillside. The wet prairie hosts many native wildflowers, including one of the larger known populations of the state and federally listed Bradshaw's lomatium (*Lomatium bradshawii*). The Hobart population of Bradshaw's lomatium is the farthest east known population of this species, and is critical to its recovery.

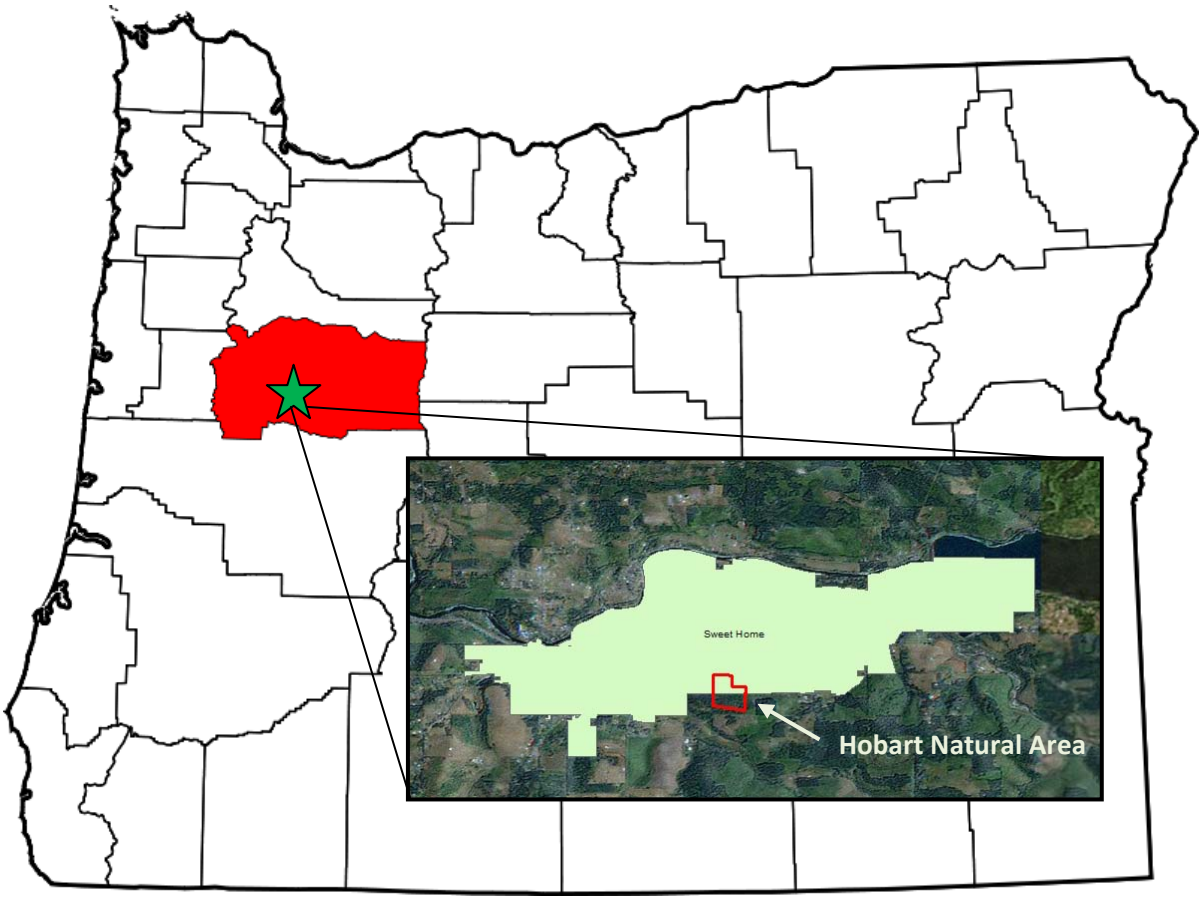

Figure 1. Hobart Natural Area is located in Sweet Home, Linn County, Oregon. Oregon Map with county boundaries and Linn County in red courtesy of: http://commons.wikimedia.org/wiki/File:Map_of_Oregon_highlighting_Linn_County.svg.

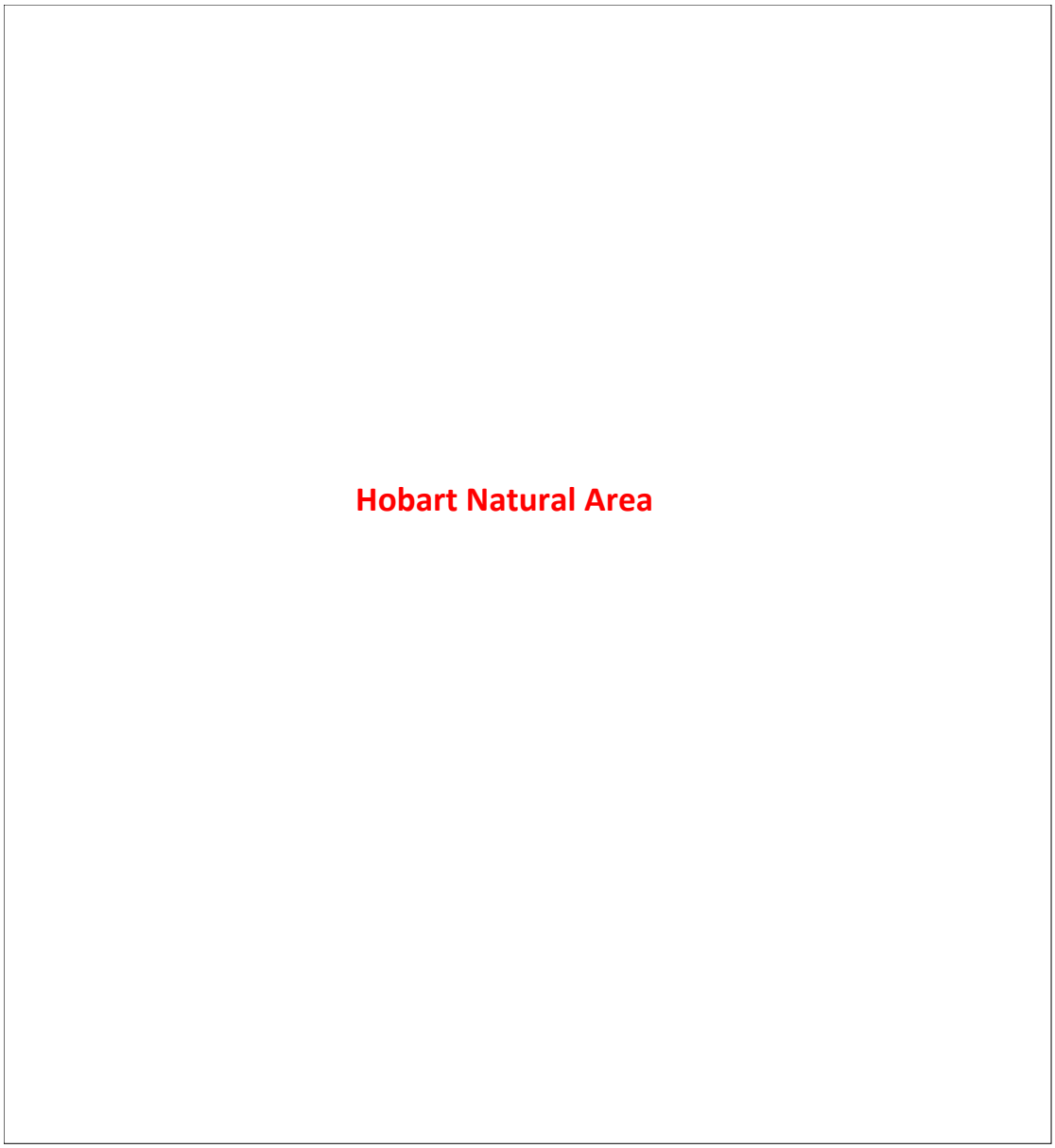

Figure 2. Hobart Natural Area boundary.

1.2 History of Site

Historical photos depicting Hobart Natural Area in the mid-1950s and 1960s (Figure 3) show the flat portion of the property as an open field that, according to verbal accounts, was used to grow hay. The small creek going through the property was clearly visible at that time. This area was maintained as an open field until the early 1990's, when all haying operations had presumably ceased. At that point, encroachment by trees and shrubs could be seen in

subsequent photos. By 2004 the property was fully covered with brush and trees and access to the forested hillside at the south end of the property required brush whacking through the overgrown field.

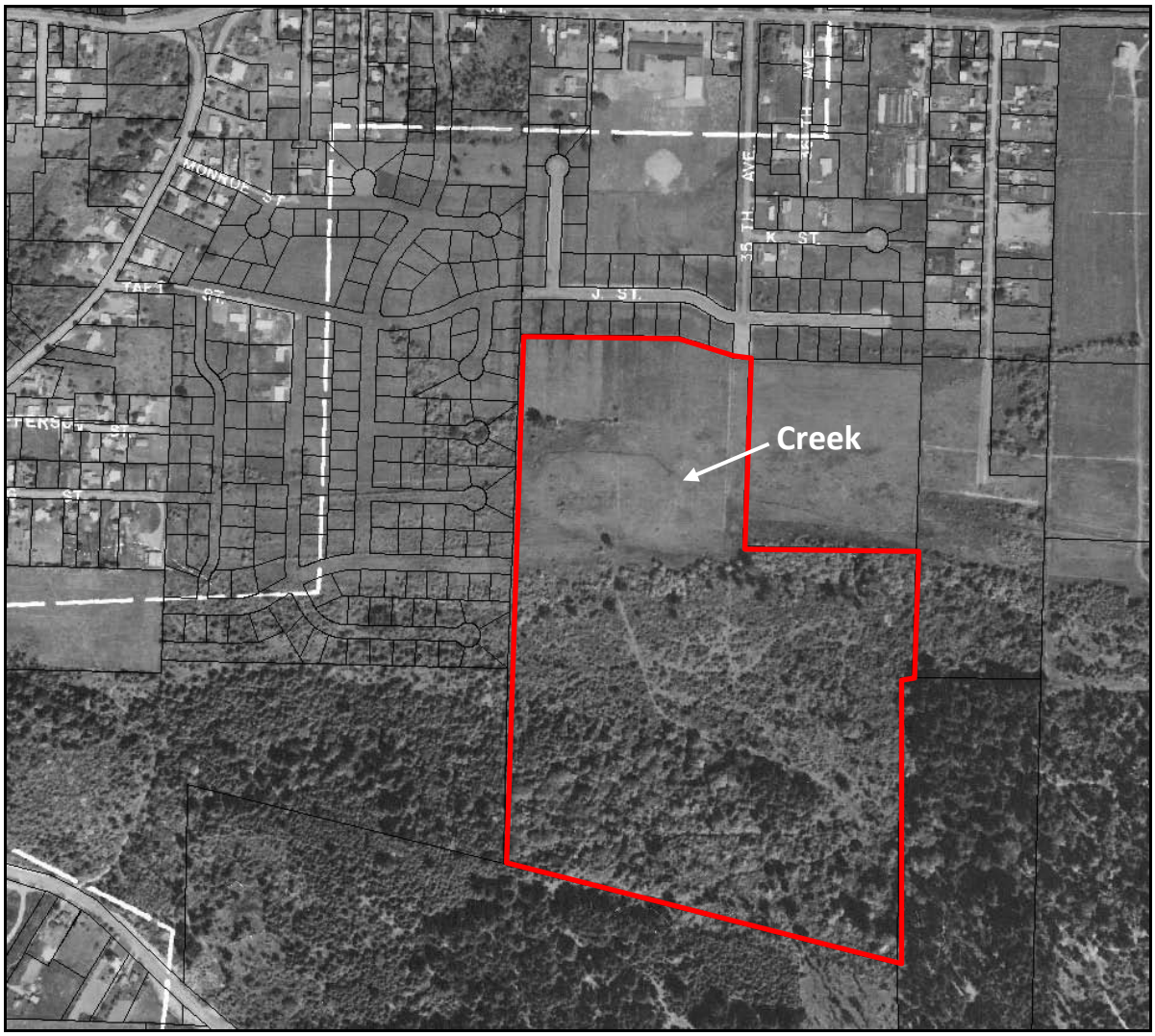

Figure 3. 1966 aerial photo of Hobart Natural Area

In the early 1990s, the property owner, Lawrence Hobart, investigated the possibility of subdividing the property. He had completed a small subdivision to the north of the subject property previously and had learned of wetlands on the property at that time. In 1994, Anneta Lalka from the Division of State Lands conducted a Wetlands Determination on the

property. Further work on delineating the wetlands was done by Sandra Muhleman from Cascade Earth Sciences in September of 1995. Mr. Hobart continued with plans to subdivide the property, and in September of 1996 hired Laura Brophy, Green Point Consulting, to do a limited delineation on a small area in the southwest corner that had potential for access into the property if not a wetland. None of these wetland assessments were conducted in the early spring when Bradshaw's lomatium would have been identifiable, and none of the initial delineation reports documented its presence on the property.

