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Technical Memo to Metro

**HISTORICAL AND EXISTING VASCULAR AND BRYOPHYTE FLORA,
FORMER BLUE HERON PAPER MILL, WILLAMETTE FALLS,
OREGON CITY, OREGON**

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Background

Willamette Falls has long been a focus of botanical interest, but industrial development at the site has limited public access for over a century. The closure of the Blue Heron paper mill on the south bank of the river, and proposed redevelopment of the site, has given planners an opportunity to revisit this part of the falls and identify its current flora. As part of the pre-construction planning process for public access to the falls, Metro contracted John Christy to document the historical and existing vascular flora on the site, and Philip Gaddis joined us to document the bryophyte flora.

For millennia, the falls has been a magnet for fishing, settlement, and more recent industrial development. Photographs by Carleton Watkins show that the south bank of the river at Willamette Falls had been modified for industrial uses as early as 1867. Infrastructure included dams and spillways to create a boat basin, and millraces to power a sawmill, gristmill, and woolen mill. Later, paper mills and electrical generating stations were built on both sides of the falls. These activities concentrated at the falls have impacted all native habitat except vertical cliff faces on basalt outcrops along the river. Significant portions of the shoreline at the Blue Heron site have been modified by fill. Remaining habitat in natural or semi-natural condition includes areas hydrated by tidal action of the Willamette River, areas of seasonal or perennial seepage below spillways and the old grinders, and basalt outcrops with varying exposures. The basalt outcrops are a relic of the Bretz or Missoula Floods (Allen et al. 1986), and exposures along this part of the Willamette River provide outlier habitat for both mesic and xeric species more common in the Columbia River Gorge (Detling 1958). Willamette Falls has a similar history to that of Niagara Falls in terms of industrial development, presence of a rock substrate supporting disjunct populations of rare plants, and botanical exploration that occurred primarily between 1885 and 1915 (Eckel 2013).

Methods

The project area was limited to shoreline outcrops, wetland alcoves, and filled slopes between the Blue Heron mill buildings and the river. We also briefly examined the rail spur south of the mill, and the adjoining property at the falls owned by Portland General Electric. Information on the existing flora was compiled by John Christy, Philip Gaddis, and Brian Vaughn during visits to the site. Field work was done on April 17, May 8, May 11, and June 24, 2015. Access on May 11 was from the Willamette River using Metro's boat, the remaining days being done on foot. During the inventory, Christy focused primarily on vascular plants, and Gaddis focused primarily on bryophytes. Voucher specimens were collected as needed, and will be deposited in the Portland State University Herbarium.

Vascular plants. Information about the historical vascular flora at the falls was compiled from Nuttall (1841), Gorman (1916-1917), Maguire (1943), Christy et al. (2009), online herbarium databases [Academy of Natural Sciences of Drexel University (2010), Natural History Museum (2014), Consortium of Pacific Northwest Herbaria (2015)].

Bryophytes. Information about the historical bryoflora at the falls was compiled from Chapman and Sanborn (1941), Flowers (1952), online herbarium databases [Consortium of Pacific Northwest Herbaria (2015)], and historical bryophyte specimens housed at Portland State University and Oregon State University that have not yet been databased.

Precision of locality data. Unfortunately, early botanists often were not precise about where they collected specimens, so something from "Willamette Falls" could have been anywhere in the general vicinity, but possibly not from the immediate area of the falls. Because the historical record for vascular plants is fairly large, we chose to be conservative by including localities labeled specifically "Willamette Falls," but excluding records indicating that they were collected "near" the falls, or on "bluffs overlooking the falls." Conversely, because the historical record for bryophytes is more limited, we chose to include all localities relating to the falls, including those indicating that they were collected nearby or on the bluffs above the falls. Given the imprecise historical locality data, we can never be certain if all of these species really occurred at the falls.

Nomenclature follows the Oregon Flora Project (2014), Christy and Wagner (2014), and Wagner (2014).

Historical flora of Willamette Falls

Vascular plants. Primary sources about the historical vascular flora at the falls yielded 165 records, representing 67 species collected between 1834 and 1940 (Table 1). The table also includes names of collectors, collection dates, and sources of data. More information about the collectors and chronology can be found in Christy et al. (2009). Several of the region's earliest plant collectors, including David Douglas and Meredith Gairdner, are known to have visited Willamette Falls on their travels, but we could not find any plant collections made there earlier than those of Nuttall in 1834 or 1835. Despite ongoing transit of the falls by various botanists in the decades following Nuttall's visit, there is no record of specimens collected there until Louis Henderson began his investigations in 1884. The most comprehensive collecting of vascular plants at the falls was done by Edmund Sheldon in 1902 and 1903. Bryophytes at the falls were collected primarily by Albert Foster between 1903 and 1910, and to a lesser extent by Michael Flinn between 1905 and 1920.

Willamette Falls is the type locality for *Arnica amplexicaulis*, collected by Thomas Nuttall in 1834 or 1835 (Nuttall 1841, Maguire 1943). *Sullivantia oregana* and *Bolandra oregana*, rare species with type localities at Milwaukie (Watson 1879, but per specimen label at Gray Herbarium, Harvard University) have never been reported from Willamette Falls.

Two species of the historical flora are exotic (3%), the rest native (97%). Because many exotic species already were well established in the metro area by 1885 (Christy et al. 2009), the high proportion of native species collected at the falls may reflect collectors' preferences more than what actually may have occurred there.

Bryophytes. Primary sources about the historical bryoflora at the falls and vicinity yielded 57 records, representing 31 species likely to have occurred within the project area, collected between 1895 and 1920 (Table 1). None of these are considered exotic.

Existing flora at Blue Heron site

Vascular plants. Table 1 lists 166 species that we observed at the Blue Heron site in 2015.

