

ODOT Greenhill Mitigation Bank

Annual Report 2018



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1 Summary

The Oregon Department of Transportation's (ODOT) Greenhill Mitigation Bank is located on 57.55-acres in Lane County, near the City of Eugene. This report summarizes activities to enhance 57.35 acres and restore 0.2 acres of the site to native wetland prairie and includes 2018 management actions and monitoring results. The 2018 monitoring results show that the site's wet prairie plant community is establishing well, with 65 % native plant cover and less than 10% invasive non-native plant cover in summer 2018. Invasive non-native plant species have continued to emerge from the soil seedbank and have required ongoing control. The site met all performance criteria in 2018. Vernal pools are functioning as expected, filling rapidly during fall and winter rains, trapping sediment, developing characteristic native vegetation dominated by annual native species, and providing breeding sites for native invertebrates and amphibians, before drying by mid-summer. Management activities in 2018 focused on controlling non-native plant species and enhancing the native plant community through a third year of selective native seeding and planting.

2 Introduction and Site Description

2.1 Site Location

The Oregon Department of Transportation's (ODOT) Greenhill Mitigation Bank site (the site) is a 57.55-acre area located in the Long Tom River Watershed, Lane County, near the City of Eugene, Oregon. The Site slopes from an elevation of about 420 ft on its west side down to about 384 ft along its east boundary. The Site is bounded by BLM wet prairie to the north, a railroad on the south, private rural land and residences to the west and Greenhill Road to the east (Fig. 1).

2.2 Historic Vegetation and Land Use

Landform, soils, and site location, as well as early land survey maps, suggest the site and surrounding area was historically wetland prairie. Aerial photos indicate that by 1936 (the earliest photo available) the site was already subdivided into multiple agricultural fields and was in crop production or used for pasture or haying for the next 50 years.

A wetland delineation for the site completed in 2011 indicated all but 0.2 acre of the site's pre-project condition was wetland. The natural communities on the site in 2012 were followed agricultural wetlands with scattered trees and shrubs along fencelines (e.g. Oregon ash (*Fraxinus latifolia*), serviceberry (*Amelanchier alternifolia*), California black oak (*Quercus kelloggii*), Oregon white oak (*Quercus garyana*), Suksdorf's hawthorne (*Crataegus gaylussacia*)). Dominant plants were colonial bentgrass (*Agrostis capillaris*), Himalayan blackberry (*Rubus bifrons*), and velvetgrass (*Holcus lanatus*), with a few large dense patches of meadow foxtail (*Alopecurus pratensis*). The northeastern one-quarter of the site was also dominated by colonial bentgrass, large patches of reed canary grass (*Phalaris arundanaceae*), and pennyroyal (*Mentha pulegium*). This was the only area where native tufted hairgrass (*Deschampsia cespitosa*) and a few scattered native forbs and rushes occurred, particularly along the fenceline or boundary with the BLM property to the north.

2.3 Public Access, Maintenance Access, and Roads

The site currently has no public access, since it is an active mitigation bank site under construction. Access for maintenance and monitoring by City staff and contractors is via a locked gate and small gravel pad on the west side of Greenhill Road, just north of the railroad tracks or via Goble Lane, a gravel road off Highway 126, at the west end of the site. No roads bisect the site.

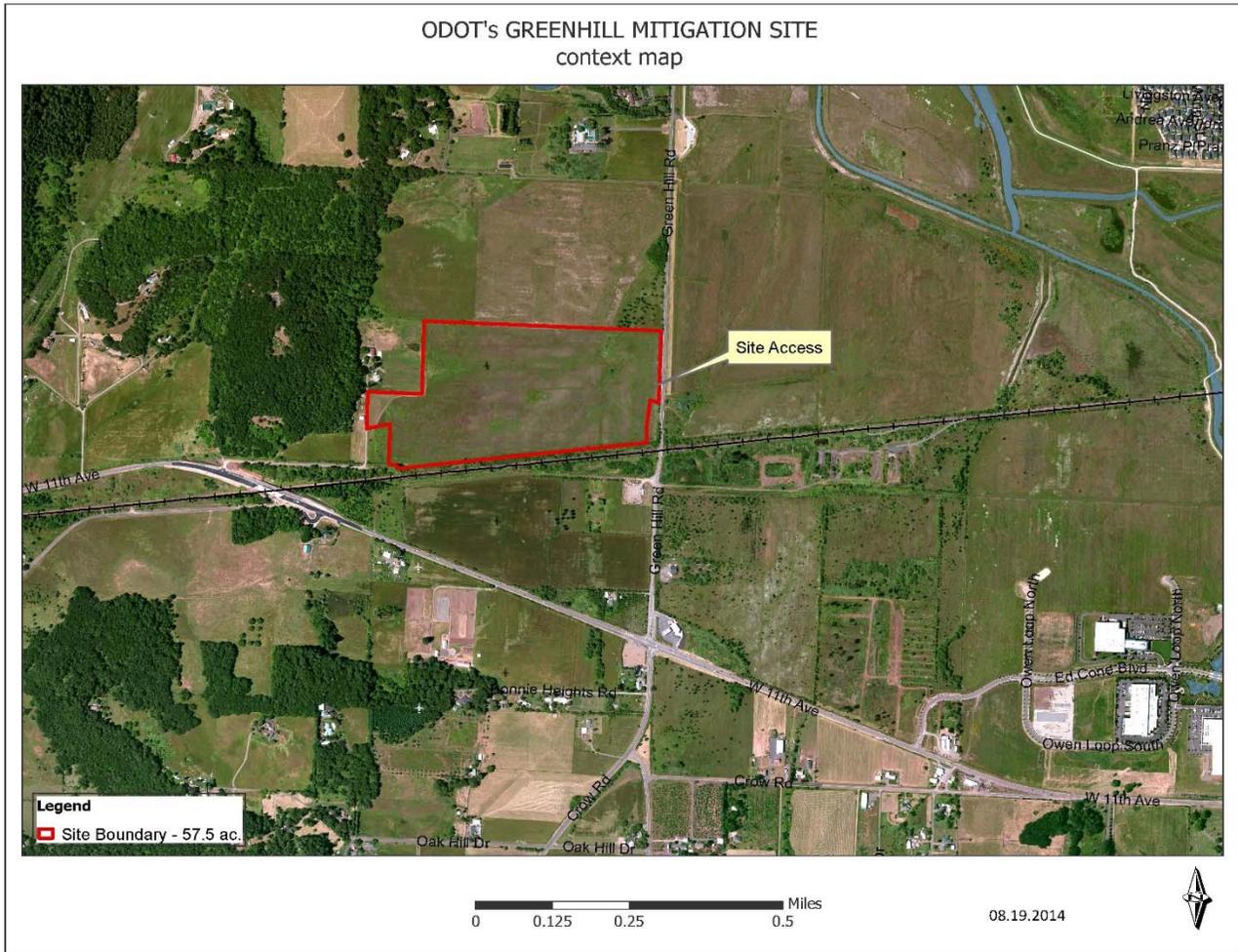


Figure 1. ODOT’s Greenhill Mitigation Bank Site boundary. Lands directly to the north and those east of Greenhill Road are conserved as part of West Eugene Wetlands natural areas. Land to the south, on the south side of the railroad tracks, is designated for protection in the West Eugene Wetlands Plan, but is currently in private ownership.

3 Bank Goals

The Mitigation Bank Instrument (MBI) indicates the goals for the Mitigation Bank are to “...enhance/rehabilitate 57.35 acres and restore 0.2 acres, resulting in the establishment of 57.55 acres of Hydrogeomorphic (HGM) class slope/flat native wetland prairie.” In addition to objectives supporting that goal and the long term sustainable management of the Bank, a further objective is to contribute to the recovery of sensitive species.

4 Mitigation Bank Administration – Credit Ledger

The Greenhill Mitigation Bank has had total releases of 1.63 credits and withdrawals of 1.14 credits. Table 1 describes transactions to date. No transactions occurred in 2018.

Table 1. ODOT Greenhill Mitigation Bank Credit Ledger, with transactions from 2017 and prior years.

Transaction Date	Transaction Type (Withdrawal or Release)	Jurisdiction (State, Federal)	Number of Credits	Credit Unit (ac)	State Permit Number	Federal Permit Number	Credit Type (HGM, Cowardin)	Balance of Released Credits
4/13/15	Release	both	1.22	1.22	RF-52761	NWP-2011-383	Slope-Flats, PEM	1.22
4/16/15	Withdrawal	both	1.14	1.14	57297	NWP 2015-43	Slope-Flats, PEM	0.08
4/14/17	release	both	0.41	0.41				0.49

5 2012-2017 Field Enhancement Activity Summary

Table 2. Key field enhancement activities from 2012 through 2017. Field surveys for invasive species, rare plants, birds, and cultural artifacts are not included in summary, nor is monitoring.

