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December 21, 2015

Dana Hicks
Oregon Department of State Lands
775 Summer Street N.E.
Department of State Lands
Salem, OR 97301

SUBJECT: REVISED 2015 Monitoring Report for Pixieland Project

Dear Dana:

Enclosed you will find a revision of our Year 3 (2015) monitoring report for the Pixieland tidal wetland restoration project. The original report was submitted to you on 10/26/15. New materials added to this revision include:

- Updated cover sheet
- Updated text for Performance Standards 5.2, 5.3 and 5.8
- Additional table (Table 7) with supporting data on herbaceous cover in the forested transect
- Data sheets for PX T1 and PR T1 (both in Appendix 4)

Our role in this project is to monitor plant community composition, plant community extent (vegetation mapping), and soils; and to analyze and interpret hydrology data collected by U.S. Forest Service staff. This year's report addresses vegetation (performance standards 5.1- 5.8) at transects PX T1, PX T2, and PX T3. Our contract with the Salmon-Drift Creek Watershed Council for monitoring of the 16 reed canarygrass study plots on the graded area ended in 2013 and was not renewed, so we did not monitor those transects in 2015.

Based on our 2015 monitoring, the project is currently meeting 2 of 5 applicable performance standards in herbaceous wetlands, and 5 out of 7 applicable performance standards in shrub-dominated habitats. Although this may appear to be a decrease in performance compared to 2013, the results are due mainly to the different transects monitored: as described above, our 2013 monitoring included the 16 reed canarygrass study plots on the graded marsh surface, but in 2015, no plots were monitored on the graded surface. However, our informal observations of the graded area in 2015 suggested that reed canarygrass cover remains relatively low.

Even though several performance standards were not met for transects PX T2 and PX T3 (on the ungraded old marsh surface), reed canarygrass cover is definitely decreasing in those transects, and bare ground is increasing. With continued exposure to brackish tidal inundation, we expect that salt-tolerant plant species will likely begin to colonize the bare ground. These will likely include both native and non-native species.

In summary, invasive reed canarygrass is clearly declining in the 2015 monitored transects on the old marsh surface, and as described in our previous reports, natural processes are in place to re-establish tidal wetland functions at the site. We recommend monitoring at least a subset of the reed canarygrass study transects in the graded area in 2017 and future years, to allow evaluation of performance criteria for the graded area.

Please refer to the report for details on our findings and recommendations. If you have any questions, please contact me at (541) 752-7671 or by email at brophyonline@gmail.com.
Sincerely,

Laura Brophy
Principal

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2015 Monitoring Report: Pixieland Tidal Wetland Restoration

Laura Brown (Ecologist with the Estuary Technical Group, Institute for Applied Ecology) monitoring vegetation at the margin of the shrub zone at Pixieland. Photo faces north towards the tidal marsh zone and Salmon River. Photo taken 8/10/15 by L. Brophy.

October 2015

Prepared by:
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Prepared for:
Salmon-Drift Creek Watershed Council
Neotsu, Oregon

Green Point Consulting

Institute for Applied Ecology
Restoration | Research | Education

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1. Mitigation monitoring report cover sheet

1: Pixieland identifiers:

DSL Permit Number 42162-GA	COE Permit # NWP	Permittee: USFS-Siuslaw NF
County: Lincoln	Report Date: Oct. 15, 2015	Monitoring Year: 3
Date Removal-Fill Activity Completed: September 2011		
Date mitigation was completed:	Grading: September 2011	Planting: 2012
Data collection: August 2015	Report submitted by Laura Brophy, 541-286-8643, brophyonline@gmail.com	

2: Monitoring report purpose

This monitoring report is for monitoring a project that includes: (check all that apply):

- ☐ Compensatory **freshwater, non-tidal** wetland mitigation for permanent wetland impacts.
- ☐ Compensatory **estuarine** wetland mitigation for permanent wetland impacts.
- ☐ **Only non-wetland** compensatory mitigation.
- ☐ **Only** mitigation for **temporary** impacts that had a monitoring requirement.
- ☐ **Voluntary** wetland enhancement, creation or restoration (General authorization or individual permit) not funded with money from DSL's wetland mitigation fund.
- ☒ Voluntary wetland enhancement, creation or restoration (General authorization or individual permit) funded with money from DSL's **wetland mitigation fund**.
- ☐ **Mitigation Bank** Report
- ☐ Other _____

3: Results

	Performance Standards*	Fully met? (Y/N)	Comments/Reason for shortfall**
1.2	By Year 7, delineation "light" shows that graded areas are (or are likely to become) wetlands.	**Not evaluated**	This standard will be addressed in Year 7.
5.1	For all habitats (but excluding Transect 1), the average cover of native herbaceous species is higher and is increasing at a greater rate than the cover of invasive herbaceous species. Standard will be in effect until native cover is >= 70% .	**N for herbaceous*** N for shrub**	For herbaceous transects PX T2 and PX T3, native herb cover is less than invasive herb cover, but invasive herb cover is decreasing and being replaced by bare ground. Invasive herb cover averaged 59.7% in 2015, down from 96.5% in 2013 (a decrease of 36.8%). For the shrub plots, native herbaceous cover averaged 29.9% (compared to 32.7% in 2013) and invasive herbaceous cover averaged 57.5% (compared to 40.9% in 2013).
5.2	For all habitats, the cover of invasive species, except for *Phalaris arundinacea* (reed canarygrass), is no more than 10%.	**Y**	There was less than 10% cover of invasive species (other than reed canarygrass) in 2015 in herbaceous transects, shrub plots, and the single forested transect.
5.3	For all habitat types, the moisture index, including all strata, is <3.0.	**Y**	Moisture index in 2015 averaged 2.0 for herbaceous transects (the same as in 2013), 1.8 for the single forested transect (not evaluated in 2013), and 1.6 for shrub plots (down from 2.27 in 2013).
5.4	In shrub-dominated (willow) habitats (excluding Transect 1), the density of native woody species is at least 1,600 stems/ac, or the cover of native woody vegetation on the site is at least 50%.	**Y**	Woody stem density averaged 3160 stems/ac in shrub plots in 2015, up from 2633 stems/ac in 2013.

5.5	In shrub-dominated (willow) habitats, the density of invasive shrub or tree species is no more than 10% of the total stem density in all monitoring years.	**Y**	There were no invasive shrub or tree species present in shrub plots.
5.6	In shrub-dominated (willow) habitats (excluding Transect 1), the shrubs have continuous average height growth. This standard will be in effect until the average height of woody species is >7.8 feet.	**Y**	Average shrub height was 7.3 ft in 2015, up from 5.6 ft in 2013.
5.7	In herbaceous wetlands, total plant cover is progressing toward reference conditions, currently measured at 100%, over the monitoring period.	**N**	Total plant cover in herbaceous transects averaged 60.2% in 2015 (down from 96.5% in 2013). These transects were previously 100% invasive reed canary grass; the decline in reed canarygrass cover is likely due to restoration of brackish tidal inundation at these transects.
5.8	For all habitat types and strata, there are at least 3 different native species by Year 5 and thereafter. To qualify, a species will have at least 5% average cover, and occur in at least 10% of plots.	**N for herbaceous** **N for shrub** **Y for forested**	Herbaceous plots had only one native species present in one plot. Shrub plots had 2 native species (soft rush and Hooker's willow) with an average cover over 5% in 2015 (27.2% and 34.0% respectively), and both occurred in more than 10% of plots (60% and 80% respectively). Forested plots met the criteria with >5% cover and >10% frequency of salmonberry, slough sedge, and red alder.

* Performance Standards are excerpted from the Pixieland Mitigation Plan (Oregon DSL 2012).

** See report narrative for detailed information.

*** Although this criterion was not met for herbaceous wetland habitats in 2015 (after meeting the criterion in 2013), failure to meet this criterion in 2015 does not represent overall site failure; instead, it is due to different locations sampled in 2015 versus 2013 (see **Vegetation monitoring methods** section of report).

4: Further Actions:

Remedial work recommended	Yes ☐	No X
Deed Restriction or other protection instrument attached	Yes ☐	No X
Final Monitoring Report?	Yes ☐	No X
Requesting release or partial release of financial security?	Yes ☐	No X

2. Pixieland mitigation plan purpose and overview

A. Location

The mitigation site is located in the Salmon River estuary (Salmon River – Siletz River watershed), Lincoln County, T6S, R11W, Section 30, tax lots 1900, 500, 600 and 100; and 06S 10W, and Section 25, tax lot 1000. The latitude is 45.022 and longitude is –123.967. Roads adjacent to the site include Highway 18 to the south and Highway 101 to the west (Map 1). Fraser Creek flows through the site, and the Salmon River forms the north boundary of the site.

B. Mitigation goals and objectives

The Pixieland mitigation project is intended to compensate for wetland impacts under the Oregon Department of State Lands (OR DSL) In-Lieu Fee (ILF) program. Goals and objectives excerpted from the Pixieland Mitigation Plan (OR DSL 2012) are listed below:

Table 1. Mitigation Goals and objectives (from OR DSL 2012)

Goal: Restore appropriate ground elevations within the project boundary.
Objective 1— An estimated 12.86 acres of filled marsh floor and excavated water features will be re-established to elevations primarily between 8 to 8.5 feet NAVD88.
Goal: To the greatest extent possible, restore the historic tidal frequency, duration, season, magnitude, and extent that is characteristic for the site's position in the estuary.
Objective 2— The tidal flow regime is similar to that in the reference estuary, after adjusting for elevations. 12.99 acres of freshwater wetlands and ditches will be rehabilitated through reconnection to tidal forces and removal of artificial flow paths. This includes all areas below 11.6 ft NAVD 88 that do not meet the definition of re-establishment.
Goal: Increase the potential for fish movement into the project area and improve fish habitat support.
Objective 3—At least 75% of the percent of surface water present during a tide of 7.5 feet or higher is in or connected to a flowing channel that leaves the project area, compared to surface water in isolated pools.
Objective 4—A 1,200 foot section of Fraser Creek will be re-established to a meandering, deeper channel.
Goal: Re-establish native estuarine vegetation and decrease invasive species cover without the use of herbicides.
Objective 5—Vegetation is managed without the use of chemicals to promote native species, reduce reed canarygrass dominance, and keep other invasive species at a level that does not hinder the functionality of the site.
Goal: Facilitate long-term success of the project.
Objective 6—Long-term success of the project is planned for through a management plan and funding mechanism.

Table 2. Summary of restoration methods, HGM and Cowardin classes for the Pixieland ILF site (from OR DSL 2012). Wetland identification codes in the first column correspond to areas shown in Map 2.

Wetland ID	Acres	Restoration Method	Current HGM	Current Cowardin	Predicted HGM	Predicted Cowardin
A	11.70	Re-establishment	-- (Upland)	-- (Upland)	Estuarine (Marine-sourced high tidal fringe)	E2EM
B	6.30	Rehabilitation	Riverine	PEMC	Estuarine (Marine-sourced high tidal fringe)	E2EMP
C	3.05	Rehabilitation	Riverine	PFOC	Estuarine (Marine-sourced high tidal fringe)	E2FOP/ E2SSP
D	2.88	Rehabilitation	Riverine	R2UBHx (open water)	Estuarine (Marine-sourced high tidal fringe)	E2EM
E	0.76	Rehabilitation	Riverine	R2UBHx (Fraser Cr.)	Estuarine (River-sourced tidal)	R2UBHx
F	0.62	Re-establishment	-- (Open Water)	PUBHx (open water)	Estuarine (Marine-sourced high tidal fringe)	E2EM
G	0.54	Re-establishment	-- (Open Water)	PUBFx (open water)	Estuarine (Marine-sourced high tidal fringe)	E2EM

Hydrologic restoration timeline summary

The U.S. Forest Service (USFS) provided key dates of hydrologic restoration activities at Pixieland (Barb Ellis-Sugai, USFS, personal communication, 12/2/13). The tide gate flap was removed or blocked open in 2010 prior to site grading; the concrete tide gate box remained in place during 2010-2011 to provide an equipment path. The tide gate was closed back up in early August 2011 to allow channel excavation & other interior work. Final removal of the tide gate and surrounding concrete occurred towards the end of August 2011.

C. Maintenance and management actions

Maintenance and management actions are reported directly to OR DSL by the U.S. Forest Service (USFS); reporting on these actions is not part of the scope of work for our monitoring contract.