In 1999 the City of Sweet Home hired Pacific Habitat Services to complete a Local Wetlands Inventory (LWI). While this was an off-site determination for the Hobart property, within the Comments section of the Wetlands Characterization Sheet it states that there was Bradshaw's lomatium on site and that it was a federally listed endangered species. The LWI also concluded that the wetlands on site were Locally Significant Wetlands.

Once Mr. Hobart learned of the issues with development of Locally Significant Wetlands creating problems for carrying forth on his subdivision plans, he entered into conversations with the City Attorney about donating the land to the City. In April of 2004, the City Council accepted the gift of 59.57 acres that Lawrence Hobart deeded to the City of Sweet Home. The deed had a number of specific conditions attached to the conveyance of the property. Of specific note are the following:

- The property shall be known as the Hobart Wildlife Habitat.
- The property is to be made a part of the City Park System.
- The property shall be managed as a natural habitat, not to be developed into a "park like" condition.
- The property shall be open to the public for public use
- The property shall be limited to non-motorized traffic
- Trees may be harvested when damaged or diseased, or for proper maintenance of the land using best management practices.
- The property may be used for education purposes that pertain to the natural habitat.

In 2005, the Community Development Department took over management of the City Parks. After review of the deed and the property, it became obvious that while the deed stated the name would be the Hobart Wildlife Habitat, the property had such a rich variety of habitats that calling the park Hobart Natural Area would better serve the property. Thus the common name used throughout is the Hobart Natural Area, fully recognizing that the property serves as Wildlife Habitat. In 2006, Rich Owen, R-J Consulting Services, LLC, a contractor doing restoration and maintenance of declining habitats, was hired to clear the brush and trees in the wetland meadows. A second mowing and brush clearing occurred in 2008 by Jason Garland, new owner of R-J Consulting Services (541-979-7282 and naturalrestoration.com) removing more of the small Oregon ash trees and other brush on the property. In 2014, the City of Sweet Home entered into an agreement with U.S. Fish and Wildlife Service's Partners for Fish and Wildlife to allow additional habitat improvement work to occur on the property.

Documentation of the extent of the Bradshaw's lomatium population began in 2009, when City staff conducted a comprehensive field survey. City staff censused 2009- and 2011 (Table 1), but were untrained and attempted to document what they saw at the time. In 2012, the Oregon Department of Agriculture (ODA) and the Institute for Applied Ecology worked with City staff to develop a censusing protocol for the site, and in 2013, ODA and the City staff refined the methodology while conducting another census.

Table 1. Bradshaw's lomatium monitoring data. In 2012, vegetative plants were further differentiated by the number of leaves or umbels (flower clusters): V1-2 (1-2 leaves), V3+ (3 or more leaves), R1 (one umbel), R2 (2 umbels), and R3+ (3 or more umbels).

Year	**Date**	**# Vegetative Plants**			**# Reproductive (Flowering) Plants**			**Total**
		Seedlings	V1-2	V3+	R1	R2	R3+	
2009								125
2011								1800
2012	May 2-3	420	1397	2797	2492	1272	295	8673 (+/-1054)
2013	May 9-10	4662			2423			7085** (+/-1385)

** The decrease in estimated population size in 2013 might be due to the fact that the phenology of Bradshaw's lomatium plants was more advanced (most reproductive plants in seed, rather than in flower) that year, and it was more difficult to locate the plants.

The land to the north and to the west of Hobart Natural area has all been developed into residential subdivisions. It is possible that, prior to development, some of that property also supported Bradshaw's lomatium. The privately-owned property to the east of the wetland portion of Hobart is also delineated as wetlands. Although no survey for Bradshaw's lomatium has taken place on this property, the species can easily be seen throughout the wetland portion of the property from Hobart Natural Area side of the fence.

1.3 Management Plan Development Process

In 2011, the City of Sweet Home initiated consultation with the ODA regarding management of the Bradshaw's lomatium population at Hobart Natural Area. During the course of this consultation, the need for a Master Plan for the Hobart Natural Area led to a grant being secured from the Oregon Watershed Enhancement Board (OWEB) to develop a management plan that takes into account the sensitive mix of wetlands, endangered species, forest land, surrounding residential development, and the need to ensure that people have full use of the property, as required by the donation deed.

In 2012, the City of Sweet Home contracted with ODA to develop a site management plan for Hobart Natural Area. As part of the process for developing this plan, ODA completed a site assessment, documenting the current conditions at the site. ODA and the City consulted with partners involved in prairie restoration throughout the Willamette Valley about improving the habitat and increasing the Bradshaw's lomatium population. ODA developed a standardized monitoring protocol for the Bradshaw's lomatium population.

The planning process also included a public process to engage the community in creating a new Vision for the Community's Strategic Plan, with a focus on the Hobart Park and other City Parks. In 2013, the City hired Chris Maser, a consultant from Corvallis, Oregon, to facilitate this update of the Sweet Home Community Strategic Plan. Maser facilitated four community workshops sessions: Vision, Goals, Objectives, and review of the draft Strategic Plan.

1.4 Putting Hobart Natural Area in Context

1.4.1 City of Sweet Home Community Strategic Plan

During 2013 and 2014, the community of Sweet Home revised their Strategic Plan. This updated Plan reflects the accomplishments, changes over the past ten years, and hopes for the future in Sweet Home. As part of the public involvement process that took place in 2013, community members developed the following Vision for the City of Sweet Home:

> Vision: Sweet Home is a community where we live in harmony with the surrounding environment supporting a clean, safe and economically viable small town lifestyle for the benefit of present and future generations.

Clearly, Hobart Natural Area, as the largest public park and open space in the City will have a strong role in supporting this vision. Of the five goals developed during the public involvement process, the third one directly pertained to Hobart Natural Area.

> Goal 3: Sweet Home protects and cares for its open space and natural environment as the foundation of its sustainable small town atmosphere and livability.

Finally, as part of the community process, several Hobart-related objectives were identified:

1. Provide opportunities for people to access and enjoy picnic amenities in Hobart Park by Fall 2015.
2. Complete by the Fall of 2014 the Hobart Natural Area Stewardship Plan, that (1) effectively addresses the care of indigenous sensitive species and their habitat, as well as (2) enhances the public's experience of this valued open space.

1.4.2 Sweet Home Parks Master Plan

In January, 2014, the City completed a new Master Plan for the City's parks and open space. Hobart was addressed in numerous areas of the Plan, with the specific following goals for this park:

Hobart Natural Area Recommendations:

• Recommendation 1: Develop an Invasive/Native Vegetation Plan and a stewardship plan that integrates people into the natural environment

• Recommendation 2: Install and improve parking by adding 4 spots with a gravel bed

• Recommendation 3: Install interpretive and educational signage about ecological qualities of the area

1.4.3 Santiam Watershed Council Action Plan

The City of Sweet Home area is home to an active Santiam Watershed Council as well. Sound stewardship of the Hobart Natural Area has the potential to help the Council achieve several of the goals and actions described in the Santiam Watershed Council Action Plan (South Santiam Watershed Council 2008).

Goal #1	Maintain diversity of species within the watershed;
Goal #2	Educate the public about watershed functions, resources, and the opportunities available to improve conditions, and
Goal #3	Implement projects which improve the health of the watershed, including projects that enhance and protect threatened native upland habitats such as wet prairies.

The Council has prioritized the following actions under their strategies for implementing the first of these goals: protecting or increasing sensitive, threatened and endangered plant species; eliminating or reducing noxious non-native plant species; planting native species; and conducting landowner outreach.

1.4.4 Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington

In order to achieve recovery Bradshaw's lomatium, the Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington calls for 20 populations of the species distributed across at least seven recovery zones. The City of Sweet Home falls within the Corvallis East Recovery Zone, which needs a minimum of three populations of Bradshaw's lomatium in order to meet recovery targets. Due to both its size and the quality of the habitat, the Hobart Natural Area Bradshaw's lomatium population plays a critical role in meeting these goals.

2.0 Current Site Conditions

2.1 Habitat Types

The habitat at Hobart Natural Area consists of three general types: upland forest, wet prairie, and ash swale (Figure 4).

2.1.1 Upland Forest

The majority of the site (≈45 acres) is located on a north-facing forested slope on the south end of the property. It is dominated by Douglas fir and primarily native forest understory species. Several overgrown trails crisscross the slope. Access to this portion of the site is limited during the winter and early spring due to standing water in the very wet ash swale at the base of the slope.

2.1.2 Wet Prairie

Roughly half of the flat portion of Hobart Natural Area can be classified as wet prairie. Although there are patches of non-native species in the grassland portions of the site, there is a high diversity of native forbs and graminoids present.

Figure 4. Hobart Natural Area habitat types: forested slope (back left/center), wet prairie (foreground) and ash swale (back right).

2.1.3 Ash Swale

Prior to the tree and brush clearing at the site in recent years, the wetland portion of Hobart Natural Area was being encroached upon by woody species, including Oregon ash and Douglas fir. There are still several large areas dominated by ash that have very saturated soils and/or standing water from late fall through the spring (Figure 5).

Figure 5. Ash swale at Hobart Natural Area.

2.2 Hydrology

Water moves across the flat portion of the site from the southeastern corner to the northwestern corner. A small creek enters the site from the east and flows through the prairie and into the ash swale on the western side of the property (Figure 6). Previous off-road vehicle usage has created several depressions and ruts in the prairie that catch and hold water. Several large branches that fell during the winter storms have caused some of the water from the creek to diffuse, creating habitat where there now appears to be more Bradshaw's lomatium (Figure 7). The water drains into a ditch along the western portion of the property, diverting it from the residential development on the other side and ultimately draining into a small creek making its way north to the South Santiam River (Figure 8). Although U.S. Forest Service hydrologist Lance Gatchell has confirmed that this creek is not fish-bearing, it plays a vital role in the ecology of the site.

Figure 6. Unnamed creek flowing through Hobart Natural Area.

Figure 7. Downed branches have caused creek waters to diffuse into the adjacent wetland.

Figure 8. Water from Hobart Natural Area drains into a ditch along the western side of the property.

2.3 Plant Species Found at Hobart Natural Area

2.3.1 Species List

As part of the process of developing a Stewardship Plan for the Hobart Natural Area, a list of the species found on the property was created. Site visits were made on 5/2/12, 5/8/13, and 6/26/14. Species lists from previous wetland delineations were also consulted. In addition to the state and federally listed Bradshaw's lomatium, the site also supports a small population of the state candidate, tall bugbane (*Cimicifuga elata*) and the rare lichen Methuselah's beard (*Dolichousnea longissima*, formerly *Usnea longissima*), as well as many other native forest and wet prairie species. A total of 111 species were identified at Hobart Natural Area. Of these, 84 were native, 26 were exotic, and one was unknown (not identified to species). For a full list of the species found at Hobart Natural Area, see Appendix 1.

2.3.2 Bradshaw's lomatium

Bradshaw's lomatium (*Lomatium bradshawii*) is a low, erect perennial species in the carrot family (Apiaceae) arising from a long slender taproot. Its stems and leaves have few to no hairs. Leaves are 10-15 cm long on equally long (or longer) petioles. Leaves are ternate then pinnately dissected, the ultimate segments linear and 0.6-1.2 cm long. Small light yellow flowers (Figure 9) are arranged in umbels with 7-16 rays; umbellets are rarely larger than 1 cm across and generally only 1-4 of the rays are fertile. This species is distinguished from other species of *Lomatium* by its conspicuously ternately divided free involucel bracts (Figure 10). The glabrous fruit is oblong, 1.0-1.3 cm long, with thick, corky lateral wings (Peck 1961, Kagan 1980).

