WASHINGTON NATURAL HERITAGE PROGRAM

Ecological Integrity Assessments and Vegetation Surveys of Washington State Parks

Prepared by
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and Irene Weber

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WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

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ON THE COVER: An A-ranked occurrence of *Artemisia rigida* / *Poa secunda* Shrub Grassland (G4/S3S4) at Ginkgo-Petrified Forest State Park (Photograph by Tynan Ramm-Granberg).

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1.0 Introduction

Indicator-based approaches to assessing and reporting ecological integrity (Harwell et al., 1999; USEPA, 2002; Young & Sanzone, 2002) are in use by many organizations to assist regulatory decisions (USACE, 2016), set mitigation performance standards, monitor land management (Schroeder et al., 2011), and set conservation priorities (Faber-Langendoen et al., 2006, 2008). The Washington Department of Natural Resources (DNR), Natural Heritage Program (WNHP) uses an indicator-based approach developed by NatureServe and the Natural Heritage Network called the Ecological Integrity Assessment (EIA) to assist in identifying ecosystem conservation priorities. Many of WNHP's partners have adopted EIA to assist with monitoring and assessment (Crawford et al., 2011; Schroeder et al., 2011; Crawford & Rocchio, 2013; Rocchio & Ramm-Granberg, 2019).

The EIA method (Faber-Langendoen et al., 2016a, 2016b, 2016c, 2016d, 2019; Rocchio et al., 2020a, 2020c) aims to measure the ecological integrity of a site through a standardized and repeatable assessment of current ecological conditions. Condition is assessed relative to expectations for an ecological system operating within the bounds of natural variation. The EIA enables a user to rapidly assess and communicate the composition, structure, and function of an ecosystem occurrence through an index of ecological integrity, which in turn aids in identifying conservation value, management effects, restoration success, and more. The EIA standardizes expert opinion and existing data up front, enabling the user to apply the EIA in a rapid manner to estimate a site's ecological integrity. The EIA improves our understanding of current ecological conditions, leading to more effective and efficient use of available resources for ecosystem protection, management, and restoration efforts.

In 2019, the Washington State Parks and Recreation Commission (Parks) decided to use EIAs to gather relevant information for future planning, surveys, and conservation of vegetation resources on their properties. Parks contracted with the Washington Department of Natural Resources, Natural Heritage Program (WNHP) to conduct these assessments. EIAs were performed primarily at the Ecological Systems Classification level (Sayre et al., 2009; Rocchio & Crawford, 2015) in a subset of areas identified by Parks. In the process, WNHP also collected related information concerning select attributes in Parks' existing Vegetation Survey and Significant Natural Resources (SNR) geodatabases.

This final report represents an omnibus of data for all parks visited by WNHP in 2020 and 2021. We hope this information will aid State Parks staff in their ongoing stewardship of the diverse natural heritage within these parks.

1.1 Project Objectives

The project had three objectives. First, conduct rapid, field-based EIA assessments (i.e. Level 2 EIAs) of select ecological systems polygons provided by Parks. Second, update Parks' Vegetation Survey and Significant Natural Resources (SNR) databases with relevant information collected during the EIAs. Third, identify plant association element occurrences (EOs) for inclusion in WNHP's Biotics database.

1.1.1 Objective 1: Conduct Level 2 EIA Assessments of Designated Ecological Systems Polygons

The purpose of the Level 2 EIA was to update the ecological condition estimates of park areas that were most likely to be of conservation or restoration significance. Contractors (including WNHP staff) assigned the previous ecological condition estimates—using their professional judgment—during vegetation surveys and ecological assessments funded by Parks over the past several decades. The EIA is an updated, standardized methodology currently used by WNHP and the Natural Heritage network. The outcome of this effort will assist Parks with land use planning, conservation/restoration prioritization, and other work. WNHP staff were not restricted to sampling only those polygons that were targeted ahead of time. Additional areas were sampled if they appeared to represent rare and/or high quality ecosystem occurrences (see Objective 3).

1.1.2 Objective 2: Collect Additional Information in Support of State Parks Databases

In concert with the EIA data collection, WNHP staff also collected data for a subset of fields used in Parks' Vegetation Survey and Significant Natural Resources (SNR) databases. This included stand age estimates and confirming that all critically imperiled (G1) and imperiled (G2) plant association occurrences had been accurately classified. These data contribute to the long-term upkeep and utility of these databases.

1.1.3 Objective 3: Identify Element Occurrences on State Parks Properties

A third objective was to identify plant association EOs for inclusion in WNHP's Biotics database. EOs highlight areas of particular global and/or statewide conservation importance and are also used in WNHP's broader mission for conservation status ranking (i.e. rarity/threat assessments) and other objectives.

1.2 Project Scope

Parks manages roughly 57,000 hectares across greater than 200 properties (parks, heritage sites, trails, etc.) (Figure 1). Parks prioritized 21 properties for WNHP surveys, with an additional 7 to be assessed as time allowed (Table 1). Prioritization was based on known habitat quality along with impending management actions and/or ongoing planning efforts. Within the 28 combined units, Parks identified a subset of 527 ecological systems polygons for assessment, measuring approximately 18,000 total hectares. Polygons were in fair or better condition—based on previous vegetation surveys—and large enough to represent functional patches of their respective ecological systems. Polygons were aggregated from Parks' Vegetation Survey geodatabase, which documents past vegetation mapping efforts completed at the USNVC plant association scale by an assortment of contractors (including past WNHP staff, at certain parks).

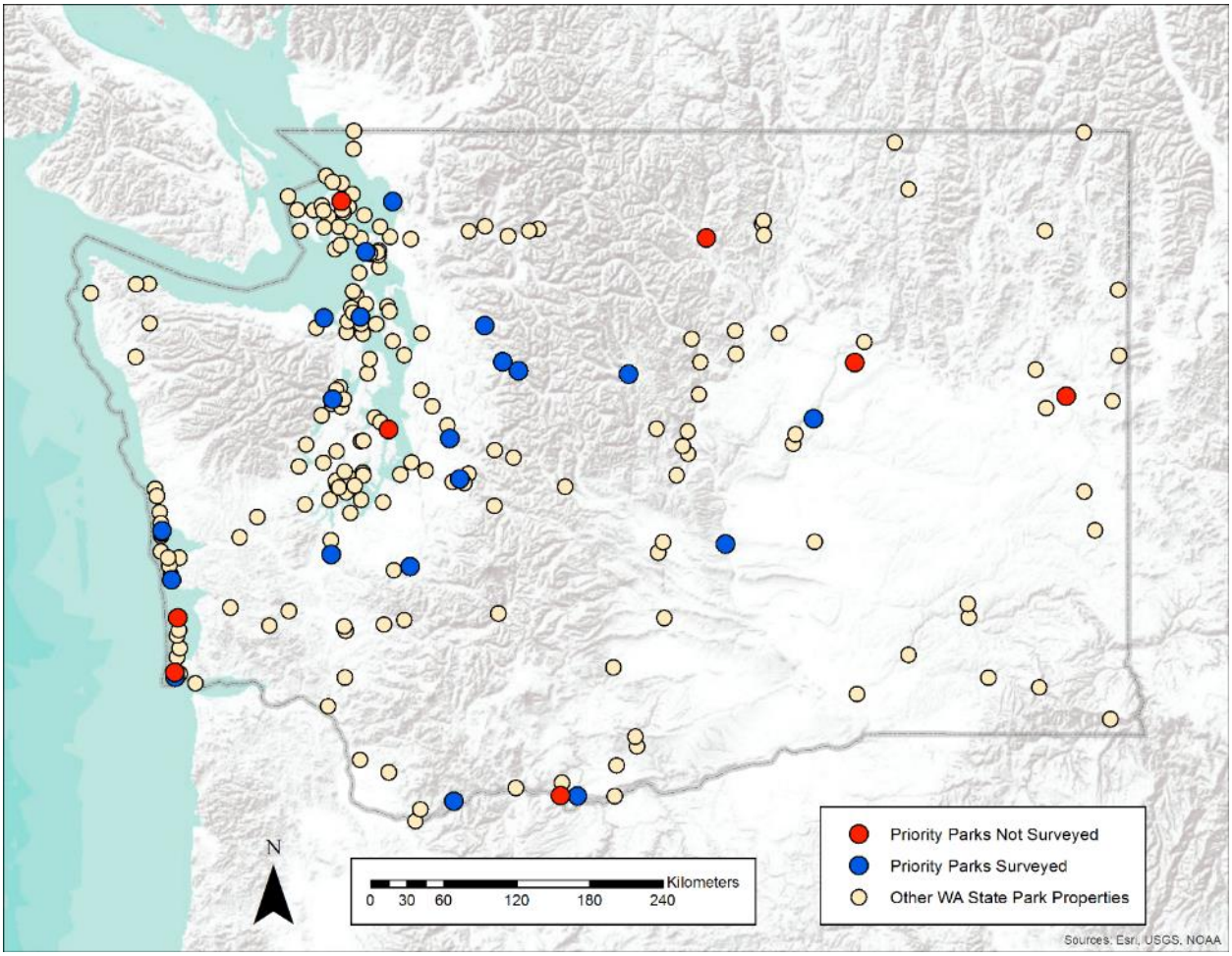

Figure 1. Project Scope. Trail systems managed by Parks (such as the Palouse to Cascades State Park Trail) are not displayed.

Table 1. Priority parks targeted for sampling. Individual polygons at some parks were not surveyed because of a) accessibility issues, b) late season phenology of herb dominated plant communities, c) unhealthy levels of smoke from forest fires, or d) reprioritization by Parks staff.

Park	Priority Level	# of Priority Polygons	# of Priority Polygons Surveyed
Beacon Rock	1	28	28
Cape Disappointment	1	33	11
Columbia Hills	1	13	13
Deception Pass	1	35	23
Ginkgo Petrified Forest	1	55	n/a (see Appendix F)
Lake Wenatchee	1	9	9
Ocean City	1	8	8
Pearrygin Lake	1	21	0
Riverside	1	22	0
Sun Lakes-Dry Falls	1	62	62
Doug's Beach	2	11	0

Park	Priority Level	# of Priority Polygons	# of Priority Polygons Surveyed
Grayland Beach	2	13	13
Leadbetter Point	2	18	0
Mount Pilchuck	2	3	3
Wallace Falls	2	7	7
Dosewallips	3	6	4
Larrabee	3	22	10
Millersylvania	3	14	11
Moran	3	20	0
Seashore Conservation Area	3	29	0
Steamboat Rock	3	27	0
Blake Island	4	6	0
Forks of the Sky	4	11	11
Fort Flagler	4	7	7
Green River Gorge	4	14	14
Miller Peninsula	4	12	12
Nisqually	4	8	8
Squak Mountain	4	5	5

In the end, a larger proportion of "Priority 4" parks were surveyed than originally anticipated. COVID-19 travel restrictions delayed the start of the 2020 field season until it was phenologically impractical to survey many of the high priority parks in eastern Washington.

2.0 Methods

2.1 EIA Overview

Ecological Integrity Assessments (EIA) summarize the ecological condition (i.e. ecological integrity) of individual occurrences of ecosystems through consideration of composition, structure, and ecological processes (Faber-Langendoen et al., 2019; Rocchio & Ramm-Granberg, 2019). The method can be applied to occurrences as small as 0.05 ha and as large as thousands of hectares. EIAs can be conducted at three different sampling intensities: Level 1 (entirely GIS-based), Level 2 (rapid, mostly qualitative, field-based), and Level 3 (intensive, quantitative, field-based). The EIA is intended to measure current ecological condition as compared to a reference standard via a multi-metric index of biotic and abiotic measures of condition, size, and landscape context. Each metric is rated by comparing measured values with expected values under relatively unimpaired conditions (i.e. the reference standard), and the ratings are aggregated into a total score. The EIA uses a scorecard matrix to communicate individual metric ratings, as well as an overall index of ecological integrity. All together, the EIA framework provides a standardized language for assessing and communicating ecosystem integrity across all terrestrial ecosystem types—upland and wetland ecosystems.

Classification is critical to both the development and application of an EIA. By constraining natural variability, classification helps to clarify whether differences in ecological condition are natural or anthropogenic. Developing ecological integrity indicators requires an understanding of the characteristic structure, composition, and processes of a wide variety of ecosystem types. By classifying ecosystem types, ecologists can account for the natural variability *within types* and thereby make the differences *between occurrences* of a given type more recognizable. In other words, classification helps differentiate between signal (indicators of degradation) and noise (natural variability). Classifications are important for establishing "ecological equivalency"—particularly important for setting restoration targets and benchmarks. EIA methods can be adapted to any number of classification schemes and ecoregional frameworks. The EIA used in this project is primarily based on ecological systems (Comer et al., 2003; Comer & Schulz, 2007; Rocchio & Crawford, 2015) and wetland subgroups, a modification of the U.S. National Vegetation Classification (USNVC) created by WNHP (Rocchio & Ramm-Granberg, In Progress). Note that some Assessment Areas (AAs) were defined at the association level of the USNVC for this project.

The metrics used in wetland/riparian (Table 2) and upland ecosystems (Table 3) are presented below. Detailed information on the metrics and the methodology used to score them may be found in Rocchio et al. (2020b, 2020c). Once scored, metrics may be rolled up into major ecological factor scores/ranks (e.g., landscape, buffer/edge, vegetation, hydrology, soils, and size). These major ecological factor scores are in turn rolled up into three primary rank factors: landscape context, condition, and size. Lastly, these three factors may then be integrated to calculate an overall EIA Rank (landscape context + condition) and EO Rank (EIA score + size). These different roll-up procedures are optional and dependent on the project objective. The EIA Rank summarizes the overall current ecological integrity of the stand (useful for prioritizing restoration or management actions). The integration of size into the EO Rank is useful for prioritizing sites for conservation, since larger stands are generally considered more important and more likely to retain their integrity than smaller occurrences. For more targeted insight into management needs, goals, and measures of success, land managers may have more interest in specific metric scores. In the

middle ground, primary and/or major ecological factor scores/ranks can be helpful for understanding the current status of primary ecological drivers. For example, a site may score very poorly in vegetation metrics, but have intact hydrology, indicating potential for restoration.

Table 2. Wetland and Riparian EIA Metrics

Primary Rank Factor	Major Ecological Factor	Metric/Variant NAME	Where Measured	Apply to:
LANDSCAPE CONTEXT	LANDSCAPE	**LAN1 Contiguous Natural Cover** (0-500 m)	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
		LAN2 Land Use Index (0-500 m)	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
	BUFFER	**BUF1 Perimeter with Natural Buffer**	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
		BUF2 Width of Natural Buffer Width	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
		BUF3 Condition of Natural Buffer	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
CONDITION	VEGETATION	**VEG1 Native Plant Species Cover**	Field	All Types (not for use with sub-AAs or most point-based AAs)
		<u>*Submetrics*</u>*:* *VEG1a. Tree Stratum*		Flooded & Swamp Forest Formation
		VEG1b. Shrub/Herb Stratum		All Types
		VEG2 Invasive Nonnative Plant Species Cover	Field	All Types
		VEG3 Native Plant Species Composition	Field	All Types
		<u>*Submetrics*</u>*:* *VEG3a. Native Diagnostic/Functional Species*		See USNNVC Subgroup descriptions for guidance
		VEG3b. Native Species Diversity		See USNNVC Subgroup descriptions for guidance
		VEG3c. Native Increasers		See USNNVC Subgroup descriptions for guidance
		VEG3d. Native Decreasers		See USNNVC Subgroup descriptions for guidance
		VEG4 Vegetation Structure	Field	All Types (variant differs by USNVC Formation)
		VEG4, variant 1		Flooded & Swamp Forest Formation
		<u>*Submetrics*</u>*:* *VEG4 var1a. Canopy/Subcanopy Age Class diversity*		
		VEG4 var1b. Old/Large Live Trees		

Primary Rank Factor	Major Ecological Factor	Metric/Variant NAME	Where Measured	Apply to:
		VEG4, variant 3		Freshwater Marsh, Wet Meadow and Shrubland Formation
		VEG4, variant 4		Salt Marsh Formation
		VEG4, variant 5		Bog and Fen Formation
		Submetrics: *VEG4 var5a. Tree Structure*		
		VEG4 var5b. Shrub/Herb Structure		
		VEG4 var5c. Bryophyte Structure		
		VEG4, variant 6		Aquatic Vegetation Formation
		VEG5. Woody Regeneration	Field	Flooded & Swamp Forest Formation
		VEG6 Coarse Woody Debris	Field	Flooded & Swamp Forest Formation and optional for shrub-dominated types
		VEG6, variant 1		Forested Wetlands
		Submetrics: *VEG6 var.1a. CWD Size Diversity*		
		VEG6 var.1b. CWD Decay Class Diversity		
		VEG6 var.1c. Snag Size Diversity		
		VEG6 var.1d. Snag Decay Class Diversity		
		VEG6, variant 2		Non-forested Wetlands
		Submetrics: *VEG6 var2a. Litter Source*		
		VEG6 var2b. Litter Accumulation		
	HYDROLOGY	**HYD1 Water Source**	Field & Office	All Types (varies by HGM Class)
		HYD1, variant 1		Riverine (non-tidal)
		HYD1, variant 2		Organic Soil Flats, Mineral Soil Flats
		HYD1, variant 3		Depression, Lacustrine, Slope
		HYD1, variant 4		Estuarine Fringe (tidal)
		HYD2 Hydroperiod	Field	All Types (varies by HGM)
		HYD2, variant 1		Riverine (non-tidal)
		HYD2, variant 2		Organic Soil Flats, Mineral Soil Flats
		HYD2, variant 3		Depression, Lacustrine, Slope
		HYD2, variant 4		Estuarine Fringe (tidal)
		HYD3 Hydrologic Connectivity	Field	All Types (varies by HGM)
		HYD3, variant 1		Riverine (non-tidal)

Primary Rank Factor	Major Ecological Factor	Metric/Variant NAME	Where Measured	Apply to:
		HYD3, variant 2		Organic Soil Flats, Mineral Soil Flats
		HYD3, variant 3		Depression, Lacustrine, Slope
		HYD3, variant 4		Estuarine Fringe (tidal)
	SOIL	**SOI1 Soil Condition**	Field	All Types (variant differs by USNVC Formation)
		SOI1, variant 1		Flooded and Swamp Forest, Freshwater Marsh, Wet Meadow and Shrubland (nontidal), Bog and Fen, and Aquatic Vegetation formations.
		SOI1, variant 2		Salt Marsh Formation and Freshwater Marsh, Wet Meadow, and Shrubland (tidal) Formation
SIZE	SIZE	**SIZ1 Comparative Size (Patch Type)**	Office then field check	All Types (ratings vary by patch type); not for use with sub-AAs or points
		SIZ2 Change in Size (optional)	Office then field check	All Types (not for use with sub-AAs or points)

Table 3. Upland EIA Metrics.

Primary Rank Factor	Major Ecological Factor	Metric/Variant Name	Where Measured	Apply to:
LANDSCAPE CONTEXT	LANDSCAPE	**LAN1 Contiguous Natural Cover** (0-500 m)	Office then field check	All EIA modules and AA sizes (for large AAs, score entire AA, not assessment points)
		LAN2 Land Use Index (0-500 m)	Office then field check	All EIA modules and AA sizes (for large AAs, score entire AA, not assessment points)
	EDGE	**EDG1 Perimeter with Natural Edge**	Office then field check	All EIA modules (all sizes; for large AAs, score entire AA, not assessment points)
		EDG2 Width of Natural Edge	Office then field check	All EIA modules (all sizes; for large AAs, score entire AA, not assessment points)
		EDG3 Condition of Natural Edge	Office then field check	All EIA Modules (small AAs)
CONDITION	VEGETATION	**VEG1 Native Plant Species Cover**	Field	All EIA modules (all sizes); Use lowest submetric score
		<u>*Submetrics*</u>*: VEG1a. Tree Stratum*		Forested EIA modules (all sizes)
		VEG1b. Shrub/Herb Stratum		All EIA Modules (all sizes)
		VEG2 Invasive Nonnative Plant Species Cover	Field	All EIA Modules (all sizes)
		VEG3 Native Plant Species Composition	Field	All EIA Modules (all sizes)
		<u>*Submetrics*</u>*: VEG3a. Native Diagnostic/Functional Species*		
		VEG3b. Native Species Diversity		
		VEG3c. Native Increasers		
		VEG3d. Native Decreasers		
		VEG4 Vegetation Structure	Field	All EIA Modules (all sizes; variant differs by EIA Module)
		VEG4, variant 7		Dry Forests and Woodlands (all sizes)
		VEG4, variant 8		Mesic / Hypermaritime Forests (all sizes)

Primary Rank Factor	Major Ecological Factor	Metric/Variant Name	Where Measured	Apply to:
		Submetrics for VEG4 var7 and var8 *VEG4 var7/8a. Canopy Structure*		
		VEG4 var7/8b. Old/Large Live Trees		
		VEG4, variant 9		Shrublands (all sizes)
		Submetrics: VEG4 var9a Shrub cover		
		VEG4 var9b Tree encroachment		
		VEG4, variant 10		Shrub-Steppe (all sizes)
		VEG4, variant 11		Grasslands / Meadows (all sizes)
		Submetrics for VEG4 var10 and var11: VEG4 var10/11a Woody Vegetation Cover		
		VEG4 var10/11b Bunchgrass Cover		
		VEG4 var10/11c Biological Soil Crust		
		VEG4, variant 12		Bedrock / Cliffs (all sizes)
		VEG5 Woody Regeneration	Field	Forested EIA modules (all sizes; variant differs by EIA Module)
		VEG5, variant 2		Dry Forests and Woodlands (all sizes)
		VEG5, variant 3		Mesic / Hypermaritime Forests (all sizes)
		VEG6 Coarse Woody Debris	Field	Forested EIA modules (all sizes; variant differs by EIA Module)
		VEG6, variant 3		Dry Forests and Woodlands (all sizes)
		VEG6, variant 4		Mesic / Hypermaritime Forests (all sizes)
		Submetrics for VEG6 var3 and var4: VEG6 var3/4a. CWD Size Diversity		
		VEG6 var3/4b. CWD Decay Class Diversity		

Primary Rank Factor	Major Ecological Factor	Metric/Variant Name	Where Measured	Apply to:
		VEG6 var3/4c. Snag Size Diversity		
		VEG6 var3/4d. Snag Decay Class Diversity		
		VEG6, variant 5		Shrub-Steppe; Grasslands / Meadows (all sizes)
		Submetrics: *VEG6 var5a. Litter Source*		
		VEG6 var3/4d. Litter Accumulation		
	SOIL	**SOI1 Soil Condition**	Field	All EIA Modules (all sizes)
		SOI1, variant 3		All EIA Modules (all sizes)
SIZE	SIZE	**SIZ1 Comparative Size (Patch Type)**	Office then field check	All EIA Modules (for large AAs, score entire AA, not assessment points)
		SIZ2 Change in Size (Optional)	Office then field check	Required for small AAs of large-patch ecosystems; optional for other small AAs

2.2 EIA Field Work

2.2.1 Site-Based Surveys

At each priority polygon (=AA), WNHP staff traversed the area to ensure that the full ecological variation of the polygon was observed. Variation was interpreted from aerial photography, lidar derivatives, modeled stand age, and other remote sensing data, as well as through observation of ecological variation on-site. After observing a polygon's internal variation, EIA metrics were scored based on protocols and rating criteria in the EIA manuals (Rocchio et al., 2020b, 2020c). For large polygons, discrete assessment points were often established at subjectively chosen locations distributed across the assessment area. Scores for these individual points were then integrated into an overall score. Landscape context and size metrics were finalized via GIS assessments in the office.

2.2.2 Data Collected for Parks vegetation Survey and Significant Natural Resources Databases

Along with EIA metric ratings, scores, and comments, Parks requested additional data for updating their plant association-scale Vegetation Survey geodatabase (Table 4). Much of this information is used in scoring EIA metrics as well, though the terminology and/or bins may differ. For example, WNHP estimates the stand development stage (Van Pelt, 2007, 2008) of forested ecosystems to as part of interpreting vegetation structure (VEG4), woody regeneration (VEG5), and coarse woody debris (VEG6), but these development stages do not map perfectly to the binned age groups used in Parks databases.

Table 4. Additional Data Collected for Parks at the Plant Association Scale

Stand Age Estimate (for forested ecosystems)	1 = very young, 0-40 years
	2 = young, 40-90 years
	3 = mature, 90-200 years
	4 = old growth, 200+ years
	5 = young with scattered old growth trees (2-10 trees/ac)
	6 = mature with scattered old growth trees
	7 = young and mature
Primary Plant Association	Assessments were primarily applied at the ecological systems (uplands) and subgroup (wetlands) scales. However, WNHP confirmed presence of all G1 and G2 plant associations identified in existing association-scale vegetation at the park. WNHP also confirmed that these associations were components of the larger ecological system to which they had been crosswalked. Other association calls (for types with lower conservation status ranks) were also confirmed or revised as time allowed. Before going in the field, WNHP staff crosswalked primary plant association calls in Parks' Vegetation Survey database to their current names and EL codes as of USNVC Version 2.03 (hierarchy 36).
General Ecological Condition of the Primary Plant Association	Rapid, qualitative ("best professional judgement") estimate of plant association polygon (A, B/C, or D). These estimates were made whenever the condition of a component plant association polygon varied significantly from the EIA-derived condition of the larger ecological system polygon. Otherwise, this data field was given the same value as the overall ecological system-scale EIA Rank. Plant association polygons identified as potential EOs in the field (See Section 2.2.3) received full EIAs at the association-scale.
Plant Association Scale Comments	Noted recent disturbance, invasive species patches, etc. within individual plant association polygons.

Updating park vegetation mapping was not the focus of this project. However, defining (i.e. mapping) assessment areas is a critical piece of any EIA and requires accurate vegetation classification. In addition to confirming plant association calls (Table 4), WNHP adjusted the boundaries to ensure that assessment areas did not overlap multiple ecological systems (for uplands) or subgroups (for wetlands). WNHP also applied various tweaks such as fixing slivers between plant association polygons and park boundaries.

2.2.3 Polygons Meeting 'Element Occurrence' Criteria

WNHP revisited numerous documented element occurrences (EOs) within the parks. EOs are specific sites or stands of a given ecosystem type that have significant conservation value (http://www.natureserve.org/conservation-tools/standards-methods/element-occurrence-data-standard). Occurrences are prioritized for inclusion in WNHP's database based on a combination of two ranks: the conservation status rank (CSR) and the element occurrence rank (EO Rank) (https://www.dnr.wa.gov/NHPmethods). The CSR establishes how rare and threatened that *ecosystem* is across its global and subnational (i.e. state) range. The EO Rank integrates the EIA rank and Size score for a specific *occurrence* of the ecosystem (Rocchio et al., 2020b, 2020c). The EIA and EO Ranks range from "A" (excellent ecological integrity) to "D" (poor ecological integrity). A decision matrix (Table 5) is then used to determine whether the occurrence meets the criteria for an EO. Essentially, most occurrences of rare ecosystem types, regardless of their condition, are considered EOs, while more common ecosystem types must be in good to excellent condition to receive that designation.

Table 5. Decision matrix for identifying WNHP element occurrences (EOs).

<table>
<tr><th colspan="2">EORANK
Global Rank
State Rank</th><th>G1S1, G2S1, GNRS1, GUS1</th><th>G2S2, GNRS2, G3S1, G3S2, GUS2</th><th>GUS3, GNRS3, G3S3, G4S1, G4S2, G5S1, G5S2, any SNR</th><th>G4S3, G4S4, G5S3, G5S4, G5S5, GNRS4, GNRS5, GUS4, GUS5</th></tr>
<tr><td colspan="2">A+ (3.8 to 4.0)</td><td>EO</td><td>EO</td><td>EO</td><td>EO</td></tr>
<tr><td colspan="2">A- (3.5 to 3.79)</td><td>EO</td><td>EO</td><td>EO</td><td>EO</td></tr>
<tr><td colspan="2">B+ (3.0 to 3.49)</td><td>EO</td><td>EO</td><td>EO</td><td rowspan="3">Not an Element Occurrence</td></tr>
<tr><td colspan="2">B- (2.5 to 2.99)</td><td>EO</td><td>EO</td><td>EO</td></tr>
<tr><td colspan="2">C+ (2.0 to 2.49)</td><td>EO</td><td>EO</td><td rowspan="2">Not an Element Occurrence</td></tr>
<tr><td colspan="2">C- (1.5 to 1.99)</td><td>EO</td><td rowspan="2">Not an Element Occurrence</td></tr>
<tr><td colspan="2">D (1.0 to 1.49)</td><td>EO</td></tr>
</table>

In addition to revisits, WNHP identified additional plant association polygons meeting the minimum criteria for EOs. Historically, state parks have been more intensively surveyed than most of Washington, so how are we just now identifying new EOs? A combination of updated vegetation classifications, revised conservation status ranks, and standardized assessment methods (EIA) help to highlight stands that might have otherwise fallen through the cracks. When rare or high-quality common USNVC plant associations were encountered during field inventories conducted for this project, WNHP ecologists used the standards outlined above to determine whether the polygon met EO criteria. All element occurrences identified by WNHP were assessed at the USNVC plant association scale.

2.3 Modifications to Standard EIA Methodology

With standard EIA methodology, landscape metrics (LAN1 Contiguous Natural Land Cover and LAN2 Land Use Index) are assessed within 500m of each *assessment area* (i.e. polygon). As a time-saving measure for this project, and in consideration of Parks management objectives, WNHP assessed landscape metrics within 500m of each *park unit* and then applied those same metric scores to each assessment area within the park. However, that naturally obfuscates variation in the landscape immediately surrounding individual polygons in the park. Under this system, for example, a shrub swamp bordering a parking lot on the edge of the park will receive the same landscape metric scores as one surrounded by natural vegetation at the center of the park. With that in mind, WNHP re-assessed landscape metrics at the scale of the individual assessment area for any polygons that otherwise appeared to meet EO criteria.

2.3.1 Ginkgo Petrified Forest Methodology

Ginkgo Petrified Forest State Park was mapped in 2018 and divided into 399 finely mapped plant association polygons. 347 of those association polygons were aggregated into 55 priority ecological system polygons (totally 2651 hectares) by Parks. At the time of our surveys, Parks staff were also working on a proposal to designate much of the Park as a Natural Area, so there was a high degree of interest in this unit. Complicating matters was the fact that an estimated 78% of the park burned in 2018—immediately after contractors finished their vegetation map and condition estimates (Morrison et al., 2019). Because of this combination of factors, we chose to a assess a stratified random sample of vegetation polygons, using contractor-estimated condition grades, mapped plant association, and whether or not the polygon burned in 2018 to distribute random assessment areas across the park. The full methodology is provided in Appendix F.

2.4 Data Analysis and Storage

WNHP uses an automated Microsoft Excel EIA workbook to calculate rolled-up major ecological factors, primary rank factors, and overall EIA scores. Metric ranks, comments, and calculations (buffer widths, etc.) are entered into this workbook. Raw metric scores, calculated scores, and associated comments are stored in individual worksheets within the workbook. Field forms will be scanned and stored on DNR servers. Modified vegetation survey mapping and EO locations for each state park are stored in a file geodatabase (linked to the Excel workbook by the WNHP_ES_Poly_ID field). EO information is also stored in WNHP's Biotics database.

2.4.1 Parks' Vegetation Survey Geodatabase Updates

Mapping and attribute updates to Parks' Vegetation Survey database are included in an accompanying geodatabase, along with miscellaneous survey points. All updates have been made in new feature classes linked to the Vegetation Survey by the 'keylink' field. Additional fields are defined in Table 6.

Table 6. WNHP Data Fields Appended to Parks' Vegetation Survey Geodatabase

Field	Definition
WNHP_Observer	WNHP staff member initials IJW = Irene Weber RAB = Bec Braisted RXC = Rex Crawford

Field	Definition
	TRG = Tynan Ramm-Granberg
WNHP_Date	Date of survey (MM/DD/YYYY)
WNHP_Stand_Age	Stand age estimate 1 = very young, 0-40 years 2 = young, 40-90 years 3 = mature, 90-200 years 4 = old growth, 200+ years 5 = young with scattered old growth trees (2-10 trees/ac) 6 = mature with scattered old growth trees 7 = young and mature
WNHP_EL_CODE	EL code associated with the association entered in “WNHP_PA1”
WNHP_PA1	Primary plant association (PA1) assigned by WNHP in the field. For G1 and G2 associations, if we entered the polygon, this field was always populated with a plant association name. For other conservation status ranks, if we did not confirm or reject the assigned plant association, we left this field blank.
WNHP_RANK1	Either the rough, “best professional judgment” condition assigned in the field or the calculated EIA rank for the polygon. Entries allowed: A+, A, A-,B+, B, B-,B/C, C+, C, C-, D. If the vegetation PA polygon covers the extent of the combined ecological system polygon, or if the PA polygon was assessed independently, the calculated EIA rank was entered.
WNHP_RankMethod	EIA = WNHP_RANK1 was assigned via a calculated EIA rank BPJ = WNHP_RANK1 was assigned via a “best professional judgment” in the field. These polygons may still have calculated EIA ranks at the ecological systems level in the EIA workbook. MOD = WNHP_RANK1 was assigned via a modeling process (Ginkgo Petrified Forest only). See Appendix F for more details.
WNHP_LANMethod	Park = Landscape metrics were assessed using the park boundary (see Section 2.3 Modification to Standard EIA Methodology) Polygon = Landscape metrics were assessed using the boundary of the PA or ecological systems polygon Other = Some other landscape metric method was used. See comments associated with that assessment area. Most commonly this means that multiple ecological system polygons were aggregated for the purposes of assessing landscape metrics.
WNHP_Comments	Polygon-specific comments such as management concerns or classification issues
WNHP_EcoSysCode	The code corresponding to the ecological system
WNHP_EcoSysDefin	Full name of the ecological system
WNHP_ES_Poly_ID	This is the assessment area (usually ecological system-scale) ID we used in the field. This links the spatial data to the EIA data (Excel workbook)
Perimeter_m	Perimeter in meters, used for calculation of EDG1
Area_ha	Area in hectares, used for calculation of SIZ1
Estimated_CEGL_ WNHP_Update	Before going in the field, WNHP crosswalked the EL Code for the PA1 to the current version of the USNVC. It is referred to here as “estimated” because the PA had not yet been confirmed in the field. This may differ from WNHP_EL_Code, which is the confirmed field-based association call.
Estimated_Current_ Name	As with “Estimated_CEGL_WNHP_Update”, this is the crosswalked current name for the PA1 assigned by the previous surveyors (updated to the current USNVC hierarchy). This may differ from WNHP_PA1, which is the confirmed field-based association call.
Estimated_Current_ CSR	This is the conservation status rank associated with the PA1 assigned by the previous surveyors (updated to the current USNVC hierarchy)
WNHP_Note	Occasional notes referring to the estimated classification updates
Burn_2018	Used only at Ginkgo Petrified Forest, this indicates whether or not this polygon appears to have burned in the most recent major fires at the park (summer 2018)

3.0 Results

In total, we surveyed 325 assessment areas, in 39 ecological systems, across 20 parks (Table 1). Some priority ecological system-scale polygons that Parks identified were subdivided or lumped. Polygons were split either because of classification changes made in the field, or because the component plant association polygons varied too greatly in condition. On the other hand, multiple priority polygons of the same ecological systems were occasionally assessed together when their conditions were very similar. At the start of this project, there were 5,280 polygons in Parks' Vegetation Survey Geodatabase, totaling 47,625 ha. Our initial assessment areas encompassed 1,023 of these polygons (12,845 ha). Of that, we conducted level 2 or modeled EIAs across 10,104 ha (this total excludes "best professional judgment" scores that were were assigned outside of priority ecological systems polygons) (Table 7). 80 new EOs were identified for 58 different USNVC plant associations in 25 different ecological systems. Another 23 existing EOs were revisited and updated.

Table 7. Ecological Systems assessed during 2020 and 2021 field seasons.

Ecological System	Area Surveyed (ha)
Columbia Basin Foothill and Canyon Dry Grassland	18.7
Columbia Basin Foothill Riparian Woodland and Shrubland	29.4
Columbia Plateau Scabland Shrubland	1647.9
Columbia Plateau Vernal Pool	0.2
East Cascades Oak-Ponderosa Pine Forest and Woodland	46.8
Inter-Mountain Basins Alkaline Closed Depression	26.7
Inter-Mountain Basins Big Sagebrush Steppe	773.8
Inter-Mountain Basins Cliff and Canyon	36.3
Inter-Mountain Basins Greasewood Flat	14.2
North American Arid West Emergent Marsh	118.7
North Pacific Bog and Fen	11.3
North Pacific Broadleaf Landslide Forest and Shrubland	235.7
North Pacific Coastal Interdunal Wetland	24.5
North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	475.6
North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest	187.3
North Pacific Hardwood-Conifer Swamp	132.8
North Pacific Herbaceous Bald and Bluff	30.7
North Pacific Hypermaritime Shrub and Herbaceous Headland	8.5
North Pacific Lowland Riparian Forest and Shrubland	172.5
North Pacific Maritime Coastal Sand Dune	8.5
North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	1968.2
North Pacific Maritime Mesic Parkland	194.3
North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	2409.4
North Pacific Mesic Western Hemlock-Silver Fir Forest	143.0
North Pacific Montane Massive Bedrock, Cliff and Talus	7.2
North Pacific Mountain Hemlock Forest	297.9

Ecological System	Area Surveyed (ha)
North Pacific Ruderal Riparian and Swamp Forest	5.0
North Pacific Seasonal Sitka Spruce Forest	206.7
North Pacific Shrub Swamp	118.9
Northern Columbia Plateau Basalt Pothole Pond	1.2
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	39.9
Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland	2.5
Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland	699.3
Rocky Mountain Alpine Bedrock and Scree	2.0
Rocky Mountain Alpine-Montane Wet Meadow	2.1
Rocky Mountain Subalpine-Montane Riparian Shrubland	1.1
Temperate Pacific Freshwater Aquatic Bed	2.6
Temperate Pacific Freshwater Emergent Marsh	3.2
Temperate Pacific Tidal Salt and Brackish Marsh	0.3
Total	**10,104**

Figure 2 and Figure 3 show the breakdown of EIA ranks by number of polygons and by area. The clustered distribution around the B+/B- range ("good" integrity) was expected—Parks asked us to survey those areas most likely to be of conservation interest (e.g. we rarely sampled known poor-integrity polygons unless they represented very rare types). There are also relatively few "excellent" integrity ("A") polygons. Upland forests represented a large proportion of our sample—we conducted EIAs across more than 6000 ha of forestland—and even stands with relatively good onsite condition were marked down for metrics associated with logging history. The vast majority of upland forests are also large-patch or matrix communities, so a greater proportion of their EIA rank is determined by their landscape context. Most of the parks we visited represented relatively small areas within fragmented landscapes, resulting in landscape context metrics commonly in the "fair" integrity ("C") range.

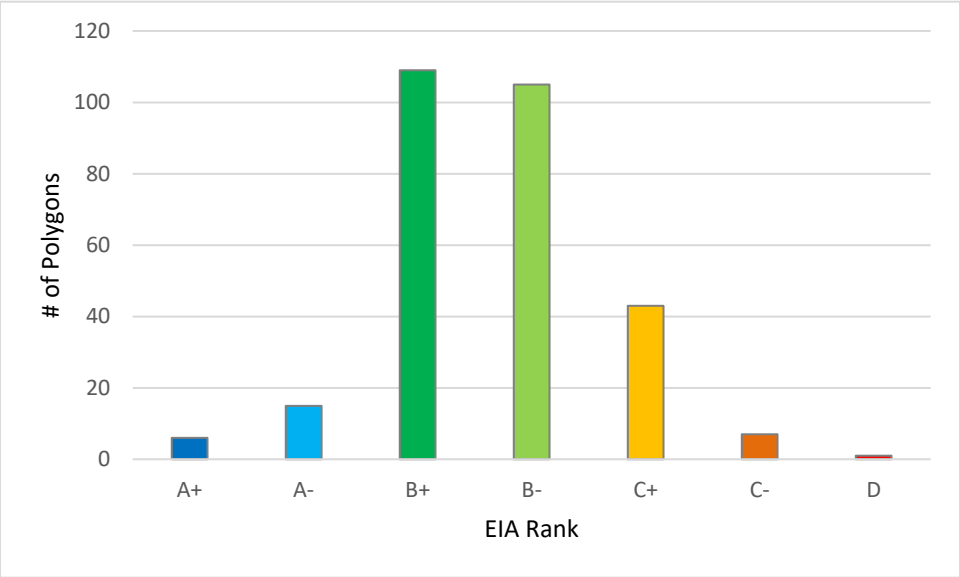

Figure 2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

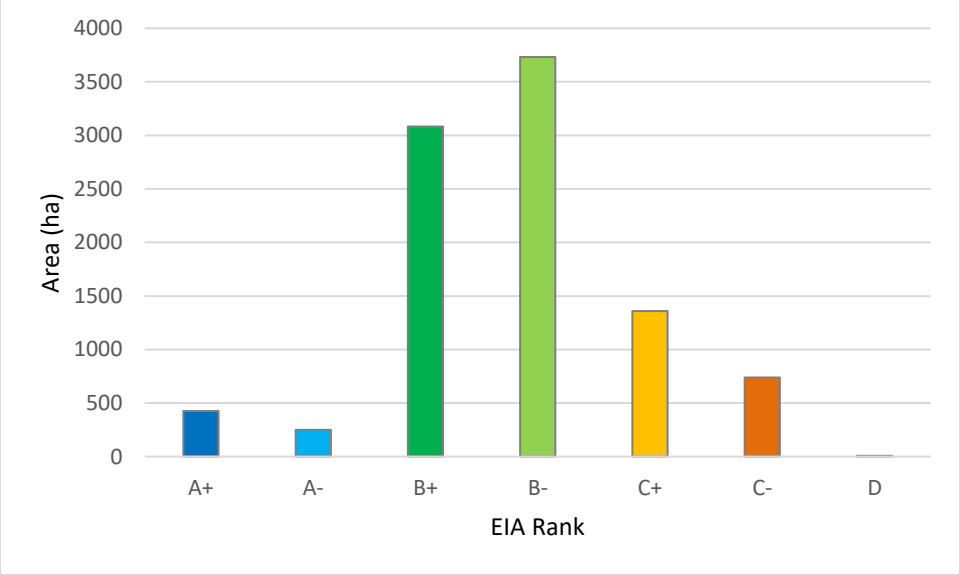

Figure 3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Figure 4 through Figure 14 show the distribution in EIA ratings for each of the condition metrics. For information on landscape context, see the park-specific tables in Appendices A-T, or the accompanying Excel spreadsheet. Roughly 65% of the assessed area had 95-100% relative native plant cover (A- to A) (Figure 4). Ratings of the absolute cover of invasive plants were more mixed, but the plurality had <1 % cover (A) (Figure 5). The preponderance of high ratings in these two metrics is at least partially attributable, again, to the large proportion of forests assessed as part of this project, particularly conifer forests of western Washington. Aside from early seral stands,

these communities are characteristically resistant to exotic/invasive species, which often thrive in sunnier and/or more disturbed environments.

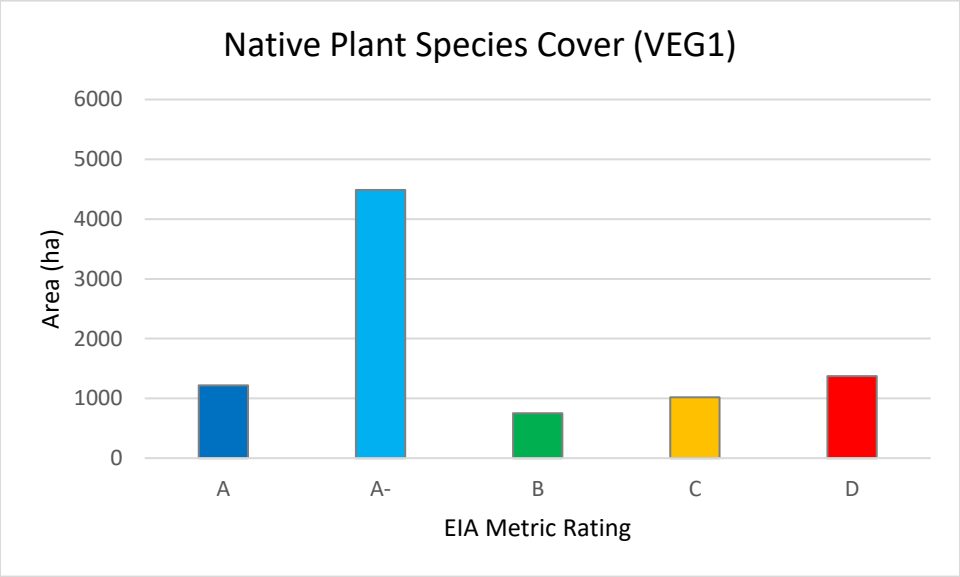

Figure 4. Native Plant Species Cover (VEG1) metric ratings, by area.

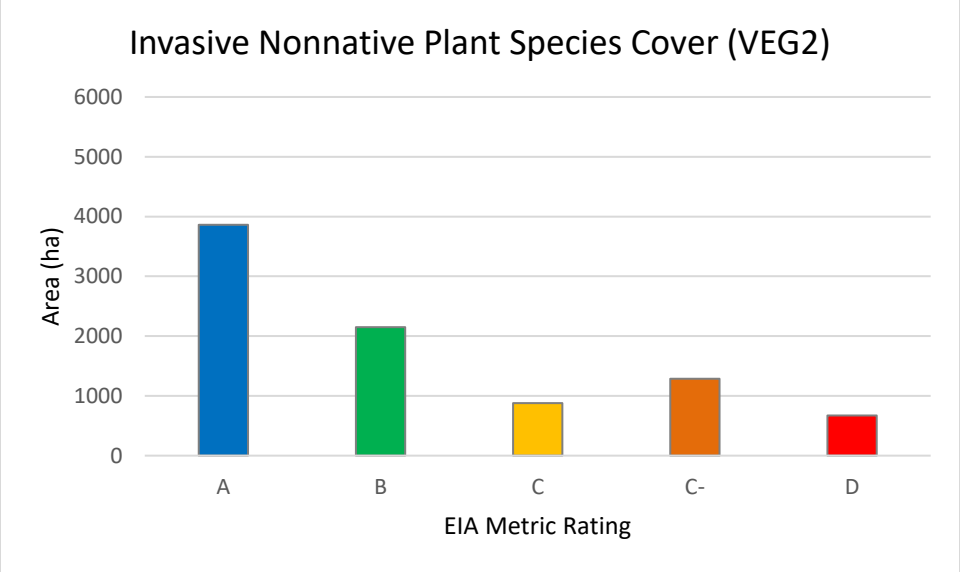

Figure 5. Invasive Nonnative Plant Species Cover (VEG2) metric ratings, by area.

The lowest ratings in VEG1 and VEG2 were generally found in dry grasslands and herbaceous wetlands. Control of exotic species in these habitats involves intensive management over frequently large areas. In riparian systems in which upstream areas are private or managed by other entities, control may not be practical at all.

The majority of the sampled area (61%) received an A in Native Plant Species Composition (Figure 6). This metric is divided into four submetrics: 1) diagnostic species, 2) diversity, 3) native increasers, and 4) native decreasers. The diagnostic species for most forested plant communities west of the Cascade Crest—again, the majority of or our sampled area—recover relatively quickly from logging, the primary stressor. Similarly, most of these communities are naturally species-poor, so the diversity metric is rarely marked down. The native increaser submetric was occasionally marked down in these stands, in cases where species indicative of anthropogenic disturbance were prominent (such as *Alnus rubra*), but native decreasers (plants sensitive to anthropogenic disturbance) were rarely assessed. The increaser and decreaser submetrics have the greatest utility in plant communities for which grazing, soil disturbance, and/or changes in fire frequency are primary stressors.

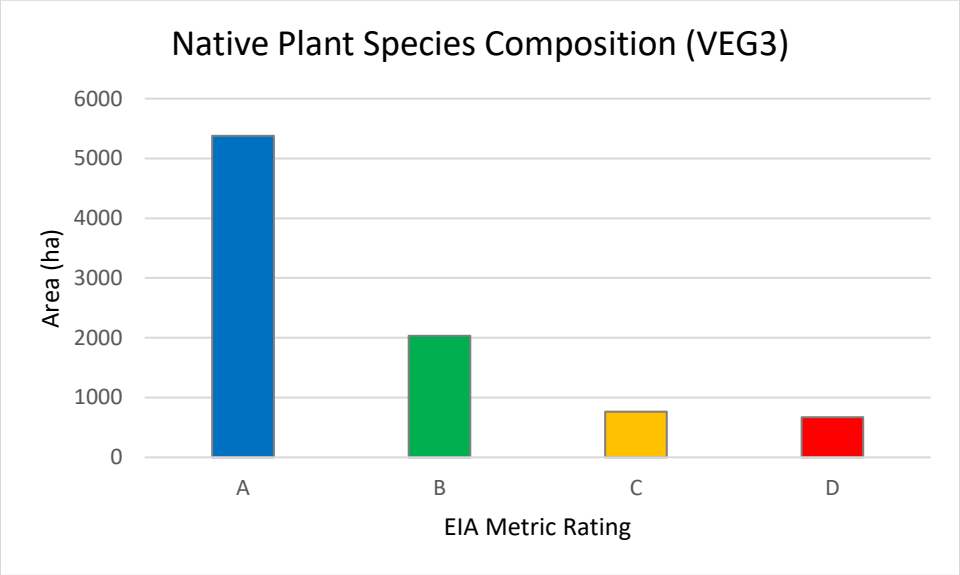

Figure 6. Native Plant Species Composition (VEG3) metric ratings, by area.

Vegetation Structure (VEG4) is where the logging history of these forested stands becomes apparent (Figure 7). Many of the areas we assessed were in the Maturation I or Maturation II stand development stages (*sensu* Van Pelt, 2007, 2008) having been logged during Euroamerican settlement and into the 20th century (Figure 8). Note that young stands that develop after *natural* disturbances are not marked down in this metric--in fact, such stands are rare in western Washington today, relative to presettlement norms. In most cases, vegetation structure in these westside forests will improve naturally, over time—although stands previously managed as intensive plantations will likely require some level of restoration thinning to jumpstart the process.

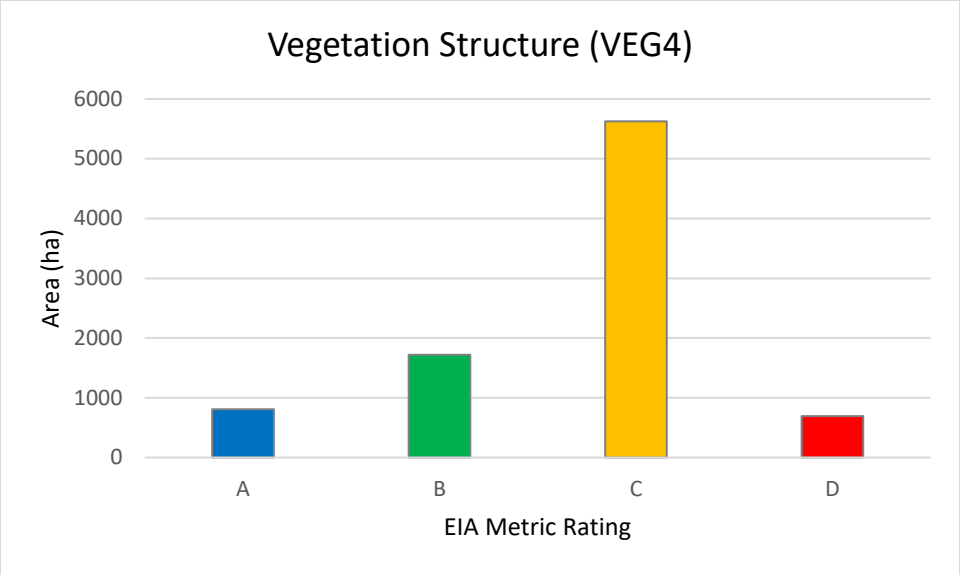

Figure 7. Vegetation Structure (VEG4) metric ratings, by area.