D. Monitoring methods

Vegetation monitoring followed the routine methods specified in the OR DSL Removal-Fill Guidelines, Routine Vegetation Monitoring Guidance (OR DSL 2009), with exceptions as described below. The Pixieland monitoring plan is outlined in Appendix 1.

Vegetation monitoring methods

Vegetation was monitored on August 10-11, 2015, as close as possible to the dates of the baseline and 2013 monitoring. Three sampling methods were used; details of monitoring methods differed by sampling method (Table 3).

Table 3. Vegetation sampling methods at Pixieland

	Standard transects	**Shrub plots**	**Reed canarygrass control experiment transects**
Vegetation type(s)	Emergent and forested	Shrub	Emergent
Years sampled	2010, 2013, 2015	2013, 2015	2011, 2013
Sample design	Transect/quadrat	Circular plot	Transect/quadrat
Transect length/circular plot radius	91.4 m (300 ft) length	10 ft radius	91.4 m (300 ft) length
Sample unit size	1 sq m	1/4 plot (7.3 sq m)	1 sq m
Measurements made	% cover and frequency for herbaceous species; stem density and DBH for woody species	% cover for all species; stem density and height for woody species	% cover and frequency
Transect/plot numbers	PX T1, T2, T3	PX S1, S2, S3	PX RCG 01 to PX RCG 16

Standard transects

Standard transects were 300 ft (91.4 m) in length, and were established in summer 2010, prior to restoration. They were located in representative areas of major plant communities, in areas that were not graded (Map 3); therefore, they are intended to provide data on the restoration trajectory of the ungraded area, which constitutes about half of the Pixieland project area (OR DSL 2012). The length of these transects, the large number of quadrats sampled, and the random placement of the samples within transects provide reasonable assurance that these transects sampled their respective plant communities in an unbiased fashion.

Two of these three standard transects (PX T2 and PX T3) were placed on the old marsh surface at Pixieland (Map 3), an area that was not developed during the Pixieland amusement park era (Brainerd

2010). The old marsh surface was dominated by reed canarygrass prior to restoration, and is still dominated by reed canarygrass in 2015. One of the standard transects (PX T1) was placed in a forested area near the wetland/upland boundary (Map 3). One standard transect (PR T1) was established in least-disturbed emergent tidal marsh west of Highway 101 (Map 3). This transect serves as an appropriate reference for the Pixieland site, since it is at about the same elevation as the ungraded old marsh surface at PX T2 and PX T3 – approximately 2.7 m (8.9 ft), based on 2007 LIDAR data (USFS 2007).

For the standard transects in emergent vegetation (PX T2, PX T3, and PR T1), percent cover and frequency were visually determined in fifteen 1.0 m^2 quadrats placed at random locations along the full length of the transect. Quadrats were randomly offset 1 m to the right or left of the transect to minimize vegetation trampling. All of the 15 quadrats surveyed in 2010 were re-sampled during 2015. Total plant cover summed to 100% in the herbaceous plots. Layers of vegetation not visible from above were not searched exhaustively, so species richness estimates may be underestimates of total plant richness.

For the standard transect in the forested area (PX T1), nested plots were used to determine woody plant density and herbaceous cover. All trees present within 4.9 m (16 ft) of either side of the 91.4 m (300 ft) transect were counted and measured (diameter at breast height, DBH, measured at 1.4 m = 4.6 ft) to estimate tree density and size (892 m^2 plot). Eight 9.3 m^2 (10 ft by 10 ft) shrub plots were randomly positioned along the transect to estimate shrub density. Stems reaching at least breast height were counted. Percent cover of herbaceous species was visually estimated within two smaller plots (1.0 m^2) placed at the corners of each shrub sub-plot to (total of 16 herbaceous plots for the whole forested transect). The same shrub and herbaceous plots were sampled in 2010, 2013, and 2015. Cover of shrubs and trees was estimated separately from the herb layer within the shrub plots; cover of shrubs and tree seedlings less than breast height (i.e. within the herb layer) was measured as part of the herbaceous understory.

Shrub plots

Three circular shrub plots of 3.05 m (10 ft) radius were sampled in the shrub zone (Map 3). For shrub plots S2 and S3, percent cover of herbaceous and woody species was assessed visually within four subplots, each occupying one-quarter of the circular shrub plot. Cover was measured separately within the herb layer and the shrub layer, but cover of shrubs less than breast height was measured as part of the herbaceous understory. For shrub plot S1, stem densities were so thick that only one half of the circular shrub plot was sampled (S1). Willow densities and heights were also sampled for plants at that had attained at least breast height.

Reed canarygrass control experiment

A manipulative experiment on reed canarygrass control methods was initiated in 2011 and sampled in 2013. This experiment was located on the graded marsh portion of the restoration site and was used to evaluate results in that graded area. However, our contract with the Salmon-Drift Creek Watershed Council for monitoring these experimental plots expired in 2013 and was not renewed; therefore we did not sample these plots in 2015. This change in sampling strongly affected 2015 results, as described in **Results** below. For more information on the reed canarygrass control experiment, see Brophy and Janousek (2013).

Vegetation analysis methods

Species were assigned native (N), non-native (NN), or invasive (I) status based on data in USDA Plants (http://plants.usda.gov), Cook et al. (2013) and the Oregon Department of Agriculture's Noxious Weed List (http://www.oregon.gov/ODA/PLANT/WEEDS/Pages/lists.aspx) as required in the Pixieland Mitigation Plan (OR DSL 2012). Invasive species present in this project were common velvetgrass *(Holcus lanatus),* reed canarygrass *(Phalaris arundinacea)*, and Himalayan blackberry (*Rubus bifrons)*.

Vegetation composition in 2010, 2013, and 2015 in the four standard transects and shrub plots was reported as summary statistics (means, standard deviations, and percent change between years). Results were compared against the Oregon Division of State Lands performance criteria for the Pixieland restoration site. Statistical tests of significance (1-way ANOVA and Wilcox test) were applied to determine significance of year-to-year changes in cover for species of interest.

Soil monitoring and analysis methods

Soil sampling and analysis was conducted for the standard transects in 2010, and for the reed canarygrass control plots in 2011. Post-restoration soils monitoring will occur in Year 10 (2020).

E. Monitoring locations

Vegetation was monitored in the standard transects and shrub plots shown in Map 3 (Appendix 3). The rationale behind the sampling locations is described in "**Monitoring methods"** above.

Transect markers from 2013 were recovered in 2015. GPS coordinates for vegetation monitoring locations are provided in Table 4.

Table 4. Standard transects and shrub plots: GPS coordinates (meters, UTM Zone 10N, NAD83) for end posts (or shrub plot centers). Coordinates are from recreational grade GPS and are accurate within 2-4 meters.

Transect end post or shrub plot center	Northing (m)	Easting (m)
PR-T1_2010_S	4986125.0	423525.0
PR-T1_2010_N	4986196.0	423584.0
PX-T1_2010_S	4985707.5	423668.0
PX-T1_2010_N	4985795.1	423723.1
PX-T2_2010_E	4985857.5	423640.8
PX-T2_2010_W	4985854.3	423544.9
PX-T3_2010_N	4985952.4	423663.3
PX-T3_2010_S	4985882.3	423604.3
PX_S1	4985777.0	423876.0
PX_S2	4985776.0	423901.0
PX_S3	4985900.0	423739.0

3. Results

A. Vegetation performance standards

This section evaluates the mitigation performance standards for Pixieland. For further details on vegetation change at the site, see **Vegetation change since baseline monitoring** below.

Performance Standard 5.1: NOT MET for herbaceous zone; NOT MET for shrub zone. For all habitats (excluding forested transect PX T1), the average cover of native herbaceous species was higher and was increasing at a greater rate than the cover of invasive herbaceous species. This standard will be in effect until there is at least 70% native cover. Transect 1 will not be used in calculating the average.

For the two herbaceous transects sampled in 2015 (PX T2 and PX T3), native herbaceous cover averaged 0.5% in 2015 compared to 0.0% in 2013 (an increase of 0.5%); invasive herbaceous cover averaged 59.7% in 2015, down from 96.5% in 2013 (a decrease of 36.8%).

The herbaceous zone failed to meet this standard in 2015, but had previously met the standard in 2013. At first glance, this may appear to indicate a decrease in project performance. However, in reality, this result was due to the different areas sampled in 2015 versus 2013. As described in **Vegetation monitoring methods** above, 2015 sampling included only the two herbaceous transects on the ungraded old marsh surface, compared to the 18 herbaceous transects sampled in 2013 (16 on the graded surface, 2 on the ungraded surface). The two transects sampled in 2015 were intended only to represent the ungraded old marsh surface; they should not be viewed as representative of restoration results for the graded area.

For shrub plots, native herbaceous cover was 29.9% in 2015 (compared to 32.7% in 2013) and invasive herbaceous cover -- entirely reed canarygrass -- was 57.5% in 2015 (compared to 40.9% in 2013). For forested plots, native herbaceous cover was 53.1% in 2015 (compared to 21.0% in 2013) and invasive herbaceous cover – entirely reed canarygrass – was 4.6% in 2015 (compared to 4.0 % in 2013).

Table 5 summarizes native, non-native, invasive, and total plant cover across the two herbaceous transects sampled in 2015 at Pixieland. Table 6 summarizes the same data for the three shrub plots, and Table 7 summarizes the same data for the forested transect. Data for individual plots and all species is found in Appendix 4.

Table 5. Herbaceous transects: Average cover of native, non-native, and invasive species in herbaceous transects at Pixieland during baseline monitoring (2010-2011), and Years 1 and 3 post-restoration monitoring (2013, 2015 respectively). Data do not include the reference transect.

	2010-2011	**2013**	**2015**	**Change in % cover since 2013**
Total cover, native herbaceous species	0.0	0.0	0.5	0.5
Total cover, non-native herbaceous species	0.0	0.0	0.0	0.0
Total cover of invasive herbaceous species, including reed canarygrass (for Standard 5.1)	100.0	96.5	59.7	-36.8
Total cover of invasive herbaceous species, excluding reed canarygrass (for Standard 5.2)	0.0	0.0	0.0	0.0
Total cover, all herbaceous species	100.0	96.5	60.2	-36.3

Table 6. Shrub plots: Average cover of native, non-native, and invasive herbaceous species in the first year of monitoring (2013) and Year 3 post-restoration (2015).

	2013	**2015**	**Change in % cover since 2013**
Total cover, native herbaceous species	32.7	29.9	-2.8
Total cover, non-native herbaceous species	26.3	12.6	-13.7
Total cover of invasive herbaceous species, including reed canarygrass (for Standard 5.1)	40.9	57.5	16.6
Total cover of invasive species, excluding reed canarygrass (for Standard 5.2)	0.1	0.0	-0.1
Total cover, all species	105.0	135.3	30.3

Table 7. Forested transects (herbaceous cover): Average cover of native, non-native, and invasive species in Year 3 post-restoration (2015).

	2015
Total cover, native herbaceous species	53.1
Total cover, non-native herbaceous species	0.2
Total cover of invasive herbaceous species, including reed canarygrass (for Standard 5.1)	4.6
Total cover of invasive species, excluding reed canarygrass (for Standard 5.2)	0.4
Total cover, all species	58.3

Performance Standard 5.2: MET. For all habitats, the cover of invasive species, except for *Phalaris arundinacea* (reed canarygrass), is no more than 10%.

There was no cover of invasive species (other than reed canarygrass) in 2015 herbaceous transects and shrub plots (Tables 5 and 6; Appendix 4). There was 0.4% of invasive species (other than reed canarygrass) in 2015 forested transects (Table 7; Appendix 4).

Performance Standard 5.3: MET. For all habitat types, the moisture index, including all strata, is <3.0.

The average moisture index for all herbaceous transects was 2.0; for shrub plots, the average moisture index was 1.6 (Appendix 4). The average moisture index for the forested transect was 1.8 (Appendix 4).

Performance Standard 5.4: MET. In shrub-dominated (willow) habitats, the density of native woody species is 1,600 stems per acre, or the cover of native woody vegetation on the site is at least 50%. Native species volunteering on the site may be included, dead plants do not count. Transect 1 will not be used in calculating the average.

The average stem density in the shrub plots was 3160 stems per acre in 2015, up from 2633 stems per acre in 2013 (Appendix 4).

Performance Standard 5.5: MET. In shrub-dominated (willow) habitats the density of invasive shrub or tree species is no more than 10% of the total stem density in all monitoring years.

No invasive shrubs or trees were present in the shrub plots in 2015.