Figure 9. *Bradshaw's lomatium* flower. Photo by Melissa Carr.

Bradshaw's lomatium is listed as endangered by both the U.S. Fish and Wildlife Service and the State of Oregon. It is on the Oregon Biodiversity Information Center List 1 (threatened or endangered throughout its range), and has a Natural Heritage Network Rank of G2/S2 (imperiled throughout its range/imperiled in Oregon) (ORBIC 2013). Bradshaw's lomatium is listed as Endangered by Washington State, and is assigned a rank of S1 (critically imperiled in Washington) by the Washington Natural Heritage Program (WNHP 2010a).

The majority of the 45 known natural occurrences are located in the southern Willamette Valley in seasonally saturated or flooded prairies near creeks and small rivers, in moist, heavy clay soils. Some populations occur near the Santiam River in shallow, well-drained soils underlain by basalt, usually in vernal wetlands or along stream channels. Commonly associated species include Carex spp., Danthonia californica, Deschampsia caespitosa, Eryngium petiolatum, Galium cymosum, Grindelia integrifolia, Hordeum brachyantherum, Juncus spp., Luzula campestris, Microseris laciniata, Perideridia sp., and Poa pratensis

(Meinke 1982, ORBIC 2012). Many of the Oregon populations are small, ranging from about 10 to 1,000 individuals. Although there are only two known occurrences of the species in Washington, they contain more plants than all of the Oregon populations combined.

Figure 10. Distinctive ternately divided involucres bracts of Bradshaw's lomatium. Photo by Melissa Carr.

2.3.3 Tall Bugbane

Tall bugbane (*Cimicifuga elata*) is an herbaceous perennial member of the buttercup family (Ranunculaceae) ranging from 1-2 meters in height. Frothy clusters of white flowers top stems ranging from 1-2 meters in height in June and July. Compound leaves have shallowly lobed leaflets that are often finely serrated (Figure 11; Kaye 1994).

Figure 11. Left: Tall bugbane. Photo courtesy of Dianne Fristrom, © 2007 Dianne Fristrom (http://calphotos.berkeley.edu/cgi/img_query?seq_num=227954&one=T). Right: Tall bugbane leaves found on forested slope at Hobart Natural Area. Photo by Rebecca Currin.

Tall bugbane is found in moist woods at lower elevations west of the Cascades from southern British Columbia through Washington and Oregon. It is a state candidate in Oregon, and it is on the Oregon Biodiversity Information Center's List 1 (ORBIC 2013). Although this species has a fairly wide range, many of the populations are very small (<25 individuals). The population at Hobart Natural Area is limited to handful of small patches of leaves. No flowering plants were observed in 2013.

2.3.4 Non-Native Invasive Species

Although the majority of the plants found at Hobart Natural Area are native, there are some exotic species of concern at the site, primarily along the northern and eastern edges, where the property borders residential development. The northeastern corner of the site has several large patches of Himalayan blackberry (*Rubus armeniacus*) and scotch broom (*Cystisus scoparius*), both noxious weeds (Figure 12). There is a small amount of English ivy (*Hedera helix*) and English holly (*Ilex aquifolium*) on the forested slope. The wet prairie has some ox-eye daisy (*Leucanthemum vulgare*), Queen Anne's lace (*Daucus carota*) and non-native blackberry, although the woody encroachment from the native Oregon ash is equally as concerning.

Figure 12. Scotch broom and blackberry in the northwestern corner of Hobart Natural Area.

3.0 Stewardship Objectives and Tasks

The 2014 Sweet Home Strategic Plan identifies two objectives for the Hobart Natural Area Stewardship Plan:

1. Effectively address the care of indigenous sensitive species and their habitat
2. Enhance the public's experience of this valued open space

The sections below describe how these objectives might be met. Potential tasks are summarized in Section 3.4.

3.1 Stewardship of Bradshaw's lomatium and its Habitat

3.1.1 Annual or Ongoing Maintenance

Unfortunately, natural mechanisms for maintaining wet prairie habitat in the Willamette Valley are no longer in effect. Prior to settlement by non-indigenous peoples in the area, fire (natural or human-caused) served to open and maintain prairie habitat in the valley. As residential and agricultural development covered the landscape, natural fire regimes have been suppressed. Today, maintaining prairie habitat requires ongoing management, and Hobart Natural Area's wet prairie is no exception to this. The following strategies are recommended for maintaining the high quality wet prairie habitat found at this site. A detailed description of Bradshaw's lomatium habitat vegetation management guidelines and restrictions can be found in Appendix 2. As long as guidelines the vegetation management guidelines are followed, no additional consultation with Oregon Department of Agriculture is needed; however, if changes to management techniques are required, the City will initiate consultation.

1. **Mowing**: Mowing annually or as needed can reduce invasive and woody vegetation and maintain or enhance existing native vegetation. Although there are not severe concerns about invasive species at Hobart Natural Area at this time, woody encroachment is an ongoing issue at the site. Ideally, mowing would

occur every 1-3 years in the late summer or fall. See Appendix 2 for recommended mowing guidelines and restrictions.

2. **Woody species (tree and shrub) removal**: In addition to mowing, cutting and girdling trees and shrubs, herbicide treatment and stump removal are also helpful techniques for prairie habitat maintenance. It should be noted that the use of herbicides in Sweet Home parks is not encouraged, thus this activity should be utilized very sparingly. The primary species of concern in the wet prairie at Hobart Natural Area are Oregon ash (*Fraxinus latifolia*) , hawthorn (*Crataegus* ssp.), blackberry (*Rubus* spp.), rose (*Rosa* spp.), Douglas-fir (*Pseudotsuga menziesii*), Scot's broom (*Cytisus scoparius*) and Douglas spirea (*Spriraea douglasii*). Annual assessment of woody encroachment and treatment as needed (most likely every 2-3 years) will be necessary to maintain the wet prairie habitat. For detailed guidelines and restrictions for woody species removal, see Appendix 2.

3. **Chemical treatment:** Herbicides are used to control invasive species and woody vegetation encroachment. They should, however, be used sparingly to avoid lethal effects on non-target native species. In addition, as noted above, the use of chemicals in the City's parks is not encouraged. Because the wet prairie at Hobart Natural Area has relatively few serious weed problems, herbicide treatment recommendations are limited to spot spraying of target species and resprouted woody species. For detailed guidelines and restrictions for chemical treatments, see Appendix 2.

3.1.2 Long Term Habitat Improvement

1. **Removal of trees/creating more wet prairie**: Much of the current Bradshaw's lomatium habitat was created when the City of Sweet Home mowed and brushed large patches of Oregon ash and other woody species that had encroached into the wet prairie habitat over the years since the property was no longer used to grow hay. In order to further expand Bradshaw's lomatium habitat, further removal of

trees to create more open prairie is recommended. See Appendix 2 for guidelines for removing woody vegetation.

In addition, probably the woody species of most concern at Hobart Natural Area is the Oregon ash. In order to reduce the recruitment of seedlings into the wet prairie habitat, all female Oregon ash trees bordering the habitat should be removed or girdled. This will eventually reduce the amount of annual woody encroachment treatment needed at the site.

2. **Treatment of weeds along western and northern edges of property:** Due to the forested slope at the southern edge of Hobart Natural Area, and the private property along the eastern boundary, the primary points of entry (authorized and unauthorized) onto the site have been along the north and west sides of the property. Adjacent land consists of residential development. Not surprisingly, this is also where the worst incursions of noxious weeds and other non-natives occur. Although the bulk of the property has a fairly healthy and intact native ecosystem that has resisted being severely invaded by weeds, these edge patches of species like Scot's broom and Himalayan blackberry should be treated in order to remove a seed source for future invasion.

3. **Seeding with native bunch grasses and forbs**: Once habitat treatments such as herbicide applications or brush removal have been implemented, immediate seeding and/or outplanting with native bunch grasses and forbs is recommended to maintain and improve the wet prairie habitat. For a list of recommended species, see Appendix 3.

4. **Creek improvements**: Habitat restoration experts have observed that downed branches that fell into the unnamed creek running through Hobart Natural Area's wet prairie served to slow the water flow and diffuse water on the adjacent banks (see Figure 7 above). This appeared to improve the habitat for Bradshaw's

lomatium habitat, since larger and more abundant plants were observed in the area the following spring. It is recommended that downed or cut woody debris be strategically placed along the creek to further slow and diffuse water flow. Attention should be place on the distribution of Bradshaw's lomatium in relationship to the diffused water during subsequent monitoring efforts.

The creek empties into a drainage ditch that runs along the western edge of Hobart Natural Area. There is an elevation drop between the creek and the ditch. Currently, the entry point has a layer of large rocks to prevent erosion of the creek banks (Figure 13). This point of entry should be checked annually to ensure that no creek bank erosion is taking place. If the creek shifts, or the rocks have been removed or are no longer sufficient to prevent erosion, additional rocks/boulders should be placed in and along the creek at its junction with the ditch.

Figure 13. Point where Hobart Natural Area's unnamed creek enters the drainage ditch at the western edge of the property.

5. **Prevention of illegal off-road vehicular use**: Although this topic could be addressed in Section 3.3 as well, the potential impacts of off-road vehicle use on the Bradshaw's lomatium population, both direct (crushing, uprooting and killing plants) and indirect (negatively impacting site hydrology, introducing non-native invasive vegetation to the site, etc.) are serious, and should be addressed. This can be approached in several ways:

    a. Block vehicle access through the installation of boulders and/or fencing.
    b. Educate local residents about the importance and delicate nature of the site. This could be done through community outreach (including development of educational materials), placement of interpretive signage, and increased recreational and educational use of the site (see Section 3.3 for more information).

6. **Prevention of trampling during sensitive times of year**: Although foot traffic does not cause the same level of damage that vehicular traffic does, recreational use of Hobart Natural Area by humans and dogs in the spring (April – June) when Bradshaw's lomatium plants are growing can result in trampling of the plants. There are several ways that trampling can be minimized during this sensitive period (create clear trails that avoid Bradshaw's lomatium plants, interpretive signs, boardwalk). These options will be discussed further in Section 3.3 below.

3.1.3 Increasing Bradshaw's lomatium Population Size

Currently, the lower estimate of Hobart Natural Area population of Bradshaw's lomatium is slightly above the required 5,000 individuals needed to meet recovery criteria outlined in the Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington (USFWS 2010). However, Hobart Natural Area has the potential to support a larger population of this species. Increasing the size and area of the Bradshaw's lomatium population is desirable for several reasons. First, having a larger population size ensures that the population remains above the 5,000 individual recovery threshold in the face of annual population size fluctuation. Secondly, having a larger population size and area helps protect

the population if a stochastic or random event (e.g., illegal vehicular use, downed trees) that negatively impacts the habitat occurs. All population augmentation work should be overseen by a qualified botanist/biologist familiar with Bradshaw's lomatium. Strategies that may be utilized to increase the lomatium population in Hobart Natural Area include the following:

1. **Seed collection and storage**: Regardless of the method used for introduction of Bradshaw's lomatium, seed will need to be collected from existing populations. Ideally, seed used for introduction at Hobart Natural Area should come from the same Recovery Zone (Corvallis East). Currently, there are two existing populations that would be good sources for seed: Hobart Natural Area itself, and Oak Creek (a U.S. Fish and Wildlife Service easement property supporting a population of at least a hundred thousand Bradshaw's lomatium individuals). See Appendix 4 for detailed guidelines about collecting and storing Bradshaw's lomatium.

2. **Population augmentation:** The most efficient way to augment the Hobart Natural Area population of Bradshaw's lomatium would be the direct sowing of seed or planting of plugs in newly improved or opened habitat. Augmentation projects should be directed by a qualified botanist/biologist familiar with this species. For detailed guidelines on cultivation and introduction of Bradshaw's lomatium, see Appendix 4.