Native species seen at Blue Heron in 2015 that are rare to the Portland metro area include: *Agrostis pallens*, *Apocynum cannabinum*, *Carex vulpinoidea*, *Cystopteris fragilis*, *Eriogonum compositum*, *Erythranthe moschata*, *Festuca roemerii*, *Penstemon richardsonii*, *Poa secunda*, *Rubus leucodermis*, *Saxifraga mertensiana*, *Scutellaria lateriflora*, *Sedum spathulifolium*, *Sedum stenopetalum*, and *Selaginella wallacei* (Christy et al. 2009, Appendix D). However, work done in the Willamette Narrows by Philip Gaddis and John Christy between 2011 and 2015, and by Maze and Bushman (2015) at Elk Rock have confirmed that a number of these species still persist in the area and may not be quite as scarce as they were thought to be in 2009. Of the species listed above, *Cystopteris fragilis* and *Penstemon richardsonii* are the most significant finds at Blue Heron because few sightings are known from the metro area, particularly for the *Penstemon* that had not been seen since 1976, and otherwise is known locally only from Elk Rock (Figure 1; Maze and Bushman 2015). Specimens of *Alnus rhombifolia*, *Cyperus fuscus*, and *Cystopteris fragilis* seen at the Blue Heron site need verification.

In contrast to the historical flora, 86 species (52%) of the existing flora are exotic, and 80 (48%) are native. This proportion of native to exotic species reflects the long-term disturbance that has occurred at the site since the earliest times, and probably is a more comprehensive documentation of the flora than was done by the early collectors. Most of the exotic taxa are well-known invasive upland species and do not need special mention here. Wetland invasives of particular concern include *Iris pseudacorus*, *Ludwigia hexapetala*, *Lythrum salicaria*, and *Phalaris arundinacea*. The *Lythrum* is quite abundant on cobble areas of river alcoves among the basalt bluffs, and can easily spread downstream by seed and fragmentation. *Carduus pycnocephalus* and *Verbena brasiliensis* may be weeds of emerging concern, the latter also on cobble and capable of dispersal downstream. *Verbena brasiliensis* needs verification, but seems distinct from *V. bonariensis* that has also been found in the metro area.

Bryophytes. 53 species of bryophytes were observed at the Blue Heron Mill site in 2015. This includes 13 (42%) of the 31 historically documented species. Conversely, 18 species (58%) of the historically documented bryophyte species were not detected. Two missing species, *Blindia acuta* and *Orthotrichum rupestre*, were the only known occurrences in the Portland metropolitan area. Two others, *Encalypta ciliata* and *Pseudobraunia californica*, were each known from only one other site in the metro area. All of these species are mosses primarily associated with rocky cliffs and outcrops. *Blindia acuta* is typically associated with permanently wet rock and splash zones of waterfalls, a habitat only marginally surveyed in the current study.

Barbula convoluta is new to the list of bryophytes known from the Portland metro area, but is a ruderal species. *Leptobryum pyriforme* is known from one other site in the metro area. *Fissidens*

fontanus is a List 2 species (Oregon Biodiversity Information Center (2013), but appears to be undercollected in the state and is probably more common than first thought.

Of the observed species, 2 are known to be exotic. *Lunularia cruciata* is a regionally abundant, thallose liverwort of moist riparian soil banks. *Campylopus introflexus* is an invasive moss on dry, exposed soil and sand.

Significant habitat at Blue Heron, and presence or absence of botanical components

Rock outcrops and alcove wetlands are the principal native habitats remaining in the project area. Many of the outcrops have been impacted by construction of mill facilities, and presumably by decades of poor air quality. However, significant remnants of undisturbed cliff faces remain (Figures 1 and 2). The top of the cliffs presently occupied by the clarifier structure are in good condition and subject to seasonal washover below the spillway. The wetland alcoves contain industrial structures and debris, some of which are of considerable cultural interest. However, sand and cobble substrates, as well as areas hydrated by leakage from spillways and the old grinders support a diverse array of native wetland plants, although they are subject to considerable disturbance during peak river flows.

Native vegetation on the cliffs and outcrops is better preserved at Blue Heron than elsewhere in the metro area, because of the absence of overhanging mats of English ivy. This greatly increases their conservation value. Based on what we saw in the project area in 2015, important vascular species for the outcrops include *Agrostis pallens*, *Eriogonum compositum*, *Eriophyllum lanatum*, *Festuca roemeri*, *Penstemon richardsonii*, *Philadelphus lewisii*, *Physocarpus capitatus*, *Poa secunda*, *Saxifraga mertensiana*, *Sedum spathulifolium*, *Sedum stenopetalum*, *Selaginella wallacei*, *Symphyotrichum subspicatum*, *Tolmiea menziesii*, and *Triteleia hyacinthina*. Five species of willows (*Salix exigua*, *S. hookeriana*, *S. lasiandra*, *S. scouleriana*, *S. sitchensis*) are also present on site, and probably were a component of original riparian vegetation, though some may have been aided by leakage from mill structures.

Although the bryophyte communities at the Blue Heron site are relatively diverse, they appear to be dominated inordinately by a few abundant species. Most other species appear to be comparatively sparsely distributed in the study area compared to more protected sites in the vicinity, such as Willamette Narrows, Canemah Bluffs, Camassia Preserve, and immediately above the Blue Heron site on the grounds of the Museum of the Oregon Territory. The river shoreline rocks are surprisingly devoid of bryophyte species. Above ordinary high water, moist and shaded rock habitats are overwhelmingly dominated by dense monocultures of *Scleropodium cespitosum*, a common species in our area, but usually mixed with other bryophyte species. More horizontal rock surfaces on ledges and tops of bluffs are comparatively sparsely populated by colonies of *Racomitrium* and *Grimmia* species. At other, more protected sites outside the project area, these habitats are densely covered with these species as well as with *Dicranum howellii*, *Polytrichum juniperinum*, and *Homalothecium megaptilum*. Where well established, this community can be several inches deep and support habitat for many vascular plants of conservation concern such as *Comandra umbellata*, *Allium acuminatum*, *Allium amplexans*, *Brodiaea coronaria*, *Piperia transversa*, *Lomatium triternatum*, and *Lomatium utriculatum*.

Increasing the diversity of native historical species on basalt outcrops at Willamette Falls would be a desirable restoration target. Although portions of the rocks are subject to periodic scouring by high river flows, higher ledges and cliffs are free of scour and could support an array of species that probably once occurred there. In this habitat, bryophytes are critical keystone ecosystem builders because of their ability to create soils and trap sediments on these otherwise barren substrates. Establishment and spread of bryophyte mats is an essential first step in creating habitat for vascular plants. This could be accomplished by transplanting moss mats and excluding trampling from foot traffic. With proper management, the basalt bluffs at Blue Heron could become a showcase for all of these plants.