Performance Standard 5.6: MET. In shrub-dominated (willow) habitats the shrubs have continuous average height growth. This standard will be in effect until the average height of woody species is greater than (2.4 m) 7.8 feet. Transect 1 will not be used in calculating the average.

The average shrub height in 2015 was 2.2 m (7.3 ft), which was up from an average of 1.7 m (5.5 ft) in 2013. This standard will continue to be monitored until the average height of woody species in greater than 2.4 m (7.8 ft), which will likely occur by the next monitoring episode (2017).

Performance Standard 5.7: NOT MET. In herbaceous wetlands, total plant cover is progressing toward reference conditions, currently measured at 100% in 2015, over the monitoring period.

Total plant cover in the two herbaceous transects monitored in 2015 (PX T2 and PX T3) decreased to 60.2% in 2015 from 96.5% in 2013. These plots were covered with 100% reed canarygrass, therefore a decline in plant cover also indicated a decline in invasive species cover. The space left by the decline in reed canarygrass was not yet filled by other plant species; bare ground occupied this space, increasing from 3.5% in 2013 to 39.8% in 2015.

Performance for this standard appeared to decline in 2015 compared to 2013, but in reality, the change was due to the reduced sampling in 2015 (see Performance Standard 5.1 above). The increase in bare ground is a very positive sign, as discussed in **Vegetation change since baseline monitoring** below.

Performance Standard 5.8: NOT MET. For all habitat types, there are at least 3 different native species **by year 5** and thereafter. To qualify, a species will have at least 5% average cover, and occur in at least 10% of the plots sampled in the habitat type. Species from all strata may be counted.

> In the herbaceous transects, there was only one native species present (*Carex obnupta*), and it was only present in 15% cover in one plot in one transect (PX-T2). For the shrub plots, there were eight native species present, but only two native species had at least 5% average cover: soft rush (27.2% cover) and Hooker's willow (34.0% cover), and both occurred in more than 10% of plots (60% and 80% respectively). In the forested transect, there were three native species present (*Carex obnupta, Rubus spectabilis,* and *Alnus rubra*) that had over 5% average cover, and each of them occurred in at least 10% of the plots sampled.

B. Vegetation change since baseline monitoring

Standard transects

Restoration site

Herbaceous transects

The two herbaceous transects monitored in 2015 (PX T2 and PX T3) were both on the ungraded old marsh surface section of the Pixieland restoration site. This area was previously dominated by reed canarygrass, but in 2015, it was increasingly covered by bare ground (Figure 1 and 2; Tables 8 and 9), as the reed canarygrass cover declined in both transects. In 2015, bare ground in PX T2 increased to 40%, while reed canarygrass cover had decreased to 59% (Table 8). Slough sedge (*Carex obnupta)* was also present at PX T2 in 2015, though cover averaged only 1% (Table 8). Reed canarygrass cover at PX T3 also decreased, from 100% in 2010 and 2013 to 60% in 2015, and bare ground increased (Table 9). These results were also reflected in decreased reed canarygrass frequency in these plots (Tables 8 and 9).

While standards regarding native cover versus invasive cover were not met for the herbaceous plots monitored in 2015, these plots definitely showed a positive trajectory, with the invasive species reed canarygrass declining and bare ground increasing. This result was likely due to increased salinity and tidal inundation in this ungraded portion of the site. We expect to see a further decrease in reed canarygrass at these transects over the next few years. Reed canarygrass is not very salt-tolerant; with the restored tidal regime, it will continue to die off, and it will likely be replaced by a mix of native and non-native species tolerant of brackish salinities. Similar trends have been shown at other restoration sites, including the Ni-les'tun unit of the Bandon Marsh National Wildlife Area (Brophy et al. 2014), where bare ground continued to increase through Year 5 at some transects, while native and non-native salt-tolerant species began to fill in the bare ground at other transects (Brophy, 2015 monitoring data, report in progress). In one transect at Pixieland, a native species, slough sedge, had already appeared within a single plot, and another native species, common orache (*Atriplex patula*), occurred nearby but not within any of the sample plots.

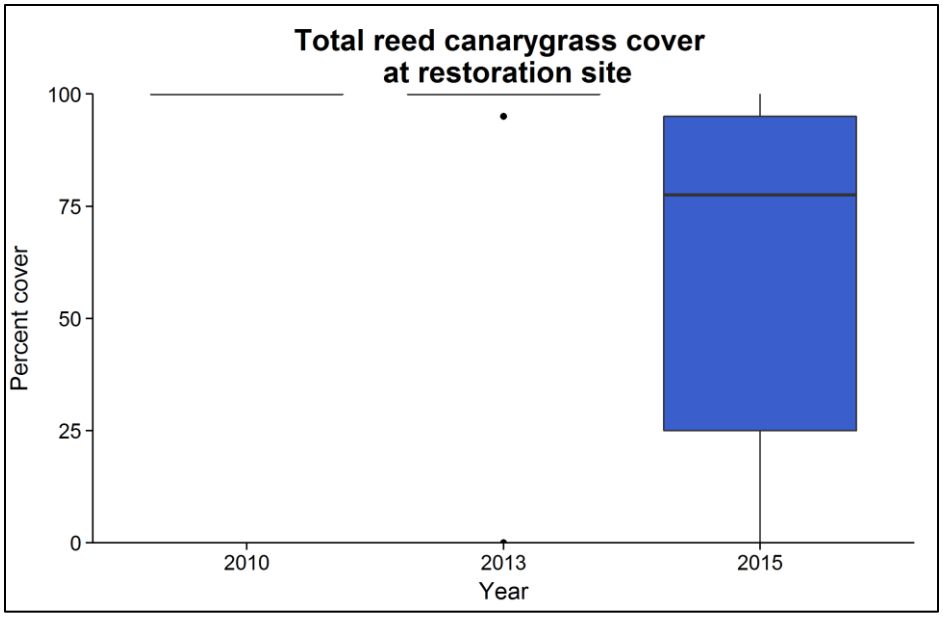

Figure 1. Total reed canarygrass cover, averaged across 30 plots in the restoration marsh (transects PX T2 and PX T3) in 2010, 2013, and 2015. The thick horizontal bar shows median percent cover; boxes show upper and lower 25% quantiles. The dots represent outliers. Restoration occurred in 2011; reed canarygrass cover was 100% in 2010 and 2013 (shown as a single line at top of graph), with the exception of one outlier.

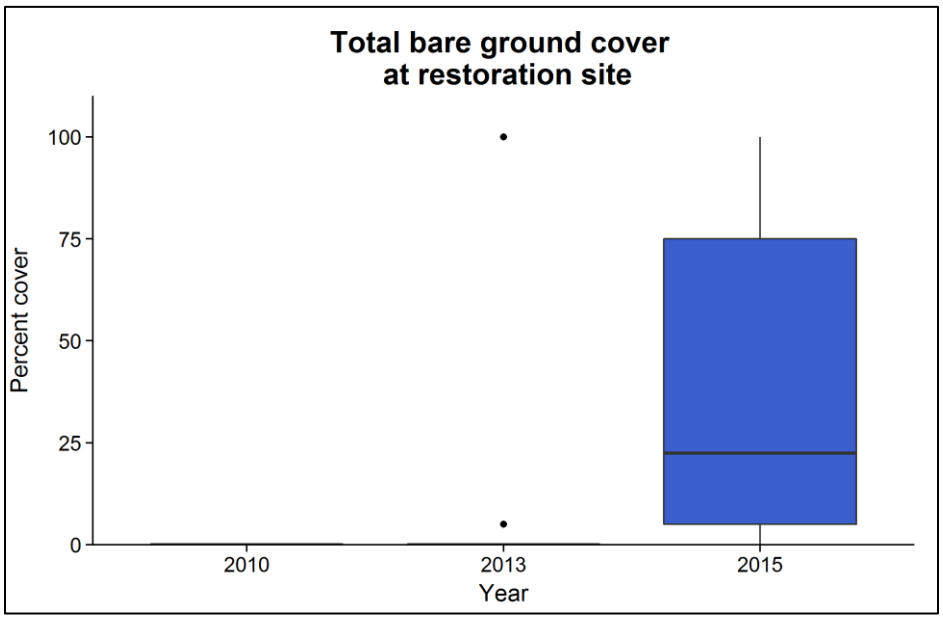

Figure 2. Total bare ground, averaged across 30 plots in the restoration marsh transects (PX T2 and PX T3) in 2010, 2013, and 2015. The thick horizontal bar shows median percent cover; boxes show upper and lower 25% quantiles. The dots represent outliers. Restoration occurred in 2011; there was no bare ground in 2010 or 2013 (shown as a single line at bottom), with the exception of one outlier.

Table 8. Frequency of occurrence (% of quadrats in which species was present) and mean (± SD) percent cover of vascular plant species in emergent marsh transect 2 (PX T2) in the Pixieland restoration site. Native species are in green, non-native/invasive species are in orange.

Species	Common name	Native status	Frequency (%)			Percent cover			Change in cover (2013-2015)
			2010	2013	2015	2010	2013	2015	
Carex obnupta	slough sedge	native	0	0	7	0±0	0±0	1±4	1%
Phalaris arundinacea	reed canarygrass	invasive	100	93	93	100±0	93±26	59±45	-34%
Bare ground			0	0	80	0±0	7±26	40±44	33%
Total native cover						0±0	0±0	1±4	
Total non-native cover						100±0	93±26	59±45	

Table 9. Frequency of occurrence (% quadrats in which species was present) and mean (±SD) percent cover of vascular plant species in emergent marsh transect 3 (PX T3) in the Pixieland restoration site. Native species are in green, non-native/invasive species are in orange.

Species	Common name	Native status	Frequency (%)			Percent cover			Change in cover (2013-2015)
			2010	2013	2015	2010	2013	2015	
Phalaris arundinacea	reed canarygrass	invasive	100	100	93	100±0	100±0	60±37	-40%
Bare ground			0	0	80	0±0	0±0	40±37	40%
Total native cover						0±0	0±0	0±0	
Total non-native cover						100±0	100±0	60±37	

Forested transect

Tree and shrub density and herbaceous understory plant cover were assessed in the forested transect at the Pixieland restoration site (PX T1). Red alder (*Alnus rubra*) was the dominant tree species in 2010, 2013 and 2015 (Table 10). Alder density and average tree size (DBH) were similar between 2013 and 2015 (Table 10). Cover of red alder was 58.8% (Appendix 4). Understory shrubs consisted of salmonberry (*Rubus spectabilis*), elderberry (*Sambucus racemosa*), and Himalayan blackberry (*Rubus bifrons*). Salmonberry was the dominant species, while the other two species were less abundant. Salmonberry stem densities exceeded 14,000 stems/hectare during all monitoring years, and elderberry continued to decrease in density (Figure 3). Elderberry is less tolerant of inundation than salmonberry, so these changes may be due to the restoration of tidal inundation in this forested wetland. During our field work, we observed very wet conditions (saturation or standing water) across much of the forested transect at Pixieland (PX T1); the area was noticeably wetter compared to pre-restoration baseline conditions. LIDAR data from USFS (USFS 2007) suggest elevations in this area are around 2.6 to 2.7 m (8.5 to 8.9 ft) NAVD88. Accounting for likely interference from vegetation (Ewald 2013), actual ground surfaces are probably 20 to 30 cm lower than that – perhaps 2.3 to 2.5 m (7.5 to 7.9 ft). Our field work

occurred during a spring tide cycle with peaks around 2.3 m (7.5 ft) NAVD88, so tidal inundation was definitely possible at PX T1 during this period. These observations confirm the restoration of tidal swamp (forested tidal wetland) at Pixieland – important, because forested tidal wetlands were once prevalent but are now very rare on Oregon's outer coast (Brophy 2007, 2009).

Slough sedge (*Carex obnupta*), salmonberry (*Rubus spectabilis*), and skunk cabbage (*Lysichiton americanum*) were the most common herbaceous or understory species in the forested transect during 2015 (Table 11). (Although salmonberry is a shrub, cover of shrubs within the herb layer was measured as part of the understory.) The native species lady fern (*Athyrium filix-femina*) and invasive species reed canarygrass (*Phalaris arundinacea*) were both high in frequency (an average of 31% of plots within the transect), but low in cover (less than 5%) (Table 11). Shading in forested habitats will help keep reed canarygrass percentages low.

