Inventory for Fens and Associated Sensitive and Other Notable Plant Species Wallowa-Whitman National Forest, 2014

South over short-statured fen community with *Utricularia minor*, *Tomentypnum nitens*, *Helodium blandowii*, and *Meesia triquetra* at the 43-942 wetland system, La Grande Ranger District

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Drosera anglica, *Eleocharis quinqueflora* and *Sphagnum* at Duck Lake, Hells Canyon Ranger District

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Summary

Thirty-five sites with promise of including instances of groundwater dependent ecosystems with persistent, diffusely discharging groundwater, were visited on Wallowa-Whitman National Forest (WAW NF) during 18 field days between 8/5/2014 and 9/4/2014. Six US Forest Service Region 6 (USFS R6) sensitive species (2011 list), one strategic species, and six otherwise notable species were detected during this project. Of the 35 sites visited in the course of this project, 25 include areas that the project lead can comfortably refer to as fens. These fens are identified by their combination of evident persistent, *diffuse* groundwater discharge and presence of certain fen-loving plant taxa (fen indicator taxa = FIT). Although very little exploration was conducted within the Eagle Cap Wilderness, it appears likely that Forest-wide, the highest incidence and density of both fens, and fens rich in sensitive and other "notable" plant species, occurs in the northern half of Whitman Ranger District, and the adjacent far southern portion of La Grande Ranger District, on the Forest's west side. These west side sites represented 57% (20/35) of all 35 project sites, but accounted for 82% (51/62) of all detected occurrences of "notable" species. A case is presented for recognizing fens based on presence of persistent, diffuse groundwater discharge, and the presence of a flora characterized by species of Cyperaceae and mosses, in general, and fen indicator taxa in particular. A case is also presented for recognizing fens as a) biophysical entities that are distinct from riparian habitats and communities, where they are often included and b) deserving of special management consideration as variously rare or uncommon *groundwater supported ecosystems*, in addition to providing habitats that may support notable numbers of rare or uncommon plants species.

Gently sloping, robustly groundwater-discharging toeslope fen at edge Cabell Meadow, Whitman Ranger District

Introduction

This project is part of a series of Forest-level inventories within USFS Region 6 that are focused on better understanding the regional distribution of rare and uncommon fen-loving plants, as well as of the fen and fen-like ecosystems which include them. These inventories typically involve several days of pre-field analysis followed by 3-4 weeks of fieldwork by 1-2 persons. To date, the project lead has conducted surveys for fens and fen-loving rare plants on the Deschutes, Ochoco, Fremont-Winema, Malheur and Umatilla National Forests, and the Klamath Falls Resource Area of the Lakeview BLM District in Oregon, and Gifford Pinchot and Okanogan-Wenatchee National Forests in Washington.

Objectives

The intent of this study was to identify a group of sites on Wallowa-Whitman NF that were reasonably likely to include fen or fen-like ecosystems, and could be visited and examined with preferably no more than 1-2 hours hiking time, each way. Examination was to include development of a list of on-site bryophytes and vascular plants, including sensitive and other notable plant species, and a cursory description of vegetative structure, site wetness and soils, and site condition. It was hoped that this examination would allow at least a tentative recognition of sites as fens as opposed to some other type of wetland or meadow, and allow some type of comparison among fens. A list of project target species is presented in Appendix I.

Looking west over short-statured fen community on northern edge of Duck Lake, Hell's Canyon Ranger District

Swertia perennis (felwort) in fen on tributary to Baldy Creek, North Fork John Day Wilderness Area, Whitman Ranger District

Methods

Over the period of these fen studies, funded by the Interagency Special Status/Sensitive Species Program (ISSSSP), the project lead has used a variety of data sources for the pre-field analysis process. The number and types of sources has depended on availability and potential usefulness. In this project, the project lead initially identified three data sources that were both available and potentially useful: a) WAW NF potential natural vegetation mapping in GIS; b) site information for selected fen indicator taxa (FIT) extracted from the Consortium of PNW Herbaria website; c) wetland mapping provided by the USF&W National Wetland Inventory (NWI). Early on, comparison of fen candidate sites developed from each of these sources indicated that WAW GIS and Consortium data sets were largely redundant and less complete than the NWI. Hence, it was decided to primarily utilize the NWI data set for this project. The NWI utilizes a very large set of wetland categories. Recent prior experience with the NWI has allowed the project lead to determine that the PEMB category is perhaps the single category most likely to be associated with fens and fen-like ecosystems. Other NWI categories such as PEMC and PSSB are also known to include fen and fen-like ecosystems. A more detailed explanation of these codes is available at http://www.fws.gov/wetlands/data/wetland-codes.html, but briefly, “P” = palustrine, “EM” = emergent, and “B” = substrate saturated to surface for extended periods during the growing season. “C” =

seasonally flooded, and "SS" = scrub-shrub. Ultimately, the list of candidate fen and fen-like ecosystems for this project was derived from an initial collection of NWI PEMB and PEMC sites screened for ease of access and promise as assessed by examining NAIP aerial imagery views.

Meesia triquetra/*Eleocharis quinqueflora* fen community at upper West Eagle Meadow, La Grande Ranger District

Field visits to fen candidate sites usually involved driving, parking, and some amount of trail and/or cross-country hiking. Upon arrival at a site, an effort was made to identify and walk through structurally differentiable plant communities within the site. Typically, the time spent in particular communities, and at sites in general, was directly related to spatial extent of the community and the extent to which community or site exhibited fen features. Types of information collected at a site included a plant species list, plant collections, a brief description of site character (vegetation structure, wetness, adjacent topography), soil probes, photographs and GPS coordinates of selected features. Plant species lists were never comprehensive. Known taxa were generally always recorded. Unknown taxa, after consideration of taxon's potential significance in interpreting site conditions, were either collected to provide an opportunity for later identification, simply noted in field notebook, or left for some other, less time-sensitive visit. Field visits to fen candidate sites are best done in late summer or fall, in order to better assess the relative contributions of surface water vs. diffusely-discharging groundwater in contributing to wetness at the site.

The fen moss *Tomentypnum nitens* with *Hypericum anagalloides* at Mahoney Meadows (e), Whitman Ranger District

Results

Thirty-five sites were visited during 18 field days between 8/5/2014 and 9/4/2014. These sites, by ranger district, are presented in Appendix A. A map illustrating the distribution of these sites on Wallowa-Whitman NF is presented in Appendix B. Sites ranged in elevation from 4350-7200 feet. Biophysical descriptions of these sites are presented in Appendix C. One hundred eighteen plant taxa/82 species, including 14 *Carex* species and 27 bryophyte species were noted among the fen and fen-like ecosystems visited. This group of plants is presented in Appendix D. Six USFS R6 sensitive species (2011 list), one strategic species, and six otherwise notable species were detected during this project. Detected occurrence of these species among the 35 sites visited is presented in Table 1 below, as well as in Appendix E.

Table 1. Project target taxa and otherwise notable taxa detected (target taxa in bold). Hdws = headwaters.

District	Site	Vascular Taxa	Bryophyte Taxa
Whitman (east)	66-410	***Utricularia minor***	***Campylium stellatum***
	66	***Utricularia minor***	***Campylium stellatum***
Hells Canyon	Duck Lake	***Carex lasiocarpa*** var. ***americana***	*Hamatocaulis vernicosus*
		Utricularia minor	
Eagle Cap	East Fork Wallowa River		***Helodium blandowii***
La Grande (east)	West Eagle (upper)		***Helodium blandowii***
	West Eagle (lower)		*Meesia triquetra*
Whitman (west)	Haystack (east)		***Helodium blandowii***
	Mahoney (east)		***Tomentypnum nitens***
	Baldy Creek	*Swertia perennis*	***Campylium stellatum***
			Lophozia gillmanii
			Splachnum sphaericum
	Cabell		***Helodium blandowii***
			Meesia triquetra
			Meesia uliginosa
	Davis Creek		*Meesia triquetra*
	Hoodoo Creek		***Helodium blandowii***
	5185-010		***Helodium blandowii***
			Meesia triquetra
	Grande Ronde R. hdws (s)	*Swertia perennis*	***Campylium stellatum***
			Hamatocaulis vernicosus
			Helodium blandowii
			Hypnum lindbergii
			Meesia triquetra
	73-140 (upper)	***Utricularia minor***	***Campylium stellatum***
			Hamatocaulis vernicosus
La Grande (west)	Grande Ronde R. hdws (n)	*Swertia perennis*	***Campylium stellatum***
			Hamatocaulis vernicosus
			Helodium blandowii
			Hypnum lindbergii
			Meesia triquetra
	Grande Ronde Lake		*Hamatocaulis vernicosus*
			Helodium blandowii
			Meesia triquetra
	Friday	*Swertia perennis*	*Hamatocaulis vernicosus*
		Utricularia minor	***Helodium blandowii***
			Hypnum lindbergii
			Hypnum pratense
			Meesia triquetra
			Tomentypnum nitens
	43-940		*Hamatocaulis vernicosus*
			Helodium blandowii
			Hypnum lindbergii
			Meesia triquetra
			Tomentypnum nitens
	43-942	***Utricularia minor***	*Hamatocaulis vernicosus*

			Helodium blandowii
			Meesia triquetra
			Splachnum sphaericum
			Tomentypnum nitens

Of the 35 sites visited in the course of this project, 25 include areas that the project lead can comfortably refer to as fens. These fens are identified by their combination of evident persistent, *diffuse* groundwater discharge and presence of certain fen-loving plant taxa (fen indicator taxa = FIT). Based on the characteristics of a) presence or absence of recognized fens within the site and b) numbers of detected FIT, the 35 sites can be sorted into 3 groups: 1) fens present, and FIT ≥ 15; 2) fens present, and detected FIT < 15; 3) fens lacking within site. These groups are presented in Appendix F. It's interesting that with consideration of a third character – number of "notable" species (same 13 species that are included in Table 1 above) - the threshold of ≥ 15 FIT seems to be clearly supported. Within the 12 sites with ≥ 15 FIT, the mean number of detected "notable" species per site = 4.3, while among the 13 sites that included fens but had <15 FIT, the mean number of detected "notable" species = 0.7 (Appendix F). As used here, "notable" refers to known or suspected fen-loving species that are either a) sensitive or strategic on the Regional Forester's Special Status Species List (SSL) or b) at least locally in Oregon, are either rare or uncommon. It is also notable that of the 14 sites at which Sphagnum moss was detected, 10 were within the 12 sites with FIT ≥ 15.

The dung moss *Splachnum sphaericum* – a first state record – with the moss *Campylium stellatum*, at Baldy Creek tributary fen, North Fork John Day Wilderness Area, Whitman Ranger District.

Site of *Splachnum sphaericum* occurrence (white rod) in southwest corner of the large Baldy Creek tributary fen, North Fork John Day Wilderness Area, Whitman Ranger District

Discussion

Further information regarding the 13 sensitive/strategic or otherwise notable species detected during this project and presented in Table 1 above and in Appendix E, is provided below.

1) *Carex lasiocarpa* var. *lasiocarpa*. This *sensitive* species (2011 R6 SSL; 2015 R6 Draft SSL) was detected only at Duck Lake, where it was previously known to occur. A useful feature with which to separate this species from other sedges with "hairy peris" is the presence of leaves with upper portions that are essentially solid, and triangular in cross-section. This species appears to often occur at the seasonally wet edges of persistently groundwater-wetted sites.

2) *Swertia perennis*. This *strategic* species (2011 R6 SSL; 2015 R6 Draft SSL) in the gentian family was detected at four sites. This species is known from several groundwater-rich sites on neighboring Umatilla NF and is elsewhere known on WAW NF (Darrach, personal communication). It may be appropriate to

regard this species as a Fen Indicator Taxon (FIT), but further experience with its habitat amplitude is needed.

3) *Utricularia minor*. This *sensitive* species (2011 R6 SSL; 2015 R6 Draft SSL) was detected at six sites within the project area. Lesser bladderwort is a sensitive species that appears to be quite rare in NE OR, and was not previously documented on Wallowa-Whitman NF. It is consistently found over peat in areas of shallow (an inch or two or less) standing or slow-moving water on flat or very gently sloping surfaces, or at the shallow edges of somewhat deeper, better defined pools, also over peat. It is confusable with *U. intermedia*, but is differentiated by its generally small size, presence of bladders on both leafy and leafless shoots, fewer number of ultimate divisions of individual leaves, and fewer number of spines along leaf margins.

The bladderwort *Utricularia minor*, with emergent *Eleocharis quinqueflora*, at 73-140 wetland, La Grande Ranger District

4) *Campylium stellatum*. Found at six sites, the sharply tapering, closely spaced, abruptly spreading leaves of this moss give it a highly distinctive appearance in the field, where it is likely to be confused only with another groundwater-loving moss, *Dicranella palustris*. This moss is only recently documented in Oregon, and beyond the project area, may only be known from one site each on Umatilla, Malheur, and Rogue-Siskiyou NFs. The species has List 3 status (more information needed) in the current (2013) Oregon Biodiversity Information Center's (ORBIC) rare plant list.

5) *Hamatocaulis vernicosus*. This species was detected at eight project sites. Formerly included within the genus *Drepanocladus*, ORBIC does not regard this as a rare moss in Oregon, but the species appears to have been formerly very poorly documented in NE Oregon. This is an important moss to know, as it is very specific to fens with robust, persistent groundwater discharge (although its presence at Duck Lake is worthy of discussion a bit later).

6) *Helodium blandowii*. Found at 12 project sites. This large, handsome, distinctive moss was also formerly very poorly documented in NE Oregon, and was not previously documented on Wallowa-Whitman NF. This species has a broader habitat amplitude than *Hamatocaulis vernicosus*, but will continue to have importance as an indicator of fens, and particularly, of areas with strong groundwater influence. *Helodium blandowii* was listed as *sensitive* in the 2011 R6 SSL; under a new name, "*Elodium blandowii*", its status is changed to *strategic* in the 2015 R6 Draft SSL.

The fen moss *Helodium blandowii* at upper East Fork Wallowa River wetland, Eagle Cap Ranger District

7) *Hypnum lindbergii*. Found at four sites. This may be a fen-loving species. There appear to be only two confidently documented Oregon records of this moss species (Christy and Wagner, 2015). *Hypnum lindbergii* is very morphologically similar to *Hypnum pratense*, and confident differentiation of the two species can be challenging, especially with sterile material. This species is not included in the current (2013) ORBIC rare plant list.

8) *Hypnum pratense*. Found at one site. This may be a fen-loving species. The Consortium of PNW Herbarium currently lists only one Oregon record for this species. Dewey has an unreported record of this species from a fen on Ochoco NF. The documented incidence of *Hypnum pratense* in Oregon needs to be further researched. Both *Hypnum pratense* and *H. lindbergii* appear to be potentially rare, fen-loving mosses in Oregon. *Hypnum pratense* is not listed in the current (2013) ORBIC rare plant list.

9) *Lophozia gillmanii*. Found at one site. This *sensitive* leafy liverwort (2011 R6 SSL; 2015 R6 Draft SSL) is not well known to the project lead, who previously had seen it only at a single site on Umatilla NF. Based on habitat at these two sites, this species appears to favor peaty soils that are persistently wetted, or at least dampened, by diffuse groundwater discharge.