Because Willamette Falls is the type locality of *Arnica amplexicaulis*, special effort should be made to reestablish this species at the falls. *Delphinium leucophaeum*, a federally-listed endangered species documented from the falls in 1903 but missing today, should be another target for restoration. Records from Willamette Narrows and Elk Rock indicate that other species also are missing from today's Blue Heron site, and are suitable targets for restoration. These include *Allium amplexans*, *Allium acuminatum*, *Arctostaphylos uva-ursi*, *Bolandra oregana*, *Brodiaea coronaria*, *Brodiaea elegans*, *Castilleja hispida*, *Cascadia nuttallii*, *Ceanothus cuneatus*, *Grindelia integrifolia*, *Heuchera micrantha*, *Lithophragma parviflorum*, *Lomatium dissectum*, *Lomatium triternatum*, *Micranthes gormanii*, *Micranthes integrifolia*, *Micranthes fragosa*, *Micranthes marshallii*, *Micranthes rufidula*, *Penstemon serrulatus*, *Rupertia physodes*, *Silene antirrhina*, *Silene douglasii*, *Silene menziesii*, *Sullivantia oregana*, and *Viburnum ellipticum*. Bryophyte species suitable for reintroduction at Blue Heron include *Racomitrium*, *Grimmia*, *Dicranum howellii*, *Polytrichum juniperinum*, and *Homalothecium megaptilum*.

Only 8 (12%) of the historical vascular plants were seen at Blue Heron in 2015, while 13 (42%) historical bryophytes persist at the site (Table 1). This difference may be attributable in part to the limited accuracy of historical locality data and collecting activity of early botanists. It also may illustrate the vulnerability of vascular plants in the face of habitat change, and the relatively greater resilience of some bryophyte species that are able to persist in protected microsites, or, like some of the wetland and aquatic species, are habitat generalists that are able to survive as long as water is present and of reasonably good quality.

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Table 1. Historical and existing vascular and bryophyte flora of Blue Heron mill site, Willamette Falls, 1834-2015. Herbarium acronyms: BM = Natural History Museum, London; HPSU = Portland State University; NY = New York Botanical Garden; OSC = Oregon State University; PH = Academy of Natural Sciences, Philadelphia; REED = Reed College; SOC = Southern Oregon University; SRP = Boise State University; UBC = University of British Columbia; WS = Washington State University.

Taxon	Family	Habitat	Native/ Exotic	Collector	Historical	Current	Source
Vascular plants							
<i>Acer macrophyllum</i>	Sapindaceae	fill banks, outcrops	N	–	–	2015	
<i>Achillea millefolium</i>	Asteraceae	outcrops	N	–	–	2015	–
<i>Acmispon americanus</i> var. <i>americanus</i>	Fabaceae	outcrops, cobbles	N	–	–	2015	–
<i>Agrostis microphylla</i>	Poaceae	?	N	L.F. Henderson	1885	–	OSC, REED
<i>Agrostis pallens</i>	Poaceae	outcrops	N	L.F. Henderson	1884	2015	OSC
<i>Agrostis stolonifera</i>	Poaceae	spillways, cobbles, outcrop seepage	E	–	–	2015	–
<i>Aira caryophylla</i> var. <i>caryophylla</i>	Poaceae	outcrops	E	–	–	2015	–
<i>Aira praecox</i>	Poaceae	outcrops	E	–	–	2015	–
<i>Allium acuminatum</i>	Amaryllidaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Allium vineale</i>	Amaryllidaceae	outcrops	E	–	–	2015	–
<i>Alnus rhombifolia</i>	Betulaceae	fill banks, riparian	N	–	–	2015	–
<i>Alnus rubra</i>	Betulaceae	fill banks	N	–	–	2015	–
<i>Alopecurus pratensis</i>	Poaceae	buildings	E	–	–	2015	–
<i>Anisocarpus madioides</i>	Asteraceae	?	N	?	?	–	Gorman 1916-17
<i>Apocynum cannabinum</i> var. <i>glaberrimum</i>	Apocynaceae	cobbles	N	–	–	2015	–
<i>Arnica amplexicaulis</i>	Asteraceae	?	N	T. Nuttall	1834- 1835	–	Nuttall 1841; BM, PH
<i>Artemisia douglasiana</i>	Asteraceae	fill banks, outcrops	N	–	–	2015	–
<i>Athyrium filix-femina</i> var. <i>cyclosum</i>	Athyriaceae	water, dam, spillways	N	–	–	2015	–
<i>Azolla</i> sp. (sterile)	Salviniaceae	grotto, dam, spillways	N	–	–	2015	–
<i>Berberis aquifolium</i>	Berberidaceae	outcrops	N	–	–	2015	–
<i>Brodiaea coronaria</i> ssp. <i>coronaria</i>	Asparagaceae	?	N	Flinn	1906	–	Gorman 1916-17; HPSU
<i>Brodiaea elegans</i> ssp. <i>hooveri</i>	Asparagaceae	?	N	E.P. Sheldon, T. Howell	1902	–	OSC
<i>Bromus racemosus</i>	Poaceae	fill banks, outcrops	E	–	–	2015	–
<i>Bromus sterilis</i>	Poaceae	fill banks, outcrops	E	–	–	2015	–
<i>Buddleja davidii</i>	Scrophulariaceae	buildings	E	–	–	2015	–
<i>Calystegia sepium</i> ssp. <i>angulata</i>	Convolvulaceae	fill banks, cobbles	E	–	–	2015	–
<i>Carduus pycnocephalus</i>	Asteraceae	buildings	E	–	–	2015	–
<i>Carex unilateralis</i>	Cyperaceae	?	N	E.P. Sheldon	1902	–	OSC
<i>Carex vulpinoidea</i>	Cyperaceae	spillways	N	–	–	2015	–