Year	Activity
2012 – fall	Controlled reed canary grass (<i>Phalaris arundinacea</i>), Himalayan blackberry (<i>Rubus bifrons</i>), and Scots broom (<i>Cytisus scoparius</i>).
2012 – fall	Mowed entire site.
2013 – spring/summer	Controlled reed canary grass, Himalayan blackberry, and Scot’s broom.
2013 - fall	Salvaged seeds and bulbs of native species with small populations in the site’s east region and along east fenceline.
2013 – summer	Mowed, disked, harrowed, and rolled site prior to earth-moving.
2013 – summer/fall	Earthwork to excavate shallow pools, remove agricultural drainage channels, and install snags and downed wood
2013 – fall	Implemented erosion control measures (jute netting, coir logs, and compost berms).
2014 – winter/spring	Installed additional coir logs.
2014 – spring	Controlled all non-native species with broadcast herbicide applications
2014 – summer/fall	Manual removal and herbicide applications to control non-native plant species, including Himalayan blackberry, pennyroyal, and ox-eye daisy (<i>Leucanthemum vulgare</i>).

Year	Activity
2014 – summer/fall	Earthwork to recontour pool outlet in NE site corner. Installed more erosion control materials (coir, jute, and river rock) where needed.
2015 – spring/summer	Controlled all non-native species with broadcast herbicide applications.
2015 - summer	Spot herbicide applications to control invasive non-native species, including Himilayan blackberry, sheep sorrel (<i>Rumex acetosella</i>), pennyroyal, and ox-eye daisy.
2016 – spring/summer	Controlled invasive non-native plants, with focus on bentgrass, false dandelions, ox-eye daisy, and pennyroyal.
2016 – fall	Installed 15 monitoring staff gauges to track inundation of vernal pools.
2016 - fall (Sept/Oct)	First native seeding distributes 304 lbs of native seed of 60 native forb, rush, and sedge species in more than 15 seed mixes across the site.
2016 – fall	Planted over 6,000 plants of 10 native species across site.
2017 – spring/summer	Controlled invasive non-native plants, with focus on bentgrass, false dandelions, sheep sorrel, and pennyroyal.
2017 - fall	Second native seeding distributes 215 lbs of native seed of forb, rush, grass, and sedge species in 20 mix combinations across the site.

6 2018 Management Actions

1. Staff continued to track locations of non-native invasive plant species and implemented mechanical and chemical control of pennyroyal (*Mentha pulegium*) from fall 2017 through fall 2018. Staff and contractors controlled pennyroyal, sheep sorrel (*Rumex acetosella*), false dandelion, and hairy hawkbit (*Hypocheris radicata/Leontodon saxatilis*), using spot-herbicide applications across the site. Contractors used ATV and spot applications of Milestone herbicide in flagged polygons to control false dandelion and hairy hawkbit and these polygons were later mapped using GPS for planned native grass drilling and competitive forb seeding in fall 2018. Grasses were typically targeted with grass-specific herbicide. Hand removal of non-native invasive species was used in some planting locations to reduce non-target effects, where uncommon or slow-growing native species such as racemed goldenweed (*Pyrracoma racemosa*) or narrow-leaf mules ears (*Wyethia angustifolia*) were establishing well. Hand-weeding was also used site-wide for removal of species such as Queen Anne’s lace (*Daucus carota*) and curly dock (*Rumex crispus*), that can be successfully hand pulled.
2. In July, staff mowed native grasses in parts of the buffer (boundary) areas to keep non-native invasive forbs from flowering and later implemented manual control for some regions where non-native species regrew.
3. Staff distributed about 315 pounds of native forb and grass seed across the site in October 2018 (Figure 3). Forbs used were primarily those that had larger amounts of seed available in 2018, but had not already established well across the site, including geophytes such as *Camasssia* and *Perideridia*. Native grasses were introduced across the site in 10 polygons; grass seed was drilled in all 10 locations and in 4 locations grasses and *Potentilla gracilis* were hand broadcast where additional competition with invasive non-native species would be beneficial.

- Staff and contractors implemented a small planting at the end of November of about 650 plants and 1,000 small bulbs of 6 species in the east half of the site. The planting locations and species list are shown in Figure 4 and Table A2.

7 Vernal Pool Monitoring

Methods. Vernal pool hydroperiods and presence of breeding amphibians was tracked in the 2016-2017 year (see 2017 report), so this year only the depths of the pools when full and the number that maintained water into June were tracked. Full pool depth was recorded on March 20, 2018 for the 18 pools that had staff gauges (of 32 pools total) in spring 2018. Presence of Pacific chorus frog egg masses (*Pseudacris regilla*) was noted if they were observed from the pool edge. In 2017, about 1/5 of the pools held water into the first week in June, so the first week in June 2018 pools with staff gauges were checked for continued inundation, with a final check on July 6.

Results. Pool water depth on March 20 ranged from 5 to 21 inches, with most of the pools being 8 to 12 inches deep in their deepest region. Pacific chorus frog egg masses were observed in 8 of the 18 sampled pools and others likely also supported egg masses or larval amphibians that were not apparent from the pool edge.

By June 5, 2018, only 3 of the 18 sampled pools (1/6) still held water. No amphibian larvae were seen, as metamorphosis had occurred by that time. The largest pool had a water depth of 5" and a surface area of almost 400 sq ft at that time. All pools were dry by the July 6 check. Vernal pool native vegetation continued to establish, providing locations for amphibian egg attachment, sheltering locations for amphibians and invertebrates, and pollen and nectar resources for bees and other species as pools dried in May and June.

8 Vegetation Monitoring

Methods. Vegetation establishment was tracked by walking the site periodically throughout the year and recording emerging plant species, especially those uncommon across the landscape and non-native invasive species that would require treatment. Staff conducted quantitative vegetation sampling from June 5 – 7, 2018, using the point-intercept method, with a tripod and steel pole with pin point. Point-intercept sampling involved identifying all species that contact the pin point as it is dropped at locations along the transects. Sampling is systematic with a random start. Sample points were taken along 10 transects that ran from the east to west side of the site, with an additional 2 partial transects parallel to the others, to encompass the broader west end of the site. Transects are shown on Figure 2 and more detail on the point-intercept method employed at this site is provided in Appendix C. Monitoring staff collected 443 sample points in 2018. A list of all species found on the site was developed from site-wide meandering surveys in May, June, July and September. Plants encountered were identified to species and sometimes to the subspecific level. The following non-native species were considered together, since our response to them would be identical and close inspection (or

reproductive parts) was required to distinguish them: *Agrostis capillaris* and *Agrostis stolonifera*; *Vulpia myuros* and *Vulpia bromoides*; *Leontodon saxatilis* and *Hypochaeris radicata*.