10) *Meesia triquetra*. Found at 11 sites. ORBIC does not regard this moss as rare in Oregon, and it is well represented in fens on the east flank of the Oregon Cascades. However, this moss – highly distinctive due to its spirally ranked, abruptly spreading (squarrose) leaves – was very poorly documented in NE Oregon prior to this project. As with *Hamatocaulis vernicosus*, this moss is important to know because it is highly specific to fens with robust, persistent groundwater discharge.

Sporophytes of the fen moss *Meesia uliginosa* at toeslope fen in Cabell Meadow, Whitman Ranger District

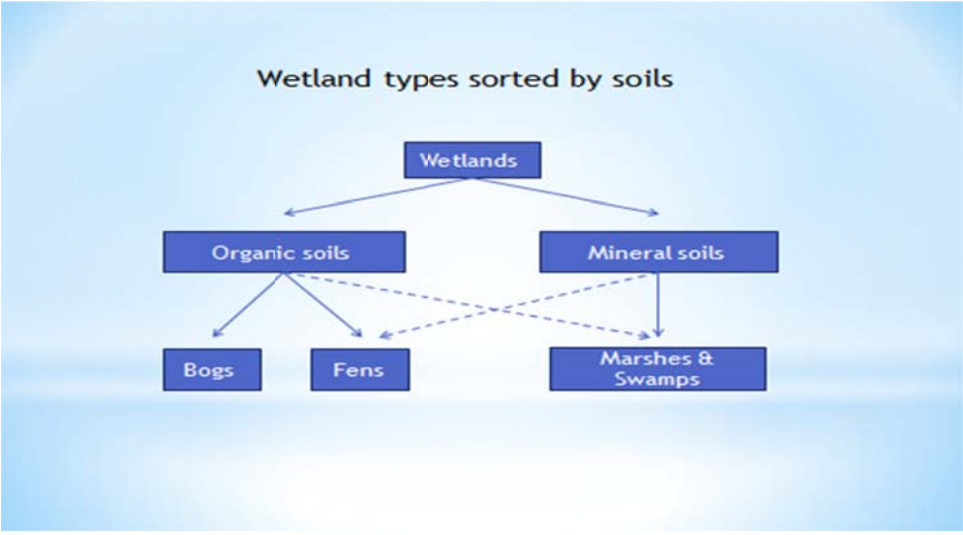
11) *Meesia uliginosa*. Found at one site. *Meesia uliginosa* was listed as *sensitive* in the 2011 R6 SSL; it has been reassigned to *no status* in the 2015 R6 Draft SSL due to ORBIC downgrading the state status from S1 to S2 and List 2 to List 4. It is the project lead's opinion, that outside of Jackson and Grant Counties, this species will continue to be rare in Oregon.

12) *Splachnum sphaericum*. Found at two sites. This dung moss was previously not documented in OR. At each site, it was found on decomposing elk dung on peat persistently wetted by diffuse groundwater discharge.

13) *Tomentypnum nitens*. Found at five sites. This large, distinctive moss, listed as *sensitive* in the 2011 R6 SSL, is assigned to no status in the 2015 R6 Draft SSL SSL due to the ORBIC downgrading the state status from S2 to S3 and List 2 to List 4. It is abundantly present in fens on and near the eastern flank of the central and southern Cascades of OR, but apparently uncommon elsewhere in the state. The species was not documented on Wallowa-Whitman NF prior to this project. The moss is important to know because it has high fidelity to fen habitats. Its habitat amplitude within fens is somewhat narrower than that of *Helodium blandowii*, and broader than that of *Hamatocaulis vernicosus* or *Meesia triquetra*.

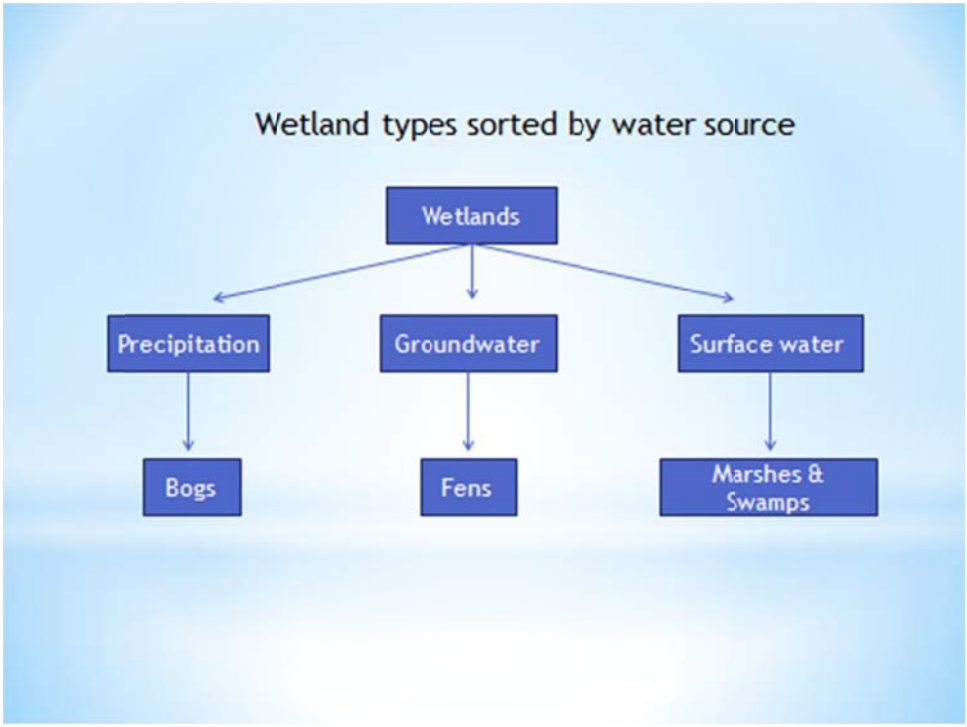
Other project-specific notes/comments that seem worthy of brief discussion are as follows:

1. Characterizing and differentiating fens, bogs and marshes : the case for recognizing fens primarily as *groundwater-fed* wetlands, not primarily as a type of peatland. The Draft Environmental Impact Statement for the Proposed Revised Land Management Plans for the Blue Mountains National Forests was released for public comment on March 14, 2014. The following is an excerpt from that document: "Two major types of peatlands are fen and bog. Fen, the main type of peatland in the Blue Mountains, is fed by groundwater or mineral-rich surface water, has neutral to alkaline pH, and supports relatively rich marsh-like vegetation. Fen is distinguished from marsh, which is a wetland on mineral soil (USDA Forest Service 1998). A bog receives water entirely from precipitation, accumulating sufficient peat to raise the surface layer above the influence of the water table (USDA Forest Service 1998), and are very acidic in pH." Excluding consideration of the arrows with dashed lines, the diagram below appears to be an accurate representation of the concepts conveyed in the Draft EIS excerpt.



This particular characterization/differentiation of bogs, fens and marshes, places primary importance on soil character and secondary importance on water source, and more particularly, defines fens as a type of peatland. This has been regarded as an overly restrictive definition of fens that "probably derives from

the fact that most literature on fens originates from boreal regions where peatlands dominate the landscape" (Bedford and Godwin, 2003). In their review of fens and fen literature of the United States, Bedford and Godwin (2003) cite multiple authors in noting that fens at more temperate latitudes occur on mineral and carbonate substrates, as well as on peat. Bedford and Godwin (2003) suggest that, regardless of latitude, *water source* (groundwater) and *vegetation* (typically a mix of mosses, graminoids and dicot herbs), rather than soil type, are more useful, applicable characters with which to define and differentiate fens. This view is essentially exactly mirrored by the authors of large review of fens and fen literature of Central Europe (Hájek, et al. 2006). With their reviews, both sets of authors referenced above have proposed their own definitions of fens; these are definitions better able to work across the broad range of latitudes and landscapes across which fens occur. Bedford and Godwin (2003) propose that fens are "wetlands that develop where a relatively constant supply of ground water to the plant rooting zone maintains saturated conditions most of the time and the water chemistry reflects the minerology of the surrounding and underlying soils and geological materials." More concisely, Hájek et al. (2006) have defined fens as "groundwater-fed wetlands that host low productive nutrient-limited vegetation dominated by Cyperaceae and bryophytes." Notably, neither of these definitions includes the presence of peat. These definitions, and additional discussion within these two papers, appear to be accurately represented by the following diagram (generated by project lead).



This "water-source" model, relative to the "soils-first" model for defining and differentiating fens, bogs and marshes not only has broader geographic applicability and accuracy, it is also more simple: it does not require dashed lines to indicate that fens can feature mineral soils or that marshes can occur over mucky peat. The "water-source" model also reduces that opportunity for rare or uncommon fen plant species or communities associated with mineral-soiled fens to be denied the same level of management consideration/protection afforded plants species and communities associated with peatland fens.

2. Structural fen types. In the experience of the project lead, there are perhaps four basic structural types of plant communities associated with fen ecosystems: a) short-statured, b) tall sedge, c) shrub and d) forested. In turn, particular plant species, or plant species sets, are often associated with these basic structural types. Transitional communities between these basic types are typical, and two or more basic types are often present within the same wetland system.

Short-statured fen communities are characterized by persistently high water tables, high diversity of graminoids, forbs and bryophytes, and low stature of the vegetation. Height of vegetation in these communities is typically 12-16" or less, even while some included species are generally much taller outside of this community (e.g., *Carex aquatilis*, *Carex utriculata*, *Betula glandulosa*, *Kalmia microphylla*, and several *Vaccinium* and *Salix* species). This is the structural community type in which rare and uncommon vascular and nonvascular plant species, including sensitive species, are most likely to be found. Few-flowered spikerush (*Eleocharis quinqueflora*) is frequently either dominant or abundant among the vascular plants in this community. This is also the basic fen community type that includes the "brown mosses" which typify *rich* and *extremely rich* fens (Hájek et al., 2006; Bedford and Godwin, 2003); examples of brown mosses include species of *Tomentypnum*, *Drepanocladus, Warnstorfia*, *Calliergon*, *Calliergonella* and *Campylium.*

Patch of short-statured fen community at Grande Ronde headwaters meadow (n), La Grande Ranger District

The short-statured fen community appears to be the type of fen community to which Bedford and Godwin (2003) refer in noting that low nutrient availability may underlie "the low stature, distinctive flora, and high species diversity of some rich fen vegetation." This is also the basic fen community type from which most of the project lead's fen indicator species set is drawn. A strong expression of this structural

community type is not especially well represented among the sites visited on Wallowa-Whitman NF. It is best represented among the fens with FIT ≥ 15.

Tall sedge fen communities generally have low species diversity, little moss or forb ground cover, and are often dominated by 30-48" tall *Carex aquatilis* and/or *Carex utriculata*. It currently appears that the soil surface in tall-sedge fen communities is commonly saturated or inundated early in the growing season, but becomes damp, moist or even dry by late summer.

The fen moss *Meesia triquetra* at Cabell Meadow, Whitman Ranger District

Shrub fen communities are often intermediate between short-statured and tall sedge fen communities with regard to species diversity, and likely include a patchy cover of graminoids, forbs and mosses. High early-season water tables commonly dip down towards the end of the growing season, but perhaps not so much as within tall sedge communities. In the Oregon Cascades, *Vaccinium uliginosum* (bog huckleberry) is perhaps the most frequent and abundant species within shrub communities, but is often accompanied by *Betula glandulosa*, *Kalmia microphylla* and various *Salix* species. On Wallowa-Whitman NF, bog huckleberry seems to be rare, at least outside of the Anthony Lake area, while *Kalmia microphylla, Ledum* and various *Salix* species, particularly perhaps *S. eastwoodiae*, are often important taxa.

Forested fens appear to be uncommon within the forests visited to date by the project lead. These generally are areas that, in viewing aerial imagery, have more the character of forest than of meadow. On the ground, however, the wetland character of the site is evident. Persistent groundwater-fed wetness and a moderate level of species diversity (shrubs, graminoids, forbs and bryophytes) may be typical of forested fens. Lodgepole pine (*Pinus contorta*) and/or Engelmann spruce (*Picea engelmannii*) are most commonly present but a variety of other conifer species may be represented as well.

While these basic fen types are largely a product of the project lead's subjective field observations, it is interesting to note that Cooper and Wolf (2006) recognize a rather similar set of fen types in the Sierra Nevada of California. Using TWINSPAN analysis, and after removing basin fens and extremely rich fens, they recognize three basic fen types: 1) tall and dense sedge stands with low diversity, 2) shrub/sphagnum moss fens and 3) sedge/moss fens that they split out into a few-flowered spikerush (ELQU2)/moss fen and a fen type with larger and smaller sedges and forbs such as TRGL5, HYAN2 and MIPR (plant codes defined in Appendix D).

Toeslope fen (background, green) at 43-940 wetland, La Grande Ranger District

A number of larger PNW wetland classification efforts (MacKenzie and Moran, 2004; Kovalchik and Clausnitzer, 2004; Rocchio, 2013) work at the basic level of the plant association, a finer scale than that of structural types. And while it is being proposed here that structural typing can be an intuitive and meaningful part of the field site description process, it must be noted that in the actual practice of time-efficient, initial site visits, the project lead has come to place highest value on efforts, as fully as possible, to develop site-specific comprehensive plant species lists.

3. Field recognition of fens. Efforts at fen recognition in the field sometimes result in an uncertain assessment, and generally require considering multiple lines of evidence including topography, hydrology, site wetness, plant community structure and composition and soil character. Although fens may occupy mid-slope locations, sites in valley bottoms or along toe slopes are particularly well-situated to intercept groundwater flow from adjacent slopes. Favorable topography and soppy soil late in the summer are especially suggestive. If possible, it is very helpful to assess site wetness in late summer. Many fen candidate sites have wet soil in the spring or early summer due to direct, on-site wetting by rain or snow-melt and/or due to surface transport and delivery of rain and melt-waters by laminar or channeled flow, or even seasonal groundwater discharge. In late summer, high water tables are most likely due to proximity to lakes, perennial streams, or to a groundwater aquifer perennially at or near the soil surface. Vegetation is also an important guide in the recognition of fens. While fens may be dominated by shrubs or rarely, trees, most commonly the dominant vegetation is herbaceous and the community structure is that of a meadow, which may have minor inclusion of shrubs or trees. The presence of a vegetative structural-compositional type described in the section above is indicative of a fen ecosystem.

Meadow-edge fen and habitat for the bladderwort *Utricularia minor* at 43-492 meadow, La Grande Ranger District

Fen location also appears to correlate with elevation; most PNW forests visited to date have a lower elevation threshold at which fens generally do not occur. On Wallowa-Whitman NF, this elevation may be about 5000 feet. Finally, while it may not be appropriate to tie the presence of deep, peaty soil to fen recognition (see above), fens on R6 forests visited to date commonly do exhibit such soils. Peaty soils deeper than 40 cm (16 inches) appear to be a universal feature of Wallowa-Whitman sites visited during

this project where at least some local instance of persistent, diffuse groundwater discharge is occurring. R6 forests, where the project lead noted a less robust correlation between soil character and fen designation, include the Umatilla and Okanogan-Wenatchee NFs.