<i>Centaureum erythraea</i>	Gentianaceae	outcrop seepage	E	–	–	2015	–
<i>Cerastium arvense</i> ssp. <i>strictum</i>	Caryophyllaceae	fill banks	N	–	–	2015	–
<i>Cerastium glomeratum</i>	Caryophyllaceae	buildings	E	–	–	2015	–
<i>Chamaesyce maculata</i>	Euphorbiaceae	cobbles	E	–	–	2015	–
<i>Cicuta douglasii</i>	Apiaceae	water, dam, spillways	N	–	–	2015	–
<i>Cirsium arvense</i>	Asteraceae	fill banks	E	–	–	2015	–
<i>Clarkia gracilis</i> ssp. <i>gracilis</i>	Onagraceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Claytonia perfoliata</i> ssp. <i>perfoliata</i>	Montiaceae	outcrops	N	–	–	2015	–
<i>Clematis vitalba</i>	Ranunculaceae	fill banks, buildings	E	–	–	2015	–
<i>Collinsia grandiflora</i>	Plantaginaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Conium maculatum</i>	Apiaceae	fill banks, cobbles	E	–	–	2015	–
<i>Convolvulus arvensis</i>	Convolvulaceae	fill banks, cobbles, outcrops	E	–	–	2015	–
<i>Cornus nuttallii</i>	Cornaceae	?	N	unknown	1899	–	OSC
<i>Cornus sericea</i>	Cornaceae	cobbles, riparian	N	–	–	2015	–
<i>Crataegus monogyna</i>	Rosaceae	fill banks, outcrops, cobbles	E	–	–	2015	–
<i>Cuscuta</i> sp. (sterile)	Convolvulaceae	water, spillways	?	–	–	2015	–
<i>Cyperus fuscus</i>	Cyperaceae	cobbles	E	–	–	2015	–
<i>Cyperus strigosus</i>	Cyperaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Cystopteris fragilis</i>	Cystopteridaceae	?; buildings (grotto)	N	E.P. Sheldon	1903	2015	OSC
<i>Cytisus scoparius</i>	Fabaceae	fill banks, cobbles	E	–	–	2015	–
<i>Danthonia californica</i>	Poaceae	?	N	E. P. Sheldon	1903	–	OSC, SRP
<i>Daucus carota</i>	Apiaceae	fill banks, cobbles	E	–	–	2015	–
<i>Daucus pusillus</i>	Apiaceae	?	N	E.P. Sheldon	1903	–	Gorman 1916-17; OSC, SOC, UBC
<i>Delphinium leucophaeum</i>	Ranunculaceae	outcrops	N	E.P. Sheldon	1903	–	HPSU
<i>Dichanthelium acuminatum</i> ssp. <i>acuminatum</i>	Poaceae	?	N	W.N. Suksdorf	1895	–	WS
<i>Dichanthelium oligosanthes</i> ssp. <i>scribnerianum</i>	Poaceae	?	N	W.N. Suksdorf, E.P. Sheldon	1896, 1903	–	OSC, WS
<i>Dichelostemma capitatum</i> ssp. <i>capitatum</i>	Asparagaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Draba verna</i>	Brassicaceae	outcrops	E	–	–	2015	–
<i>Drymocallis glandulosa</i>	Rosaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Dysphania ambrosioides</i>	Amaranthaceae	seepage on fill banks, cobbles	E	–	–	2015	–
<i>Eleocharis ovata</i>	Cyperaceae	water, dam, spillways	N	–	–	2015	–
<i>Eleocharis palustris</i>	Cyperaceae	water, spillways, outcrop seepage	N	–	–	2015	–
<i>Epilobium brachycarpum</i>	Onagraceae	fill banks, cobbles, outcrops, buildings	N	–	–	2015	–

<i>Epilobium ciliatum</i> ssp. <i>ciliatum</i>	Onagraceae	fill banks, water, dam, spillways, cobbles, outcrop seepage, buildings	N	–	–	2015	–
<i>Epilobium densiflorum</i>	Onagraceae	outcrops	N	–	–	2015	–
<i>Equisetum arvense</i>	Equisetaceae	fill banks, water, spillways, cobbles	N	–	–	2015	–
<i>Erigeron annuus</i>	Asteraceae	buildings, outcrops	E	–	–	2015	–
<i>Erigeron philadelphicus</i>	Asteraceae	?	N	?	?	–	Gorman 1916-17
<i>Erigeron strigosus</i>	Asteraceae	?	E	?	?	–	Gorman 1916-17
<i>Eriogonum compositum</i> var. <i>compositum</i>	Polygonaceae	outcrops	N	–	–	2015	–
<i>Eriophyllum lanatum</i> var. <i>integrifolium</i>	Asteraceae	outcrops	N	–	–	2015	–
<i>Erythranthe alsinoides</i>	Phrymaceae	outcrop seepage, buildings	N	–	–	2015	–
<i>Erythranthe guttata</i>	Phrymaceae	water, dam, spillways, buildings	N	–	–	2015	–
<i>Erythranthe microphylla</i>	Phrymaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Erythranthe moschata</i>	Phrymaceae	?; water, spillways	N	T. Howell	1902	2015	OSC
<i>Euphorbia crenulata</i>	Euphorbiaceae	?	N	?	?	–	Gorman 1916-17
<i>Festuca roemerii</i> var. <i>roemerii</i>	Poaceae	outcrops	N	–	–	2015	–
<i>Fraxinus latifolia</i>	Oleaceae	fill banks, outcrop seepage	N	–	–	2015	–
<i>Galium aparine</i>	Rubiaceae	?; fill banks, outcrops	N	E.P. Sheldon	1904	2015	OSC
<i>Geranium dissectum</i>	Geraniaceae	fill banks	E	–	–	2015	–
<i>Geranium lucidum</i>	Geraniaceae	fill banks, buildings, outcrops	E	–	–	2015	–
<i>Geranium robertianum</i>	Geraniaceae	fill banks, outcrops, buildings	E	–	–	2015	–
<i>Gnaphalium palustre</i>	Asteraceae	cobbles	N	–	–	2015	–
<i>Gnaphalium stramineum</i>	Asteraceae	buildings	N	–	–	2015	–
<i>Hedera helix</i> ssp. <i>helix</i>	Araliaceae	fill banks, buildings	E	–	–	2015	–
<i>Helianthus tuberosus</i>	Asteraceae	?	N	W.N. Suksdorf	1896	–	WS
<i>Holcus lanatus</i>	Poaceae	fill banks, cobbles, outcrops	E	–	–	2015	–
<i>Holodiscus discolor</i> var. <i>discolor</i>	Rosaceae	outcrops	N	–	–	2015	–
<i>Hordeum brachyantherum</i>	Poaceae	outcrops	N	–	–	2015	–
<i>Hydrocotyle ranunculoides</i>	Araliaceae	water, dam, spillways	N	–	–	2015	–
<i>Hypericum perforatum</i>	Hypericaceae	fill banks, cobbles, outcrops	E	–	–	2015	–
<i>Hypochaeris radicata</i>	Asteraceae	fill banks, outcrops, cobbles	E	–	–	2015	–
<i>Impatiens capensis</i>	Balsaminaceae	water, dam, spillways	E	–	–	2015	–
<i>Iris pseudacorus</i>	Iridaceae	water, dam, spillways	E	–	–	2015	–