Table 10. Tree and shrub density, and mean (±SD) diameter at breast height (DBH) for trees, in the forested transect (PX T1) during 2010, 2013, and 2015. Average DBH was not determined for *Malus fusca*, since only a single tree was present in the plot during all years. Native species are in green, non-native/invasive species are in orange.

Species	Common name	Native status	Density (stems/ha)			Average DBH (cm)		
			2010	2013	2015	2010	2013	2015
Alnus rubra	red alder	native	516	213	213	31±7	39±9	40±9
Malus fusca	western crabapple	native	11	11	11	ND	ND	ND
Ribes divaricatum	straggly gooseberry	native	1,384	0	0			
Rubus bifrons	Himalayan blackberry	non-native	135	0	135			
Rubus parviflorus	thimbleberry	native	135	0	0			
Rubus spectabilis	salmonberry	native	14,263	22,740	41,308			
Sambucus racemosa	elderberry	native	6,324	1,615	538			

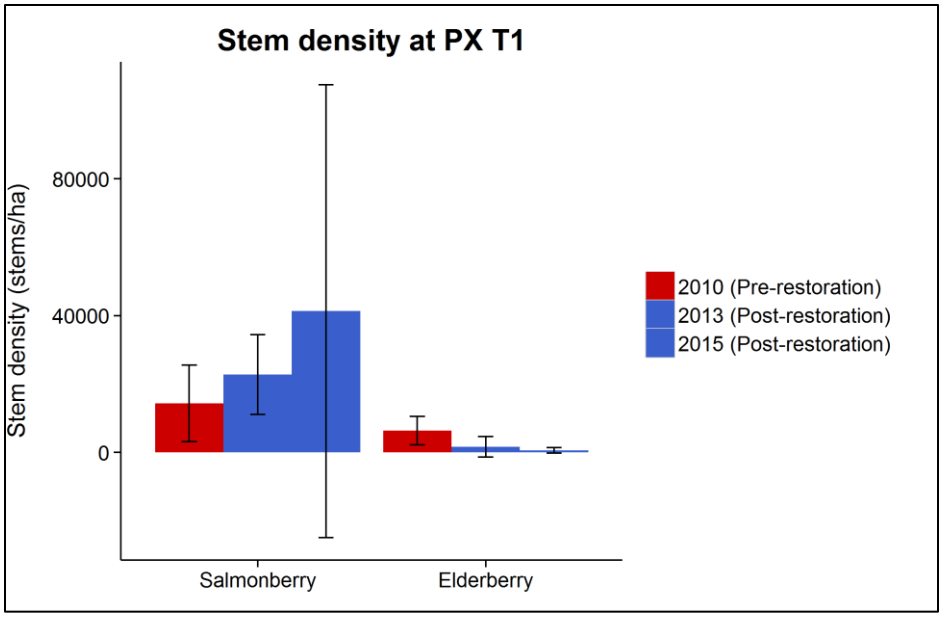

Figure 3. Mean (± SD) stem densities of salmonberry (*Rubus spectabilis*) and elderberry (*Sambucus racemosa*) in eight 0.00093 hectare shrub plots located along the forested transect (PX T1) at the Pixieland restoration site in 2010, 2013, and 2015. Restoration occurred in 2011.

Table 11. Frequency of occurrence (% of quadrats in which species was present) and mean (± SD) percent cover of herbaceous vascular plant species in the forested transect (PX T1). Native species are in green, non-native/invasive species are in orange.

Species	Common name	Native status	Frequency (%)			Percent cover		
			2010	2013	2015	2010	2013	2015
Athyrium filix-femina	lady fern	native	44	25	31	9±15	1±4	3±9
Callitriche sp.		not determined	0	0	6	0±0	0±0	0±2
Carex obnupta	slough sedge	native	44	69	75	21±35	14±25	26±33
Epilobium ciliatum	purple leaved willowherb	native	0	13	0	0±0	1±2	0±0
Hedera helix	English ivy	non-native	38	0	0	1±2	0±0	0±0
Heracleum lanatum	cow parsnip	native	6	0	0	0±0	0±0	0±0
Holcus lanatus	velvetgrass	invasive	0	13	6	0±0	4±12	0±2
Lotus corniculatus	birdsfoot trefoil	non-native	0	19	6	0±0	2±5	0±0
Lysichiton americanus	skunk cabbage	native	38	44	31	7±10	5±9	5±9
Oenanthe sarmentosa	Pacific water parsley	native	25	13	0	1±1	0±1	0±0
Phalaris arundinacea	reed canarygrass	invasive	6	19	31	0±0	0±1	4±14
Polystichum munitum	common sword fern	native	50	19	0	16±30	0±1	0±0
Ranunculus repens	double flowered creeping buttercup	non-native	0	6	0	0±0	0±0	0±0
Rubus bifrons	Himalayan blackberry	non-native	0	13	6	0±0	1±3	0±1
Rubus spectabilis	salmonberry	native	63	13	75	15±22	0±1	19±17
Sambucus racemosa	red elderberry	native	0	0	13	0±0	0±0	0±1
Stachys sp.		not determined	6	13	0	2±9	1±3	0±0
Trisetum canescens	tall trisetum	native	6	0	0	0±0	0±0	0±0
Vinca major	greater periwinkle	non-native	6	0	0	0±0	0±0	0±0
Unidentified fern			0	6	0	0±0	0±0	0±0
Litter/wood/moss/soil						24±28	56±43	3±11

Shrub plots

As described in **Methods** above, monitoring of shrub plots (PX S1, PX S2, PX S3) began in 2013, so comparison to baseline data was not possible. At the shrub plots, native and non-native woody and herbaceous species cover remained relatively unchanged between 2013 and 2015 (Wilcox test, p = 0.64 and p = 0.27 respectively; Table 12). Native herbaceous cover was 29.9% in 2015 and 32.7% in 2013 (Figure 4). Invasive herbaceous cover (entirely reed canarygrass) was 57.5% in 2015 and 40.9% in 2013 (Figure 4). In both years, plots were vegetated with planted native willows (*Salix* spp.); herbaceous cover was dominated by invasive reed canarygrass, native soft rush, and a mix of other native and non-native species (Table 12).

Willow heights increased from 1.7 m (5.6 ft) in 2013 to 2.2 m (7.3 ft) in 2015, growing towards the target height of 2.4 m (specified in Performance Standard 5.6), with some individuals currently exceeding that height (Figure 5).

Table 12. Percent cover of woody and herbaceous species in shrub plots recorded in 2013 and 2015 (means ± SD). Native species are in green, non-native/invasive species are in orange.

Species	Common name	Native status	Percent cover	
			2013	2015
Herbaceous layer				
Carex obnupta	slough sedge	native	0 ± 0	1 ± 2
Eleocharis palustris	common spikerush	native	0 ±1	0 ± 0
Epilobium ciliatum	purple leaved willowherb	native	0 ± 0	0 ± 0
Equisetum telmateia	giant horsetail	native	0 ± 0	0 ± 0
Juncus effusus	soft rush	native	32 ± 55	27 ± 31
Lotus corniculatus	birdsfoot trefoil	non-native	23 ± 37	11 ± 14
Oenanthe sarmentosa	Pacific water parsley	native	0 ± 0	0 ± 0
Phalaris arundinacea	reed canarygrass	invasive	41 ± 53	58 ± 35
Ranunculus repens	double flowered creeping buttercup	non-native	3 ± 5	2 ± 2
Salix hookeriana	Hooker's willow	native	3 ± 3	2 ± 6
Shrub layer				
Salix hookeriana	Hooker's willow	native	3 ± 3	34 ± 27
Salix scouleriana	Scouler's willow	native	2 ± 3	1 ± 3
Salix sitchensis	Jepson's willow	native	0 ± 0	1 ± 2
Bare ground			0 ± 0	0 ± 0
Total native cover			33 ± 48	30 ± 30
Total non-native cover			41 ± 45	58 ± 35

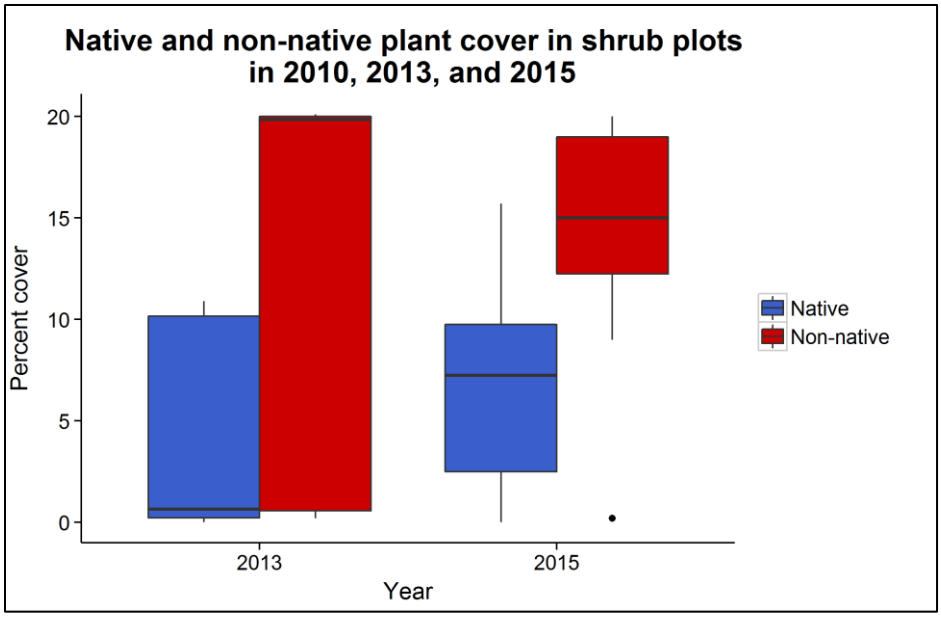

Figure 4. Total cover of native and non-native vascular plants, averaged across three shrub plots (S1, S2, S3) in 2013 and 2015. The thick horizontal bar shows median percent cover; boxes show upper and lower 25% quantiles. The dots represent outliers.

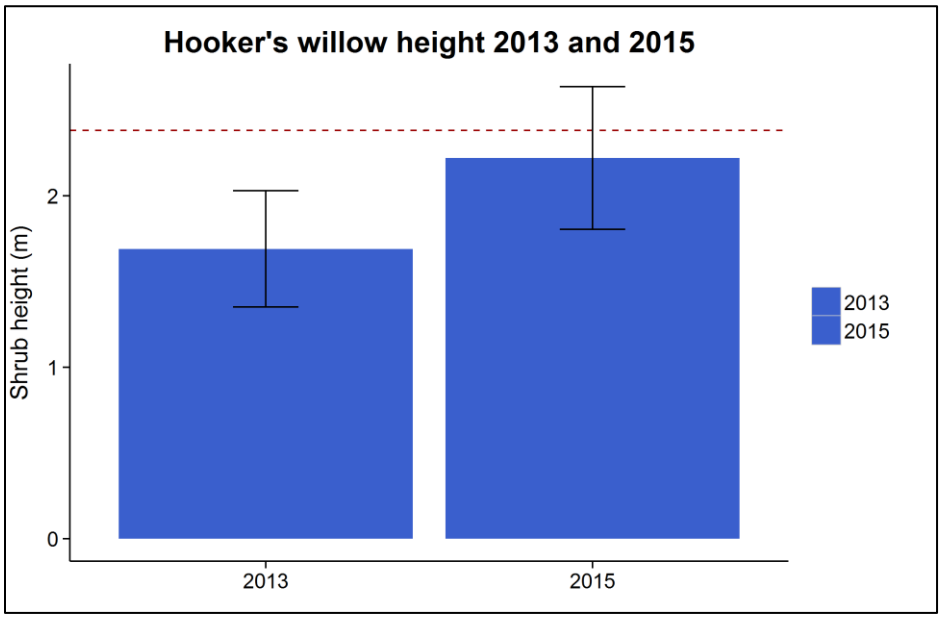

Figure 5. Mean (± SD) height of Hooker's willow (*Salix hookeriana*) in three circular shrub plots (S1, S2, S3) at the Pixieland restoration site in 2013, and 2015. The dashed line indicates the target height of 2.4 m established in Performance Standard 5.6.