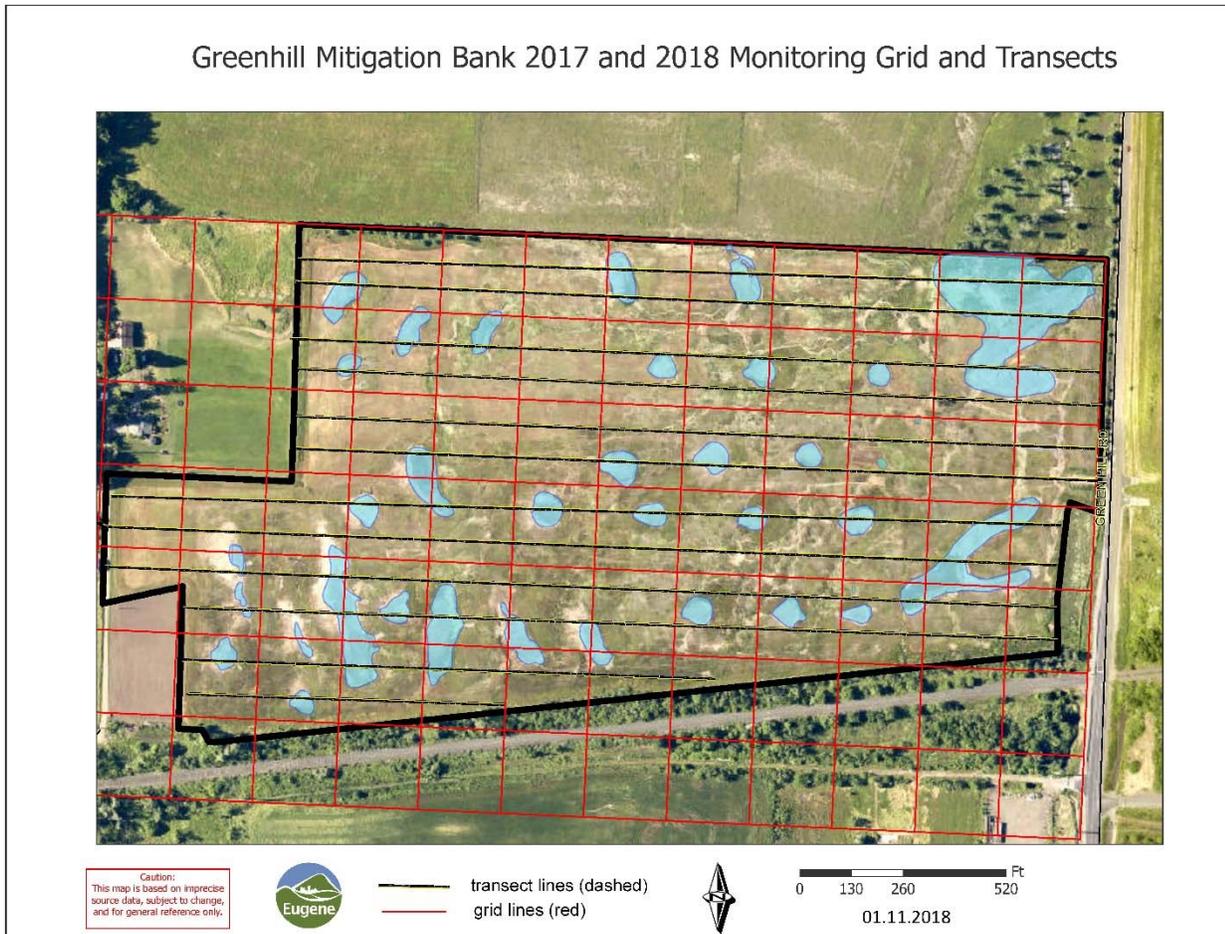


Figure 2. Approximate locations of monitoring grid and transects for point-intercept plant cover monitoring.

Results. Native wetland grasses. Native grasses are currently well-established along the borders of the site and, in fall 2018, were introduced in a patchy configuration throughout the site. The border grass areas in summer 2018 were dominated by native flowering spike bentgrass (*Agrostis exarata*), meadow barley (*Hordeum brachyantherum*), and tufted hairgrass (*Deschampsia cespitosa*).

Site-wide species. Results of the site-wide point-intercept plant cover monitoring for 2018 are presented in Table 4. Overall, native species establishment remains robust, with absolute cover of native species over 64%. Native cover is beginning to shift from primarily annual-dominated to increasing perennial cover, as expected in the second growing season after first native seeding; the two most common annuals, *Plagiobothrys scouleri* and *Juncus bufonius*, declined by about a third and cover of perennials such as *Prunella vulgaris* var. *lanceolata* and *Grindelia integrifolia* x *nana* more than doubled. Both native plant cover and non-native plant cover was lower in 2018 than in 2017, and bareground was higher than the previous year at 40%, likely due to invasive non-native species control earlier in the

season that left more open areas. In addition, one area of the site is being managed for a higher abundance of small native species (e.g. *Gnaphalium* sp., *Plagiobothrys* sp., *Juncus bufonius*) and bareground to support breeding streaked horned larks. Although no nests were located in 2018, streaked horned larks were noted calling from the NW region of the site repeatedly during the breeding season.

Non-native invasive species abundance declined substantially from the first growing season. In 2018 non-native invasive plant species cover was only 8.6% (absolute cover) and non-native (non-invasive) species cover, also declined substantially to 5.9% (absolute). Non-native plant species are identified as invasive based on the definition in the mitigation bank instrument. Invasive plant species include those that are identified specifically in the MBI for this site (e.g. *Mentha pulegium*), those on the Oregon Noxious Weed list (not encountered in 2018 monitoring), and *Agrostis capillaris/stolonifera*, due to its abundance on the site pre-enhancement and during first year monitoring, and its competitive behavior in wet prairies elsewhere in the West Eugene area. In addition to these, staff evaluated the cover of all non-native species this year, to determine if they met the criteria for invasive in the MBI: that they both increased from last year and they exceeded previously identified abundance levels (15% cover in 10% of the site). At this site, 8 non-native species in 2018 exceeded their 2017 cover estimates. Seven of these 8, however, were still at less than 1% cover and therefore did not meet the secondary abundance criterion. This was evaluated in point intercept monitoring by identifying the number of points of the total sampled that would constitute 10% (44 points) and then taking 15% of that total (7 points). So any non-native species that was encountered ("hit") 7 times during the 2018 monitoring and had increased since 2017 was further evaluated. Only *Leontodon saxatilis* / *Hypochaeris radicata* met this criterion (5.9% cover or 26 hits). We then evaluated the clustering of this species group (based on sampling points where it occurred) and determined that occurrence of *Leontodon/Hypochaeris* was concentrated in the west region to the extent it met the definition of having 15% cover in 10% of the site area and therefore was considered invasive at this site (Table 4).

During point-intercept monitoring, 24 native species and 16 non-native species were encountered at sampling points (Table 4). During meandering surveys throughout the spring and summer 75 native species and 48 non-native species were recorded on the site (Appendix 2), similar to last year. Notable species that were located on the site only in the last two years and were not seeded, include *Montia howellii* (candidate for Oregon state listing), found in at least two patches near vernal pools and *Nuttallanthus texanus* (no State or Federal status but on local chapter of Native Plant Society of Oregon rare list). Staff introduced two other species, *Navarettia willametensis* and *Pyrracomma racemosa* over the past two years and will evaluate their establishment on the site in the 5th or final monitoring year in which performance criteria are evaluated.

Table 4. Greenhill Mitigation Bank Site Point-intercept Monitoring Results, 2018.
 Percent cover results are shown (with 80% binomial confidence intervals (CI)) for several guild types as well as each species intercepted during monitoring.

		Area Sampled		57.6 acres	
		Sample Size		443	
		Plant Community		Wet Prairie with vernal pools	
Origin¹	Species or Guild (all herbaceous)	% Cover	CI Low	CI High	
	Native (absolute cover)	64.6			
	Invasive Non-native (absolute cover)	8.6			
	Non-native, excluding invasives (absolute cover)	5.9			
	Total Plant Cover (absolute cover)	79.0			
	Bare ground (no vascular plants, moss may occur)	40.0			
	Native² (a relative cover value)	51.0	47.8	54.2	
	All Non-native² (a relative cover value)	13.5	11.5	15.8	
Native	<i>Juncus bufonius</i>	19.4	17.0	22.0	
Native	<i>Plagiobothrys scouleri</i>	18.7	16.4	21.3	
Native	<i>Prunella vulgaris var. lanceolata</i>	9.9	8.1	12.0	
Native	<i>Gnaphalium palustre</i>	3.6	2.5	5.0	
Native	<i>Grindelia integrifolia</i>	2.3	1.4	3.5	
Native	<i>Epilobium ciliatum</i>	0.9	0.4	1.8	
Native	<i>Gratiola ebracteata</i>	0.9	0.4	1.8	
Native	<i>Plagiobothrys figuratus</i>	0.9	0.4	1.8	
Native	<i>Veronica peregrina xalapensis</i>	0.9	0.4	1.8	
Native	<i>Navarretia intertexta</i>	0.7	0.2	1.5	
Native	<i>Microsteris gracilis</i>	0.7	0.2	1.5	
Native	<i>Eriophyllum lanatum</i>	0.7	0.2	1.5	
Native	<i>Juncus occidentalis</i>	0.7	0.2	1.5	
Native	<i>Potentilla gracilis</i>	0.7	0.2	1.5	
Native	<i>Dowlingia yina</i>	0.5	0.1	1.2	
Native	<i>Agrostis exerata</i>	0.5	0.1	1.2	
Native	<i>Eleocharis obtusa</i>	0.5	0.1	1.2	
Native	<i>Deschampsia cespitosa</i>	0.5	0.1	1.2	
Native	<i>Microseris laciniata</i>	0.5	0.1	1.2	
Native	<i>Ranunculus occidentalis</i>	0.5	0.1	1.2	
Native	<i>Myosotis laxa</i>	0.2	0.0	0.9	

Table 4. Greenhill Mitigation Bank Site Point-intercept Monitoring Results, 2018.
 Percent cover results are shown (with 80% binomial confidence intervals (CI)) for several guild types as well as each species intercepted during monitoring.