<i>Juncus covillei</i>	Juncaceae	?	N	E.P. Sheldon	1902	–	OSC
<i>Juncus effusus</i> ssp. <i>effusus</i>	Juncaceae	fill banks, water, riparian	E	–	–	2015	–
<i>Kickxia elatine</i>	Plantaginaceae	fill banks, cobbles	E	–	–	2015	–
<i>Lapsana communis</i>	Asteraceae	fill banks	E	–	–	2015	–
<i>Lathyrus latifolius</i>	Fabaceae	fill banks, cobbles, outcrops	E	–	–	2015	–
<i>Leersia oryzoides</i>	Poaceae	water, spillways	N	–	–	2015	–
<i>Lemna minor</i>	Araceae	water, dam, spillways	N	–	–	2015	–
<i>Leptosiphon bicolor</i>	Polemoniaceae	?	N	?	?	–	Gorman 1916-17
<i>Leucanthemum vulgare</i>	Asteraceae	fill banks, cobbles, outcrops	E	–	–	2015	–
<i>Ligusticum apiifolium</i>	Apiaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Lomatium utriculatum</i>	Apiaceae	?	N	E.P. Sheldon	1903	–	Gorman 1916-17; OSC
<i>Lotus corniculatus</i>	Fabaceae	fill banks, water, dam, spillways, outcrop seepage	E	–	–	2015	–
<i>Ludwigia hexapetala</i>	Onagraceae	water, dam, spillways	E	–	–	2015	–
<i>Lycopus americanus</i>	Lamiaceae	water, dam, spillways, outcrop seepage	N	–	–	2015	–
<i>Lysimachia nummularia</i>	Primulaceae	water, spillways	E	–	–	2015	–
<i>Lythrum portula</i>	Lythraceae	water, spillways, cobbles	E	–	–	2015	–
<i>Lythrum salicaria</i>	Lythraceae	fill banks, water, dam, cobbles, riparian, outcrop seepage	E	–	–	2015	–
<i>Madia elegans</i>	Asteraceae	?	N	E. P. Sheldon	1902, 1903	–	HPSU, OSC
<i>Madia gracilis</i>	Asteraceae	?	N	E. P. Sheldon	1903, 1904	–	HPSU, OSC
<i>Medicago lupulina</i>	Fabaceae	fill banks, outcrops	E	–	–	2015	–
<i>Melilotus officinalis</i>	Fabaceae	fill banks	E	–	–	2015	–
<i>Mentha × piperita</i> ssp. <i>piperita</i>	Lamiaceae	water, dam, spillways, cobbles	E	–	–	2015	–
<i>Mentha pulegium</i>	Lamiaceae	water, dam, spillways, cobbles, outcrop seepage	E	–	–	2015	–
<i>Microseris laciniata</i> ssp. <i>leptosepala</i>	Asteraceae	?	N	E.P. Sheldon	1903	–	OSC, SOC, UBC
<i>Mollugo verticillata</i>	Molluginaceae	cobbles	E	–	–	2015	–
<i>Montia parvifolia</i>	Montiaceae	?	N	E.P. Sheldon	1902	–	OSC
<i>Mycelis muralis</i>	Asteraceae	fill banks, buildings	E	–	–	2015	–
<i>Myosotis laxa</i>	Boraginaceae	water, spillways	N	–	–	2015	–
<i>Myosotis micrantha</i>	Boraginaceae	?	E	E.P. Sheldon	1903	–	Gorman 1916-17; UBC
<i>Myriophyllum aquaticum</i>	Haloragaceae	water, dam, spillways	E	–	–	2015	–

<i>Nasturtium officinale</i>	Brassicaceae	dam, spillways	E	–	–	2015	–
<i>Navarretia intertextata</i> ssp. <i>intertextata</i>	Polemoniaceae	?	N	E.P. Sheldon, T. Howell	1902	–	OSC
<i>Navarretia squarrosa</i>	Polemoniaceae	cobbles	N	–	–	2015	–
<i>Nemophila parviflora</i> var. <i>parviflora</i>	Hydrophyllaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Oemleria cerasiformis</i>	Rosaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Oenanthe sarmentosa</i>	Apiaceae	water, dam, spillways	N	–	–	2015	–
<i>Osmorhiza berteroi</i>	Apiaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Penstemon richardsonii</i> var. <i>richardsonii</i>	Plantaginaceae	outcrops, cobbles	N	E.P. Sheldon, T. Howell	1903	2015	OSC
<i>Pentagramma triangularis</i> ssp. <i>triangularis</i>	Pteridaceae	?	N	J.W. Thompson	1928	–	OSC
<i>Persicaria hydropiper</i>	Polygonaceae	water, dam, spillways, cobbles	E	–	–	2015	–
<i>Phalaris arundinacea</i>	Poaceae	fill banks, riparian, cobbles	E	–	–	2015	–
<i>Philadelphus lewisii</i>	Hydrangeaceae	outcrops	N	–	–	2015	–
<i>Physocarpus capitatus</i>	Rosaceae	?; outcrops	N	E.P. Sheldon	1903, 1904	2015	HPSU, OSC
<i>Plagiobothrys figuratus</i> var. <i>figuratus</i>	Boraginaceae	?	N	L.F. Henderson	1885	–	OSC
<i>Plagiobothrys nothofulvus</i>	Boraginaceae	?	N	E.P. Sheldon	1902	–	OSC
<i>Plantago lanceolata</i>	Plantaginaceae	fill banks, outcrops	E	–	–	2015	–
<i>Plantago major</i>	Plantaginaceae	buildings	E	–	–	2015	–
<i>Plectritis congesta</i>	Valerianaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Poa compressa</i>	Poaceae	outcrops	E	–	–	2015	–
<i>Poa secunda</i> ssp. <i>secunda</i>	Poaceae	?; outcrops	N	L.F. Henderson	1885, 1886	2015	OSC
<i>Polygonum spergulariiforme</i>	Polygonaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Polypodium glycyrrhiza</i>	Polypodiaceae	fill banks, outcrops, maple	N	–	–	2015	–
<i>Polystichum munitum</i>	Dryopteridaceae	fill banks	N	–	–	2015	–
<i>Populus trichocarpa</i>	Salicaceae	fill banks, riparian, outcrop seepage	N	–	–	2015	–
<i>Portulaca oleracea</i>	Portulacaceae	cobbles	E	–	–	2015	–
<i>Potentilla anserina</i> ssp. <i>anserina</i>	Rosaceae	water, dam, spillways, cobbles	N	–	–	2015	–
<i>Potentilla gracilis</i> var. <i>gracilis</i>	Rosaceae	?	N	E.P. Sheldon	1903	–	HPSU, OSC
<i>Poteridium occidentale</i>	Rosaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Prunella vulgaris</i> var. <i>vulgaris</i>	Lamiaceae	cobbles	E	–	–	2015	–
<i>Pyrus</i> sp. (sterile ornamental)	Rosaceae		E	–	–	2015	–
<i>Quercus garryana</i> var. <i>garryana</i>	Fagaceae	outcrops	N	–	–	2015	–
<i>Ranunculus flammula</i>	Ranunculaceae	?	N	T. Howell	1898		OSC
<i>Ranunculus repens</i>	Ranunculaceae	fill banks, water, riparian	E	–	–	2015	–