Reference site

Plant composition at the reference site (PR T1) continued to be dominated by native species, mainly Baltic rush (*Juncus balticus*) and Pacific silverweed (*Potentilla anserina*) (Table 13, Figure 6). Species composition in 2015 was similar to that found in 2010 and 2013 (Table 13), though the total number of

species present dropped slightly, from an average of 7.6 in 2010 to 6.0 in 2015 (Figure 7). In 2013, Baltic rush had a notable decrease in percent cover, but this species' percent cover increased from 2013 to 2015 (10% to 19% respectively); these changes probably represent normal year-to-year variability. Cover of the native marsh species Pacific silverweed decreased from 55% in 2013 and 2010 to 35% in 2015, while the non-native species, tall fescue (*Schedonorus arundinaceus*), increased significantly within the transect in cover from 2% in 2010 to 25% in 2015 (one-way ANOVA, p = 0.0007). The changes in cover of Pacific silverweed and tall fescue may have been due to year-to-year variation in weather, which can result in differences in percent cover even when sampling occurs during the same time period each year. For Oregon, the period of April through August 2015 was the 11th driest on record since data collection began in 1895 (NOAA's climatological rankings, [https://www.ncdc.noaa.gov/temp-and-precip/climatological-rankings/, accessed 10/5/2015]). Pacific silverweed typically senesces during the summer dry season (i.e., its leaves turn brown and shrivel). In dry years, this species enters senescence earlier (e.g. in early August), resulting in lower cover. Since silverweed typically spreads broadly across the wetland surface, covering the foliage of other species, its early senescence can lead to an apparent increase in other species' cover, where in fact those species have only been revealed ("uncovered") by the reduction in silverweed foliage. Our observations applied only to the specific location of the reference transect, since no replicate transects were sampled at the reference site.

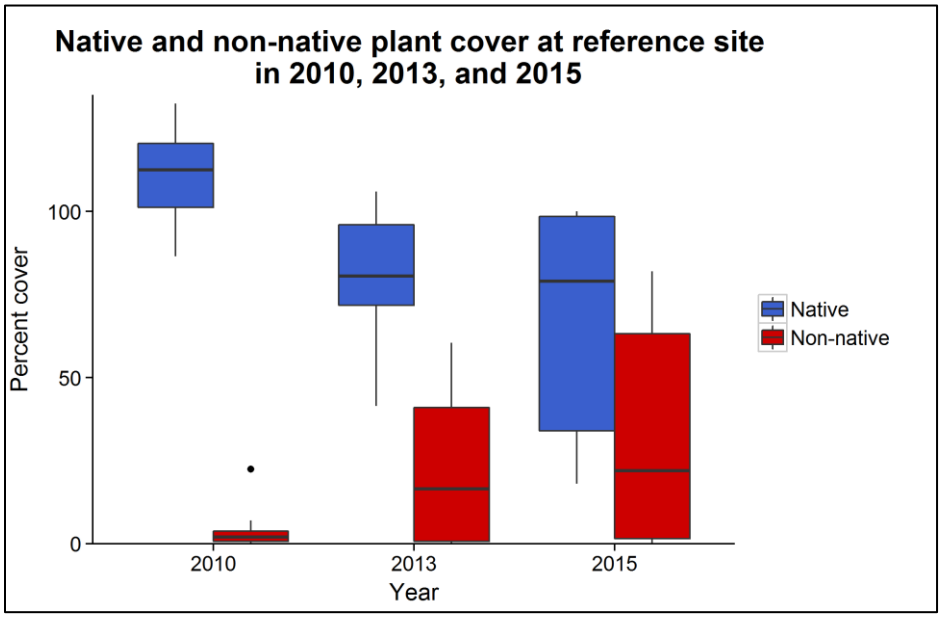

Figure 6. Total cover of native and non-native vascular plants, averaged across 15 quadrats in the reference marsh transect (PR T1) in 2010, 2013, and 2015. The thick horizontal bar shows median percent cover; boxes show upper and lower 25% quantiles. The dots represent outliers.

Table 13. Frequency of occurrence (% quadrats in which species was present) and mean (± SD) percent cover of vascular plant species in the reference site emergent marsh transect (PR T1). Native species are in green, non-native/invasive species are in orange.

Species	Common name	Native status	Frequency (%)			Percent cover		
			2010	2013	2015	2010	2013	2015
Achillea millefolium	yarrow	native	13	20	20	0±1	0±1	1±2
Agrostis stolonifera	creeping bentgrass	non-native	73	93	73	1±1	3±5	1±4
Angelica lucida	sea watch	native	73	40	33	2±3	5±10	3±5
Atriplex patula	common orache	native	27	0	0	0±1	0±0	0±0
Carex lyngbyei	Lyngbye's sedge	native	13	13	13	1±2	4±11	6±16
Deschampsia cespitosa	tufted hairgrass	native	60	47	33	5±7	4±10	3±5
Eleocharis palustris	common spikerush	native	7	0	0	0±0	0±0	0±0
Elymus sp.		not determined	7	13	20	0±1	1±4	1±3
Festuca rubra	red fescue	native	27	13	0	0±0	1±4	0±0
Galium aparine	stickywilly	native	0	0	7	0±0	0±0	0±0
Galium trifidum	small bedstraw	native	27	13	0	0±0	0±0	0±0
Holcus lanatus	velvetgrass	invasive	33	27	33	0±1	1±1	3±5
Hordeum brachyantherum	meadow barley	native	33	27	20	0±1	0±0	0±1
Juncus balticus	Baltic rush	native	100	93	93	48±13	10±7	18±19
Lathyrus palustris	marsh peavine	native	73	20	27	1±1	0±0	0±1
Oenanthe sarmentosa	Pacific water parsley	native	0	7	13	0±0	0±0	0±0
Potentilla anserina	Pacific silverweed	native	100	100	100	55±14	55±17	35±20
Rumex occidentalis	Rocky Mountain western dock	native	7	0	0	0±1	0±0	0±0
Schedonorus arundinaceus	tall fescue	non-native	47	67	67	2±5	17±19	25±28
Symphyotrichum subspicatum	Douglas' aster	native	33	40	13	0±0	1±1	1±2
Trifolium wormskioldii	springbank clover	native	7	0	0	0±0	0±0	0±0
Triglochin maritimum	seaside arrow-grass	native	53	33	33	1±1	2±8	1±2
Vicia nigricans	giant vetch	native	7	7	0	0±1	1±3	0±0
Bare ground						1±4	0±0	0±0
Total native cover						113±14	82±22	69±32
Total non-native cover						3±5	21±21	28±30

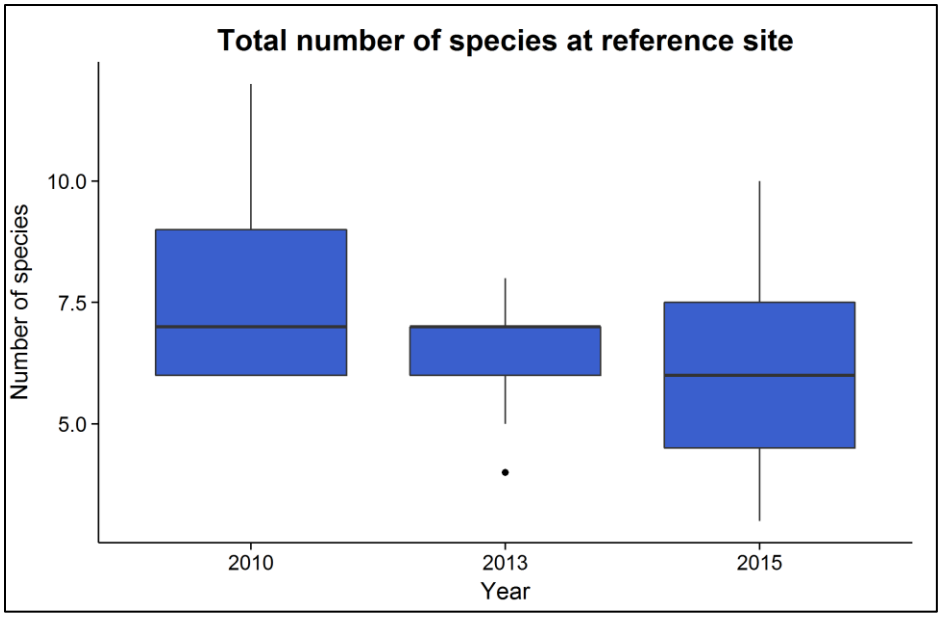

Figure 7. Total number of vascular plant species (species richness) per quadrat, averaged across 15 quadrats in the reference marsh transect (PR T1) in 2010, 2013, and 2015. The thick horizontal bar shows median richness; boxes show upper and lower 25% quantiles. The dots represent outliers.

C. Soils

Post-restoration soil samples will be collected in Year 10 (2022).

4. Conclusions and recommendations

Based on our 2015 observations, plant communities at Pixieland appear to be on a trajectory towards full recovery of native wetland habitats. Invasive species cover declined on the old marsh surface, opening up bare ground for native species to colonize. Willow plantings in the shrub zone increased in height since 2013 and are expected to continue growing, likely meeting the height performance standard by the next monitoring episode (2017). Continuing growth of the willows will shade the shrub zone, gradually reducing reed canarygrass cover in that zone.

Based on the monitoring data provided in this report, we do not have any adaptive management recommendations for Pixieland at this time. Continued monitoring following the plan presented in Appendix 1 will be needed to verify that the changes documented in 2015 continue on their current trajectory, and in order to address performance standards regarding native species cover. We recommend future monitoring events include at least a subset of the reed canarygrass study plots to allow evaluation of plant community development on the graded marsh surface.

We recommend monitoring of soil and surface water salinity at Pixieland; such data would be very helpful in understanding the role of salinity in the decline of reed canarygrass in transects PX T2 and PX T3. Soil and surface water salinity data would also provide needed guidance for other restoration projects in Oregon that are dominated by reed canarygrass.

Appendix 1. Effectiveness monitoring scope of work

Project: Effectiveness Monitoring at the Pixieland Restoration Project, Salmon River Estuary, 2010-2022

Contact

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Goal

Track effectiveness of restoration investments and achievement of project goals through measurements of key ecological and physical parameters at Pixieland.

Ecological Significance

This project will evaluate the outcome of restoration investments at the Pixieland Restoration Project through quantitative monitoring of controlling factors and ecosystem services for 10 years after restoration.

Methods

Use standard monitoring protocols and analytical methods established in national and regional restoration monitoring guidance (Roegner et al. 2008, Rice et al. 2005, Thayer et al. 2005). Monitor both restoration and reference sites to help track system-wide changes. Monitor physical "controlling factors" ("ecosystem drivers") that create desired wetland functions, and resulting biological characteristics. Compare baseline data to post-restoration data to document restoration trajectory.

Controlling and structural factors to be monitored include tidal inundation and soil characteristics. Biological characteristics to be monitored include plant community composition, plant community extent, and benthic invertebrates. The project will use stratified, randomized and replicated sample design to allow statistical analysis of ecological linkages and change over time. Practical, user-friendly analyses and products will be provided. All work will be compatible with regional and national standards and guidance, to maximize exchange of scientific knowledge.

Rationale

The physical and biological characteristics of tidal wetlands, and the ecosystem services they provide, are tightly linked. The most effective and sustainable restoration projects are those which, like the Pixieland project, restore natural forces ("controlling factors"). These natural forces structure and maintain wetland functions without further human intervention, maximizing the likelihood of long-term restoration success (Simenstad and Bottom 2005). Because of the importance of controlling factors, they should be monitored directly to document whether restoration has successfully restored these "ecosystem drivers." The controlling factors we will measure in this project are recognized as top priorities for effectiveness monitoring (Roegner et al. 2008, Rice et al. 2005, Thayer et al. 2005).

Along with ecosystem drivers, we will simultaneously measure biological characteristics (plant community composition, plant community extent, and benthic invertebrates). Vegetation forms the vital link between "controlling factors" and valued wetland functions and ecosystem services. Plant

communities form the base of the food web, and they shelter, feed, and house valued fish and wildlife species. Vegetation processes and converts nutrients; traps sediment; and detains flood flows. Vegetation is a top priority monitoring parameter in regional and national monitoring guidance (Roegner et al. 2008, Rice et al. 2005, Thayer et al. 2005) because it is clearly visible, easily measured in one field session per year, and stabilizes relatively quickly following restoration. Benthic invertebrates are of high interest because they provide food for many valued species including salmon, and may be useful indicators of wetland condition.