		Area Sampled	57.6 acres		
		Sample Size	443		
		Plant Community	Wet Prairie with vernal pools		
Origin ¹	Species or Guild (all herbaceous)	% Cover	CI Low	CI High	
Native	<i>Lotus unifoliatius</i>	0.2	0.0	0.9	
Native	<i>Lasthenia glaberrima</i>	0.2	0.0	0.9	
Native	<i>Galium trifidum</i>	0.2	0.0	0.9	
Invasive	<i>Leontodon saxatilis/Hypochaeris radicata</i>	5.9	4.5	7.6	
Invasive	<i>Agrostis capillaris/stolonifera</i>	1.6	0.9	2.6	
Invasive	<i>Mentha pulegium</i>	1.1	0.6	2.1	
Non-native	<i>Vulpia myuros (not distinguishing VUMY and VUBR)</i>	0.9	0.4	1.8	
Non-native	<i>Rumex acetosella</i>	0.7	0.2	1.5	
Non-native	<i>Myosotis discolor</i>	0.7	0.2	1.5	
Non-native	<i>Cerastium glomeratum</i>	0.7	0.2	1.5	
Non-native	<i>Parentucellia viscosum</i>	0.7	0.2	1.5	
Non-native	<i>Trifolium subterraneum</i>	0.7	0.2	1.5	
Non-native	<i>Anagalis arvensis</i>	0.2	0.0	0.9	
Non-native	<i>Lythrum hyssopifolium</i>	0.2	0.0	0.9	
Non-native	<i>Lythrum portula</i>	0.2	0.0	0.9	
Non-native	<i>Taraxacum officinalis</i>	0.2	0.0	0.9	
Non-native	<i>Leucanthemum vulgare</i>	0.2	0.0	0.9	
Non-native	<i>Geranium dissectum</i>	0.2	0.0	0.9	
Non-native	<i>Callitriche stagnalis</i>	0.2	0.0	0.9	

1 In Origin column, invasive is as defined in the Mitigation Bank Instrument for this site.

2 Native and non-native cover data are provided here transformed to allow calculation of binomial confidence intervals appropriate for point guild data. In the transformed data, each of the two guilds (native and non-native) can only be recorded once at each point (e.g. each point is either native, non-native, both, or neither). Total native and non-native cover could therefore each equal 100%.

9 Anticipated Actions for 2019

In 2019, staff will:

1. continue to focus on control of non-native invasive plant species across the site, particularly the pennyroyal, non-native grasses, hawksbit/false dandelion, and sheep sorrel, since these have been problematic at other sites.
2. monitor vegetation using quantitative and qualitative methods. Tracking native grass establishment at the site in 2019 will be used to determine the need for further native grass seeding.
3. disperse native seed in areas that may need it due to invasive species control activities.
4. continue to track the effectiveness of erosion control measures.
5. continue to coordinate with neighboring landowners, including the BLM; remove site trash (very minimal so far); and monitor for site trespass, illegal camping, or new threats.

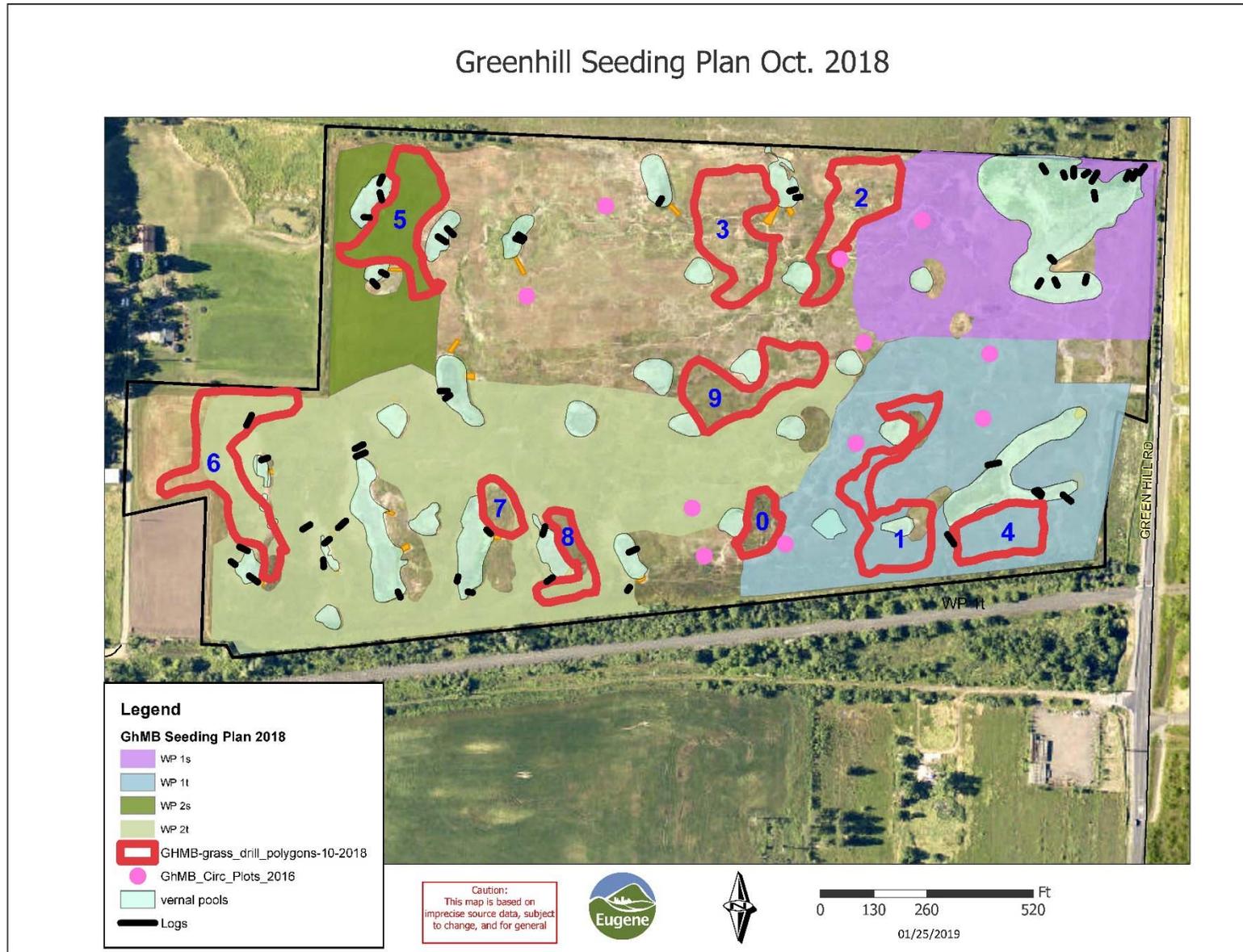


Figure 3. Map of seed mixes distributed October 2018. Detail on the seed mixes is in Appendix A, Table A1.

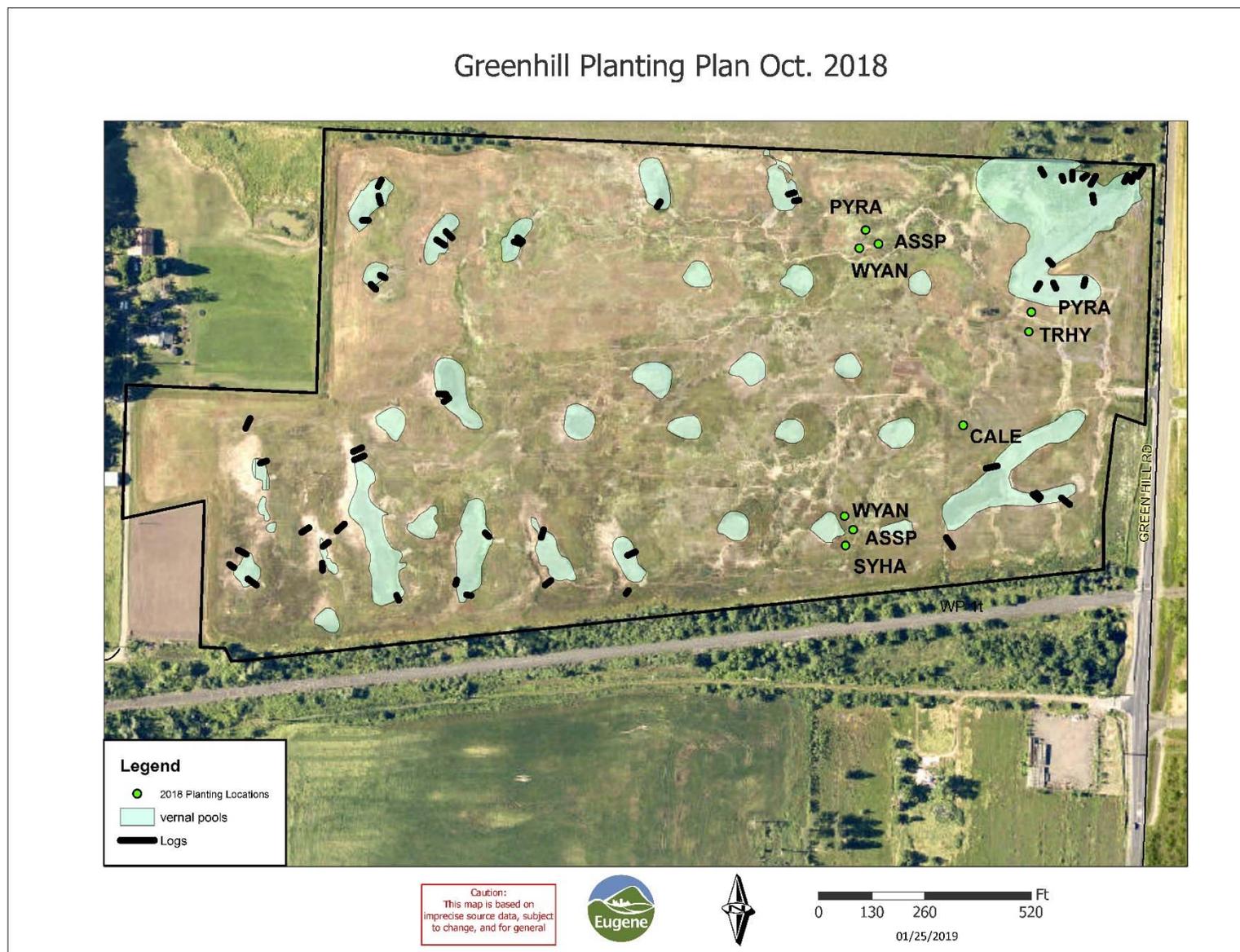


Figure 4. Map of plants installed November 2018. Detail on plantings is in Appendix A, Table A2.