<i>Robinia pseudoacacia</i>	Fabaceae	fill banks	E	–	–	2015	–
<i>Rorippa curvisiliqua</i>	Brassicaceae	water, spillways	N	–	–	2015	–
<i>Rorippa palustris</i> ssp. <i>palustris</i>	Brassicaceae	seepage on fill banks, cobbles	N	–	–	2015	–
<i>Rosa pisocarpa</i> ssp. <i>pisocarpa</i>	Rosaceae	?	N	E.P. Sheldon	1902	–	OSC
<i>Rosa</i> sp. (ornamental)	Rosaceae	fill banks	E	–	–	2015	–
<i>Rubus bifrons</i>	Rosaceae	fill banks, outcrops, cobbles	E	–	–	2015	–
<i>Rubus laciniatus</i>	Rosaceae	fill banks, outcrops, cobbles	E	–	–	2015	–
<i>Rubus leucodermis</i>	Rosaceae	outcrops	N	–	–	2015	–
<i>Rubus ursinus</i>	Rosaceae	fill banks, outcrops	N	–	–	2015	–
<i>Rumex acetosella</i>	Polygonaceae	fill banks, spillways, outcrops	E	–	–	2015	–
<i>Rumex crispus</i>	Polygonaceae	cobbles	E	–	–	2015	–
<i>Rumex salicifolius</i> var. <i>salicifolius</i>	Polygonaceae	cobbles	N	–	–	2015	–
<i>Sagina procumbens</i>	Caryophyllaceae	fill banks, outcrop seepage	E	–	–	2015	–
<i>Salix exigua</i> var. <i>columbiana</i>	Salicaceae	riparian, outcrop seepage, spillways	N	–	–	2015	–
<i>Salix hookeriana</i>	Salicaceae	fill banks, riparian, outcrop seepage	N	–	–	2015	–
<i>Salix lasiandra</i> var. <i>lasiandra</i>	Salicaceae	fill banks, riparian	N	–	–	2015	–
<i>Salix scouleriana</i>	Salicaceae	outcrops	N	–	–	2015	–
<i>Salix sitchensis</i> var. <i>sitchensis</i>	Salicaceae	spillways	N	–	–	2015	–
<i>Sanicula bipinnatifida</i>	Apiaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Sanicula crassicaulis</i> var. <i>crassicaulis</i>	Apiaceae	?	N	E.P. Sheldon	1903	–	Gorman 1916-17; OSC, SOC, UBC
<i>Saponaria officinalis</i>	Caryophyllaceae	fill banks	E	–	–	2015	–
<i>Saxifraga mertensiana</i>	Saxifragaceae	outcrops	N	–	–	2015	–
<i>Schedonorus arundinaceus</i>	Poaceae	buildings	E	–	–	2015	–
<i>Scirpus microcarpus</i>	Cyperaceae	fill banks, riparian	N	E.P. Sheldon	1902	2015	OSC
<i>Scutellaria antirrhinoides</i>	Lamiaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Scutellaria lateriflora</i>	Lamiaceae	water, dam, spillways	N	–	–	2015	–
<i>Sedum spathulifolium</i> ssp. <i>spathulifolium</i>	Crassulaceae	outcrops	N	E.P. Sheldon	1903	2015	OSC
<i>Sedum stenopetalum</i> ssp. <i>stenopetalum</i>	Crassulaceae	outcrops	N	L.F. Henderson	1885	2015	OSC
<i>Selaginella wallacei</i>	Selaginellaceae	outcrops	N	–	–	2015	–
<i>Senecio jacobaea</i>	Asteraceae	fill banks	E	–	–	2015	–
<i>Senecio sylvaticus</i>	Asteraceae	outcrops	E	–	–	2015	–
<i>Senecio vulgaris</i>	Asteraceae	fill banks, cobbles	E	–	–	2015	–
<i>Sherardia arvensis</i>	Rubiaceae	fill banks, outcrops	E	–	–	2015	–
<i>Sinapis arvensis</i>	Brassicaceae	fill banks	E	–	–	2015	–