Table A1. Pixieland monitoring methods summary

Indicator category	Monitored metric	Data collection method(s)
Hydrology	Surface water elevation	Automated water level logger ("tide gauge")
Elevation	Elevation of study transects and instrumentation	Laser level or total station
Vegetation	Plant community composition	Transects located within elevation strata; plots placed at random within transects. Visual estimate of percent cover for herbaceous species; stem counts in diameter classes for woody species
Vegetation	Extent of plant communities	GIS mapping via heads-up digitization from orthorectified aerial photos provided by USFS
Soils	% organic matter, pH, electrical conductivity	Surface 30cm cores from sample plots; analysis at OSU Central Analytical Lab

Deliverables

Brief annual summary reports will be provided, describing work completed, a summary of results, and problems or challenges encountered or anticipated. A final report will be provided, including methods, results, statistical analysis, discussion, and recommendations for future work. All data collected will be delivered as electronic datafiles, JPGs (for photos), and shapefiles as appropriate.

Table A2. Timeline for Pixieland monitoring program (GPC activities)*

				OR DSL year number**				
				Year 1	Year 3	Year 5	Year 7	Year 10
#	Monitored metric	2010	2011	2013	2015	2017	2019	2022
1	Tidal inundation regime	X[1]	X[1]	X[1]				
2	Elevations of instrumentation and transects	X[2]		X[2]				
3	Vegetation composition in wetland transects	X[3]	X	X	X	X	X	X
4	Wetland vegetation mapping	X[4]						X[5]
5	Soil OM, pH, texture, EC	X						X
6	Wetland delineation	X[6]				X[8]		
7	Functional assessment	X[6]				X[8]		

* Timeline and year numbering reflects Amendment 2 (July 2013) of the contract between GPC and the Salmon-Drift Creek Watershed Council (original contract established in 2010), and also matches.
** Year numbering reflects the Pixieland In-Lieu Fee Instrument Modification Proposal dated September 21, 2012 (OR DSL 2012)

Notes on monitoring program:

1. USFS-DSL Grant Agreement calls for monitoring of tidal inundation regime for 1 year. Post-restoration inundation monitoring may occur in 2011 if tidal reconnection is implemented in 2010. Tidal inundation monitoring budget assumes USFS water level loggers will be used, and USFS staff will download and transmit data from loggers (see "Summary of USFS responsibilities related to monitoring program" below). Data will be analyzed and interpreted by GPC, and GPC will report to DSL on tidal inundation in 2012 as required in the DSL Grant Agreement.
2. Elevation survey budget assumes USFS will: 1) establish a local elevation benchmark with known NAVD88 elevation; 2) survey elevations of water level loggers at the beginning and end of the water level monitoring period, and 3) either survey elevations of vegetation/soils transects, or provide a laser level for GPC use in surveying elevations of transects. In shrub and forested wetlands, LiDAR may be used to estimate elevations of transects.
3. Vegetation monitoring will follow the methods outlined in DSL's Routine Monitoring Guidance. At least 4 transects will be monitored, including at least one reference transect. Following grading and planting, monitoring will include at least one transect in an area planted with shrubs or trees.
4. Baseline vegetation map (2010) will focus on wetland areas and will use USFS 2008 aerial orthophotos.
5. Post-restoration plant community mapping will be limited to wetlands, and will be conducted in 2022. Budget assumes that USFS will provide recent, high resolution, orthorectified aerial photos for the 2022 vegetation mapping.
6. Pre-project wetland delineation and functional assessment are covered under a separate

contract between Green Point Consulting and Salmon-Drift Creek Watershed Council.

7. Post-project wetland delineation in 2017 will follow DSL's "delineation lite" methods.
8. Functional assessment will use the ORWAP method to meet current state requirements.

References for Appendix 1 are included in Appendix 2 (References)

Appendix 2. References

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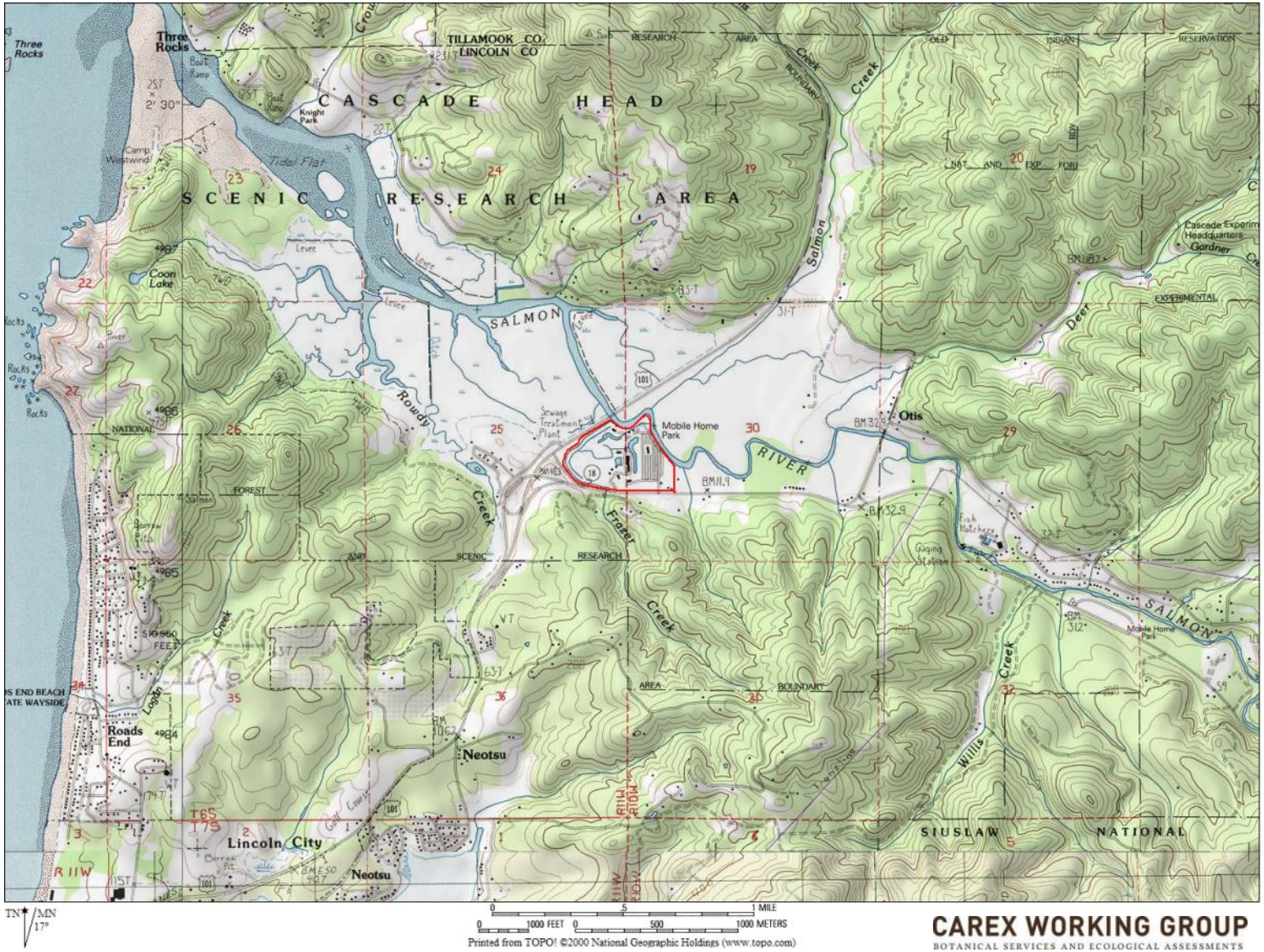
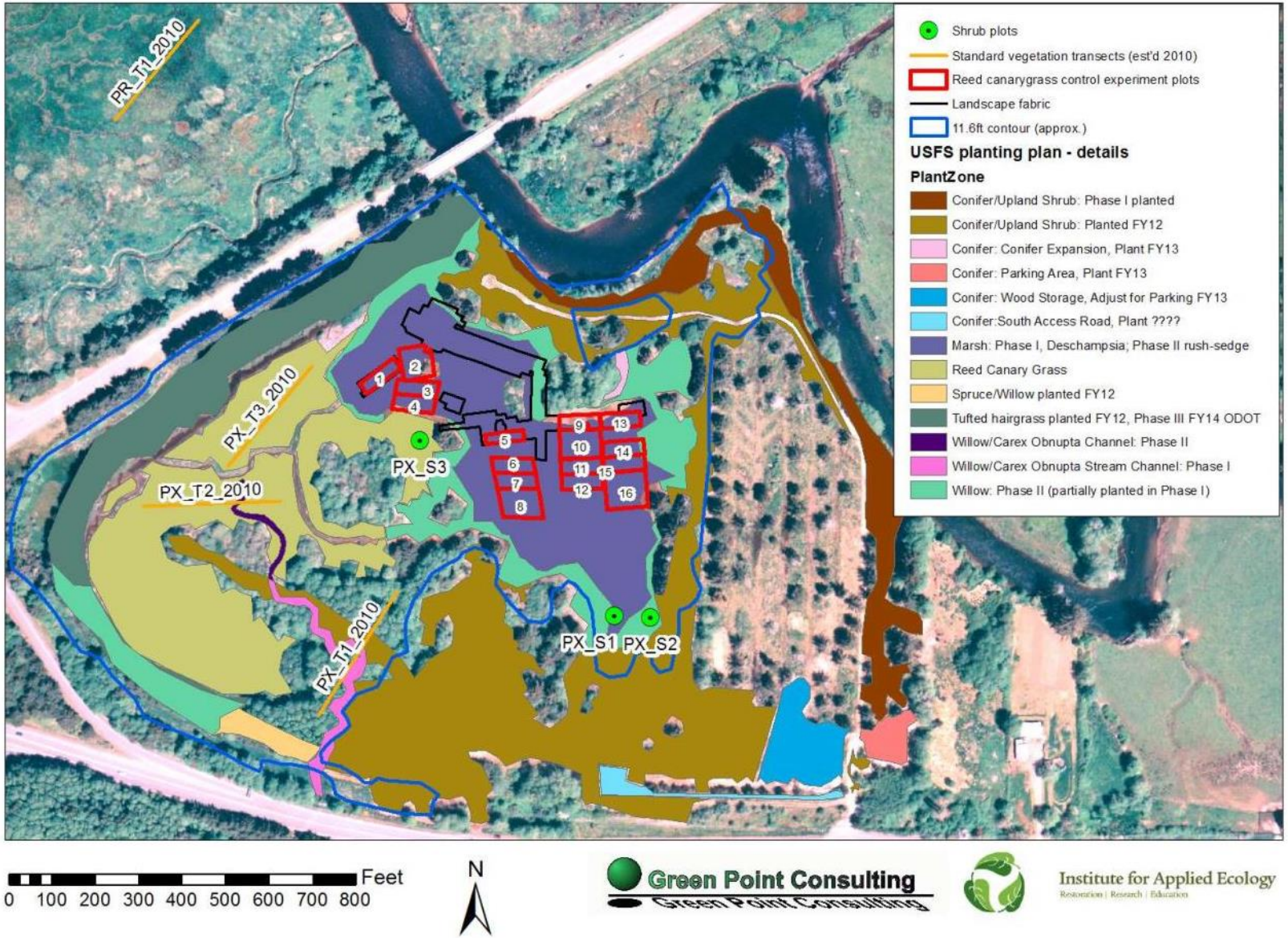
Appendix 3. Maps

Map 1. Pixieland vicinity map (from Brainerd 2010).



Map 2. Pre-restoration wetland habitats at Pixieland, with wetland identifiers corresponding to rehabilitation areas in Table 2. Map is from the Pixieland Mitigation Plan (OR DSL 2012), modified from Brainerd (2010).

Map 3. Pixieland vegetation monitoring locations, 2010-2015. Areas below the 11.6 ft contour line are within the ILF project boundary.