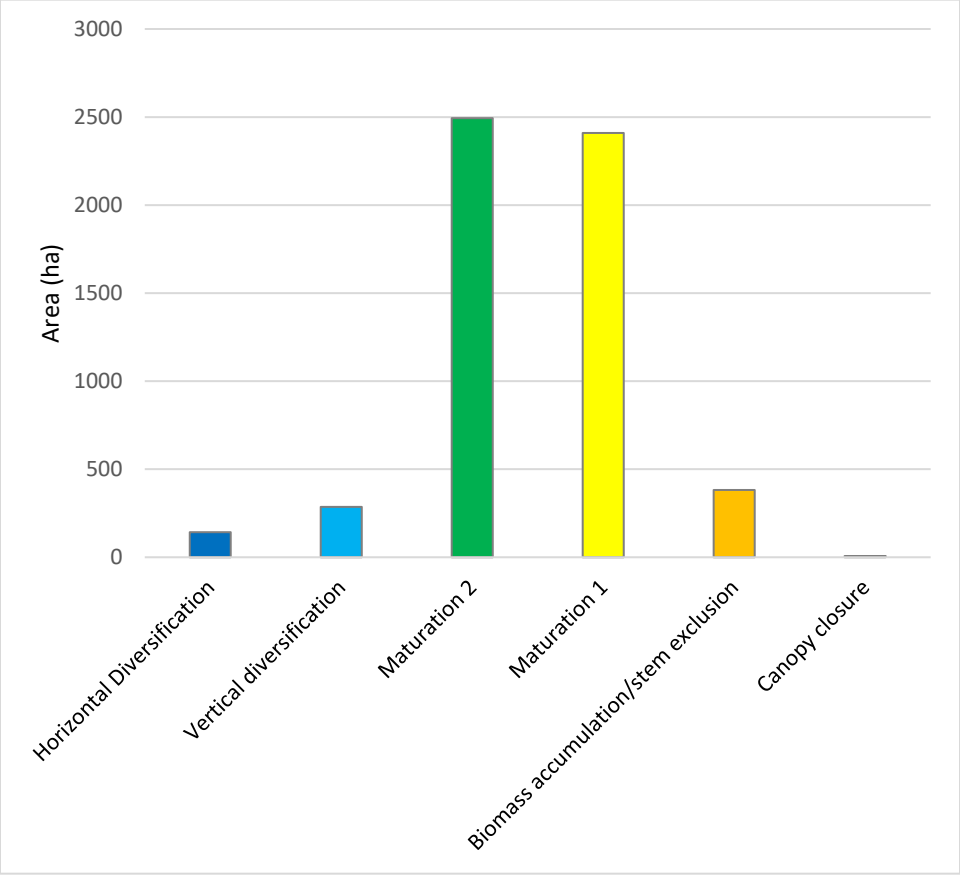

Figure 8. Stand Development Stages of forested plant communities (Van Pelt, 2007, 2008), by area.

Woody Regeneration (VEG5) was often marked down slightly in communities in which *Tsuga heterophylla* is a dominant regenerating tree (Figure 9). *T. heterophylla* regenerates best when

there are nurse logs or other organic debris on which to germinate. Such debris is usually reduced in logged stands (VEG6, Figure 10), along with snags. A few young stands also appeared to have been planted, resulting in more substantially reduced VEG5 scores. Planted stands typically have reduced species diversity. Planting is often done in conjunction with herbicide treatments in order to bypass the shrubland seral stage, with implications for nitrogen fixation and wildlife habitat.

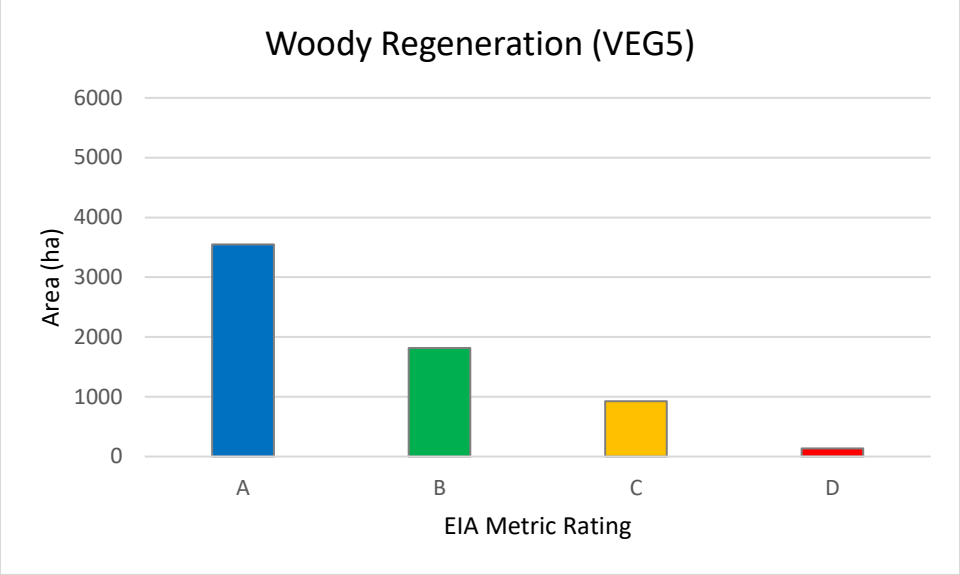

Figure 9. Woody Regeneration (VEG5) metric ratings, by area. Not scored for all plant communities.

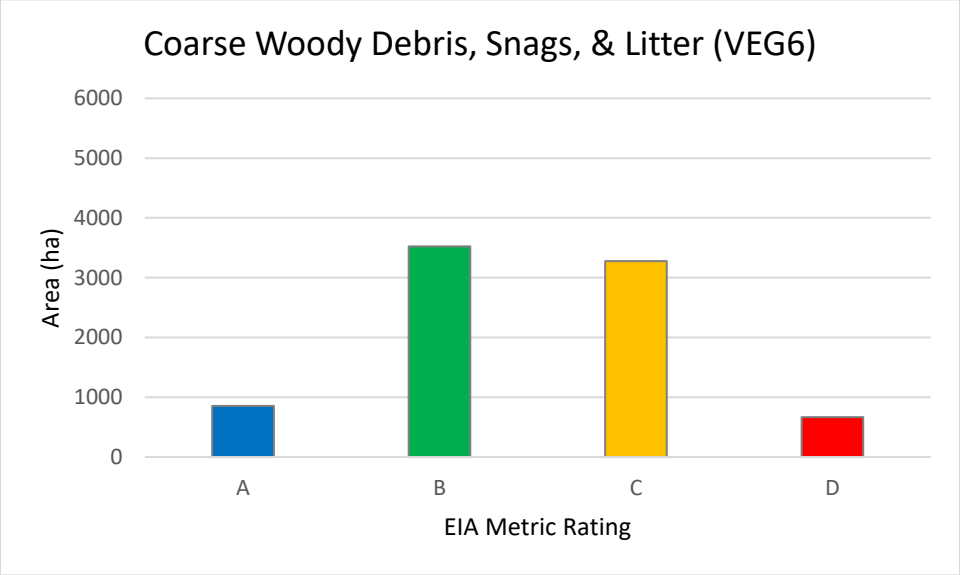

Figure 10. Coarse Woody Debris, Snags, & Litter (VEG6) metric ratings, by area. Not scored for all plant communities.

Besides tree regeneration, the reduction in coarse woody debris and snags also impacts nutrient cycles (Harmon & Hua, 1991; North et al., 1997; Luyssaert et al., 2008), soil moisture (Marra & Edmonds, 1996), and habitat for invertebrates, fungi, bryophytes, birds, and small mammals (Marra & Edmonds, 1998; Bull, 2002). While less important in mesic westside forests than in eastern Washington, the amount of CWD also has implications for the movement of fire through the ecosystem. Trees that die and become snags away from campgrounds or park structures should be left in place.

Water Source (HYD1), Hydroperiod (HYD2), and Hydrologic Connectivity (HYD3) are only scored in wetlands. Most of the wetland area we assessed had entirely natural water sources (Figure 11), though approximately 40% had enough non-natural land cover (with presumed runoff) in the surrounding drainage that the metric was marked down to a "B". No assessed wetlands deviated from the natural range of variability ("C's" or "D's") in this metric. Most wetlands were also within the natural range of variability for hydroperiod (Figure 12) and hydrologic connectivity (Figure 13). These metrics were most frequently impacted by nearby roads.

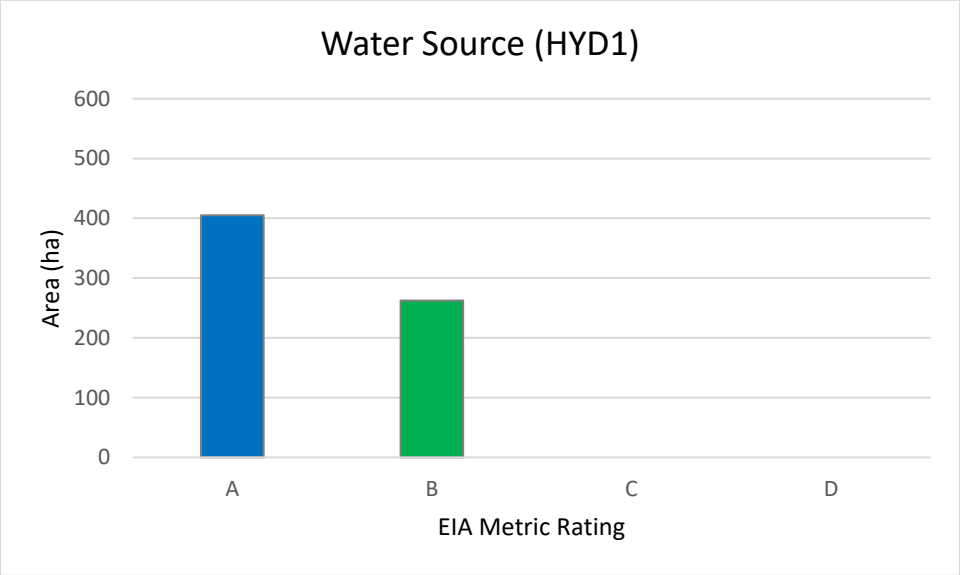

Figure 11. Water Source (HYD1) metric ratings, by area. Only scored in wetlands.

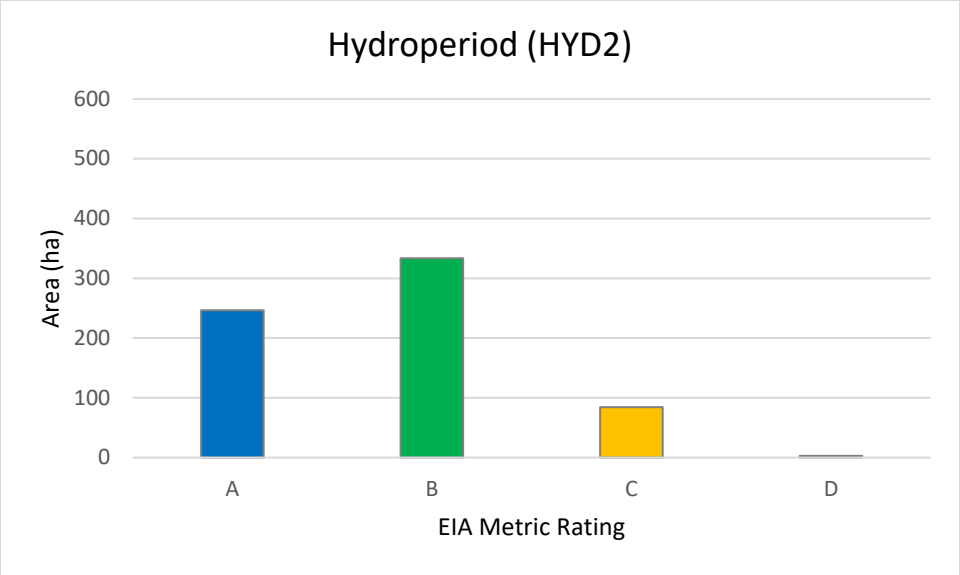

Figure 12. Hydroperiod (HYD2) metric ratings, by area. Only scored in wetlands.

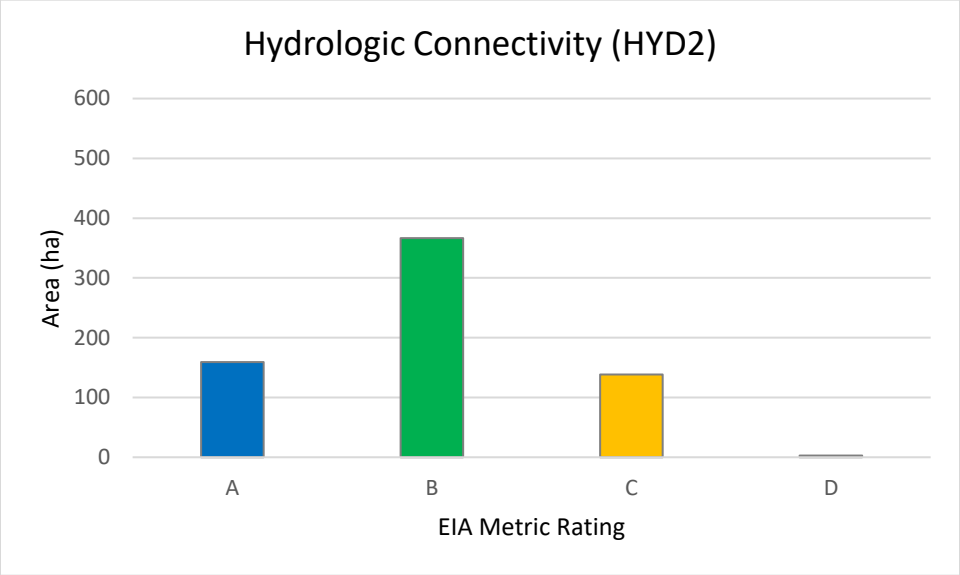

Figure 13. Hydrologic Connectivity (HYD2) metric ratings, by area. Only scored in wetlands.

Within a level 2 EIA, the Soil Condition metric (SOI1) is a very rapid assessment of soil condition that is primarily dependent on visible, surficial disturbance. This metric was most frequently marked down due to relictual skid trails and other logging disturbance, or occasionally for social trail proliferation. This metric was almost never considered to be outside the natural range of variability.

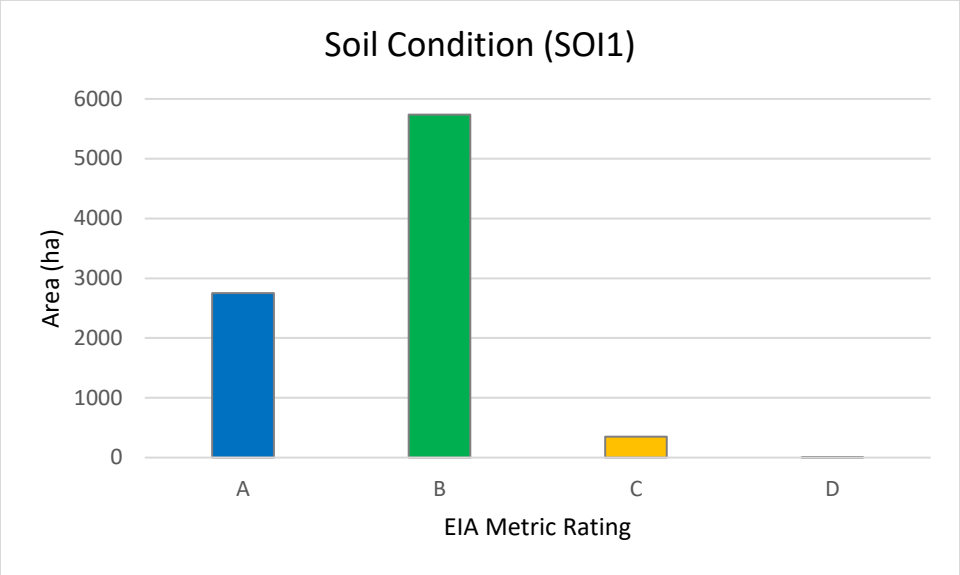

Figure 14. Soil Condition (SOI1) metric ratings, by area.

See Appendices A-T for park-specific breakdowns of EIA ranks and EOs. For site- and polygon-specific scores, including comments and rationale, please see the accompanying Excel workbook and ArcGIS file geodatabase.

4.0 Summary

This project had three objectives. First, to conduct Level 2 Ecological Integrity Assessments (EIA) at an array of Washington State Parks (Parks), with priority going to those with known high quality ecosystem elements and/or impending management actions/planning efforts. Second, we updated Parks' Vegetation Survey and Significant Natural Resources (SNR) data for surveyed polygons we surveyed. Finally, we identified plant association element occurrences (EOs) for inclusion in WNHP's Biotics database.

The EIA data presented here and in accompanying documents may inform the planning process, as staff seek to find appropriate locations for facilities and public access, identify restoration possibilities, or delineate areas of high priority for conservation. Indeed, Parks has a stated goal of maintaining those lands they manage for natural vegetation in 'good' condition (an EIA rank of 'B' or higher). 78% of the assessed land area cleared that threshold in our surveys. Of course, it is important to keep in mind that our assessment areas were skewed towards those park areas previously identified as rare and/or high-quality.

The EIA is a metric-based approach and the data from this project can be used in a wide assortment of applications. If land managers are interested in a particular ecological facet of a specific polygon, the metric ratings estimate the degree of deviation from the natural range of variability (Table 2, Table 3). If a slightly coarser approximation of ecological integrity is needed, those metrics can be rolled up into six "major ecological factors": Landscape, Buffer/Edge, Vegetation, Hydrology, Soil, and Size. In turn, the major ecological factors are aggregated into three primary rank factors: Landscape Context, Condition, and Size. Landscape Context and Condition are

integrated to reach the EIA rank. Size is brought in at the end to calculate the overall EO Rank, which approximates the conservation significance of the polygon. For some applications, land managers may not be interested in landscape context, because there may be little they can do about it. It is perfectly reasonable to focus on the condition primary rank factor, so long as the manager understands that the landscape context will still have an impact on the long-term viability of the stand and on the success of potential restoration efforts (e.g. the landscape may be a vector for invasive species, or a source of polluted runoff).

To summarize, if you want to know the onsite ecological condition of a particular polygon, look at the condition score. If you want to know the overall ecological integrity, look at the EIA Rank. If you want to know the statewide/global conservation significance of the occurrence, look at the EO Rank (and consult the conservation status rank for that ecosystem). Users of the EIA data are encouraged to read the comments associated with each metric rating, to get a fuller understanding of the stressors and ecological processes considered by the surveyor.

4.1 Future Assessment/Survey Recommendations

We hope that EIA continues to be a long-term tool for Washington State Parks. To that end, future assessments would benefit from a greater emphasis on parks and ecosystems in eastern Washington—we sampled a greater-than-planned proportion of western Washington parks in this project, due to COVID-related project delays and travel restrictions. A balanced sampling of the eastside of the state would better capture the ecological diversity managed by Parks.

Eastern Washington surveys may be further prioritized in a number of different ways. One approach might focus on ecological systems that were not sampled in 2020/2021 (Table 8). Another strategy could prioritize polygons representing plant associations that are imperiled (S2) or critically imperiled (S1) in Washington (Table 9). Of course, both of these attributes could also be integrated into a sampling strategy that takes into account specific management interests, planning efforts, or data gaps. Note that a number of parks from the 2020/2021 priority list (Riverside, Pearrygin Lake, Steamboat Rock, Doug's Beach) also show up as likely targets in these analyses.

Table 8. Ecological Systems that were not assessed in the 2020/2021 field seasons and are mapped at eastern Washington state parks.

Ecological System	Eastern Washington Parks (Not Previously Surveyed by WNHP)
Columbia Basin Palouse Prairie	Bridgeport Brooks Memorial Columbia Plateau Trail Conconully Curlew Lake Fields Spring Palouse Falls Riverside Steptoe Butte
Columbia Plateau Steppe and Grassland	Doug's Beach
East Cascades Mesic Montane Mixed-Conifer Forest and Woodland	Lake Easton
East Cascades Oak-Pine Forest and Woodland	Brooks Memorial Doug's Beach Fort Simcoe Klickitat Rail Trail
Inter-Mountain Basins Active and Stabilized Dune	Bridgeport Potholes
Inter-Mountain Basins Semi-Desert Shrub-Steppe	Columbia Plateau Trail Potholes
Northern Rocky Mountain Foothill Conifer Wooded Steppe	Alta Lake Twenty-Five Mile Creek
Northern Rocky Mountain Lower Montane, Foothill, and Valley Grassland	Fields Spring Steptoe Butte
Northern Rocky Mountain Ponderosa Pine Woodland and Savanna	Alta Lake Brooks Memorial Columbia Plateau Trail Conconully Fields Spring Fisk Lake Chelan Lake Newport Pearrygin Lake Riverside Spokane River Centennial Squilchuck Steamboat Rock Steptoe Butte
Northern Rocky Mountain Subalpine Dry Grassland	Fields Spring Mount Spokane
Rocky Mountain Aspen Forest and Woodland	Brooks Memorial Columbia Plateau Trail Pearrygin Lake Squilchuck
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	Mount Spokane
Temperate Pacific Subalpine-Montane Wet Meadow	Palouse Falls

Table 9. Summary of S1 and S2 plant associations mapped at eastern Washington state parks that were not assessed in 2020/2021.

Eastern Washington Parks (Not Previously Surveyed by WNHP)	# of S1-S2 Plant Association Polygons	Area (ha) of S1-S2 Plant Association Polygons
Alta Lake	15	27
Bridgeport	27	168
Brooks Memorial	38	254
Columbia Plateau Trail	27	194
Conconully	12	27
Curlew Lake	2	23
Daroga	2	5
Doug's Beach	12	11
Fields Spring	14	220
Fisk	21	206
Fort Simcoe	9	19
Klickitat Rail Trail	9	38
Lake Chelan	8	25
Lake Easton	1	5
Lake Newport	1	9
Mount Spokane	8	9
Palouse Falls	15	12
Pearrygin Lake	55	349
Potholes	8	41
Riverside	119	1448
Spokane River Centennial	33	180
Squilchuck	7	12
Steamboat Rock	10	323
Steptoe Butte	15	48
Twenty-Five Mile Creek	2	4
Wenatchee Confluence	14	42
Yakima Sportsman	9	59
Total	**493**	**3757**

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Appendix A. Miller Peninsula

Figure A-1. North Pacific Dry Douglas-fir-(Madrone) Forest & Woodland Ecological System at Miller Peninsula State Park

The Ecological Integrity Assessment for Miller Peninsula State Park is presented below (Figure A-4). WNHP staff previously surveyed vegetation at Miller Peninsula as part of a Natural Forest Inventory of state parks (Chappell, 1992a). That report identified three naturally regenerated, early-seral forest EOs at the site. In 2003, Joe Arnett and Kathryn Beck produced a vegetation mapping report in conjunction with a rare plant survey of the peninsula (Arnett & Beck, 2003). This mapping was the basis for the assessment areas used in our surveys.

There were three previously documented community EOs at the park. Parks identified 12 polygons (867 hectares) of 5 different ecological systems as priorities for assessment at Miller Peninsula (Figure A-5). All maps (Figure A-4 through Figure A-7) are presented at the end of the appendix for ease of reading.

NOTE: This appendix includes considerably more detail than subsequent park summaries (with the exception of Ginkgo Petrified Forest) due to the Classification and Management Planning (CAMP; https://parks.state.wa.us/DocumentCenter/View/11751/08-Classification-and-Management-Planning-CAMP-PDF) process that was underway for this property.

EIA Results

All priority polygons were surveyed at Miller Peninsula. Table A-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table A-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table A-1. EIA Summary for Miller Peninsula. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
279	Temperate Pacific Freshwater Emergent Marsh	B	C	C+
280	North Pacific Maritime Coastal Sand Dune	A	A	A-
281	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	B	C+
283	North Pacific Dry Doug-fir-(Madrone) Forest and Woodland	C	B	B-
286	North Pacific Dry Doug-fir-(Madrone) Forest and Woodland	B	B	B-
287	North Pacific Dry Doug-fir-(Madrone) Forest and Woodland	C	B	B-
288	North Pacific Dry Doug-fir-(Madrone) Forest and Woodland	C	B	B+
282-04	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	B	B	B+
282-05	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	B	B-
282-08	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	C	C+
282-10	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	B	B-
282-15	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	B	B-
282-17,24	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	B	A	A-
282-22	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	B	B-
284-25	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	B	B-
284-46	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	C	C+
285-19	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	B	C+
285-28	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	B	C	B-
285-30	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	B	B	B-
285-32	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	B	C	B-
285-7	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	B	B	B+
285-9	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	B	A	A-
289-D	North Pacific Dry Doug-fir-(Madrone) Forest and Woodland	B	C	C+
289-DM	North Pacific Maritime Dry-Mesic Doug-fir-Western Hemlock Forest	C	B	C+
290-49,65	North Pacific Dry Doug-fir-(Madrone) Forest and Woodland	C	B	B-
290-51	North Pacific Dry Doug-fir-(Madrone) Forest and Woodland	B	B	B-
MillerPeninsula_37	North Pacific Dry Doug-fir-(Madrone) Forest and Woodland	B	B	B+

Table A-2. Individual EIA Metric Ranks for Miller Peninsula.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
289-D	C	C	B	B	B	A-	B	B	D	D	D				B	
289-DM	C	C	C	C	C	A-	B	A	C	B	C				B	
285-19	C	C	B	C		A-	B	A	C	B	D				B	
285-7	B	B	A	A	A	A-	A	A	C	A	C				B	D
285-28	B	B	B	C	B	A-	B	B	D	C	D				B	D
285-32	B	B	B	B	B	A-	B	B	D	B	D				B	D
285-30	B	B	B	B	B	A-	B	B	C	B	D				B	D
280	A	A	A	A	A	C	A	A	A						A	D
281	C	C	C	C	B	A-	A	A	C	C	C				B	
283	C	B	C	C	B	A	A	A	C	C	C				A	A
286	C	B	B	C	B	A-	A	A	C	A	C				B	A
287	C	B	C	C	B	A	A	A	C	B	C				A	A
288	D	A	C	C	B	A	A	A	C	A	C				A	A
290-51	C	C	C	C	A	B	B	A	B	B	B				B	B
290-49,65	C	C	C	C	B	A-	A	A	C	B	B				B	A
282-04	B	A	B	B	A	A	A	B	C	A	C				B	
MillerPeninsula_37	C	C	B	C	A	A	A	A	B	C	B				A	A
279	C	C	A	B	B	D	D	D	C			A	B	B	A	
282-17,24	C	A	B	B	A	A	A	A	A	A	A				A	D

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
285-9	B	B	A	C	A	A	A	A	A	A	A				A	D
284-25	C	C	C	C	B	A	A	A	C	C	D				A	
284-46	C	C	B	C	B	A-	B	A	C	C	D				B	
282-22	C	C	B	B	B	A	A	A	C	B	D				B	
282-05	C	C	B	B	B	A-	B	A	C	B	D				B	
282-15	C	C	B	B	B	A-	B	A	C	B	D				B	
282-08	C	C	B	B	B	A	A	C	D	D	D				B	
282-10	C	C	B	B	B	A-	B	B	C	A	D				B	D

Figure A-2 and Figure A-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure A-6.

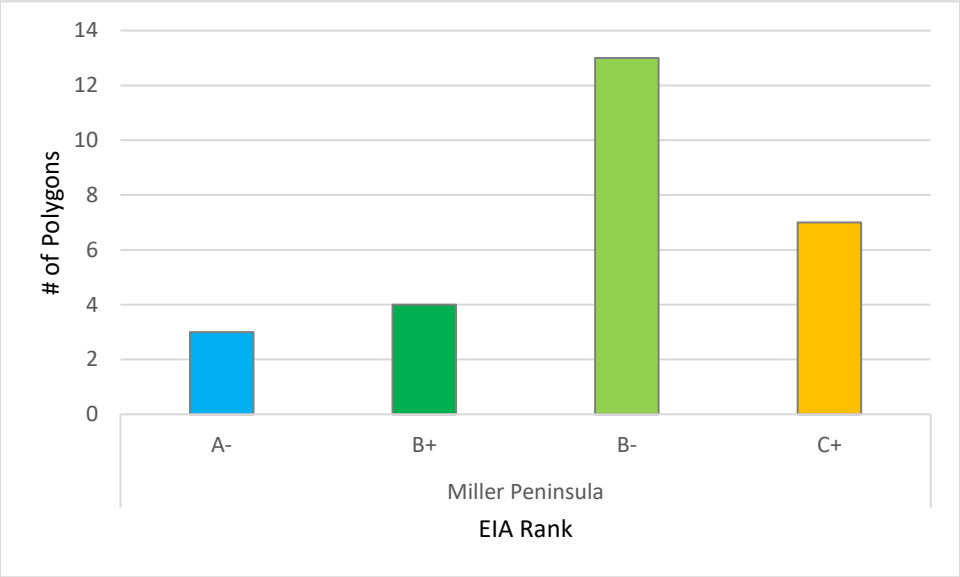

Figure A-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

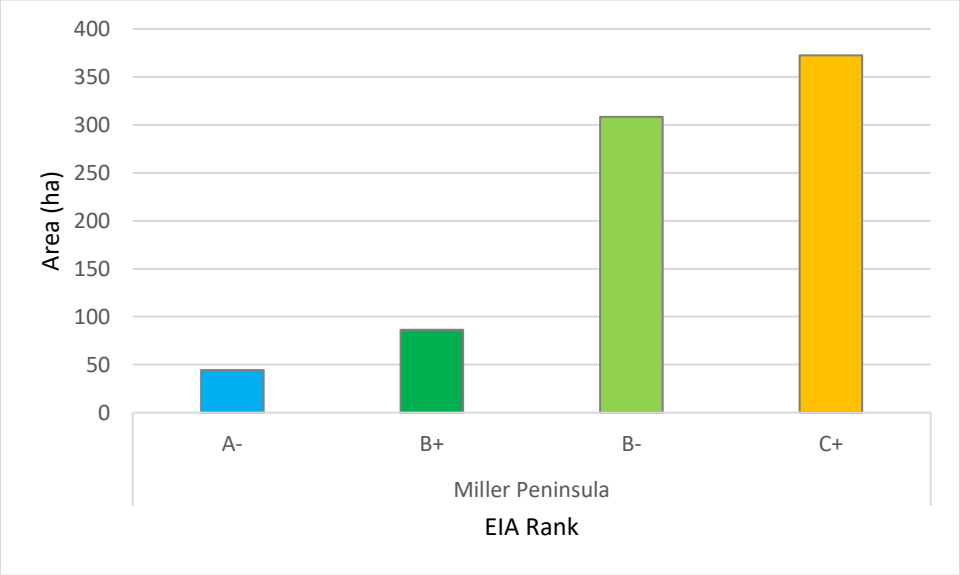

Figure A-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Five total element occurrences were documented at Miller Peninsula (Figure A-7). Three were previously known and documented in WNHP's Biotics database, while two were previously undocumented. Two of the previously known EOs (5937, 7020) were simply remapped—EO 7020

had a sizeable, disjunct expansion—and then reassessed with current methodology. Another (EO 4465) was revisited and found to have gone through succession to another critically imperiled ecosystem. That EO was also expanded. The remaining two EOs were entirely new, representing small patches of imperiled to critically imperiled forest communities. Table A-3 summarizes the classification, conservation status ranks, and EO ranks (landscape context + condition + size) of new and revised EOs at Miller Peninsula. For additional information, see the accompanying Excel workbook.

Table A-3. Summary of new element occurrences at Miller Peninsula. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9968	290-51	CEGL000422	Pseudotsuga menziesii - Arbutus menziesii / Holodiscus discolor Forest	G1G2Q/S1S2	B+
9967	282-10	CEGL002848	Thuja plicata - Pseudotsuga menziesii - Abies grandis / Mahonia nervosa / Polystichum munitum Forest	G1/S1	D

It should be noted that two of the element occurrences (one existing and one new EO) at Miller Peninsula have EO Ranks of "D", indicating poor long-term viability. These EOs are in fair condition, with significant historic logging disturbance, and are very small for matrix forest communities. However, as G2/S1 and G1/S1 communities, the bar for inclusion in our database is very low. In fact, the new EO of *Thuja plicata* - *Pseudotsuga menziesii* - *Abies grandis* / *Mahonia nervosa* / *Polystichum munitum* Forest (CEGL002848; G1/S1) is the first to be documented in Washington.

A small patch of *Leymus mollis ssp. mollis* - *Abronia latifolia* Grassland (CEGL001796; G2/S2?) was also surveyed in the northeast corner of the park. The portion on Parks property was found to be in good to excellent condition, but the majority of the community is on the neighboring private land, where invasive annual grasses are much more prevalent. That area was not surveyed, as we did not have access permission. Between the access restrictions and the apparently poor condition of the majority of the occurrence, that community was not added as an EO.

Summary and Discussion

Overall Conditions

Miller Peninsula State Park is bordered by the Strait of Juan de Fuca to the north, with a mix of exurban development and intensively managed timber land to the east, south, and west. As a relatively consolidated tract of forest, however, the outer portions of the park serve to buffer the interior. Polygons in the center of the park generally received good (B) landscape context ranks when assessed separately from the park unit as a whole (i.e. polygons that were assessed as potential EOs). These areas are still somewhat fragmented by gravel roads that remain in the park as part of the trail system.

The majority of the park is covered by *Pseudotsuga menziesii*-dominated forests in the biomass accumulation/stem exclusion or early maturation I stand development stages (Van Pelt, 2007).

Average-sized trees from the dominant cohort were cored at a selection of points in surveyed polygons. Estimated ages ranged from 60 to 100 years. Most of these forests represent occurrences of the North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest ecological system. North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland is common along the coastal bluffs and may also be found on subtly higher topographic positions with relatively thin soils on the interior of the park. North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest covers a much smaller portion of the landscape than previously mapped, due to a proposed changes in the crosswalk from USNVC plant association to ecological system. With a few exceptions, that system is restricted to narrow drainages, gullies, and other topographic depressions.

Nearly all assessed polygons scored well in vegetation metrics (Table A-4), as exotic/invasive species (VEG1, VEG2) are largely restricted to the immediate fringe of trails and roads. Non-native species rarely pose significant threats in these forested ecological systems, save in more open occurrences of the Dry Douglas-fir Forest and Woodland found elsewhere (that have herb-dominated understories). Similarly, native plant species composition usually rebounds after logging (VEG3). The Dry-Mesic Douglas-fir-Western Hemlock forests in particular are naturally species-poor systems. Condition ranks were primarily brought down by the extensive logging history on the peninsula. Vegetation structure over much of the park is very homogeneous (VEG4). Snags and large coarse woody debris are minimal (VEG6) and natural woody regeneration is reduced (VEG5). Some areas were likely planted. Hydrologically (HYD1-HYD3), the wetland that was assessed was within the natural range of variability. Soils have been impacted moderately by the extensive logging history on the peninsula (SOI1), but also remain within the natural range of variability.

Table A-4. Summary of EIA metric ratings by area (ha) at Miller Peninsula State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	**792**	17	2	< 1
VEG2	**441**	370		< 1
VEG3	**658**	147	6	< 1
VEG4	44	27	**674**	66
VEG5	175	277	**322**	35
VEG6	42	65	324	**377**
HYD1	**< 1**			
HYD2		**< 1**		
HYD3		**< 1**		
SOI1	154	**657**		

The areas that scored highest were those with minimal evidence of logging, where young stands appear to have regenerated naturally after fires (EO IDs 5937 and the western-most polygon of 7020). From a Natural Heritage perspective, the highlights of the park are these young, natural regeneration *Arbutus menziesii* and *Pseudotsuga menziesii* forests, particularly polygons 9, 17, 24, and 37 in the Vegetation Survey database (Figure A-7). While early seral forests in general are more common today than they were historically, early seral forests that were initiated by natural

disturbance (fire) rather than logging are much *less* common. Chappell (1992a) postulated that these areas were skipped over during past periods of selective logging in favor of areas with larger trees.

Recommendations for Enhancing / Maintaining Ecological Integrity

Many of the rare and threatened forest types present at Miller Peninsula are part of the North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland ecological system. These systems were historically dependent on moderately frequent, low- to mixed-severity fires, with high-severity fires promoting dominance of *Arbutus menziesii* (Chappell & Giglio, 1999; Van Pelt, 2007). Introduction of prescribed fire would likely be the most effective analogue for maintaining these imperiled communities, but there are certainly challenges to doing so in this exurban setting. On a positive note, our revisit to EO 4465 indicates that these communities may develop into dry-mesic forests with similar conservation status ranks, should fire return intervals remain extended. Additionally, even without fire, it's possible that the *Arbutus menziesii*-dominated forests on and immediately adjacent to the coastal bluffs may be maintained by natural erosion processes.

In terms of enhancing ecological integrity within the dry-mesic forests, much of that will simply take time. Vegetation structure will improve as subcanopies develop in the understories. Coarse woody debris and snags will return to the natural range of variability as trees continue to mature and die. In the young, planted ex-plantations, restoration thinning may be required to accelerate these processes.

The one wetland we surveyed is small and hydrologically isolated and may therefore be a promising target for invasive species control.

Future Assessment / Survey Recommendations

Nearly all of Miller Peninsula State Park was surveyed as part of this project. Exceptions were primarily areas of young ex-plantations or very steep bluffs. Additional surveys at Miller Peninsula are not a priority at this time.

Maps

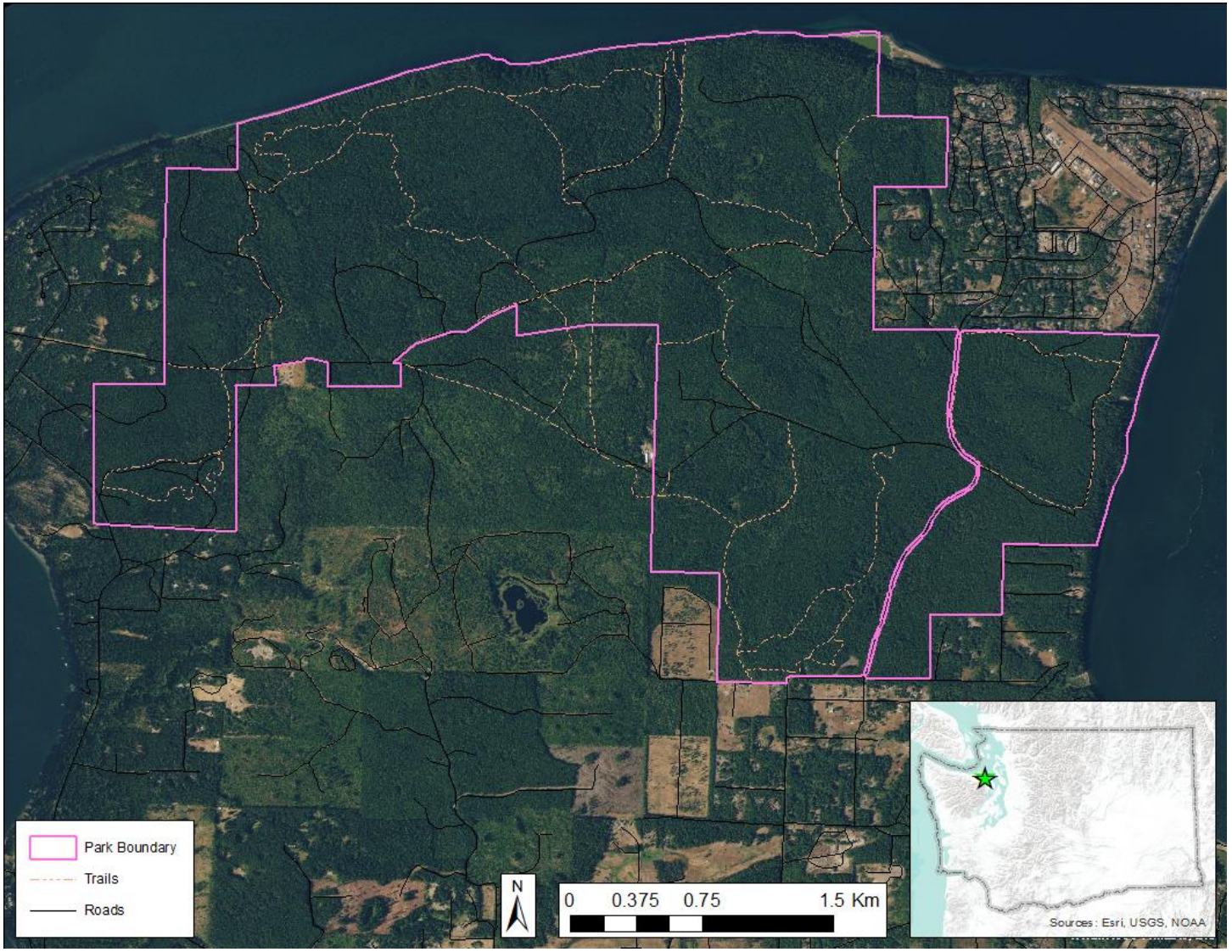

Figure A-4. Overview of Miller Peninsula State Park.

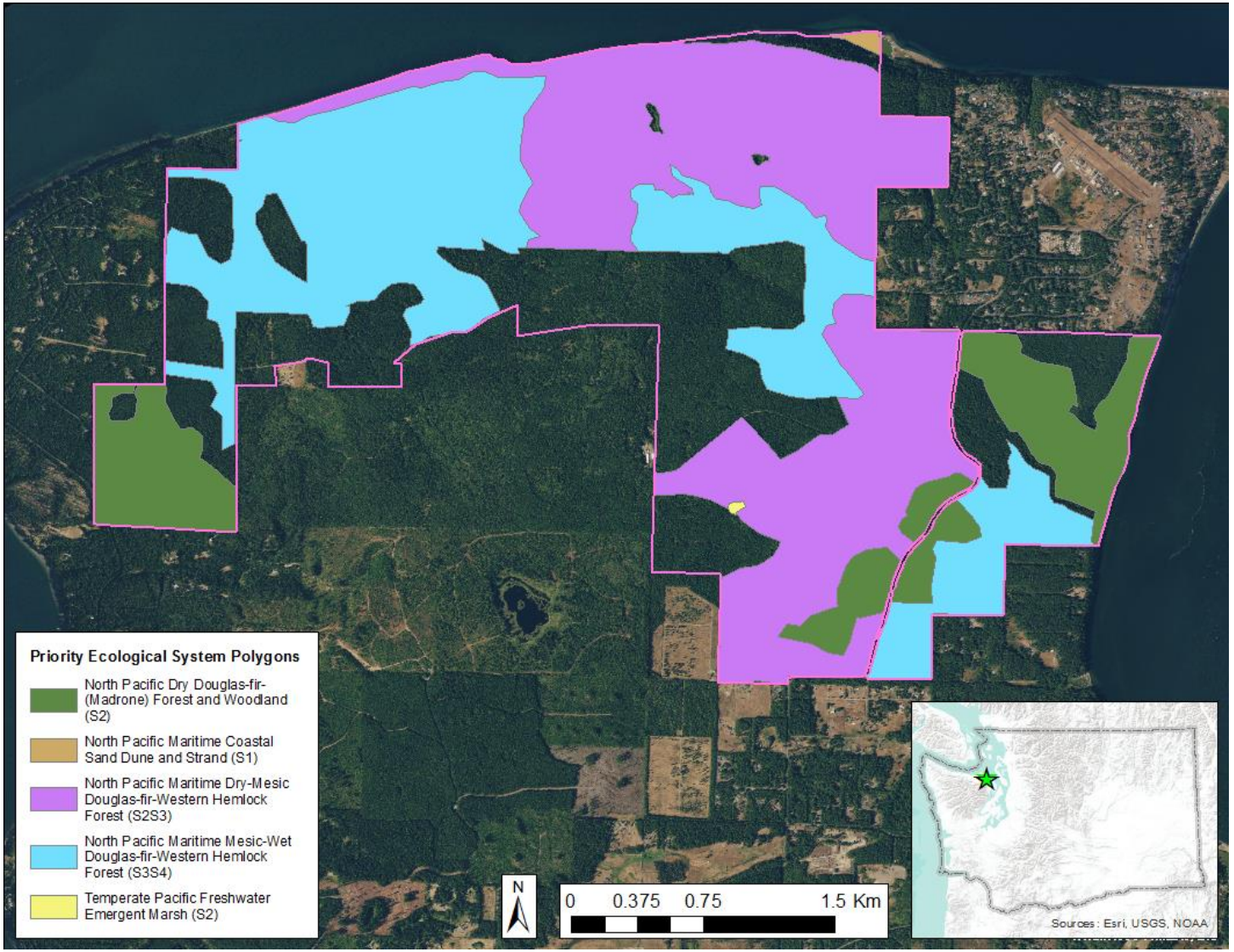

Figure A-5. Priority ecological systems polygons for assessment at Miller Peninsula State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

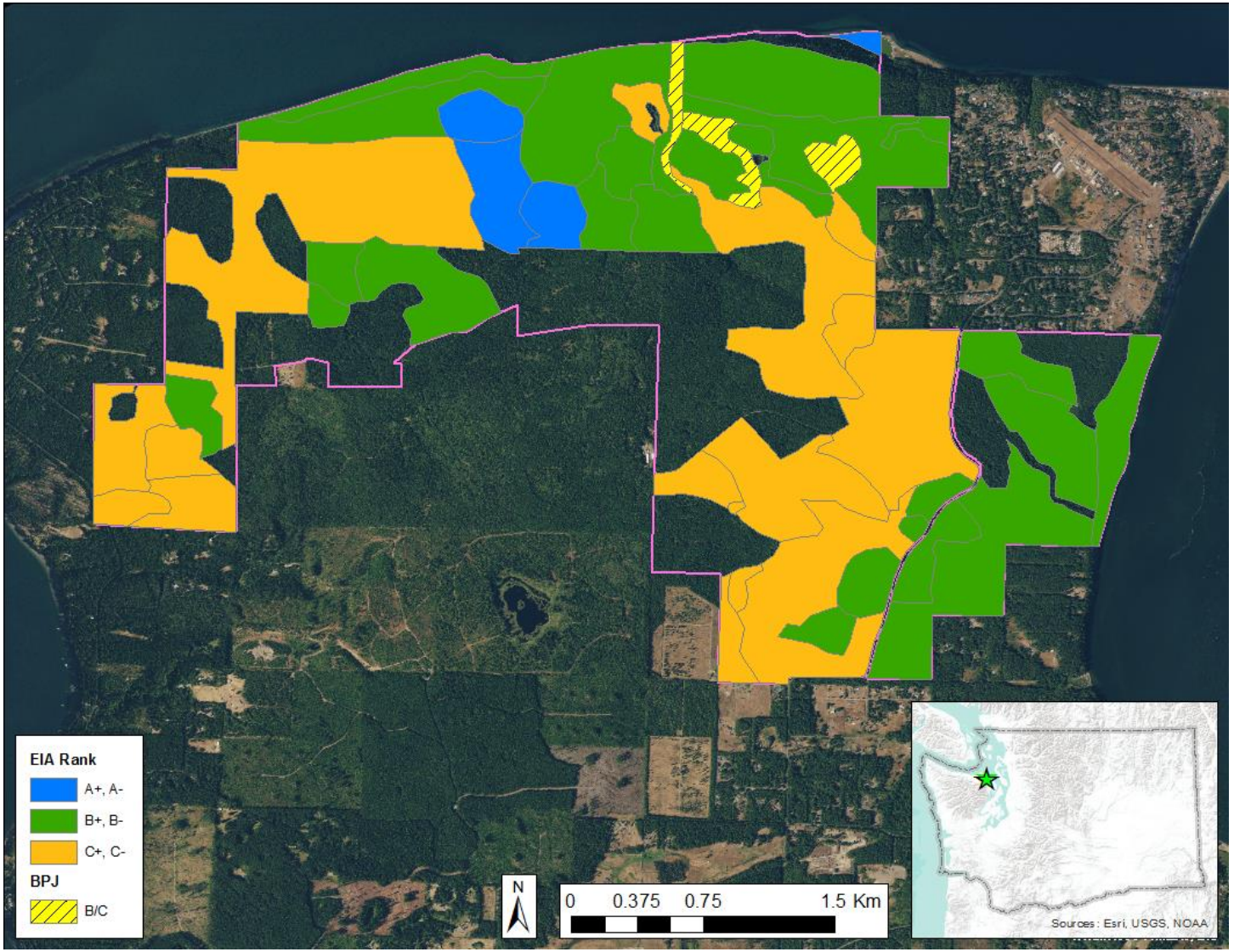

Figure A-6. EIA Ranks for all polygons assessed at Miller Peninsula State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, "best professional judgment" rank (not EIA).

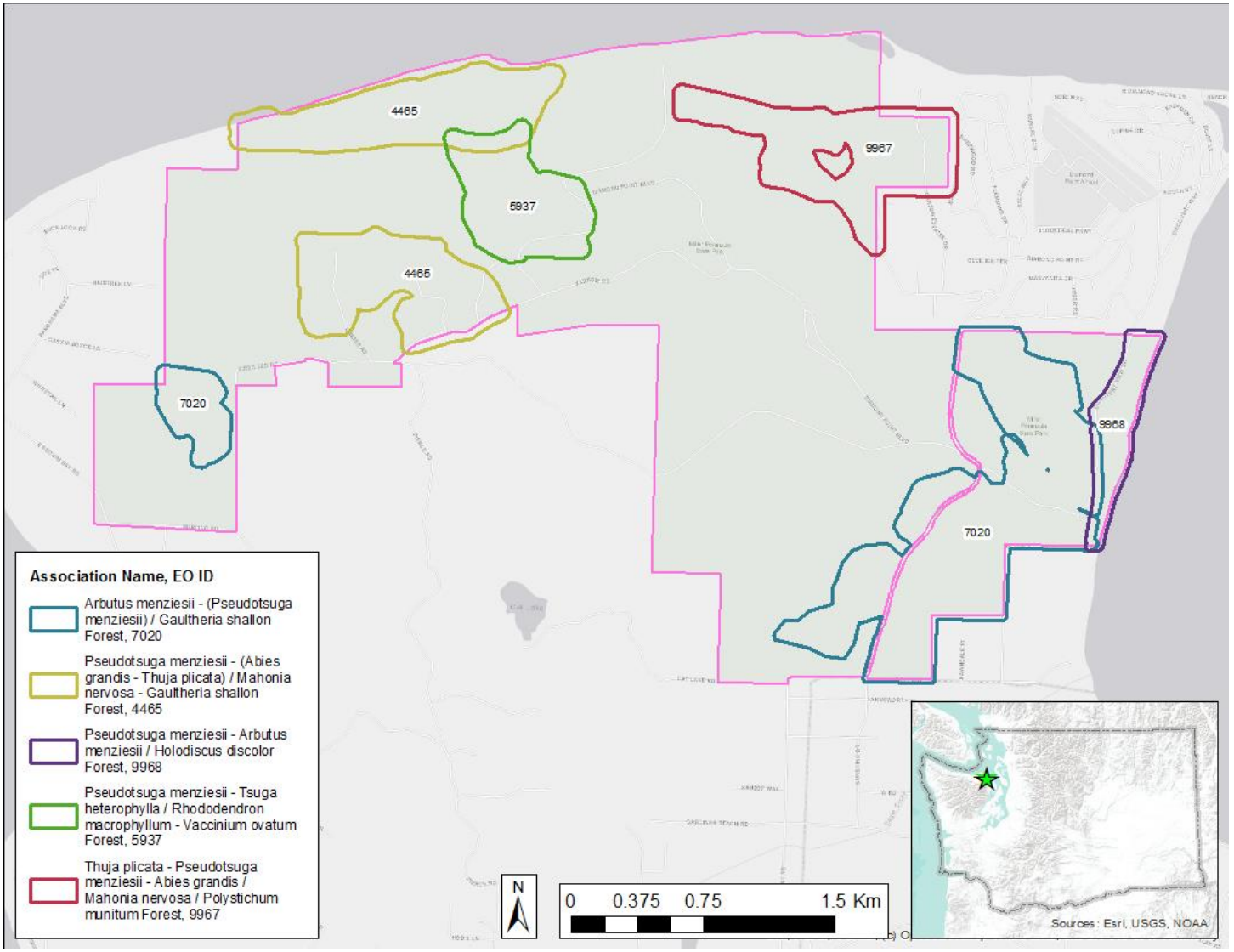

Figure A-7. Element occurrences at Miller Peninsula State Park.

Appendix B. Beacon Rock

Figure B-1. The eponymous feature of Beacon Rock State Park.

The Ecological Integrity Assessment for Beacon Rock State Park (Figure B-4) is presented below. WNHP staff previously surveyed vegetation at Beacon Rock as part of a Natural Forest Inventory of state parks (Chappell, 1992b). In 2009, a vegetation map and rare plant survey was completed by URS (2009a). This mapping was the basis for the assessment areas used in our surveys.

There were 15 previously documented community EOs at the park. Parks identified 28 polygons (1454 hectares) of 8 different ecological systems as priorities for assessment (Figure B-5). All maps (Figure B-4 through Figure B-7) are presented at the end of the appendix for ease of reading.