3. **Investigate protection of nearby Bradshaw's lomatium properties:** Another obvious way of expanding the Hobart Natural Area Bradshaw's lomatium population is to investigate ways to protect adjacent or nearby populations. One of the adjacent properties supports Bradshaw's lomatium, and it is possible that other properties containing wetlands in the area do as well. An excellent first step would be to initiate conversation with landowners to see if they are interested in a) having a survey done to determine the extent of Bradshaw's lomatium and its habitat on their property, b) entering into a Partners for Fish and Wildlife

agreement and improving habitat for this and other wetland species on their property, c) placing a conservation easement on the property or d) selling a portion of the property. If there is interest, there are several potential mechanisms for funding such work (U.S. Fish and Wildlife's non-traditional Section 6 funds, land trust organizations, etc.).

3.1.4 Monitoring Bradshaw's lomatium

Regular monitoring Bradshaw's lomatium serves several valuable purposes. First, monitoring is required by state law (Oregon Revised Statute 564) after any ground or vegetative-disturbing activity occurs at a site. Second, monitoring provides valuable feedback on the effects of habitat restoration activities. Third, monitoring data helps assess the status of Bradshaw's lomatium recovery, since downlisting or delisting of this species requires 15 years of monitoring data showing stable or increasing population sizes for all populations counting towards recovery. For a detailed protocol for monitoring Bradshaw's lomatium at Hobart Natural Area, see Appendix 5.

Monitoring frequency: Ideally, Hobart Natural Area's Bradshaw's lomatium population will be monitored annually. However, recognizing the reality of limited resources, monitoring should occur at a minimum of once every three years. In years when the population is not monitored, the site should be checked for any changes or damage so that management actions may be taken in a timely manner when necessary. If active management of the site is taking place, monitoring should occur annually.

When to monitor: Because vegetative plants are often very difficult to find, Bradshaw's lomatium should be monitored when it is blooming, typically mid-April through May.

What to count: At a minimum, all non-seedling individuals (vegetative and reproductive) should be counted, and the presence/absence of seedlings should be noted. Bradshaw's lomatium seedlings are very difficult to find. If found, count as vegetative, and note their presence, but we do not recommend spending a huge amount of time looking for seedlings.

Amount of time needed: In 2013, monitoring the Hobart Natural Area Bradshaw's lomatium population took approximately 72 person hours (six people for ≈2 days). The population was censused, with one particularly dense area subsampled, and the estimated size of the population that year was 8,760 individuals.

3.2 Stewardship of Forested Slope and Tall Bugbane Habitat

3.2.1 Improve Tall Bugbane Habitat

Tall bugbane, a state candidate species, was first identified by a U.S. Forest Service biologist leading a Summer Recreation tour of Hobart Natural Area. Since then, the forest canopy has filled in, reducing light on the forest floor. Currently, only a few small vegetative patches of this species remain. In order to improve habitat for this beautiful forest understory plant, selected thinning of trees in the vicinity of the population to create small clearings and optimal light conditions is recommended.

3.2.2 Monitor and Treat Non-Native Invasive Species

Although much of the forested slope contains native vegetation, there are several species of concern that should be eradicated when found: English ivy and English holly. Field staff removed small patches of English ivy when surveying the forested slope in 2013. However, it is recommended that an annual survey be conducted and any ivy that is found pulled to prevent larger infestations of this difficult-to-eradicate species. English holly produces large amounts of fruit that is attractive to birds and easily spread. Holly trees should be cut down when found. Any workers accessing to the forested slope through the wetland portion of the site should take care to follow guidelines for working in or near Bradshaw's lomatium habitat (see Appendix 2).

3.3 Enhancement of the Public's Experience of Hobart Natural Area

Although stewardship of the sensitive species and ecosystems at Hobart Natural Areas is very important, a second and equally important goal is to provide year-round public access to the site and enhance public enjoyment of the natural resources found there. There is no

reason why these two objectives cannot be compatible, or even complementary. Walking, hiking, picnicking, and wildlife viewing are all possible without causing undue harm to Bradshaw's lomatium and other sensitive resources.

3.3.1 Parking

Currently, the easiest way to access Hobart Natural Area is via 35th Street, which ends near the northeast corner of Hobart Natural Area. There is a very small gravel parking area, but no good way to turn vehicles around to exit. In addition, there is nothing preventing cars and trucks from driving straight out onto the property. Ideally, a slightly larger parking area would be developed in the northeast corner, where the current gravel area is located. The vegetated area immediately adjacent to the gravel parking area is on slightly higher ground (not wetland), and primarily supports weedy non-native species, so this is the area most conducive to installing a parking area with the least impact to the natural resources of the site. Such a parking area should have boulders or fencing installed along the south and west sides to limit vehicular access to the greater site. A locked gate might be needed to allow maintenance vehicles access. The parking area should be designed to allow vehicles to enter and exit more easily, while not blocking the adjacent neighbor's driveway. A circular design might facilitate traffic flow (if there is enough room for its installation).

3.3.2 Trail Improvements

There are no formal trails within the wetland portion of Hobart Natural Area, although there are a few old tracks from vehicular use that provide slightly easier access to the site. There is what appears to be several old roadbeds, as well as some wildlife paths, that cross through the forested slope, but they are quite overgrown and not very accessible at this point. A more formal trail system would increase accessibility to the site, minimize negative impacts to native vegetation, and increase public awareness and enjoyment of the natural resources present. Figure 14 shows a proposed trail system, building upon the existing system of old roads and wildlife paths. Some guidelines for trail installation are listed below:

1. Trails should be designed to avoid sensitive resources and minimize disturbance of native vegetation.

2. Trail routes should be marked when Bradshaw's lomatium is blooming and when tall bugbane is visible to avoid impacting these species, but installation should occur once soils are dry enough to avoid compaction.
3. Workers installing and maintaining trails should take care to avoid trampling Bradshaw's lomatium and minimize impacts to other native plants.
4. Workers installing and maintaining trail system should clean all shoes and equipment of mud and debris before entering the site to avoid spreading non-native invasive species.
5. If applicable, trail surface materials should be weed-free certified.
6. Because ground disturbance and increased foot traffic could lead to the spread of weeds along trails, the trail system should be monitored regularly for non-native weed infestations, and weeds should be treated appropriately and as quickly as possible to avoid further spread.

3.3.3 Boardwalk

Hobart Natural Area should be accessible to the public throughout the year; however, there is some concern that encouragement of foot traffic through the wetland in the spring during the time when Bradshaw's lomatium is growing will increase the risk of trampling and destroying individuals of a listed species. One way to increase accessibility to both the wetland and the forested slope beyond, while at the same time protecting Bradshaw's lomatium and other native vegetation when soils are saturated or there is standing water is to install a boardwalk that connects the parking area with the forested slope trail system. Careful design and planning of the boardwalk's placement could avoid impacts to Bradshaw's lomatium. Having a designated raised walkway through the wetland will reduce the risk of trampling, increase the public's enjoyment of the site during the wetter parts of the year, and increase use of forested trails which might otherwise be difficult to access.

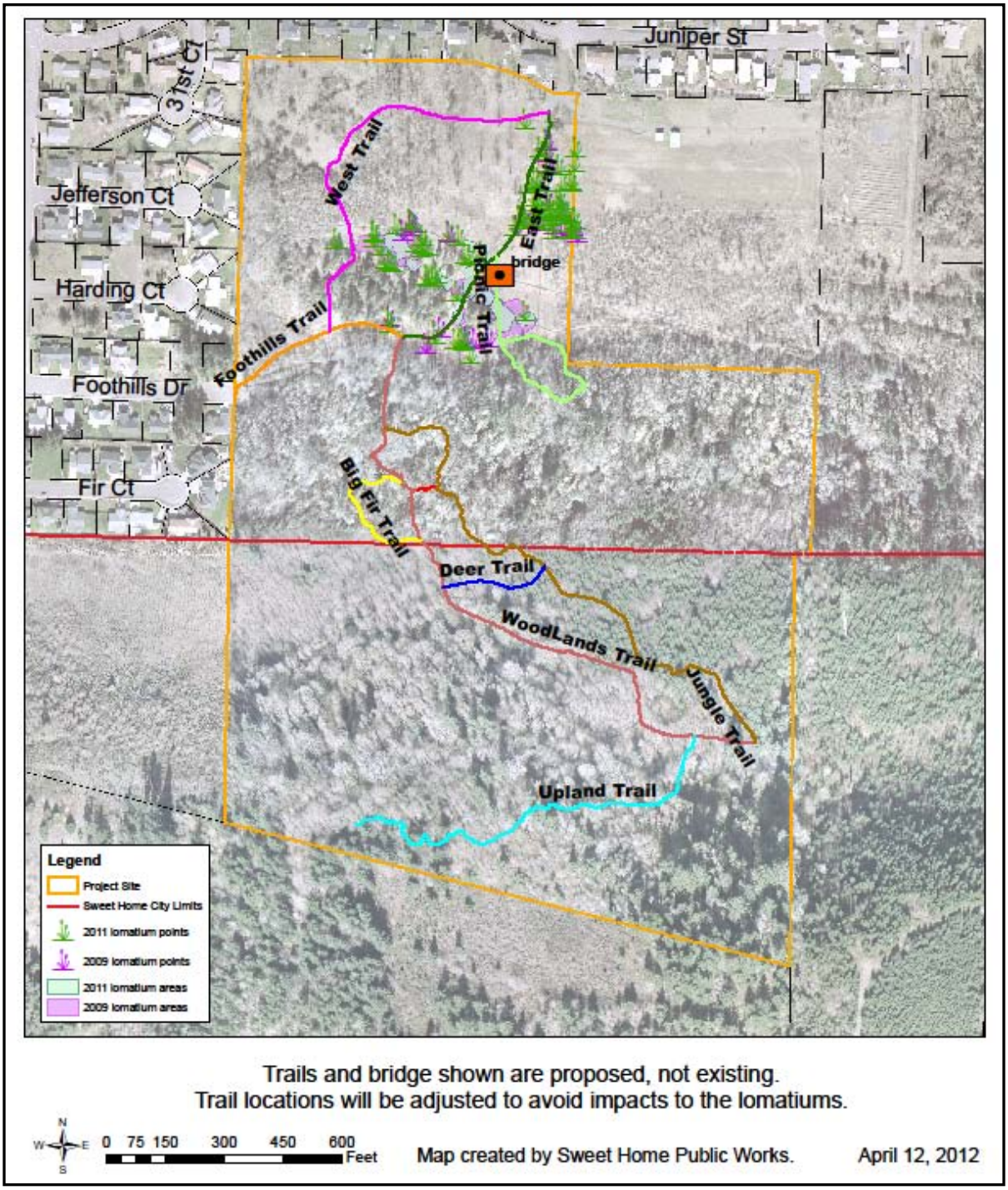

Figure 14. Proposed trail system at Hobart Natural Area.

3.3.4 Linkage to Regional Trails and Greenspaces

There is an active trail development community in Linn County. Within Sweet Home, the Sweet Home Trails Group address issues concerning trails and linkages. In order to maximize the recreational potential of Hobart Natural Area, the City would like to explore ways to link Hobart Natural Area trails to other trail systems in the region.

3.3.5 Picnic Areas

There are no picnic areas at Hobart Natural Area at this time, although a local youth is working on the design and installation of one as his Eagle Scout project. There are several areas that would make good picnic spots, increasing public usage and enjoyment without negatively impacting the natural resources at the site. When designing and installing picnic facilities, the following issues should be considered:

1. Picnic areas should not be located on or near sensitive species. A buffer of at least 10 meters should be maintained between sensitive species and a picnic area.
2. Trash receptacles will need to be installed and serviced on site, even if just at the parking area at the entrance. Signs encouraging people to remove their trash and dispose of it appropriately off-site should be installed.
3. Picnic areas should be accessible by designated trails to minimize the risk of trampling Bradshaw's lomatium plants and habitat.
4. Picnic areas should be installed near trees so that at least some shade is available to those using the facilities.
5. Minimize ground and vegetation disturbance during the installation of picnic areas.
6. Care should be taken to avoid trampling Bradshaw's lomatium plants during installation and maintenance of picnic areas.
7. Workers installing picnic areas should carefully clean shoes and equipment of mud and debris before entering the site to reduce the chance of introducing non-native invasive weeds.