Appendix 4. Vegetation summary tables, DSL Routine Monitoring Protocol

Performance standards for herbaceous transects (PX T2 & PX T3)

Overall project performance standards (all transects)

Performance Standards	Threshold		Average	Standard Error		Standard Met?		2015	2013	2010-2011	% increase 2013/2015
STD 5.1: Cover of Native Herbaceous Species	Mean native cover > Mean Inv cover	See table to right				N	**Total cover, native species**	0.5	0.0	0.0	0.5
> Invasive cover (incl. PHAARU)	Rate incr N cover > rate incr I cover	See table to right				Y	**Total cover, non-native species**	0.0	0.0	0.0	0.0
							Tot cov inv spp INCL PHAARU (for std. 5.1)	59.7	96.5	100.0	-36.8
STD 5.2: Invasive cover (minus PhaAru) <10%	10%		0.0			Y	**Tot cov inv spp EXCL PHAARU (for std. 5.2)**	0.0	0.0	0.0	0.0
							Total cover, all species	60.2	96.5	100.0	-36.3
STD 5.3: Moisture Index	< 3.0		2.0			Y					
STD 5.7: Total plant cover is progressing towards 98%	98%		60.2	0.2		N					
Lower CI (80%)			59.9								
Upper CI (80%)			60.5								
STD 5.8: At least 3 native species are present with at least	3 by Year 5					N					

Performance standards for forested transect (PX T1)

Performance Standards	Threshold	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Transect average	Standard Error	Standard Met?
STD 5.2: Invasive cover (minus PhaAru) <10%	0.1	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0.4	0.4	Y
STD 5.3: Moisture Index	<3.0	1.103	1.1	1.1	1.0	2.0	2.0	2.7	2.7	2.6	3.0	2.4	1.0	1.0	2.3	0.7	2.4	1.8	0.2	Y
STD 5.8: At least 3 native species are present with at least 5% cover and 10% frequency of occurrence	3 by Year 5																			Y
3 by Year 5																			Y	

PX-T2 Restoration	Sample Date(s):	Wetland indicator status: 1=OBL 2=FACW 3=FAC 4=FACU 5=UPL																			
Herbaceous Wetland Habitat Unit	8/11/2015		Percent Cover																		
Species	Origin (N, NN, I)	Wetland Status (1-5)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Transect Average	% plot occurrence		
Native Herbaceous Species																					
Carex obnupta	N	1	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	1.0	6.7		
Invasive Herbaceous Species																					
Phalaris arundinacea L.	I	2	85	95	100	35	0	5	1	70	1	95	5	100	100	99	95	59.1	93.3		
Non-Native Herbaceous Species																					
Bare Substrate																					
Bare ground			15	5	0	50	100	95	99	30	99	5	95	0	0	1	5	39.9	80.0		
		Transect	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	2015	2013	2010	Rate increase (2013/2015)
Total cover, native species			0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	1.0	0.0	0.0	1.0
Total cover, non-native species			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Tot cov inv spp INCL PHAARU (for std. 5.1)			85	95	100	35	0	5	1	70	1	95	5	100	100	99	95	59.1	93.0	100.0	-33.9
Tot cov inv spp EXCL PHAARU (for std. 5.1)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Total cover, all species			85	95	100	50	0	5	1	70	1	95	5	100	100	99	95	60.1	93.0	100.0	-32.9
Lower CI (80%)																		45.4			
Upper CI (80%)																		74.7			
Performance Standards	**Threshold**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Transect average**	**Standard Error**	**Standard Met?**	
STD 5.1: Cover of Native Herbaceous Species	*Mean native cover > Mean Inv cover*		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N			N	
> Invasive cover (incl. PHAARU)	*Rate incr N cover > rate incr Inv cover*																			Y	
STD 5.2: Invasive cover (minus PhaAru) <10%	*0.1*		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Y	
STD 5.3: Moisture Index	*<3.0*		2.0	2.0	2.0	1.7		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	Y	
STD 5.7: Total plant cover is progressing towards 98%	*0.98*		85.0	95.0	100.0	50.0	0.0	5.0	1.0	70.0	1.0	95.0	5.0	100.0	100.0	99.0	95.0	60.1	11.4	N	
STD 5.8: At least 3 native species are present with at least 5% cover and 10% frequency of occurrence	*3 by Year 5*																			N	

PX-T3 Restoration	Sample Date(s):	Wetland indicator status: 1=OBL 2=FACW 3=FAC 4=FACU 5=UPL																			
Herbaceous Wetland Habitat Unit	8/11/2015		Percent Cover																		
Species	Origin (N, NN, I)	Wetland Status (1-5)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Transect Average	% plot occurrence		
Native Herbaceous Species																					
Invasive Herbaceous Species																					
Phalaris arundinacea L.		2	100	30	1	95	70	100	85	100	25	75	30	90	80	0	25	60.4	93.3		
Non-Native Herbaceous Species																					
Bare Substrate																					
Bare ground			0	70	99	5	30	0	15	0	75	25	70	10	20	100	75	39.6	80.0		
		Transect	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	2015	2013	2010	Rate increase (2013/2015)
Total cover, native species			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Total cover, non-native species			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Tot cov inv spp INCL PHAARU (for std. 5.1)			100	30	1	95	70	100	85	100	25	75	30	90	80	0	25	60.4	100.0	100.0	-39.6
Tot cov inv spp EXCL PHAARU (for std. 5.1)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Total cover, all species			100	30	1	95	70	100	85	100	25	75	30	90	80	0	25	60.4	100.0	100.0	-39.6
Lower CI (80%)																		48.0			
Upper CI (80%)																		72.8			
Performance Standards	**Threshold**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Transect average**	**Standard Error**	**Standard Met?**	
STD 5.1: Cover of Native Herbaceous Species	*Mean native cover > Mean Inv cover*		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N			N	
> Invasive cover (incl. PHAARU)	*Rate incr N cover > rate incr I cover*																			Y	
STD 5.2: Invasive cover (minus PhaAru) <10%	*0.1*		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Y	
STD 5.3: Moisture Index	*<3.0*		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	0.0	Y	
STD 5.7: Total plant cover is progressing towards 98%	*0.98*		100.0	30.0	1.0	95.0	70.0	100.0	85.0	100.0	25.0	75.0	30.0	90.0	80.0	0.0	25.0	60.4	9.7	N	
STD 5.8: At least 3 native species are present with at least 5% cover and 10% frequency of occurrence	*3 by Year 5*																			N	

Site: Pixieland	**Sample Date(s):**		8/10/2015																
Shrub-Dominated Wetland Habitat Unit			**Percent Cover**																
Species	Origin (N, NN, I)	Wetland Status (1 - 5)	1	2	3	4	5	6	7	8	9	10	11	12	Row average	Stdev	% sub-plot occurrence		
Plot			S1	S1	S1	S1	S2	S2	S2	S2	S3	S3	S3	S3					
Subplot			1	2	3	4	1	2	3	4	1	2	3	4					
Native Herbaceous Species																			
Eleocharis palustris	N	1	0	0			0	0	0	0	0	0	0	0	0.0	0.0	0.0		
Epilobium ciliatum	N	2	1	0			0	0	0	0	0	0	0	0	0.1	0.3	10.0		
Juncus effusus	N	2	97	55			35	35	20	30	0	0	0	0	27.2	31.2	60.0		
Equisetum telmateia	N	2	1	0			0	0	0	0	0	0	0	0	0.1	0.3	10.0		
Carex obnupta	N	1	0	0			5	0	0	0	0	0	0	0	0.5	1.6	10.0		
Salix hookeriana	N	2	0	0			0	0	0	0	0	20	0	0	2.0	6.3	10.0		
Invasive Herbaceous Species																			
Phalaris arundinacea L.	I	2	0	45			35	30	50	35	100	80	100	100	57.5	35.3	90.0		
Holcus lanatus	I	3	0	0			0	0	0	0	0	0	0	0	0.0	0.0	0.0		
Non-Native Herbaceous Species																			
Lotus corniculatus	NN	3	1	0			23	30	25	30	0	0	0	0	10.9	14.0	50.0		
Rumex conglomeratus	NN	2	0	0			0	0	0	0	0	0	0	0	0.0	0.0	0.0		
Ranunculus repens	NN	3	0	0			2	5	5	5	0	0	0	0	1.7	2.4	40.0		
Native Shrub and Tree Species																			
Salix hookeriana	N	2	50	50			50	30	5	50	25	80	0	0	34.0	26.6	80.0		
Salix scouleriana	N	3	8	0			0	0	0	0	0	0	0	0	0.8	2.5	10.0		
Salix sitchensis	N	2	0	5			0	0	0	0	0	0	0	0	0.5	1.6	10.0		
Non-Native Shrub and Tree Species																			
Invasive Shrub and Tree Species																			
Bare Substrate																			
Bare Ground			0	0			0	0	0	0	0	0	0	0	0.0		0.0		
			Woody Plant Count																
Native Shrub and Tree Count																			
Salix hookeriana	N	2	10	9			6	6	3	6	6	9	0	0	5.5	80.0			
Salix scouleriana	N	3	1	0			0	0	0	0	0	0	0	0	0.1	10.0			
Salix sitchensis	N	2	0	1			0	0	0	0	0	0	0	0	0.1	10.0			
															2015			**2013**	**Rate of increase (%)**
Total cover, native herbaceous species			99.0	55.0			40.0	35.0	20.0	30.0	0.0	20.0	0.0	0.0	29.9			32.7	-2.8
Total cover, non-native herbaceous species			1.0	0.0			25.0	35.0	30.0	35.0	0.0	0.0	0.0	0.0	12.6			26.3	-13.7
Total cover, invasive herbaceous species INCL. PHAARU (for std. 5.1)			0.0	45.0			35.0	30.0	50.0	35.0	100.0	80.0	100.0	100.0	57.5			40.9	16.6
Total cover, invasive species EXCL. PHAARU (for std. 5.2)			0.0	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.1	-0.1
Total cover, all species			158.0	155.0			150.0	130.0	105.0	150.0	125.0	180.0	100.0	100.0	135.3			105.0	30.3

Performance Standards	Threshold	1	2	3	4	5	6	7	8	9	10	11	12	Habitat Average	Standard Error	Standard Met?			
Standard 5.1: Cover of native herb spp is > cover of invasive herb spp., and is increasing faster than cover of invasive herb spp.		**Y**	**Y**			**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	**N**		**N**			
	70% native																		
Cover native spp	cover	99.0	55.0			40.0	35.0	20.0	30.0	0.0	20.0	0.0	0.0	29.9	9.7	**N**			
Lower CI (80%)														17.5					
Upper CI (80%)														42.3					
Cover invasive spp		0.0	45.0			35.0	30.0	50.0	35.0	100.0	80.0	100.0	100.0	57.5	10.6				
Rate of increase																**N**			
Standard 5.2: Cover of other invasive spp is no greater than 10%		0.0	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	**Y**			
Standard 5.3: Moisture index for all strata is <3.0																			
	<3.0	1.3	1.3			1.4	1.8	2.2	1.6	1.6	0.9	2.0	2.0	1.6	0.1	**Y**			
Weighted Prevalence Index		201.0	200.0			215.0	235.0	230.0	235.0	200.0	160.0	200.0	200.0	207.6	7.1				
Sum of plant cover		158.0	155.0			150.0	130.0	105.0	150.0	125.0	180.0	100.0	100.0	135.3	8.7				
Standard 5.4: Density of woody stems is >=1600 per acre, or native woody veg cover is >=50%																			
	>=50%																		
Density woody veg/m2	(alternative)	1.5	1.4			0.8	0.8	0.4	0.8	0.8	1.2	0.0	0.0	0.8	0.2				
Density woody veg/acre		6098.0	5543.6			3326.2	3326.2	1663.1	3326.2	3326.2	4989.3	0.0	0.0	**3159.9**	666.5	**Y**			
Lower CI (80%) (per acre)														2305.4					
Upper CI (80%) (per acre)														4014.4					
Standard 5.5: Density of invasive woody stems is <10% total stem density																**Y**			
																		2013	**2015**
Standard 5.6: Shrubs have continuous average height growth until average height is greater than 7.8 ft.																**Y**	**Heights**	5.55	7.30
Standard 5.8: By year 5, at least 3 native species are present with at least 5% cover and 10% frequency of occurrence																**N**	Only 2 native species with an average cover of over 5% cover		

Shrub heights in PX circular plots, August 2015

			Original data in feet & inches												Shrub height (m)											
		Plot	S1				S2				S3				S1				S2				S3			
Species	Tree	Subplot	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Salix sitchensis	1			10												3.05										
Salix scouleri	1		10												3.05											
	2																									
	3																									
	4																									
	5																									
	6																									
	7																									
	8																									
	9																									
	10																									
	11																									
	12																									
Salix hookeriana	1		10	8			7	4	6	8	8	6			3.05	2.44			2.13	1.22	1.83	2.44	2.44	1.83		
	2		9	8			7	6	7	8	8	6			2.74	2.44			2.13	1.83	2.13	2.44	2.44	1.83		
	3		6	10			7	7	7	8	7	6			1.83	3.05			2.13	2.13	2.13	2.44	2.13	1.83		
	4		9	5			8	7		7	6	9			2.74	1.52			2.44	2.13		2.13	1.83	2.74		
	5		5	8			6	8		6	6	6			1.52	2.44			1.83	2.44		1.83	1.83	1.83		
	6		8	8			7	8		6	6	7			2.44	2.44			2.13	2.44		1.83	1.83	2.13		
	7		9	10								7			2.74	3.05								2.13		
	8		8	9								9			2.44	2.74								2.74		
	9		5	7								5			1.52	2.13								1.52		
	10		7												2.13											