EIA Results

All priority polygons were surveyed in the summer of 2020. Table B-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table B-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table B-1. EIA Summary for Beacon Rock. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
0	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
1	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	B	B-
2	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	B	B+
3	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
4	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	B	B+
5	North Pacific Montane Massive Bedrock, Cliff and Talus	B	A	B+
6	North Pacific Herbaceous Bald and Bluff	B	C	B-
7	North Pacific Herbaceous Bald and Bluff	B	B	B+
9	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	C	C	C+
10	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	C	B	B-
11	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	C	B	B-
13	North Pacific Broadleaf Landslide Forest and Shrubland	B	B	B+
14	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
15	North Pacific Broadleaf Landslide Forest and Shrubland	B	B	B-
16	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
17	North Pacific Broadleaf Landslide Forest and Shrubland	B	B	B+
18	North Pacific Broadleaf Landslide Forest and Shrubland	A	A	A-
21	Temperate Pacific Freshwater Aquatic Bed	D	C	C-
22	North Pacific Lowland Riparian Forest and Shrubland	C	B	B-
23	North Pacific Lowland Riparian Forest and Shrubland	C	C	C+
24	North Pacific Herbaceous Bald and Bluff	B	C	B-
26	North Pacific Lowland Riparian Forest and Shrubland	C	B	B-
19b	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
25b	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
BeaconRock-27-bald	North Pacific Herbaceous Bald and Bluff	B	C	C+

Table B-2. Individual EIA Metric Ranks for Beacon Rock.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
0	B	B	B	B	A	A-	A	A	C	A	B				A	C
1	B	C	B	C	B	A-	A	A	C	B	C				B	
2	B	B	B	B	B	A-	A	B	C	B	B				B	
3	A	B	B	C	B	A-	A	A	C	B	C				B	
4	B	B	B	B	B	A-	A	A	B	C	B				A	D
5	B	C	A	B	A	A-	B	A	A						A	
6	C	A	B	C	B	C	C	B	B						C	A
7	C	A	A	B	B	C	B	B	B						A	A
9	B	C	C	C	C	C	C-	B	C	B	C				B	
10	D	C	D	D	A	B	C	A	B	A	B				B	C
11	C	C	C	C	B	A	B	A	B	B	B				B	B
13	B	C	B	B	A	A-	B	A	C	A	B				B	
14	B	C	B	B	A	A-	A	A	C	A	C				B	
15	B	C	B	B	B	A-	B	A	C	A	C				B	
16	A	B	B	C	A	A-	A	A	C	B	C				B	
17	B	B	B	B	A	A-	A	A	C	A	C				A	B
18	A	B	A	A	A	A-	A	A	B	A	A				A	B
21	D	C	C	D	D	C	C-	C	C			B	D	D	C	
22	C	C	B	B	D	D	D	B	B	A		A	C	A	A	C

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
23	B	C	C	C	C	D	D	C	B	B	B	B	C	C	A	
24	B	A	B	B	A	C	C	B	C						C	A
26	C	C	A	B	D	D	D	D	A	C	B	A	C	A	A	C
19b	B	C	B	B	A	A	A	A	B	C	B	A	A	B	A	
25b	B	C	B	B	A	A-	A	A	C	A	B	A	A	B	B	
BeaconRock-27-bald	C	A	A	A	B	D	C-	C	C						A	B

Figure B-2 and Figure B-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure B-6.

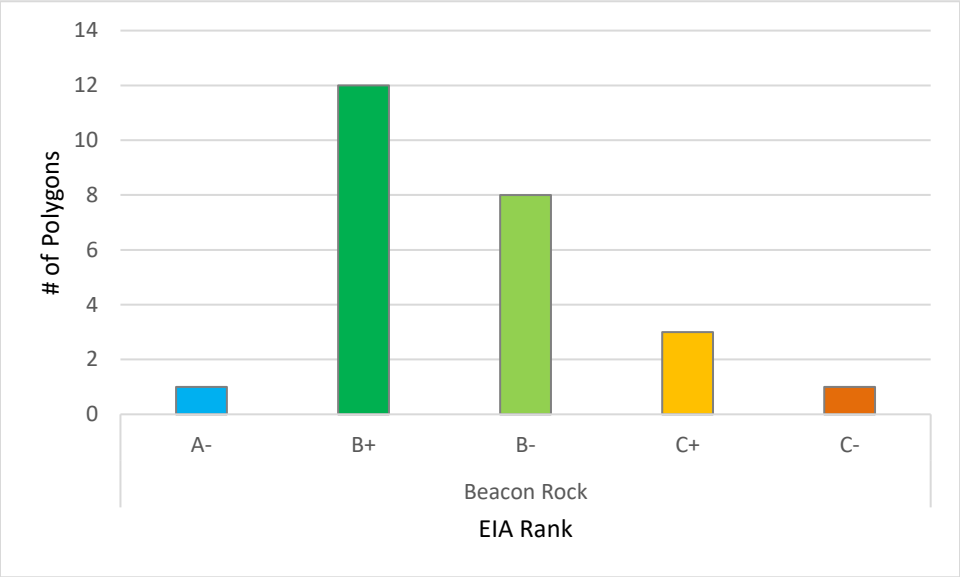

Figure B-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

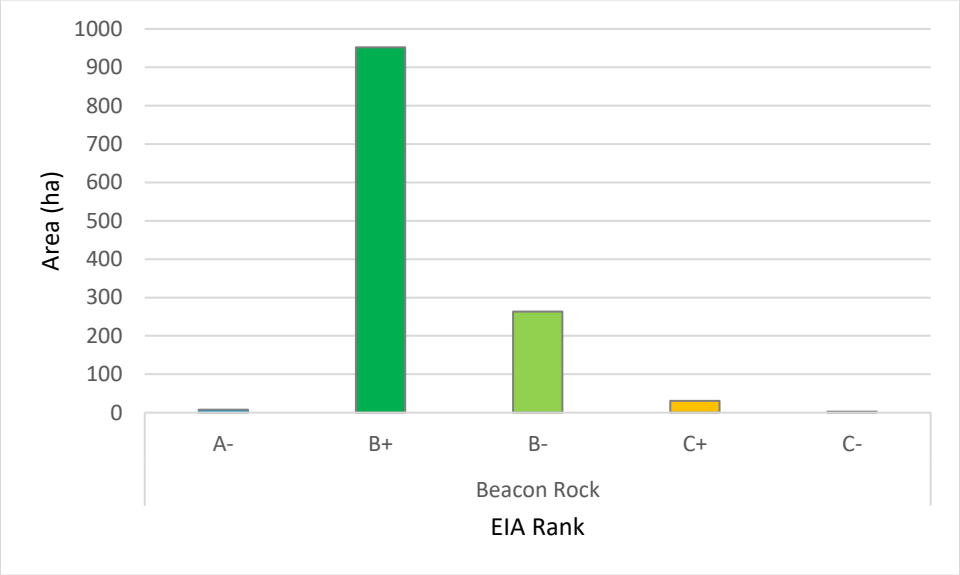

Figure B-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Three new element occurrences were documented at Beacon Rock (Table B-3, Figure B-7). The occurrence of *Pseudotsuga menziesii* / *Corylus cornuta* / *Symphoricarpos* (*albus, hesperius*) - *Polystichum munitum* Forest (CEGL007358) is the first EO-quality occurrence documented in the

state. This community was formerly classified as *Pseudotsuga menziesii* / *Corylus cornuta* / *Polystichum munitum* Forest (CEGL002616), but that association was split into two new units as part of the Coastal Correlation Project (Meidinger et al., 2005). 6 of the 13 existing EOs were also revisited and reassessed with current methodology (see accompanying Microsoft Excel workbook).

Table B-3. Summary of new element occurrences at Beacon Rock State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9959	17; 18	CEGL003334	Acer macrophyllum - Alnus rubra / Polystichum munitum - Tellima grandiflora Forest	G2G3/S2	A-
9976	10	CEGL007358	Pseudotsuga menziesii / Corylus cornuta / Symphoricarpos (albus, hesperius) - Polystichum munitum Forest	GNR/S1	C-
9960	0	CEGL005574	Tsuga heterophylla - (Pseudotsuga menziesii, Thuja plicata) / Polystichum munitum - Athyrium filix-femina Forest	G3G4/S3	B-

Summary and Discussion

Overall Conditions

Beacon Rock is located in an ecoregional mixing zone—between the west and east Cascades—in the Columbia River Gorge. The park is well-known for its balds (including its eponymous feature) and rare plants. The park is also notable for a large occurrence of a high-quality North Pacific Broadleaf Landslide Forest and Shrubland (EO ID 9959) located in the seldom visited northeast portion of the park. While no old-growth conifer stands were noted in our surveys, the lower slopes do have a large area of naturally regenerated, mature North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland (including EO ID 9976) in generally good condition. Chappell (1992b) hypothesized that these may have historically been relatively mesic stands with greater abundance of shade-tolerant species, but that stand-replacing fires in unusually quick succession had eliminated most of the fire-sensitive taxa. Chappell also estimated that approximately 40% of the park is covered by forests of natural origin, without significant logging disturbance. Logging over the remainder of the park removed nearly all of the large trees and simplified the stand structure in those areas (Table B-4, VEG4). More recent harvests have included salvage logging, which included cutting and leaving residual snags (VEG6). The long history of logging has left abundant skid trails and logging roads (SOI1)—many of these roads are now used primarily as hiking and equestrian trails.

Riparian plant communities along the higher order streams are hydrologically intact, but wetlands along and near the Columbia River have been unavoidably impacted by the construction of the Bonneville Dam. In particular, the dam has significantly modulated the hydroperiod (HYD2). Ecosystems along the Columbia also contain a diverse array of exotic/invasive species (VEG1, VEG2) deposited by the river.

Table B-4. Summary of EIA metric ratings by area (ha) at Beacon Rock State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	**1155**	24	57	20
VEG2	**974**	182	52	48
VEG3	**929**	315	8	4
VEG4	11	276	**969**	
VEG5	400	**710**	106	
VEG6	8	**716**	481	
HYD1	**52**	7		
HYD2	**37**		19	3
HYD3	15	**37**	5	3
SOI1	395	**825**	31	

Recommendations for Enhancing / Maintaining Ecological Integrity

The North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland portions of the park were historically dependent on moderately frequent, low- to mixed-severity fires (Van Pelt, 2007). Prescribed fire or managed wildfires will be necessary to maintain these systems. The dry forests are primarily located on gentle terrain and are already somewhat fragmented, which makes prescribed fire somewhat more practicable. There is little development in the immediate vicinity of the park, as well.

Restoring the vegetation structure of the logged dry-mesic and mesic-wet areas of the park will mainly be a function of time. Structure will improve as subcanopies develop in the understories. Coarse woody debris and snags will return to the natural range of variability as trees continue to mature and die.

Many of the balds are experiencing tree and shrub encroachment in the absence fire on those sites. It may be necessary to remove woody species from these areas.

Future Assessment / Survey Recommendations

Old-growth patches have previously been reported along Hamilton Creek (Chappell, 1992b). These stands should be prioritized in future assessments at Beacon Rock.

Maps

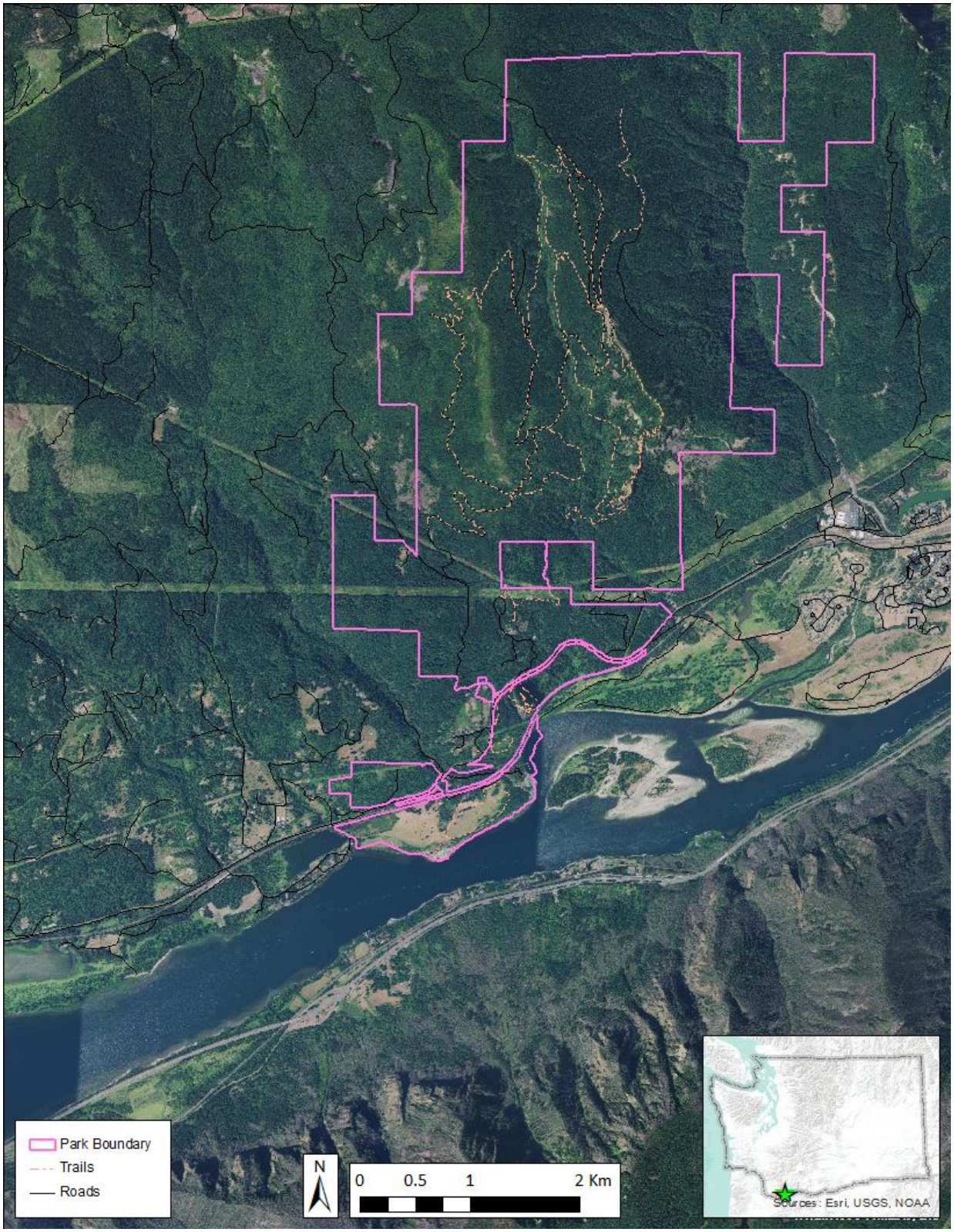

Figure B-4. Overview of Beacon Rock State Park

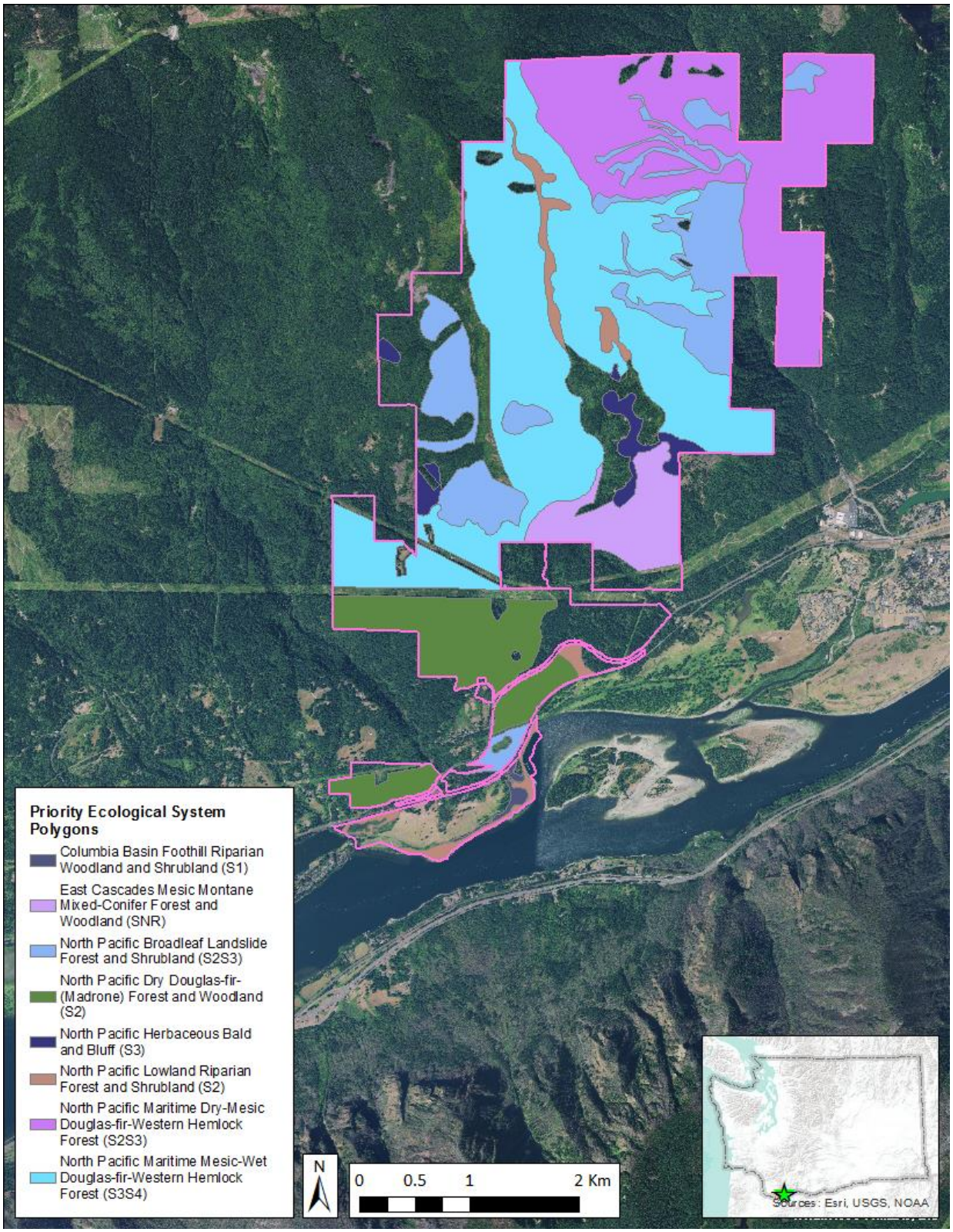

Figure B-5. Priority ecological systems polygons for assessment at Beacon Rock State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

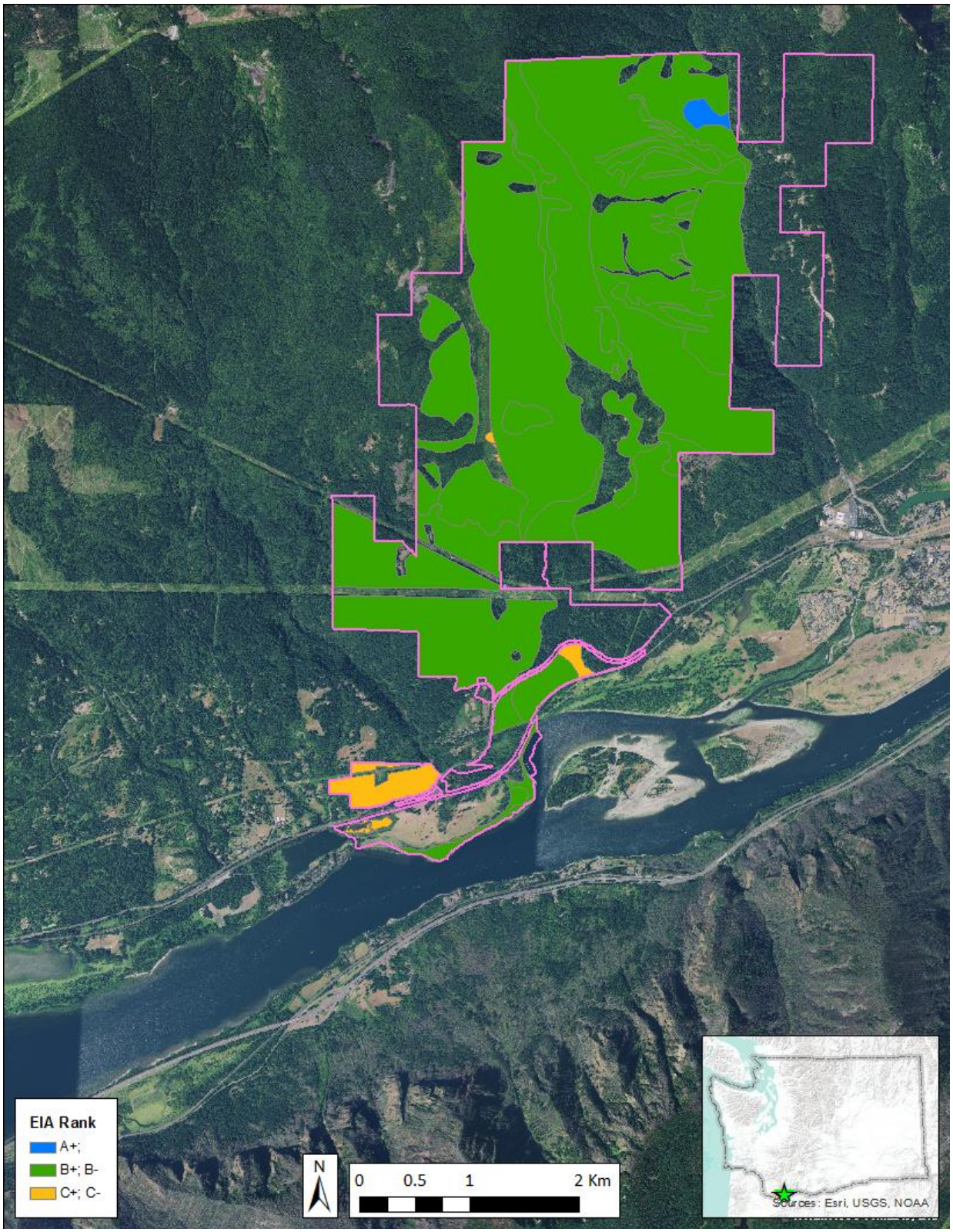

Figure B-6. EIA Ranks for all polygons assessed at Beacon Rock State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

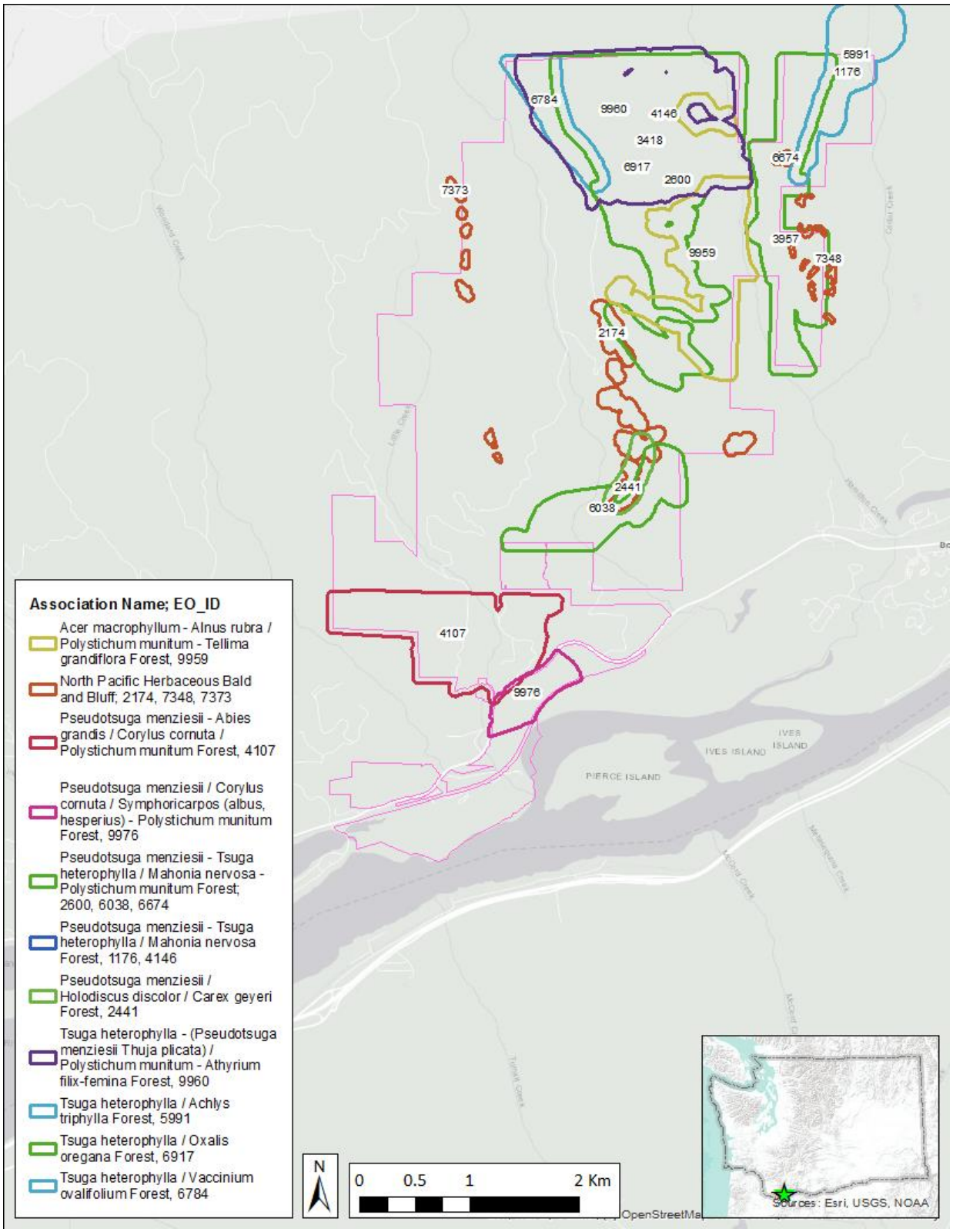

Figure B-7. Element occurrences at Beacon Rock State Park.

Appendix C. Cape Disappointment

Figure C-1. *Calamagrostis nutkaensis* - *Elymus glaucus* Grassland (G2/S2) on an oppressively smoky day at Cape Disappointment State Park.

The Ecological Integrity Assessment for Cape Disappointment State Park is presented below (Figure C-4). WNHP staff previously surveyed vegetation at Cape Disappointment (then known as Fort Canby State Park) in 2001 (Beck & Arnett, 2001) and a subsequent conservation assessment was completed by Chris Chappell (2002). In 2004, Kathleen Sayce and Nancy Eid conducted additional plant and ecosystem surveys (Sayce & Eid, 2004). This mapping was the basis for the assessment areas used in our surveys.

There were three previously documented community EOs at the park. Parks identified 33 polygons (493 hectares) of 8 different ecological systems as priorities for assessment (Figure C-5). All maps (Figure C-4 through Figure C-7) are presented at the end of the appendix for ease of reading.

EIA Results

Only a partial survey was completed at Cape Disappointment. We visited the park during the peak of the 2020 wildfire season and air quality deteriorated to the point where it was unsafe to be outside. Table C-1 summarizes the landscape context and condition primary factor ranks and

overall EIA ranks for the polygons we were able to assess. Table C-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table C-1. EIA Summary for Cape Disappointment. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
37	North Pacific Shrub Swamp	B	B	B+
47	North Pacific Hardwood-Conifer Swamp	B	B	B+
54	North Pacific Seasonal Sitka Spruce Forest	C	B	B-
55	North Pacific Seasonal Sitka Spruce Forest	C	B	B-
59	North Pacific Coastal Interdunal Wetland	B	B	B+
60	North Pacific Hardwood-Conifer Swamp	B	B	B+
63	North Pacific Hardwood-Conifer Swamp	B	C	C+
521	North Pacific Hypermaritime Shrub and Herbaceous Headland	B	A	B+
49-55	North Pacific Hardwood-Conifer Swamp	B	A	A-
49-56-Marsh	North Pacific Coastal Interdunal Wetland	C	C	C+
49-56-Shrubland	North Pacific Coastal Interdunal Wetland	C	B	B-
49-57	North Pacific Coastal Interdunal Wetland	C	B	B-
52-1	North Pacific Hypermaritime Shrub and Herbaceous Headland	B	B	B+
521-1	North Pacific Hypermaritime Shrub and Herbaceous Headland	B	C	C-
52-2	North Pacific Hypermaritime Shrub and Herbaceous Headland	B	A	A-
58-Shrub	North Pacific Coastal Interdunal Wetland	B	B	B+
60b	North Pacific Hardwood-Conifer Swamp	B	B	B+

Table C-2. Individual EIA Metric Ranks for Cape Disappointment.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
37	C	B	B	C	A	A	A	A	A	A		B	C	C	A	B
47	B	B	C	C	A	A	A	A	A	A	A	B	C	C	A	B
54	D	B	C	D	A	A-	B	A	C	A	B				A	A
55	C	B	C	C	B	A-	A	A	C	A	C				A	A
59	B	B	A	B	B	A-	B	A	A			A	B	B	B	C
60	C	B	B	B	B	A-	C	A	A	A	A	A	B	B	B	A
63	B	B	C	C	A	C	C	B	D	A	D	B	C	B	D	
521	B	B	B	B	B	A-	B	A	A						B	B
49-55	C	B	A	B	B	A-	B	A	A	A	A	A	A	A	A	A
49-56-Marsh	B	B	A	B	D	D	D	C	B			A	B	B	B	
49-56-Shrubland	C	A	B	C	D	B	C-	B	A			A	B	B	B	B
49-57	C	A	B	B	D	B	C	B	A	A	A	A	B	B	C	B
52-1	A	B	A	A	B	B	C	A	B						B	B
521-1	B	B	C	C	A	D	C-	D	D						A	
52-2	A	B	A	A	B	A-	B	A	A						A	B
58-Shrub	B	B	A	B	B	B	C	B	A			A	B	B	B	C
60b	C	B	C	C	A	A	A	A	A	A	A	B	C	C	A	B

Figure C-2 and Figure C-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure C-6.

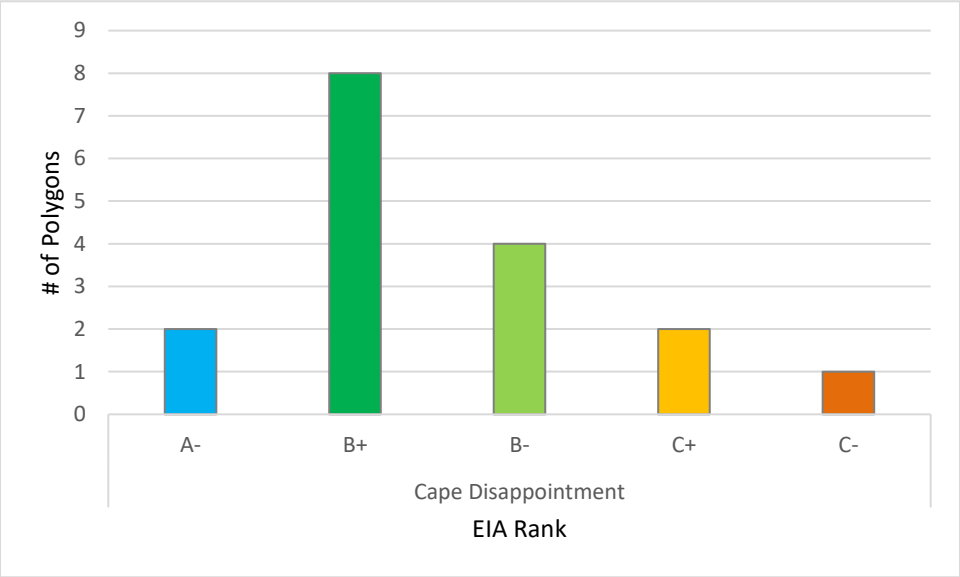

Figure C-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

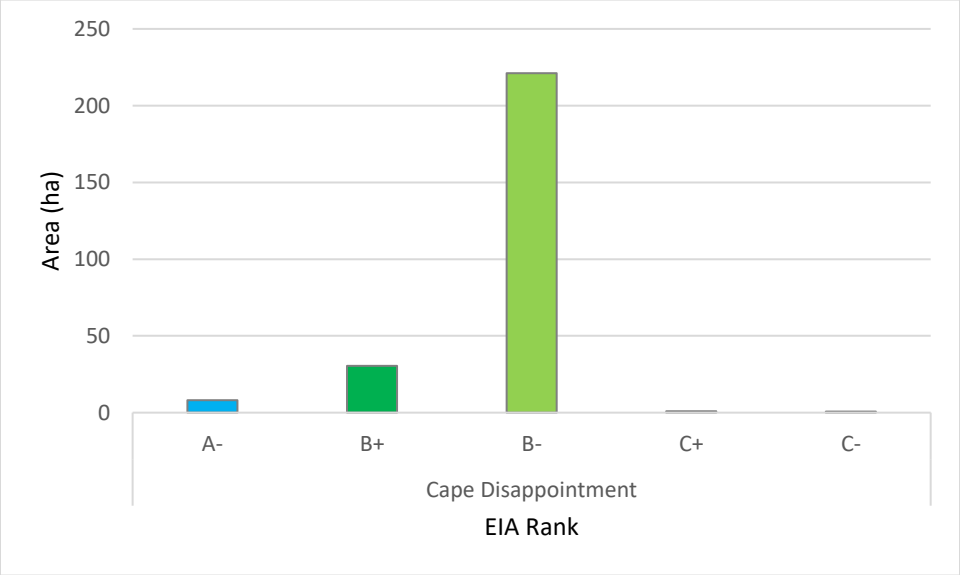

Figure C-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Ten new element occurrences were documented at Cape Disappointment (Table C-3, Figure C-7). One existing EO was also revisited and reassessed with current methodology.

Table C-3. Summary of new element occurrences at Cape Disappointment State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9899	52-2; 521	CEGL000972	Gaultheria shallon - Vaccinium ovatum / Pteridium aquilinum Shrubland	G3/S2S3	A-
9900	52-1; 521	CEGL001564	Calamagrostis nutkaensis - Elymus glaucus Grassland	G2/S2	B+
9920	49-56-Shrubland	CWWA000140	Salix hookeriana / Carex obnupta - (Argentina egedii ssp. egedii) Shrub Swamp	G4/S1?	B-
9921	59, 68-Shrub	CEGL003386	Salix hookeriana - Spiraea douglasii Shrub Swamp	GNR/S1	B+
9922	49-57	CEGL000142	Pinus contorta var. contorta / Carex obnupta Swamp Forest	G2/S1	B-
9923	49-55; 60	CEGL000400	Picea sitchensis / Rubus spectabilis / Carex obnupta - Lysichiton americanus Swamp Forest	G2G3/S2	A-
9931	47	CEGL000400	Picea sitchensis / Rubus spectabilis / Carex obnupta - Lysichiton americanus Swamp Forest	G2G3/S2	B+
9932	37	CEGL003432	Salix hookeriana - (Malus fusca) / Carex obnupta - Lysichiton americanus Wet Shrubland	G3/S2	B+
9933	60b	CEGL003389	Alnus rubra / Rubus spectabilis / Carex obnupta - Lysichiton americanus Swamp Forest	G3G4/S3S4	B-
9898	521	CEGL001567	Festuca rubra Coastal Headland Grassland	G2/S1	BC

Summary and Discussion

Overall Conditions

Most of the surveyed areas at Cape Disappointment were in overall good condition. Exotic/invasive plants (Table C-4, VEG1, VEG2) are not currently a significant threat in the forests, aside from areas of *Hedera hibernica* and scattered *Ilex aquifolium*. Nonnative species pose a greater threat in the dunes and herbaceous wetlands, where invasive grasses (*Ammophila* spp., *Phalaris arundinacea, Agrostis stolonifera, A. capillaris*) and other noxious species are often prominent. Native plant species composition (VEG3) was excellent in areas where invasive have not reduced native diversity nor reduced the cover of diagnostic species.

Table C-4. Summary of EIA metric ratings by area (ha) at Cape Disappointment State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	**244**	16	1	1
VEG2	**182**	54	20	6
VEG3	**245**	16	< 1	1
VEG4	52	1	**207**	1
VEG5	**246**			
VEG6	33	40	**167**	1
HYD1	**31**	15		
HYD2	6	**24**	15	
HYD3	6	**25**	15	
SOI1	**230**	21	10	1

Most polygons received fair ("C") ratings in vegetation structure (VEG4). Upland forested areas are in Maturation I and Maturation II successional stages (Van Pelt, 2007) due to historical logging. Coarse woody debris and snags are somewhat reduced, but within the natural range of variability. Headland communities face threats from woody encroachment, particularly on sites that have been removed from the spray zone by beach aggradation. Much of the dune and wetland vegetation at Cape Disappointment has developed on relatively new substrate that has been deposited since construction of the jetties at the mouth of the Columbia. As such, early seral forested wetlands on the north and south ends of the park scored relatively highly in the structure metrics because they are not the result of logging or other direct anthropogenic disturbance.

Wetland hydrology at Cape Disappointment is complex and fluctuating. Beach dynamics—including erosion, aggradation, and foredune stabilization by *Ammophila* spp.—have likely altered the hydroperiod (HYD1) and connectivity (HYD2) of many of the wetlands in a manner that is difficult to assess based on a single site visit.

Recommendations for Enhancing / Maintaining Ecological Integrity

The headland vegetation in the park is of particular conservation interest (EO IDs 9898, 9899, and 9900). Restoration efforts appear to be under way to remove encroaching trees on North Head—with diligent invasive plant treatments and restricted social trails, this work should help increase the size and integrity of these EOs. Elsewhere, headland vegetation also occurs on sea stacks that are now removed from the salt spray zone (due to sand aggradation). These sites should be lower priorities for restoration, as they do not appear to have long-term viability.

Perhaps more than any other park we surveyed, the ecological integrity of Cape Disappointment is influenced by anthropogenic features that are outside of the control of park managers. The jetties at the mouth of the Columbia have changed the landscape dramatically over the past century. Eradicating the *Ammophila* infestations that have established on the new beach surfaces is likely a daunting task. However, successful removal has occurred on the adjacent Willapa National Wildlife Refuge.

Future Assessment / Survey Recommendations

There appear to be discrepancies in the Vegetation Survey Database attributes for Cape Disappointment. The EL codes for many polygons do not match the primary plant association names (PA1). The codes sometimes match one of the secondary calls (PA2, PA3, or PA4), but not always. We attempted to fix the mistakes we came across, but there may still be some EL codes and names that do not match the intent of the contractor's PA1. We recommend a focused quality control review of the data fields for this park.

We did not complete field surveys over most of the area inland of Benson Beach, in the southern sector of the park. Sayce & Eid (2004) reported this area to be particularly dynamic over the past few decades, with dramatic changes in hydrology and the rate of aggradation/erosion. Further investigation is warranted—including hydrological monitoring.

Maps

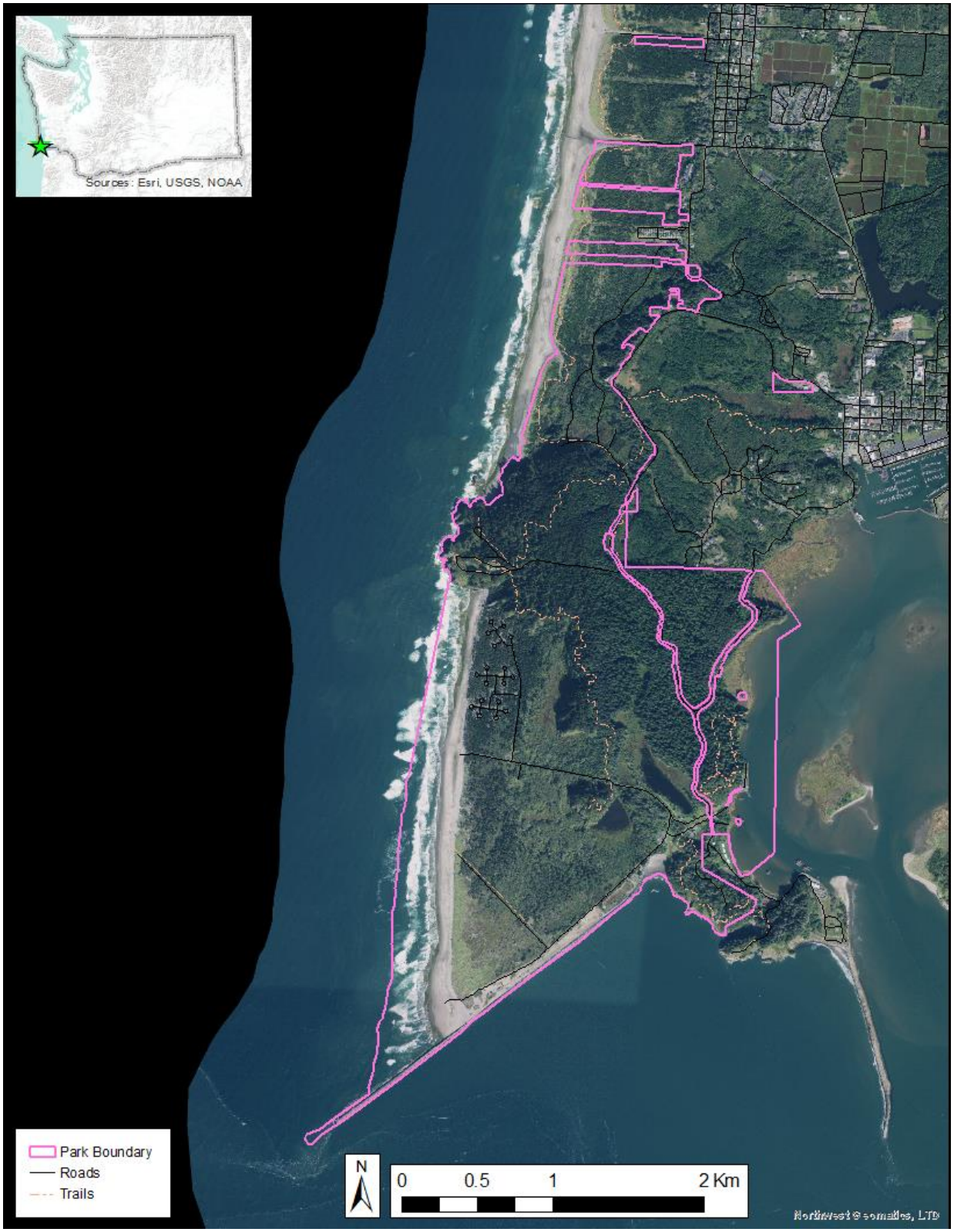

Figure C-4. Overview of Cape Disappointment State Park

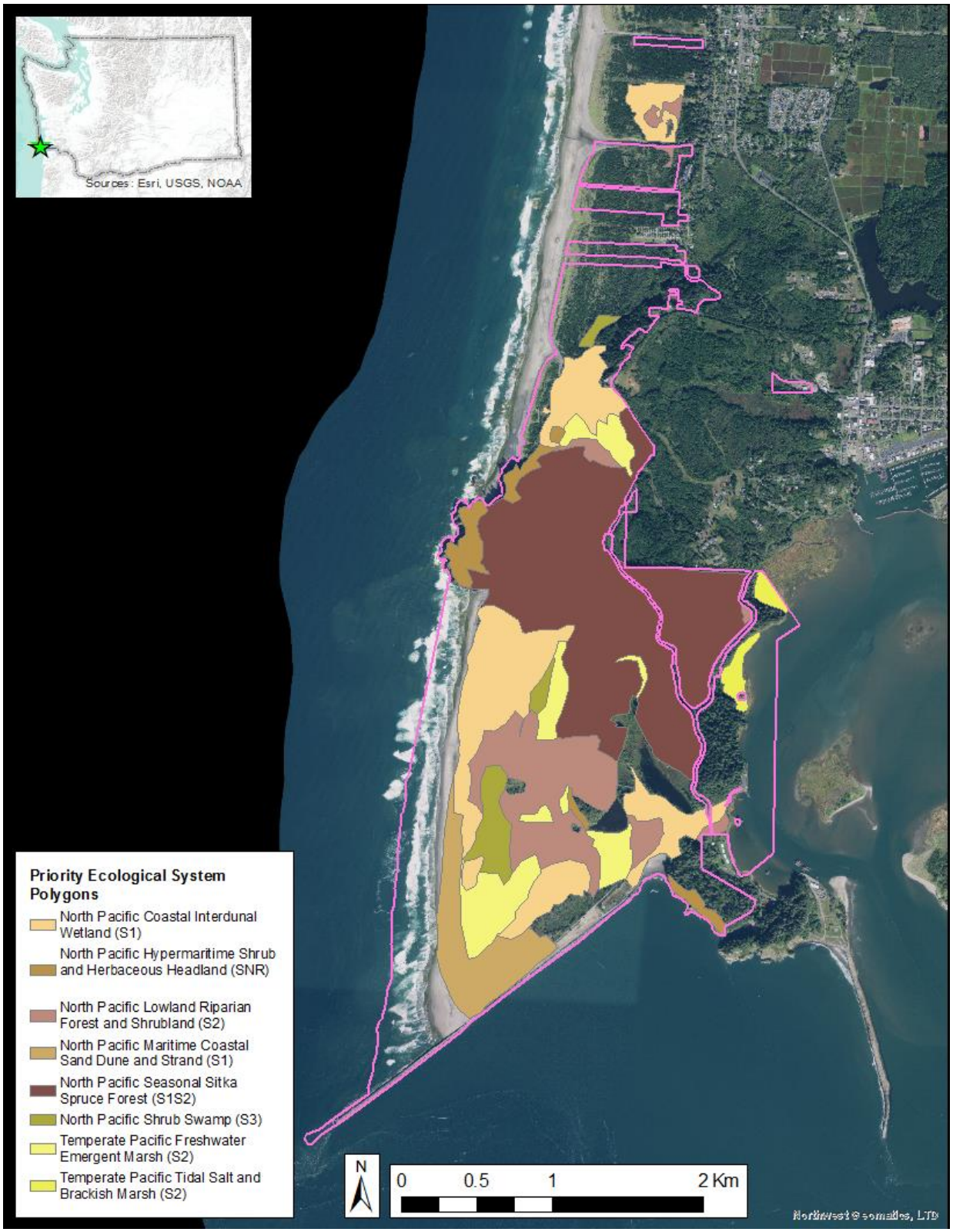

Figure C-5. Priority ecological systems polygons for assessment at Cape Disappointment. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

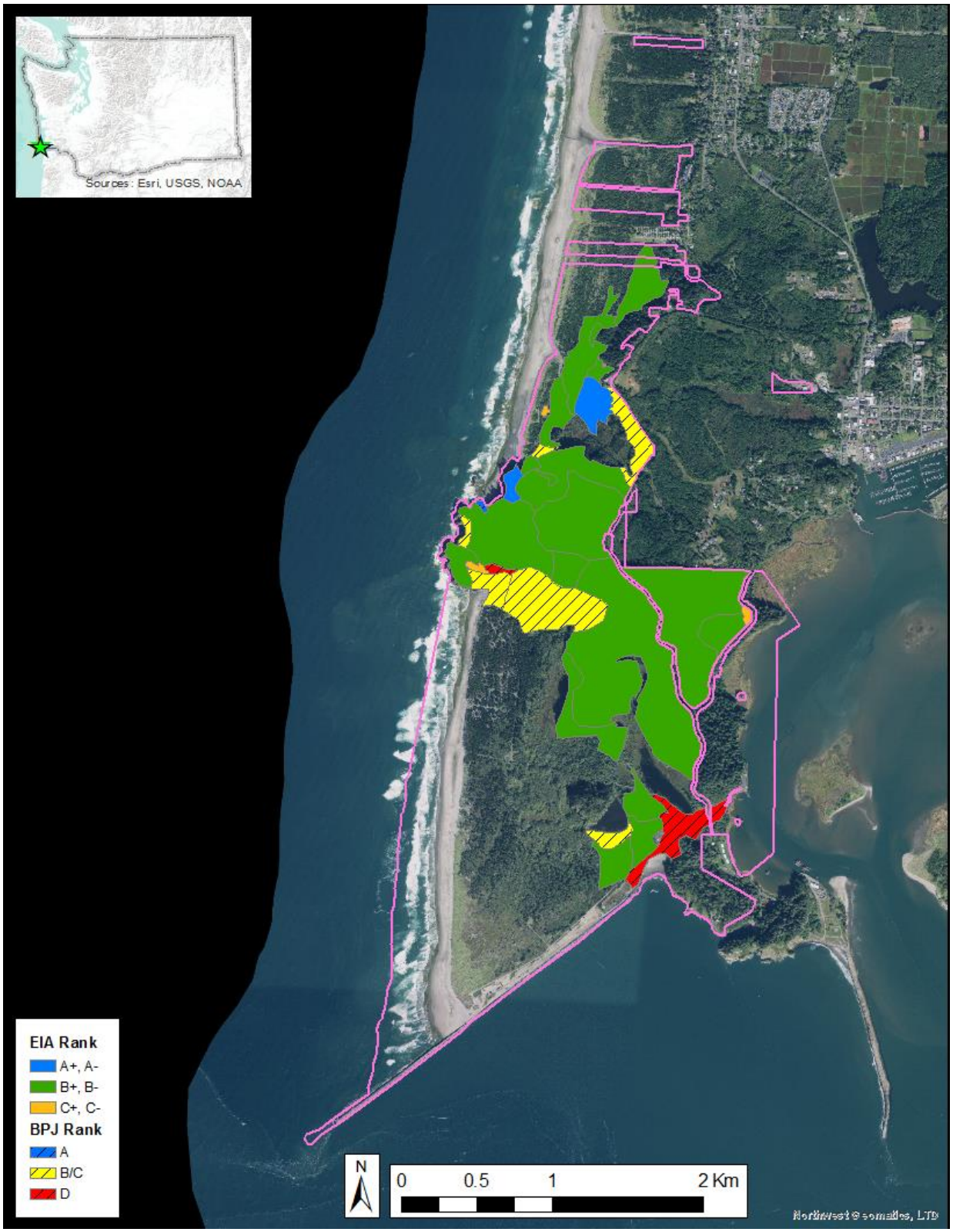

Figure C-6. EIA Ranks for all polygons assessed at Cape Disappointment State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, "best professional judgment" rank (not EIA).

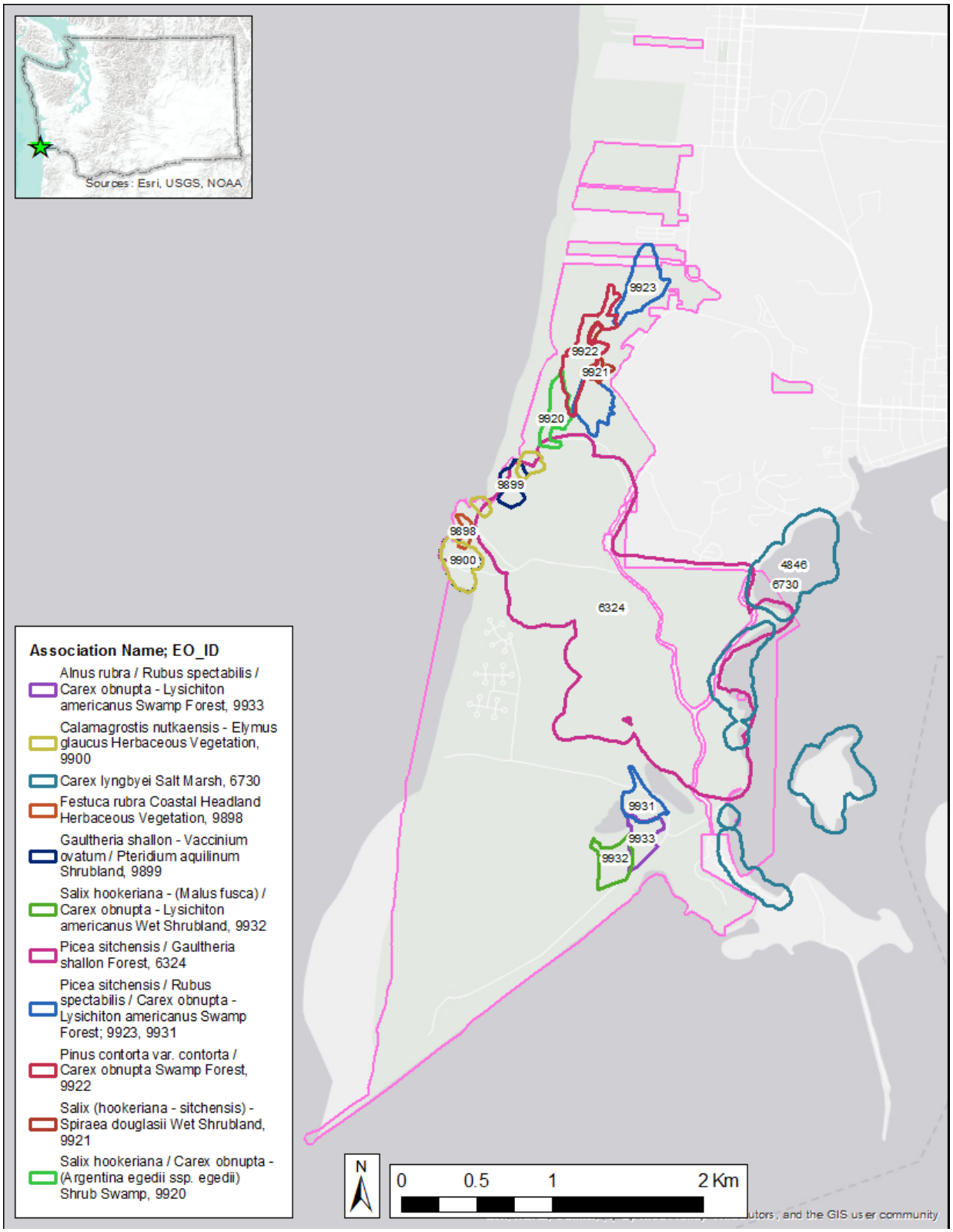

Figure C-7. Element occurrences at Cape Disappointment State Park.