4. Fen indicator taxa. These are taxa that the project lead has consistently detected within fens, especially short-statured fen communities, during his visits to fen candidate sites across multiple national forests within the Pacific Northwest (Appendix G). This list, which is admittedly subjective and always open to edits, seems to be largely applicable across the Cascadian and NE Oregon (Blue Mountain) national forests visited to date, although the incidence of certain species can change geographically. For instance, *Eleocharis quinqueflora*, *Carex jonesii*, *Vaccinium uliginosum* and the mosses *Tomentypnum nitens* and *Meesia triquetra* are more frequently encountered in the Cascadian fens of Oregon than those of Washington. Conversely, *Salix pedicellaris*, *Vaccinium oxycoccos*, *Eriophorum* species and the mosses *Campylium stellatum* and *Calliergon* species appear to be better represented in fens of the Washington Cascades than those of Oregon. Notably, several taxa on this list (*Scheuchzeria palustris* ssp. *americana*, *Drosera rotundifolia*, *Triantha glutinosa*, *Vaccinium oxycoccos* and *Vaccinium uliginosum* appear to be scarcely present or lacking in fens in of the NE Oregon National Forests. With continuing field observations, species that have potential to be added to the current list of FIT include *Salix eastwoodiae*, *Sphenosciadium capitellatum*, *Swertia perennis* and the mosses *Hypnum pratense* and *H. lindbergii*.

The fen indicator taxon *Vaccinium uliginosum* (bog blueberry) at the 73-140 meadow (upper), La Grande Ranger District

5. Biogeography of fen indicator taxa. The Oregon and Washington fen indicator taxa recognized by the project lead (Appendix G) are largely higher latitude, boreal taxa. North American distributions of 12 of these taxa that are generally representative of the group are illustrated in Appendix H (NRCS Plants Database). It's evident from Appendix H that the distributions of the fen indicator taxa have one or more southward extensions into decidedly non-boreal latitudes. For the most part, these southward distributional extensions are possible due to the presence of mountains (e.g., in the western US, the Cascades, Sierra Nevada, Ochoco, Blue and Wallowa Mountains and the Rockies). This seems to be simply another case of the long-standing observation that, at lower latitudes, sites at higher elevations can be climatically similar to sites at higher latitudes. Hence, while at higher latitudes these fen indicator species are components of *boreal fen communities*, in Oregon and Washington, these same species are components of *montane fen communities*. But while the presence of mountains makes the presence of the Oregon and Washington fen communities possible, it is the presence of particular, coincident topographic, geologic and hydrologic features that seem to dictate the distribution of suitable montane fen habitats. Along the Cascade crest and east, this coincidence of fen-enabling features among R6 forests is generally uncommon.

6. Notable sites. For various reasons, a number of the sites visited during this project are particularly notable.

a) Duck Lake fen. This site features a moderate number of FIT as well as good extent of the short-statured fen community type. But this site is special because the fen nearly encircling the Lake appears to be slowly overtopping the Lake and being wetted by the Lake's water table, rather than by a flow-through, gravity-powered subsurface aquifer, as is typical of sloping fens, or of groundwater accumulation that seems to support the so-called basin fens. It would be interesting to test the possibility that subsurface groundwater flow is actually moving through the encircling fen *en route* to the lake. The project lead has elsewhere seen such a fen only at Fish Lake, on the Wenatchee River Ranger District of Okanogan-Wenatchee NF in Washington.

b) Skookum Creek headwaters fen. This fen has a modest 10 detected FIT and 0 "notable" species (as defined for this project), but as of its visit date of 8/7/2014, appears to be a supported by a remarkably broad zone of robust groundwater discharge. Understanding the origin of this particular aquifer would be especially satisfying.

c) Cabell Meadow fen. An outstanding example of a type of toe slope fen that the project lead would love to name (if only he could imagine a good one). Like toe slope fens in general, the base of this type of fen typically occurs at the slope break between a forested side slope and the edge of its adjacent, low-gradient meadow. However, instead of being largely restricted to this toe slope edge, the Cabell Meadow-type fen extends as a soppy-wet swath well up into the otherwise forested slope. This type of sloping fen was encountered regularly during the course of this project.

d) Davis Creek meadows. In far SW corner of lowest meadow in group is a borderline fen remnant. A few shoots of the fen-loving mosses *Tomentypnum nitens* and *Meesia triquetra* were detected here on apparent peat 50+" thick. Even though small pools of shallow water were nearby, it was not evident that the peaty habitat of these two mosses was still persistently wetted by groundwater. Similar to multiple smallish fens just a few miles to the west in the upper Trout Creek Meadows of Umatilla NF, this Davis Creek peatland appears to be losing its fen character as a result of reduced groundwater input.

e) Friday Meadow. With a less than optimal NWI classification a PEMC, and aerial imagery indicating possible strong riparian influence, this site, with substantially the largest number of FIT and "notable"

species among all other project sites, was quite a surprise, and continuously interesting to explore. Its surpassing richness in FIT and "notables" can at least in part, be explained by the great heterogeneity of hydrologic environments within the meadow.

Meadow-edge fen rich in the fen indicator moss *Tomentypnum nitens*, Friday Meadow, La Grande Ranger District

7. Distribution of fens. Although very little exploration was conducted within the Eagle Cap Wilderness, it appears likely that Forest-wide, the highest incidence and density of both fens, and fens rich in sensitive and other "notable" plant species, occurs in the northern half of Whitman Ranger District, and the adjacent far southern portion of La Grande Ranger District, on the Forest's west side. These west side sites represented 57% (20/35) of all 35 project sites, but accounted for 82% (51/62) of all detected occurrences of "notable" species. Moreover, these sites accounted for all detections of the documented or suspected fen-loving species *Vaccinium uliginosum* (5), *Saxifraga oregana* (10), *Swertia perennis* (4), *Tomentypnum nitens* (5), *Splachnum sphaericum* (2), *Meesia uliginosa* (1), *Lophozia gillmanii* (1) as well as seven of the eight project detections of *Hamatocaulis vernicosus*. When present, the occurrence of the easily detectable *Vaccinium uliginosum*, *Saxifraga oregana* and *Tomentypnum nitens* give the project's "west side" fen plant communities a much more Cascadian feel than is typically experienced in the project's "east side" fens.

8. Site condition. Intensive soil disturbance in fens due to hooves of cattle caught the project lead's attention at only four sites. The impacts at upper and lower West Eagle Meadow, while not necessarily acceptable, are however, fairly localized. Extreme cattle-caused soil impacts were observed at the Makin Creek and Rich Creek sites, each of which appeared to feature soils only seasonally wetted by groundwater discharge. The Makin Creek site, very much the larger of the two sites, is exclosed by fencing, but the fencing is in disrepair and the cattle have clearly had unimpeded access to the seasonally wet soils for multiple seasons. It was relatively common, within many of the fens with higher numbers of FIT, to see soil impacts due to moose. This typically was hoof pits in wet peat, but includes areas where patches of moss (in short-statured communities) have been plucked and scattered like divots at a golf tee. Moose also seem likely to be responsible for the not uncommon wallows that have been established in persistently wet peat. The project lead knows from visiting fens within active grazing allotments in numerous national forests in both Oregon and Washington that the persistent or long-extended periods of groundwater supported soil saturation associated with these wetlands causes their soils to be highly susceptible to pitting, pedestal formation and loss of vegetative cover due to hoof impacts. Input of manure and urine into communities adapted to low nutrient conditions is also cause for concern. Based on this experience, the project lead has come to regard fens as habitats that are manifestly unsuitable to livestock grazing.

The fen indicator taxon *Eriophorum gracile* (slender cottongrass) at headwaters Skookum Creek meadow, Hell's Canyon Ranger District

9) Fens as unique ecosystems. Some familiarity with fens and fen-like ecosystems should cause hesitation in accepting their inclusion as "riparian" landscape features. The composition of plant communities included within these ecosystems is largely distinct among plant communities across the landscape of Wallowa-Whitman NF, and across the landscape of Oregon and Washington, along and east of the Cascade crest. With some notable exceptions (e.g., apparently the Duck Lake fen) this distinctness appears to be very much tied to the community water source being primarily *nutrient-poor groundwater*, near the source of its initial, diffuse, surface/near surface discharge. The project lead's current concept is that fens and fen-like ecosystems may or may not contribute surface water output to riparian systems, but they do not receive significant amounts of water from these systems. A meadow that is regularly wetted by relatively *nutrient-enriched, surface-sourced* riparian water – often by means of seasonal or episodic channel flooding - will not support the plant communities associated with fens and fen-like ecosystems (Bedford and Godwin, 2003). With this view, the project lead would offer that fens and fen-like ecosystems are not just habitats that may support notable numbers of rare or uncommon plant species, but are themselves biophysically distinct, variously rare or uncommon *groundwater-supported ecosystems* that in their own right, merit recognition and appropriate restorative or protective management.

10. Follow-up. Several opportunities for furthering the understanding and management of groundwater ecosystems on Wallowa-Whitman NF have become evident during the course of fieldwork on this project:

a) Number and geographic extent of site visits. Thirty-five sites were visited in the course of this project, but nearly 70 candidate sites were identified during the project's pre-field analysis. The decision to visit a given site was based on pre-field evidence of persistent groundwater discharge, but also on on-Forest experience such as field-testing of NWI classifications, field-testing of pre-field NAIP imagery interpretations, better understanding of site accessibility as influenced by road conditions, road closures and driving and hiking times, and time invested at each site visited. The project lead was largely able to visit the sites assigned highest priority (i.e., highest potential) either during pre-field analysis or after experience in the field. However, a more satisfying understanding of the character and amplitude of Wallowa-Whitman ecosystems largely dependent on diffusely-discharging groundwater will await the opportunity to continue visiting candidate fen sites on the Forest. This will include additional sites in all Districts, but perhaps especially in the central and northern portions of the La Grande (west), southern Whitman (west), Eagle Cap Wilderness, northern Wallowa Valley and central and northern Hells Canyon District.

b) Fen plant community descriptions. More comprehensive plant lists for the more robust, FIT-rich (say, ≥15) Wallow-Whitman fens would be very useful in better characterizing these relatively rare and important biophysical landscape features. The plant lists developed for each site (Appendix B) frequently provide only a genus code. Some of the more troubling of these are AGROS2, DODEC, JUNCU, MIMUL, PLATA2 and SPHAG2.

c) Soils characterization. Use of a fiberglass soil probe during site visits allows a very economical characterization of site soils. However, a more accurate/defensible soil characterization would be extremely welcomed. A case for recognizing fens based on water source and vegetation, rather than soil properties, has been presented in this report. Nevertheless, accurate characterization of soils at recognized fen sites, perhaps especially those in Group 2 (Appendix F) with a notable inorganic

component, would be a highly important part of the characterization of these sites, as well as in continuing to develop the understanding of the fen-soil relationship in Oregon and Washington.

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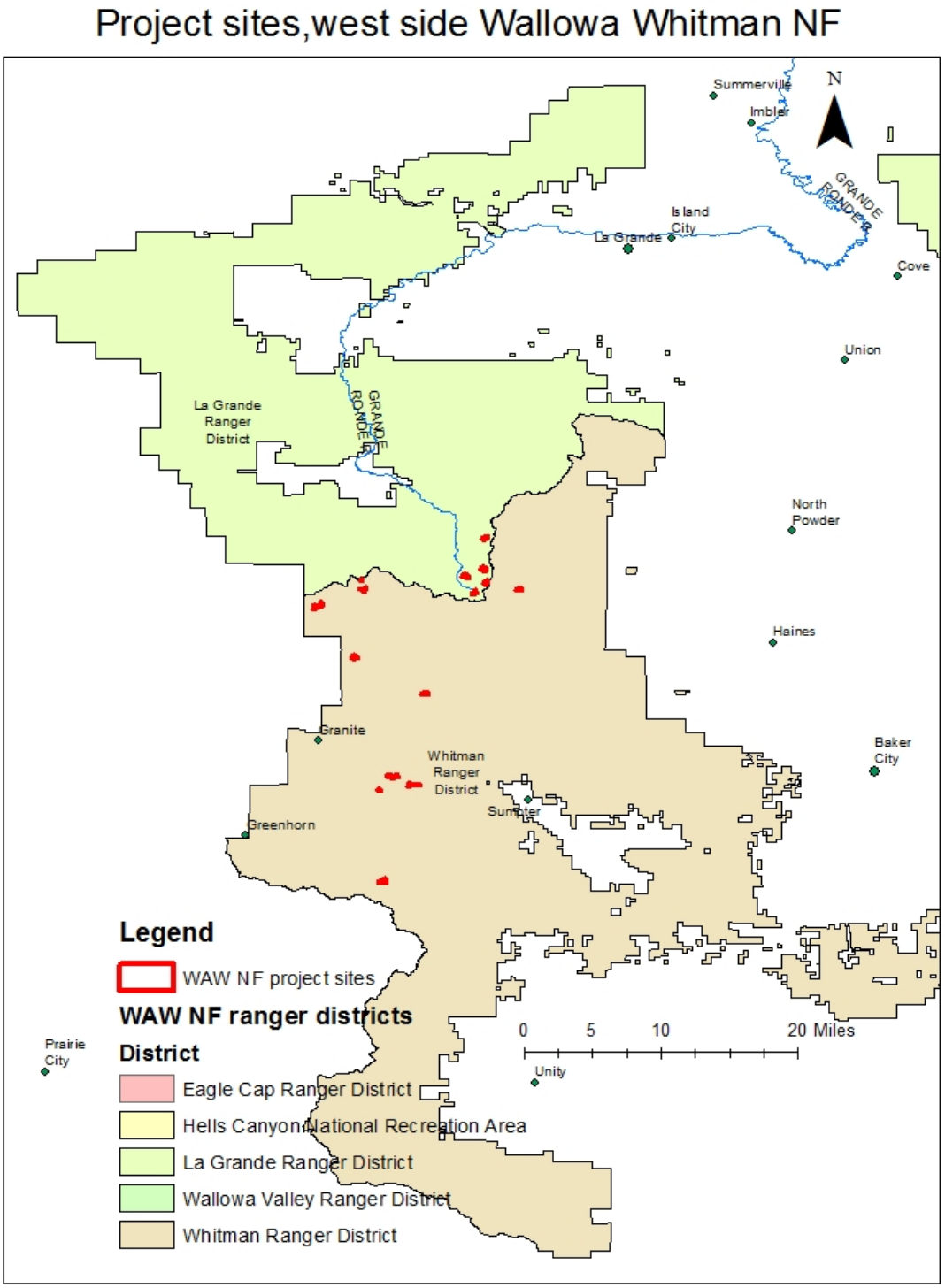
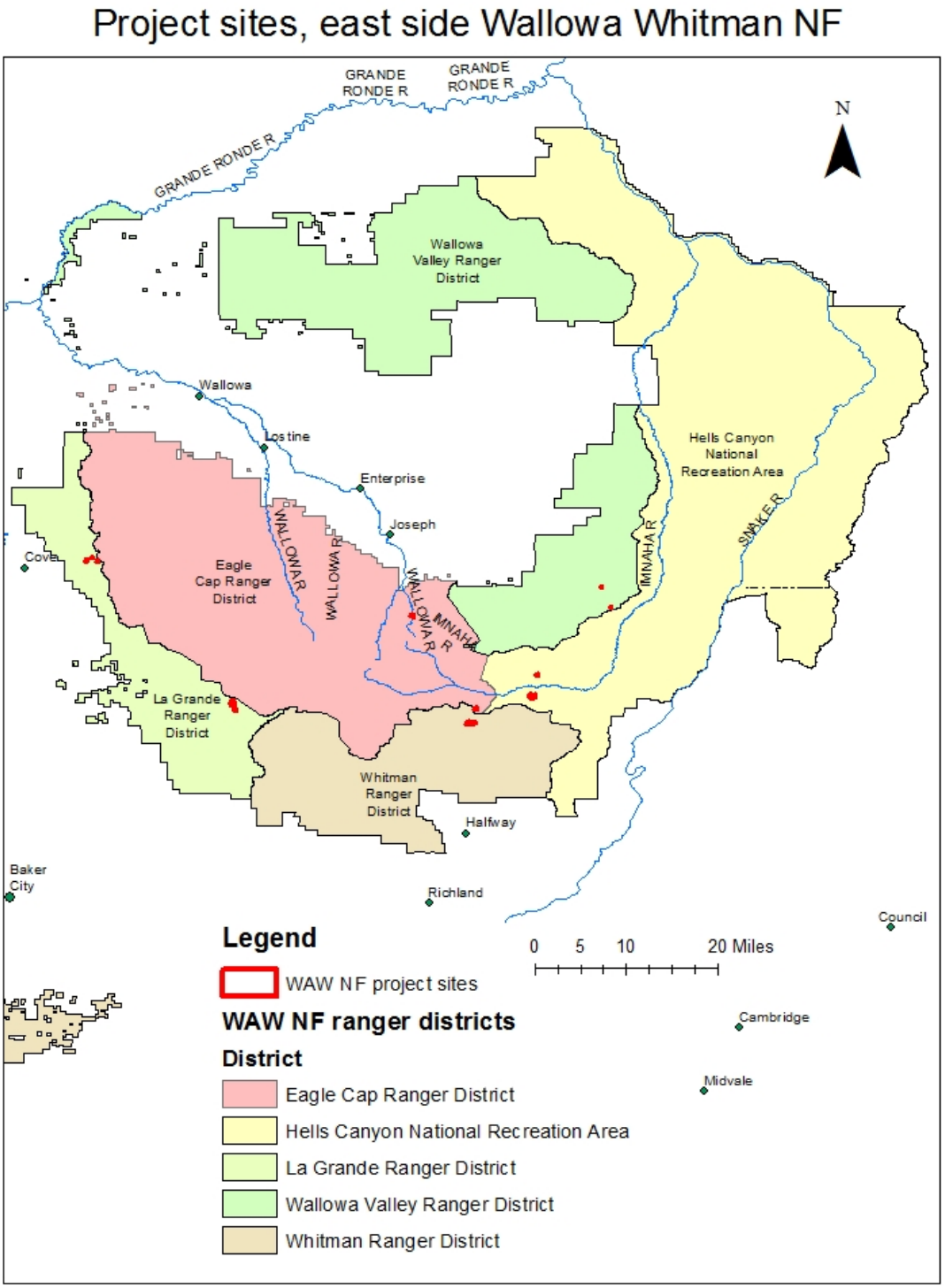
Appendix A – Fen candidate sites visited during this project.