10 Progress Toward Meeting Performance Standards

Monitoring and assessment to verify progress toward meeting performance standards in the Greenhill Bank, as described in the MBI, is summarized annually (Table 5). See Monitor Year 2 for this year's data.

Monitor Year	Performance Standard	Monitoring method	Data (Calendar Yr Collected)	Goal Met?
1	Native vascular plant cover > 40%	Point Intercept	99.5% (2017 report)	Y
1	Non-native <i>invasive</i> vascular plant cover ≤15%	Point Intercept	31.3% (2017 report)	N
1 - 5	The depth range for vernal pool inundation is 3 to 18 inches	Staff gauges (sample)	2 pools exceed identified depth range, however intent is met (2017 report)	Intent Y
1 - 5	No standing water persists permanently in vernal pools	Staff gauges (sample) and observation	No standing water persists beyond July 20 (2017 report)	Y
2	Native vascular plant cover > 50%	Point Intercept	64.6% (this report)	Y
2	Non-native <i>invasive</i> vascular plant cover ≤15%	Point Intercept	8.6.% (this report)	Y
3	Native vascular plant cover > 60%	Point Intercept		
3	Non-native <i>invasive</i> vascular plant cover ≤15%	Point Intercept		
3	25 native plant species are present, of which 6 have > 5% cover in at least 10% of area sampled	Point Intercept and Species List		
4	Native vascular plant cover > 60%	Point Intercept		
4	Non-native <i>invasive</i> vascular plant cover ≤15%	Point Intercept		
5	Native vascular plant cover > 60%	Point Intercept		
5	Non-native <i>invasive</i> vascular plant cover ≤15%	Point Intercept		
5	50 native plant species are present, of which 6 have > 5% cover in at least 10% of the area sampled	Point Intercept		
5	Bare substrate is < 20%	Point Intercept		

References cited:

Pearl, C.A., M.J. Adams, N. Leuthold, and R.B. Bury. 2005. Amphibian occurrence and aquatic invaders in a changing landscape: implications for wetland mitigation in the Willamette Valley, Oregon.

11 Photos

Photos below show representative areas of the site from 2018. Ten photo points are mapped and marked in the field for future photo documentation.



Figure a. West region pool (Pt 4E, Feb. 26, 2018).



Figure b. Shallow inundation across site (Pt. 9E, Jan. 19, 2018).



Figure c. Winter hydrology (Pt. 10E, January 19, 2018).



Figure d. Fall planting (November 2018)

Appendix A. 2018 Seed Mixes and Plantings

Table A1. Greenhill Mitigation Bank, Native Seed Mixes Distributed Fall 2018.

28.3 acres were seeded with native forbs and grasses using the ATV broadcaster and 7.6 acres were drilled with native grasses. Other regions of the site were hand seeded in patches based on moisture gradient and invasive species control. This table includes the species seeded, total grams, and grams per acre used in each mix.

Seed Mix Name	Acres	Scientific Name	Total Gms	Grams/Acre
Mix WP 1s (yr 3)	5.5	<i>Camassia quamash</i> var. <i>maxima</i>	4500	900
<i>Purpose/Location: seed 5.5 of the previously seeded 9.5 acres in the NE region (excludes vernal pools) with camas and other species available in larger quantities this year.</i>		<i>Plagiobothrys figuratus/scouleri</i>	550	110
		<i>Ranunculus occidentalis</i> var. <i>occidentalis</i>	550	110
		<i>Sisyrinchium idahoense</i> var. <i>idahoense</i>	1100	220
		Total:	6700	1340
Mix WP 1t	7.00	<i>Camassia quamash</i> var. <i>maxima</i>	6300	900
<i>Purpose/Location: seed 7 of 9 acres of very wet southeast region, with camas and other species available in larger quantities this year.</i>		<i>Perideridia oregana</i>	1750	250
		<i>Plagiobothrys figuratus/scouleri</i>	1050	150
		<i>Sisyrinchium idahoense</i> var. <i>idahoense</i>	980	140
		<i>Triteleia hyacinthina</i>	1621	232
		Total:	11701	1672
Mix WP 2s	2.50	<i>Lotus unifoliolatus</i> var. <i>unifoliolatus</i>	150	60
<i>Purpose/Location: seed 2.5 acres with competitive native species where invasive species more abundant.</i>		<i>Luzula comosa</i>	408	163
<i>Most of this previously seeded 9.5 acre central-northwest region is left with lower density, low-statured natives to encourage streaked horned lark use.</i>		<i>Potentilla gracilis</i> var. <i>gracilis</i>	750	300
		<i>Rumex salicifolius</i> var. <i>salicifolius</i>	650	260
		Total:	1958	783
Mix WP 2t	13.3	<i>Camassia leichtlinii</i> var. <i>suksdorfii</i>	6916	520

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28.3 acres were seeded with native forbs and grasses using the ATV broadcaster and 7.6 acres were drilled with native grasses. Other regions of the site were hand seeded in patches based on moisture gradient and invasive species control. This table includes the species seeded, total grams, and grams per acre used in each mix.

Seed Mix Name	Acres	Scientific Name	Total Gms	Grams/Acre
<i>Purpose/Location: seed 13.3 acres of this 18 acre central-southwest region, with with camas and other species available in larger quantities this year.</i>		<i>Lomatium nudicaule</i>	7315	550
		<i>Perideridia oregana</i>	3192	240
		<i>Potentilla gracilis</i> var. <i>gracilis</i>	1596	120
		<i>Ranunculus occidentalis</i> var. <i>occidentalis</i>	3911	294
		<i>Rumex salicifolius</i> var. <i>salicifolius</i>	2636	198
		<i>Wyethia angustifolia</i>	3458	260
		Total:	29024	2182
Single sp – by hand. Not locational mix	N/A	<i>Asclepias speciosa</i>	280	N/A
<i>Purpose/Location: targeted hand seeding to improve establishment for specific species.</i>		<i>Camassia quamash</i> var. <i>maxima</i>	8508	
		<i>Castilleja tenuis</i>	53	
		<i>Downingia elegans</i>	19	
		<i>Downingia yina</i>	167	
		<i>Eriophyllum lanatum</i> var. <i>lanatum</i>	400	
		<i>Galium trifidum</i>	23	
		<i>Juncus occidentalis</i>	2270	
		<i>Juncus patens</i>	184	
		<i>Lasthenia glaberrima</i>	200	
		<i>Lomatium nudicaule</i>	1200	
		<i>Lupinus polyphyllus</i>	561	
		<i>Lupinus rivularis</i>	544	
		<i>Madia elegans</i>	900	
		<i>Phlox gracilis</i>	168	
		<i>Plectritis congesta</i>	1200	
		<i>Ranunculus orthorhynchus</i>	292	
		<i>Sidalcea cusickii</i>	500	
	<i>Veronica scutellata</i>	13		
	<i>Wyethia angustifolia</i>	1500		
	<i>Symphotrichum hallii</i>	540		

Table A1. Greenhill Mitigation Bank, Native Seed Mixes Distributed Fall 2018.

28.3 acres were seeded with native forbs and grasses using the ATV broadcaster and 7.6 acres were drilled with native grasses. Other regions of the site were hand seeded in patches based on moisture gradient and invasive species control. This table includes the species seeded, total grams, and grams per acre used in each mix.