3.3.6 Wildlife Viewing and Interpretive Signage

Part of increasing the public enjoyment of Hobart Natural Area is educating the public about the unique natural resources that are present at the site. In addition to the rare species, there

are many beautiful native wildflowers on site. The wetland provides valuable ecosystem functions for the area. There are also many types of wildlife that live in or pass through Hobart Natural Area. One way to provide information in an educational and engaging manner is to design and install interpretive signage along the trail system, pointing out plant and animal species of interest and describing the ways that wetlands benefit the area.

3.3.7 Educational Programming

Hobart Natural Area provides a unique opportunity for nearby schools. The site is the ideal outdoor classroom for local teachers interested in engaging their students in the study of biology, botany, ecology, hydrology, natural history, conservation, restoration, designing scientific research projects, urban-wildlife interface and urban planning, to name just a few of the potential topics. There are many available curricula that could be adapted for use at Hobart Natural Area, as well as organizations that could potentially partner with local teachers to develop programming. Engaging and supporting teachers in using the site in this manner not only increases use of the site, it helps build a community that understands and appreciates the many benefits that Hobart Natural Area provides the area.

3.4 Summary of Tasks

Table 2 summarizes the tasks described above for easy reference. The timeline and frequency are suggested, and depend on City priorities and resources available for implementation.

Table 2. Summary of Hobart Natural Area Stewardship Tasks

Objective	Task	Timeline/Frequency	Potential Steps
Maintaining Bradshaw's lomatium prairie habitat	Mowing	August – October, Every 1-3 years as needed	• Coordinate with Partners for Fish and Wildlife • Hire contractor
	Woody species removal	Annually or as needed	• Coordinate with Partners for Fish and Wildlife • Hire contractor
	Invasive weed treatment	Annually or as needed	• Coordinate with Partners for Fish and Wildlife • Hire contractor

Table 2, continued. Summary of Hobart Natural Area Stewardship Tasks

Objective	Task	Timeline/Frequency	Potential Steps
Longer-term Bradshaw's lomatium habitat improvement	Removal of trees to create more prairie habitat	Within 2-5 years	
	Removal of female Oregon ash trees bordering prairie habitat	Initial removal: as soon as possible	
	Treatment of weedy areas along western and northern boundaries	Initial treatment: 1-2 years. Follow-up maintenance: annually	• 50' mowed fire lane is required by the City
	Enhance native prairie species matrix with native grasses and forbs	After removing trees or weeds	
	Install woody debris in creek to slow and diffuse water	Annually as existing debris breaks down	
	Monitor and shore up area where creek enters ditch on east side of property	Monitor annually, install additional rocks as needed	
Increase Bradshaw's lomatium population	Seed collection	June-July	
	Population augmentation	Direct sowing in fall after preparing site	
	Protection of nearby Bradshaw's lomatium populations	Ongoing	• Outreach to property owners • Survey willing landowner property with potential habitat • Explore easement options with local land trusts • Investigate funding mechanisms for purchasing property
Monitor Bradshaw's lomatium	Monitor Bradshaw's lomatium	Annually, early May	• Coordinate and train volunteers • Gather materials • Monitor population

Table 2, continued. Summary of Hobart Natural Area Stewardship Tasks

Objective	Task	Timeline/Frequency	Potential Steps
Improve tall bugbane/forested habitat	Selective tree thinning	Within 1-3 years	• Consult with qualified biologist/silvaculturist to select trees to thin • Hire contractor
	Monitor and treat invasive species	Annually	• Recruit volunteers to monitor trail system for invasives • Post signs encouraging reporting of invasive species
Enhance public experience	Install parking area, including barriers to illegal vehicular use	Within next five years	• Develop designs for structures and trails • Rework Oregon Parks and Rec trails grant application and submit
	Improve trail system		
	Install boardwalk		
	Connect to regional trails		
	Install picnic areas		
	Install interpretive signs		
	Develop educational opportunities	Within the next five years	• Recruit teachers interested in outdoor classroom experiences • Recruit volunteer scientists, natural resource professionals, and environmental education organizations to develop curricula • Investigate sources for environmental education program funding

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Appendices

Appendix 1. Hobart Natural Area Plant List

Scientific Name	Common Name	Origin	Notes
Trees/Shrubs/Woody			
Abies grandis	Grand fir	Native	
Acer circinatum	Vine maple	Native	
Acer macrophyllum	Big-leaf maple	Native	
Alnus rubra	Red alder	Native	
Amelanchier alnifolia	Western serviceberry	Native	
Berberis nervosa	Cascade Oregon grape	Native	
Cornus stolonifera	Red-osier dogwood	Native	
Corylus cornuta	Western hazelnut	Native	
Crataegus douglasii	Black hawthorne	Native	
Cystisus scoparius	Scot's broom	Exotic	
Fraxinus latifolia	Oregon ash	Native	
Gaultheria shallon	Salal	Native	
Hedera helix	English ivy	Exotic	
Ilex aquifolium	English holly	Exotic	
Malus fusca	Pacific crabapple	Native	
Oemleria cerasiformis	Indian plum	Native	
Prunus sp.	Cherry	Exotic	
Pseudotsuga menziesii	Douglas-fir	Native	
Psycocarpus capitatus	Pacific ninebark	Native	
Rhamnus purshiana	Cascara	Native	
Rosa sp.	Rose		
Rubus armeniacus	Himalayan blackberry	Exotic	
Rubus laciniatus	Cutleaf blackberry	Exotic	
Rubus parviflorous	Thimbleberry	Native	
Rubus spectabilis	Salmonberry	Native	
Rubus ursinus	Trailing blackberry	Native	
Sorbus scopulina	Rocky Mountain mountain ash	Native	
Spiraea douglasii	Douglas spirea	Native	
Symphorocarpos albus	Common snowberry	Native	
Thuja plicata	Western red cedar	Native	
Vaccinium parvifolium	Red huckleberry	Native	

Appendix 1, continued*. Hobart Natural Area Plant List*

Scientific Name	Common Name	Origin	Notes
Perennial forbs			
Achillea millefolium	Yarrow	Native	
Adenocaulon bicolor	Pathfinder	Native	
Adiantum aleuticum	Western maidenhair fern	Native	
Apocynum cannabinum	Common dogbane	Native	
Asarum caudatum	Western wild ginger	Native	
Athyrium filix-femina	Lady Fern	Native	
Camassia quamash	Small camas	Native	
Castilleja exserta	Owl clover	Native	
Cimicifuga elata	Tall bugsbane	Native	State candidate
Circaea alpina	Alpine enchanter's nightshade	Native	
Claytonia sibirica	Candyflower	Native	
Daucus carota	Queen Anne's lace	Exotic	
Dicentra formosa	Western bleeding heart	Native	
Digitalis purpurea	Foxglove	Exotic	
Downingia elegans	Elegant downingia	Native	
Epilobium angustifolium	Fireweed	Native	
Erechtites minima	Australian burnweed	Exotic	
Eringium petiolatum	Coyote thistle	Native	
Fragaria virginiana	Wild strawberry	Native	
Galium sp.	Cleavers	Exotic	
Gentiana sceptrum	King's gentian	Native	
Hosackia pinnata	Meadow bird's-foot trefoil	Native	Syn. *Lotus pinnatus*
Hydrophyllum tenuipes	Pacific waterleaf	Native	
Hypericum anagalloides	Bog St. John's wort	Native	
Hypericum perforatum	Common St. John's wort	Exotic	
Hypochaeris radicata	False dandelion	Exotic	
Lapsana communis	Nipplewort	Exotic	
Leucanthemum vulgare	Oxe-eye daisy	Exotic	
Lilium columbianum	Columbia lily	Native	
Lomatium bradshawii	Bradshaw's lomatium	Native	Endangered
Lysimachia nummularia	Creeping Jenny	Exotic	Garden plant
Maianthemum dilatatum	False lily of the valley	Native	
Maianthemum stellatum	Starry false Solomon's seal	Native	Syn. *Smilacina stellata*

Appendix 1, continued*. Hobart Natural Area Plant List*

Scientific Name	Common Name	Origin	Notes
Perennial forbs, continued			
Mimulus guttatus	Common monkeyflower	Native	
Oenanthe sarmentosa	Pacific water parsley	Native	
Osmorhiza berteroi	Sweet cicely	Native	Syn. *Osmorhiza chilensis*
Parentucellia viscosa	Yellow glandweed	Exotic	
Polypodium glycyrrhiza	Licorice fern	Native	
Polystichum munitum	Western sword fern	Native	
Potentilla gracilis	Cinquefoil	Native	
Prosartes sp.	Fairybells	Native	Syn. *Disporum* sp.
Prunella vulgaris	Self heal	Native	
Pteridium aquilinum	Bracken fern	Native	
Ranunculus uncinatus	Little buttercup	Native	
Saxifraga oregana	Oregon saxifrage	Native	Syn. *Micranthes oregana*
Senecio triangularis	Arrowleaf grounsel	Native	
Sisyrinchium bellum	California blue eyed grass	Native	
Solidago elongata	Western goldenrod	Native	
Stellaria crispa	Crisped tarwort	Native	
Symphyotrichum hallii	Hall's aster	Native	Syn. *Aster hallii*
Taraxacum officinale	Common dandelion	Exotic	
Thalictrum occidentale	Western meadowrue	Native	
Trifolium sp.	Clover	Exotic	
Trillium sp.	Trillium	Native	
Triteleia hyacinthina	White brodiaea	Native	
Vancouveria hexandra	White inside out flower	Native	
Veronica scutellaria	Marsh speedwell	Native	
Zigodenus venenosus	Meadow deathcamas	Native	Syn. *Toxicoscordion venenosum*
Annual forbs			
Centaurium erythraea	European centaury	Exotic	
Minuartia sp.	Sandwort	Native	
Sherardia arvensis	Blue fieldmadder	Exotic	
Vicia sativa	Common vetch	Exotic	

Appendix 1, continued*. Hobart Natural Area Plant List*

Scientific Name	Common Name	Origin	Notes
Graminoids (Grasses, rushes and sedges)			
Agrostis sp.	Bentgrass	Exotic	
Alopecurus genitalicus	Meadow foxtail	Exotic	
Carex aurea	Golden sedge	Native	
Carex obnupta	Slough sedge	Native	
Carex pellita	Woolly sedge	Native	
Danthonia californica	California oatgrass	Native	
Deschampsia cespitosa	Tufted hairgrass	Native	
Dichanthelium acuminatum var. *fasciculatum*	Western panigrass	Native	Syn. *Panicum occidentale*
Festuca sp.	Fescue		
Holcus lanatus	Velvet grass	Exotic	
Juncus encifolius	Dagger leaved rush	Native	
Juncus patens	Gray rush	Native	
Luzula sp.	Woodrush		
Poa pratensis	Kentucky bluegrass	Exotic	
Scirpus pallidus	Pale bulrush	Native	County record
Scirpus pendulus	Rufous bulrush	Native	
Other			
Dolichousnea longissima	Methuselah's beard	Native	Syn. *Usnea longissima*, rare lichen

Appendix 2. Bradshaw's lomatium Habitat Management Guidelines

Habitat loss, including habitat degradation and fragmentation, is the biggest threat to rare native prairie species such as Bradshaw's lomatium. Successional processes (tree and shrub encroachment and invasive species spread can quickly alter and degrade prairie habitat. Two important components of any restoration, enhancement, or maintenance effort are removal of woody vegetation and control of invasive species. The following habitat management guidelines are based on those described in the U.S. Fish and Wildlife Service Biological Opinion for prairie restoration in western Oregon (USFWS 2008). These guidelines reflect the best management practices known at this time. However, as new information or improved techniques become known, this Plan should be adapted to reflect the updated knowledge.

A number of restoration, enhancement, and maintenance techniques are available (see below). These techniques include, but are not limited to, manual or machine cutting, mowing, prescribed burning, herbicide application, solarization, and use of shade cloth. Once a site has been manipulated to remove unwanted vegetation, the site will need to be replanted with appropriate native prairie species, which may include the covered plant species.