Appendix D. Columbia Hills

Figure D-1. *Pseudoroegneria spicata - Poa secunda* Grassland (G4/S2) at Columbia Hills State Park.

The Ecological Integrity Assessment for Columbia Hills State Park is presented below (Figure D-5). WNHP staff previously surveyed vegetation at Columbia Hills (then known as Dalles Mountain Ranch and Horsethief Lake) in 2001 (Beck & Arnett, 2001) and a subsequent conservation assessment was completed by Rex Crawford (2001).

There were two previously documented community EOs at the park. Parks identified 13 polygons (554 hectares) of 5 different ecological systems as priorities for assessment at Columbia Hills (Figure D-6). All maps (Figure D-5 through Figure D-8) are presented at the end of the appendix for ease of reading.

EIA Results

All priority polygons were surveyed at Columbia Hills in mid- to late-April 2021. The copious exotic bromes on site were difficult to distinguish at that time of year and were largely identified by flowers from the previous season. *Bromus tectorum* and *B. diandrus* were confirmed. *B. hordeaceus* was almost certainly present as well. It should also be noted that field staff were unaware of the presence of *Elymus wawawaiensis* (SECAR cultivar) at Columbia Hills—they did

not closely examine any of the apparent *Pseudoroegneria spicata* in surveyed polygons to determine if these were actually *E. wawawaiensis*. Depending on the relative proportion of *E. wawawaiensis*, metric ratings for relative native plant cover (VEG1) and native plant species composition (VEG3) may need to be revised downwards in the grasslands and oak woodlands.

Table D-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table D-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table D-1. EIA Summary for Columbia Hills. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
67	Columbia Basin Foothill and Canyon Dry Grassland	B	C	C+
68	Columbia Basin Foothill Riparian Woodland and Shrubland	B	C	C+
73	Inter-Mountain Basins Cliff and Canyon	B	B	B-
76	Columbia Basin Foothill Riparian Woodland and Shrubland	B	C	B-
77	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland	B	D	C-
78	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland	B	D	C-
66-18R	Columbia Basin Foothill Riparian Woodland and Shrubland	B	B	B+
66-18U	East Cascades Oak-Ponderosa Pine Forest and Woodland	B	B	B-
66-21,45	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland	B	D	C-
70-71	Inter-Mountain Basins Cliff and Canyon	B	B	B-
72c	Columbia Basin Foothill Riparian Woodland and Shrubland	B	B	B-
74-75	Columbia Plateau Scabland Shrubland	C	C	C+
74-Pothole	Northern Columbia Plateau Basalt Pothole Pond	B	B	B-
74-Ruderal	Northern Columbia Plateau Basalt Pothole Pond	B	B	B-
Columbia Hills-19	East Cascades Oak-Ponderosa Pine Forest and Woodland	B	B	B-

Table D-2. Individual EIA Metric Ranks for Columbia Hills.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
67	C	B	B	B	B	D	D	C	C		C				C	C
68	B	B	A	B	C	D	D	C	C		C	B	C	C	B	
73	B	B	A	A	C	D	C	C	A						A	
76	C	A	A	B	C	D	D	B	B		C	B	B	B	B	C
77	B	B	B	C	C	D	C-	D	C		C				C	
78	B	B	A	A	C	D	D	B	C		C				A	
66-18R	B	A	B	B	C	D	D	B	A	B	A	A	A	B	B	B
66-18U	B	A	B	B	C	D	C-	B	C	A	A				A	B
66-21,45	B	B	B	A	C	D	D	D	D		C				B	
70-71	B	B	A	B	C	C	C	B	A						A	
72c	B	A	A	A	C	D	D	B	B			A	A	B	A	C
74-75	C	B	B	B	C	D	C-	C	C		C				B	
74-Pothole	B	B	A	B	C	D	C-	B	B			A	A	A	A	
74-Ruderal	B	B	A	B	C	D	C-	D	C		D	A	A	A	A	
ColumbiaHills-19	B	A	B	B	C	D	D	B	B	B	B				A	B

Figure D-2 and Figure D-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure D-7.

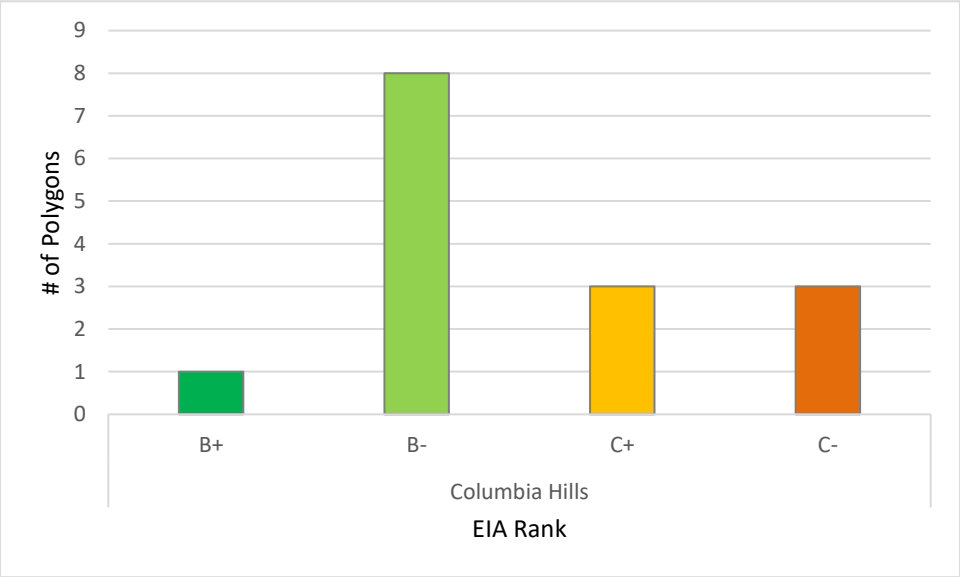

Figure D-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

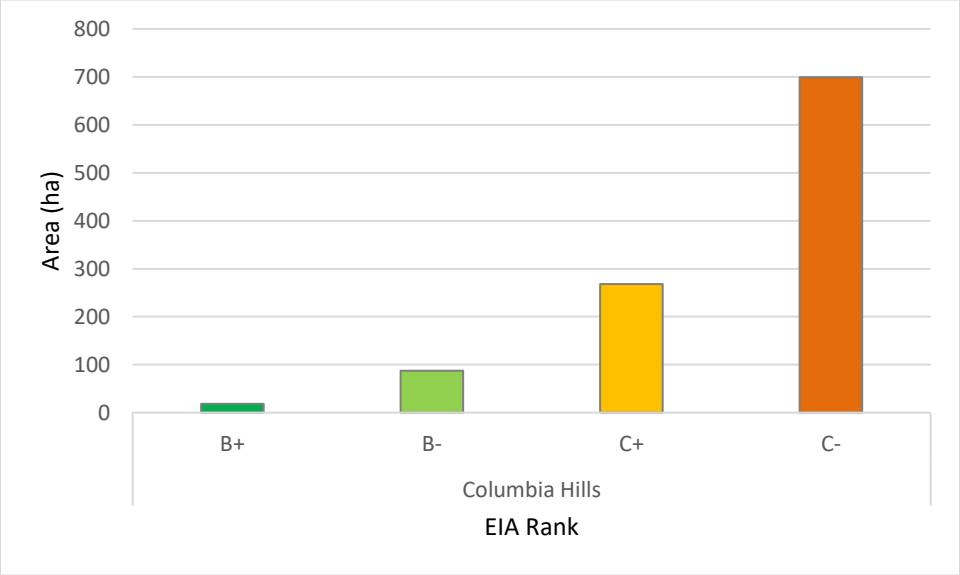

Figure D-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Five new element occurrences were documented at Columbia Hills (Table D-3, Figure D-8). While most of these are in poor on-site condition, they represent critically imperiled plant associations. The two existing EO on site were not revisited as part of this project.

Table D-3. Summary of new element occurrences at Columbia Hills State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9934	67	CEGL001516	Sporobolus cryptandrus - Poa secunda Grassland	G2/S1S2	C-
9935	66-18R	CEGL000553	Quercus garryana / Symphoricarpos albus Riparian Woodland	G2G3/S2S3	B-
9936	66-18U; ColumbiaHills-19	CEGL000552	Quercus garryana / Pseudoroegneria spicata	G1G2/S1S2	B+
9937	72c	CEGL000875	Philadelphus lewisii / Symphoricarpos albus Wet Shrubland	G1G2/S1S2	C-
9938	76	CEGL001170	Philadelphus lewisii Wet Shrubland	G2/S1S2	C-

Summary and Discussion

Figure D-4. This *Philadelphus lewisii* / *Symphoricarpos albus* Wet Shrubland is one imperiled plant association in fair/poor condition that may be a target for restoration at Columbia Hills.

Overall Conditions

Overall ecological integrity at Columbia Hills is fair, with generally poor on-site condition (condition primary rank factor) buoyed somewhat by the limited development in the surrounding landscape (landscape context primary rank factor). Lower elevations have been degraded by highway and rail construction and by heavy recreational impacts, while the higher elevations show clear signs of the intensive ranching and farming that preceded establishment of the park (Beck & Arnett, 2001). Exotic/invasive species (Table D-4, VEG1, VEG2) are significant threats and native plant species composition (VEG3) is extremely degraded over the great majority of the park. *Poa bulbosa*, *Taeniatherum caput-medusae*, *Chondrilla juncea*, and a suite of invasive bromes are the primary culprits. Structurally (VEG4), much of the grassland areas have been converted from perennial bunchgrass communities to exotic annual grasslands, also impacting the amount and origin of fine litter (VEG6). In the oak woodlands, *Quercus garryana* seedlings, snags, and coarse woody debris appear to be within the natural range of variability (VEG5, VEG6). Most of the park's wetlands appear hydrologically intact (HYD1-HYD3), save for some impoundments generated by roads and the railroad. Most soil disturbance (SOI1) has been generated by grazing, social trails, and two-track roads.

Table D-4. Summary of EIA metric ratings by area (ha) at Columbia Hills State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1			7	**1066**
VEG2			35	**1039**
VEG3		155	295	**623**
VEG4	53	27	**582**	411
VEG5	25	**40**		
VEG6	44	22	**972**	1
HYD1	**20**	6		
HYD2	**20**	5	1	
HYD3	1	**24**	1	
SOI1	160	**684**	230	

Recommendations for Enhancing / Maintaining Ecological Integrity

Several of the EOs at Columbia Hills are in fair or poor condition, notably the *Philadelphus lewisii* dominated shrublands (Figure D-4, EO IDs 9937 and 9938) and the *Sporobolus cryptandrus - Poa secunda* Grassland (EO ID 9934). Their long term viability is questionable. These imperiled communities may be targets for restoration, although restoring the grassland community (and eliminating its invasion of exotic bromes) would likely be difficult.

A recent project at the park has tested the utility of using adaptively managed grazing to promote biological diversity and reduce fuel load in the park's degraded grasslands (Nelson & Van Vleet, 2013; Menke & Bahm, 2020). This study has shown increased native perennial forb cover in grazed areas, though without significant changes in native diversity. Most of this increased forb cover likely comes from unpalatable "increaser" species such as *Balsamorhiza careyana*, *Lomatium nudicaule*, etc. Of course, this study is occurring in a portion of the park that was

particularly heavily impacted by past agricultural practices, so any improvement in native plant cover is certainly notable.

Managed fire remains the tool that most closely mimics historic disturbance regimes in these grasslands—grasslands that did not develop with large, native grazers. While grazing may be useful for lowering fuel loads, such benefits will usually be accompanied by degradation in native plant species composition, relative to the natural range of variability. Notably, while the study design compares grazed/burned, grazed/unburned, and ungrazed/unburned parcels, it does not include a comparison with ungrazed/burned areas.

Future Assessment / Survey Recommendations

The areas most likely to be in good ecological condition were surveyed as part of this project. Additional assessments at Columbia Hills are not a priority at this time, although we encourage continued monitoring of restoration activities.

Maps

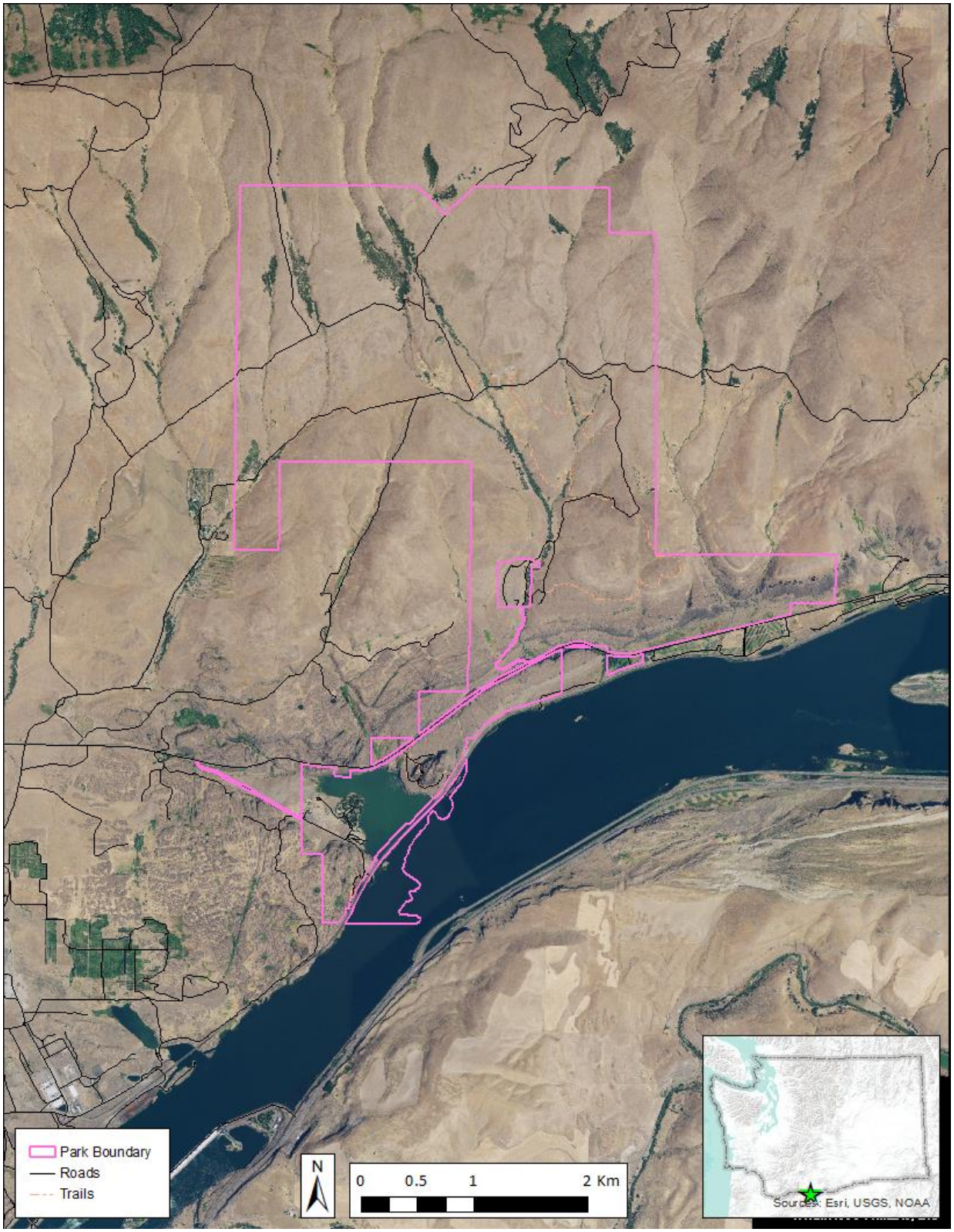

Figure D-5. Overview of Columbia Hills State Park

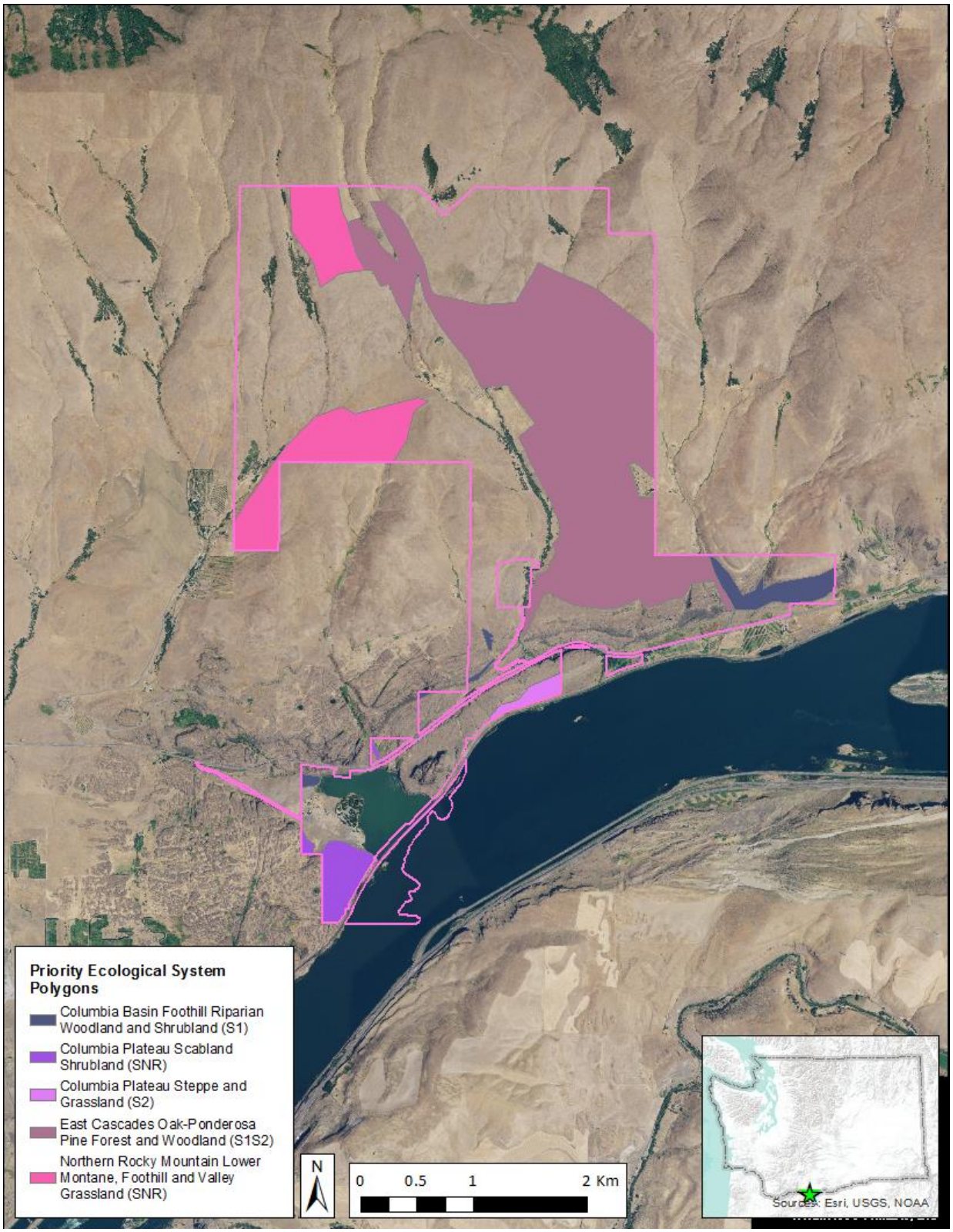

Figure D-6. Priority ecological systems polygons for assessment at Columbia Hills State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

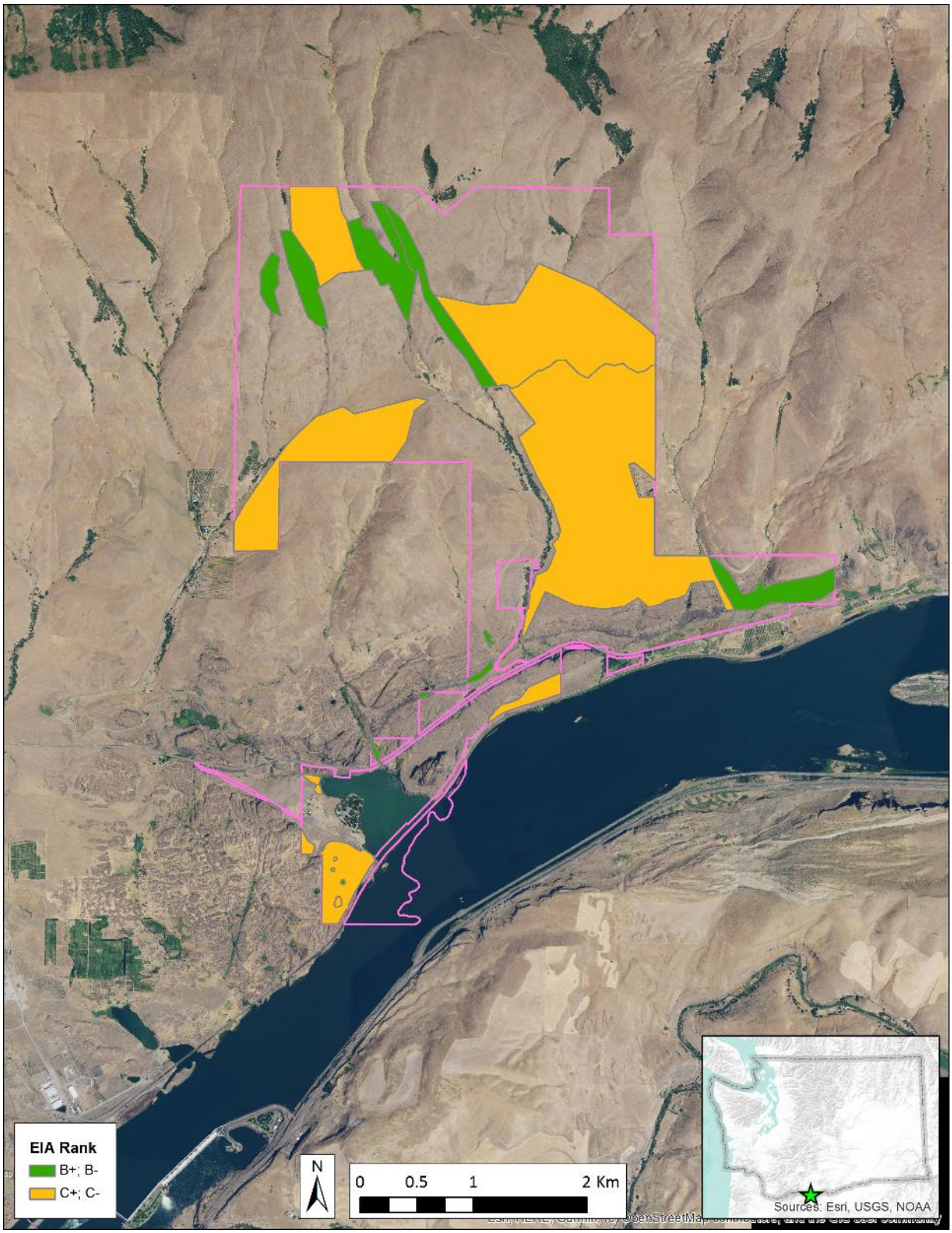

Figure D-7. EIA Ranks for all polygons assessed at Columbia Hills State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, "best professional judgment" rank (not EIA).

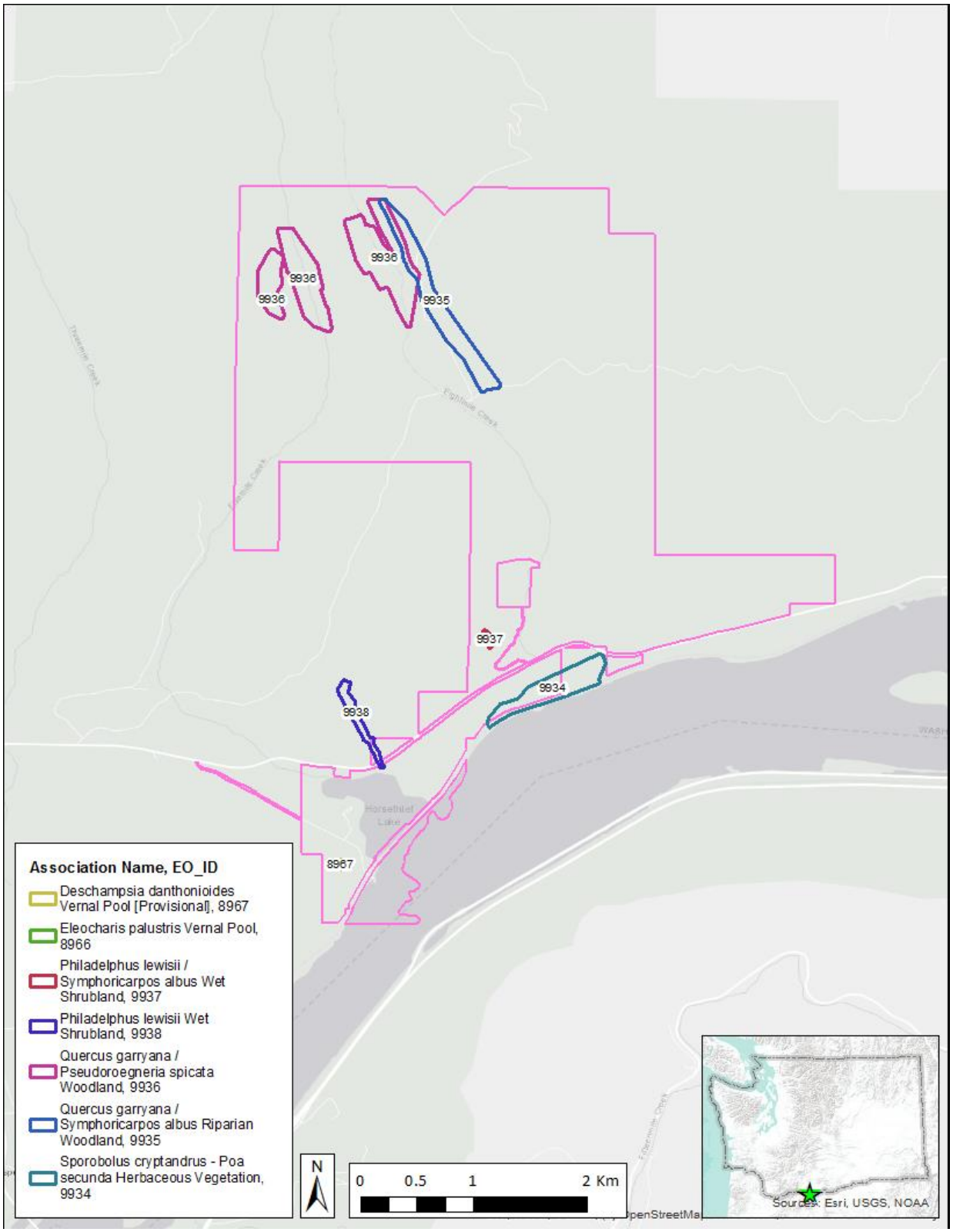

Figure D-8. Element occurrences at Columbia Hills State Park.

Appendix E. Deception Pass

Figure E-1. *Artemisia campestris - Festuca rubra* / *Racomitrium canescens* Grassland (G1/S1) at Deception Pass State Park.

The Ecological Integrity Assessment for Deception Pass State Park is presented below (Figure E-4). The vegetation of the area has been extensively surveyed in the past, including during a WNHP Natural Forest Inventory by Chris Chappell (1993). A more recent vegetation survey report was also completed by URS (2009b). This mapping was the basis for the assessment areas used in our surveys.

There were 30 previously documented community EOs at the park. Parks identified 35 polygons (809 hectares) of 10 different ecological systems as priorities for assessment (Figure E-5). All maps (Figure E-4 through Figure E-7) are presented at the end of the appendix for ease of reading.

EIA Results

Most priority polygons were surveyed at Deception Pass. While several balds were identified by Parks as priority polygons, we did not assess those sites, as our late-season surveys (due to COVID delays) were poorly timed for accurately assessing herb-dominated communities. Likewise, a few wetlands were inaccessible without watercraft. Table E-1 summarizes the landscape context and

condition primary factor ranks and overall EIA ranks for these polygons. Table E-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table E-1. EIA Summary for Deception Pass. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
82	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	C	B	B-
83	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	B	B-
85	North Pacific Bog and Fen	B	A	A-
86	North Pacific Bog and Fen	B	B	B+
98	North Pacific Hardwood-Conifer Swamp	C	B	B-
99	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	C	B	B-
100	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	B	B+
101	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	A	B+
102	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	B	B+
103	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	B	B+
105	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	B	B+
107	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	B	B+
108	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
109	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
112	North Pacific Hardwood-Conifer Swamp	B	B	B-
113	North Pacific Hardwood-Conifer Swamp	B	B	B+
114	North Pacific Ruderal Riparian and Swamp Forest	C	B	B-
104-D	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	B	B+
104-DM	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	A	A-
106-D	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	B	B-
106-DM	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	B	B+
80-1	North Pacific Maritime Coastal Sand Dune	B	B	B+
80-2	North Pacific Maritime Coastal Sand Dune	B	C	C+
80-4	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	A	A-
81-52,53,97	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	C	B	B-
81-64,66,98	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	A	B+
84-D	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	A	B+
84-DM	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	B	B+
84-MW	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
87d	North Pacific Bog and Fen	B	B	B+

Table E-2. Individual EIA Metric Ranks for Deception Pass.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
82	C	C	C	C	A	A-	B	A	C	B	D				B	B
83	B	C	B	B	B	A-	B	A	C	A	B				B	B
85	C	B	A	B	A	A	A	B	B			A	B	A	A	C
86	C	B	A	B	A	A	A	B	C			B	B	A	A	B
98	B	B	B	C	C	A-	A	B	C	A	D	A	B	B	B	A
99	C	C	C	C	A	A-	B	A	C	B	B				B	B
100	B	B	C	C	A	A-	B	A	B	A	B				A	D
101	B	B	B	B	B	B	B	A	A	A	A				B	A
102	C	A	B	B	B	C	C	B	A	A	A				B	C
103	B	B	B	B	B	B	B	A	C	A	B				B	CD
105	B	B	A	A	B	A-	A	A	B	B	B				A	BC
107	B	B	B	B	A	A-	B	A	B	A	B				A	B
108	C	C	C	B	A	A-	B	B	C	B	C				B	
109	B	C	B	C	A	A-	B	A	C	B	C				A	
112	D	B	C	C	A	B	C	B	C	A	B	B	C	C	A	C
113	A	B	B	B	A	A-	B	B	C	A	B	B	A	B	A	
114	B	C	B	C	C	D	C-	D	C	B	D	A	A	A	A	
104-D	B	A	B	B	B	A-	A	A	B	B	B				B	BC
104-DM	B	A	B	B	B	A	A	A	A	A	A				B	CD

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
106-D	C	B	C	C	A	A-	B	A	C	A	C				A	BC
106-DM	C	B	B	B	B	A-	B	A	B	A	B				B	CD
80-1	A	B	B	B	C	C	B	A	A						A	D
80-2	A	B	B	C	B	C	C-	C	D						C	D
80-4	A	B	B	B	B	A	B	A	A	A	A				B	D
81-52,53,97	C	C	C	C	A	A-	A	C	C	B	C				B	C
81-64,66,98	B	B	C	C	A	A-	B	A	B	A	A				A	C
84-D	B	B	B	C	A	B	A	A	B	A	B				A	BC
84-DM	B	B	B	C	A	A-	A	A	C	A	C				B	D
84-MW	B	B	B	C	A	A-	B	A	C	A	C				B	D
87d	C	B	A	B	A	A	A	B	C			A	B	A	A	C

Figure E-2 and Figure E-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure E-6.

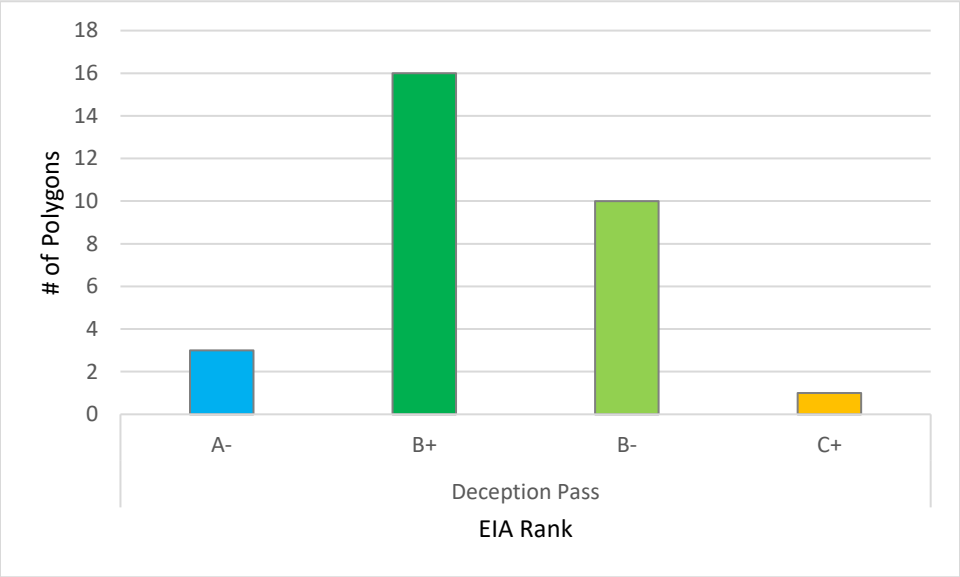

Figure E-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

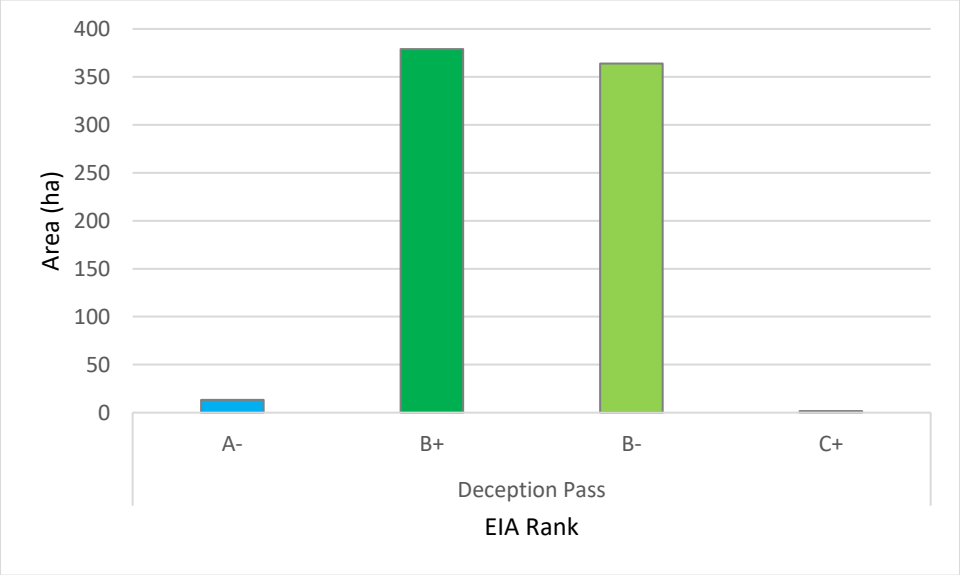

Figure E-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

11 new element occurrences were documented at Deception Pass (Table E-3, Figure E-7) and another 9 existing EOs were revisited and assessed with current methodology. Table E-3 summarizes the classification, conservation status ranks, and EO ranks (landscape context +

condition + size) of new EOs at Deception Pass. For additional information, see the accompanying Excel workbook.

Table E-3. Summary of new element occurrences at Deception Pass State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9905	86	CWWA000229	Ledum groenlandicum / Carex utriculata / Sphagnum spp. Shrub Bog	GNR/S2	B+
9906	80-1	CEGL003370	Artemisia campestris - Festuca rubra / Racomitrium canescens Grassland	G1/S1	C+
9907	80-4	CEGL000150	Pinus contorta var. contorta - Pseudotsuga menziesii / Gaultheria shallon Forest	G1/S1	B-
9939	104-D; 105; 106-D; 84-D	CEGL005531	Pseudotsuga menziesii / Gaultheria shallon - Holodiscus discolor Forest	GNR/S2	B+
9940	104-DM; 106-DM; 103	CEGL002845	Pseudotsuga menziesii - (Abies grandis, Thuja plicata) / Mahonia nervosa - Gaultheria shallon Forest	G2/S1	B-
9941	87d	CWWA000226	Ledum groenlandicum - Gaultheria shallon / Sphagnum spp. Shrub Bog	GNR/SNR	B+
9942	85	CWWA000226	Ledum groenlandicum - Gaultheria shallon / Sphagnum spp. Shrub Bog	GNR/SNR	B+
9943	84-MW	CEGL000468	Thuja plicata - (Abies grandis) / Polystichum munitum Forest	G1/S1	C-
9961	82; 83	CEGL002848	Thuja plicata - Pseudotsuga menziesii - Abies grandis / Mahonia nervosa / Polystichum munitum Forest	G1/S1	B+
9914	98	CEGL007322	Tsuga heterophylla - (Thuja plicata - Alnus rubra) / Lysichiton americanus - Athyrium filix-femina Swamp Forest;	GNR/S2S3	B+
9915	98	CEGL003388	Alnus rubra / Athyrium filix-femina - Lysichiton americanus Swamp Forest	G3G4/S3	B+
9945	81-64,66,98	CEGL005576	Tsuga heterophylla - (Pseudotsuga menziesii, Thuja plicata) / Polystichum munitum - Athyrium filix-femina Forest	G3G4/S3	B-

Summary and Discussion

Overall Conditions

Deception Pass represents one of the most ecologically significant forested areas in the Puget Trough (Chappell, 1993). Extensive surveys have been completed previously. Most of the new EOs are in good-but-not-excellent condition and would not have stood out, previously, as the "best" condition stands in the park. However, many of these stands represent globally imperiled ecosystems.

Relative native plant cover (Table E-4, VEG1) is excellent across the park areas we surveyed. Note that while balds were not assessed at Deception Pass (due to phenology), those that were observed were clearly colonized by numerous exotic species. Away from the balds and dunes, invasive

(VEG2) are low in cover, with *Rubus bifrons*, *Ilex aquifolium*, *Geranium robertianum*, and *Hedera hibernica* the most problematic species in the forests. Native plant species composition (VEG3) is also excellent across most of the park, but forests with more recent and extensive logging history have codominant *Alnus rubra* (acting as an "increaser" species). Much of the park has been logged—at least selectively—which has simplified the canopy structure, but there are some old-growth, naturally early seral, and edaphically limited stands with good to excellent structure (VEG4). Woody regeneration (VEG5), snags, and coarse woody debris (VEG6) are within the natural range of variability for the most part. Again, more recently logged areas are lacking in snags and coarse woody debris. Hydrology (HYD1-HYD3) appears to be within the natural range of variability in nearly all of the surveyed wetlands. Some of the peatlands are experiencing tree encroachment, which may indicate a deviation in hydroperiod (HYD2), but this appears to be a region-wide phenomenon. Most soil disturbances (SOI1) are from social trails or past logging operations.

Table E-4. Summary of EIA metric ratings by area (ha) at Deception Pass State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	**729**	17	11	1
VEG2	261	**488**	7	3
VEG3	**557**	66	135	1
VEG4	26	283	**448**	2
VEG5	**475**	266		
VEG6	**260**	137	251	94
HYD1	**28**	13		
HYD2	5	**35**	1	
HYD3	12	**28**	1	
SOI1	317	**439**	2	

Recommendations for Enhancing / Maintaining Ecological Integrity

One highlight of the park is the globally critically imperiled *Artemisia campestris - Festuca rubra / Racomitrium canescens* Grassland (G1/S1). This is the only EO-quality occurrence documented in Washington. Parks staff appear to have had good success at recent efforts to remove invasive *Ammophila* from this deflation plain at West Beach. Unlike park units on the outer coast, general *Ammophila* control may be practical at Deception Pass due to the less extensive dune systems. Long-term success may require collaboration with landowners to the south.

Many of the rare and imperiled forest types present at Deception Pass are part of the North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland ecological system. These systems were historically dependent on moderately frequent, low- to mixed-severity fires (Van Pelt, 2007). Introduction of prescribed fire would likely be the most effective analogue for maintaining these imperiled communities, but there are certainly challenges to burning in an area with so much exurban development. Some of these stands appear to be edaphically maintained (e.g. soils are too dry and shallow for mesic conifers like *Tsuga heterophylla*)—these are more likely to persist even without fire.

Future Assessment / Survey Recommendations

Balds, islands, and the wetlands surrounding Cranberry Lake were not surveyed as part of this effort (though portions of Cranberry Lake were observed by WNHP staff as recently as 2012). The balds are of significant conservation interest and should be prioritized for future assessments. Hydrologic and vegetation/bryophyte monitoring of the peatlands on Hoypus Hill would be useful for tracking tree encroachment and teasing apart underlying drivers.

Maps

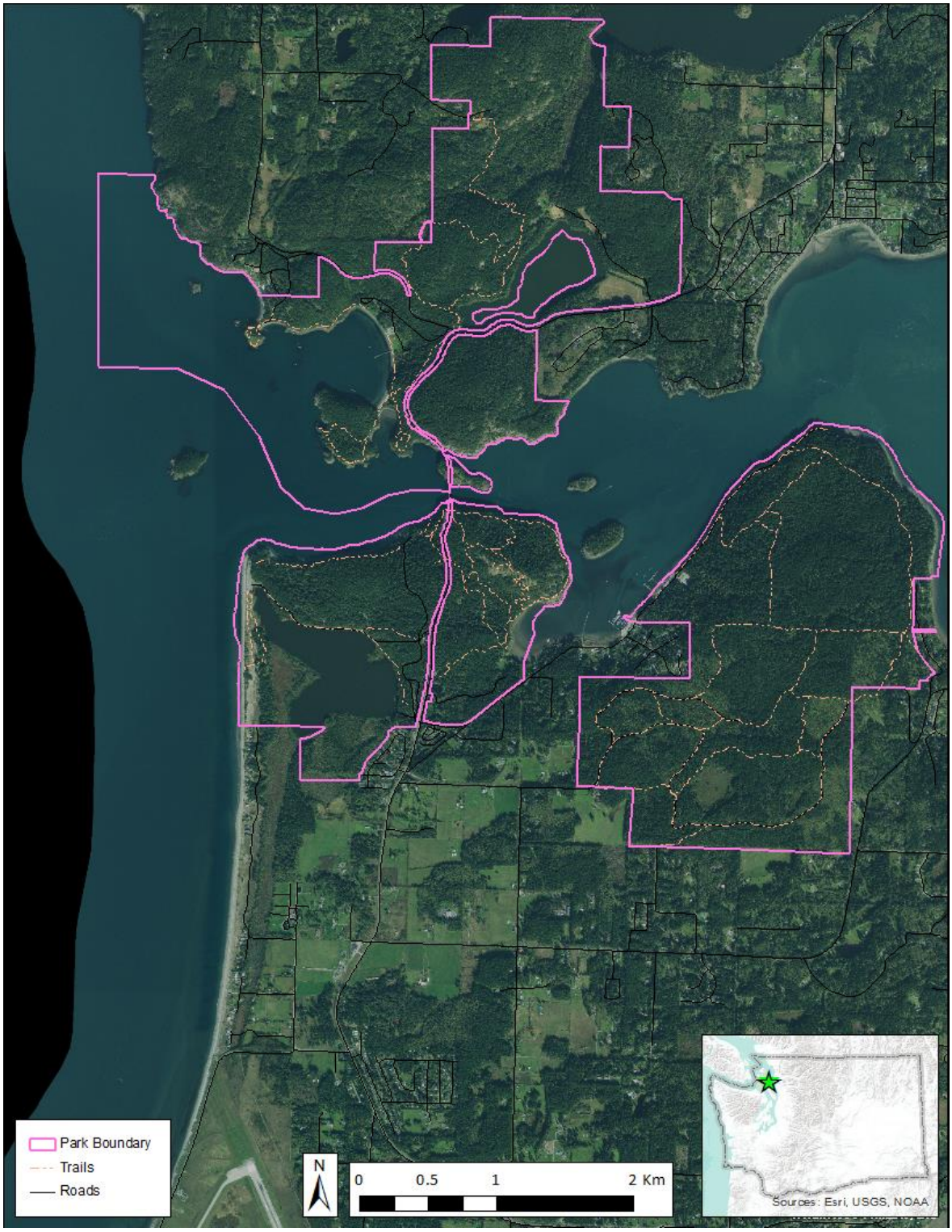

Figure E-4. Overview of Deception Pass State Park

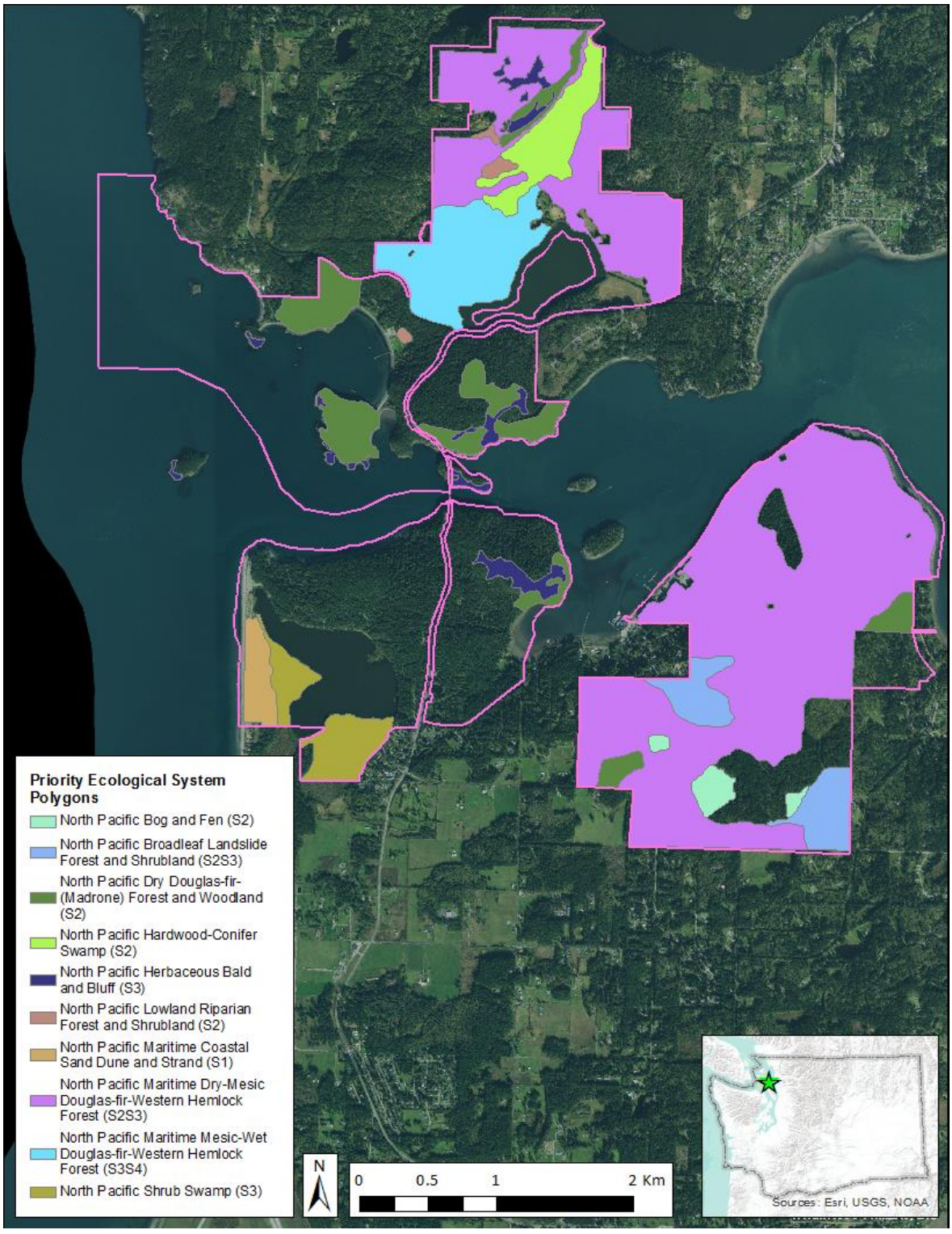

Figure E-5. Priority ecological systems polygons for assessment at Deception Pass State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

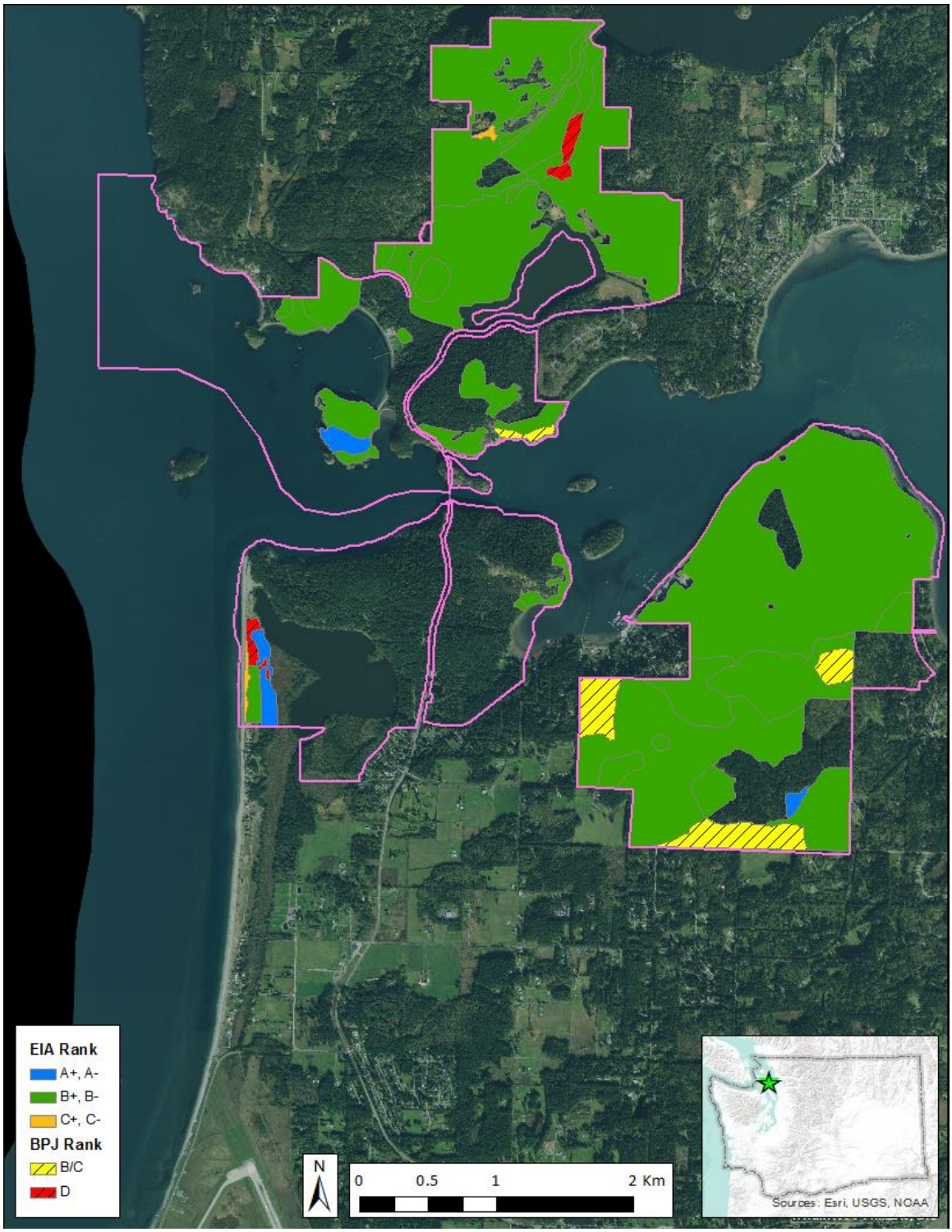

Figure E-6. EIA Ranks for all polygons assessed at Deception Pass State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

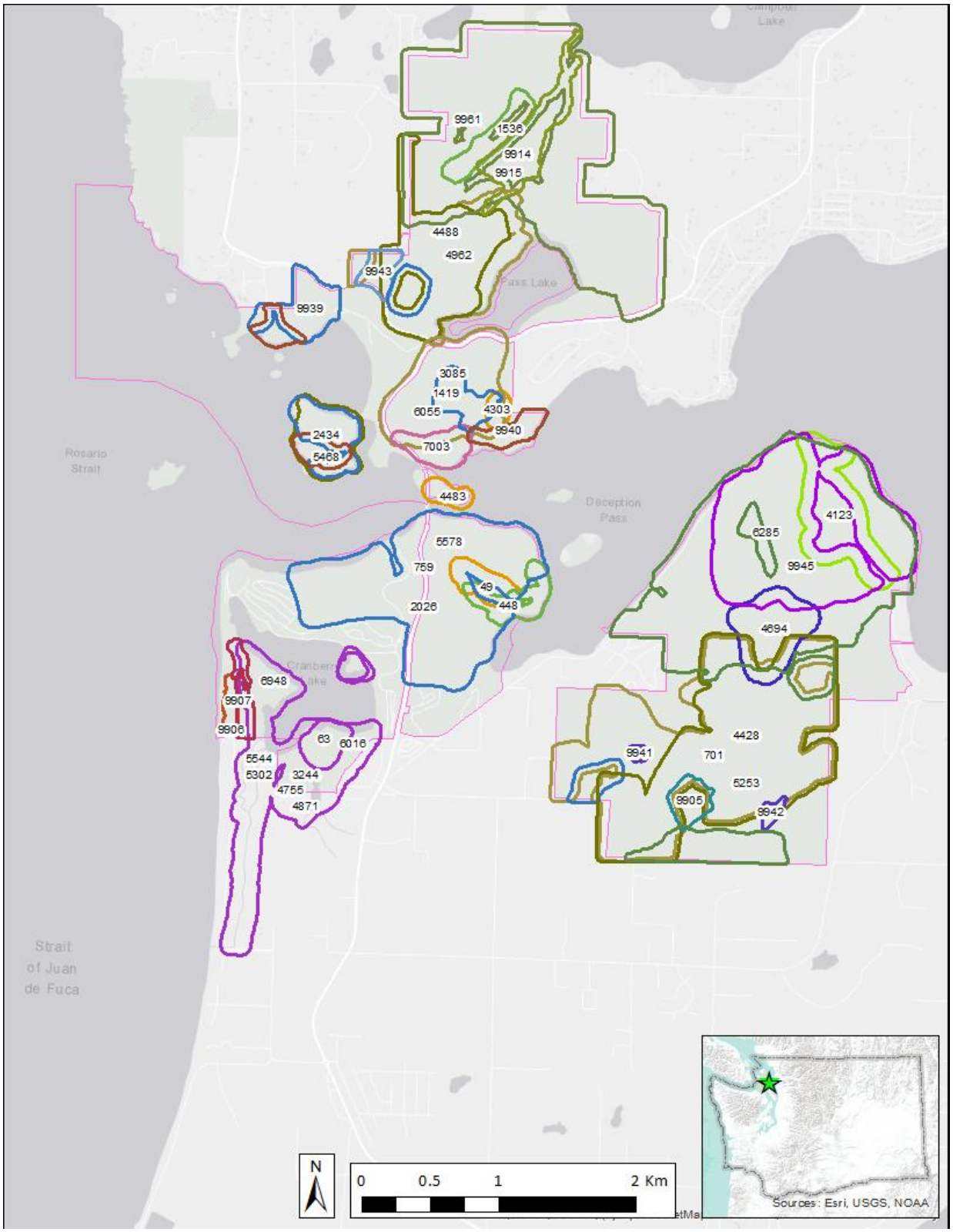

Figure E-7. Element occurrences at Deception Pass State Park. Because of the number of different associations present, the legend is displayed in a separate table (Table E-5)

Table E-5. Legend to element occurrences at Deception Pass State Park

Association Name, EO ID

- Alnus rubra / Athyrium filix-femina - Lysichiton americanus Swamp Forest, 9915
- Alnus rubra / Rubus spectabilis / Carex obnupta - Lysichiton americanus Swamp Forest, 4694
- Artemisia campestris - Festuca rubra / Racomitrium canescens Grassland, 9906
- Festuca idahoensis ssp. roemeri - Cerastium arvense - Koeleria macrantha Grassland, 4303; 4483; 49
- Hippuris vulgaris Aquatic Vegetation, 6016
- Juncus balticus Pacific Coast Wet Meadow, 4871
- Ledum groenlandicum - Gaultheria shallon / Sphagnum spp. Shrub Bog, 9941; 9942
- Ledum groenlandicum / Carex utriculata / Sphagnum spp. Shrub Bog, 9905
- Menyanthes trifoliata Aquatic Vegetation, 5544
- Nuphar polysepala Aquatic Vegetation, 6948
- Pinus contorta var. contorta / Gaultheria shallon Forest, 9907
- Pinus contorta var. contorta / Ledum groenlandicum / Sphagnum spp. Treed Bog, 63
- Pseudotsuga menziesii - (Abies grandis - Thuja plicata) / Mahonia nervosa - Gaultheria shallon Forest, 9940
- Pseudotsuga menziesii - Arbutus menziesii / Holodiscus discolor Forest, 1536; 448
- Pseudotsuga menziesii - Tsuga heterophylla / Gaultheria shallon - Holodiscus discolor Forest, 2026; 4962; 6055; 701
- Pseudotsuga menziesii - Tsuga heterophylla / Gaultheria shallon / Polystichum munitum Forest, 1419; 4488; 5253; 5468
- Pseudotsuga menziesii - Tsuga heterophylla / Holodiscus discolor / Polystichum munitum Forest, 759
- Pseudotsuga menziesii - Tsuga heterophylla / Mahonia nervosa - Polystichum munitum Forest, 4123
- Pseudotsuga menziesii - Tsuga heterophylla / Mahonia nervosa Forest, 4428; 6285
- Pseudotsuga menziesii / Gaultheria shallon - Holodiscus discolor Forest, 2434; 3085; 5578; 9939
- Pseudotsuga menziesii / Symphoricarpos albus - Holodiscus discolor Forest, 7003
- Spiraea douglasii Wet Shrubland, 5302
- Thuja plicata - Abies grandis / Polystichum munitum Forest, 9943
- Thuja plicata - Pseudotsuga menziesii - Abies grandis / Mahonia nervosa / Polystichum munitum Forest, 9961
- Tsuga heterophylla - (Pseudotsuga menziesii - Thuja plicata) / Polystichum munitum - Athyrium filix-femina Forest, 9945
- Tsuga heterophylla - (Thuja plicata - Alnus rubra) / Lysichiton americanus - Athyrium filix-femina Swamp Forest, 9914
- Typha latifolia Pacific Coast Marsh, 3244

Appendix F. Ginkgo Petrified Forest

Figure F-1. A patch of *Artemisia tridentata* ssp. *wyomingensis* / *Pseudoroegneria spicata* Shrub Grassland (G4/S3) spared from the 2018 fires by a two-track road.