Seed Mix Name	Acres	Scientific Name	Total Gms	Grams/Acre
Mix WP - Drill Grass Polygons 0 (0.3 ac), 2 (0.8 ac), 3 (1.1 ac), 6 (1.0 ac), 7 (1.3 ac), 9 (0.3), 10 (0.8 ac)		<i>Danthonia californica</i>	(varies by acreage)	9080
<i>Purpose/Location: Drill native grasses in polygons where invasive forb species control needs and treatment were greatest.</i>		<i>Deschampsia cespitosa</i>		150
		<i>Hordeum brachyantherum</i>		450
Mix WP Drill Grass Polygon 1	0.9	<i>Agrostis exarata</i>	135	150
<i>Purpose/Location: Drill native grasses in polygons where invasive forb species control needs and treatment were greatest.</i>		<i>Deschampsia cespitosa</i>	207	230
		<i>Hordeum brachyantherum</i>	900	1000
Mix WP Drill & Hand Broadcast Grass Polygon 4	0.8	<i>Danthonia californica</i> (drill)	8160	13600
<i>Purpose/Location: Drill California oatgrass at high rates, and other natives, where invasive forb species control needs and treatment were greatest.</i>	0.3	<i>Carex tumulicola</i> (hand)	816	2720
	0.3	<i>Deschampsia cespitosa</i> (hand)	69	230
	0.3	<i>Juncus occidentalis</i> (hand)	21	70
	0.3	<i>Potentilla gracilis var. gracilis</i> (hand)	408	1360
Mix WP Drill Grass Polygon 8	0.25	<i>Danthonia californica</i>	2724	7567
<i>Purpose/Location: Drill California oatgrass at high rates, and other natives, where invasive forb species control needs and treatment were greatest.</i>		<i>Deschampsia cespitosa</i>	45	127
		<i>Hordeum brachyantherum</i>	135	373
Mix WP Hand Broadcast over Grass Polygon 0 (0.15 ac), and 2 (0.4 ac)		<i>Deschampsia cespitosa</i>		900

Table A1. Greenhill Mitigation Bank, Native Seed Mixes Distributed Fall 2018.

28.3 acres were seeded with native forbs and grasses using the ATV broadcaster and 7.6 acres were drilled with native grasses. Other regions of the site were hand seeded in patches based on moisture gradient and invasive species control. This table includes the species seeded, total grams, and grams per acre used in each mix.

Seed Mix Name	Acres	Scientific Name	Total Gms	Grams/Acre
<i>Purpose/Location: Hand broadcast competitive species over drilled areas to compete with invasive forbs.</i>		<i>Juncus occidentalis</i>		200
		<i>Potentilla gracilis var. gracilis</i>		4540
Mix WP Hand Broadcast over Grass Polygon 3	0.5	<i>Deschampsia cespitosa</i>	115	230
<i>Purpose/Location: Hand broadcast competitive species over drilled areas to compete with invasive forbs.</i>		<i>Juncus occidentalis</i>	100	200
		<i>Potentilla gracilis var. gracilis</i>	2270	4540

*Seed originally purchased and reported (in mix lists) as *Plagiobothrys figuratus* was determined to include a large component of *Plagiobothrys scouleri* seed in it, based on emergence at this site and discussions with the seed producer. In this year's seed mixes (Appendix 1) this is reported as a species mix.

Table A2. Plants Installed November 2018. Plant code is used on map to identify planting location.

Species	Map Code	Size	Quantity
<i>Asclepias speciosa</i>	ASSP	Band pots	173
<i>Camassia leichtlinii</i>	CALE	8 flats of bulbs	~800 bulbs
<i>Pyrracoma racemosa</i>	PYRA	plugs	230
<i>Symphotrichum hallii</i>	SYHA	6 flats of small plants	~50
<i>Triteleia hyacinthina</i>	TRHY	Bulbs (loose)	~200 bulbs
<i>Wyethia angustifolia</i>	WYAN	Band pots	190
		Total	1643

Appendix B. Species List

Those species recorded at the Greenhill Mitigation Bank site in 2018 during site-wide spring and summer surveys, as well as those encountered during point-intercept monitoring, are marked with an X.

Scientific Name	Common Name	Origin	Present
<i>Achillea millefolium</i>	yarrow	N	X
<i>Acmispon americanus</i> (Syn: <i>Lotus unifoliolatus</i>)	Spanish-clover	N	X
<i>Agrostis exarata</i>	spike bentgrass	N	X
<i>Agrostis stolonifera/capillaris</i>	fiorin (bentgrass)	I	X
<i>Aira caryophyllea</i>	silver hairgrass	I	X
<i>Alisma lanceolatum</i>	narrowleaf waterplantain	I	
<i>Alisma trivale</i>	northern waterplantain	N	X
<i>Allium amplexans</i>	Slim leaf onion	N	
<i>Alopecurus geniculatus</i>	water foxtail	N	
<i>Alopecurus pratensis</i>	meadow foxtail	I	X
<i>Amelanchier alnifolia</i> var. <i>semiintegrifolia</i>	western serviceberry	N	
<i>Anagallis arvensis</i>	scarlet pimpernel	I	X
<i>Anaphalis margaritacea</i>	pearly everlasting	N	
<i>Anthemis cotula</i>	mayweed chamomile	I	
<i>Anthoxanthum odoratum</i>	sweet vernalgrass	I	X
<i>Anthriscus caucalis</i>	bur chervil	I	
<i>Asclepias speciosa</i>	showy milkweed	N	X
<i>Barbarea orthoceras</i>	American wintercress	N	X
<i>Beckmannia syzigachne</i>	American sloughgrass	N	X
<i>Bidens frondosa</i>	leafy beggars-ticks	N	X
<i>Bidens cernua</i>	nodding beggar-ticks	N	X
<i>Briza minor</i>	little quaking-grass	I	X
<i>Brodiaea coronaria</i>	harvest brodiaea	N	
<i>Brodiaea elegans</i>	harvest brodiaea	N	X
<i>Bromus carinatus</i>	California brome	N	
<i>Bromus hordeaceus</i>	soft brome	I	X
<i>Calandrinia ciliata</i>	red maids	N	
<i>Callitriche stagnalis</i>	Pond water-starwort	N	X
<i>Camassia leichtlinii</i> ssp. <i>suksdorfii</i>	tall camas	N	X
<i>Camassia quamash</i> ssp. <i>maxima</i>	common camas	N	
<i>Cardamine hirsuta</i>	hairy bittercress	I	X
<i>Cardamine penduliflora</i>	Willamette V. bittercress	N	

<i>Carex densa</i>	dense sedge	N	
<i>Carex feta</i>	green-sheath sedge	N	X
<i>Carex leporina</i>	oval broom sedge	N	X
<i>Carex obnupta</i>	slough sedge	N	
<i>Carex stipata</i> var. <i>stipata</i>	awl-fruit sedge	N	
<i>Carex tumulicola</i>	foothill sedge	N	
<i>Carex unilateralis</i>	one-sided sedge	N	X
<i>Carex vesicaria</i>	inflated sedge	N	
<i>Castilleja tenuis</i>	hairy owl-clover	N	X
<i>Centaurium erythraeae</i>	common centaury	I	X
<i>Centunculus minimus</i>	chaffweed	N	
<i>Cerastium glomeratum</i>	sticky chickweed	I	X
<i>Chamerion angustifolium</i> var. <i>canescens</i>	perennial fireweed	N	
<i>Cicendia quadrangularis</i>	Timwort	N	
<i>Cirsium arvense</i>	Canada thistle	I	
<i>Cirsium vulgare</i>	bull thistle	I	
<i>Clarkia amoena</i> ssp. <i>lindleyi</i>	farewell-to-spring	N	
<i>Clarkia purpurea</i> ssp. ssp. <i>quadrivulnera</i>	winecup clarkia	N	X
<i>Collomia grandiflora</i>	grand collomia	N	
<i>Convolvulus arvensis</i>	bindweed	I	
<i>Conyza canadensis</i>	Canadian horseweed	I	
<i>Crassula aquatica</i>	water pygmy weed	N	
<i>Crataegus monogyna</i>	English hawthorn	I	
<i>Crataegus suksdorfii</i>	black hawthorn	N	
<i>Crataegus suksdorfii</i> X <i>monogyna</i>	hybrid hawthorn	I	
<i>Crepis capillaries</i>	smooth hawksbeard	I	X
<i>Crepis setosa</i>	bristly hawksbeard	I	
<i>Cynosurus echinatus</i>	hedgehog dogtail	I	
<i>Cyperus eragrostis</i>	tall flatsedge	I	
<i>Cyperus</i> sp. (likely <i>C. erythrorhizos</i>)	(red-rooted flat sedge)	(N)	X
<i>Danthonia californica</i>	California oatgrass	N	
<i>Daucus carota</i>	Queen Anne's lace	I	X
<i>Deschampsia cespitosa</i>	tufted hairgrass	N	X
<i>Deschampsia danthonioides</i>	annual hairgrass	N	
<i>Dianthus armeria</i>	Deptford pink	I	
<i>Dichanthelium acuminatum</i> var. <i>fasciculatum</i>	western witchgrass	N	
<i>Dichelostemma congestum</i>	ookow	N	