Ranger District	Site Name
Whitman (east)	
	66-410
	66-410 (upper)
	66
	Russell Mountain
Hells Canyon	
	Duck Lake
	Skookum Creek headwaters
Wallowa Valley	
	Rich Creek
	Makin Creek
Eagle Cap	
	East Fork Wallowa River
La Grande (east)	
	Mt. Fanny Spring
	6220/6220-500
	6220-500 (north)
	6220-500 (south)
	West Eagle Meadow (upper)
	West Eagle Meadow (lower)
Whitman (west)	
	1040-040
	Haystack Meadow (east)
	Haystack Meadow (west)
	7375-020
	Mahoney Meadows (west, upper)
	Mahoney Meadows (west, lower)
	Mahoney Meadows (east)
	Baldy Creek (tributary)
	Cabell Meadow
	Davis Creek
	Hoodoo Creek
	5185-010
	Grande Ronde River headwaters (south)
	73-140 (upper)
	73-140 (lower)
La Grande (west)	
	Grande Ronde River headwaters (north)
	Grande Ronde Lake
	Friday Meadow
	43-940
	43-942

Appendix B – Distribution of fen candidate sites visited on WAW NF.



Appendix B (cont.)



Appendix C - Site descriptions (codes of fen indicator taxa are in bold). Species codes are defined in Appendix D and are from the USDA NRCS Plants Database (http://plants.usda.gov).

Whitman Ranger District (east)

1. 66-410 meadow
Elevation: 6800 feet
TRS: T6S, R46E, S9
Date: 8/5 – 8/6/2014
Rationale: NWI PEMC, PFOA, PEMF
Plants: Graminoids – **CAUT**, CASCB, CACA11**, ELQU2**, JUNCU, AGROS2, MUFI2, **JUEN**, CALU7, DECE, JUOR
Forbs - **METR3**, **UTMI**, **PEGR2**, **DODEC**, **SPRO**, EQAR, **HYAN2**, TRIFO, MIMUL, DELPH, **PLATA2**, PAFI3, ARNIC, EPILO, VALER
Shrubs - LEDUM, **KAMI**. SALIX
Bryophytes – **CAST51**, **CAST70**, **WAEX**, **SPHAG2**, AUPA70, PHFO6, BRPS70, BRWE70, MAPO16
Soil probes: Probe amidst shallow UTMI pools with emergent ELQU2 = resistant organic soil with minor inorganic component to firm base at 48"; probe in soppy wet far SW corner of meadow = low density organic soil to 50+".
Notes: Access by driving to end of 66-410 road, shortly west of Fish Lake; meadow is immediately adjacent to road, along its northern edge. Although classified as NWI PEMC, PFOA and PEMF, NAIP imagery suggested significant portion of meadow may actually be PEMB. This meadow features a more or less continuous array of short-statured fen communities situated along the groundwater-rich northern and western edges. These communities include more than a dozen FIT, perhaps most notably the lesser bladderwort *Utricularia minor* (UTMI; very rare in eastern OR) and star-moss, *Campylium stellatum* (CAST51 – very rare in OR).
Photos: 1918, 1919, 1920, 1921.

2. 66-410 meadow (upper)
Elevation: 6900 feet
TRS: T6S, R46E, S8
Date: 8/6/2014
Rationale: Incidental (large meadow, detected in NAIP; very proximate to #1 above.
Plants: Graminoids – **ELQU2**, CAREX, DECE
Forbs – POBI6, **PEGR2**
Bryophytes – AUPA70
Soil probes: None attempted in meadow's predominantly dry, mineral soils.
Notes: Access from end of 66-410 road along short trail climbing to west. Although classified as NWI PEMC, NAIP imagery suggested that at least some portion of meadow may actually be PEMB. A large seasonally wet meadow with mineral soils and well developed, mostly now dry ,

seasonal water channels. Small area of damp soil at upper southern end of meadow, where plants listed above were detected.
Photos: None.

3. 66 meadow (immediately west of 66 road, just north of Fish Lake)
Elevation: 6800 feet
TRS: T6S, R46E, S9
Date: 8/6/2014

Rationale: NWI PEMC
Plants: Graminoids – **ELQU2**, CASCB, DECE, JUOR, **CAEC**, JUEN, MUFI2, **CAUT**, **CAJO**, CALU7
Forbs – ASFO, **PEGR2**, **PLATA2**, TRIFO, EQAR, MIMUL, **DODEC**, **SPRO**, **UTMI**, **HYAN2**, GENTI
Shrubs – **KAMI**, LEDUM
Bryophytes – AUPA70, BRPS70, **CAST51**, PHFO6, **SPHAG2**
Soil probes: Probe at UTMI site along northern edge of main meadow = dense soil with notable inorganic component to firm base at 34".
Notes: Direct access to meadow from W side of 66 road, shortly N of Fish Lake. Meadow consists of a main portion with a central, emergent sedge zone, and a narrow western lobe. Although classified as NWI PEMC, NAIP imagery suggested significant portion of meadow may actually be PEMB. Meadow with robust groundwater feed resulting in large areas of pooled water or slowing moving shallow surface water. Main portion of meadow slopes gently to east where a small output channel collects water from a diffuse network of small, weakly developed meadow channels. As at the 66-410 meadow, the flora of this meadow is particularly notable due to the presence of the lesser bladderwort *Utricularia minor* (UTMI; very rare in eastern OR) and star-moss, *Campylium stellatum* (CAST51 – very rare in OR).
Photos: 1922.

4. Russell Mountain meadow
Elevation: 7000 feet
TRS: T6S, R46E, S4
Date: 8/6/2014
Rationale: NWI PEMC, PEMA
Plants: Graminoids – DECE, JUNCU, CASCB, **CAJO**, CALU, MUFI2, **ELQU2**, AGROS2, **CAUT**, CACA11, DANTH
Forbs – GENTI, **SPRO**, ASFO, **PEGR2**, **DODEC**, MIMUL
Shrubs – LEDUM
Bryophytes – AUPA70, **SPHAG2**, BRPS70, RIBE, **WAEX**, **CAST70**, PHFO6

Soil probes: Single probe in primary, but small patch of short-statured fen community within site = low density organic soil to firm base at 48".
Notes: Access via the 66-450 road to lookout tower, hiking W along ridge top trail, then dropping N down trail-less steep slope to meadow. Although classified as NWI PEMC and PEMA, NAIP imagery suggested significant portion of meadow may actually be PEMB. Except for 1) ELQU2/WAEX-CAST70 community mid-way along southern edge of meadow (which is receiving shallow groundwater input), 2) edges of active channels and ponds and, 3) marsh at far NE corner of meadow, most of this meadow is moist or dry-soiled at time of visit. Water level in ponds and channels indicates that groundwater underlies this meadow, but at a depth of 12-18", too deep for mosses and perhaps, many forbs. Large number of dry or drying ponds, hollows and channels within meadow suggest that meadow is typically very wet earlier in season. The long, steep, north-aspect slope immediately adjacent to the southern edge of the meadow likely provides abundant ground and surface water to the meadow each spring.
Photos: 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930.

Hell's Canyon Ranger District

1. Duck Lake meadows
Elevation: 5500 feet
TRS: T5S, R47E, S29, 30
Date: 8/5/2014
Rationale: NWI PEMC and PEMF; multiple FIT CPNWH records.
Plants: Graminoids – AGROS2, DANTH, **JUNE**, CABU6, **CAUT**, CALAA, DECE, CASCB, JUOR, PHLEU, **ELQU2**, MUFI2, LUCA2, CACA11, **CAEC**, **CALI7**, **ERGR8**
Forbs - ASFO, ANTEN, COPA28, NUPHA, **METR3**, SPARG**, PEGR2**, EQAR, VERAT, EPILO, BOTRY, **MIPR**, UTMA, **SPRO**, **DRAN**, **UTMI**
Shrubs - ALNUS, RHAL, SALIX
Bryophytes – AUPA70, BRPS70, **CAST70**, **HAVE70**, **SPHAG2**
Soil probes: Probes in the somewhat wetter, southern half of the lowest, larger meadow indicate organic soil to a depth of 50+". A several inch-thick layer of very dense, apparently organic soil, begins at a depth of 32-36". Probe within the short-statured fend community at the northern edge of the Lake found very low-density organic soil (probe could be conducted with a single hand) to 50+".
Notes: Access via the 3980-160 road. Although classified as NWI PEMC and PEMF, NAIP imagery suggested significant portion of meadows may actually be PEMB. Primary survey targets were Duck Lake itself, and immediately west of the Lake, a chain of three progressively larger meadows, draining from north to south. Soil in southern-most and largest of these three meadows is generally very wet but less wet areas are interspersed, and plants species diversity is moderately high. The wettest soils are sedge-dominated with little or no bryophyte and forb presence. Notable sedges include *Carex lasiocarpa* var. *americana* and *C. buxbaumii*. The

upper two meadows are more uniformly wet, with much standing water and relatively low plant species diversity. *Utricularia macrorhiza* is present in each of these meadows. Groundwater flow does not appear to be the primary basis for the notable wetness of these meadows. All three meadows appear to be the products of lake-to-meadow vegetational succession with deep, peaty soils. Duck Lake itself appears to be undergoing this same type of vegetational succession. The Lake is nearly entirely bordered by a peaty-soiled, short-statured fen community, which, particularly along the northern edge of the Lake, is clearly overtopping the Lake as a quaking mat of vegetation and underlying peat. This short-statured fen community includes a dozen or so FIT with such notables as UTMI, DRAN, ERGR8, CALAA, CALI7, and HAVE70. Records available through the Consortium of PNW Herbaria website indicate that multiple botanical surveys have occurred at this site; the rare (in Oregon) CALAA is previously documented at this site. The overtopping peat mat at the Lake in itself makes this a very notable biophysical site.
Photos: 1915, 1916, 1917.

2. Headwaters Skookum Creek meadow
Elevation: 6050 feet
TRS: T5S, R47E, S17
Date: 8/7/2014
Rationale: NWI PEMB
Plants: Graminoids – PHLEU, JUOR, **ELQU2**, MUFI2, **JUEN**, CALU7, **CAUT**, **CAJO**, **ERGR8**, CASCB
Forbs – VERAT, TRIFO, EPILO, EQAR, **PLATA2**, **PEGR2**, **SPRO**, MIMUL
Bryophytes – **DRAD2**, CAGI70, BRWE70, **PLEL2**, BRPS70
Soil probes: Depth of organic layer ranging from 20-50+" in soppy-wet portion of main body of meadow, and 38" in soppy-wet portion of upper, narrower part of meadow.
Notes: Access via the 3925 road Meadow +/- triangular in shape, with a lower, southern base tapering to the upper, northern top. Meadow slopes gently downward to both south and east. A large, very soppy-wet area occupies much of the southern half of the meadow, and smaller soppy-wet area occurs near the top of the meadow. Seasonal drainage from the meadow occurs from its southeastern corner. Lower soppy-wet area dominated by ELQU2/WAEX-CAGI70, while upper soppy-wet area dominated by ELQU2 with abundant low-statured CAUT. No sensitive species were detected in this meadow, and only a moderate number of FIT were noted. However, this meadow is special regarding the broad area over which very robust, diffuse groundwater discharge occurs.
Photos: 1933, 1934, 1935, 1936.

Wallowa Valley Ranger District

1. Rich Creek (upper)
Elevation: 5500 feet

TRS: T4S, R47E, S1
Date: 8/7/2014
Rationale: NWI PEMB
Plants: Graminoids – SCMI2
Forbs – VERAT, TRIFO
Bryophytes – PHFO6, MAPO16, BRPS70, AUPA70
Soil probes: None attempted.
Notes: Meadow accessed via the 3935 road. Soil in SW corner of this small meadow still damp-wet, but elsewhere, dry. Southern end of meadow densely hoof-pitted; stubble height between 2-3". Recognizable flora indicates the presence of modest, seasonal groundwater discharge at this heavily over-utilized (grazing) meadow.
Photos: None.

2. Makin Creek (upper)
Elevation: 5400 feet
TRS: T30S, R47E, S25
Date: 8/7/2014
Rationale: NWI PEMB
Plants: Graminoids – None recognizable.
Forbs – VERAT
Shrubs – ALNUS, SALIX
Bryophytes – PHFO6, MAPO16, BRPS70
Soil probes: None attempted.
Notes: Access via 3935-380 road. Seasonal diffusely discharging groundwater at the SW corner of meadow is being collected in a small, constructed pond. A seasonal spring channel exists in the SE corner of the meadow. Meadow is fenced but fence is in disrepair. Grazing, trampling and hoof-pitting within the seasonally wet, upper (southern) portion of meadow is both extensive and very intensive.
Photos: 1937.