General Guidelines

1. Any project that exposes soils to run-off between project and creek will include a 15-meter (50 ft) buffer.
2. Herbicide treatments should include a 37-meter buffer (120 ft) between treatment and creek to minimize chemical runoff into water.
3. Soil disturbing equipment (till, disk equipment, etc.) will not be used within 2 meters (6 ft) of known locations of Bradshaw's lomatium.
4. During growing season (February to July), heavy equipment will not be operated within 2 meters (6 ft) of Bradshaw's lomatium plants.
5. Habitat treatments will generally take place after Bradshaw's lomatium has senesced for the season.

6. For habitat treatments with areal limits (e.g. not more than one-third of the occupied habitat for herbicide treatment of severe weed infestation), no more than one-third of an occupied habit will be treated in the same calendar year.
7. Habitat restoration work will be supervised by a qualified botanist/biologist whenever possible.
8. All vehicles and heavy construction equipment will be cleaned to remove mud, debris and vegetation prior to entering the project area in order to prevent the spread of noxious weeds and non-native plants.
9. Access routes for work vehicles will be planned ahead of time to minimize potential adverse effects to Bradshaw's lomatium.
10. Vehicle use will be minimized to reduce damage to soils and native vegetation.

Mowing

1. Limit mowing in areas where Bradshaw's lomatium occurs to July 15 – February 28, when the species is dormant.
2. Tractor mowing throughout the site should occur when soils are dry enough not to be disturbed by tires/tracks. In order to avoid soil compaction and rutting, do not mow when soil is saturated.
3. Set the mowing deck at a minimum of 15 cm (6 in) above the ground in the Bradshaw's lomatium population area.
4. Spring mowing is only allowed where it is necessary to control a weed infestation involving a weed species reproducing mainly by seed (e.g., meadow knapweed), in which case up to ½ of the listed and/or covered plant population may be mowed in an effort to control invasive species seed set.
5. Flail mowers will not be used.

Cutting

Cutting is used to remove woody species such as hawthorn, blackberry, rose, Scot's broom Oregon ash and Douglas-fir, as well as to remove resprouting stems after previous mowing or cutting efforts. Cutting may be done manually (using tools such as loppers, shovels, hoes, weed wrenches/pullers) or with machines such as trimmers and chainsaws. Target species may be trimmed, cut, girdled, hoed, grubbed, pulled, dug, and chipped. The following

guidelines and restrictions should be followed when employing these techniques at Hobart Natural Area.

1. When cutting trees and large shrubs, directional falling should be used to avoid impacts to Bradshaw's lomatium plants whenever possible.

2. Cut materials should be removed from the wet prairie area. The one exception is when selected cut materials are to be piled strategically in the stream to slow and diffuse the flow of water through the site. Care should be taken to avoid creating soil compaction and ruts when moving heavy cut materials through the wet prairie area when soils are saturated.

3. In areas where Bradshaw's lomatium occurs, cutting should only be done when Bradshaw's lomatium is dormant (late July through February).

4. In other areas of the site (those not supporting Bradshaw's lomatium), manual cutting may occur at any time of year.

5. Cutting of woody species may also be combined with herbicide application to the cut stem to avoid resprouting.

6. When possible, prairie restoration specialists should be consulted before embarking on large-scale woody removal to ensure no damage to listed species.

Girdling Trees

Girdling trees involves the removal of a ring of bark near the base of the tree with either an axe or chainsaw. Girdling eventually kills the tree. This practice is used to control and remove invasive woody plants.

1. Girdling may occur at any time of year.

2. If girdling takes place between March 1 and July 15, workers should enter the site on foot and take care to avoid trampling Bradshaw's lomatium plants.

3. Girdled trees may remain on site or be removed during the dry season.

Cutting, Thinning and Removing Tree Stumps

1. These activities should occur when Bradshaw's lomatium is dormant (July 15 – February 28). If activities must occur during the Bradshaw's lomatium growing season, a "no work" buffer around all Bradshaw's lomatium plants should be observed and care should be taken to avoid trampling plants.

2. Handheld power tools may be used to cut down, control, or remove woody vegetation

3. Stump removal involving vehicles will occur only during dry periods to avoid soil compaction and ruts.

4. All cut material will either be removed from the site or piled or chipped outside of the wet prairie habitat.

5. If activities occur during the wet season, removal of debris from site can be postponed until the soil is dry enough to support vehicular-assisted removal. Care should be taken to not pile debris on or near Bradshaw's lomatium plants.

Shade Cloth

Shade cloth is used to control dense weed infestations. Although currently the wet prairie areas of Hobart Natural Area do not, for the most part, have dense weed infestations, there are some weedy areas on the perimeter of the site, and this technique might be of use in the future. Typically, a dark cloth is placed over the infestation and fastened to the ground with stakes. The cloth is generally removed after two years.

1. Shade cloth should be installed during the growing season to ensure that the appropriate areas are shaded, and no non-target areas are impacted.

2. Shade cloth shall not be used directly over any Bradshaw's lomatium plants.

Solarization

Solarization is used to control dense weed infestations. The weed infestation is covered with black plastic sheeting and remains in place for at least three months during the subsequent

growing season. Tilling may occur prior to installation of the plastic sheeting. Once plastic is removed, follow-up weeding may be necessary.

1. Solarization will not be used directly over any Bradshaw's lomatium plants.

Tilling/Disking

Tilling and disking is used to remove invasive plants.

1. Tilling and disking should only be implemented during the dry season to avoid or minimize alterations to site hydrology and destruction of soil structure. This method should be implemented along existing ground contours where possible.

2. Unless follow-up treatments are needed to further control weeds (i.e. herbicide treatments, solarization), tilling/disking should be immediately followed by seeding or outplanting native species.

3. A minimum "no work" buffer of at least five meters (15 ft) around Bradshaw's lomatium plants will be observed when employing this technique.

Raking

Raking is used to reduce thatch build up. Although thatch has not been a huge problem in the wet prairie at Hobart Natural Area, if it does become an issue the following guidelines should be observed.

1. Raking shall only occur during Bradshaw's lomatium dormant period (July 15 – February 28).

2. Raking may be tractor mounted or hand held. If tractor mounted, raking will only occur when the ground is dry to avoid soil compaction and rutting. Tractors shall be equipped with rubber tracks when needed.

3. Soil disturbance should be avoided or minimized when employing this technique.

4. Raked thatch and litter shall be removed from the site.

Chemical Treatment

1. If herbicide treatments are used in the vicinity of Bradshaw's lomatium, the population will be closely monitored following the treatment in order to quickly identify any adverse effects.

2. Herbicide will be applied by a licensed applicator, using appropriate equipment and best management practices.

3. Herbicide applications will be used as part of an Integrated Pest Management Plan.

4. Any non-target species exposure to herbicides (through drift, leaching into groundwater, or runoff) will be avoided or minimized.

    a. The lowest effect nozzle pressure and minimal effective nozzle height recommended by the nozzle manufacturer will be used

    b. Droplet size shall be at least 500 microns

    c. Spraying will not occur when winds exceed the wind limits specified by the manufacturer, and never when winds exceed 11 km (7 mi) per hour.

    d. Spraying shall occur when temperatures are below 30º C (85º F).

    e. Drift retardant adjuvants may only be used for boom spray applications and must be non-toxic and applied under the above strict application requirements.

    f. Dyes may be used for applications to ensure complete and uniform application and to observe the amount of drift.

5. Chemical treatments will follow labeled restrictions, including limitations for use near water.

6. Only the chemicals in Table 3 below are allowed for herbicide application at Hobart Natural Area. If new, more effective or less toxic herbicides become

available, the City of Sweet Home will coordinate with ODA to update this Appendix for their inclusion.

Table 3. Approved herbicides for Hobart Natural Area. Adapted from Benton County Prairie Species Habitat Conservation Plan (Benton County 2010)

Herbicide	Brand Name(s)	Surfacant or Adjuvent	Target Species	Application Period	Application Method
Triclopyr	Garlon 3A only	n/a	Woody species, broadleaf weeds	February 1 – July 15: wipe on applications only. August 15-October 31: spot spray and wipe applications	Woody species: hand painted or directly wicked onto fresh cut stumps within 24 hours of cutting. Broadleaf species: apply using hand-held wand or mounted on an all-terrain vehicle
Glyphosate	Rodeo, Round-up, Aqua-Master, Accord	Vegetable oil based surfactant	Grasses and broadleafs, some woody species (including blackberry)	February 1 – July 15: wipe on applications only. August 15-October 31: spray and wipe applications	Apply with hand-held wand or boom mounted on all-terrain vehicle.
Imazapic	Plateau	Vegetable oil based surfactant	Grasses and broadleaf species (pre- and post-emergent)	September 1 – November 30: Spray or wipe on	Apply with hand-held wand or boom mounted on all-terrain vehicle
Pendimethalin	Pendulum	n/a	Grasses and broadleaf species (pre-emergent)	September 1 – November 30; spray on	Apply with hand-held wand or boom mounted on all-terrain vehicle
2,4-D amine	Weeder 64	Vegetable oil based surfactant	Broadleaf species	February 1 – July 15: wipe on applications only. August 15-October 31: spray and wipe applications	Apply with hand-held wand or boom mounted on all-terrain vehicle

Table 3, continued. Approved herbicides for Hobart Natural Area. Adapted from Benton County Prairie Species Habitat Conservation Plan (Benton County 2010)

Herbicide	Brand Name(s)	Surfacant or Adjuvent	Target Species	Application Period	Application Method
Clethodim	Envoy	Vegetable oil based surfactant	Non-native grasses	August 1 – October 25	Apply with hand-held wand or boom mounted on all-terrain vehicle. Weed wiping during growing season near covered plants should target taller grasses, avoiding low stature plants.
Sethoxydim	Poast	Vegetable oil based surfactant	Grasses	Wet prairie: August 1 – October 25, other areas: February 15-May 15 (early application)	Apply with hand-held wand or boom mounted on all-terrain vehicle.
Fluazifop-P-butyl	Fusilade	Vegetable oil based surfactant	Grasses	Wet prairie: August 1 – October 25, other areas: February 15 – May 15	Spot foliar application using a hand-held wand or mounted on an all-terrain vehicle. If weed wiper is used near Bradshaw's lomatium during growing season, herbicide shall be applied at height to target upper grass stems and avoid lower stature plants.

Appendix 3. Recommended native prairie matrix species

The following is a list of potential species that can be introduced as matrix wet prairie species. However, this list is not complete, and any native forbs and graminoid species associated with Bradshaw's lomatium may be used in restoration work at Hobart Natural Area.

Native wet prairie graminoids:
Carex obnupta (Slough sedge)
Carex tumulicola (foothill sedge)
Danthonia californica (California oatgrass)
Deschampsia cespitosa (tufted hairgrass)
Festuca (fescue)
Juncus encifolius (dagger leaved rush)
Juncus occidentalis (western rush)
Juncus patens (spreading rush)

Native prairie forbs:
Achillea millefolium (western yarrow)
Camassia leichtlinii (tall camas)
Camassia quamash (common camas)
Eryngium petiolatum (Oregon coyote thistle)
Fragaria virginiana (common strawberry)
Grindelia integrifolia (Willamette Valley gumweed)
Mimulus guttantus (common monkeyflower)
Plagiobothrys figuratus (fragrant popcornflower)
Plagiobothrys scouleri (Scouler's popcornflower)
Potentilla gracilis (slender cinquefoil)
Prunella vulgaris var. *lanceolata* (self-heal)
Ranunculus occidentalis (western buttercup)
Ranunculus orthorhynchus (straight-beaked buttercup)
Saxifraga oregana (Oregon saxifrage)
Sidalcea campestris (meadow checkermallow)
Sisyrinchium bellum (California blue-eyed grass)
Solidago elongata (western goldenrod)

Appendix 4. Bradshaw's lomatium Population Enhancement Guidelines

(Adapted from U.S. Fish and Wildlife's 2008 Programmatic Prairie Restoration Biological Opinion)

Plant populations may be augmented or introduced to increase the number and viability of listed plant populations. Collection, cultivation and outplanting methods for Bradshaw's lomatium are covered below. NOTE: An essential part of restoring populations of rare species is the restoration of native prairie structure and function. Seeds and plant parts of non-listed native species may be collected, and a variety of native forbs should be augmented or introduced as part of the Bradshaw's lomatium population enhancement and prairie restoration efforts at Hobart Natural Area.