<i>Dipsacus fullonum</i>	teasel	I	
<i>Downingia elegans</i>	showy downingia	N	X
<i>Downingia yina</i>	Willamette downingia	N	X
<i>Echinochloa crus-galli</i>	large barnyard-grass	I	X
<i>Eleocharis acicularis</i>	needle spike-rush	N	
<i>Eleocharis obtusa</i>	common spike-rush	N	X
<i>Eleocharis palustris</i>	common spikerush	N	X
<i>Elymus glaucus</i> ssp.ssp. <i>glaucus</i>	western ryegrass	N	
<i>Epilobium brachycarpum</i>	autumn willowherb	N	X
<i>Epilobium campestre</i>	smooth willowherb	N	
<i>Epilobium ciliatum</i>	hairy willowherb	N	X
<i>Epilobium densiflorum</i>	dense spike-primrose	N	X
<i>Equisetum</i> sp.	horsetail	N	
<i>Eriophyllum lanatum</i> var. <i>lanatum</i>	wooly sunflower	N	X
<i>Eryngium petiolatum</i>	coyote thistle	N	X
<i>Festuca roemerii</i>	Roemer's fescue	N	
<i>Fragaria virginiana</i> ssp.ssp. <i>platypetala</i>	mountain strawberry	N	
<i>Fraxinus latifolia</i>	Oregon ash	N	X
<i>Galium aparine</i>	catchweed	N	
<i>Galium divaricatum</i>	wall bedstraw	I	X
<i>Galium</i> sp.	bedstraw sp.	N/I	
<i>Galium trifidum</i>	small bedstraw	N	X
<i>Galium triflorum</i>	fragrant bedstraw	N	
<i>Gentiana sceptrum</i>	king's gentian	N	
<i>Geranium dissectum</i>	cut-leaved geranium	I	X
<i>Geranium lucidum</i>	shining geranium	I	
<i>Geum macrophyllum</i>	large-leaf avens	N	
<i>Gilia capitata</i> ssp. <i>capitata</i>	bluehead gilia	N	
<i>Glyceria occidentalis</i>	western mannagrass	N	
<i>Gnaphalium palustre</i>	lowland cudweed	N	X
<i>Gnaphalium purpureum</i>	purple cudweed	N	X
<i>Gnaphalium stramineum</i>	cotton batting plant	N	
<i>Gnaphalium uliginosum</i>	marsh cudweed	I	
<i>Gratiola ebracteata</i>	bractless hedge-hyssop	N	X
<i>Grindelia integrifolia</i> × <i>Grindelia nana</i> var. <i>nana</i>	Willamette V. gumweed	N	X
<i>Heracleum maximum</i>	cow parsnip	N	
<i>Holcus lanatus</i>	velvet grass	I	X
<i>Hordeum brachyantherum</i>	meadow barley	N	
<i>Hordeum marinum</i>	Mediterranean barley	I	

<i>Hypericum perforatum</i>	St. John's-wort	I	X
<i>Hypochaeris radicata</i>	false dandelion	I	X
<i>Isoetes</i> sp.	quillwort	N	
<i>Juncus acuminatus</i>	tapered rush	N	
<i>Juncus articulatus</i>	jointed rush	N	
<i>Juncus bolanderi</i>	Bolander's rush	N	
<i>Juncus bufonius</i>	toad rush	N	X
<i>Juncus effusus</i> var.var. <i>effuses</i>	common rush	I	
<i>Juncus effusus</i> var.var. <i>pacificus</i>	soft rush	N	X
<i>Juncus ensifolius</i>	Swordleaf rush	N	X
<i>Juncus marginatus</i>	grass-leaf rush	I	X
<i>Juncus nevadensis</i>	Nevada rush	N	
<i>Juncus occidentalis</i>	slender rush	N	X
<i>Juncus oxymers</i>	pointed rush	N	X
<i>Juncus patens</i>	Spreading rush	N	
<i>Kickxia elatine</i>	cancerwort	I	
<i>Lactuca saligna</i>	willow lettuce	I	
<i>Lactuca serriola</i>	prickly lettuce	I	X
<i>Lasthenia glaberrima</i>	smooth lasthenia	N	X
<i>Lamium purpureum</i>	purple deadnettle	I	X
<i>Lathyrus aphaca</i>	yellow vetch	I	
<i>Lathyrus hirsutus</i>	rough pea	I	
<i>Lathyrus sphaericus</i>	grass pea	I	
<i>Leontodon saxatilis</i> (Syn: <i>Leontodon taraxacoides</i>)	hairy hawkbit	I	X
<i>Leptosiphon bicolor</i> (Syn: <i>Linanthus bicolor</i>)	bicolored linanthus	N	X
<i>Leucanthemum vulgare</i>	oxeye daisy	I	X
<i>Limnanthes alba</i> (agriculture escape)	white meadowfoam	I	X
<i>Lindernia dubia</i>	yellowseed false pimpnel	N	X
<i>Linum bienne</i>	pale flax	I	X
<i>Lolium multiflorum</i>	Italian ryegrass	I	
<i>Lomatium bradshawii</i>	Bradshaw's desert parsley	N	
<i>Lomatium nudicaule</i>	barestem desert-parsley	N	X
<i>Lotus corniculatus</i>	bird'sfoot trefoil	I	
<i>Lotus formosissimus</i>	seaside lotus	N	
<i>Lotus micranthus</i>	small-flowered deervetch	N	
<i>Ludwigia palustris</i>	marsh speedbox	N	
<i>Lupinus affinis</i>	fleshy lupine	N	
<i>Lupinus bicolor</i>	field lupine	N	

<i>Lupinus oreganus</i>	Kincaid's lupine	N	
<i>Lupinus polycarpus</i>	small-flowered lupine	N	X
<i>Lupinus polyphyllus</i> var. var. <i>polyphyllus</i>	bigleaf lupine	N	X
<i>Lupinus rivularis</i>	stream lupine	N	
<i>Luzula comosa</i> var. <i>comosa</i>	field woodrush	N	
<i>Lythrum hyssopifolium</i>	hyssop loosestrife	I	X
<i>Lythrum portula</i>	water-purslane	I	X
<i>Madia elegans</i>	showy tarweed	N	X
<i>Madia glomerata</i>	cluster tarweed	N	X
<i>Madia sativa</i>	coast tarweed	N	X
<i>Malus fusca</i>	western crab-apple	N	
<i>Matricaria discoidea</i>	pineapple weed	N	
<i>Melilotus alba</i>	white sweetclover	I	
<i>Mentha pulegium</i>	pennyroyal	I	X
<i>Micranthes integrifolia</i>	swamp saxifrage	N	
<i>Micranthes oregana</i> (syn: <i>Saxifraga oregana</i>)	bog saxifrage	N	
<i>Microseris laciniata</i> ssp. <i>laciniata</i>	cut-leaved microseris	N	X
<i>Microsteris gracilis</i>	pink microsteris	N	X
<i>Mimulus guttatus</i> var. <i>depauperatus</i>	depauperate monkeyflower	N	
<i>Moenchia erecta</i> ssp. <i>erecta</i>	moenchia	I	
<i>Montia fontana</i>	spring water chickweed	N	X
<i>Montia linearis</i>	narrow-leaved montia	N	X
<i>Myosotis discolor</i>	yellow & blue forget me not	I	X
<i>Myosotis laxa</i>	small-flowered forget me not	N	X
<i>Navarretia intertexta</i> ssp. <i>intertexta</i>	needle-leaved navarretia	N	X
<i>Navarretia squarrosa</i>	skunkweed	N	
<i>Navarretia willamettensis</i>	Willamette navarretia	N	X
<i>Nemophila menziesii</i>	baby blue eyes	N	
<i>Nuttallanthus texanus</i>	Large flowered blue toadflax	N	X
<i>Orobanche californica</i> ssp. <i>californica</i>	California broomrape	N	
<i>Orthocarpus bracteosus</i>	rosy owl-clover	N	
<i>Panicum capillare</i> ssp. <i>capillare</i>	common witchgrass	N	X
<i>Parentucellia viscosa</i>	yellow parentucellia	I	X
<i>Perideridia montana</i>	Gairdner's yampah	N	
<i>Perideridia oregana</i>	Oregon yampah	N	
<i>Persicaria hydropiperoides</i>	marshpepper smartweed	N	
<i>Persicaria maculosa</i>	heartweed	I	X
<i>Phalaris aquatica</i>	Harding grass	I	