Eagle Cap Ranger District

1. East Fork Wallowa River meadow
Elevation: 7150 feet
TRS: T4S, R45E, S9, 16
Date: 8/8/2014
Rationale: NWI PEMC, PEMA
Plants: Graminoids – **ELQU2**, **CAUT**, CASCB, PHLEU, AGROS2, **CAJO**, DANTH, JUNCU, **CAAQ**

Forbs – ALVA, ASFO, EQAR, COPA28, SETR, **PLATA2**, MIMUL, **PEGR2**, ARNIC, DELPH, **DODEC**, CASTI, ANTEN, GENTI, **SPRO**, VIOLA
Shrubs – SALIX, LEDUM
Bryophytes – AUPA70, PHFO6, **DRAD2, PLEL2**, **HEBL2**, MAPO16, BRWE70, BRPS70, **SPHAG2, WAEX,** HYOC5

Soil probes: In gently sloping fen at far SE corner of wetland system, pure organic soil to first obvious inorganic layer at 36". Squishy wet community along southern 1/3 of western edge = organic soil with minor, fine-grained inorganic component to first obvious inorganic layer at 38". Soppy soil in zone of lateral wetting from W to E-flowing creek midway along western edge = organic soil with sparse fine-grained inorganic component to at least 48" (low density after breaking through resistant thin layer at 24").

Notes: Access via hiking trail that continues on to Aneroid Lake. Although classified as NWI PEMC and PEMA, NAIP imagery suggested significant portion of meadow may actually be PEMB. Large area of meadow and lightly forested wetland was surveyed, most of it on west side of E. Fork Wallowa River. Best expression of gently sloping groundwater rich fen encountered just off trail, east of E. Fork Wallowa River at far SE corner of wetland complex. This is only site where HEBL2 and DRAD2 detected. In the main meadow, west of the River, several wet-soiled sites were encountered, including a linear zone wetted by lateral flow from the south-most of two small creeks flowing west-to-east midway along the western edge of the meadow, and a steep seepy toeslope that feeds this (and an adjacent small creek). Numerous small, inactive drainage routes and drying pools indicate that the main meadow is very wet seasonally, but overall, groundwater does not appear to have a strong influence on the composition of meadow vegetation. The two adjacent east-to-west flowing small creeks within the main meadow are notable in the each flows along an elevated bed (12-18" above the adjacent meadow), apparently due to incremental filling by continuously adjacent, essentially pure mats of *Sphagnum* moss.

Photos: 1938, 1939-1941, 1942, 1943, 1944.

<u>La Grande Ranger District (east)</u>

1. Mt. Fanny Spring meadow

Elevation: 6850 feet
TRS: T3S, R41E, S9
Date: 8/9/2014
Rationale: NWI PEMC
Plants: Graminoids – **CAJO**, CASCB, PHLEU, MUFI2, **ELQU2**, LUCA2, CALU7, JUNCU, **JUEN**, AGROS2
Forbs – **DOJE**, RAGO, POBI6, TRIFO, MIMUL, **PEGR2**, VERAT, ASFO, EPILO, DELPH, **PLATA2**, POTEN
Bryophytes – BRWE70, PHFO6, **DRAD2**, BRPS70, AUPA70, DIPA20, RICCI

Soil probes: Near soppy DRAD2 site soil with notable inorganic content ("scratchy") to 24", then scratchier-yet to firm base at 40".
Notes: Access via 6220 (meadow is immediately adjacent to east). Although classified as NWI PEMC, NAIP imagery suggested significant portion of meadow may actually be PEMB. A central, sloping, groundwater-fed soppy-soiled area occupies 20-25% of total meadow area. A weak presence of FIT, but occurrence of DRAD2, CAJO, and DOJE is notable.
Photos: None.

2. 6220/6220-500 meadow
Elevation: 6800 feet
TRS: T3S, R41E, S9
Date: 8/9/2014
Rationale: NWI PEMC
Plants: Graminoids – CASCB, CALU7, MUFI2, **CAJO**, **ELQU2**
Forbs – **DOJE**, RAGO, ASFO, POTEN, TRILO
Bryophytes – BRWE70, PHFO6
Soil probes: None attempted.
Notes: Access via 6220 (meadow is immediately adjacent on east side of road). Although classified as NWI PEMC, NAIP imagery suggested significant portion of meadow may actually be PEMB. Meadow soils generally not wet enough to support robust ground cover of mosses, which are mostly sparsely distributed, small and dehydrated. Groundwater-loving vascular plants found at Mt. Granny Springs meadow, such as ELQU2 and CAJO, are present but poorly represented. Highest soil moisture within meadow found along creek that enters from S and meanders along SE portion of meadow, and an area of apparent seasonal groundwater feed on the western edge of meadow (where the only easily recognizable mosses, BRWE70 and PHFO6, were detected).
Photos: None.

3. 6220-500 meadow (north)
Elevation: 6700 feet.
TRS: T3S, R41E, S8
Date: 8/9/2014
Rationale: NWI PEMC
Plants: Graminoids – DECE, CASCB, CALU7, **CAJO**, MUFI2, LUCA2, **ELQU2**
Forbs – VERAT, **DOJE**, TRIFO, **MIPR**, **SPRO**, DELPH, EPILO, RAGO, **PEGR2**, EQAR, POTEN
Shrubs – SALIX
Bryophytes – AUPA70, PHFO6, DIPA20, PELLI, CHPO14, **DRAD2**, **WAEX**, BRPS70, MAPO16, BRWE70, HYOC5

Soil probes: Deepest soil in SE portion of meadow at site of robust, emergent WAEX where apparent pure organic to firm base at 38".
Notes: Meadow visible from and very shortly south of 6220-500 road. Although classified as NWI PEMC, NAIP imagery suggested significant portion of meadow may actually be PEMB. Multiple robust groundwater discharge areas exist within this topographically varied meadow. While only a modest number of FIT were detected, this meadow is the most botanically diverse (somewhat more so than Mt. Fanny Spring meadow) of the four meadows visited in the Mt. Fanny area. Its small-scale biophysical diversity makes this a very interesting meadow to explore.
Photos: 1947.

4. 6220-500 meadow (south)
Elevation: 6600 feet
TRS: T3S, R41E, S8
Date: 8/9/2014
Rationale: NWI PEMC
Plants: See below.
Soil probes: Efforts largely rebuffed by high density of relatively dry soils.
Notes: Accessed via short walk down active channel from #3 above. Although classified as NWI PEMC, NAIP imagery suggested significant portion of meadow may actually be PEMB. Surprisingly, floristic composition is quite similar to much wetter meadow above (#3). Wet soils largely restricted to multiple shallow depression in southern portion of this meadow. Only a single sparse occurrence of ELQU2 detected, and very little PEGR2 and SPRO noted as well. This is largely a seasonally (apparently briefly) wet meadow.
Photos: None.

5. West Eagle Meadow (upper)
Elevation: 5500 feet
TRS: T5S, R43E, S31, 32
Date: 8/26/2014
Rationale: NWI PEMC
Plants: Graminoids – **JUEN**, PHLEU, **CAUT**, **CAAQ**, LUCA2, JUOR, CASCB, MUFI2, **ELQU2**, JUBA**, ERGR8**, **JUNE**, CALU7, SCMI2
Forbs – **PEGR2**, **SPRO**, VERAT, EQAR, ASFO, EPILO, **PLATA2**, **HYAN2**, POOC2, **DODEC**, MIMUL, PAFI3, DELPH
Shrubs – SAEA
Bryophytes – BRPS70, BRWE70, **DRAD2**, **PLEL2**, MAPO16, AUPA70, **METR70**, PHFO6, **HEBL2**, BRFR70, **WAEX**

Soil probes: Probes in soppy wet communities in SE portions of meadow, that include groundwater-loving taxa such as DRAD2, METR70 and ERGR8, indicated organic soil layers ranging in thickness from 40-50+".
Notes: Meadow accessed by a short walk north from parking lot at northern extent (before looping to south) of 77 road. Although classified as NWI PEMC, NAIP imagery suggested significant portion of meadow may actually be PEMB. This is a large meadow with a variety of hydrological settings and a respectable number of FIT. Most of the FIT are associated with three spatially distinct short-statured fen communities located just below midpoint along the eastern edge of the meadow, at the far northern end of the main meadow, and on the lower portion of a seepy treeless slope on the NW edge of the meadow. Each of these SSFCs appears to be persistently wetted by toeslope groundwater discharge. These SSFCs include all, or most of, the following groundwater-loving FIT: ELQU2, METR70, HEBL2, ERGR8, and a DREPA3 species (DRAD2 or WAEX). Intense, (over-)utilization by cattle noted only at far northern end of meadow.
Photos: 1998, 1999, 2000, 2001, 2002, 2003.

6. West Eagle Meadow (lower)
Elevation: 5400 feet
TRS: T6S, R43E, S6
Date: 8/27/2014
Rationale: NWI PSSA
Plants: Graminoids – **ELQU2**, LUCA2, MUFI2, PHLEU, **CAUT**, JUBA, **JUEN**, **CAAQ**, CASCB, DECE, **ERGR8**, **CASI2**, CALU7, SCMI2
Forbs – POOC2, **PEGR2**, TRIFO, EPILO, **SPRO**, MIMUL, EQAR, **PLATA2**, DELPH, ALVA, LUPIN, **HYAN2**
Shrubs – SALIX, ALNUS
Bryophytes – PHFO6, MAPO16, AUPA70, **DRAD2**, **METR70**
Soil probes: None conducted.
Notes: Access via short walk on west bearing from 77 road. Although classified as NWI PSSA, NAIP imagery suggested significant portion of meadow may actually be PEMB. This is a smallish meadow (200+ m long by mostly < 80 m wide), sloping both N to S, and W to E. Few instances of wet soil were detected in N half of meadow. The S half of the meadow was generally soppy-wet, with groundwater discharge occurring along much of the western edge, and numerous shallow, poorly defined channels carrying low volumes of this water slowly towards West Eagle Creek, which flows along the E edge of the meadow. Vegetation of N half of meadow is dominated by tallish sedge and grass; vegetation in the S half is less tall, includes much less grass cover (although DECE appears to be restricted to this half), and more forbs and mosses. Virtually all of the FIT noted above occur exclusively in the S half of the meadow. Intensive soil pitting by hooves of cattle occurs locally, but cattle seem inclined to pass through, rather than dwell, in the S half of the meadow.

Photos: 2004.

Whitman Ranger District (west)

1. 1040-040 meadow
Elevation: 4350
TRS: T10S, R36E, S30
Date: 8/11/2014
Rationale: NWI PEMB (eastern half)
Plants: See below.
Soil probes: None attempted in generally dry, firm, inorganic soil.
Notes: Access via 1040 road and walking in on 040 road. This is an early seasonally wet meadow. Dampest portion of meadow at time of visit was SE corner, although soils here locally moist, at best. Dry and brown vegetation noted include VERAT, PHLEU, MADIA, JUBA, DREPA3, FONTI. Old Cabin Spring, just S of the 040 road, shortly S of its junction with 1040 road, is a soppy, sloping seep at time of visit. Has been fenced, but fence is in disrepair and cattle are regularly inside. Noted species include CAAU3, JUBA VERAT, PLATA2, BRPS70. Most sedge tops were grazed-off, but a single intact plant appeared to be CAAQ.
Photos: 1950.

2. Haystack Meadows (e)
Elevation: 5300 feet
TRS: T9S, R36E, S20, 21
Date: 8/11/2014
Rationale: NWI PEMB
Plants: Graminoids – DECE, PHLEU, JUBA**, CAUT**, **JUEN**, SCMI2, **CAEC**, **CAAQ**, **ELQU2**, **CAJO**, LUCA2
Forbs – VERAT, RUMEX, **PLATA2**, **PEGR2**, **HYAN2**, POOC2, **DOJE**, EQAR, TRIFO, EPILO, **SPRO**, **SAOR2**
Shrubs – ALNUS
Bryophytes –BRPS70, PHFO6, FONTI, AUPA70, **HEBL2**, **PLEL2**
Soil probes: One probe below 24 road (where moist enough to allow probe) = strong inorganic component to sandy firm base at 13". Probe in soppy HEBL2 community above 24 road = smooth organic to first evidence of inorganic component at 36", then higher density to 50+".
Notes: Direct access as 24 road bisects this meadow. Soil below 24 road never more than damp, but presence of ten FIT indicates presence of seasonal groundwater discharge. Evident persistent groundwater-fed soppiness in upper 2/3s of meadow above 24 road. Much of this soppy soil is occupied by short-statured fen community which includes HEBL2. PHFO6 and HYAN2 = dominant cover in the SSFC. Habitat seems perfect for TONI70, but none detected.
Photos: 1951.

3. Haystack Meadow (w)
Elevation: 5200 feet
TRS: T9S, R36E, S20
Date: 8/11/2014
Rationale: NWI PEMB
Plants: Graminoids – JUBA**, CAAQ, CAJO**, PHLEU
Forbs - MADIA, VERAT, **PEGR2**, **HYAN2**
Bryophytes – PHFO6, **PLEL2**
Soil probes: None attempted.
Notes: Access via short walk S from 24 road. Bit of damp soil in NE corner of meadow, and wet soil along ~30m-long seepage channel in lower part of meadow. Otherwise, soils in this early seasonally wet, rather steep-sloped, *Madia*-scented meadow were dry and hard at time of visit.
Photos: None.

4. 7375-020 meadow
Elevation: 5800 feet
TRS: T9S, R35 ½ E, S25; T9S, R36E, S30
Date: 8/11/2014
Rationale: NWI PEMB
Plants: Graminoids – SCMI2, **JUEN**, CAPE42, **CAUT**
Forbs – VERAT, EQHY, EQAR, **HYAN2**, **PEGR2**, **PLATA2**
Bryophytes –BRPS70, AUPA70, **DRAD2**
Soil probes: Probe in SE meadow = 50+" pure organic soil; residue on probe indicates that soil column is not especially wet.
Notes: Access by parking near junction of 7375 and 020 spur and walking short distance east on 020 road to enter NW meadow. This site consists of two closely proximate NWI PEMB meadows (NW and SE). An excavated pond sits at the western edge of the NW meadow, bordered by SCMI2; sparse EQHY, JUEN and BRPS occur in a dry drainage channel from the pond. Most of the NW meadow cover is VERAT on dry, hard soil. The SE meadow seems to be perfectly flat around edges and perhaps overall a bit concave. Meadow cover is predominantly CAUT ringed by +/- *Calamagrostis*. There is very little ground cover beneath the dense stand of sedge and grass. Soil moist-damp except soft and wet in depressed central portion of meadow. SE meadow seems likely to be a small lake that has undergone successional fill-in. Groundwater may not be an important source of moisture within this meadow. A shallow, weakly defined drainage course runs NE from the N end of the meadow.
Photos: None.