The Ecological Integrity Assessment for Ginkgo Petrified Forest State Park is presented below (Figure F-5). An initial vegetation map was completed by Easterly and Salstrom (2003), with an updated version (Morrison et al., 2019). This mapping was the basis for the assessment areas used in our surveys.

There were no previously documented community EOs at the park. Parks identified 55 polygons (2651 hectares) of 3 different ecological systems as priorities for assessment (Figure F-6). **NOTE:** This appendix includes considerably more detail than other park summaries (with the possible exception of Miller Peninsula). At the time of our surveys, Parks staff were working to designate much of the park as a Natural Area, so a more complete picture of the high-integrity portions of the property was required. As noted above (Section 2.3.1), we chose to employ a stratified random sample approach for assessing this park. All maps (Figure F-5 through Figure F-9) are presented at the end of the appendix for ease of reading.

We began by visiting a sampling of polygons—mapped by Morrison et al. (2019) in 2017 and 2018—to determine a) whether we consistently agreed with their association calls contractors and

b) how closely their condition estimates aligned with our EIA methods. Based on that initial visit, we found the association calls to be reliable (other than one USNVC mixup between two easily confused associations) and that their ranks were reasonable approximations of what we would assign. However, most of the park had burned since their mapping and fire has had deleterious effects on these systems in recent years. We needed to determine what the current condition rank would be for a polygon that burned in 2018. To do this, we developed a stratified random sample across the park, with a goal of collecting three samples per combination of the following attributes:

1) Contractor assigned rank, binned into:
    a. A/AB/B, BC/C, or CD/D
2) Recent Fire, initially determined by a coarse fire line shapefile given by Parks:
    a. Burned or unburned as of Fall 2018
3) Ecological System:
    a. Scabland v. Big Sagebrush Steppe

That gave us 12 total bins and a total of 36 sample points to visit. If we visited a polygon and the fire status did not match what was mapped (i.e. it was mapped as burned, but actually escaped the fire, or vice versa), we replaced it with another polygon from the same bin OR we only assessed the portion of the polygon that matched our target. In the office, we then digitized a finer scale fire map of the park by comparing 2017 (pre-fire, but post-contractor-mapping) and 2019 (post-fire, post-mapping) imagery (Figure F-7). Decreased shrub cover, visible ash from torched sagebrush, and increases in exotic annual grasses were readily visible indicators on the 2019 imagery. For polygons that were split between burned and unburned, we then digitized those into separate polygons.

Next, we averaged the EIA condition scores for each bin and then extrapolated those across the park. We found the following relationships between burned and unburned ecosystem patches of varying initial condition (Table F-1):

Table F-1. Relationships between contractor-estimated condition and EIA condition ranks in burned and unburned shrub steppe.

Ecological System	Contractor Rank (2017, 2018)	EIA Condition Rank (2020)	
		Unburned	Burned
Intermountain Basins Big Sagebrush Steppe	A, A/B, B	A-	B-
	B/C, C	B+	C+
	C/D	C-	C-
	D	D	D
Columbia Plateau Scabland Shrubland	A, A/B, B	A-	B-
	B/C, C	B-	C+
	C/D	C+	C-

Ecological System	Contractor Rank (2017, 2018)	EIA Condition Rank (2020)	
		Unburned	Burned
	D	D	D

To determine where EOs might be, we aggregated all of the polygons that cleared the threshold determined by their conservation status ranks. We then scored landscape metrics and size, then calculated the combined EO ranks. Note that this modeling process was used only for the two shrub steppe ecological systems. The Columbia Basin Foothill Riparian Woodland and Shrubland polygons were assessed in a standard fashion (Rocchio et al., 2020a).

EIA Results

Table F-2 summarizes the condition primary factor ranks for the polygons we visited as part of our modeling process (in addition to one riparian shrubland that was assessed separately. Table F-3 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments, including the aggregated EIA/EO Rank scores for the EOs that were documented.

Table F-2. EIA Summary for polygons visited (not modeled) at Ginkgo Petrified Forest.

WNHP ES Poly ID	Ecological System	Plant Association	Burned in 2018?	Condition Rank	Part of EO?
19	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	Yes	B+	No
25	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	No	C+	No
42	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	No	A+	Yes
48	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	No	B+	No
49	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	No	A+	Yes
53	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	No	C+	No
69	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	Yes	C+	No
72	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	D	No
79	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	C-	No
87	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	Yes	C-	No
106	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	Yes	B+	No
145	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	C+	No
151	Columbia Basin Foothill Riparian Woodland and Shrubland	Philadelphus lewisii / Clematis ligusticifolia Wet Shrubland	Yes	C	No

WNHP ES Poly ID	Ecological System	Plant Association	Burned in 2018?	Condition Rank	Part of EO?
155	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	B-	No
160	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	B+	No
162	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	No	A+	Yes
169	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	C-	No
240	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	C-	No
254	Columbia Plateau Scabland Shrubland	Artemisia rigida / Pseudoroegneria spicata Shrub Grassland	No	B+	Yes
318	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	No	B+	No
325	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	No	C-	No
107c	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	C+	No
165b	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	C+	No
200a	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	Yes	B-	No
230a	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	B+	No
254burn	Columbia Plateau Scabland Shrubland	Artemisia rigida / Pseudoroegneria spicata Shrub Grassland	Yes	C-	No
257b	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	Yes	C-	No
280a	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	Yes	C-	No
300b	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	C+	No
304c	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	C-	No
326a	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	No	B+	No
326b	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	Yes	B-	No
39a	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	No	C-	No
39b	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	No	B+	No
54b	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	No	C-	No
58a	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	No	A+	Yes
61a	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	No	B-	No
62d	Intermountain Basins Big Sagebrush Steppe	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	Yes	B-	No
280d	Columbia Plateau Scabland Shrubland	Artemisia rigida / Poa secunda Shrub Grassland	Yes	C+	No

Table F-3. Individual EIA Condition Metric Ranks for polygons surveyed (not modeled) at Ginkgo Petrified Forest.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
19					B	A-	A	C	C						A	
25					B	C	C	B	C						B	
42						A-	A	A	A						A	
48					A	B	C	A	B						B	
49					A	A-	A	A	A						A	
53					C	C	C	C	C						B	
69					C	C	C	C	C						B	
72					C	D	C-	D	D						B	
79					C	D	C	C	D						B	
87					C	D	C-	C	D						A	
106					B	A-	A	B	B						A	
145					B	D	C-	C	B						B	
151	C	B	C	C	C	D	D	D	D	D		B	B	B	C	B
155					B	A-	A	C	B						C	
160					B	A-	B	B	B						A	
162					A	A	A	A	A						A	
169					C	D	C-	C	C						A	
240					C	D	C-	C	C						D	
254					A	B	C	A	B						A	

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
318					A	B	B	A	A						B	
325					A	D	D	C	C						A	
107c					B	C	C	C	C						A	
165b					C	C	C	C	C						A	
200a					B	B	B	B	C						B	
230a					B	A-	B	A	B						A	
254burn					A	D	D	C	D						A	
257b					B	D	C-	C	C						B	
280a					C	D	C-	C	C						B	
280d					C	C	C	C	C						B	
300b					C	C	C	C	C						B	
304c					C	D	C-	C	C						B	
326a					B	B	B	A	B						B	
326b					B	B	B	C	C						B	
39a					A	D	D	C	C						A	
39b					A	B	C	A	A						A	
54b					B	D	D	C	C						A	
58a					B	A-	A	A	A						A	
61a					B	B	B	C	B						B	
62d					B	A-	B	B	C						B	

Figure F-2 and Figure F-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure B-6.

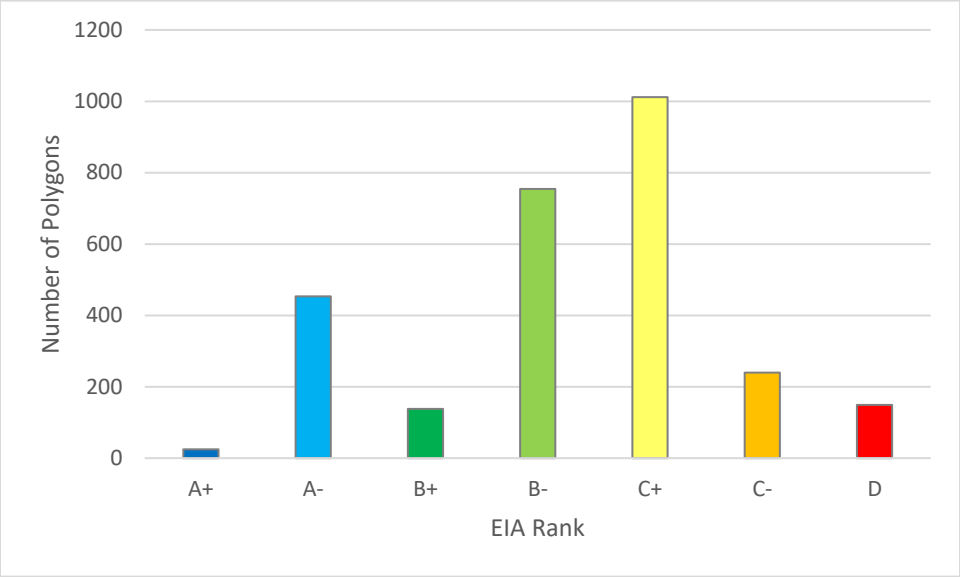

Figure F-2. Modeled and on-site EIA condition by number of polygons at Ginkgo Petrified Forest.

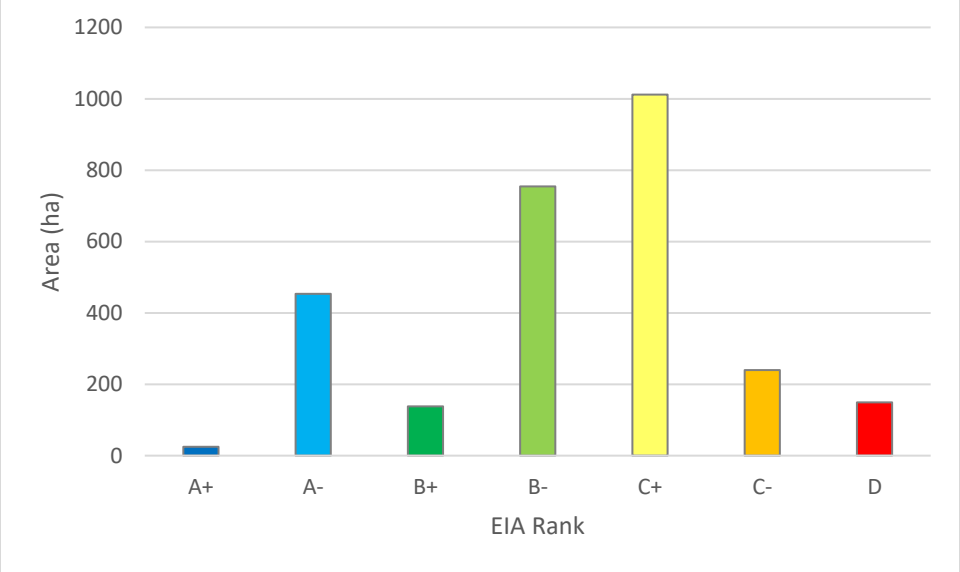

Figure F-3. Modeled and on-site EIA condition by area at Ginkgo Petrified Forest.

Element Occurrences

Five element occurrences were documented at Ginkgo Petrified Forest (Figure F-9). Table F-4 summarizes the classification, conservation status ranks, and EO ranks (landscape context + condition + size) of these new EOs. The scabland (*Artemisia rigida*-dominant) associations have

two EOs each because the patches are separated by Interstate 90. For additional information, see the accompanying Excel workbook.

Table F-4. Summary of new element occurrences at Ginkgo Petrified Forest State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9925	ARRI/PSSP-N-Revised	CEGL001529	Artemisia rigida / Pseudoroegneria spicata Shrub Grassland	G3/S2	A+
9916	ARRI/POSE-N-Revised	CEGL001528	Artemisia rigida / Poa secunda Shrub Grassland	G4/S3S4	A+
9917	ARRI/POSE-S-Revised	CEGL001528	Artemisia rigida / Poa secunda Shrub Grassland	G4/S3S4	A+
9962	ARRI/PSSP-S-Revised	CEGL001529	Artemisia rigida / Pseudoroegneria spicata Shrub Grassland	G3/S2	A+
9918	ARTR/PSSP-N-Revised	CEGL001535	Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland	G4/S3	B+

Summary and Discussion

Figure F-4. At Ginkgo Petrified Forest, many of the burned areas on north-facing slopes retain high native bunchgrass cover.

Overall Conditions

The ecological integrity of Ginkgo Petrified Forest varies widely across the park based on the interactive effects of aspect, fire frequency, ecological system, and intensity of historical livestock use. Relatively moist, northern aspects have been better able to resist invasion by exotic/invasive species (Table F-5, VEG1, VEG2), particularly *Bromus tectorum* and *Sisymbrium altissimum*, and maintain good to excellent native plant species composition (VEG3). Areas that have burned repeatedly—generally those areas closest to I-90 and other human activities—are likely to be dominated by exotic species and may lack sagebrush entirely (VEG4). The notable exceptions are occurrences of the Columbia Plateau Scabland Shrubland, which are relatively resilient when fires burn across the landscape. The low growing, widely spaced species of these disjunct patches do not produce much fuel on their own and they are also relatively resistant to invasion from *Bromus tectorum*.

Table F-5. Summary of EIA metric ratings by area (ha) at Ginkgo Petrified Forest State Park. This table only includes polygons that were surveyed on the ground—not modeled results.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	65	59	53	**86**
VEG2	45	64	70	**84**
VEG3	68	49	**141**	6
VEG4	38	67	**139**	18
VEG5				**5**
VEG6				
HYD1		**5**		
HYD2		**5**		
HYD3		**5**		
SOI1	120	**131**	8	4

The *Philadelphus lewisii* / *Clematis ligusticifolia* Wet Shrubland in Rocky Coulee is in very poor condition, despite hydrology (HYD1-HYD3) within the natural range of variability. This intermittent riparian shrubland is dominated by a diverse array of invasive (*Bassia scoparia, Salsola tragus, Sisymbrium altissimum, Phragmites australis,* and more). Few native species are currently present, aside from *Philadelphus lewisii* that is resprouting after the 2018 fires.

Recommendations for Enhancing / Maintaining Ecological Integrity

The 2018 fires also seem to have burned in a more patchwork fashion than the initial fire line shapefile would indicate. We estimate that 1906 ha burned in 2018 (Figure F-7), rather than the 2257 delineated in the original estimate. Many of the areas of burned big sagebrush steppe retain strong native bunchgrass cover (Figure F-4) and are not far from sagebrush seed sources—they may recover with time. However, the interactive effects of invasive annual grasses and increased fire frequency are the primary threats to the long-term viability of big sagebrush steppe at Ginkgo Petrified Forest. While scabland occurrences are relatively resilient to fire, burned portions of big sagebrush steppe may take decades recover. The most important management action for maintaining the ecological integrity of shrub steppe within the park will be limiting human-sparked ignitions.

While currently in poor condition, the intermittent riparian shrubland in Rocky Coulee is of significant conservation interest, positioned as it is near the terminus of a very long, unfragmented drainage. However, the diversity of invasive species on site will be difficult to control.

Future Assessment / Survey Recommendations

Much of our sampling was done later in the season than ideal for EIA. Some forbs may have been misidentified because of the late phenology—we made sure to confirm any species where nativity was in question, but otherwise did not dedicate much time to "forensic" botany. In most cases we also chose not to score the diversity submetric of Native Plant Species Composition (VEG3).

Our simple “model” provides a reasonable estimate of the ecological integrity of big sagebrush steppe and scabland shrublands across the park. However, before land use decisions are made for any specific polygon, we recommend an on-site visit to confirm the current integrity.

Maps

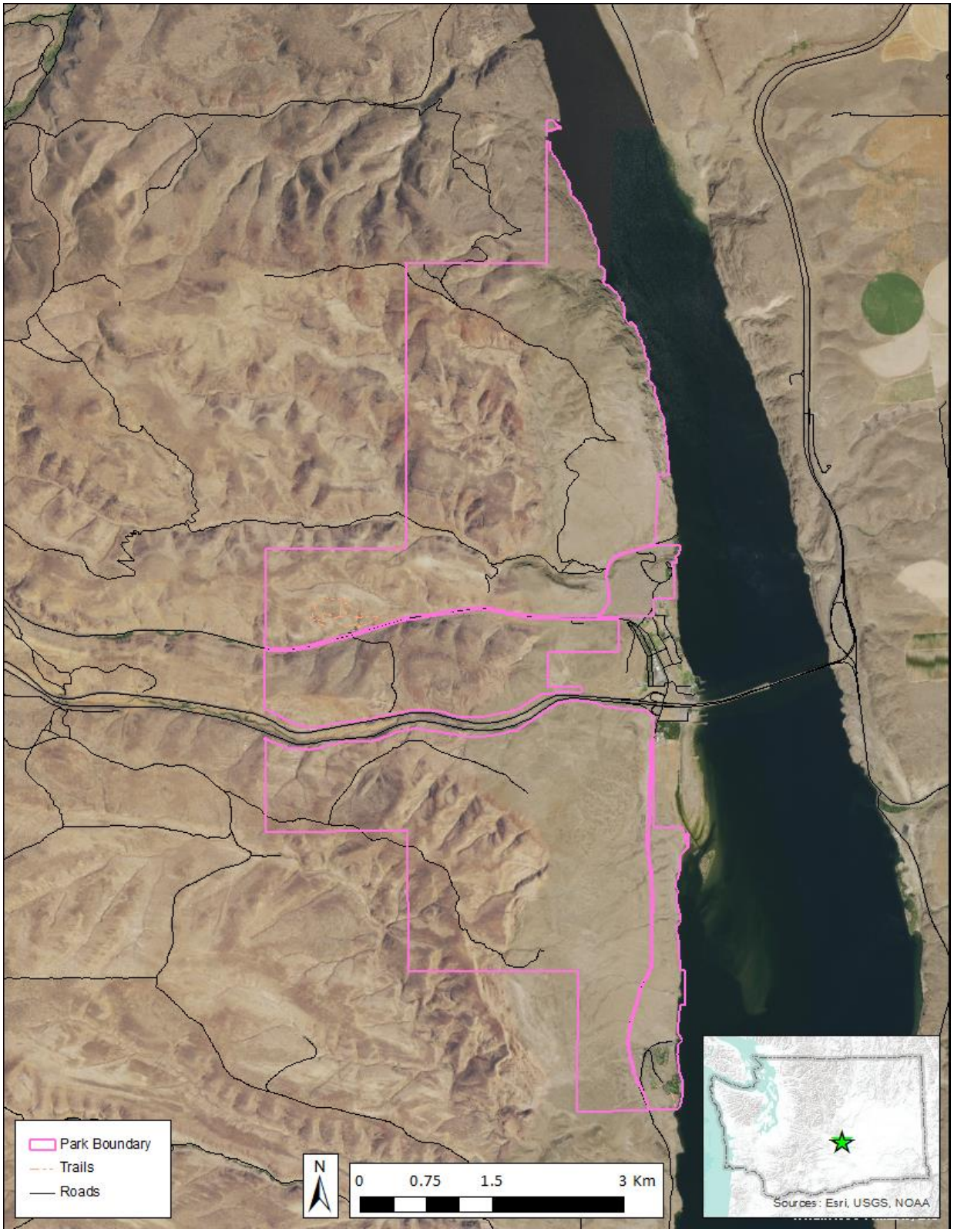

Figure F-5. Overview of Ginkgo Petrified Forest State Park

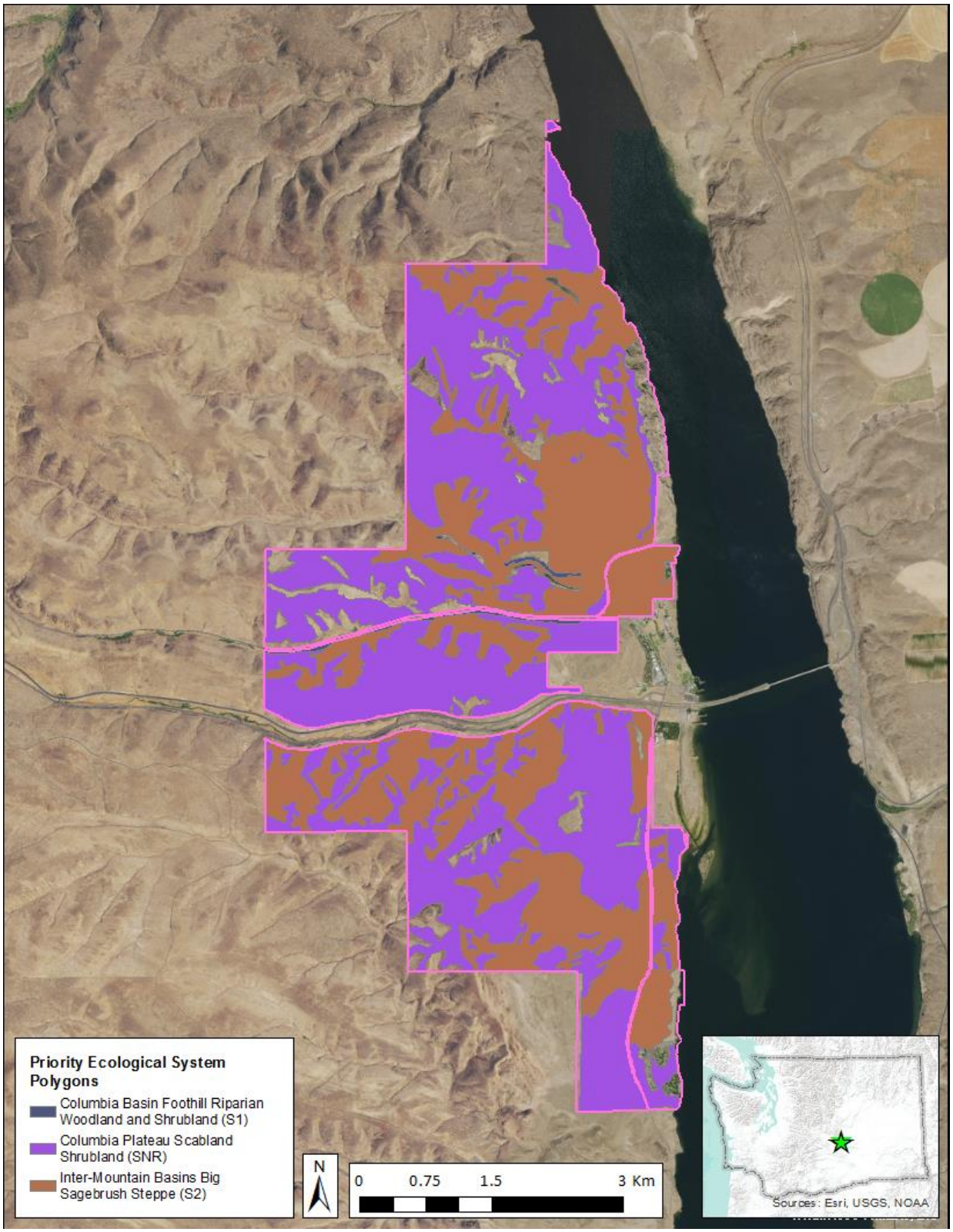

Figure F-6. Priority ecological systems polygons for assessment at Ginkgo Petrified Forest State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

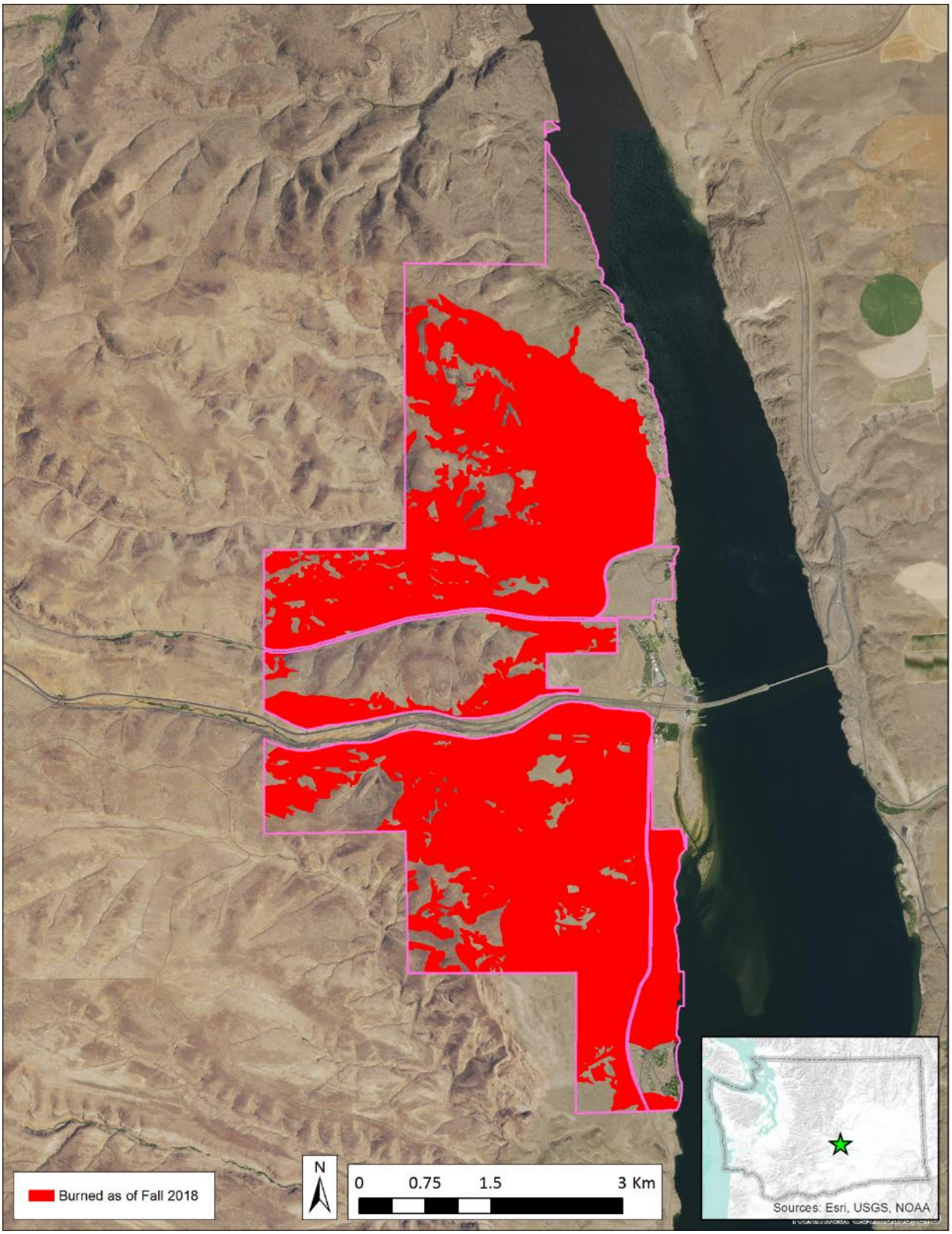

Figure F-7. 2018 wildfires at Ginkgo Petrified Forest (boundaries digitized by WNHP staff).

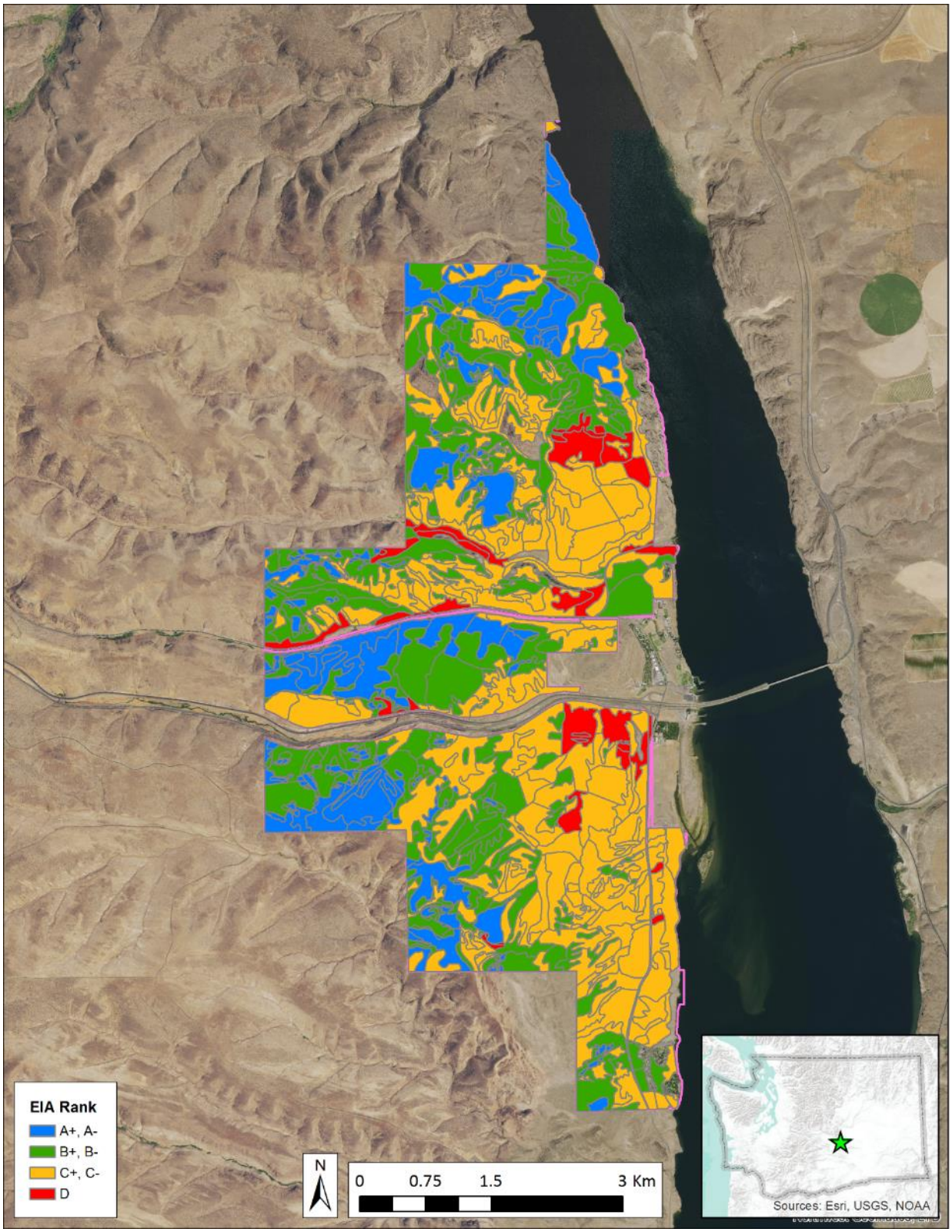

Figure F-8. Modeled EIA condition ranks for all shrub-steppe polygons at Ginkgo Petrified Forest State Park. The modeling procedure did not assess landscape context, but that was factored in for the final development of element occurrences (see Figure F-9).

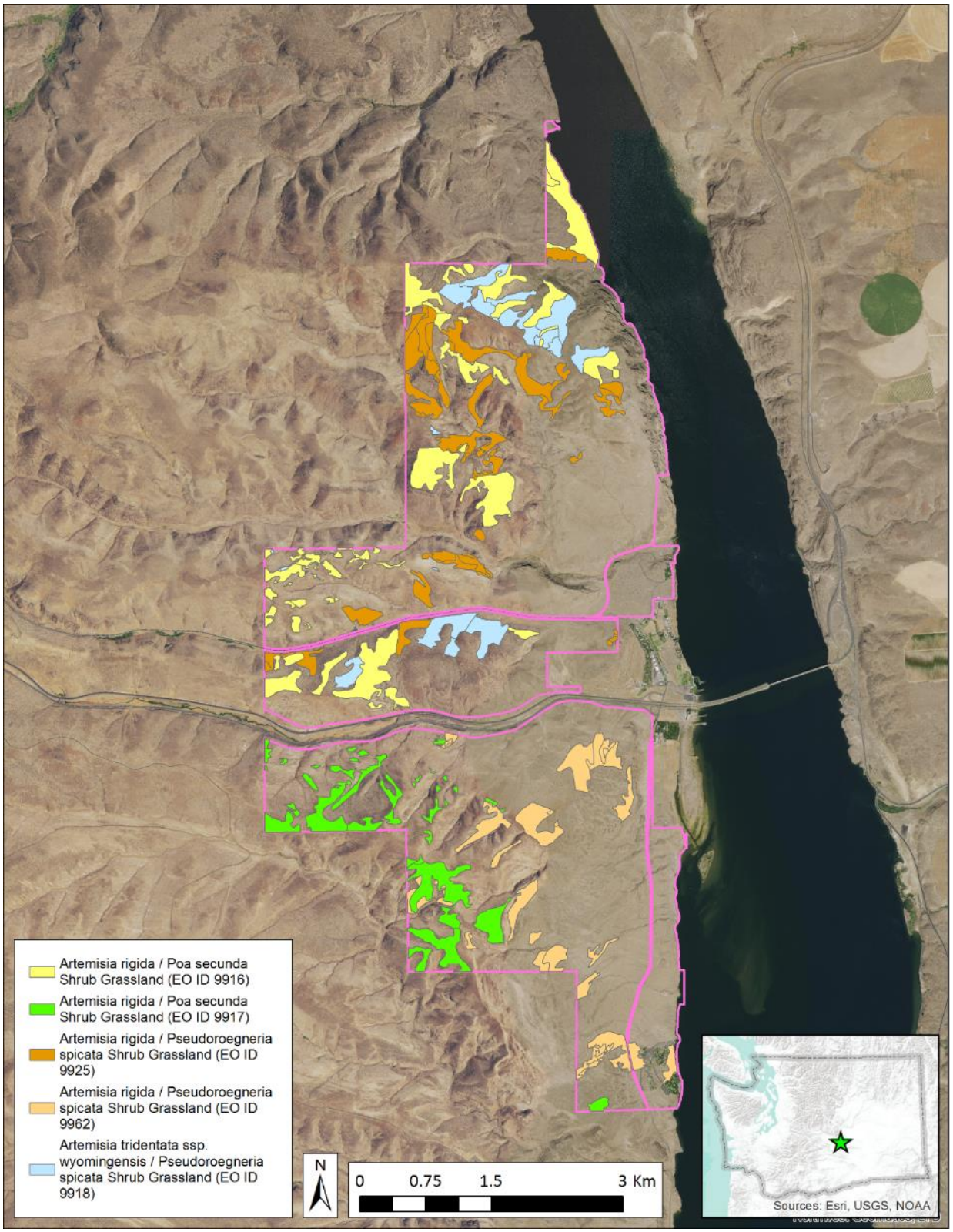

Figure F-9. Element occurrences at Ginkgo Petrified Forest State Park. Uncertainty distance buffers have not yet been applied to these features.

Appendix G. Lake Wenatchee

Figure G-1. A narrow strip of *Carex lenticularis var. lipocarpa* (= *Carex kelloggii* var. *kelloggii*) Marsh (G3?/S2S3) at Lake Wenatchee State Park.

The Ecological Integrity Assessment for Lake Wenatchee State Park is presented below (Figure G-4). WNHP staff previously surveyed vegetation at Lake Wenatchee as part of a Natural Forest Inventory of state parks (Chappell, 1992c). More recently, a rare plant and vegetation survey was completed by Visalli (2004a). This mapping was the basis for the assessment areas used in our surveys.

There was one previously documented community EO at the park. Parks identified 9 polygons (72 hectares) of 4 different ecological systems as priorities for assessment (Figure G-5). All maps (Figure G-4 through Figure G-7) are presented at the end of the appendix for ease of reading.

EIA Results

A full survey of priority polygons was completed at Lake Wenatchee. Table G-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table G-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table G-1. EIA Summary for Lake Wenatchee. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
231	Rocky Mountain Alpine-Montane Wet Meadow	C	A	B+
232	Rocky Mountain Alpine-Montane Wet Meadow	B	A	B+
233	Rocky Mountain Alpine-Montane Wet Meadow	B	B	B+
234	Rocky Mountain Alpine-Montane Wet Meadow	A	A	A-
235	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	C	B	B-
236	Rocky Mountain Subalpine-Montane Riparian Shrubland	B	A	B+
237	Rocky Mountain Subalpine-Montane Riparian Shrubland	B	B	B+
238	Rocky Mountain Subalpine-Montane Riparian Shrubland	B	A	B+
239	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland	C	B	B+

Table G-2. Individual EIA Metric Ranks for Lake Wenatchee.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
231	C	C	B	B	C	A-	A	B	B			A	A	A	B	C
232	C	B	A	C	B	A-	A	B	B			A	A	A	B	C
233	C	B	A	B	B	B	B	B	B			A	A	A	B	C
234	B	B	A	A	A	A-	B	A	A			A	A	A	B	C
235	C	C	C	C	A	A	A	A	C	A	C				A	D
236	C	C	A	B	B	B	C	B	A	A		A	A	A	A	C
237	C	C	A	B	B	B	C	B	B	A		A	A	A	B	C
238	C	C	A	B	B	B	C-	B	A	A		A	A	A	A	C
239	C	C	B	C	B	B	B	B	B	A	B	A	A	A	B	D

Figure G-2 and Figure G-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure G-6.

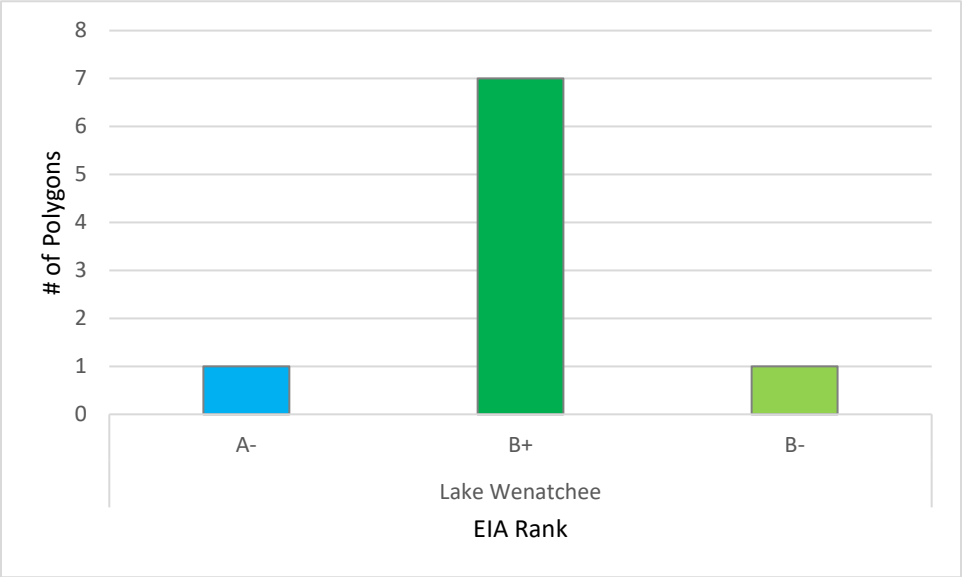

Figure G-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

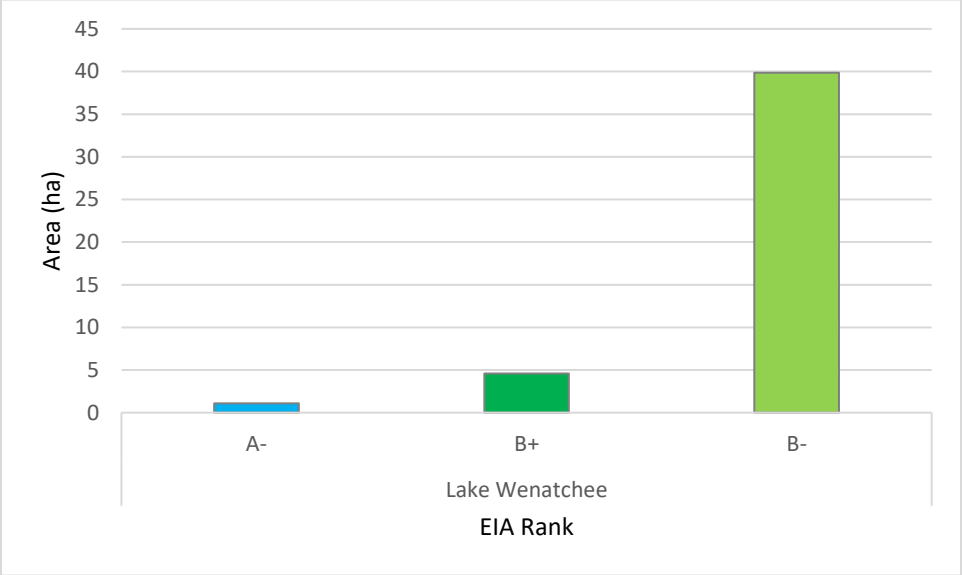

Figure G-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Three new element occurrences were documented at Lake Wenatchee (Figure G-7). The one previously documented EO (ID 36) was removed, however, as it did not clear the EO rank threshold determined by the conservation status rank (Table 5) of the community. That EO was

last observed by WNHP staff in 1992, when it was classified as an *Abies grandis* / *Acer circinatum* Forest (G4/S3). We classified the stand as a *Pseudotsuga menziesii* / *Paxistima myrsinites* - *Spiraea betulifolia* Woodland (GNR/S3S4), an association that was not yet defined in 1992. Recent classification revisions arising from National Park Service vegetation mapping have refined our understanding of forest plant associations in the East Cascades. Regardless, neither our assessment (EIA Rank = B-, EO Rank = D, due to size) nor the original assessment (EO Rank = BC) would represent an element occurrence based on current EO standards. Table G-3 summarizes the classification, conservation status ranks, and EO ranks (landscape context + condition + size) of new EOs at Lake Wenatchee. For additional information, see the accompanying Excel workbook.

Table G-3. Summary of new element occurrences at Lake Wenatchee State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9924	234	CEGL001599	Deschampsia caespitosa Wet Meadow	G4/S2?	B+
9952	231; 232; 233	CWWA000011	Carex lenticularis var. lipocarpa Marsh	G3?/S2S3	B-
9953	237; 238; 236	CWWA000403	Salix sitchensis - (Alnus incana) / Angelica arguta Wet Shrubland	GNR/SNR	B-

Summary and Discussion

Overall Conditions

Natural vegetation at Lake Wenatchee is in excellent condition. Exotic plants (Table G-4, VEG1,) are present with only minimal cover. Of those, *Tanacetum vulgare*, *Centaurea stoebe*, *Hypericum perforatum*, *Leucanthemum vulgare*, and *Phalaris arundinacea* are the most common invasive (VEG2). Native plant species composition is within the natural range of variability (VEG3), although the *Populus balsamifera* ssp. *trichocarpa* / *Alnus incana* Riparian Forest is in an unusual location for a riparian community (along the southeastern shorelines of the lake). Fluctuations in lake level and wind-driven waves seem to maintain the bare alluvial substrate necessary for this community to persist.

Table G-4. Summary of EIA metric ratings by area (ha) at Lake Wenatchee State Park.

	Metric Rating			
Metric	A/A-	B	C	C-/D
VEG1	**41**	4		
VEG2	**40**	4	< 1	1
VEG3	**41**	5		
VEG4	2	4	**40**	
VEG5	**43**			
VEG6		3	**40**	
HYD1	**6**			
HYD2	**6**			
HYD3	**6**			
SOI1	**41**	5		

As with many other parks, vegetation structure (VEG4) and coarse woody debris, snags, and litter (VEG6) were the primary metrics that fell outside the natural range of variability. The early mature upland forest patch that was surveyed (covering most of the northern portion of the park) has been logged and larger stumps are all greater in diameter than the largest remaining trees. The only snags present are from mortality in the current cohort (i.e. not "legacy trees").

Wetland hydrological conditions (HYD1-HYD3) were excellent, while the soil disturbance metric (SOI1) was occasionally marked down due to trampling by campers.

Recommendations for Enhancing / Maintaining Ecological Integrity

Appropriately enough for a park named after a lake, the primary highlights at Lake Wenatchee are the wetlands along the lacustrine fringe. The lakeshore strips of *Deschampsia caespitosa*- and *Carex kelloggii* (=*C. lenticularis*)-dominated vegetation were in good condition. The primary stressor for these communities is pervasive trampling, particularly in the areas near the campground and parking lot. Such trampling may be inevitable at such an attractive locale for recreation, but efforts to concentrate beachfront use would only benefit these communities.

The upland forests will most likely require intermittent thinning over time, as deployment of prescribed fire seems unlikely on such small parcels embedded in a context of intensive recreation interest.

Phalaris arundinacea has only minimal cover within the park boundaries, for now. We recommend making efforts to eradicate these patches now, while they are still manageable.

Future Assessment / Survey Recommendations

Most of the undeveloped area at Lake Wenatchee State Park was surveyed as part of this project. Additional surveys are not a priority at this time.