<i>Solanum dulcamara</i>	Solanaceae	fill banks, water, cobbles	E	–	–	2015	–
<i>Solidago elongata</i>	Asteraceae	outcrops, cobbles	N	–	–	2015	–
<i>Sonchus asper</i>	Asteraceae	buildings	E	–	–	2015	–
<i>Spiraea douglasii</i> var. <i>douglasii</i>	Rosaceae	water, dam, spillways	N	–	–	2015	–
<i>Stellaria media</i>	Caryophyllaceae	fill banks	E	–	–	2015	–
<i>Stellaria nitens</i>	Caryophyllaceae	outcrops	N	–	–	2015	–
<i>Symphotrichum subspicatum</i>	Asteraceae	fill banks, outcrops	N	–	–	2015	–
<i>Tanacetum vulgare</i>	Asteraceae	fill banks, cobbles	E	–	–	2015	–
<i>Taraxacum officinale</i>	Asteraceae	fill banks	E	–	–	2015	–
<i>Tolmiea menziesii</i>	Saxifragaceae	outcrop seepage	N	–	–	2015	–
<i>Toxicodendron diversilobum</i>	Anacardiaceae	fill banks, outcrops	N	–	–	2015	–
<i>Toxicoscordion venenosum</i>	Melanthiaceae	?	N	E.P. Sheldon	1903	–	Gorman 1916-17; OSC
<i>Trichostema oblongum</i>	Lamiaceae	?	N	E.P. Sheldon, T. Howell	1902	–	OSC
<i>Trifolium arvense</i>	Fabaceae	fill banks	E	–	–	2015	–
<i>Trifolium ciliolatum</i>	Fabaceae	?	N	?	?	–	Gorman 1916-17
<i>Trifolium variegatum</i>	Fabaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Triteleia hyacinthina</i>	Asparagaceae	outcrops	N	E.P. Sheldon	1903, 1904	2015	Gorman 1916-17; OSC
<i>Turritis glabra</i>	Brassicaceae	?	N	E.P. Sheldon	1903	–	OSC
<i>Typha latifolia</i>	Typhaceae	water, dam, spillways	N	–	–	2015	–
<i>Urtica dioica</i> ssp. <i>dioica</i>	Urticaceae	water, spillways, cobbles	E	–	–	2015	–
<i>Vaccinium cespitosum</i>	Ericaceae	?	N	L.F. Henderson	1885	–	OSC, SRP
<i>Verbascum blattaria</i>	Scrophulariaceae	fill banks, outcrops, cobbles	E	–	–	2015	–
<i>Verbascum thapsus</i>	Scrophulariaceae	fill banks, outcrops, buildings	E	–	–	2015	–
<i>Verbena brasiliensis</i>	Verbenaceae	cobbles	E	–	–	2015	–
<i>Veronica americana</i>	Plantaginaceae	water, dam, spillways	N	–	–	2015	–
<i>Veronica peregrina</i> var. <i>peregrina</i>	Plantaginaceae	buildings	N	–	–	2015	–
<i>Viburnum ellipticum</i>	Adoxaceae	?	N	E.P. Sheldon	1903	–	Gorman 1916-17; OSC
<i>Vicia americana</i> var. <i>americana</i>	Fabaceae	?	N	L.F. Henderson	1887	–	OSC
<i>Vicia hirsuta</i>	Fabaceae	fill banks, cobbles, outcrops	E	–	–	2015	–
<i>Vicia sativa</i> var. <i>sativa</i>	Fabaceae	fill banks, outcrops	E	–	–	2015	–
<i>Vulpia bromoides</i>	Poaceae	buildings, outcrops	N	–	–	2015	–
<i>Woodsia scopulina</i>	Woodsiaceae	?	N	E.P. Sheldon	1903	–	OSC

<i>Xanthium strumarium</i> var. <i>canadense</i>	Asteraceae	cobbles	N	–	–	2015	–
Liverworts							
<i>Lunularia cruciata</i>	Lunulariaceae	shaded soil	N	–	–	2015	–
<i>Porella cordaeana</i>	Porellaceae	shaded wet rocks	N	–	–	2015	–
<i>Porella navicularis</i>	Porellaceae	maple trunk	N	–	–	2015	–
Mosses							
<i>Amblystegium serpens</i>	Amblystegiaceae	outcrops	N	–	–	2015	–
<i>Amphidium californicum</i>	Rhabdoweisiaceae	outcrops	N	A.S. Foster	1910	–	HPSU
<i>Anacolia menziesii</i>	Bartramiaceae	outcrops	N	A.S. Foster, M.A. Flinn	1905, 1907	–	Flowers 1952; HPSU, NY, WTU
<i>Antitrichia californica</i>	Leucodontaceae	maple trunk	N	–	–	2015	–
<i>Barbula convoluta</i>	Pottiaceae	moist shaded outcrops, buildings	N	–	–	2015	–
<i>Bartramia pomiformis</i>	Bartramiaceae	outcrops	N	M.A. Flinn	1906	–	HPSU
<i>Blindia acuta</i>	Seligeriaceae	outcrops	N	M.A. Flinn	1912	–	HPSU
<i>Bryolawtonia vancouveriensis</i>	Neckeraceae	moist rock	N	M.A. Flinn	1905	–	HPSU
<i>Bryum argenteum</i>	Bryaceae	cracks in concrete pavement	N	–	–	2015	–
<i>Campylopus introflexus</i>	Dicranaceae	outcrops	E	–	–	2015	–
<i>Ceratodon purpureus</i>	Ditrichaceae	outcrops	N	A.S. Foster	1903	2015	HPSU
<i>Claopodium bolanderi</i>	Leskeaceae	outcrops	N	–	–	2015	–
<i>Claopodium crispifolium</i>	Leskeaceae	soil over rock, tree bases	N	A.S. Foster	1905	–	HPSU
<i>Climacium dendroides</i>	Climaciaceae	moist soil	N	–	–	2015	–
<i>Dichodontium pellucidum</i>	Rhabdoweisiaceae	wet shaded rocks	N	–	–	2015	–
<i>Dicranum fuscescens</i>	Dicranaceae	outcrops	N	M.A. Flinn	1906	–	HPSU
<i>Dicranum scoparium</i>	Dicranaceae	soil, soil over rock	N	A.S. Foster	1906	–	HPSU, WS, WTU
<i>Dicranum tauricum</i>	Dicranaceae	base of spruce	N	A.S. Foster	1906	–	HPSU
<i>Didymodon vinealis</i>	Pottiaceae	outcrops	N	–	–	2015	–
<i>Encalypta ciliata</i>	Encalyptaceae	outcrops	N	A.S. Foster	1905	–	HPSU
<i>Fissidens bryoides</i>	Fissidentaceae	moist, shaded soil	N	–	–	2015	–
<i>Fissidens fontanus</i>	Fissidentaceae	wet rocks	N	–	–	2015	–
<i>Fissidens ventricosus</i>	Fissidentaceae	wet rocks	N	A.S. Foster	1905	2015	HPSU, WTU
<i>Funaria hygrometrica</i>	Funariaceae	outcrops	N	M.A. Flinn	1905	2015	HPSU
<i>Grimmia pulvinata</i>	Grimmiaceae	rocks, buildings	N	A.S. Foster	1906	2015	HPSU
<i>Grimmia trichophylla</i>	Grimmiaceae	outcrops	N	A.S. Foster	1895, 1905	2015	HPSU, NY, WS, WTU
<i>Hedwigia stellata</i>	Hedwigiaceae	rocks	N	A.S. Foster	1906	–	HPSU
<i>Homalothecium aureum</i>	Brachytheciaceae	rocks	N	A.S. Foster	1906	2015	HPSU
<i>Homalothecium fulgescens</i>	Brachytheciaceae	maple trunk	N	–	–	2015	–
<i>Homalothecium megaptilum</i>	Brachytheciaceae	outcrops	N	M.A. Flinn	1906	–	HPSU
<i>Homalothecium nevadense</i>	Brachytheciaceae	rocks	N	–	–	2015	–