5. Mahoney Meadows (w, upper)

Elevation: 5100 feet
TRS: T9S, R36E, S19
Date: 8/11/2014
Rationale: NWI PEMB
Plants: Graminoids – JUNCU, MUFI2, LUCA2, PHLEU, AGROS2, **JUEN**, **CAAQ**, **ELQU2**, SCMI2
Forbs – **HYAN2**, LEMNA, MIGU, TRIFO, **PEGR2**, **SAOR2**, VERAT, **DOJE**
Bryophytes – MAPO16, AUPA70, PHFO6, FONTI, **DRAD2, PLEL2**
Soil probes: At soppy, upper portion of meadow with ELQU2 and DRAD2 = 28-38" organic, with minor component of fine-grained inorganic, on firm base.
Notes: Accessible from 24 road by crossing adjacent creek and hiking west up short but steep slope-break. The meadow features a persistently wet bench at its far western, upper end. Surface water from the bench collects in a primary channel and travels, in low volume, east down a relatively steep slope to creek below. Persistently wet soils within meadow are restricted to immediate edges of this active channel and to the bench above. It appears possible that much of the wetness on the bench is due to lateral surface and subsurface transport from a small, weak-channeled creek that enters the meadow at its far western end. It is difficult to assess the contribution to persistent soil wetness on the bench, but the presence of multiple FIT in this area suggests that groundwater discharge is also occurring at the bench. Beyond the bench and its active drainage channel, meadow soils are dry; however, multiple shallow dry channels within the mid- to lower meadow indicate early season wetness exists across the full meadow.
Photos: 1952, 1953.

6. Mahoney Meadows (w, lower).
Elevation: 5000 feet.
TRS: T9S, R36E, S19
Date: 8/12/2014
Rationale: NWI PEMB
Plants: Graminoids – **CAAQ**, CAVE6, JUBA, PHLEU, DECE, **JUEN**, **CAJO**, SCMI2
Forbs – POTEN, **PEGR2**, ALVA, GENTI, TRIFO, VERAT**, SAOR2**, **PLATA2**, **HYAN2**, **DOJE**, EQAR
Bryophytes – PHFO6, MAPO16, AUPA70, BRPS70, **PLEL2**, BRFR
Soil probes: Probes at soppy soils in N portion of meadow = organic with minor (mildly abrasive) inorganic component is 26-37" thick.
Notes: Meadow is immediately adjacent to 24 road. Toe-slope groundwater discharge appears to be responsible for general soppiness in N 1/3 of meadow. Surface and groundwater moves E from forested upland to join creek flowing N along W edge of 24 road. PLEL2 is far and away the dominant moss in the area. S 2/3s of meadow with little evidence of persistent groundwater influence. Small creek enters southern end of meadow from its western edge, but quickly

disappears. Green swath in meadow below last point of active creek suggests it continues into the meadow some distance as subsurface flow.
Photos: None.

7. Mahoney Meadows (e)
Elevation: 5100 feet
TRS: T9S, R36E, S19
Date: 8/12/2014
Rationale: NWI PEMB
Plants: Graminoids – CALU7, **ELQU2**, PHLEU, MUFI2, **CAAQ**, **CAJO**, JUBA, AGROS2
Forbs – **PEGR2**, **HYAN2**, MIMUL, **DOJE**, **SAOR2**, **PLATA2**, ASFO
Bryophytes – PHFO6, BRPS70, MAPO16, **TONI70**, **PLEL2**
Soil probes: Probes within the TONI70 population = dense organic with component of fine-textured inorganic to 18", then very dense to firm base at 24"; dense organic, with no evident inorganic component, to firm base at 37".
Notes: Accessed by short, uphill hiking to east, from parking spot along 24 road. Three NWI PEMB polys are mapped in close proximity here: a very small west-most poly, and larger polys to NE and SE. Soils at the w-most poly site are persistently wetted by mid-slope groundwater discharge. Flora similar to that of soppy sites at Mahoney Meadows (w), but with SAOR2 better represented. Moistest soils within the area included in the NE poly are moist (not damp or wet) at best, and too firm to allow soil probes. Area within mapped SE poly ranges from gentle upper slopes to steep mid- and lower slopes. Soil moistness within area ranged from moist to soppy-wet. All FIT in Plants list above were noted within this area. While the number of FIT noted at this site is smallish, the presence of TONI70 greatly elevates its botanical significance. The TONI70 population here is moderately large, occurring continuously from the bench-like top to the steep-sloped base of the southern 30% of this meadow. The population appears to occupy a zone of persistent groundwater discharge. Intense livestock disturbance of soil and vegetation is not evident in any part of the meadow.
Photos: 1954, 1955, 1956, 1957, 1959, 1960.

8. Baldy Creek meadow
Elevation: 6600 feet
TRS: T8S, R36E, S21
Date: 8/14/2014
Rationale: NWI PEMB
Plants: Graminoids – **ELQU2**, CASCB, **JUEN**, CALU7, **CAEC**, **JUNE**, **CAUT**, **CAAQ**, MUFI2, JUBA
Forbs – **PEGR2**, **SPRO**, **PLDI3**, **DOJE**, **HYAN2**, ALVA, ASFO, EQAR, PAFI3, EPILO, SWPE

Bryophytes – **CAST51**, SAUN8, PHFO6, AUPA70, ONVI4, SPSP70, **SPHAG2**, MAPO16, **WAEX**, BRWE70, PACO47, LOGI3

Soil probes: Probes at SPSP70 site = smooth organic to sandy layer at 33"; organic with component of fine-grained inorganic to sandy layer at 37".

Notes: Access via 7345-400 until road condition (ruts, large rocks, steepness) force parking and hiking to road-end at ridge top; then hiking weakly demarked trail down to Baldy Creek; followed trial north at bit, paralleling Creek, then crossed Creek and hiked cross-country/horse trails to lower west end of target meadow; hiking time about 75 minutes. The target meadow is within the North Fork John Day Wilderness Area. Meadow tucked into deep canyon, but somewhat oddly, seems to receive most of its groundwater feed from S-aspect slope along N edge of E-W oriented meadow. Main body of meadow is bit more than 0.5 miles in length. Meadow slopes gently downward from E to W, as well as from N to S. A small creek runs along the lower, southern side of the meadow. Soils vary from soppy wet to dry, but are predominantly soppy wet; robustness and geographic extent of groundwater discharge within this valley is one of its defining features. A respectable number of FIT were detected but flora is most notable for its inclusion of the dung moss *Splachnum sphaericum* (SPSP70 – a first OR state record), the rare, groundwater-loving (often where peat development is modest or lacking) star-moss *Campylium stellatum* (CAST51), the leafy liverwort *Lophozia gillmanii* (LOGI3), and felwort (flowering plant) *Swertia perennis* (SWPE).

Photos: 1981, 1983, 1984, 1985, 1986, 1987, 1988.

9. Cabell Meadow

Elevation: 5500 feet

TRS: T8S, R35 ½ E, S2

Date: 8/12/2014

Rationale: NWI PEMB

Plants: Graminoids – DECE, **CAJO**, PHLEU, JUBA, **CAUT**, **CAAQ**, LUCA2, **JUEN**, **ELQU2**, **CAEC**, MUFI2

Forbs – **PEGR2**, **SPRO**, **DOJE**, **PLDI3**, POOC2, TRIFO, ASFO, EQAR**, HYAN2**, RAGO, EPILO

Bryophytes – PHFO6, MAPO16, **METR70**, **PLEL2**, **DRAD2**, **HEBL2**, **MEUL70**

Soil probes: In damp-soiled toe-slope seasonal groundwater site at SW edge of main meadow, organic soil with minor inorganic component to first obvious inorganic soil layer at 24"; in the meadow's primary toe-slope GDE (at far SE corner of meadow), multiple probes = mildly abrasive organic soil (i.e., minor inorganic component) to first obvious inorganic soil layer at 14", 24" and 26".

Notes: Access via 7335 road, then short, due-north downhill walk to meadow. Meadow entered midway along narrow E-W meadow corridor between main, open meadow to east, and narrow, consolidated riparian meadow to west. The only evident groundwater-influenced communities in the main meadow occur along its southern edge. Soil in the west-most of these two communities

was only damp, suggesting a seasonal nature of the groundwater supply. The primary groundwater-fed community, in the far SE corner of the meadow, extends well up and into the otherwise forested toeslope. The wetness of this community increases with movement upslope, ending in very soppy soils under a thin cover of PIEN and PICO. All FIT listed above were present within this community, making this very small community also one of the most notable among those visited during this project.
Photos: 1962, 1964, 1065-1966, 1967, 1968, 1969, 1970.

10. Davis Creek meadows
Elevation: 5500-5600 feet
TRS: T7S, R35 ½ E, S15, 16
Date: 8/13/2014
Rationale: NWI PEMB
Plants: Graminoids – **JUEN**, VEDU, CAVE, **ELQU2**
Forbs – ACMI, TRIFO, TARAX, MADIA, **SPRO**, **HYAN2**, EPILO, OROBA
Bryophytes – PHFO6, BRPS70, AUPA70, **TONI70**, **METR70**, CLDE70
Soil probes: In ELQU2/AUPA70 community in far SW corner of lowest meadow, organic soil with very minor inorganic component to first obvious, but very thin (a few inches) inorganic soil layer; beyond this thin layer, apparent low-density organic soil to 50+". Soil elsewhere in meadow system was dry, hard and impenetrable.
Notes: Access by driving west along the 5190 road as far as possible, then hiking along non-serviceable road about an hour. Site is a meadow system consisting to two larger meadows (NE and SW) with a much smaller donut-shaped meadow lying along the dry creek channel connecting the two larger meadows. NE meadow has moderately steep slope, dry hard soils and much *Madia* cover. Intermediate meadow is also dry and occupied by much *Madia*. SW meadow has a low gradient, with a dry soils and *Madia* in its upper (N) half, and increasing evidence of pro-longed seasonal wetness with movement toward the far SW corner. Soil in this corner range from damp to soppy; multiple small pools are present. ELQU2 and AUPA70 comprise the dominant vegetation in a small, short-statured fen community here. This community is especially notable in that it appears to be associated with essentially 50+" of peat, and includes at least a few shoots of TONI70 and METR70. A determined search for additional TONI70 and METR70 was conducted, but none was detected. Get strong impression – as did during a 2012 visit to Trout Creek Meadow, a few miles to the west in Umatilla NF – that this TONI70-METR70 fen community is barely persisting, and will soon enough be gone.
Photos: 1971.

11. Hoodoo Creek area meadows
Elevation: 5700-5900 feet
TRS: T7S, R35 ½ E, S12
Date: 8/13/2014

Rationale: NWI PEMB and PEMC (along Creek)
Plants: Graminoids – LUCA2, MUFI2, **JUEN**, **CAAQ**, **CAEC, CAJO**, SCMI2, CALU7, **ELQU2,** PHLEU, JUOR, JUBA, **CAUT**, DECE, CASCB
Forbs – **PEGR2**, POOC2, **HYAN2**, EQAR, **SPRO**, **PLATA2**, MIGU, ASFO, SPCA5, ALVA, **DOJE**, SETR, EPILO, TRIFO, PAFI3
Shrubs – SALIX
Bryophytes – PHFO6, **PLEL2**, MAPO16, **DRAD2**, BRPS70, BRWE70, AUPA70, CLDE70, **HEBL2**, BRFR
Soil probes: In small GDE immediately west of 51 road, abrasive organic soil (with high inorganic content) to coarse-textured inorganic layer at 12"; at far SW edge of Hoodoo Ck. meadow, on soppy, convex, groundwater-fed slope, organic with fine-textured inorganic component to thin sandy layer at 24", the continuing organic with fine-textured inorganic component to 50+"; at HEBL2 site, dense organic soil to first obvious inorganic layer at 23".
Notes: Access from 51 road either by short hike upslope to west (to one GDE) or east downslope to remaining GDEs). This is a groundwater discharge complex, consisting of three small, upslope GDEs, and GDEs, with varying strength of groundwater influence, along the western edge of the Hoodoo Ck. meadow corridor. The three most notable GDEs in this complex are 1) well upslope, immediately west of the 51 road, 2) on a convex-slope at the far SW corner of the Hoodoo Ck. meadow, and 3) along a long, NW, upslope extension of the Hoodoo Ck. Meadow, about mid-way along the meadow's extent. The first of these listed GDEs is very notable in including 11 of the 14 FIT noted within the complex as a whole, while being both very small and very steep-sloped. The third-listed GDE is notable both in being the only detected location of HEBL2 within the complex, and in being perhaps the only expression of short-statured fen community within the complex.
Photos: 1972, 1973, 1974, 1975-1976, 1977.

12. 5185-010 meadow
Elevation: 5850 feet
TRS: T7S, R35 ½ E, S1
Date: 8/13/2014
Rationale: NWI PEMC
Plants: Graminoids – **ELQU2**, LUCA2, PHLEU, **CAAQ**, CALU7, JUBA**, CAJO**
Forbs – **HYAN2**, MIGU, POOC2, ASFO, **SPRO**, ACMI, MIMUL
Bryophytes – **HEBL2**, AUPA70, MAPO16**, DRAD2**, **METR70**

Soil probes: None attempted.
Notes: Direct access via the 5185-010 road. Although classified as NWI PEMC, NAIP imagery suggested significant portion of meadow may actually be PEMB.This site features a prominent spring-mound whose cover is dominated by ELQU2, HEBL2 and AUPA70. Upslope from the

spring-mound are an unusual, contouring series of groundwater-promoted terraces the wettest (north-most) of which support METR70.
Photos: 1978, 1979, 1990.

13. Grande Ronde R. headwaters meadow (s)
Elevation: 7200 feet
TRS: T7S, R36E, S11
Date: 8/27/2014
Rationale: NWI PEMB
Plants: Graminoids – CASCB, CALU7, **ELQU2**, **CAEC**, MUFI2, **JUEN**, **CAJO**, DECE, **CAAQ**, LUCA2, CANE6
Forbs – **DOJE**, GENTI, CABI2, RAGO, ASFO, **SPRO**, MIMUL, **PLATA2**, **PEGR2**, SWPE, PAFI3, **SAOR2**, ALVA, VERAT, MIGU, DELPH
Shrubs – PHYLL3, **KAMI**, GAULT
Bryophytes – PHFO6, AUPA70, **SPHAG2**, BRPS70, **HAVE70**, **WAEX**, **METR70**, HYLI70, **HEBL2, CAST51**, CAGI70, BRFR70
Soil probes: In low gradient area of very shallow standing water with emergent ELQU2 and CAREX, centrally located in middle of main body of low-gradient meadow, pure organic soil to 50+" (full depth of probe). In CAGI70 occurrence on soppy soil well up into steeply sloping, lightly wooded W portion of meadow, organic soil to a coarse sandy soil layer at 13".
Notes: Meadow is immediately south of 73 road. A topographically varied and generally very wet, groundwater-rich site with a high number of FIT (relative to other WAW NF sites visited), including such notable FIT as CAST51, METR70, HAVE70 and HEBL2. Other notable taxa are SWPE and HYLI70.
Photos: 2007, 2008, 2009, 2011, 2012, 2013.

14. 73-140 meadow (upper)
Elevation: 7050 feet
TRS: T7S, R37E, S8
Date: 8/30/2014
Rationale: NWI PEMC, PEMF
Plants: Graminoids – CALU7, **CAJO**, JUBA, **CAUT, CAAQ**, CASCB, LUCA2, **ELQU2**, **CAEC**, DECE
Forbs – **PLATA2**, GENTI, **SPRO**, CABI2, ASFO, **DOJE**, **SAOR2**, **PEGR2**, PAFI3, **UTMI**, COPA28
Shrubs – **KAMI**, **VAUL**
Bryophytes – **SPHAG2**, PHFO6, AUPA70**, HAVE70**, **CAST70**, SAUN8, **CAST51**
Soil probes: At soppy-wet west-central edge of meadow (with HAVE70 and CAST70), organic soil to 50+" with thin sandy layer at 24"; at +/- central location within meadow (in midst of extensive area of shallow pools with UTMI), low density organic soil to 50+".