Maps

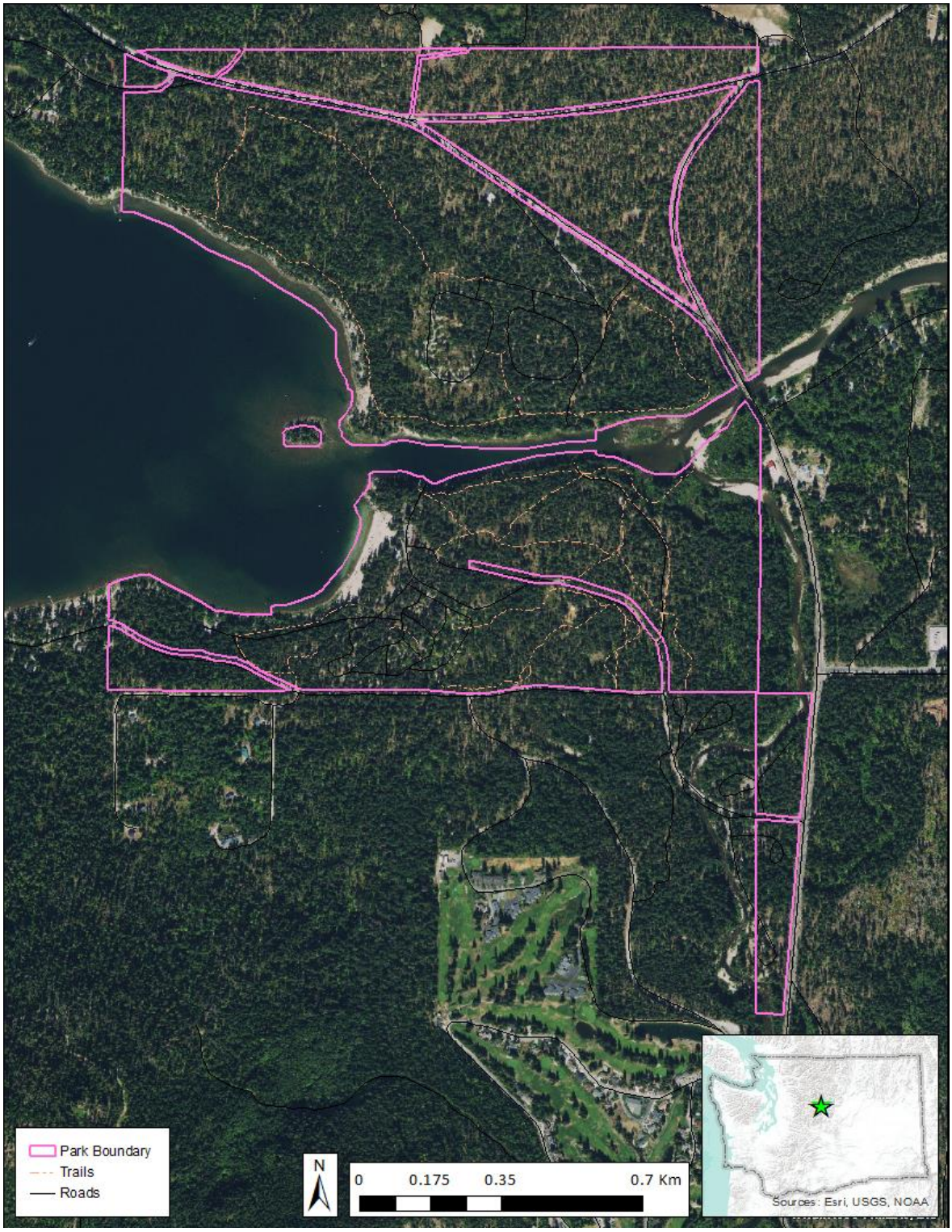

Figure G-4. Overview of Lake Wenatchee State Park

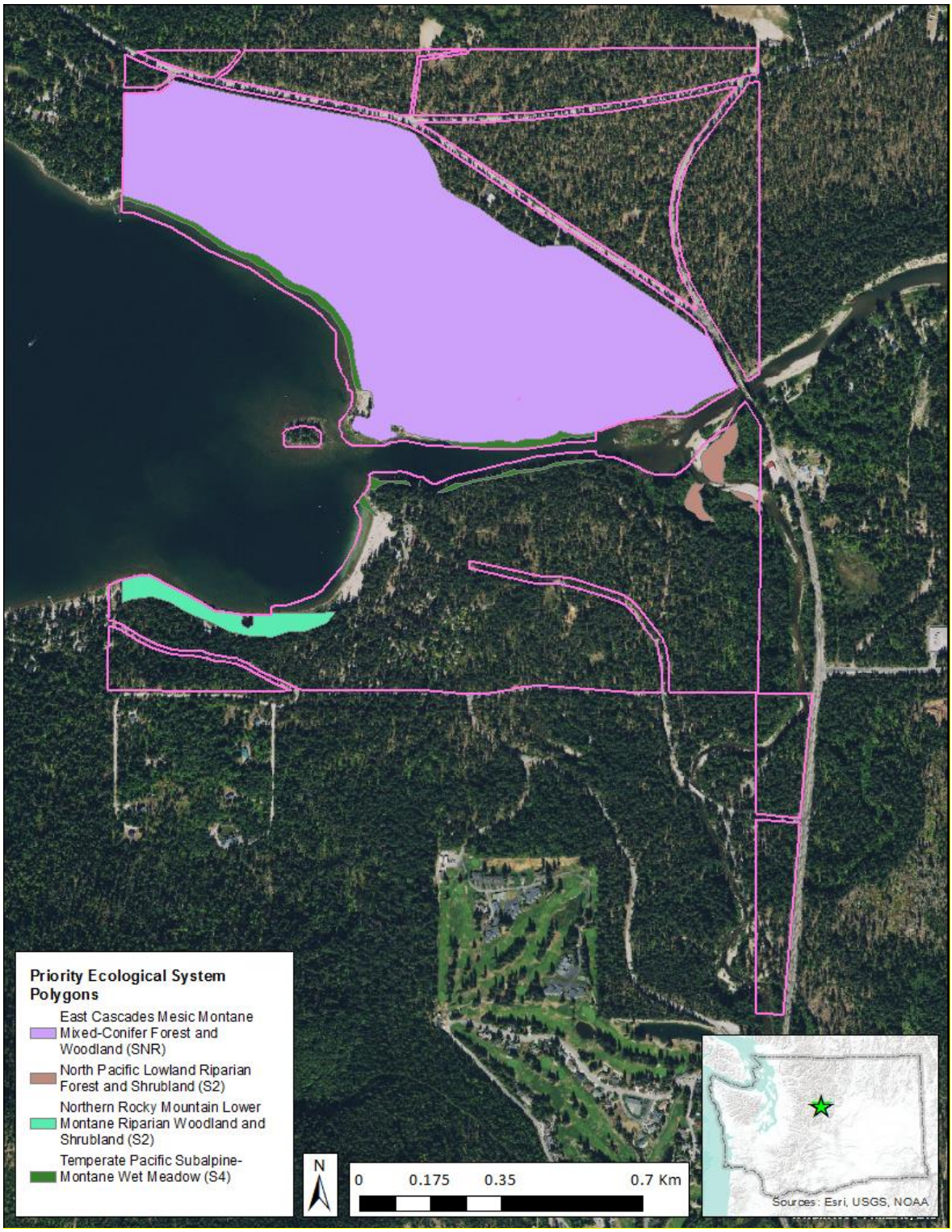

Figure G-5. Priority ecological systems polygons for assessment at Lake Wenatchee State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

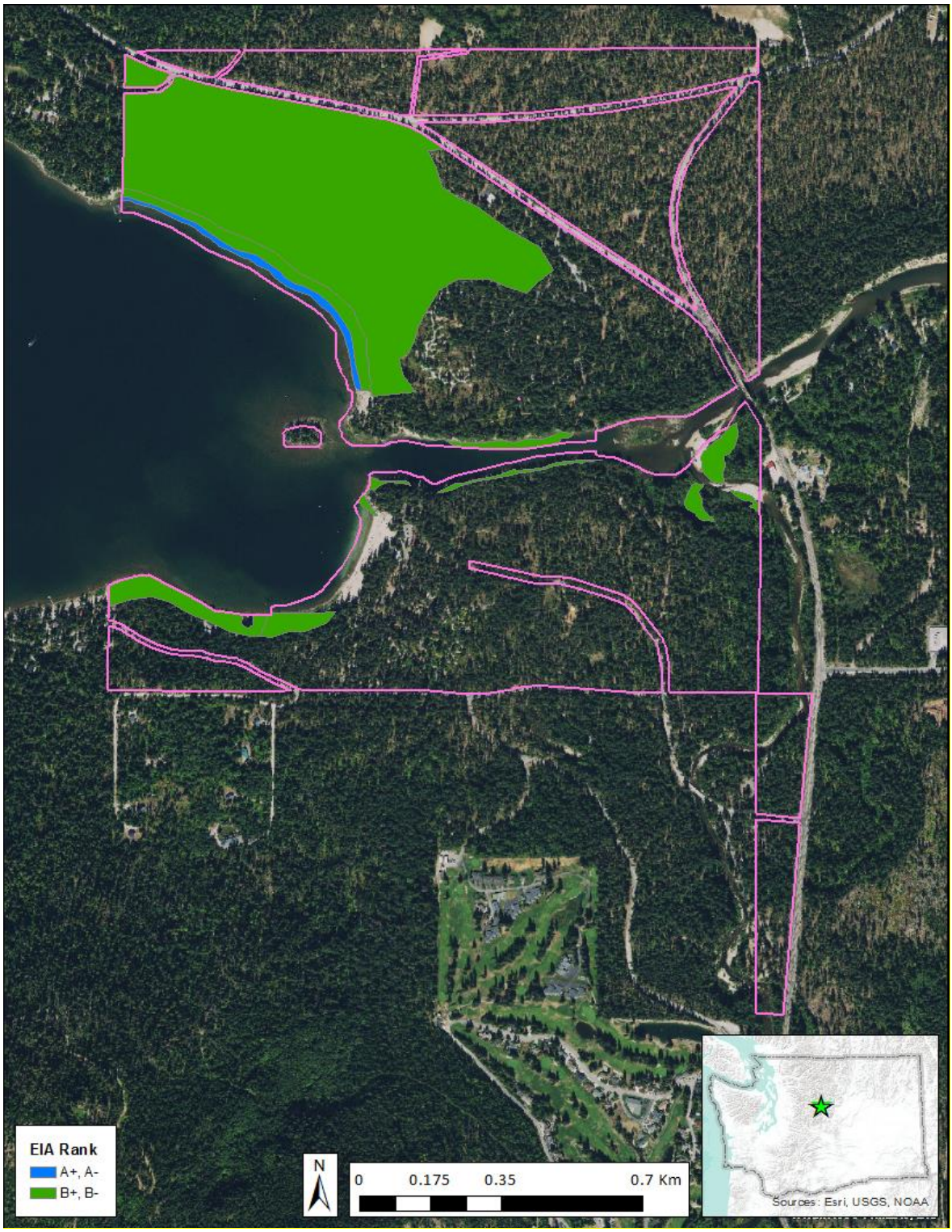

Figure G-6. EIA Ranks for all polygons assessed at Lake Wenatchee State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

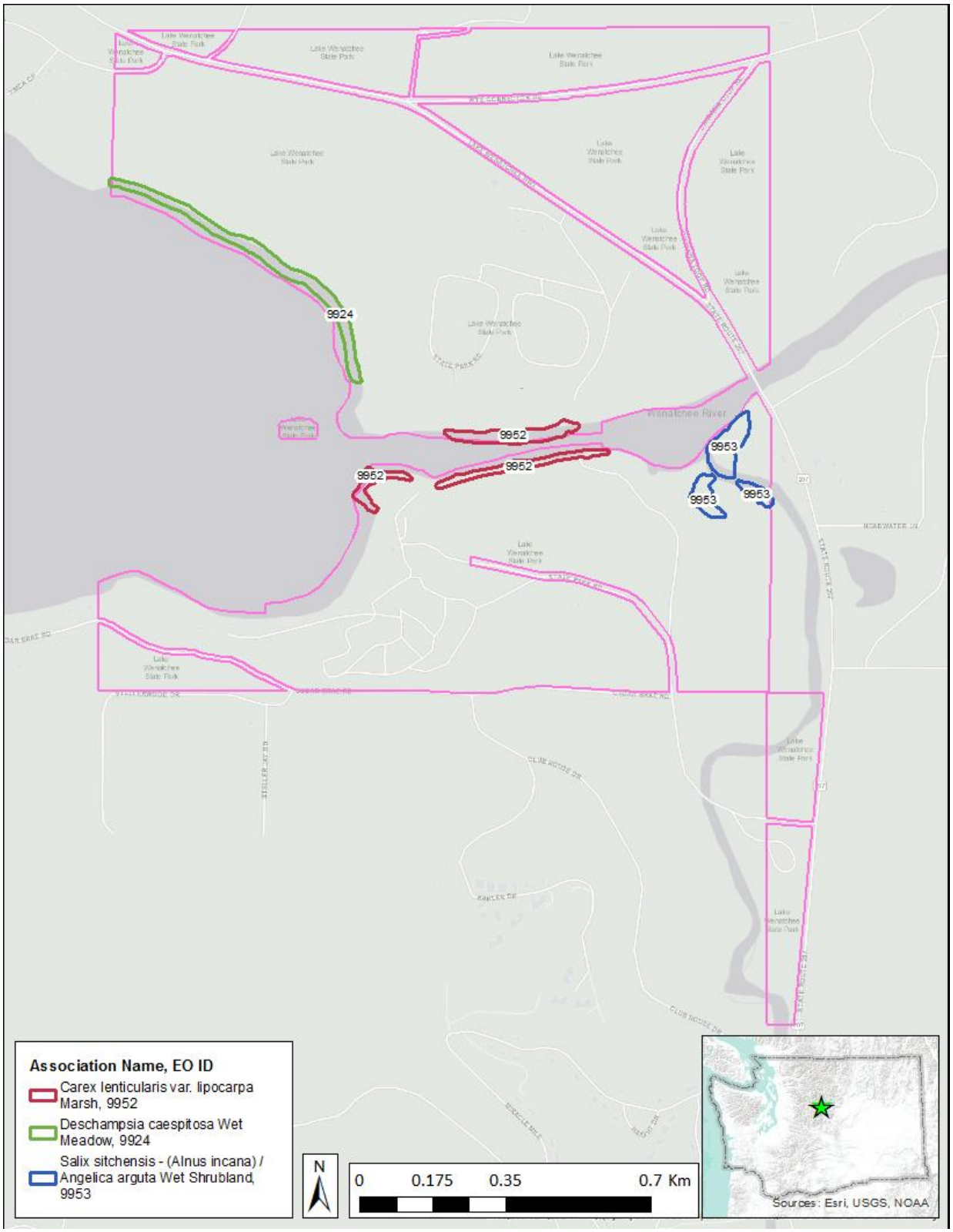

Figure G-7. Element occurrences at Lake Wenatchee State Park

Appendix H. Ocean City

Figure H-1. *Salix hookeriana* - (*Malus fusca*) / *Carex obnupta - Lysichiton americanus* Wet Shrubland (G3/S2) at Ocean City State Park.

The Ecological Integrity Assessment for Ocean City State Park is presented below (Figure H-4). A rare plant and vegetation survey was completed by Morrison and Smith IV (2007). This mapping was the basis for the assessment areas used in our surveys.

There were two previously documented community EOs at the park. Parks identified 8 polygons (39 hectares) of 5 different ecological systems as priorities for assessment (Figure H-5). All maps (Figure H-4 through Figure H-7) are presented at the end of the appendix for ease of reading.

EIA Results

A nearly complete survey was completed at Ocean City. Vegetation Survey Database polygon OceanCity_14 was not surveyed, due to an oversight in the field. That polygon borders a campground loop and includes the large ditch on the southern end of the park, lined with numerous exotic species. OceanCity_14 would likely receive a B/C "best professional judgement" rank. Table H-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table H-2 lists the individual metric ranks for each assessed polygon.

The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table H-1. EIA Summary for Ocean City.

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
339	North Pacific Hardwood-Conifer Swamp	B	B	B-
340	North Pacific Hardwood-Conifer Swamp	B	B	B+
342	North Pacific Shrub Swamp	B	B	B-
343	North Pacific Hardwood-Conifer Swamp	B	B	B-
346	North Pacific Shrub Swamp	B	B	B+
345-FS	North Pacific Hardwood-Conifer Swamp	B	B	B+
345-SS	North Pacific Shrub Swamp	B	B	B+
345-WM	Temperate Pacific Freshwater Emergent Marsh	B	B	B+

Table H-2. Individual EIA Metric Ranks for Ocean City.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
339	C	B	B	B	B	A	A	B	A	C	C	B	C	C	A	AB
340	B	B	B	B	A	A-	B	A	A	B	B	B	B	B	B	AB
342	B	B	C	C	B	A	A	B	B			B	C	C	A	B
343	C	B	B	B	B	A	A	B	C	A	B	B	C	C	B	C
346	B	B	B	B	C	A-	B	A	B			A	B	B	A	B
345-FS	C	B	B	C	B	A	A	A	A	B	B	B	B	B	A	AB
345-SS	B	B	C	C	B	A	A	A	A			B	C	C	A	B
345-WM	B	B	A	B	B	A	A	C	A			B	C	C	A	C

Figure H-2 and Figure H-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure H-6.

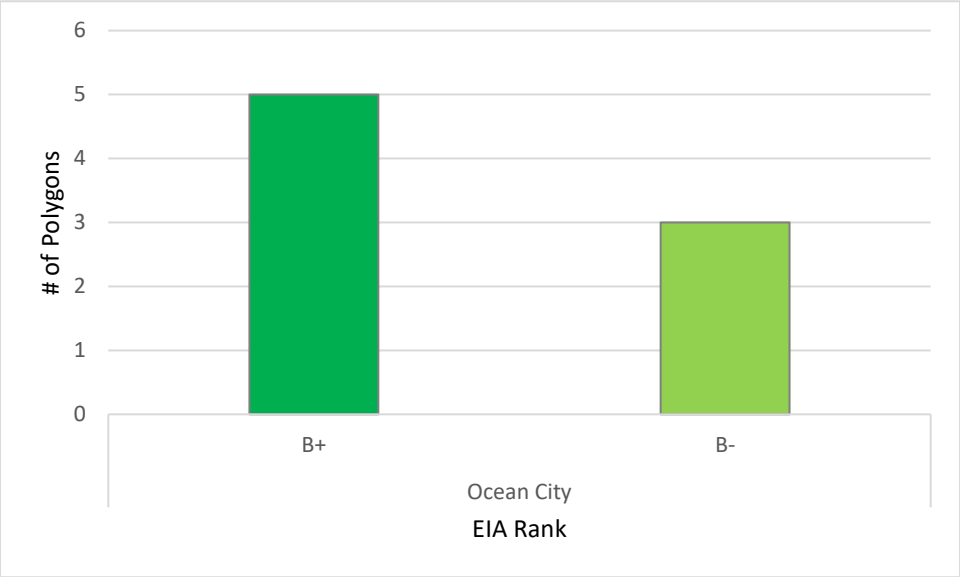

Figure H-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

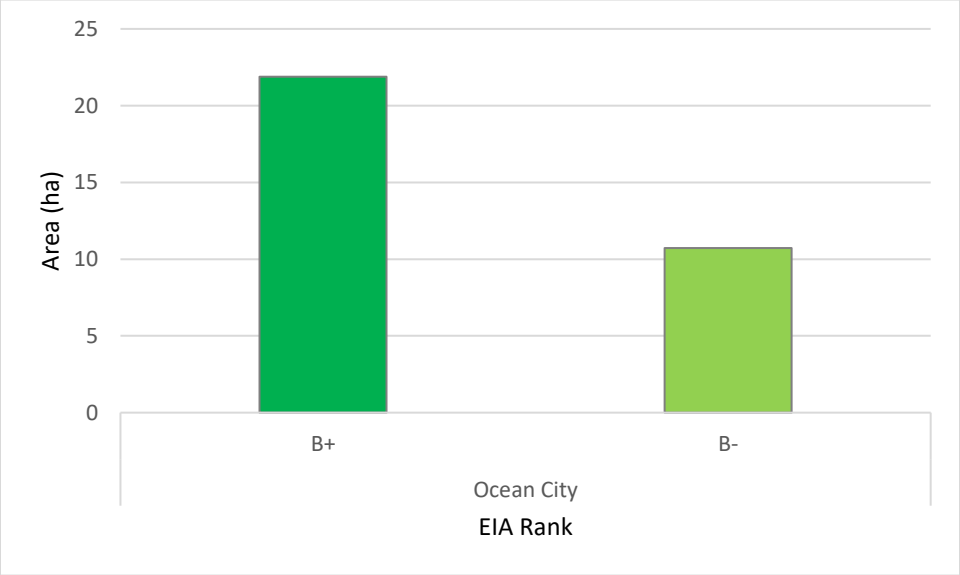

Figure H-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Four new element occurrences were documented at Ocean City (Table H-3, Figure H-7). One other existing EO is located just east of Route 115 (outside of the park). For additional information, see the accompanying Excel workbook.

Table H-3. Summary of new element occurrences at Ocean City State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9970	342	CWWA000109	Myrica gale / Lysichiton americanus Shrub Swamp	G1/S1	B+
9971	345-FS; 340; 339	CEGL000400	Picea sitchensis / Rubus spectabilis / Carex obnupta - Lysichiton americanus Swamp Forest	G2G3/S2	A-
9972	346	CEGL003432	Salix hookeriana - (Malus fusca) / Carex obnupta - Lysichiton americanus Wet Shrubland	G3/S2	B+
9973	345-SS	CEGL003386	Salix hookeriana - Spiraea douglasii Shrub Swamp	GNR/S1	B+

Summary and Discussion

Overall Conditions

A large portion of Ocean City was previously mapped as freshwater intertidal communities (Figure H-5), but we did not detect any tidal influence. Freshwater intertidal sites are more common on the coastal stretches of low-elevation rivers. Similarly, while many of the wetlands on site occur in old dune landforms, these are no longer active, functional dune systems. The rate of sediment deposition along the southwestern coast (see Appendix C) combined with foredune stabilization by *Ammophila* has essentially pushed these depressions further inland. At this point, they function as shrub or hardwood-conifer swamps and we decided to assess them as such, despite the semi-natural original of their successional arc. Furthermore, Ocean City forested swamps with no stumps are likely "naturally" early seral and were scored as such (VEG4, VEG6). In other words, these are young stands not because they were logged, but because the land itself is young (deposited in the last 100+ years, due to jetties to the south).

Few exotic and/or invasive plants were noted at Ocean City (Table H-4, VEG1, VEG2). *Ranunculus repens*, *Holcus lanatus*, and *Phalaris arundinacea* were mainly found along trails, ditches, and road edges. *Ulex europaeus* and *Cytisus scoparius* are common in the dunes, but were present with only trace cover along the western edges of the swamps that were surveyed.

Table H-4. Summary of EIA metric ratings by area (ha) at Ocean City State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	**33**			
VEG2	**19**	13		
VEG3	**20**	11	2	
VEG4	**19**	13	1	
VEG5	1	**8**	3	
VEG6		**9**	3	
HYD1	6	**27**		
HYD2		14	**18**	
HYD3		14	**18**	
SOI1	**24**	8		

One large trough bisects the parks and contains multiple imperiled wetland ecosystems. While the hydrology has been impacted by ditching and road construction (HYD2, HYD3), these communities have few invasive (VEG2) and are otherwise in good condition.

Recommendations for Enhancing / Maintaining Ecological Integrity

The clearest area for improvement is the hydrology of the large dune trough wetland in the center of the park. Perhaps the park road that divides the wetland could be modified (e.g. a larger culvert, or replacement with a bridge). With that said, the wetland extends well beyond the park and the park road is not even the most significant impediment to water flow—the road to the casino north of the park appears to impound far more water. With the rapid aggradation to the west, hydrology in these wetlands is also something of a moving target. Hydrological monitoring would help paint a clearer picture of the impacts from not only the road, but also the two ditches that lead beachward.

Future Assessment / Survey Recommendations

One Vegetation Survey Database polygon (OceanCity_14) was not surveyed. That polygon is bisected by the most significant ditch and berm that we came across within the park boundary—it is likely to be in fair condition, at best. Aside from hydrological monitoring, further assessments at Ocean City are not a priority at this time.

Maps

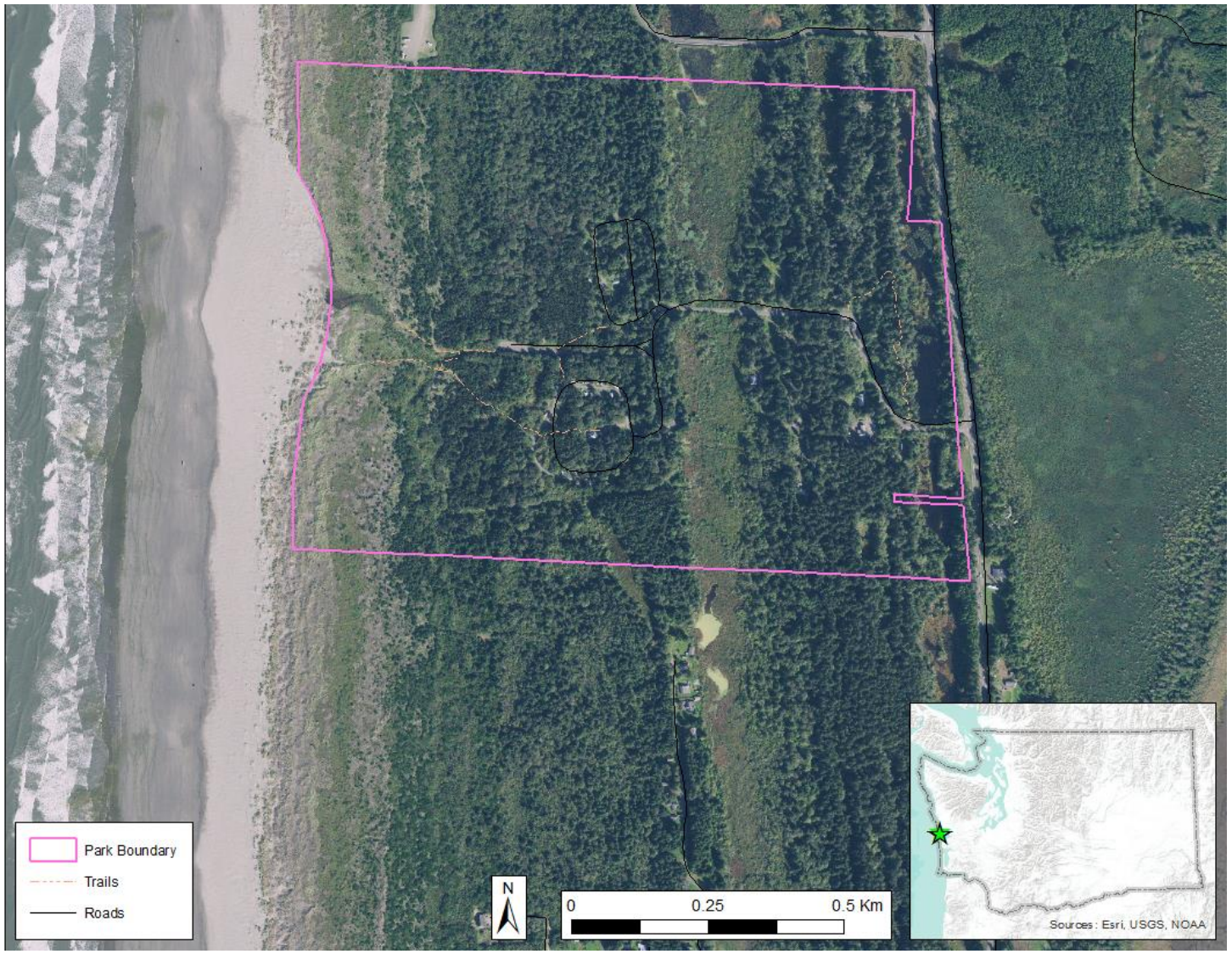

Figure H-4. Overview of Ocean City State Park

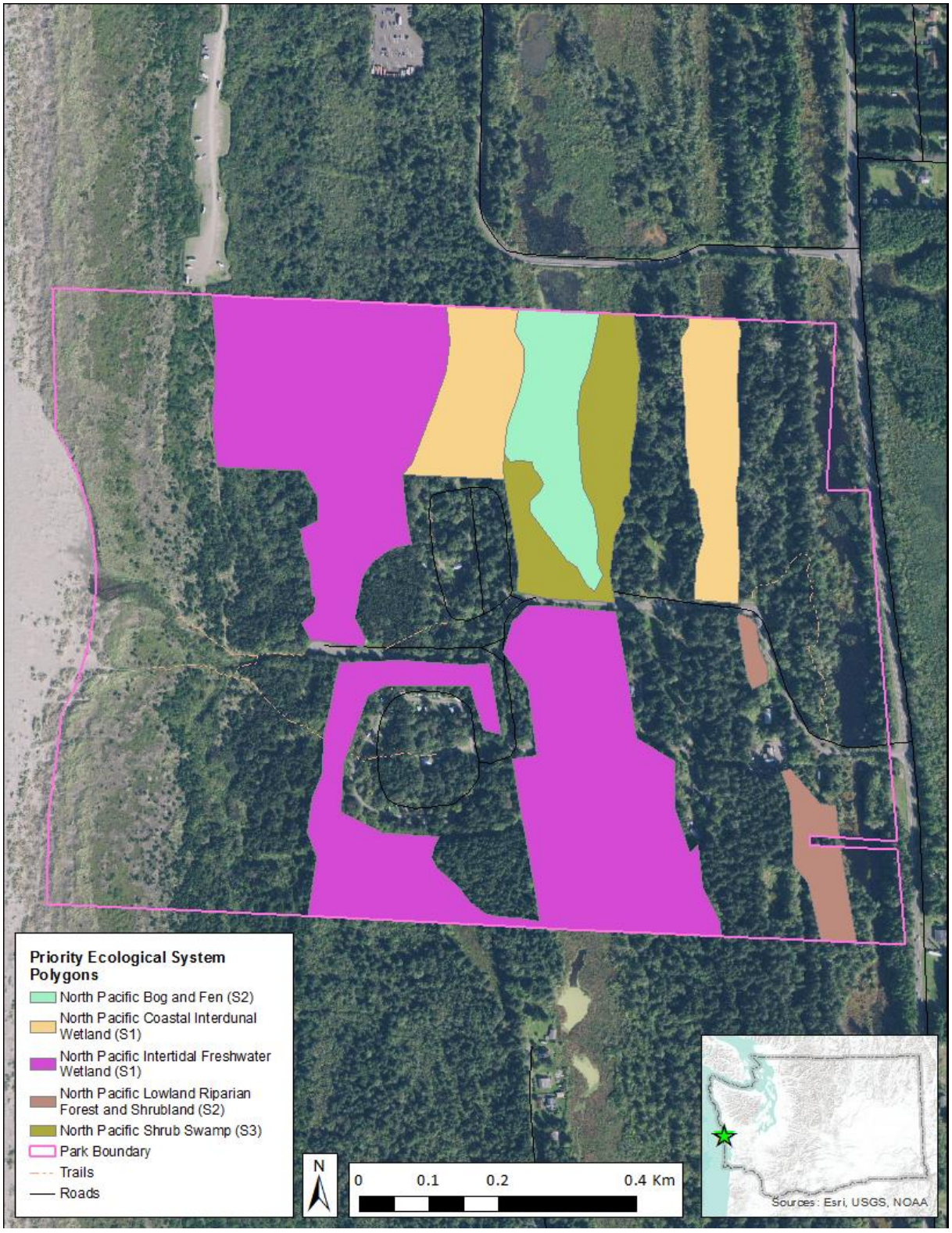

Figure H-5. Priority ecological systems polygons for assessment at Ocean City State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

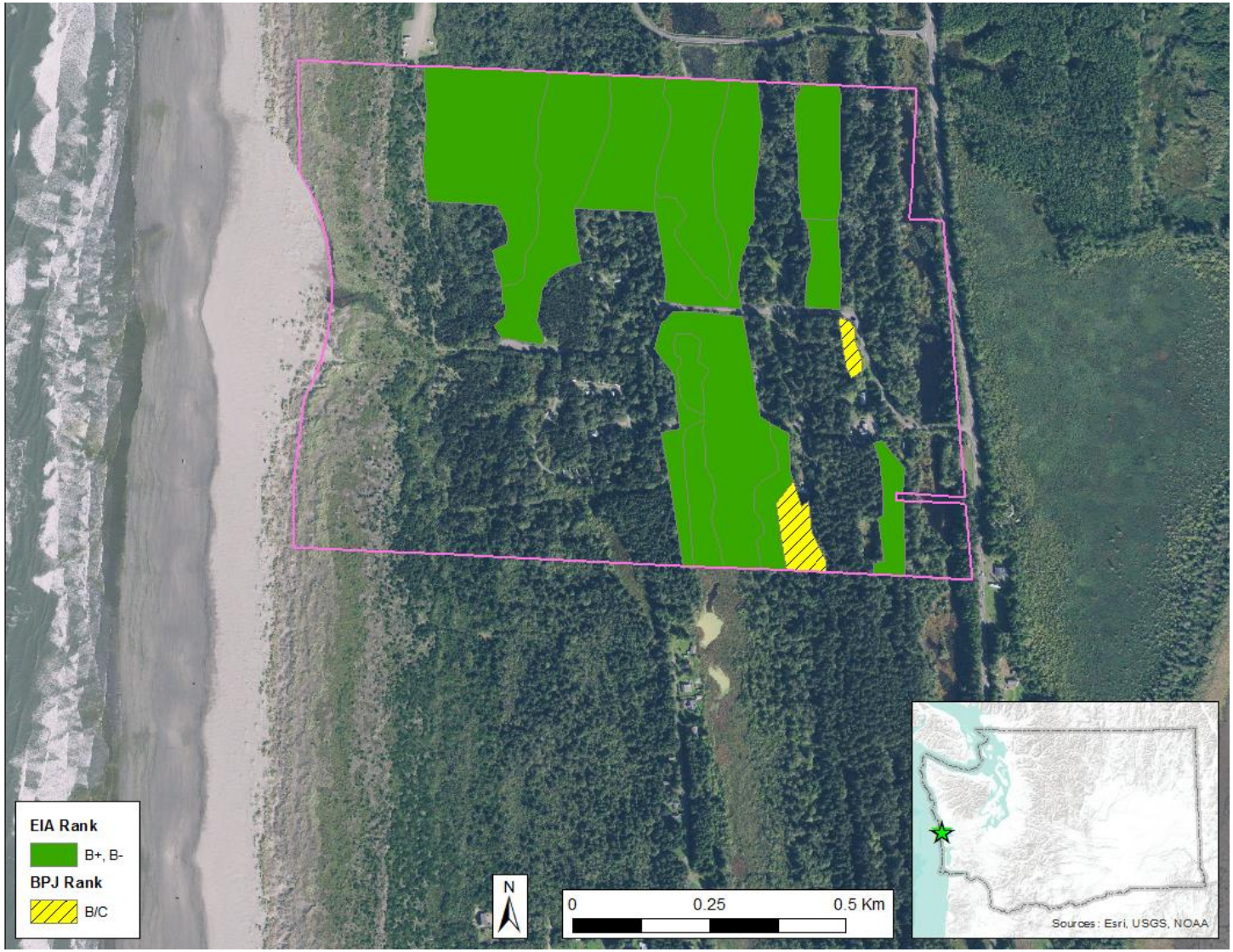

Figure H-6. EIA Ranks for all polygons assessed at Ocean City State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

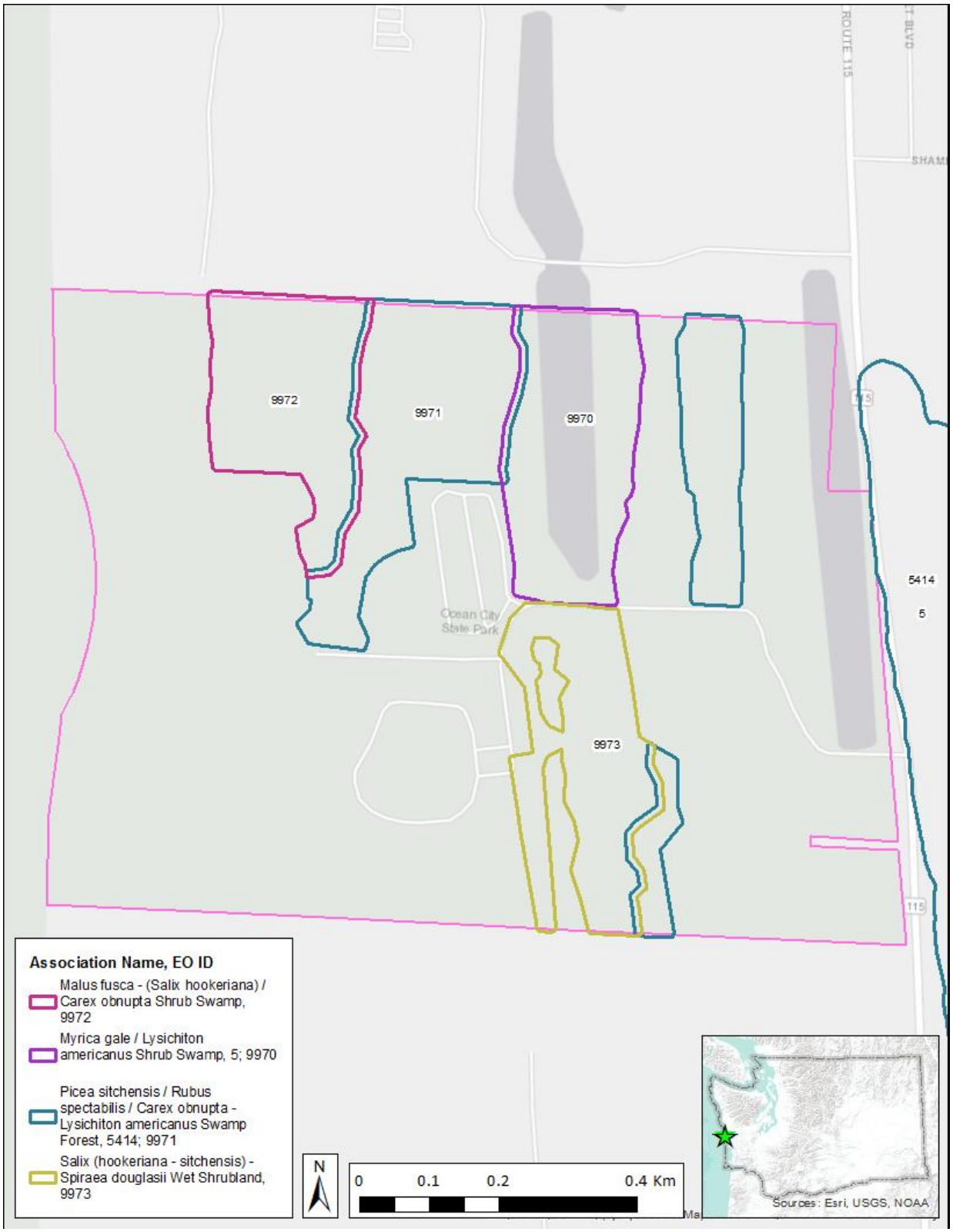

Figure H-7. Element occurrences at Ocean City State Park

Appendix I. Sun Lakes - Dry Falls

Figure I-1. *Sarcobatus vermiculatus* / *Distichlis spicata* Wet Shrubland (G4/S2) at Sun Lakes - Dry Falls State Park.

The Ecological Integrity Assessment for Sun Lakes - Dry Falls State Park is presented below (Figure I-5). A rare plant and vegetation survey was completed by Visalli (2004b). This mapping was the basis for the assessment areas used in our surveys.

There were no previously documented community EOs within the boundaries of the park. Parks identified 62 polygons (1085 hectares) of 8 different ecological systems as priorities for assessment (Figure I-6). All maps (Figure I-5 through Figure I-8) are presented at the end of the appendix for ease of reading.

EIA Results

All priority polygons were surveyed in April and May 2021. Sun Lakes had many priority polygons that shared the same ecological system, plant association, and were in similar condition to one another. In cases where these priority polygons were in the same vicinity, we chose to assess them together, even if they were separated by short distances. Parkwide landscape metrics did not

include the property on the southwest side of Lenore Lake, as there were no priority polygons identified in that small parcel.

By the end of our surveys in late May, many of the spring forbs and other annuals had already senesced, potentially impacting diversity submetric scores within the Native Plant Species Composition metric (VEG3). However, when we chose to mark down this submetric, there was both reduced live plant diversity and little forensic (dead) material present that would indicate presence of additional species.

Table I-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table I-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table I-1. EIA Summary for Sun Lakes - Dry Falls. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
450	Inter-Mountain Basins Alkaline Closed Depression	B	B	B-
453	North American Arid West Emergent Marsh	B	C	C+
455	North American Arid West Emergent Marsh	C	B	B-
456	North American Arid West Emergent Marsh	B	B	B+
457	North American Arid West Emergent Marsh	B	B	B+
458	North American Arid West Emergent Marsh	B	B	B+
459	North American Arid West Emergent Marsh	B	B	B+
460	Inter-Mountain Basins Alkaline Closed Depression	B	B	B-
461	Inter-Mountain Basins Alkaline Closed Depression	B	B	B-
462	Northern Columbia Plateau Basalt Pothole Pond	B	B	B+
463	Columbia Plateau Scabland Shrubland	B	B	B-
476	Columbia Plateau Scabland Shrubland	B	C	C+
477	Inter-Mountain Basins Cliff and Canyon	B	B	B+
482	Columbia Plateau Scabland Shrubland	B	C	B-
495	Columbia Plateau Scabland Shrubland	B	C	B-
504	Inter-Mountain Basins Alkaline Closed Depression	C	B	B-
505	Inter-Mountain Basins Greasewood Flat	C	C	C+
506	Inter-Mountain Basins Greasewood Flat	B	B	B+
507	Inter-Mountain Basins Greasewood Flat	B	B	B-
508	Inter-Mountain Basins Greasewood Flat	C	C	C+
509	Inter-Mountain Basins Alkaline Closed Depression	B	B	B-
510	Inter-Mountain Basins Cliff and Canyon	B	B	B+
511	Inter-Mountain Basins Alkaline Closed Depression	C	C	C+
451-452-454	North American Arid West Emergent Marsh	B	B	B-

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
464-497	Inter-Mountain Basins Big Sagebrush Steppe	B	C	B-
465-468-470-471	Columbia Plateau Scabland Shrubland	B	B	B-
466-467	Columbia Plateau Scabland Shrubland	B	C	C+
468,470, 471-VP	Columbia Plateau Vernal Pool	B	B	B-
468-W	Inter-Mountain Basins Alkaline Closed Depression	B	B	B-
469-473-475	Columbia Plateau Scabland Shrubland	B	B	B-
472-503	Inter-Mountain Basins Big Sagebrush Steppe	B	B	B-
474-498	Columbia Plateau Scabland Shrubland	B	B	B-
478-479-480	Columbia Plateau Scabland Shrubland	B	C	C+
481-483-484	Columbia Plateau Scabland Shrubland	B	B	B-
485-489	Columbia Plateau Scabland Shrubland	B	B	B-
488-490-491	Columbia Plateau Scabland Shrubland	B	C	B-
492-496	Columbia Plateau Scabland Shrubland	B	C	B-
493-494	Columbia Plateau Scabland Shrubland	B	B	B-
499-502	Inter-Mountain Basins Big Sagebrush Steppe	B	C	C+
499-Scab	Columbia Plateau Scabland Shrubland	B	C	B-
500,501-burn	Inter-Mountain Basins Big Sagebrush Steppe	B	C	C+
500-501	Inter-Mountain Basins Big Sagebrush Steppe	B	C	B-

Table I-2. Individual EIA Metric Ranks for Sun Lakes - Dry Falls.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
450	B	C	A	A	C	C	D	C	C		B	A	B	A	C	
453	A	C	C	C	B	D	D	C	B		B	B	B	C	B	
455	A	C	B	C	C	C	C	B	B		B	A	A	A	B	
456	A	B	A	A	C	C	C	C	A		C	A	A	A	A	
457	A	C	A	A	B	D	D	B	B		C	A	A	A	A	
458	A	C	B	B	B	C	C	B	B		B	A	A	A	B	
459	A	C	A	A	C	B	B	B	C		B	A	A	A	B	
460	B	C	A	A	B	C	C-	B	C		C	A	B	A	B	
461	A	C	A	A	C	C	C	C	C		B	A	B	A	C	
462	A	C	A	A	B	D	B	A	A		B	A	A	A	A	
463	A	C	B	B	C	C	C-	B	B		B				A	
476	A	C	C	C	C	D	D	C	C		C				A	
477	A	C	A	C	B	B	A	A	B		A				B	
482	A	C	B	B	B	C	C	B	C		C				B	
495	A	C	A	A	C	C	C	B	B		B				C	
504	C	B	B	B	C	C	C-	B	C		C	A	B	B	C	
505	C	B	C	C	C	C	C-	B	C		B	B	B	C	C	
506	B	A	A	A	B	C	C-	B	B		C	A	A	A	A	B
507	C	B	B	C	B	C	C-	B	C	B	C	B	B	B	A	B

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
508	A	C	C	C	C	C	C-	C	C		C	B	B	C	B	
509	A	C	A	A	B	B	C	C	C		B	A	A	B	C	A
510	A	C	A	A	B	B	B	A	A						B	
511	B	B	B	C	C	D	C-	C	C		C	B	B	C	A	
451-452-454	A	C	B	C	B	B	C	B	B		B	B	B	B	B	
464-497	B	B	B	B	C	C	C-	B	B		C				B	
465-468-470-471	A	C	A	A	B	C	C	B	B		B				B	
466-467	A	C	C	C	B	C	C-	B	C		B				B	
468,470,471-VP	B	C	A	A	C	B	C	B	C		B	A	A	A	C	B
468-W	A	C	A	A	C	B	C	B	C		B	A	B	A	C	
469-473-475	A	C	A	B	B	B	C	B	B	A	B				B	
472-503	B	C	B	B	B	B	C	A	B		B				B	
474-498	A	B	B	B	B	C	C	B	B		B				B	
478-479-480	A	C	C	C	B	C	C-	B	C		C				B	
481-483-484	A	C	A	A	B	C	C-	B	B	A	B				A	
485-489	A	C	B	C	B	C	C-	B	B		C				A	
488-490-491	A	C	A	A	B	C	C-	B	B		C				B	
492-496	A	C	A	A	C	C	C-	B	C		B				B	
493-494	A	C	B	C	C	C	C	B	B		B				B	
499-502	A	C	B	C	C	D	C-	B	C		C				A	
499-Scab	A	C	A	A	B	C	C-	B	C		B				A	
500,501-burn	A	C	B	B	B	D	C-	C	C		C				B	
500-501	B	B	B	C	B	C	C-	B	B		C				B	

Figure I-2 and Figure I-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure I-8.

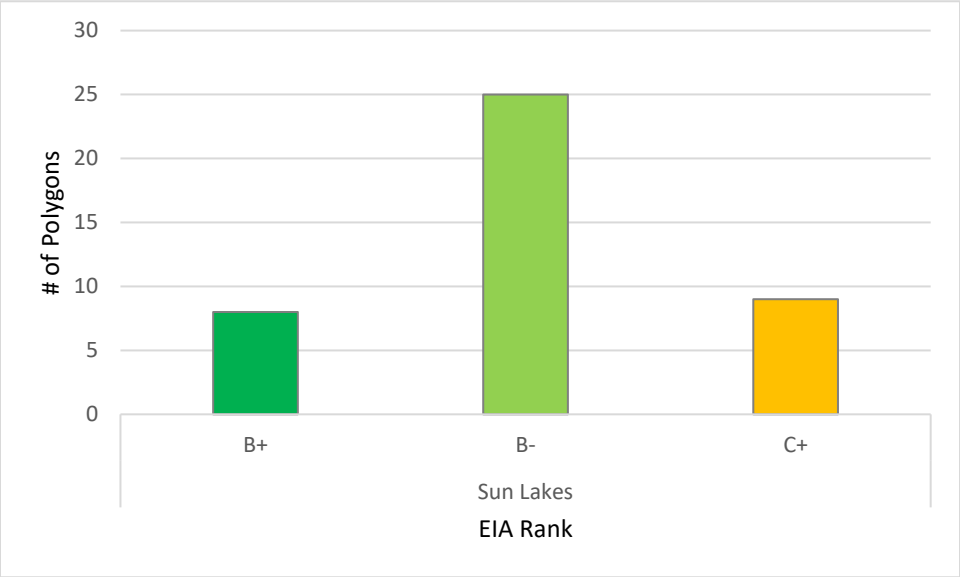

Figure I-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

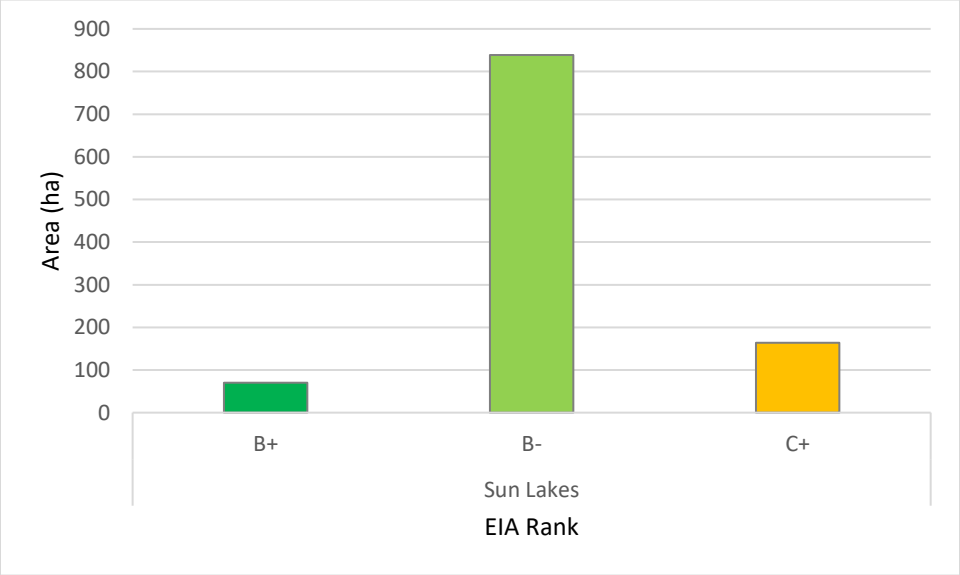

Figure I-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Three new element occurrences were documented at Ocean City (Table H-3, Figure H-7). The *Deschampsia danthonioides* - *Grindelia* (*hirsutula*, *squarrosa*) and *Leymus cinereus* - *Carex*

praegracilis wetlands are the only documented EO-quality occurrences for those associations in Washington. For additional information, see the accompanying Excel workbook.

Table I-3. Summary of new element occurrences at Sun Lakes - Dry Falls State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9974	468,470 ,471-VP	CWWA000367	Deschampsia danthonioides - Grindelia (hirsutula, squarrosa) Vernal Pool [Provisional]	GNR/SNR	B+
9975	509	CWWA000363	Leymus cinereus - Carex praegracilis Alkaline Wet Meadow	GNR/SNR	B+
9977	506	CEGL001363	Sarcobatus vermiculatus / Distichlis spicata Wet Shrubland	G4/S2	B+

Summary and Discussion

Figure I-4. A vernal pool at Sun Lakes - Dry Falls. These ephemeral wetlands are used—and impacted—heavily by domestic grazers.

Overall Conditions

Most of Sun Lakes - Dry Falls lies within a portion of Grand Coulee that was ranched and grazed prior to its acquisition by Parks. There were also dams built along Meadow Creek to impound water in the ranching days. Today, the upper rims of the coulee continue to be grazed and the Meadow Creek outlet into Park Lake is cleared of vegetation every 2-3 years in order to keep the outlet flowing. These and other stressors have contributed to fair or poor metric ratings for exotic/invasive plants (VEG1, VEG2) across the large majority of the park (Table I-4). The most problematic invasive include *Bromus* (*tectorum*, *hordeaceus*), *Poa bulbosa*, *Phragmites australis* ssp. *australis*, and *Chondrilla juncea*, among many others.

Table I-4. Summary of EIA metric ratings by area (ha) at Sun Lakes - Dry Falls State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1		136	**789**	147
VEG2	1	2	399	**671**
VEG3	45	**919**	109	
VEG4	8	**744**	320	
VEG5	**94**	8		
VEG6	1	**558**	513	
HYD1	**95**	65		
HYD2	**86**	74		
HYD3	**78**	66	16	
SOI1	184	**867**	22	

Over most of the park, native plant species composition (VEG3) is in good (B) condition. However, this metric was often marked down in the shrub steppe areas—both scabland and big sagebrush steppe—due to reduced cover of diagnostic bunchgrasses, low forb diversity, and occasionally low diagnostic shrub cover (in burned areas). While naturally species-poor, a number of Inter-Mountain Basins Alkaline Closed Depression polygons are also outside of the natural range of variability for plant composition. These shallow basins tend to have reduced cover of diagnostic species due to active grazing and invasive, as well as high cover of native increaser species such as *Juncus balticus* and *Hordeum jubatum*. Areas of Inter-Mountain Basins Greasewood Flat and North American Arid West Emergent Marsh are also outside of the natural range of variability, with reduced cover of diagnostic species (associated with invasive) and increased cover of upland species (associated with hydrologic stressors).

Woody regeneration (VEG5) is as expected in most of the AAs at Sun Lakes, but large areas of the park are outside of the natural range of variability in vegetation structure (VEG4) and litter (VEG6). Biological soil crust is frequently patchy in shrub-steppe polygons and—as noted above—bunchgrasses are frequently replaced by exotic annuals or *Poa bulbosa*. Burned areas also have low sagebrush cover. Similarly, large wetland areas (including vernal pools, alkaline closed depressions, greasewood flats, and emergent marshes) all show structural and litter impacts from grazing and exotic species. Across all ecosystems, litter was marked down due to large swaths of continuous, excess fine litter from exotic grasses and other invasive species.

Hydrologically (HYD1-HYD3), most wetlands are in good (B) or excellent condition (A), with minimal modern impacts from past alterations related to ranching. Soil disturbance (SOI1) most commonly comes in the form of social trails and trampling by cattle, but typically remains in the good-to-excellent range. The vernal pools are an exception, as these have been disproportionately impacted by cattle.

Recommendations for Enhancing / Maintaining Ecological Integrity

All areas of the park show at least some impacts from historical and contemporary land uses. Ceasing grazing or implementing more compatible grazing regimes is recommended to prevent futher degradation. In particular, removing grazing pressure would benefit the vernal pools found amid the scablands of the coulee rims. All of the vernal pools surveyed showed significant soil disturbance from cattle. One *Deschampsia danthonioides* - *Grindelia* (*hirsutula*, *squarrosa*) Vernal Pool (Figure I-4) remains marginally EO-quality for the time-being—it is currently the only such occurrence in the Biotics database.