Propagule Collection, Propagule Storage, and Cultivation of Bradshaw's lomatium

The following activities are included: collect limited amounts of listed plant seed; store seed for later cultivation or outplanting, and cultivate plants in nursery or greenhouse for later propagule collection and outplanting.

1. Propagule Collection

Bradshaw's lomatium seed may be collected from existing populations located in the same Recovery Zone as Hobart Natural Area (Corvallis East). For now, there are two populations that are recommended for collection:

a. Hobart Natural Area

b. Oak Creek

Before propagule collection begins, collectors will determine the number of propagules needed for plant cultivation or reintroduction objectives. Restrictive seed collection methods are intended to protect the viability of the source population (Menges *et al.* 2004). Collection limits are defined separately for populations of different sizes and levels of vulnerability. In this case, both target populations have more than 500

individuals. The following guidelines should be followed when collecting seed at either site:

a. Collections will occur only after seed is fully mature (generally June - July).

b. Collectors should harvest mature seed from throughout the population and within all habitat types found at the population location, in order to collect a genetically diverse sampling of the population.

c. Collections should occur in dry weather or when seeds can be dried immediately after collection.

d. Bradshaw's lomatium achenes (single-seed fruits) are exposed at the terminal ends of the flowering structure. These may be collected off the flowering structures (umbels) which are upright or ascending and suitable for direct collection by hand. The species is tap-rooted and therefore not suitable for propagation from root cuttings.

e. Collectors should collect no more than 25% of the seed produced by a population in any given year.

2. Propagule Transport

a. Before seeds are transferred to storage bags, they must be cleaned by hand or by sieve and blower.

b. Collectors should use "breathable" containers to store and transport collected plant propagules; these containers include paper envelopes and bags, tin or glass vessels, or glassine envelopes. Plastic bags will not be used.

c. Collectors will label all propagule containers, either before placing seeds in them, or immediately after collection with the following information: 1) Name of plant; 2) Place of collection, and 3) Date of collection.

d. During transport, propagules must be stored in a cool, dry environment, avoiding placing propagules in heat (*i.e.*, trunk of car) or direct sunlight.

3. Propagule Storage

Plant propagules must be properly stored until cultivation or outplanting.

a. Remove and discard all diseased propagules.

b. Thoroughly dry seeds at room temperature before long-term storage. Only well dried seed should be stored. Moist seeds become damp, moldy and vulnerable to insect attacks. Seeds should be mixed and turned 4-5 times per day over 4 to 5 days.

c. After drying the seeds, seeds should be cleaned to remove all malformed, broken, undersized, diseased seeds, weed seeds, other crop seeds, chaff and other vegetative matter.

d. Seed should be stored in containers that are airtight and moisture proof to prolong their viability. Seeds have a tendency to absorb moisture; to maintain dryness and deter insect predation, the storage containers may be filled to a quarter capacity with such agents as dry wood ash, diatomaceous earth, dry charcoal, lime, silica gel or paper.

e. See material should be stored for no more than two years before cultivating or outplanting unless placed in a cold-storage facility.

4. Propagule Cultivation

a. Bradshaw's lomatium plants should be grown in a greenhouse or nursery facility.
b. Plants will be cultivated in greenhouses so that populations from the same Recovery Zone are isolated in a manner that cross-pollination contamination does not occur.

c. Under greenhouse cultivation, propagules and progeny from F1 and F2 generations may be used for introduction into prairie habitat. Only the F1 generation should be used for subsequent propagation. The F2 generation propagules and plant plugs may be outplanted in the field, but further greenhouse propagation is not permitted. The F3 propagules or plant plugs will not be propagated or introduced into prairie habitat unless genetic information suggests that negative effects of genetic drift or domestication have not occurred.
d. Bradshaw's lomatium seed should be cold stratified for at least eight weeks, followed by an alternating 10°/20°C (50°F/68°F) temperature treatment.
e. Germinated seeds should be transferred to larger pots with standard sterilized potting mixture following germination and then grown until robust enough for transplant at augmentation or re-introduction sites (Gisler 2004).
f. Plants should be provided with fertilizers or other chemical additives to prevent algal, fungal or insect infestations that inhibit growth or cause mortality.

5. Propagule Collection from Propagated Plants

Propagules may be collected from plants cultivated at a greenhouse or nursery facility for further cultivation or outplanting. Seed can be collected from greenhouse grown propagules and successive F1 progeny and outplanted to augmentation and reintroduction sites. To avoid in-breeding depression or genetic drift that could arise from successive population in-crossing of a limited greenhouse-grown population, seed collected from F3 progeny will not be outplanted to augmentation or reintroduction sites.

Population Augmentation

Augmentation of Hobart Natural Area's Bradshaw's lomatium population may be accomplished by sowing seeds or planting plugs to increase the population size. To minimize the potential for outbreeding depression, the source of seeds used in augmentation projects should be populations that are nearby or which occupy similar habitat as the

restoration site. Management tasks to implement augmentation and reintroduction are provided below.

1. Direct seeding

a. If necessary to prepare the seed bed, soil may be prepared for sowing by shallow-depth hand- or (where listed plants are not present) equipment tilling the site.
b. Seed will be sown in the ground either by no-till drill if soil is dry enough to support vehicle weight without soil compaction, or by hand-sowing into the soil.
c. Seed will be sown in a manner that conforms to the density and spacing of the source populations, taking into consideration that significant pre-establishment mortality may occur and planting in higher densities may compensate for loss.
d. Seed will be planted in a manner to facilitate subsequent monitoring efforts. Mapped grids, metal tags or flags will be used to indicate the planted areas. This will assist with post-planting monitoring of introduction efforts.
e. Seed will be sown in the fall directly into suitable habitats at augmentation and reintroduction sites. Seed will be sown on the soil surface October through January without fertilizer into existing habitat, raked ground, or lightly tilled soil. Seed burial is not necessary in this species.
f. Invasive vegetation will be cleared to the extent practicable prior to seeding.

2. Outplanting plugs

a. If outplanting plugs in areas that already contain Bradshaw's lomatium, field personnel should take care to avoid trampling listed plants.
b. Plugs should be outplanted by hand in the fall (after the rains have begun).
c. The outplanting site should be prepared for plugs by first clearing away existing dead and living vegetation to expose soil. Avoid disturbing existing native plants and their roots if possible.
d. Excavate soil to the approximate depth and width of the plug.

e. Insert plug directly into the soil or with amended soils containing mulch or fertilizer so that the rim of the plug is level with the surrounding soil. A small amount of native soil should be added over the plug to reduce desiccation.
f. Do not use fertilizer at outplanting, as it may benefit competing vegetation.
g. Plugs should be planted in a manner that conforms to the density and spacing of the source populations, taking into consideration that some pre-establishment mortality will occur and planting in higher densities may compensate for loss.
h. Plugs should be planted in habitat conditions (soil, topography, etc.) similar to the seed source's habitat.
i. Plugs should be planted in a manner to facilitate subsequent monitoring efforts. Mapped grids, metal tags or flags will be used to indicate the planted areas. This will assist with post-planting monitoring of introduction efforts.

Collection and Outplanting of Non-Listed Native Plants

An essential part of restoring populations of rare species is the restoration of native prairie structure and function. Seed and plant parts from many native prairie plants may be collected to create nursery stock for restoration projects, and a variety of native forbs and grasses should be augmented or introduced as part of prairie restoration efforts. Seed collection, propagation and outplanting of these unlisted species are not restricted by federal or state endangered species laws. However, these activities could have some effects to listed species. If listed species occur at a site where collection of seeds or plant parts of non-listed plants is to take place, care will be taken to avoid trampling or otherwise harming listed plants.

Appendix 5. Bradshaw's lomatium Monitoring Protocol

Pre-Monitoring Checklist

- □ Have someone familiar with Bradshaw's lomatium visit Hobart Natural Area in mid-April to check on flowering phenology. Schedule monitoring dates based on when expect Bradshaw's lomatium to be in full flower (very difficult to locate otherwise).
- □ Budget staff/volunteer time. Previous monitoring took 4-6 people approximately 2 days (72 hours total person-hours with a mixture of experienced/inexperienced crew).
- □ Make arrangements for volunteers to assist with monitoring if necessary.
- □ Print aerial photos/maps with gps layer of Bradshaw's lomatium locations from last monitoring effort.
- □ Review Bradshaw's lomatium counts and distribution from previous monitoring data
- □ Gather equipment (see list below)

Monitoring Field Equipment List

- □ 100 meter tapes (at least 3)
- □ Flagging (if only 2 meter tapes)
- □ Meter tape chaining pins
- □ Meter sticks or 0.25 m plastic PVC pipe (1/investigator)
- □ Pinflags (at least 300-500, 2 colors, orange and pink work best)
- □ Camera + extra batteries/memory Card
- □ GPS + extra batteries
- □ Tally/click counters (2/person)
- □ Waterproof knee-high boots (if site still has a lot of standing water)
- □ Scientific calculator
- □ Write-in-rain notebooks (especially if raining)
- □ Pencils
- □ Clipboard
- □ Sharpie pens (1/person)
- □ Sample size calculation worksheets (on write-on-rain paper if raining)
- □ Pictures of species/identifying characteristics
- □ Plant identification key/guides
- □ Method for generating random numbers (phone application, stopwatch, etc.)
- □ Previous year's monitoring data
- □ Site species list
- □ Aerial photos/maps with GPS layer of previously-mapped target population locations, if available
- □ Directions to site (if haven't been there before)

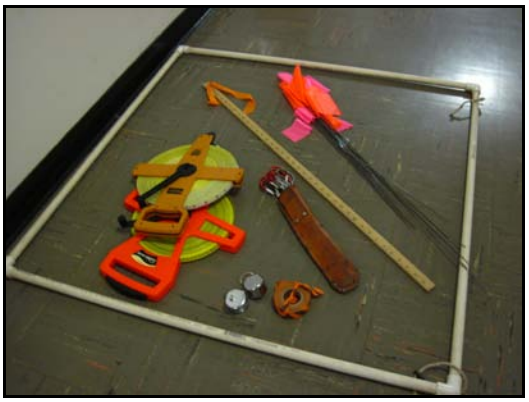

Figure 15. An example of monitoring field equipment.

Monitoring Protocol

A. Orient monitoring staff/volunteers

1. Locate examples of a flowering, vegetative and seedling Bradshaw's lomatium plants, have everyone review what the species looks like so that everyone is confident they can identify it. If unable to find an example of a seedling at the site, bring a picture of what a seedling looks like. If helpful, provide copies of pictures of Bradshaw's lomatium (see Appendix 6) for monitoring staff/volunteers.

2. Review definition of an "individual" of Bradshaw's lomatium: stems are at least 4 cm (≈ 3 finger widths) apart at their bases.

3. Review definition of "seedling" of Bradshaw's lomatium: single leaf with cotyledons still present (see Appendix 6 for picture of seedling).

4. Review aerial photo of previous year's monitoring data to orient crew to the site and expected location of the Bradshaw's lomatium.

5. Give overview of monitoring protocol:
    a. Locate and flag plants
    b. Subsample in densest area (Area 1; Figure 16)
    c. Census the rest of the site

Figure 16. Hobart Natural Area Bradshaw's lomatium censusing areas. Area 1 is very densely populated, and is subsampled. Areas 2-6 can be censused, although subdividing the areas (especially Area 6) can be helpful.

B. Locate extent and distribution of Bradshaw's lomatium plants

1. Provide everyone with large handful of orange and pink flags

2. Everyone canvases area where Bradshaw's lomatium plants and potential habitat are located

3. Mark encountered plants with pinflags (orange for flowering, pink for vegetative). In the dense polygon where sampling will occur, do not mark every individual. Spend enough time to cover the entire area (usually 30-45 minutes, depending on how many people there are). The goal at this point is to get a general sense of the population size, density, and geographical distribution, rather than to mark every plant.