Notes: Access via 73-140 road to point of closure, then a short walk N along closed road, followed by short walk SE downslope to upslope, NW edge of meadow. Although classified as NWI PEMC and PEMF, NAIP imagery suggested significant portion of meadow may actually be PEMB. From NW edge, meadow appears quite flat and with homogeneous graminioid cover. Little evidence of persistent groundwater influence in vegetation composition or soil moisture along long NW edge of meadow, but persistent groundwater discharge is evident along western edge and SW corner; most of the detected FIT within this meadow located here. Meadow is most notable for extensive presence of UTMI in very shallow, low-velocity or standing water over much of the central and west-central portion of meadow. Groundwater contribution to wetness of this portion of meadow is not obvious. Topography of much of meadow suggests that infilling of a large pond/small lake may have produced the current meadow; if so, a subsurface layer of low permeability may be present and contributing to water retention at and near the meadow surface currently supporting UTMI.
Photos: 2032, 2033, 2034-2036, 2038-2039.

15. 73-140 meadow (lower)
Elevation: 7050 feet
TRS: T7S, R37E, S8
Date: 8/30/2014
Rationale: NWI PEMC
Plants: Graminoids – **CAJO**, CASCB, CALU7, **CAAQ**, **CAEC**
Forbs – **SPRO**, **DODEC**, CABI2, GENTI, EQAR
Shrubs – **VAUL**, GAULT
Bryophytes – PHFO6, BRPS70, AUPA70, **SPHAG2**, DREPA3
Soil probes: None attempted.
Notes: Access via short walk to east through wooded area separating upper meadow from lower meadow. Although classified as NWI PEMC, NAIP imagery suggested significant portion of meadow may actually be PEMB. Gradient between "upper" meadow (#4, above) and this meadow is barely perceptible. NAIP shows multiple water channels throughout this meadow, but all are dry at time of visit. Except for far SW corner, this meadow appears to be only seasonally wet. Soil in far SW corner is soppy-wet due to groundwater discharge. FIT detected within this meadow largely restricted to this corner. Presence of UTMI +/- expected in damp, mucky low-lying patches this SW corner, but perhaps due to small size of area and weakened, late-season groundwater discharge rates, no UTMI detected.
Photos: 2040.

<u>La Grande Ranger District (west)</u>

1. Grande Ronde R. headwaters meadow (n)
Elevation: 7100 feet

TRS: T7S, R36E, S12
Date: 8/28/2014
Rationale: NWI PEMB, PFOB
Plants: Graminoids – **ELQU2**, LUCA2, CASCB**, CAJO**, CALU, **CAEC**, **CAAQ**, PHLEU, CANE6
Forbs – MIMUL, **SPRO**, **DODEC**, **PEGR2**, **SAOR2**, ASFO, EQAR, PAFI3, SWPE, **PLATA2**, ALVA, GENTI
Shrubs – **KAMI**, SALIX
Bryophytes – **HEBL2**, PHFO6, BRWE70, **SPHAG2**, **METR70**, **CAST51**, HYLI70, BRPS70, BRFR70, MAPO16, AUPA70, **HAVE70**
Soil probes: In short-statured HAVE70-METR70 fen community in lower portion of main meadow, organic soil layer to 24", then very dense (but not obviously inorganic) layer to 36", below which is sandy layer to firm base at 46".
Notes: Access by short walk due N, downslope from 73 road. This meadow is composed of a S lobe, with moderate NE aspect slope, and larger, main meadow, with moderate W aspect slope. Two notables at this site are a spring mound in the S lobe, and a short-statured fen community with dominance of HAVE70 with intermixed METR70, near the base of the main, W aspect meadow. Other notable FIT detected in this meadow system are CAST51 and HEBL2. Other notable taxa are SWPE and HYLI70.
Photos: 2014, 2015, 2016, 2017.

2. Grande Ronde Lake meadow
Elevation: 7200 feet
TRS: T7S, R36E, S12
Date: 8/28/2014
Rationale: NWI PEMB
Plants: Graminoids – **CAUT**, **CAAQ**, **CAEC**, **ELQU2**, CALU7, CASCB, **CAJO**
Forbs – **DOJE**, **SPRO**, **PLATA2**, **SAOR2**, **PEGR2**, ASFO, SETR, EQAR
Shrubs – **KAMI**
Bryophytes – AUPA70, BRPS70, PHFO6**, SPHAG2**, **HEBL2**, **METR70**, **HAVE70**
Soil probes: at METR70-HAVE70 site (on moderately steep seepage slope), organic soil to depth of 47".
Notes: Access from day-use parking lot on SE edge of Grande Ronde Lake. Green band of likely (few inflorescences) CAUT and CAAQ immediately S of Lake in shallow standing water over firm soil; water level may represent water level in Lake; further S of Lake, a + /- solid cover of low-statured, unfamiliar herbaceous vegetation, largely lacking flowers or fruit, on very low-gradient slope with dry soil; continuing SW, slope slightly steepens and becomes quite wet, mostly transitioning to relatively steep, soppy-wet slope bordering the upper meadow. Most of this site's FIT located on these very wet soils.
Photos: 2018, 2019.

3. 43-940 meadow
Elevation: 6850 feet
TRS: mostly T7S, R36E, S1, but also, T6S, R36E, S36
Date: 8/29/2014
Rationale: NWI PEMC
Plants: Graminoids – **ELQU2**, **CAUT**, LUCA2, CALU7, MUFI2, CASCB, **CAEC**, **CAAQ**, **JUEN**, **CAJO**
Forbs – GENTI, **SPRO**, **HYAN2**, **PLATA2**, CABI2, **DOJE**, **SAOR2**, ALVA
Shrubs – **KAMI**, **VAUL**, SALIX
Bryophytes – **SPHAG2**, AUPA70, PHFO6, BRPS70, HYLI70, **HEBL2**, SAUN8, **TONI70**, **HAVE70**, **METR70**, **CAST70**
Soil probes: Amidst drying muck pools at center SW lobe, organic soil to abrupt firm base at 41"; within large area of soppy-wet soil in central portion of meadow (with TONI70 and HAVE70), organic soil with minor component of fine-textured sand to 50+" (length of rod); within swath of soppy-wet soil with TONE70 and METR70 on steepish slope at far eastern end of meadow, organic soil to 50+"; at soppy-wet eastern edge of southern slope of western lobe of meadow system (with TONI70, METR70 and HEBL2), 24" of organic soil to firm sandy base at 24".
Notes: Access by walking west on 940 road from its point of closure near its junction with 43 road. Although classified as NWI PEMC, NAIP imagery suggested significant portion of meadow may actually be PEMB. A moderately large, FIT-rich, meadow system consisting of adjacent slopes and valley bottom with much of area of the adjacent slopes persistently soppy-wet due to groundwater discharge. Principal areas of FIT-richness and/or target species presence = 1) southern edge of SW lobe, 2) southern edge of central lobe, 3) upper SE portion of eastern lobe and 4) eastern edge of southern slope of western lobe.
Photos: 2020, 2021, 2022, 2023, 2024, 2025-2026, 2027-2028, 2030, 2031.

4. Friday Meadow
Elevation: 6650 feet
TRS: T6S, R36E, S24
Date: 9/2/2014
Rationale: NWI PEMC, PSSC
Plants: Graminoids – CALU7, LUCA2, **CAJO**, **ELQU2**, **CAEC**, AGROS2, CASCB, **JUEN**, **CAAQ**, DECE, **CAUT**, JUBA, PHLEU, **CASI2**
Forbs – CABI2, **SPRO**, SWPE, **DODEC**, ASFO, ALVA, **HYAN2**, **PLATA2**, EQAR, POOC2, CIAR4, MIGU, **UTMI**, **SAOR2**, **PEGR2**, TRIFO
Shrubs – SALIX, **KAMI**, PHYLL3, **VAUL**

Bryophytes – AUPA70, **SPHAG2**, HYLI70, HYPR70, **CAST70**, BRPS70, PHFO6, RHIZO2, MAPO16, PELLI, **TONI70**, **HAVE70**, **METR70**, **HEBL2**

Soil probes: At SWPE site midway along SE edge = organic soil to first obvious inorganic (sandy) layer at 34" and 47" (slight abrasiveness felt during probe, but residue on rod smooth, lacking any detectable inorganic component). In TONI70 occurrence along lower half of SE edge = organic soil to dense layer causing refusal at 45" (sparse, fine-textured grit in residue). In TONI70 carpet at SW corner of meadow, organic soil to firm base at 47"; dense, thin layer of indeterminate composition at 12".

Notes: Access by parking at junction of 43 road and closed, unmapped road, and walking W along closed road to midpoint along SE edge of meadow. Although classified as NWI PEMC and PSSC, NAIP imagery suggested significant portion of meadow may actually be PEMB. A remarkably large number of FIT were detected within this very hydrologically heterogeneous meadow. Large areas of soils persistently wetted by groundwater discharge occur within the meadow 1) along the lower half of the SE edge, 2) in the SW corner and 3) in the upper NW corner. All FIT listed above, except PEGR2, were detected at these three portions of the meadow. The UTMI occurrence consists of only a few shoots immediately downslope from a large elk wallow, which may well have formerly been the meadow's primary UTMI site.

Photos: 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048.

5. 43-942 meadow

Elevation: 6400 feet

TRS: T7S, R36E, S2

Date: 9/3-9/4/2014

Rationale: NWI PEMB

Plants: Graminoids – CASCB**, ELQU2**, CALU7, LUCA2, **CAUT**, **CAAQ**, **CAJO**, **CAEC**, MUFI2, PHLEU, CADI6, **JUEN**, JUBA, **CASI2**

Forbs – **PLATA2**, CABI2, ALVA, **DOJE**, **SPRO**, **HYAN2, UTMI**, EQAR, POOC2, ASFO

Shrubs **– KAMI**, **VAUL**

Bryophytes – **SPHAG2**, AUPA70, **HAVE70**, **METR70**, SPSP70, **HEBL2**, **TONI70**, CAGI70, BRPS70, PHFO6, **PLEL2**, MAPO16

Soil probes: Two probes in soppy soil at +/- midpoint of lightly wooded N edge (entry point to meadow, with HEBL2, TONI70, SPSP70) = organic soil to very dense layer (of indeterminate composition) at 42" and 48". At +/- midpoint along S edge of meadow (at a UTMI site) = organic soil to 50+". At soppy TONI70-METR70/UTMI site +/- midway along N edge of open meadow, organic soil to 50+"; nearby at CAGI70 site, organic soil to non-descript firm base at 45" (stopped due to effort, at 48"; residue on extracted rod with sparse fine sand component).

Notes: Access by walking one hour+, W along 940 and 942 roads, from point of closure on 940 road, shortly W of its junction with 43 road. This is a large, topographically varied valley meadow system with a few local areas with moist-dry soil, but predominantly, is remarkably

wet. Very soppy, groundwater-wetted soils are prevalent along the meadow edges (except the SW edge), and an extensive area of shallow (1" or less) water occupies virtually all of the large E and W lobes of the meadow. These very wet lobes are species-poor, although the W lobe supports a very large population of UTMI. The presence of two occurrences of SPSP70 within this meadow is highly notable, as is perhaps, the failure to detect the presence of either PEGR2 or SAOR2.
Photos: 2049, 2050, 2051, 2052&2054, 2055, 2056-2057, 2058, 2059, 2060, 2062, 2063, 2064-2065, 2066.

Appendix D - Plant taxa noted at project field sites

Code	Scientific Name
Graminoids	
AGROS2	*Agrostis*
CAAU3	*Carex aurea*
CABU6	*Carex buxbaumii*
CACA11	*Carex canescens*
CADI6	*Carex disperma*
CAEC	*Carex echinata*
CAJO	*Carex jonesii*
CALAA	*Carex lasiocarpa* var. *americana*
CALI7	*Carex limosa*
CALU7	*Carex luzulina*
CANE6	*Carex neurophora*
CAPE42	*Carex pellita*
CASCB	*Carex scopulorum* var. *bracteosa*
CASI2	*Carex simulata*
CAUT	*Carex utriculata*
CAVE6	*Carex vesicaria*
DANTH	*Danthonia*
DECE	*Deschampsia cespitosa*
ELQU2	*Eleocharis quinqueflora*
ERGR8	*Eriophorum gracile*
JUEN	*Juncus ensifolius*
JUNCU	*Juncus*
JUNE	*Juncus nevadensis*
JUOR	*Juncus orthophyllus*
LUCA2	*Luzula campestris*
MUFI2	*Muhlenbergia filiformis*
PHLEU	*Phleum*
SCMI2	*Scirpus microcarpus*
VEDU	*Ventenata dubia*
Forbs	
ACMI2	*Achillea millefolium*
ALVA	*Allium validum*
ANTEN	*Antennaria*
ARNIC	*Arnica*
ASFO	*Aster foliaceous*
BOTRY	*Botrychium*

Appendix D (cont.)

CASTI	*Castilleja*
CIAR4	*Cirsium arvense*
COPA28	*Comarum palustre*
DELPH	*Delphinium*
DODEC	*Dodecatheon*
DOJE	*Docecatheon jeffreyi*
DRAN	*Drosera anglica*
EPILO	*Epilobium*
EQAR	*Equisetum arvense*
EQHY	*Equisetum hyemale*
GENTI	*Gentiana*
HYAN2	*Hypericum anagalloides*
LEMNA	*Lemna*
LUPIN	*Lupinus*
MADIA	*Madia*
METR3	*Menyanthes trifoliata*
MIGU	*Mimulus guttatus*
MIMUL	*Mimulus*
MIPR	*Mimulus primuloides*
NUPHA	*Nuphar*
OROBA	*Orobanche*
PAFI3	*Parnassia fimbriata*
PEGR2	*Pedicularis groenlandica*
PLATA2	*Platanthera*
PLDI3	*Platanthera dilitata*
POBI6	*Polygonum bistortoides*
POOC2	*Polemoniunm occidentale*
RAGO	*Ranunculus gormanii*
RUMEX	*Rumex*
SETR	*Senecio trianglularis*
SPARG	*Sparganium*
SPCA5	*Sphenosciadium capitellatum*
SPRO	*Spiranthes romanzoffiana*
SWPE	*Swertia perennis*
TARAX	*Taraxacum*
TRIFO	*Trifolium*
UTMA	*Utricularia macrorhiza*
UTMI	*Utricularia minor*
VALER	*Valeriana*
VERAT	*Veratrum*
VIOLA	*Viola*

Appendix D (cont.)

Shrubs

ALNUS	*Alnus*
GAULT	*Gaultheria*
KAMI	*Kalmia microphylla*
LEDUM	*Ledum*
PHYLL3	*Phyllodoce*
RHAL	*Rhamnus alnifolia*
SAEA	*Salix eastwoodiae*
SALIX	*Salix*
VAUL	*Vaccinium uliginosum*

Bryophytes

AUPA70	*Aulacomnium palustre*
BRFR70	*Brachythecium frigidum*
BRPS70	*Bryum pseudotriquetrum*
BRWE70	*Bryum weigelii*
CAGI70	*Calliergon giganteum*
CAST51	*Campylium stellatum*
CAST70	*Calliergon stramineum*
CHPO14	*Chiloscyphus polyanthos*
CLDE70	*Climacium dendroides*
DIPA20	*Dicranella palustris*
DRAD2	*Drepanocladus aduncus*
DREPA3	*Drepanocladus*
HAVE70	*Hamatocaulis vernicosus*
HEBL2	*Helodium blandowii*
HYLI70	*Hypnum lindbergii*
HYOC5	*Hygrohypnum ochraceum*
HYPR70	*Hypnum pratense*
LOGI3	*Lophozia gillmanii*
MAPO16	*Marchantia polymorpha*
METR70	*Meesia triquetra*
MEUL70	*Meesia uliginosa*
ONVI4	*Oncophorus virens*
PACO47	*Palustriella commutata*
PELLI	*Pellia*
PHFO6	*Philonotis fontana*
PLEL2	*Plagiomnium ellipticum*

Appendix D (cont.)