Future Assessment / Survey Recommendations

Nearly all of Sun Lakes - Dry Falls State Park was surveyed as part of this project. Additional assessments at Sun Lakes are not a priority at this time.

Maps

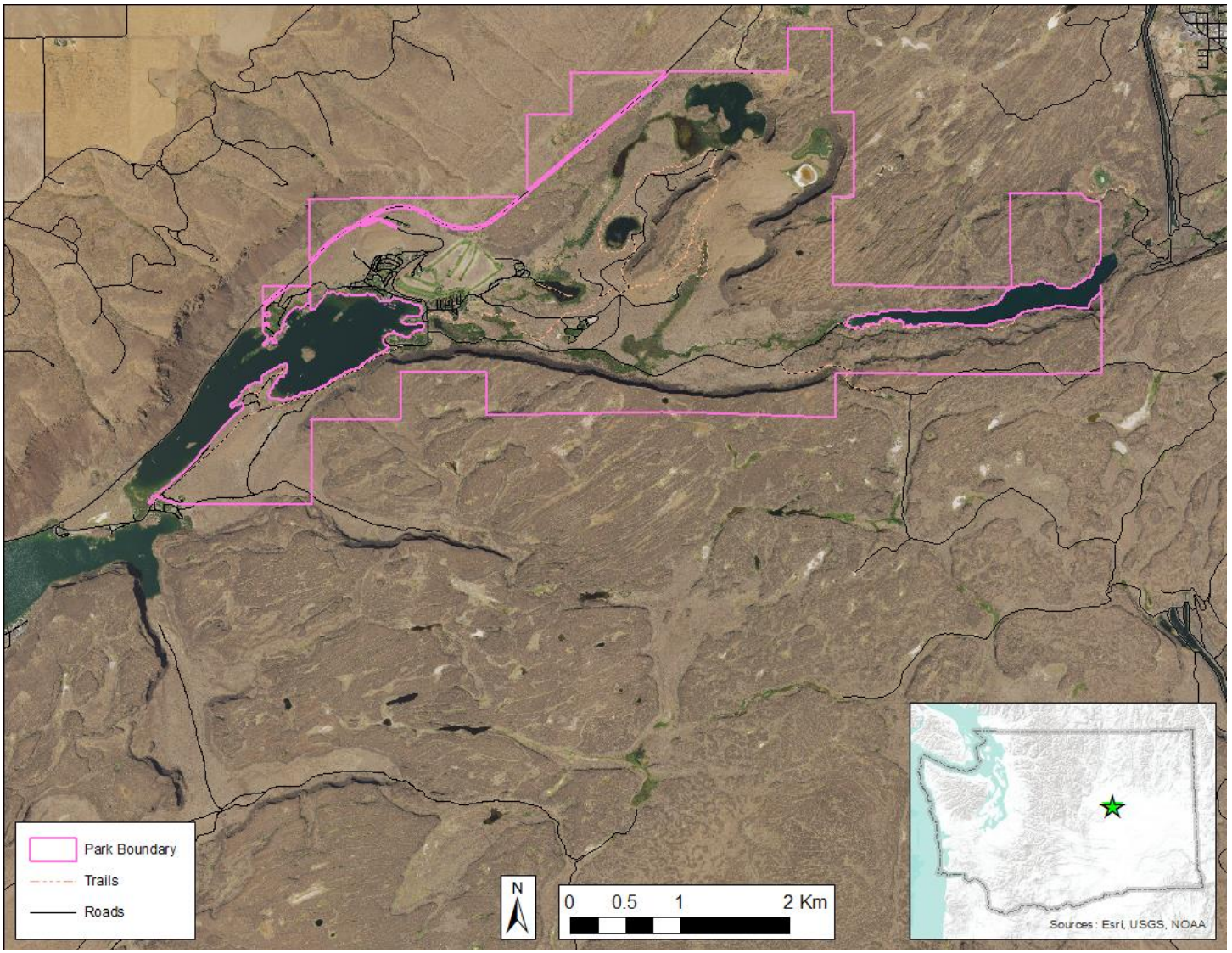

Figure I-5. Overview of Sun Lakes - Dry Falls State Park

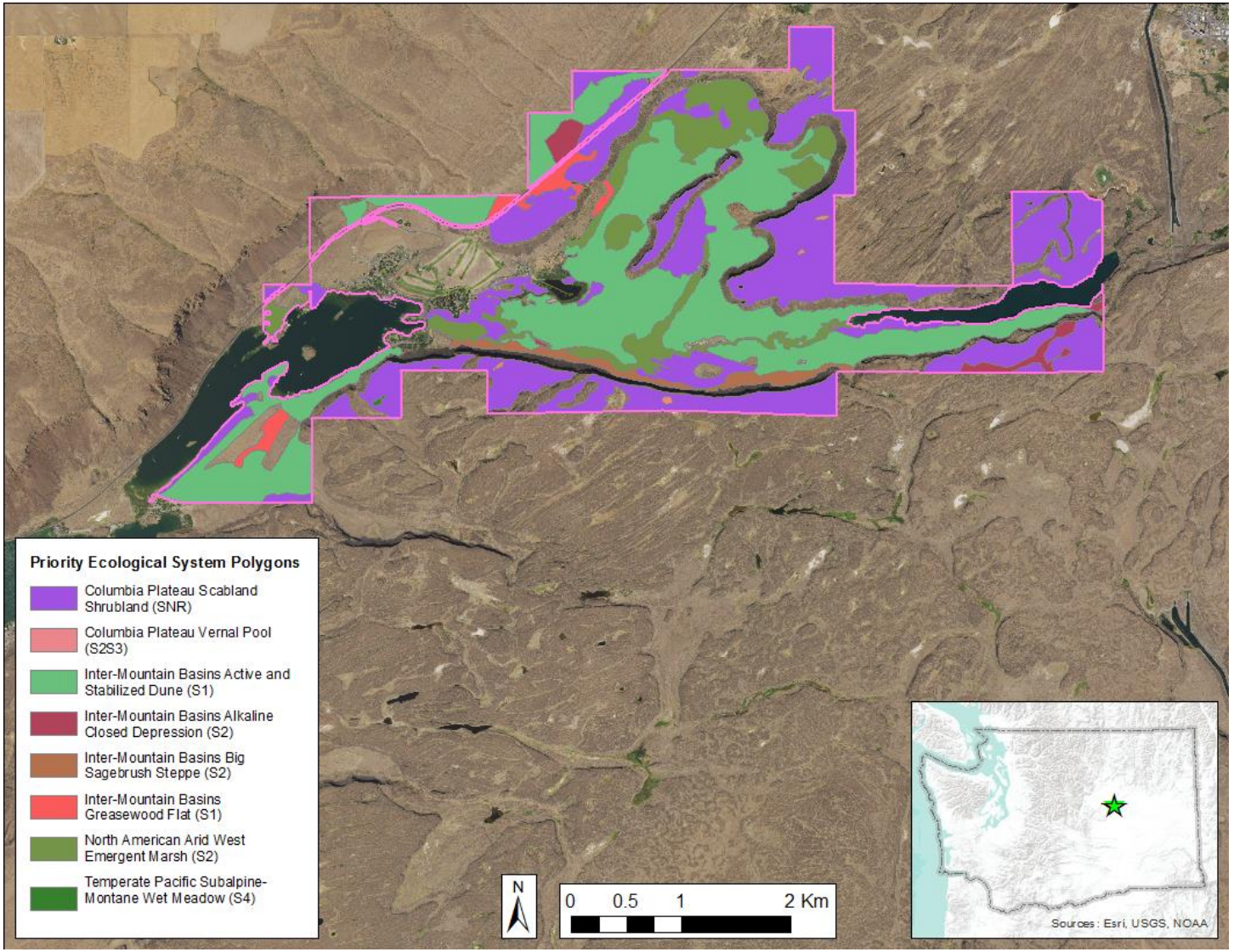

Figure I-6. Priority ecological systems polygons for assessment at Sun Lakes - Dry Falls State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

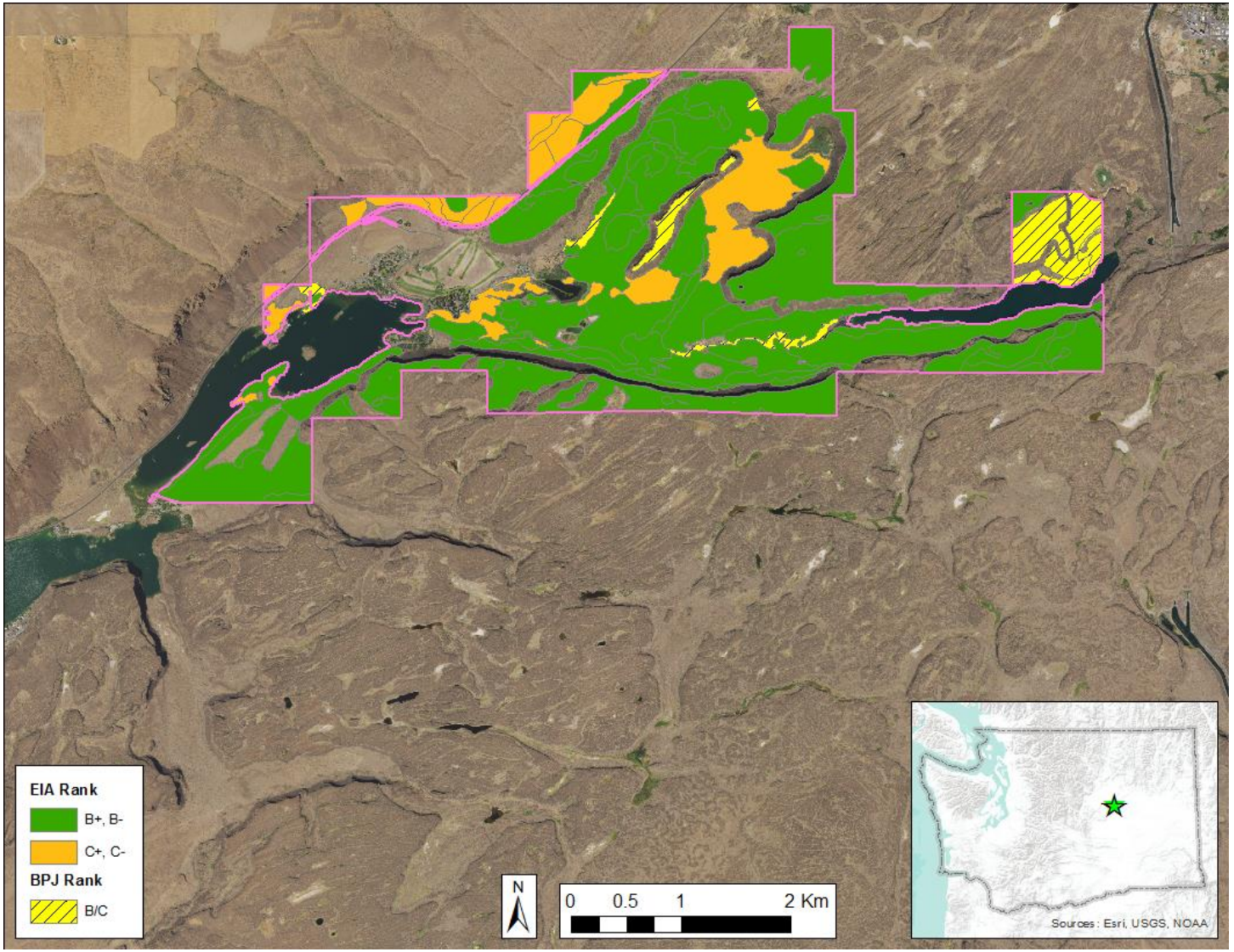

Figure I-7. EIA Ranks for all polygons assessed at Sun Lakes - Dry Falls State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

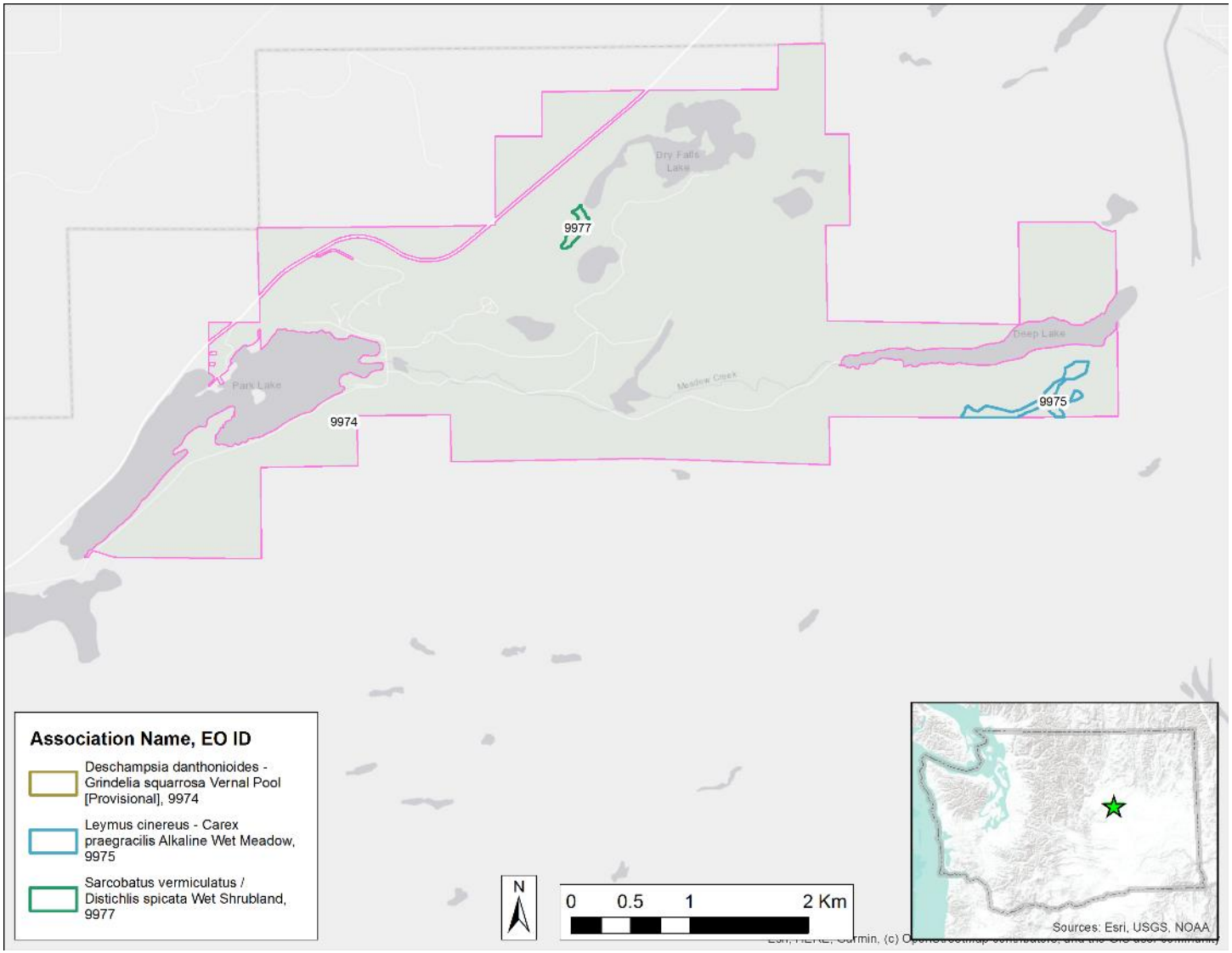

Figure I-8. Element occurrences at Sun Lakes - Dry Falls State Park

Appendix J. Mount Pilchuck

Figure J-1. *Carex* (*aquatilis* var. *dives*, *nigricans*, *utriculata*) - *Caltha leptosepala* ssp. *howellii* Fen [Provisional] *(*G2G3Q/S1S2) at Mount Pilchuck State Park.

The Ecological Integrity Assessment for Mount Pilchuck State Park is presented below (Figure J-4). A rare plant and vegetation survey was completed by URS (2009c). This mapping was the basis for the assessment areas used in our surveys.

There were two previously documented community EOs at the park. Parks identified 3 polygons (584 hectares) of 2 different ecological systems as priorities for assessment (Figure J-5). All maps (Figure J-4 through Figure J-7) are presented at the end of the appendix for ease of reading.

EIA Results

All priority polygons were surveyed at Mount Pilchuck, with additional areas assessed opportunistically. Surveys occurred over two days in July 2020. Table J-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table J-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table J-1. EIA Summary for Mount Pilchuck.

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
326	North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest	A	A	A+
327	North Pacific Mountain Hemlock Forest	A	A	A+
325-Fen1	North Pacific Bog and Fen	A	A	A+
325m	North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest	A	A	A+
327-ATHAME	Rocky Mountain Alpine Bedrock and Scree	A	A	A+
327-SPISPL	North Pacific Maritime Mesic Parkland	A	A	A-
MountPilchuck_3	North Pacific Maritime Mesic Parkland	A	A	A+

Table J-2. Individual EIA Metric Ranks for Mount Pilchuck.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
326	A	B	A	B	A	A	A	A	A	A	A				A	B
327	A	A	A	A	A	A	A	A	A	A	A				A	C
325-Fen1	A	A	A	A	A	A	A	A	A			A	A	A	A	D
325m	A	A	A	A	A	A	A	A	A	A	A				A	B
327-ATHAME	A	A	A	A	A	A	A	A	A						A	B
327-SPISPL	A	A	A	A	A	A	A	A	B						B	B
MountPilchuck_3	A	A	A	A	A	A	A	A	A	A	A				B	A

Figure J-2 and Figure J-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure J-6.

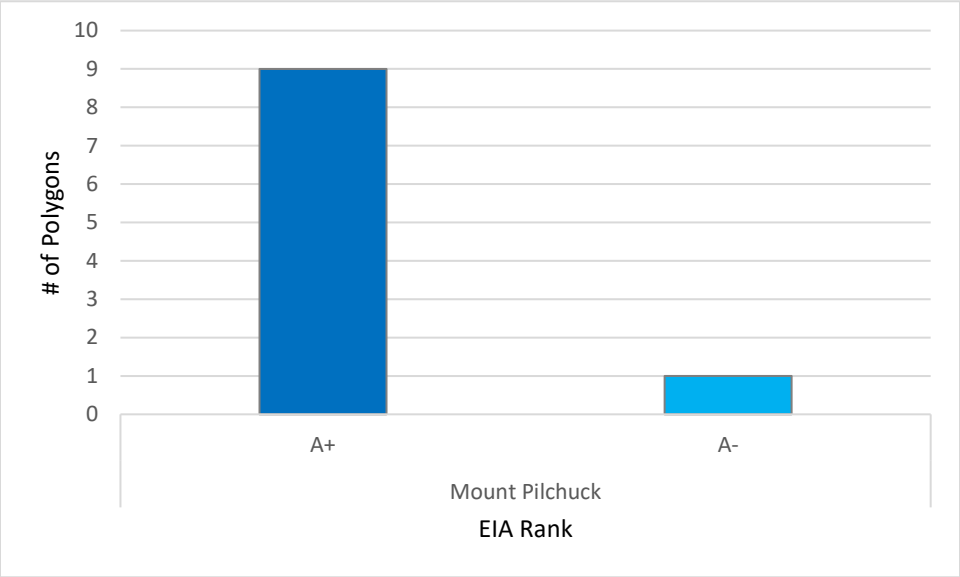

Figure J-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

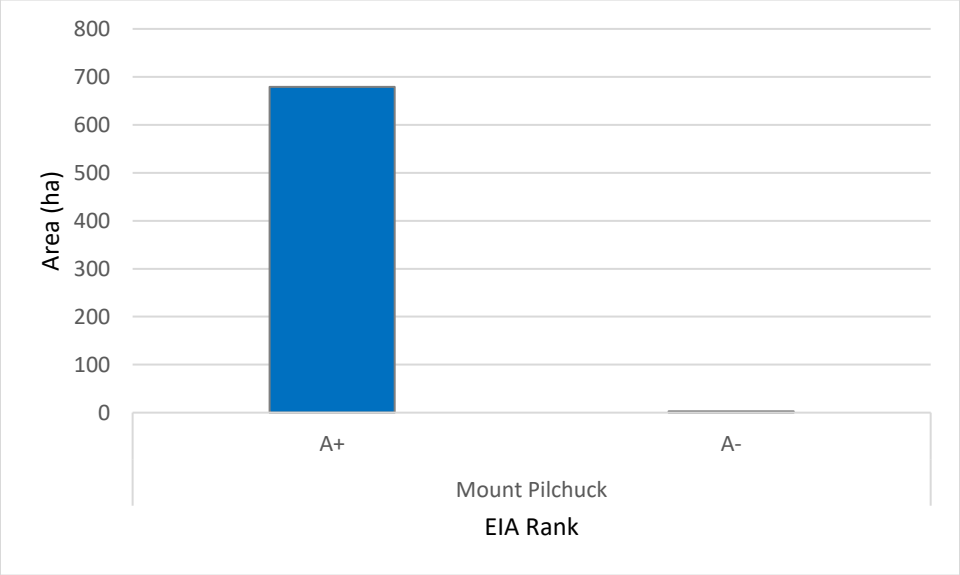

Figure J-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

7 new element occurrences were documented at Mount Pilchuck (Table J-3, Figure J-7) and two other existing EOs were revisited and assessed with current methodology. EO ID 1988 (Figure J-7) is a matrix *Tsuga heterophylla - Abies amabilis* / *Vaccinium alaskaense* / *Tiarella trifoliata*

Forest that extends well into Morning Star Natural Resource Conservation Area, to the east. *Spiraea splendens* / *Carex spectabilis* - (*Polygonum bistortoides*) Shrubland is a newly published association (Ramm-Granberg et al., 2021) that was accepted via USNVC peer-review (Ramm-Granberg et al., In Press), but has yet to be assigned an EL Code (hence the "pending" EO ID). Table J-3 summarizes the classification, conservation status ranks, and EO ranks (landscape context + condition + size) of new EOs at Deception Pass. For additional information, see the accompanying Excel workbook.

Table J-3. Summary of new element occurrences at Mount Pilchuck State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9869	325-Fen1	CWWA000169	Carex (aquatilis var. dives, nigricans, utriculata) - Caltha leptosepala ssp. howellii Fen [Provisional]	G2G3Q/S1S2	B+
9872	327-SPISPL	CEGL001828	Carex spectabilis - Polygonum bistortoides Alpine Meadow	G4/S3S4	A+
Pending	327-SPISPL	CEGL008281	Spiraea splendens / Carex spectabilis - (Polygonum bistortoides) Shrubland	GNR/S3S4Q	A+
9873	327-ATHAME	CEGL005900	Athyrium americanum - Cryptogramma acrostichoides Alpine Sparse Vegetation	G2G3/S2S3	A+
9874	MountPilchuck_3	CEGL005579	Tsuga mertensiana / Phyllodoce empetriformis - Vaccinium deliciosum Woodland	G4/S3S4	A+
9870	327	CEGL002617	Tsuga mertensiana - Abies amabilis / Vaccinium ovalifolium / Maianthemum dilatatum Forest	G3G4/S3S4	A-
9871	327	CEGL005580	Tsuga mertensiana - Abies amabilis / Vaccinium alaskaense / Rubus pedatus Forest	G4G5/S4	A-

Summary and Discussion

Overall Conditions

Mount Pilchuck was the highest elevation park we surveyed and had by far the fewest human stressors and the most intact ecological integrity. The lower flanks are covered by old-growth *Tsuga heterophylla - Abies amabilis* forests. Moving up in elevation, the forests transition to *Tsuga mertensiana*-dominant subalpine forests and then relatively open parklands. The heavy recreational use along the trail to Mount Pilchuck has had little impact on the surrounding ecosystems, aside from depositing shocking amount of surficial human waste. The eastern portion of the park is more difficult to access. That area supports a small—but high-quality—montane fen (EO ID 9869). Mount Pilchuck State Park and the neighboring Morning Star Natural Resource Conservation Area (managed by DNR) combine to protect a very large area of high-quality forested ecosystems.

Table J-4. Summary of EIA metric ratings by area (ha) at Mount Pilchuck State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	**670**			
VEG2	**670**			
VEG3	**670**			
VEG4	**667**	3		
VEG5	**665**			
VEG6	**665**			
HYD1	**< 1**			
HYD2	**< 1**			
HYD3	**< 1**			
SOI1	**476**	194		

Recommendations for Enhancing / Maintaining Ecological Integrity

Our primary recommendation for maintaining and enhancing ecological integrity at Mount Pilchuck is to discourage proliferation of social trails whenever possible. Continuing to focus visitor use along the well-worn summit trail will help the remainder of the park stay in excellent condition.

Future Assessment / Survey Recommendations

Vegetation Survey Database polygon MountPilchuck_8 was not accessed as part of our survey. Aerial imagery and modeled structure data indicate that this stand has been logged previously, or otherwise disturbed. This area should be assessed for potential restoration options that may put it on a path to the same ecological integrity as the rest of the park.

Maps

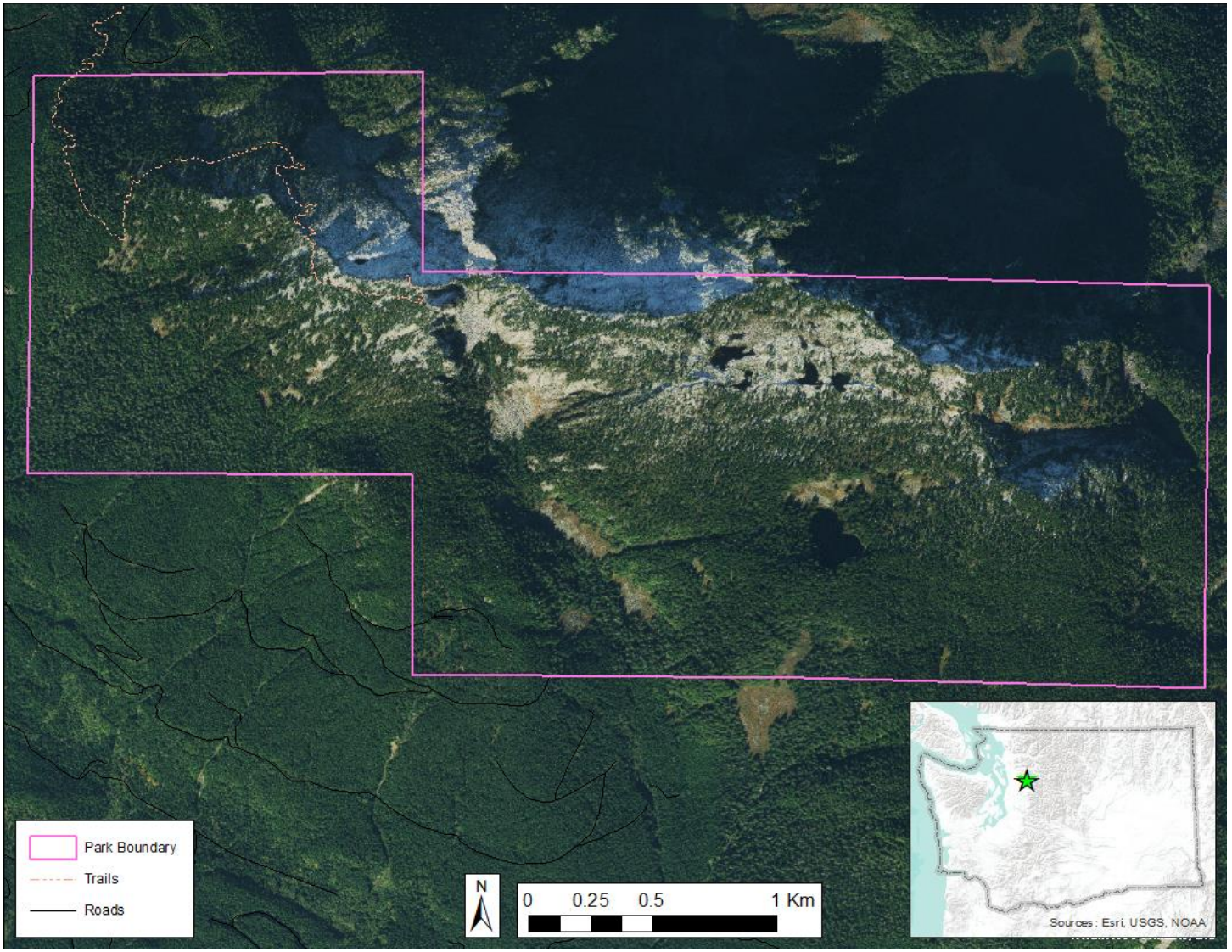

Figure J-4. Overview of Mount Pilchuck State Park

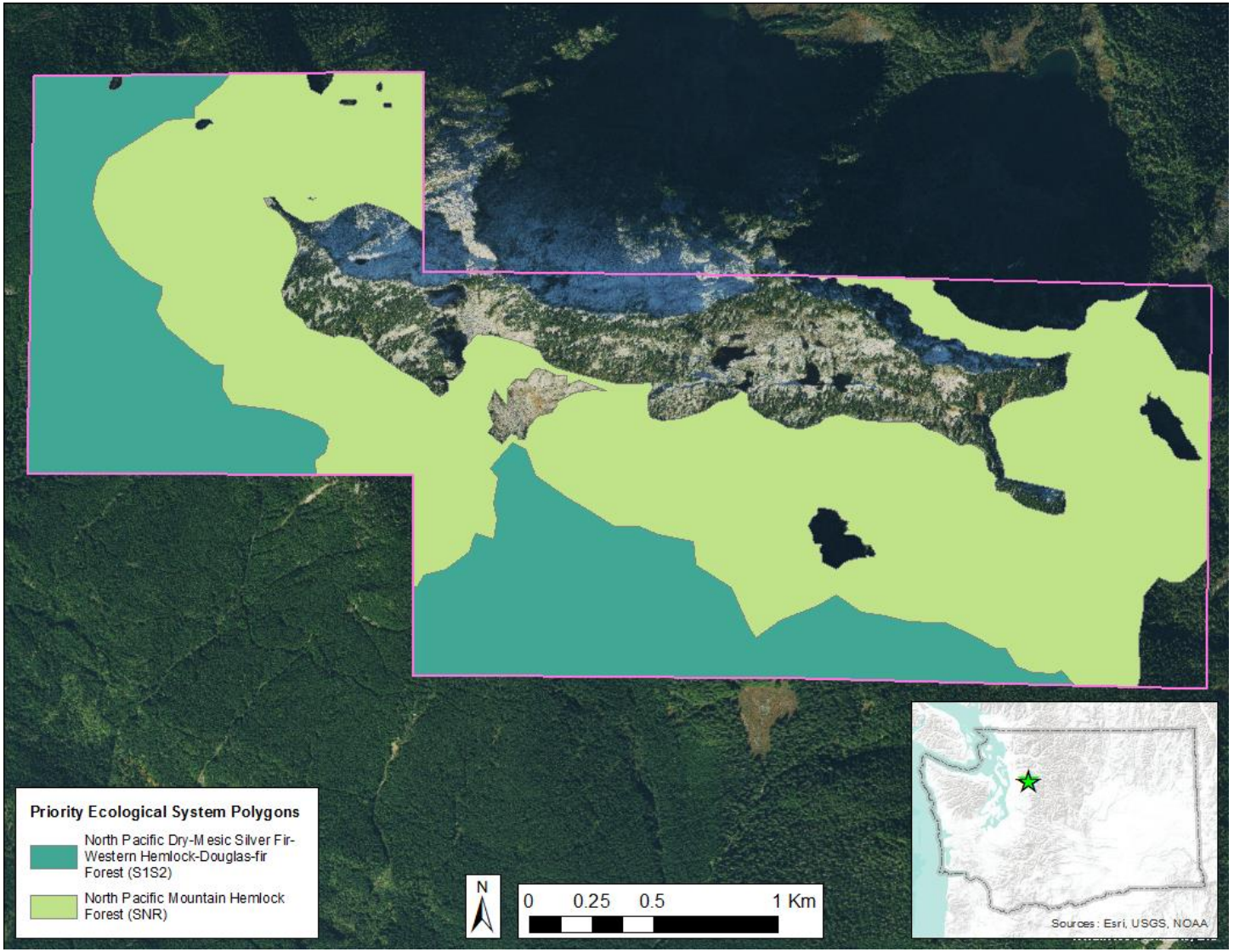

Figure J-5. Priority ecological systems polygons for assessment at Mount Pilchuck State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

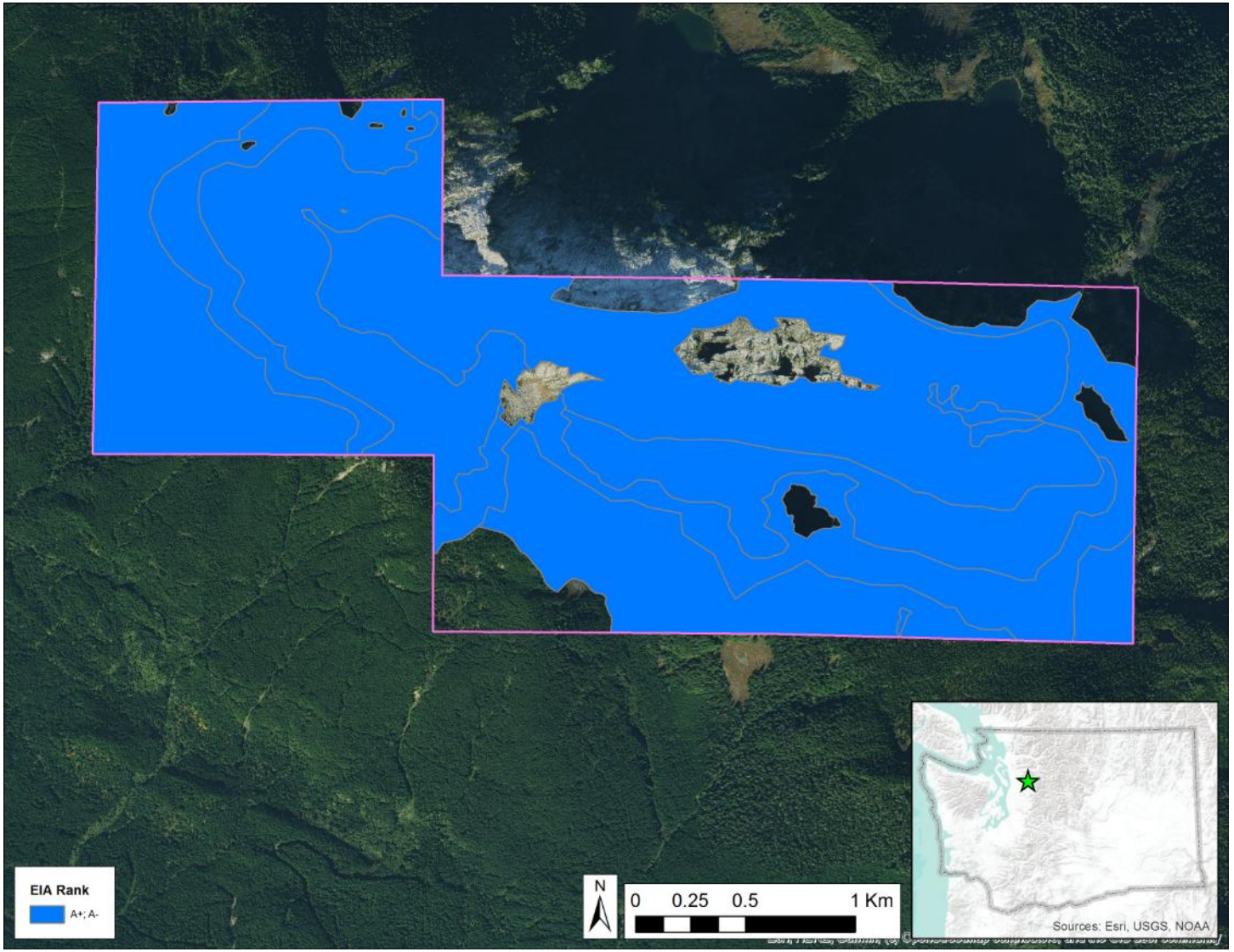

Figure J-6. EIA Ranks for all polygons assessed at Mount Pilchuck State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

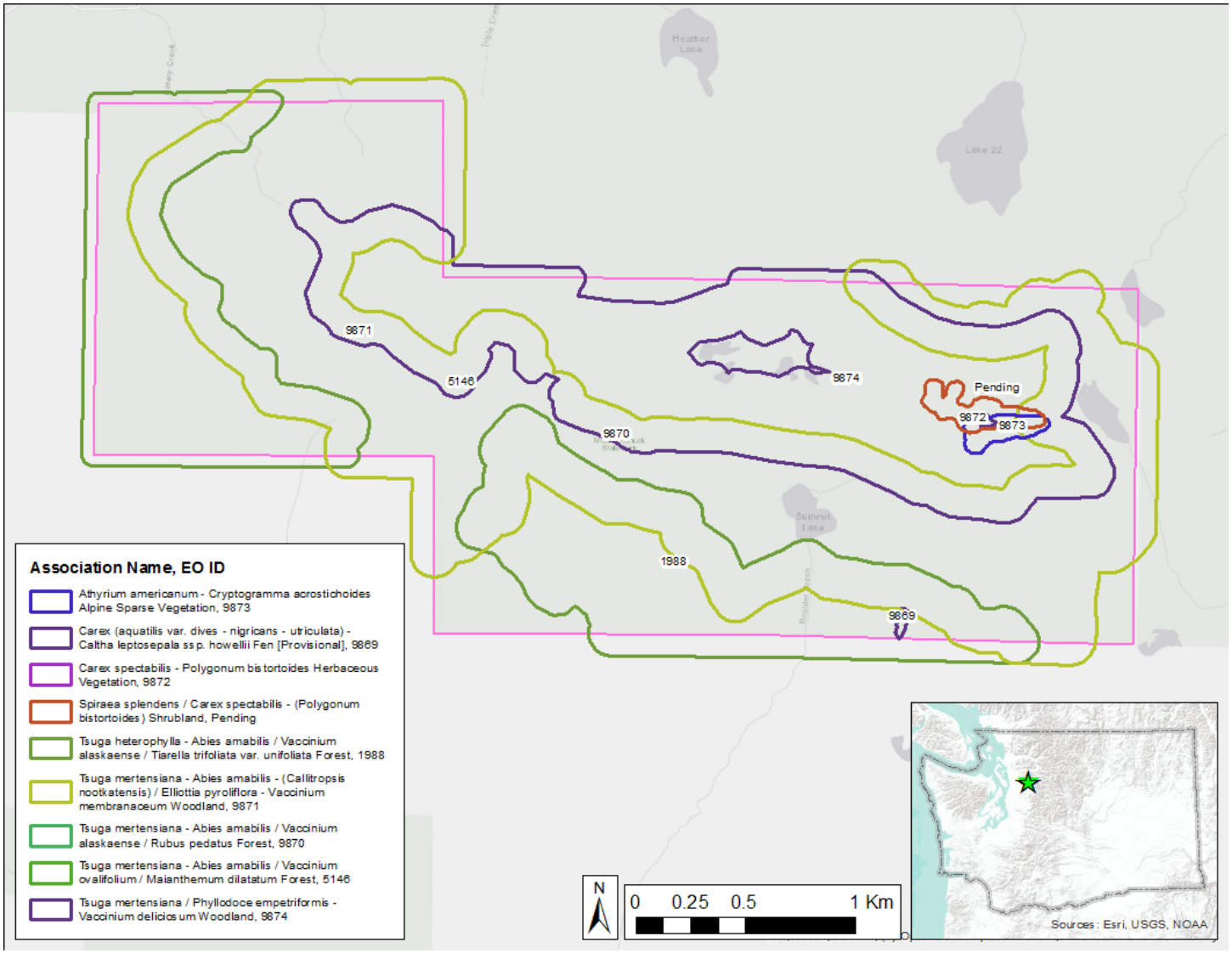

Figure J-7. Element occurrences at Mount Pilchuck State Park

Appendix K. Wallace Falls

Figure K-1. *Carex utriculata* Marsh (G5/S5) at Wallace Falls State Park.

The Ecological Integrity Assessment for Wallace Falls State Park is presented below (Figure K-4). A vegetation survey was completed by URS (2009d). This mapping was the basis for the assessment areas used in our surveys.

There were no previously documented community EOs at the park. Parks identified 7 polygons (450 hectares) of 6 different ecological systems as priorities for assessment (Figure K-5). All maps (Figure K-4 through Figure K-7) are presented at the end of the appendix for ease of reading.

EIA Results

All priority polygons were surveyed at Wallace Falls in the summer of 2020. Table K-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table K-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table K-1. EIA Summary for Wallace Falls. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
512	Temperate Pacific Freshwater Emergent Marsh	B	B	B+
513	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	C	C+
514	North Pacific Mesic Western Hemlock-Silver Fir Forest	B	B	B+
515	North Pacific Mesic Western Hemlock-Silver Fir Forest	C	B	B-
516	North Pacific Shrub Swamp	C	B	B+
517	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
518	North Pacific Shrub Swamp	B	A	A-

Table K-2. Individual EIA Metric Ranks for Wallace Falls.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
512	B	C	A	B	B	B	C	B	A			A	A	A	A	
513	B	C	B	B	B	A-	A	A	C	B	B				B	
514	B	C	B	B	A	A-	A	A	C	A	B				B	
515	B	C	B	B	C	A	A	A	C	A	B				B	D
516	B	C	C	C	B	C	A	B	A			A	B	B	A	
517	B	C	A	B	A	A	A	A	C	A	C	A	A	A	B	
518	B	B	A	B	A	A-	A	A	A			A	A	A	A	A

Figure K-2 and Figure K-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure K-6.

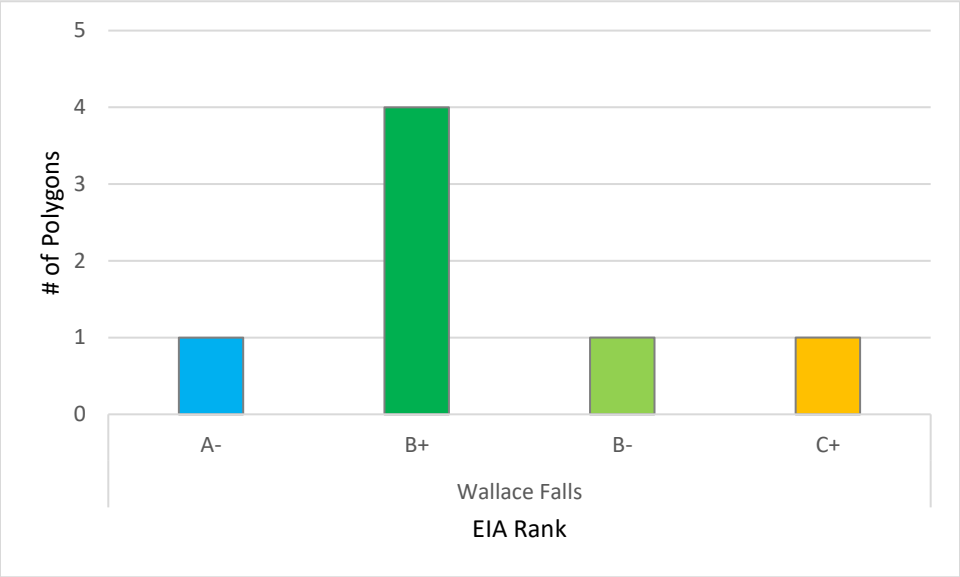

Figure K-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

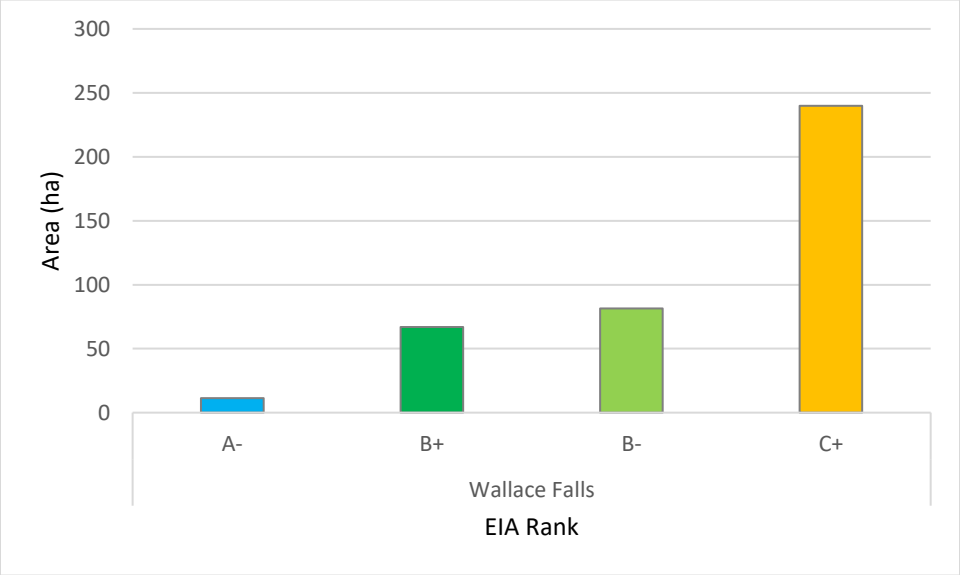

Figure K-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Three new element occurrences were documented at Wallace Falls (Table K-3, Figure K-7). These three communities form the majority of a large wetland complex that extends outward from Jay

Lake. The three EOs demonstrate few negative effects from the logging history of the area. For additional information, see the accompanying Excel workbook.

Table K-3. Summary of new element occurrences at Wallace Falls State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9911	518	CEGL001129	Spiraea douglasii Wet Shrubland	G5/S5	A-
9912	518	CWWA000167	Salix (hookeriana, lucida ssp. lasiandra, sitchensis) Wet Shrubland [Provisional]	GNR/SU	A-
9913	518	CEGL005301	Cornus sericea Pacific Shrub Swamp	G3Q/S3	A-

Summary and Discussion

Overall Conditions

The upland portions of the park have indeed been heavily logged, significantly fragmented, and are surrounded by operational timberland. Despite these past and contemporary stressors, there is little cover of exotic/invasive species (Table K-4, VEG1, VEG2) and the native plant species composition (VEG3) is well within the natural range of variability across all ecosystems. Invasives primarily occur along trails and old roads, with *Ranunculus repens*, *Geranium robertianum*, and *Rubus bifrons* most abundant. *Juncus bulbosus* is problematic within a few of the wetlands.

Table K-4. Summary of EIA metric ratings by area (ha) at Wallace Falls State Park.

	Metric Rating			
Metric	A/A-	B	C	C-/D
VEG1	**396**	1	3	
VEG2	**399**		1	
VEG3	**396**	4		
VEG4	15		**384**	
VEG5	145	**240**		
VEG6		**383**	2	
HYD1	**17**			
HYD2	**14**	3		
HYD3	**14**	3		
SOI1	15	**384**		

As noted previously, vegetation structure (VEG4) is outside of the natural range of variability in all of the forested stands, due to past logging. Canopies are simplified and homogeneous. On the positive side, coarse woody debris, snags, and litter (VEG6) are in good (B) condition—woody debris is generally abundant, despite missing the largest size classes. Woody regeneration (VEG5) is also within the natural range of variability, thanks to the abundant organic matter on the soil surface. However, the stands appear to be young enough that they may have been planted (i.e.

stands initiated in the period in which forests were clearcut and then replanted). If this can be confirmed, woody regeneration scores would need to be revised downwards. Planting is often done in conjunction with herbicide treatments in order to bypass the shrubland seral stage, with implications for nitrogen fixation and wildlife habitat, besides the potential genetic differences in planted trees.

Hydrologically (HYD1-HYD3), the wetlands on site are in mostly excellent (A) condition. Soil disturbance from logging is common across the park, but limited in overall extent and impact (SOI1).

Recommendations for Enhancing / Maintaining Ecological Integrity

Wetlands are the highlight of Wallace Falls State Park from a Natural Heritage perspective. Removal of problematic invasive species such as *Juncus bulbosus* should be priority for enhancing and maintaining their ecological integrity. Enhancing ecological integrity in the upland forests will mostly be a function of time. Vegetation structure will improve as subcanopies develop in the understories. Regardless of on-site management, however, the narrow shape of the park and its landscape context within an area intensive silviculture is a long-term challenge. These fragmented forests will frequently be subjected to edge effects (including windthrow) and are more invadable by invasive such as *Hedera* (*hibernica*, *helix*) and *Ilex aquifolium*.

Future Assessment / Survey Recommendations

Nearly all of Wallace Falls State Park was surveyed as part of this project. Additional assessments are not a priority at this time.