4. Take overall pictures of site when done flagging

C. Divide group, assign tasks, and provide equipment

1. Process documentor/photographer (this person can also count plants)
    a. Photographs overall site conditions, extent of Bradshaw's lomatium, any changes/impacts to site, methodology
    b. Records date, names/affiliations/contact information for folks monitoring
    c. Notes any deviations from monitoring protocol
    d. Equipment needed: camera, write-in-rain notebook and/or site data sheet

2. GPS person: maps all polygons/patches/lone individuals
    a. Equipment needed: GPS unit, pinflags (in case encounter missed plants)

3. Sampling rectangle group (at least two people, ideal if have three)
    a. Equipment needed: 100-meter tapes, flagging, write-in-rain notebook, meter sticks or .25 m long PVC pipe, scientific calculator, random number generator, pencils

4. Censusing group
    a. Equipment needed: Flagging (if need to subdivide an area), pinflags, sharpies, write-in-rain notebook to record counts, pencils

D. Set up sampling macroplot

1. Lay out macroplot (rectangle/parallelogram) with meter tapes (doesn't have to be perfectly square as long as sides are parallel) that encompasses the densest portion of the population (Area 1; Figure 16). The goal is to have the least amount of variation possible between transects. If there are a few outliers near the edge of the dense patch, best to leave them out and count them separately, rather than risk having a transect that has only one individual.

2. Each tape should cover two sides of the rectangle, with the lower numbers on the shorter sides.

3. Determine dimensions of macroplot (2013 dimensions: 14.5 m x 66 m).

4. Generate random numbers for ten 0.25-m-wide transect starting points.
    a. If rectangle is 14.5 meters wide, there are 58 possible transect starting points: 0, 0.25, 0.5, 0.75, 1, 1.25, etc.

b. Generate ten random numbers between 0 and 58 (using a random number generating ap on a smartphone, a stopwatch, a random number generating table, or some other method)
c. Divide each random number by 4 to get the actual starting point on the meter tape (i.e. if your random numbers are 3, 12, 15, 28, your transect starting points would be 0.75, 3.0, 3.75, 7.0).

5. Run 3rd meter tape or flagging between the first transect's starting point on one end of the rectangle and the corresponding point on the opposite side of the macroplot. Belt transects should run the length (longest dimension) of the macroplot (Figures 17 and 18).

6. Count all Bradshaw's lomatium plants within 0.25 m of the upper side of the tape (i.e. if the starting point of the belt transect is 0.25 m, the transect encompasses everything between 0.25-0.5 m). Use a meter stick, ruler or a piece of PVC pipe to determine if a plant is within 0.25 m of the tape. NOTE: If a plant falls on the border of the transect, count it in the transect if the base is rooted within the transect.

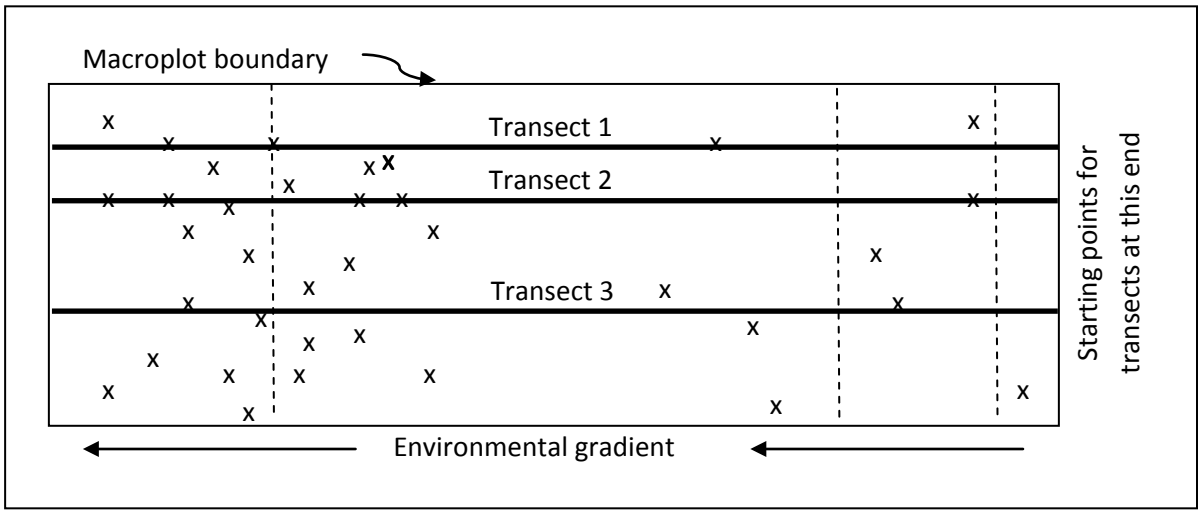

Figure 17. Sample diagram of quadrat (belt transect) orientation within a macroplot. Each x represents a cluster of plants. Quadrats are oriented lengthwise (solid lines labeled Transects 1-3) so that variability is captured within each transect (each transect passes through areas of greater and lesser density), rather than between transects (as it would be if transects were oriented the other way, as shown by the dotted lines). Orienting transects this way also places them parallel to the environmental gradient.

Figure 18. Meter tape marking edge of belt transect in sampling macroplot.

7. Ideally, there are three people sampling: 1 recorder and 2 surveyors starting at opposite ends and working toward the center, calling out plants as they encounter them (i.e. 2 vegetative, 3 reproductive, 1 seedling, etc.) while the recorder documents what is found.

8. Repeat steps 5-7 for the next 9 transects.

9. Total counts for each transect.

10. Run sample size calculation using the worksheet provided in Appendix 8. (Recommended margin of error = 30%). If the sample size needed is less than or equal to 10, the sampling is complete. If the sample size needed is greater than 10, randomly generate the additional required transect starting points, and record numbers for the new transects.

11. Don't forget to take pictures showing the population, your methodology and monitoring efforts!

E. Census all of the rest of the population (in sections)

1. Select first section to census (see Figure 16 for suggested sections)

2. If the selected area has an unclear boundary (i.e. no clear edge like the creek), lay out tape/flagging delineate where the edge is to keep track of what has been counted and what has not.

3. Start at one end of the section and methodically canvas the area. Flag all Bradshaw's lomatium plants within the target section (orange for flowering, pink for vegetative). Flagging plants before counting is useful for several reasons: 1) it enables the GPS person to record plant locations, 2) everyone knows if a plant has been counted already, which minimizes missing and double counting individuals, and 3) monitoring staff do not have to keep track of numbers while they are searching for individuals.

4. If there are not enough pinflags available to mark all of the plants in one section, there are several other ways to keep track of what has and has not been counted:
    a. A section can be further subdivided with flagging or meter tapes and counted. NOTE: If an individual falls along a boundary, only count it if it is rooted within the subdivided area (Figure 19).
    b. If plants are very dense and surveyors are not using pinflags to mark every plant (i.e. counting as they go using a hand clicker counter or recording in a notebook), it can be helpful to further subdivide a transect or subsection with a meter stick or PVC pipe length.
    c. If there are enough people monitoring, one person can be a designated recorder, and the other surveyors can call out the number and type of plants encountered (i.e. 3 veg, 2 repro, 2 seedlings, etc.)
    d. Add up counts for each subsection to get a total count for a section.

Figure 19. Using flagging to subdivide a section to facilitate censusing of Bradshaw's lomatium.

5. If plants are very dense and there are not enough pinflags, surveyors can write the counts for a cluster of plants on the pinflag with a sharpie (i.e. write "3V/2R" for three vegetative and two reproductive individuals in a cluster).

6. Once all individuals are marked, take digital photos of entire section to capture a visual representation of the size and extent of the population in that area.

7. Go back through the population collecting all pinflags, and total the number of pinflags (or the counts written on the pinflags) for a section count.

8. Repeat for other sections.

9. Add up counts for each section to get a total count of the censused portion of the population.

F. Conduct rapid assessment of site habitat quality.

1. Do a quick walk through the Bradshaw's lomatium habitat (the open wet prairie) and record:
    a. Number of native forbs and grasses (update species list)
    b. Percentage of native cover (more or less than 50%)
    c. Presence of noxious weeds (more or less than 5%, see Appendix 7 for list)
    d. Percentage of woody cover (more or less than 15%).

2. If there are patches of noxious or otherwise concerning non-natives, map locations for future treatment.

3. Note any other threats or management issues or recommendations

G. Wrap-up

1. Make detailed notes regarding who conducted the monitoring, the time it took, and any deviations from the monitoring plan.

2. Check over data to make sure there are no gaps or unclear data entries.

Appendix 6: Bradshaw's lomatium Pictures

Figure 20. Clockwise from top left: Bradshaw's lomatium diagnostic bracts, seedling, flowering plant, and vegetative plant.

Appendix 7: Partial List of Invasive Non-Native Plant Species of Concern

(From USFWS 2010)

Arrhenatherum elatius (tall oatgrass)

Brachypodium sylvaticum (false-brome)

Centaurea X *pratensis* (meadow knapweed)

Cytisus scoparius (Scotch broom)

Phalaris arundicacea (reed canary grass)

Pyrus communis (feral common pear)

Rubus armeniacus (Armenian blackberry)

Rubus vestitus (European blackberry)

Appendix 8. Sample Size Calculation Sheet

(from Silvernail et al. 2012, adapted from Elzinga et al. 1998, p 349-350)

Site Name: _____
ORBIC EO_ID: _____
Date: _____
Observers: _____

1. Caclculate standard deviation: $(s)=\sqrt{\{[\sum(x-\mu)2]/(n-1)\}}$

   x = value/count associated with quadrat
   μ=mean
   n=number of sampled quadrats

Sample	x	μ	x- μ	$(x- \mu)^2$
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
∑				
[∑(x-μ)2]/(n-1)				
s = √{[∑(x-μ)2]/(n-1)}				

   Standard deviation, s = _____

2. Initial, uncorrected sample size, $n =(Z_\alpha^2 * s^2)/(\mu*\beta)2$

   Z_α = standard normal coefficient (Elzinga et al. 1998 p 346)
   = 1.96 for 95% confidence level
   s = standard deviation calculated from pilot sampling
   β = desired precision level (maximum 30%, or 0.3)

	Value	Value2
Z_α	1.96	3.84
s		
μ		
β	0.3	
μ*β		
$Z_\alpha^2*s^2$		
$(Z_\alpha^2*s^2)/(\mu*\beta)^2$		

3. Sample size correction, n*
   (see Appendix 9)

   Corrected sample size, n* = _____

Appendix 8, continued. Sample Size Calculation Sheet

4. Correct for a "finite population" if you have sampled more than 5% of the population: n'=n*/{1+(n*/N)}

n'=the new, finite population corrected (FPC) sample size
n*=the corrected sample size from #3

N=the total number of possible quadrat locations in the population. To calculate, determine the total area of the
population and divide by the size of one quadrat.

	Value
Quadrat length (m)	
Quadrat width (m)	
Quadrat size (m^2)	
Macroplot area (m^2)	
N	

	Value
N	
n*	
n*/N	
1+(n*/N)	
n' = n*/{1+(n*/N)}	

Finite population corrected (FPC) sample size, n' =
_____

Appendix 9: Sample Size Correction Table for Single Parameters

(from Elzinga et al. 1998, p 350)

95% confidence interval[1]							
n	n*	n	n*	n	n*	n	n*
1	5	26	37	51	66	76	94
2	7	27	38	52	67	77	95
3	8	28	39	53	68	78	96
4	10	29	41	54	69	79	97
5	11	30	42	55	70	80	98
6	12	31	43	56	71	81	99
7	14	32	44	57	72	82	100
8	15	33	45	58	74	83	101
9	16	34	46	59	75	84	102
10	18	35	48	60	76	85	103
11	19	36	49	61	77	86	105
12	20	37	50	62	78	87	106
13	21	38	51	63	79	88	107
14	23	39	52	64	80	89	108
15	24	40	53	65	81	90	109
16	25	41	54	66	83	91	110
17	26	42	56	67	84	92	111
18	28	43	57	68	85	93	112
19	29	44	58	69	86	94	113
20	30	45	59	70	87	95	114
21	31	46	60	71	88	96	116
22	32	47	61	72	89	97	117
23	34	48	62	73	90	98	118
24	35	49	63	74	91	99	119
25	36	50	65	75	92	100	120

[1]for corrections based on a different confidence interval, see Elzinga et al. 1998, p 349-350