Mean shrub height (m)	2.22	=	7.30	ft		
					Standard	
Standard 5.6: Average height of shrubs exceeds 7.8 ft (2.38 m)					**N**	

Site: Pixieland PX T1	Sample Date(s):	Wetland indicator status: 1=OBL 2=FACW 3=FAC 4=FACU 5=UPL																			
Forested wetland habitat unit	8/10/2015		Percent Cover																		
Species	Origin (N,NN,I)	Wet. Ind. Status (1-5)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Transect Average	% plot occurrence	
Herbaceous plots																					
Native Herbaceous Species																					
Lysichiton americanus	N	1	18	3	20	0	0	30	5	0	0	0	0	0	0	0	0	0	4.75	31.25	
Rubus spectabilis	N	3	2	0	1	0	20	35	30	30	55	30	30	0	0	34	10	25	18.875	75	
Carex obnupta	N	1	0	70	20	20	20	3	0	5	15	0	0	97	99	33	20	10	25.75	75	
Sambucus racemosa	N	4	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0.25	12.5	
Athyrium filix-femina	N	3	0	0	1	0	0	0	0	10	8	1	0	0	0	33	0	0	3.3125	31.25	
Ribes divaricatum	N	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.125	6.25	
Invasive Herbaceous Species																					
Phalaris arundinacea L.	I	2	1	0	0	0	0	0	0	5	0	0	58	2	1	0	0	0	4.1875	31.25	
Holcus lanatus	I	3	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0.4375	6.25	
Non-Native Herbaceous Species																					
Lotus corniculatus	NN	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0.0625	6.25	
Schedonorus arundinaceus	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Rubus bifrons		4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0.125	6.25	
Unknown Species																					
Callitriche sp.			6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.375	6.25	
Bare Substrate																					
Bare ground			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Thatch/Detritus			0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	2.8125	6.25	
Summaries for herbaceous plots:																			2015	2013	% change
Total cover, native herbaceous species			22	75	42	20	40	68	35	45	78	31	32	97	99	100	30	35.0	53.1	21.0	32.0625
Total cover, non-native herbaceous species			0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0.0	0.2	3.0	-2.8125
Tot cov inv herb spp INCL PHAARU (for std. 5.1)			1	0	0	0	0	0	0	5	0	0	65	2	1	0	0	0.0	4.6	4.0	0.625
Tot cov inv herb spp EXCL PHAARU (for std. 5.1)			0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0.0	0.4	4.0	-3.5625
Total cover, all herbaceous species			29	75	42	20	40	68	35	50	78	31	99	100	100	100	30	35.0	58.3	29.0	29.25
Shrub plots																					
Native Shrub and Tree Species																			Transect Average	% Plot Occurrence	
Sambucus racemosa	N	4	0.5		0		0		0.5		45		10		0		5		7.6	62.5	
Rubus spectabilis	N	3	5		0		85		5		90		25		33		95		42.3	87.5	
Alnus rubra	N	3	70		88		85		50		0		25		92		60		58.8	87.5	

Non-Native Shrub and Tree Species																							
Rubus bifrons	NN		4	0		0		0		0		0		2		0		0		0.3	12.5		
Woody Plant Count																					**2015**		
Native Shrub and Tree Species																				**Average Stems**	**Stems/ha**		
Sambucus racemosa	N		4	1		0		0		1		0		2		0		0		0.5	538.2		
Rubus spectabilis	N		3	22		1		17		22		187		7		7		44		38.4	41307.9		
Alnus rubra	N		3	NA		NA		NA		NA		NA		NA		NA		NA		NA	NA		
Non-native Shrub and Tree Count																							
Rubus bifrons	NN			0		0		0		0		0		1		0		0		0.125	134.6		
																		TOTAL		**39**	**41980.6**		
Performance Standards	**Threshold**			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**		**Transect average**	**Standard Error**	**Standard Met?**
STD 5.2: Invasive cover (minus PhaAru) <10%	0.1			0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0		0.4	0.4	Y
STD 5.3: Moisture Index	<3.0			1.103	1.1	1.1	1.0	2.0	2.0	2.7	2.7	2.6	3.0	2.4	1.0	1.0	2.3	0.7	2.4		1.8	0.2	Y
STD 5.8: At least 3 native species are present with at least 5% cover and 10% frequency of occurrence	3 by Year 5																						Y
3 by Year 5																						Y	

DSL Routine Vegetation Monitoring Field Sampling Form													
Date: 10 Aug 2015		**Site Name: Pixieland (PX)**		**Surveyor: Brophy and Brown**					**Start time:**		**DSL Permit #:**		
County: Lincoln		**HUC:**		**TRS: 6S 1W 25**		**Hab Class (E, S, F):**			**End time:**		**Woody plot sz (ft): 32 X 300ft (see notes)**		
Transect #: 1			**Transect length (units): 300 feet**			**GPS eqpt:**					**Herb plot sz (ft):**		
Transect bearing: 36			**UTM zone 10N WGS84 (end: S) Easting (m):**			**Northing (m):**					**Waypt #:**		
Start end: S			**UTM zone 10N WGS84 (end: N) Easting (m):**			**Northing (m):**					**Waypt #:**		
	Transect side	**Location (feet from 0)**	**Species or bare ground type**	**Spp code**	**DBH (in)**	**DBH (cm)**	**Trunk area (m2)**				**Notes**		
2015	R	23	Alnus rubra	ALNRUB	22.1	56.1	0.2475						
2015	R	35	Alnus rubra	ALNRUB	19.4	49.3	0.1907						
2015	L	42	Alnus rubra	ALNRUB	19.5	49.5	0.1927						
2015	L	64	Malus fusca	MALFUS	4.8	12.2	0.0117						
2015	R	64	Alnus rubra	ALNRUB	21	53.3	0.2235						
2015	R	163	Alnus rubra	ALNRUB	11.7	29.7	0.0694						
2015	R	163	Alnus rubra	ALNRUB	13.8	35.1	0.0965						
2015	R	184	Alnus rubra	ALNRUB	12.4	31.5	0.0779						
2015	R	184	Alnus rubra	ALNRUB	14.1	35.8	0.1007						
2015	L	194	Alnus rubra	ALNRUB	18.8	47.8	0.1791						
2015	R	199	Alnus rubra	ALNRUB	12.5	31.8	0.0792						
2015	R	199	Alnus rubra	ALNRUB	11.26	28.6	0.0642						
2015	R	212	Alnus rubra	ALNRUB	18.35	46.6	0.1706						
2015	R	214	Alnus rubra	ALNRUB	11.27	28.6	0.0644						
2015	L	229	Alnus rubra	ALNRUB	16.83	42.7	0.1435						
2015	R	232	Alnus rubra	ALNRUB	16.5	41.9	0.138						
2015	R	235	Alnus rubra	ALNRUB	12.09	30.7	0.0741						
2015	R	236	Alnus rubra	ALNRUB	15.46	39.3	0.1211						
2015	R	236	Alnus rubra	ALNRUB	15.06	38.3	0.1149						
2015	R	234	Alnus rubra	ALNRUB	14.97	38.0	0.1136						
Species density (per ha)				ALNRUB	213.028								
				MALFUS	11.212								
Mean DBH and area - Alnus rubra					39.7		0.1295						
SD DBH - Alnus rubra					8.7		0.0566						
Mean DBH and area - MALFU					12.192		0.0117						
SD DBH - MALFUS													

PR-T1 Reference	Sample Date(s):	Wetland indicator status: 1=OBL 2=FACW 3=FAC 4=FACU 5=UPL																		
Herbaceous Wetland Habitat Unit	8/11/2015		Percent Cover																	
Species	Origin (N, NN, I)	Wetland Status (1-5)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Transect Average	% plot occurrence	
Native Herbaceous Species																				
Galium aparine (stickywilly)	N	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0.1	6.7	
Oenanthe sarmentosa (Pacific wtaer parsley)	N	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0.1	13.3	
Hordeum brachyantherum (meadow barley)	N	2	0	0	1	0	0	0	0	0	0	0	5	0	0	1	0	0.5	20.0	
Symphyotrichum subspicatum (Douglas' aster)	N	2	0	0	0	0	0	0	2	8	0	0	0	0	0	0	0	0.7	13.3	
Triglochin maritima (seaside arrow-grass)	N	1	0	0	0	0	0	0	0	0	2	3	6	0	0	2	2	1.0	33.3	
Deschampsia cespitosa (tufted hairgrass)	N	2	0	0	0	0	12	0	0	0	1	7	15	0	0	2	0	2.5	33.3	
Angelica lucida (sea watch)	N	3	0	0	0	0	2	1	0	15	10	12	0	0	0	0	0	2.7	33.3	
Carex lyngbyei (Lyngbye's sedge)	N	1	0	0	0	0	0	0	0	0	0	0	0	40	50	0	0	6.0	13.3	
Juncus balticus (Baltic rush)	N	2	0	10	5	5	25	15	25	10	46	10	8	5	1	46	62	18.2	93.3	
Potentilla anserina (Pacific silverweed)	N	1	15	16	10	22	35	20	25	62	12	65	63	55	49	47	35	35.4	100.0	
Achillea millefolium (yarrow)	N	4	6	4	0	0	5	0	0	0	0	0	0	0	0	0	0	1.0	20.0	
Lathyrus palustris (marsh peavine)	N	1	0	2	1	1	0	0	0	0	0	0	0	0	0	1	0	0.3	26.7	
Galium trifidum (small bedstraw)	N	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0.1	6.7	
Leymus triticoides (beardless wildrye)	N	3	5	0	0	10	4	0	0	0	0	0	0	0	0	0	0	1.3	20.0	
Invasive Herbaceous Species																				
Holcus lanatus (velvetgrass)	I	3	0	8	15	10	0	0	0	0	5	1	0	0	0	0	0	2.6	33.3	
Non-Native Herbaceous Species																				
Schedonorus arundinaceus (tall fescue)	NN	3	74	56	65	51.5	15	50	43	4	18	1	0	0	0	0	0	25.2	66.7	
Agrostis stolonifera (creeping bentgrass)	NN	3	0	4	2	1	2	14	5	1	4	0	3	0	0	1	1	2.5	73.3	
Bare Substrate																				
Bare ground			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	
																		2015	2013	% increas
Total cover, native species			26	32	18	37.5	83	36	52	95	73	98	97	100	100	99	99	69.7	82.0	-12.3
Total cover, non-native species			74	60	67	52.5	17	64	48	5	22	1	3	0	0	1	1	27.7	21.0	6.7
Total cover, invasive species INCL PHAARU (for std. 5.1)			0	8	15	10	0	0	0	0	5	1	0	0	0	0	0	2.6	0.0	2.6
Total cover, invasive species EXCL PHAARU (for std. 5.2)			0	8	15	10	0	0	0	0	5	1	0	0	0	0	0	2.6	0.5	2.1
Total cover, all species			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100.0	100.0	0.0
Performance Standards	Threshold		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Transect average	Standard Error	Standard Met?
STD 5.1: Cover of Native Herbaceous Species	*Mean native cover > Mean Inv cover*		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y
> Invasive cover (incl. PHAARU)	*Rate incr N cover > rate incr I cover*																			N
STD 5.2: Invasive cover (minus PhaAru) <10%	*0.1*		0	8	15	10	0	0	0	0	5	1	0	0	0	0	0	2.6	1.2	Y
STD 5.3: Moisture Index	*<3.0*		2.8	2.6	2.7	2.5	2.0	2.5	2.2	1.6	2.2	1.5	1.3	1.1	1.0	1.5	1.6	1.9	0.2	Y
STD 5.7: Total plant cover is progressing towards 98%	*0.98*		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100.0	0.0	Y
Lower CI (80%)																		100.0		
Upper CI (80%)																		100.0		
STD 5.8: At least 3 native species are present with at least 5% cover and 10% frequency of occurrence	*3 by Year 5*																			Y