<i>Homalothecium nuttallii</i>	Brachytheciaceae	maple trunk	N	–	–	2015	–
<i>Hygroamblystegium varium</i> var. <i>humile</i>	Amblystegiaceae	moist shaded rocks	N	–	–	2015	–
<i>Hygrohypnum bestii</i>	Amblystegiaceae	spillway seepage	N	–	–	2015	–
<i>Hygrohypnum ochraceum</i>	Amblystegiaceae	boom logs	N	A.S. Foster	1910	–	HPSU
<i>Hypnum subimponens</i>	Hypnaceae	rock	N	–	–	2015	–
<i>Imbricium minutum</i>	Bryaceae	outcrop seepage	N	A.S. Foster	1905	–	Chapman & Sanborn 1941; UBC
<i>Isothecium stoloniferum</i>	Lembophyllaceae	maple trunk	N	–	–	2015	–
<i>Kindbergia praelonga</i>	Brachytheciaceae	outcrop seepage	N	M.A. Flinn	1920	2015	HPSU
<i>Leptobryum pyriforme</i>	Meesiaceae	moist shaded rock and soil	N	–	–	2015	–
<i>Leptodictyum riparium</i>	Amblystegiaceae	aquatic	N	–	–	2015	–
<i>Leucolepis acanthoneura</i>	Mniaceae	shaded outcrops and soil	N	–	–	2015	–
<i>Orthotrichum consimile</i>	Orthotrichaceae	maple trunk	N	–	–	2015	–
<i>Orthotrichum lyellii</i>	Orthotrichaceae	maple trunk	N	–	–	2015	–
<i>Orthotrichum rupestre</i>	Orthotrichaceae	outcrops	N	A.S. Foster	1906	–	OSC
<i>Philonotis fontana</i> var. <i>fontana</i>	Bartramiaceae	wet soil over rock	N	–	–	2015	–
<i>Plagiomnium venustum</i>	Mniaceae	base of maple	N	M.A. Flinn	1905	2015	HPSU
<i>Pohlia wahlenbergii</i>	Mielichhoferiaceae	wet soil over rock	N	–	–	2015	–
<i>Polytrichum juniperinum</i>	Polytrichaceae	outcrops	N	–	–	2015	–
<i>Porotrichum bigelovii</i>	Neckeraceae	moist to wet rocks	N	–	–	2015	–
<i>Pseudobraunia californica</i>	Hedwigiaceae	outcrops	N	A.S. Foster	1906	–	HPSU
<i>Ptychomitrium gardneri</i>	Ptychomitriaceae	outcrops	N	A.S. Foster	1905	–	HPSU, NY
<i>Racomitrium elongatum</i>	Grimmiaceae	outcrops	N	A.S. Foster	1906	2015	HPSU
<i>Racomitrium heterostichum</i>	Grimmiaceae	outcrops	N	A.S. Foster	1906	2015	HPSU
<i>Racomitrium aciculare</i>	Grimmiaceae	outcrops	N	–	–	2015	–
<i>Racomitrium affine</i>	Grimmiaceae	outcrops	N	–	–	2015	–
<i>Racomitrium ericoides</i>	Grimmiaceae	outcrops	N	–	1905	–	HPSU
<i>Racomitrium varium</i>	Grimmiaceae	outcrops	N	–	–	2015	–
<i>Rhynchostegium aquaticum</i>	Amblystegiaceae	wet rocks	N	–	–	2015	–
<i>Rosulabryum capillare</i>	Bryaceae	outcrops	N	A.S. Foster	1906	2015	WTU
<i>Rosulabryum gemmascens</i>	Bryaceae	outcrops	N	–	–	2015	–
<i>Schistidium rivulare</i>	Grimmiaceae	seasonally wet rocks	N	–	–	2015	–
<i>Scleropodium cespitans</i>	Brachytheciaceae	outcrops	N	A.S. Foster	1905	2015	HPSU
<i>Scouleria aquatica</i>	Scouleriaceae	seasonally wet rocks	N	M.A. Flinn	1915	2015	NY
<i>Syntrichia princeps</i>	Pottiaceae	outcrops	N	A.S. Foster	1906	2015	HPSU
<i>Syntrichia latifolia</i>	Pottiaceae	rocks and alder trunk	N	–	–	2015	–
<i>Tortula hoppeana</i>	Pottiaceae	wet shaded rocks	N	–	–	2015	–
<i>Tortula muralis</i>	Pottiaceae	rocks, buildings	N	–	–	2015	–



Figure 1. Top: *Penstemon richardsonii* on basalt outcrops below mill clarifier. Bottom: outcrops and clarifier.



Figure 2. Basalt outcrops at Blue Heron mill site with relictual native vegetation. White flower on right is *Eriogonum compositum*. Note mats of moss in crevices and on rock faces.