RHIZO2	*Rhizomnium*
RIBE	*Riccia beyrichiana*
RICCI	*Riccia*
SAUN8	*Sanionia uncinata*
SPHAG2	*Sphagnum*
SPSP70	*Splachnum sphaericum*
WAEX	*Warnstorfia exannulata*

Appendix E – Occurrence of sensitive/strategic and otherwise notable species among project sites.

	Site	66-410	66	Duck Lake	E. Fork Wallowa R.	W. Eagle (upper)	W. Eagle (lower)	Haystack (east)	Mahoney (east)	Baldy Ck.	Cabell
Taxon											
CALAA				X							
SWPE										X	
UTMI		X	X	X							
CAST51		X	X							X	
HAVE70				X							
HEBL2					X	X		X			X
HYLI70											
HYPR70											
LOGI3										X	
METR70						X	X				X
MEUL70											X
SPSP70										X	
TONI70									X		
Total		2	2	3	1	2	1	1	1	4	3

Translation of codes:

CALAA = *Carex lasiocarpa* var. *americana*
SWPE = *Swertia perennis*
UTMI = *Utricularia minor*
CAST51 = *Camppylium stellatum*
HAVE70 = *Hamatocaulis vernicosus*
HEBL2 = *Helodium blandowii*
HYLI70 = *Hypnum lindbergii*
HYPR70 = *Hypnum pratense*
LOGI3 = *Lophozia gillmanii*
METR70 = *Meesia triquetra*
MEUL70 = *Meesia uliginosa*
SPSP70 = *Splachnum sphaericum*
TONI70 = *Tomentypnum nitens*

Appendix E (cont.)

	Davis Ck.	Hoodoo Ck.	5185-010	Grande Ronde R. (s)	Grande Ronde R. (n)	Grande Ronde Lake	73-140 (upper)	Friday	43-940	43-942	
Taxon											**Sum**
CALAA											**1**
SWPE				X	X			X			4
UTMI							X	X		X	6
CAST51				X	X		X				6
HAVE70				X	X	X	X	X	X	X	8
HEBL2		X	X	X	X	X		X	X	X	12
HYLI70				X	X			X	X		4
HYPR70								X			1
LOGI3											1
METR70	X		X	X	X	X		X	X	X	11
MEUL70											1
SPSP70										X	2
TONI70	X							X	X	X	5
Total	2	1	2	6	6	3	3	8	5	6	

Translation of codes:

CALAA = *Carex lasiocarpa* var. *americana*
SWPE = *Swertia perennis*
UTMI = *Utricularia minor*
CAST51 = *Camppylium stellatum*
HAVE70 = *Hamatocaulis vernicosus*
HEBL2 = *Helodium blandowii*
HYLI70 = *Hypnum lindbergii*
HYPR70 = *Hypnum pratense*
LOGI3 = *Lophozia gillmanii*
METR70 = *Meesia triquetra*
MEUL70 = *Meesia uliginosa*
SPSP70 = *Splachnum sphaericum*
TONI70 = *Tomentypnum nitens*

Appendix F – Project sites sorted according to presence/absence of persistently groundwater-wetted sub-sites and number of detected fen indicator taxa (FIT).

Group 1 - fens present, and FIT ≥ 15

Site	# FIT	Notables[1]	Peat[2]	Elev. (ft.)	Per. GW[3]	NWI[4]
Friday Meadow	23	8	47"	6650	Yes	PEMC
43-940 meadow	20	5	50+"	6850	Yes	PEMC
43-942 meadow	20	6	50+"	6400	Yes	PEMB
Grande Ronde R. hdws. mdw. (s)	18	6	50+"	7200	Yes	PEMB
73-140 meadow (upper)	17	3	50+"	7050	Yes	PEMF
West Eagle Meadow (upper)	16	2	50+"	5500	Yes	PEMC
Cabell Meadow	16	3	26"*	5500	Yes	PEMB
Grande Ronde R. hdws. mdw. (n)	16	6	24"	7100	Yes	PEMB
66-410 meadow	15	2	50+"	6800	Yes	PEMF
Duck Lake meadows	15	3	50+"	5500	Yes	PEMC
Baldy Creek meadow	15	4	33"	6600	Yes	PEMB
Grande Ronde Lake meadow	15	3	47"	7200	Yes	PEMB
Mean		4.3		6529		

Group 2 - fens present, and FIT < 15

Site	# FIT	Notables[1]	Peat[2]	Elev. (ft.)	Per. GW[3]	NWI[4]
Haystack Meadows (east)	14	1	36"	5300	Yes	PEMB
Hoodoo Creek meadows	14	1	24"*	5800	Yes	PEMB
66 meadow	13	2	34"*	6800	Yes	PEMC
East Fork Wallow River meadow	13	1	36"; 48"*	7150	Yes	PEMC
West Eagle Meadow (lower)	12	1	na	5400	Yes	PSSA
Headwaters Skookum Creek meadow	10	0	50+"	6050	Yes	PEMB
Mahoney Meadows (east)	10	1	37"	5100	Yes	PEMB
Russell Mountain meadow	9	0	48"	7000	Yes	PEMC
Mahoney Meadows (west, upper)	9	0	38"*	5100	Yes	PEMB
Mahoney Meadows (west, lower)	9	0	37"*	5000	Yes	PEMB
6220-500 meadow (north)	8	0	38"	6700	Yes	PEMC
5185-010 meadow	8	2	na	5850	Yes	PEMC
Mt. Fanny Spring meadow	7	0	24"*	6850	Yes	PEMC
		0.7		6008		

Appendix F (cont.)

Group 3 – fens not detected

Site	# FIT	Notables[1]	Peat[2]	Elev. (ft.)	Per. GW[3]	NWI[4]
73-140 meadow (lower)	7	0	na	7050	No (?)	PEMC
7375-020 meadow	6	0	50+"	5800	No	PEMB
Davis Creek meadows	6	2	50+"	5550	No	PEMB
Haystack Meadows (west)	5	0	na	5200	No	PEMB
6220/6226-500 meadow	3	0	na	6800	No	PEMC
6220-500 meadow (south)	3	0	na	6600	No	PEMC
66-410 meadow (upper)	2	0	na	6900	No	PEMC
Rich Creek meadow (upper)	0	0	na	5500	No	PEMB
Makin Creek meadow (upper)	0	0	na	5400	No	PEMB
1040-040 meadow	0	0	na	4350	No	PEMB
Mean		0.2		5915		

Notes:

[1] = Same 13 species listed in Table 1 and in Appendix E.

[2] = Depth to first notable inorganic layer (usually a sand-rich soil); * = minor inorganic component in otherwise organic soil to depth of first notable inorganic layer.

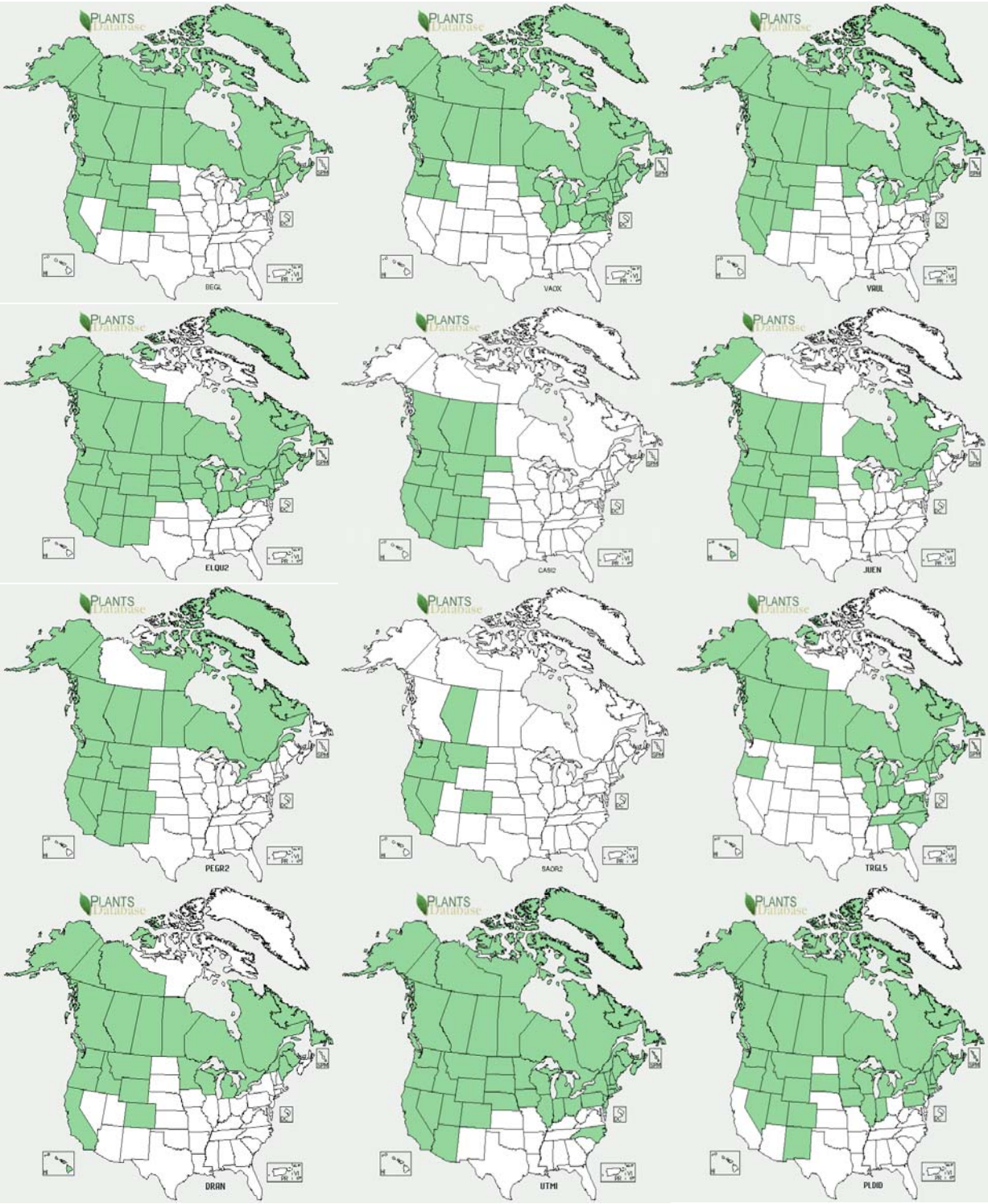
[3] - "Yes" = at least some extent of persistent, diffuse, groundwater discharge noted within site.

[4] = USF&WS National Wetland Inventory wetland category.

Appendix G – Oregon-Washington montane fen indicator taxa (FIT).

Taxon Group	Taxon Code	Scientific Name
Graminoids	CAAQ	*Carex aquatilis*
	CAEC	*Carex echinata*
	CAJO	*Carex jonesii*
	CALAA	*Carex lasiocarpa* var. *americana*
	CALI7	*Carex limosa*
	CASI2	*Carex simulata*
	ELQU2	*Eleocharis quinqueflora*
	ERIOP/ERGR8/ERAN6	*Eriophorum* spp.(especially *E. gracile* and/or *E. angustifolium*)
	JUEN	*Juncus ensifolius*
	JUNE	*Juncus nevadensis*
Forbs	DODEC/DOJE	*Dodecatheon* spp. (especially *D. jeffreyi*)
	DROSE/DRAN/DRRO	*Drosera* spp. (*D. anglica* and/or *D. rotundifolia*)
	HYAN2	*Hypericum anagalloides*
	METR3	*Menyanthes trifoliata*
	MIPR	*Mimulus primuloides*
	PEGR2	*Pedicularis groenlandica*
	PLATA2/PLDID	*Platanthera* spp. (especially *P. dilatata*)
	SAOR2	*Saxifraga oregana*
	SCPAA	*Scheuchzeria palustris* ssp. *americana*
	SPRO	*Spiranthes romanzoffiana*
	TRGL5	*Triantha glutinosa*
	UTRIC/UTMI/UTIN2	*Utricularia* spp. (*U. minor* and/or *U. intermedia*)
Shrubs	BEGL	*Betula glandulosa*
	KAMI	*Kalmia microphylla*
	SAPE	*Salix pedicellaris*
	VAOX	*Vaccinium oxycoccos*
	VAUL	*Vaccinium uliginosum*
Mosses	CACU18	*Calliergonella cuspidata*
	CAST51	*Campylium stellatum*
	CAST70	*Calliergon stramineum*
	DIPA20	*Dicranella palustris*
	DRAD2	*Drepanocladus aduncus*
	HAVE70	*Hamatocaulis vernicosus*
	HEBL2	*Helodium blandowii*
	METR70	*Meesia triquetra*
	PLEL2	*Plagiomnium ellipticum*
	SPAM5	*Splachum ampullaceum*
	SPHAG2	*Sphagnum* spp.
	TONI70	*Tomentypnum nitens*
	WAEX	*Warnstorfia exannulata*

Appendix H – Biogeography of selected fen indicator taxa (FIT). Species from left to right, by row: Row 1 = BEGL, VAOX, VAUL; Row 2 = ELQU2, CASI2, JUEN; Row 3 = PEGR2, SAOR2, TRGL5; Row 4 = DRAN, UTMI, PLDID. Maps are from NRCS Plants Database. See Appendix D for species codes.



Appendix I – Project target species. Ranking information based on R6 Regional Forester's Special Status Species List issued 12/9/2011. This List utilized information available in the 10/2010 Oregon Biodiversity Information Center's issue of the Rare, Threatened and Endangered Species of Oregon.

Non-vascular, sensitive

Calliergon trifarium (moss) G4 S1, List2
Harpanthus flotovianus (liverwort) G5 S1, List 2
Helodium blandowii (moss) G5 S2, List 2
Lophozia gillmanii (liverwort) G5 S1, List 2
Meesia uliginosa (moss) G4 S1, List 2
Splachnum ampullaceum (moss) G5 S1, List 2
Tomentypnum nitens (moss) G5 S2, List 2

Non-vascular, recently documented in Oregon

Calliergon richardsonii (moss) G4 S1, List 3
Campylium stellatum (moss) not yet ranked by ORBIC

Vascular, sensitive

Botrychium crenulatum (scalloped moonwort) G3 S2, Fed. SOC, ODA C, List 1
Carex capillaris (hair-like sedge) G5 S2, List 2
Carex capitata (capitate sedge) G5 S2, List 2
Carex gynocrates (northern bog sedge) G5T5 S1, List 2
Carex lasiocarpa var. *americana* (American woollyfruit sedge) G5T5 S2, List 2
Gentiana prostrata (pygmy gentian) G4G5 S2, List 2
Juncus albescens (northern white rush) G5T5 S1, List 2
Utricularia minor (lesser bladderwort) G5 S2, List 2