<i>Phalaris arundinacea</i>	reed canarygrass	I	X
<i>Phleum pratense</i>	Timothy	I	
<i>Plagiobothrys figuratus</i> var. <i>figuratus</i>	fragrant popcorn-flower	N	X
<i>Plagiobothrys scouleri</i>	Scouler's popcorn-flower	N	X
<i>Plantago lanceolata</i>	English plantain	I	X
<i>Plectritis congesta</i>	rosy plectritis	N	
<i>Poa annua</i>	annual bluegrass	I	
<i>Poa compressa</i>	Canada bluegrass	I	
<i>Poa pratensis</i>	Kentucky blugrass	I	
<i>Poa</i> sp.	bluegrass sp	I	
<i>Polygonum aviculare</i> ssp. <i>aviculare</i>	doorweed	I	
<i>Polygonum douglasii</i>	douglas knotweed	N	
<i>Populus trichocarpa</i>	black cottonwood	N	X
<i>Portulaca oleracea</i>	little hogweed	I	X
<i>Potentilla gracilis</i> var. <i>gracilis</i>	slender cinquefoil	N	X
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	self-heal	N	X
<i>Prunus</i> sp.	plum	I	
<i>Psilocarphus</i> spp.	wooly heads	N	
<i>Pyrrocoma racemosa</i> var. <i>racemosa</i>	racemed goldenweed	N	X
<i>Pyrus communis</i>	pear	I	
<i>Pyrus malus</i>	apple	I	
<i>Quercus garryana</i> var. <i>garryana</i>	Oregon white oak	N	
<i>Quercus kelloggii</i>	California black oak	N	
<i>Ranunculus alismifolius</i>	water-plantain buttercup	N	
<i>Ranunculus aquatilis</i>	white water buttercup	N	
<i>Ranunculus flammula</i>	creeping buttercup	N	
<i>Ranunculus occidentalis</i>	western buttercup	N	X
<i>Ranunculus orthorhynchus</i>	straight beaked buttercup	N	X
<i>Ranunculus parviflorus</i>	Small-flowered buttercup	I	X
<i>Ranunculus sceleratus</i>	celery-leaf butter-cup	N	
<i>Rhamnus purshiana</i>	casacara	N	
<i>Rorippa curvisiliqua</i>	western yellowcress	N	X
<i>Rorippa palustris</i>	Smooth marsh yellowcress	N	
<i>Rosa multiflora</i>	many flowered rose	I	
<i>Rosa nutkana</i>	Nootka rose	N	
<i>Rosa pisocarpa</i>	peafruit rose	I	
<i>Rosa</i> sp.	rose sp.	N/I	
<i>Rubus bifrons</i>	Himalayan blackberry	I	X
<i>Rubus laciniatus</i>	evergreen blackberry	I	

<i>Rumex acetosella</i>	sheep sorrel	I	X
<i>Rumex conglomeratus</i>	clustered dock	I	
<i>Rumex crispus</i>	curly dock	I	X
<i>Rumex salicifolius</i> var. <i>salicifolius</i>	willow dock	N	X
<i>Saxifraga oregana</i> (see <i>Micranthes oregana</i>)	-	-	-
<i>Salix</i> sp.	willow	N	X
<i>Schedonorus arundinaceus</i>	tall fescue	I	X
<i>Schoenoplectus tabernaemontani</i>	softstem bulrush	N	
<i>Senecio jacobea</i>	tansy ragwort	I	X
<i>Senecio sylvaticus</i>	wood groundsel	I	
<i>Senecio vulgaris</i>	old-man-in-the-spring	I	X
<i>Sericocarpus rigidus</i>	rigid white topped aster	N	
<i>Sherardia arvensis</i>	blue field-madder	I	
<i>Sidalcea cusickii</i>	Cusick's checker-mallow	N	X
<i>Sidalcea malviflora</i> ssp. <i>virgata</i>	dwarf checker-mallow	N	
<i>Sisyrinchium bellum</i>	Western blue-eyed grass	N	
<i>Sisyrinchium hitchcockii</i>	Hitchcock's blue-eyed grass	N	
<i>Sisyrinchium idahoense</i>	Idaho blue-eyed grass	N	X
<i>Solanum dulcamara</i>	bitter nightshade	I	
<i>Solanum nigrum</i>	black nightshade	I	
<i>Sonchus asper</i>	prickly sow-thistle	I	X
<i>Sparganium emersum</i>	simplestem bur-reed	N	
<i>Spergula arvensis</i>	stickwort	I	
<i>Spergularia rubra</i>	red sandspurry	I	X
<i>Spiraea douglasii</i>	Douglas spirea	N	
<i>Spiranthes romanzoffiana</i>	hooded ladies tresses	N	
<i>Stellaria media</i>	chickweed	I	
<i>Symphoricarpos albus</i> var. <i>laevigatus</i>	snowberry	N	
<i>Symphotrichum hallii</i>	Hall's aster	N	X
<i>Tanacetum vulgare</i>	common tansy	I	
<i>Taraxicum officinale</i>	dandelion	I	X
<i>Thalictrum polycarpum</i>	Meadow rue	N	X
<i>Toxicodendron diversiloba</i>	poison oak	N	
<i>Toxicoscordion venenosum</i>	meadow death camas	N	
<i>Trifolium arvense</i>	rabbitfoot clover	I	
<i>Trifolium dubium</i>	least hop clover	I	X
<i>Trifolium pratense</i>	red clover	I	
<i>Trifolium repens</i>	white clover	I	
<i>Trifolium subterraneum</i>	subterranean clover	I	X

<i>Trifolium vesiculosum</i>	arrowleaf clover	I	
<i>Triphysaria versicolor</i> ssp. <i>versicolor</i>	johnnytuck	N	
<i>Triteleia hyacinthina</i>	hyacinth brodiaea	N	X
<i>Typha latifolia</i>	cat-tail	N	X
<i>Verbascum blattaria</i>	moth mullein	I	
<i>Verbascum thapsus</i>	common mullein	I	
<i>Ventanata dubia</i>		I	X
<i>Veronica americana</i>	American speedwell	N	
<i>Veronica anagallis-aquatica</i>	water speedwell	I	X
<i>Veronica peregrine</i> var. <i>xalapensis</i>	purslane speedwell	N	X
<i>Veronica scutellata</i>	marsh speedwell	N	X
<i>Vicia cracca</i>	bird vetch	I	
<i>Vicia hirsuta</i>	hairy vetch	I	
<i>Vicia sativa</i>	common vetch	I	X
<i>Vicia tetrasperma</i>	slender vetch	I	
<i>Vulpia bromoides</i>	barren fescue	I	X
<i>Vulpia myuros</i>	rat-tail fescue	I	X
<i>Wyethia angustifolia</i>	narrow-leaf mule's ears	N	X
<i>Zeltnera muehlenbergii</i>	monterey centaury	N	

Appendix C. Monitoring Methods

Monitoring is based on the protocol included in the Compensatory Mitigation Plan of the Mitigation Bank Instrument for the Greenhill Mitigation Bank. Sections of that protocol are included below and updated to reflect the current monitoring.

Vegetation

The point-intercept method (Elzinga et al. 1998) is used to quantitatively monitor vegetation at the Greenhill Mitigation Bank site. This method is currently being used at several wetland sites managed and monitored by the City of Eugene. The point-intercept method is typically considered the most objective measure for plant cover, particularly when monitoring staff may vary from year to year. This monitoring method allows for both repeatability and reliability among monitoring staff and facilitates cross-referencing of monitoring results.

Point-intercept sampling typically occurs in June, sometimes running into early July depending on spring weather patterns. A 1-acre monitoring grid was established over the entire 58 acres of the site and grid intersections were flagged in the field using a GPS with sub-foot accuracy. At the Greenhill Mitigation Bank Site, transects were established starting at the edge of the grass buffer in the east end of the site, running west upslope. Because neither the east nor west end of the sites has a straight line boundary, the lengths of the transects vary from south to north. Transects starts were systematically placed from the acre boundary markers from south to north to achieve good interspersion of sampling points across the entire site. The sampling unit is the point, not the transect. Starting points along the transects are chosen randomly from a random number table to be between 1 and 5 meters. After the random start, three more sampling points are taken, approximately 13 meters apart using pacing. Measuring tapes were used initially in training to adjust staff's paces to meters. In summary, the first point is a random start between 1 and 5 meters, and the next three points along the transect, within each acre, were taken every 13 meters. The random start is then applied again at the beginning of each acre, after staff realign themselves along the flagged acre boundary, to ensure that site conditions that may alter pace length (e.g. presence of pools with standing water) doesn't shift sample placement. This design of systematic sampling with a random start achieved about 8 sampling points per acre, although the partial acres at the site's boundary means that a total of 443 points were sampled in 57.6 acres (7.7 points per acre on average). This relatively high number of samples was taken to ensure an adequate sample size in the first year and could be repeated fairly rapidly in 2018, so will likely be maintained.

At each sampling point, a tripod with level (ensuring perpendicular dropping of the rod) and steel rod are used to determine species cover. For each point, every individual plant that intercepts the very tip of the rod is recorded, as well as the substrate (rock, bare ground, litter, or moss). Percent absolute cover of each species is calculated and an 80% confidence interval is provided for all individual species estimates. Although point-intercept sampling provides a high level of accuracy, it occasionally discounts the presence of species with low cover values. Therefore, walking surveys are conducted to provide measurements of species richness by

species census. Walking surveys occur at least twice during the growing season. The surveyor will create a comprehensive list of all plant species observed during the walk-through. Special attention will be paid to recording and mapping the presence of invasive plant species and uncommon native, wetland plant species.

Hydrology / Vernal Pools

In addition to winter walking surveys to observe water flow across the site and look for formation of erosion channels, a set of 15 representative pools were sampled for depth (via staff gauge placement and recording) 2017. This intensive level of monitoring is not repeated annually, since initial depths and dry down have been observed across a season and in 2018 maximum pool depths at those with staff gauges were recorded (18 pools) and dry down was checked in late June and early July to determine when all pools were dry.

Approximately 8-10 photo points were established along transects after site Construction and the first year of seeding. Photographs will be routinely taken from the designated points and included in monitoring reports. Photo points will appropriately capture important areas of hydrology and representative areas of vegetation.