Maps

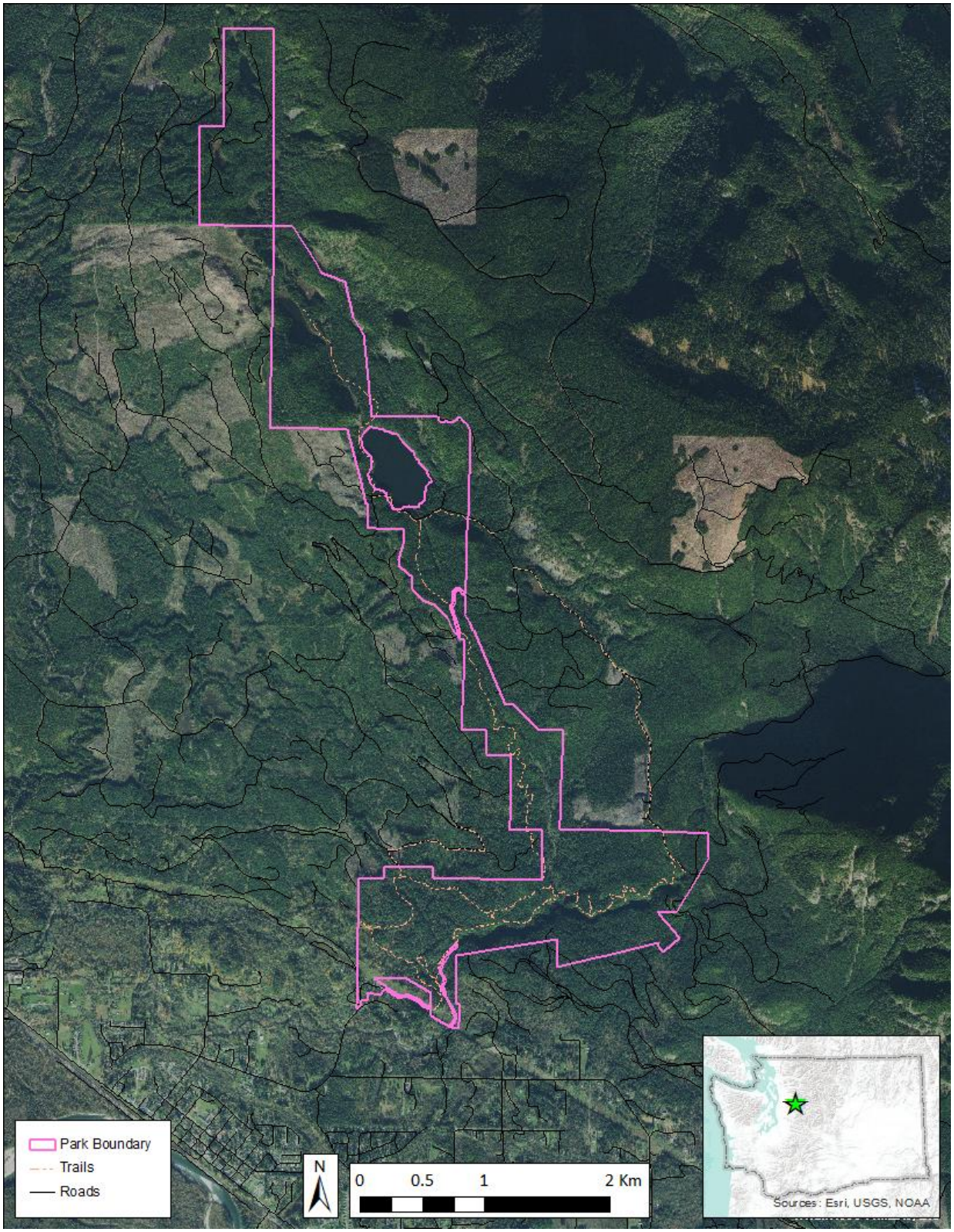

Figure K-4. Overview of Wallace Falls State Park

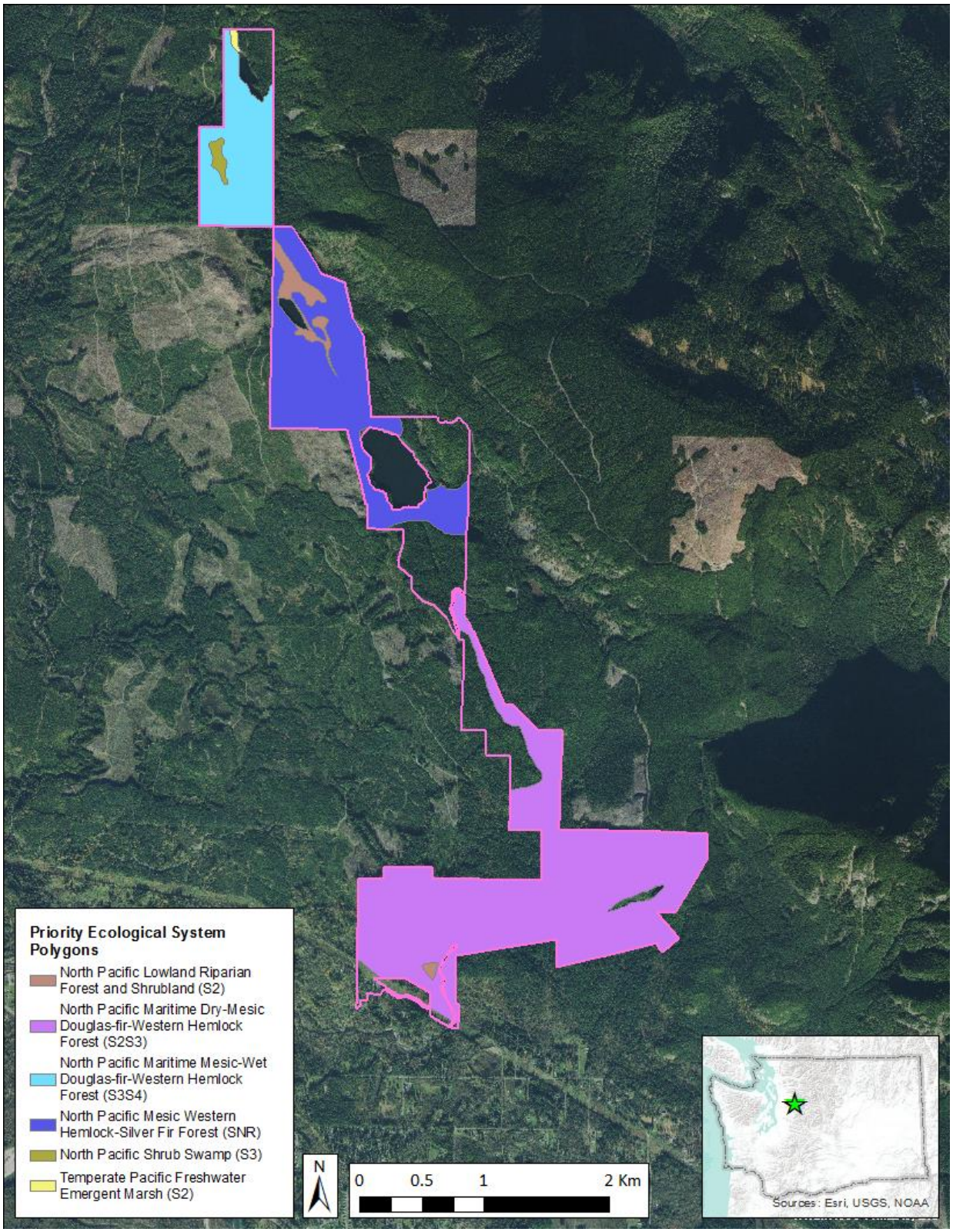

Figure K-5. Priority ecological systems polygons for assessment at Wallace Falls State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

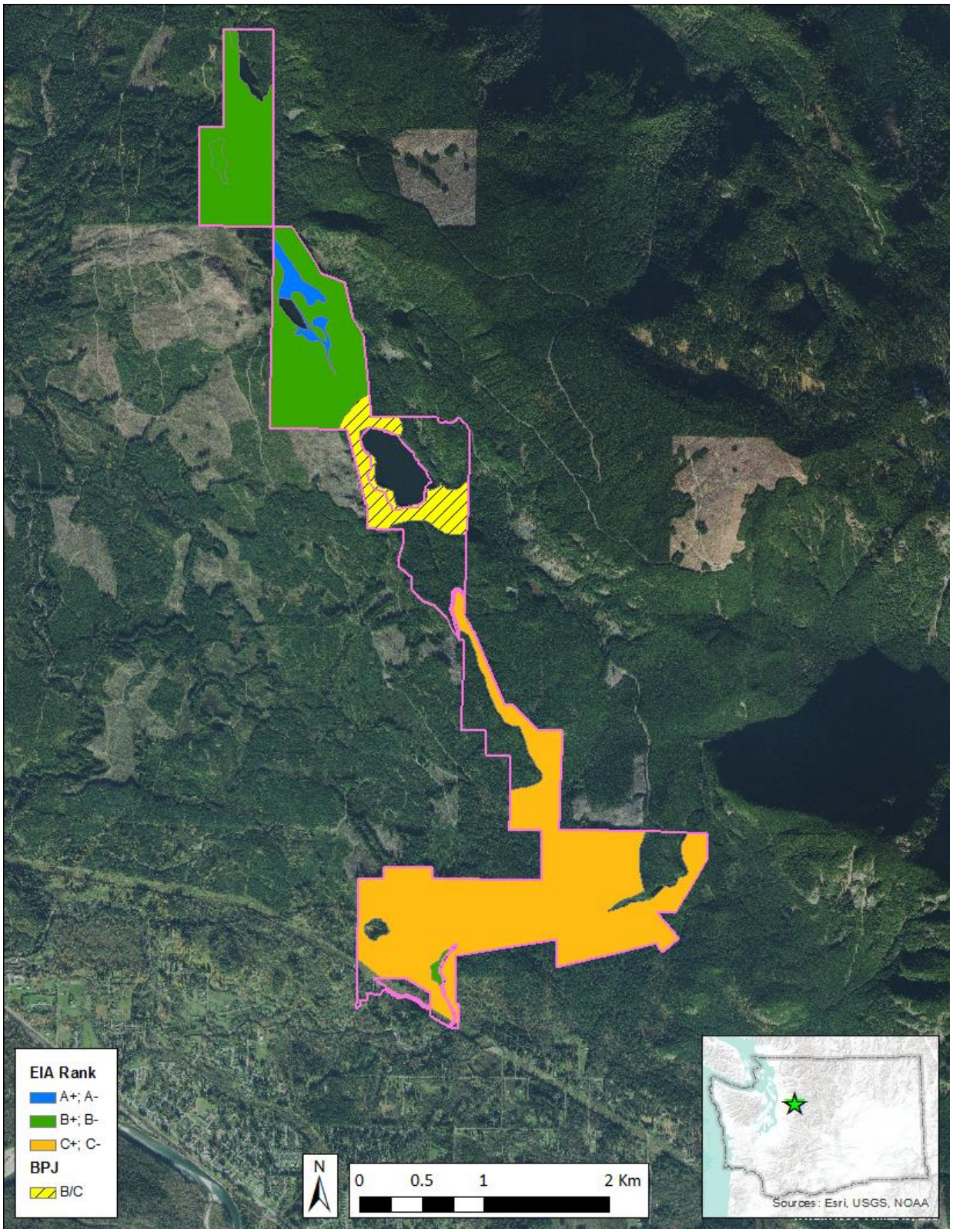

Figure K-6. EIA Ranks for all polygons assessed at Wallace Falls State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, "best professional judgment" rank (not EIA).

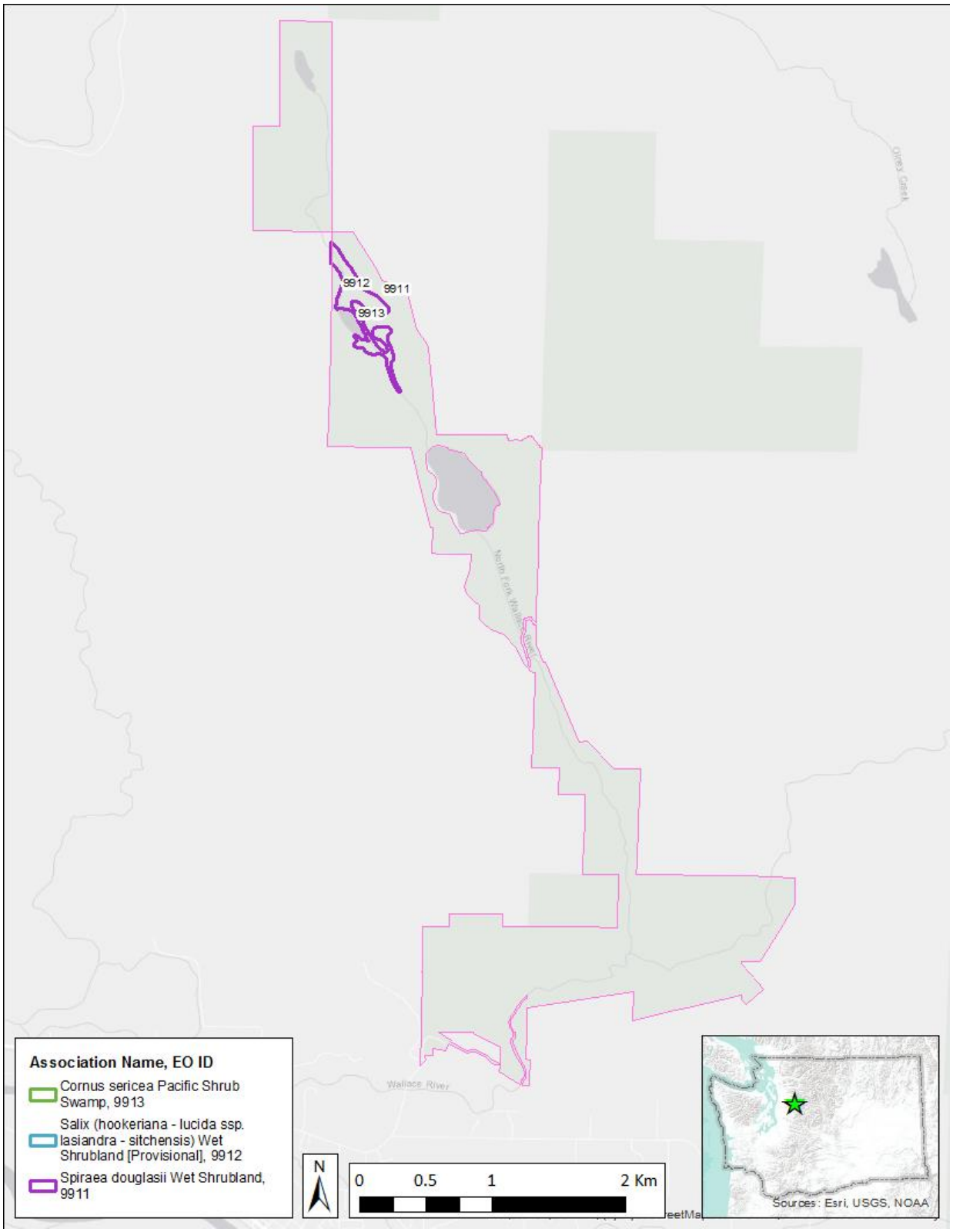

Figure K-7. Element occurrences at Wallace Falls State Park

Appendix L. Dosewallips

Figure L-1. *Arctostaphylos columbiana* Shrubland (GNR/S3) at Dosewallips State Park.

The Ecological Integrity Assessment for Dosewallips State Park is presented below (Figure L-5). A rare plant and vegetation survey was previously completed by Smith IV et al. (2005a). This mapping was the basis for the assessment areas used in our surveys.

There were no previously documented community EOs at the park. Parks identified 6 polygons (131 hectares) of 4 different ecological systems as priorities for assessment (Figure L-6). All maps (Figure L-5 through Figure L-8) are presented at the end of the appendix for ease of reading.

EIA Results

A partial survey was completed at Dosewallips in the fall of 2020. These surveys occurred too late in the season to conduct EIAs in the salt marshes and on the small bald (in the area known colloquially as the 'Bear Paw'). We did make a preliminary sortie onto the bald to estimate the plant association, at which time we found most of it to be covered by *Arctostaphylos columbiana* Shrubland (CEGL008247). A follow-up visit originally scheduled for spring 2021 was scrapped due to prioritization of parks in eastern Washington (parks that were poorly represented in the 2020 data). Table L-1 summarizes the landscape context and condition primary factor ranks and

overall EIA ranks for these polygons. Table L-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table L-1. EIA Summary for Dosewallips. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
117	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
119	North Pacific Lowland Riparian Forest and Shrubland	C	C	C+
120	North Pacific Lowland Riparian Forest and Shrubland	C	B	B-
118-2,9,10	North Pacific Lowland Riparian Forest and Shrubland	C	B	B-
118-52	North Pacific Broadleaf Landslide Forest and Shrubland	B	B	B+
9991-DM	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	C	C+
9991-MW	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
9991-R	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
9992-8	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
9992-LS	North Pacific Broadleaf Landslide Forest and Shrubland	B	A	B+
9992-MW	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	C	B-
9992-R	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+

Table L-2. Individual EIA Metric Ranks for Dosewallips.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
117	B	C	C	C	A	A-	B	A	C	A	B				B	D
119	B	C	C	C	B	D	D	C	C	B	B	B	C	B	B	
120	B	C	B	C	C	C	C-	B	B	A	B	B	B	B	A	
118-2,9,10	C	C	B	C	B	C	C	B	B	A	B	B	A	B	B	
118-52	B	B	B	B	B	B	B	A	B	A	B				A	D
9991-DM	B	C	A	B	B	A-	A	B	D	D	D				B	D
9991-MW	B	C	B	B	A	A-	B	A	C	A	C				A	D
9991-R	B	C	A	B	B	A-	B	A	B	B	B	B	B	A	A	C
9992-8	B	C	A	A	B	A-	A	A	C	B	C				A	
9992-LS	B	C	A	B	B	A-	B	A	A	A	A				B	D
9992-MW	B	C	B	B	B	B	B	B	C	B	D				B	
9992-R	B	C	A	B	B	B	C-	B	C	A	B	A	B	B	A	

Figure L-2 and Figure L-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure L-7.

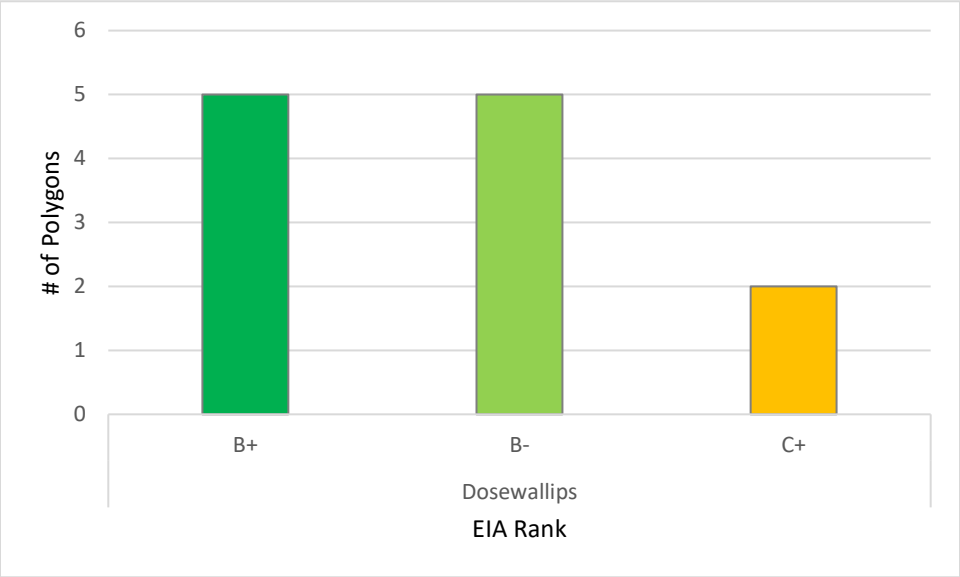

Figure L-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

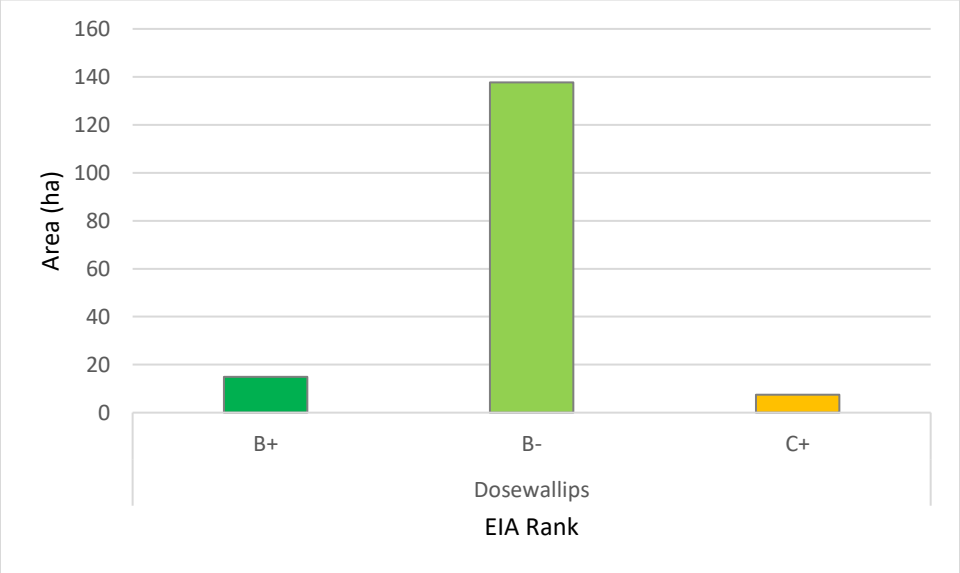

Figure L-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

We documented one new EO (two polygons) of *Acer macrophyllum* - *Alnus rubra* / *Polystichum munitum* - *Tellima grandiflora* Forest (a North Pacific Broadleaf Landslide Forest and Shrubland

association) on erosive bluffs near the river. (Table L-3, Figure L-8). For additional information, see the accompanying Excel workbook.

Table L-3. Summary of new element occurrences at Dosewallips State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9944	118-52; 9992-LS	CEGL003334	Acer macrophyllum - Alnus rubra / Polystichum munitum - Tellima grandiflora Forest	G2G3/S2	C+

Summary and Discussion

Figure L-4. A recent thinning treatment at Dosewallips State Park.

Overall Conditions

A large portion of the surveyed area at Dosewallips consists of former industrial timberland. Exotic/invasive species (Table L-4, VEG1, VEG2) are not an extensive threat, although there are significant infestations of *Rubus bifrons*, *Ranunculus repens*, *Geranium robertianum*, *Lamium galeobdolon*, *Phalaris arundinaceus*, *Ilex aquifolium*, and *Buddleja davidii* in several riparian forest polygons. Native plant species composition (VEG3) is within the natural range of variability, aside from one riparian forest polygon in which *Rubus bifrons* has nearly replaced *Rubus spectabilis* in the understory.

Table L-4. Summary of EIA metric ratings by area (ha) at Dosewallips State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	**111**	34	13	1
VEG2	10	**133**	5	12
VEG3	**108**	51	1	
VEG4	2	18	**134**	6
VEG5	**116**	38		6
VEG6	2	**112**	10	36
HYD1	2	**17**		
HYD2	5	**12**	1	
HYD3	2	**17**		
SOI1	26	**134**		

Some upland forest polygons have been thinned for restoration purposes, impacting interpretation of metrics such as vegetation structure (VEG4) and coarse woody debris, snags, and litter (VEG6). For example, one very young, homogeneous stand (WNHP_ES_Poly_ID = 9992-MW) would have received a VEG4 rating of "D". However, the recent thinning was done for restoration rather than silvicultural purpose, incorporating greater horizontal heterogeneity, so it received a "C" rating. Woody regeneration (VEG5) is excellent outside of planted areas.

Hydrologically (HYD1-HYD3), wetlands and riparian areas that were surveyed were within the natural range of variability. They may have some non-natural hydrological inputs from the town of Brinnon and nearby housing developments (e.g. point discharges, groundwater flow from irrigated yards, etc.), though this was not confirmed. These inputs may include point discharges, Some stretches of the river have been armored with large rocks or other development than may impede channel-shifting. Soil disturbance (SOI1) from past logging or social trails was frequently observed, but impacts are neither intensive nor extensive.

Recommendations for Enhancing / Maintaining Ecological Integrity

Invasive species significantly degrade the ecological integrity in most of the riparian areas of the park. Control may be difficult due to the sheer abundance of invasives and the naturally disturbance-prone landscape setting. On a positive note, however, the majority of the Dosewallips watershed is within Olympic National Park, so there are few upstream seed sources. Beyond

treating invasives, integrity of the riparian systems may be enhanced by restricting social trails and—when practical—removing obstructions to the natural migration of the Dosewallips channel.

Enhancing ecological integrity in the upland forests will mostly be a function of time, with vegetation structure gradually improving as subcanopies develop in the understories. Coarse woody debris and snags will return to the natural range of variability as trees continue to mature and die. Additional restoration thinning may be necessary in other areas that are recovering from a history of intensive silvicultural management, particularly areas that have been planted.

Future Assessment / Survey Recommendations

The Dosewallips salt marsh and bald communities both have potential conservation value and should be priorities for future assessment.

Maps

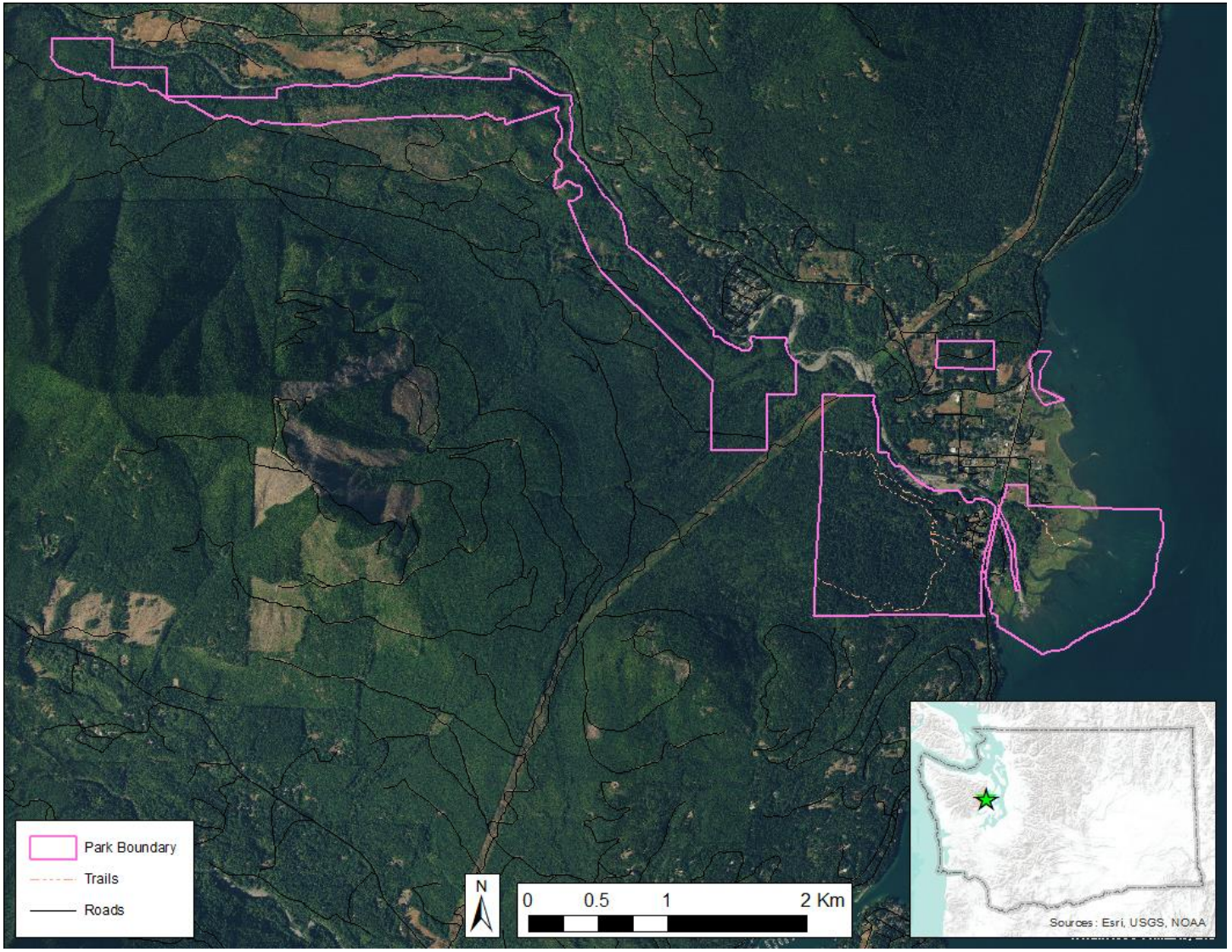

Figure L-5. Overview of Dosewallips State Park

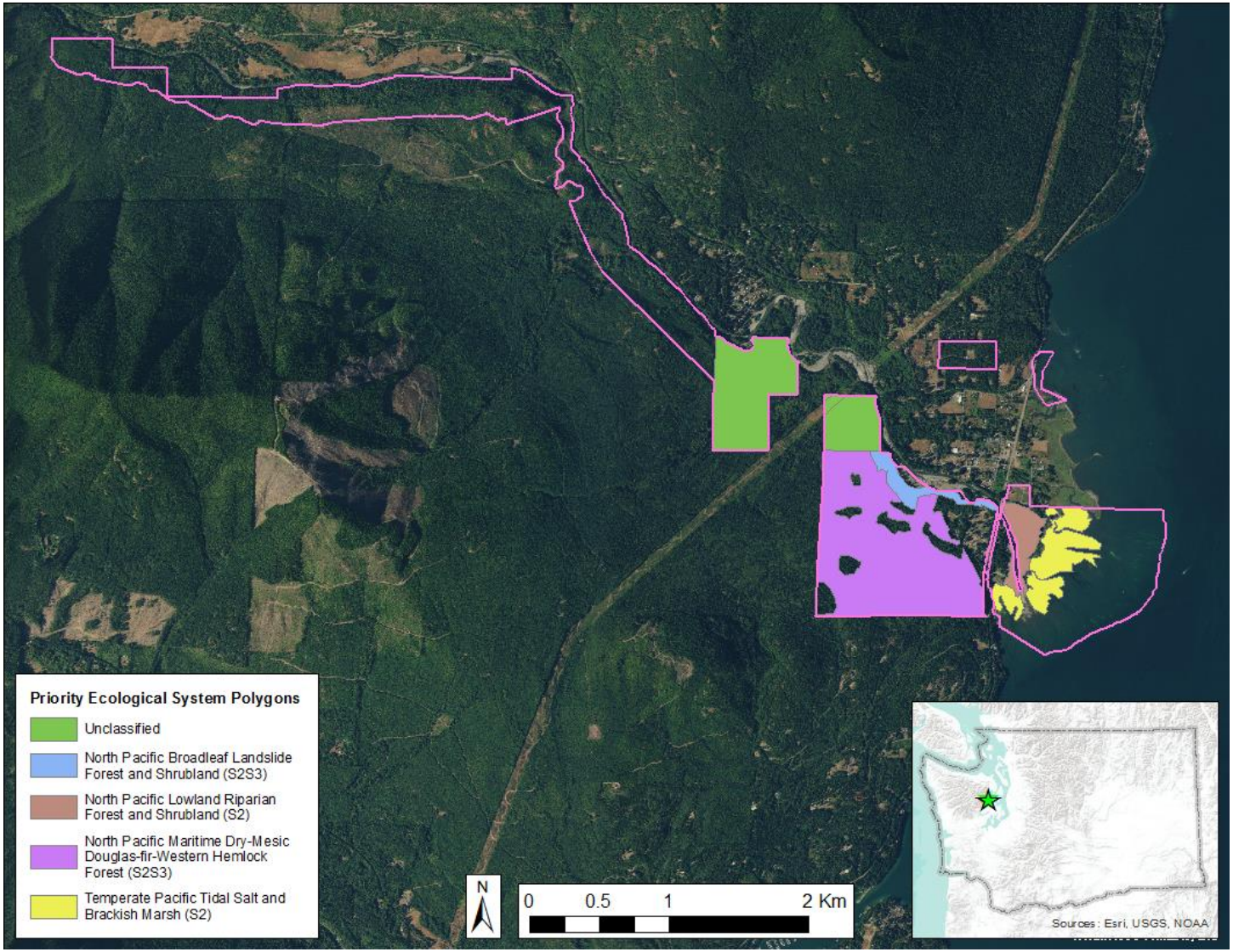

Figure L-6. Priority ecological systems polygons for assessment at Dosewallips State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

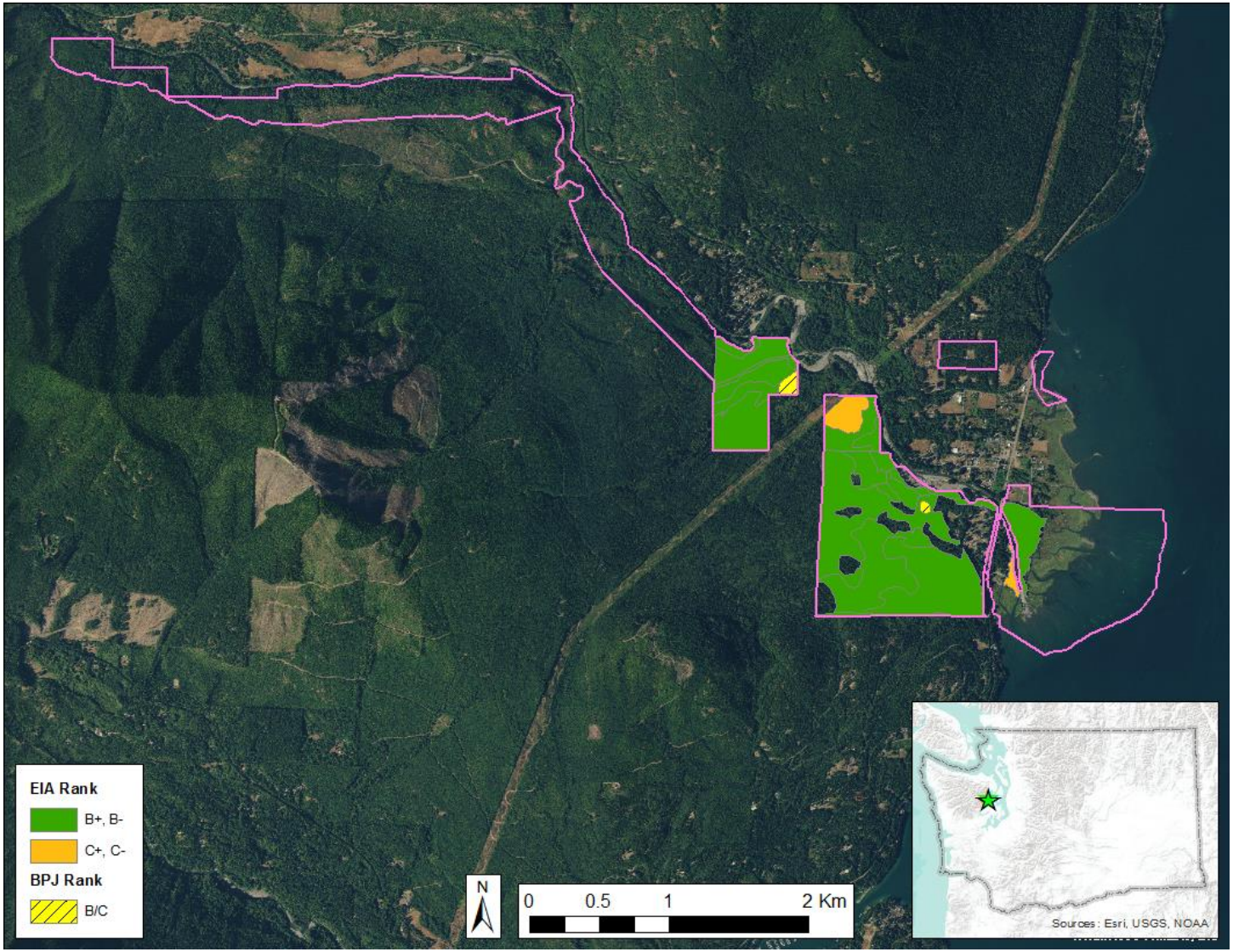

Figure L-7. EIA Ranks for all polygons assessed at Dosewallips State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

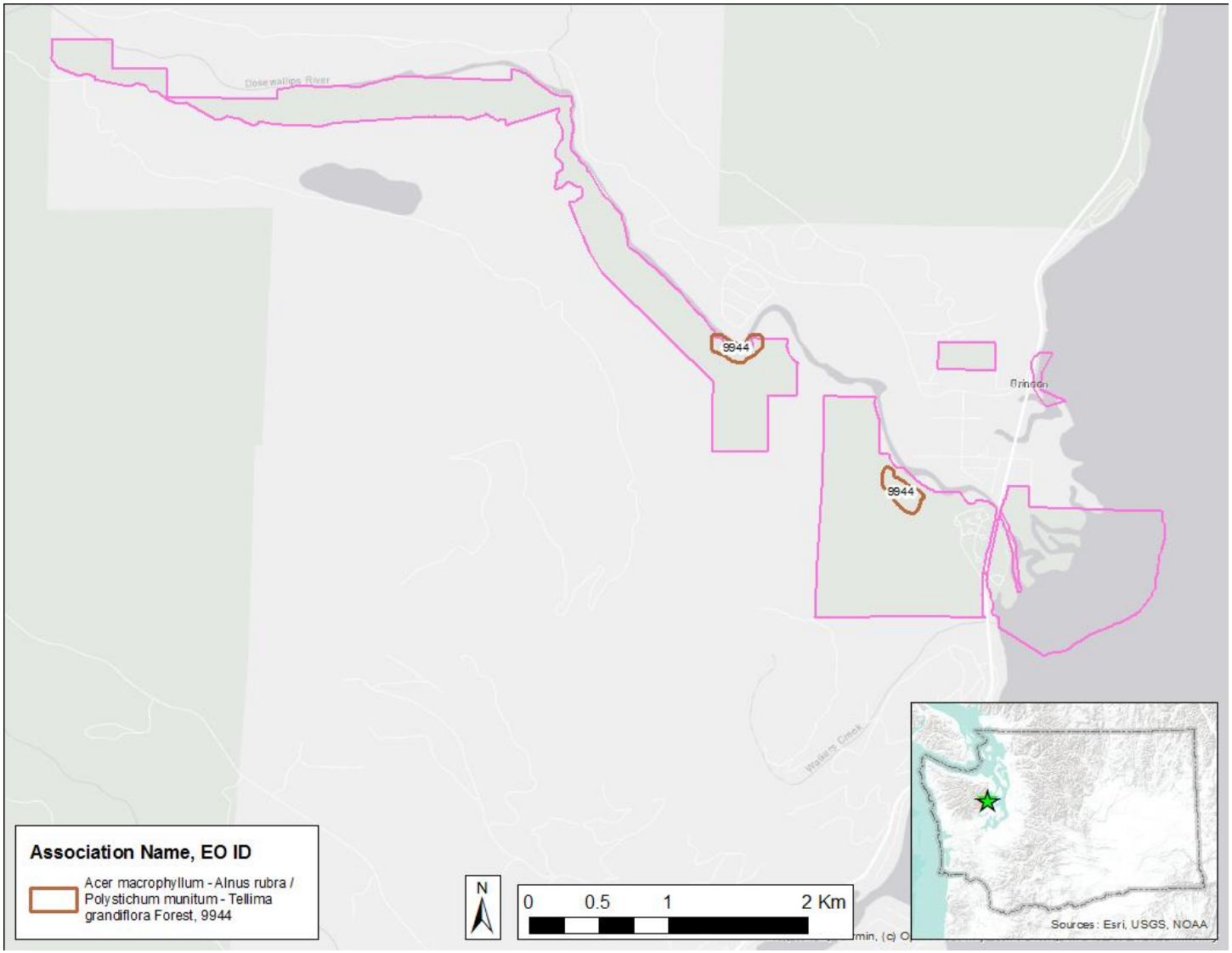

Figure L-8. Element occurrences at Dosewallips State Park

Appendix M. Larrabee

Figure M-1. *Pseudotsuga menziesii - Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum* Forest (G4G5/S4) at Larrabee State Park.

The Ecological Integrity Assessment for Larrabee State Park is presented below (Figure M-4). WNHP staff previously surveyed vegetation at Larrabee as part of a Natural Forest Inventory of state parks (Chappell, 1992d). More recently, a rare plant and vegetation survey completed by Smith IV et al. (2005b). This mapping was the basis for the assessment areas used in our surveys.

There were 7 previously documented community EOs at the park. Parks identified 22 polygons (774 hectares) of 8 different ecological systems as priorities for assessment (Figure M-5). All maps (Figure M-4 through Figure M-6) are presented at the end of the appendix for ease of reading.

EIA Results

We completed a partial assessment at Larrabee before the snows fell in 2020. Due to the late fall/early winter sampling window, the diversity submetric of Native Plant Species Composition (metric VEG3) was not scored.

Table M-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table M-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table M-1. EIA Summary for Larrabee. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
245	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
246	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
247	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	A	B	A-
249	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
250	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
251	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
253	North Pacific Broadleaf Landslide Forest and Shrubland	A	B	B+
260	North Pacific Hardwood-Conifer Swamp	B	B	B+
242-112,144, 152	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
242-148	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	B	B+
258-U	North Pacific Broadleaf Landslide Forest and Shrubland	B	B	B+
258-W	North Pacific Hardwood-Conifer Swamp	B	B	B+

Table M-2. Individual EIA Metric Ranks for Larrabee.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
245	C	B	B	B	A	A-	A	A	C	A	B				A	
246	B	B	B	C	A	A-	A	A	B	A	B				B	
247	A	A	B	B	A	A-	A	A	C	A	B				B	
249	B	B	B	B	A	A-	B	A	C	B	C				B	
250	B	B	B	B	A	A-	B	A	C	A	B				B	
251	B	B	B	C	A	A-	A	A	C	A	B				B	
253	A	A	B	C	A	A-	A	A	C	A	B				B	
260	C	A	B	B	B	A-	B	A	C	A	B	A	A	A	B	C
242-112,144,152	C	B	C	B	A	A-	B	A	B	A	B				B	
242-148	C	B	C	B	A	A-	A	A	C	A	B				B	D
258-U	A	C	B	C	A	A-	A	A	C	A	B				B	C
258-W	C	A	A	B	A	A-	A	C	C	A	B	A	A	A	A	B

Figure M-2 and Figure M-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure M-6.

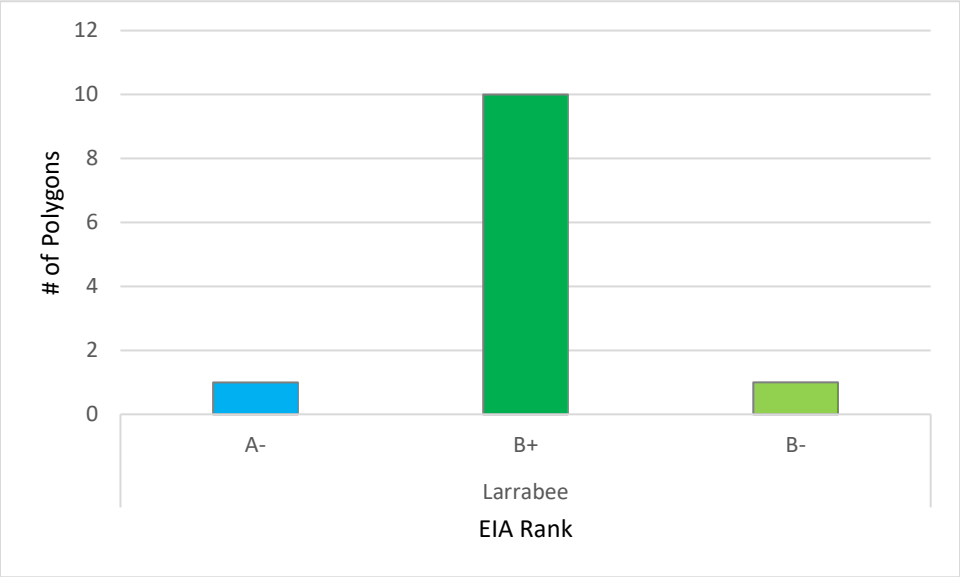

Figure M-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

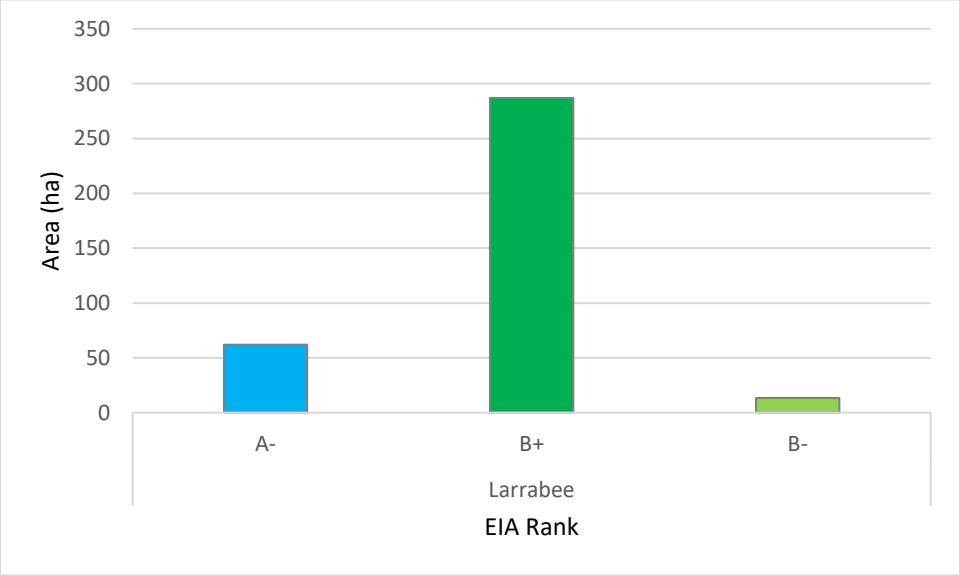

Figure M-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Two new wetland element occurrences and a landslide forest element occurrence were documented at Larrabee (Table M-3, Figure M-7). These are located along the margin of Fragrance Lake and in the narrow valley east of Fiona Ridge. In particular, the *Tsuga heterophylla* - (*Thuja*

plicata - Alnus rubra) / *Lysichiton americanus - Athyrium filix-femina* Swamp Forest (EO ID 9956) has excellent estimated long-term viability. For additional information, see the accompanying Excel workbook.

Table M-3. Summary of new element occurrences at Larrabee State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9954	260	CEGL003389	Alnus rubra / Rubus spectabilis / Carex obnupta - Lysichiton americanus Swamp Forest	G3G4/S3S4	B-
9955	258-U	CEGL003334	Acer macrophyllum - Alnus rubra / Polystichum munitum - Tellima grandiflora Forest	G2G3/S2	C+
9956	258-W	CEGL007322	Tsuga heterophylla - (Thuja plicata - Alnus rubra) / Lysichiton americanus - Athyrium filix-femina Swamp Forest	GNR/S2S3	A-

Summary and Discussion

Overall Conditions

Most of Larrabee was logged historically, but modern conditions are generally within the natural range of variability. Exotic/invasive species (Table M-4, VEG1, VEG2) are limited in the areas we surveyed. Invasives are most common in North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forests and North Pacific Hardwood-Conifer Swamps, where *Ilex aquifolium*, *Hedera hibernica*, *Phalaris arundinacea*, *Geranium robertianum*, *Ranunculus repens*, *Leucanthemum vulgare*, *Holcus lanatus*, and *Rubus* (*bifrons, laciniatus*) sometimes totaled 1-4% absolute cover. Native plant species composition (VEG3) is excellent nearly everywhere. Vegetation structure (VEG4) is simplified due to past logging, though a few old-growth trees remain. Enough time has passed (or logging was selective enough) that most stands are currently in Maturation I or Maturation II stand development stages (Van Pelt, 2007). Woody regeneration (VEG5) is generally excellent, although some areas were planted. Despite logging, most forested stands have at least a moderate range of coarse woody debris (VEG6) size and decay classes, but large snags were not observed.

Table M-4. Summary of EIA metric ratings by area (ha) at Larrabee State Park.

	Metric Rating			
Metric	A/A-	B	C	C-/D
VEG1	**362**			
VEG2	**283**	79		
VEG3	**359**		3	
VEG4		140	**222**	
VEG5	**349**	13		
VEG6		**349**	13	
HYD1	**4**			
HYD2	**4**			
HYD3	**4**			
SOI1	76	**287**		

The small wetland area that was surveyed appears to be hydrologically intact (HYD1-HYD3). Soil disturbance (SOI1) was mostly observed in the form of social trails and old skid roads, but impacts are neither intensive nor extensive.

Recommendations for Enhancing / Maintaining Ecological Integrity

As at other parks, enhancing ecological integrity in the upland forests will mostly be a function of time, with vegetation structure gradually improving as subcanopies develop in the understories. Snags will return to the natural range of variability as trees continue to mature and die. Discouraging social trails along Fragrance Lake and the nearby bluffs would help reduce soil disturbance and trampling of shoreline vegetation. Balds were not surveyed due to the late phenology during our sampling. However, these areas will likely require management actions to prevent woody encroachment and to reduce the impacts from hikers.

Future Assessment / Survey Recommendations

The coastal strand and roughly half of the forested area at Larrabee were not sampled. Several existing EOs that were not revisited as part of this project were last surveyed in the early 1990s to 2000s. Future assessments should prioritize these areas to determine their current status, particularly the *Quercus garryana* / *Carex inops* - *Camassia quamash* Woodland (G1/S1, EO ID 7161) that just barely extends into the northern end of the park. All of the balds in the park should be monitored regularly for invasive, woody encroachment, and soil disturbance from hikers.

Maps

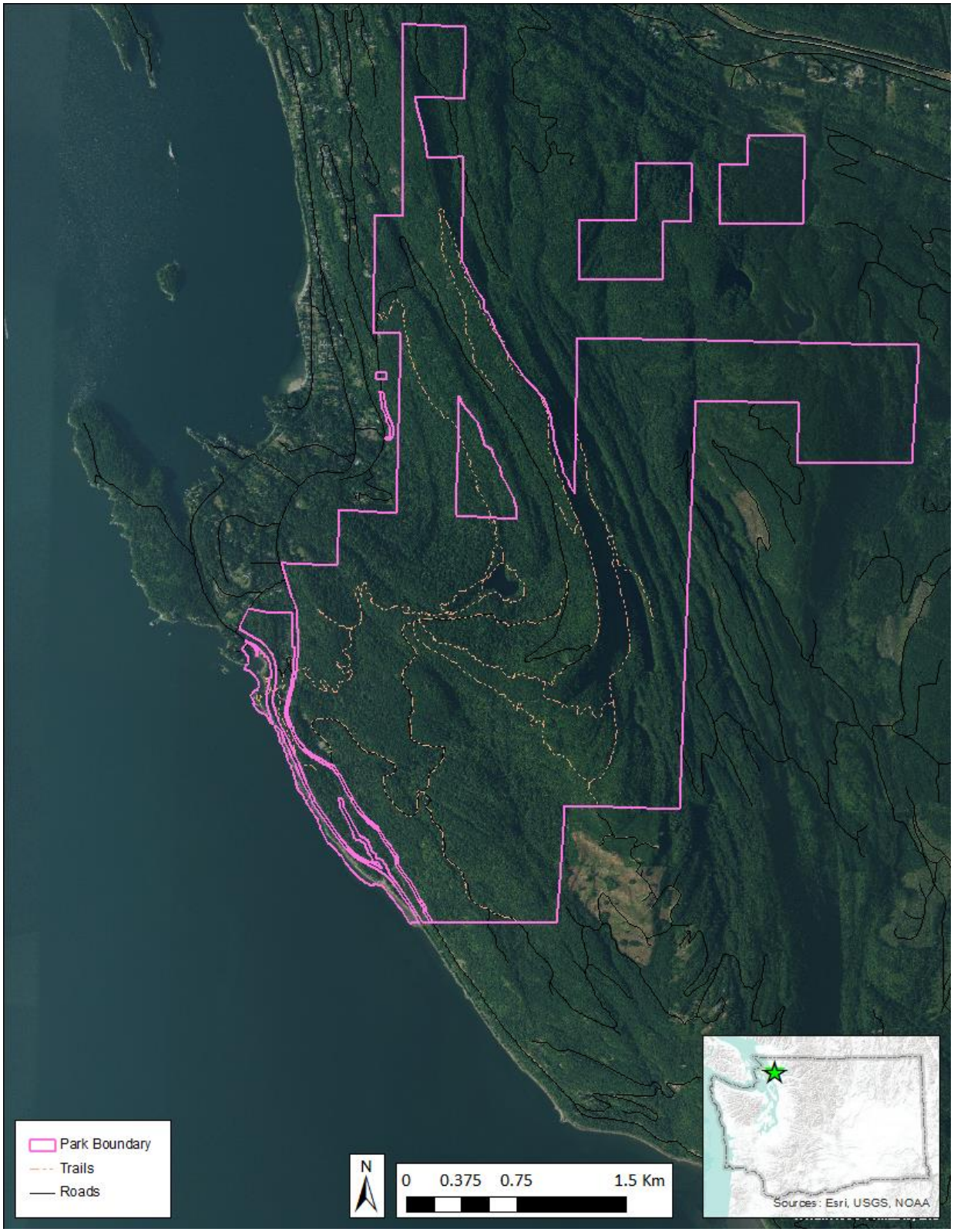

Figure M-4. Overview of Larrabee State Park

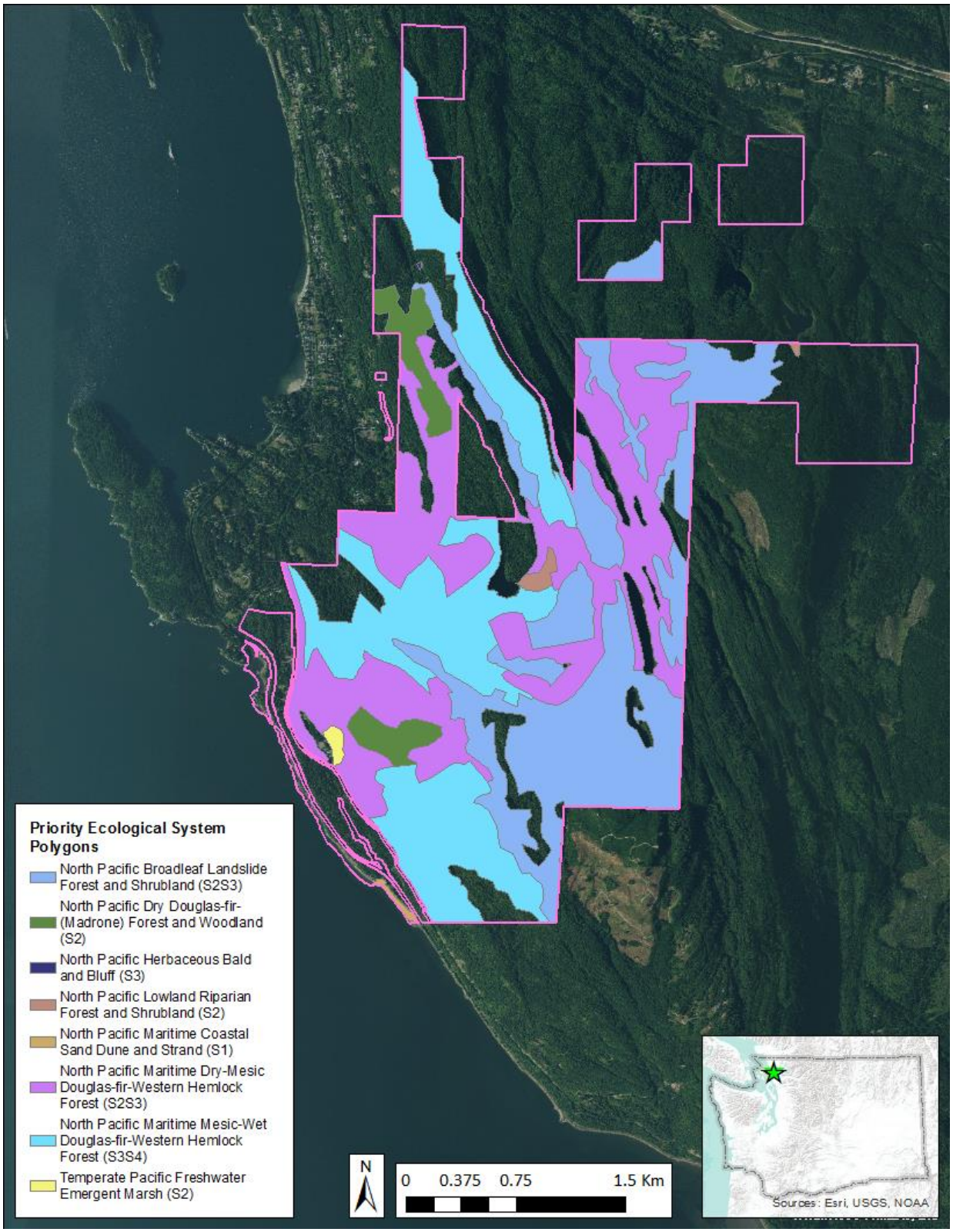

Figure M-5. Priority ecological systems polygons for assessment at Larrabee State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

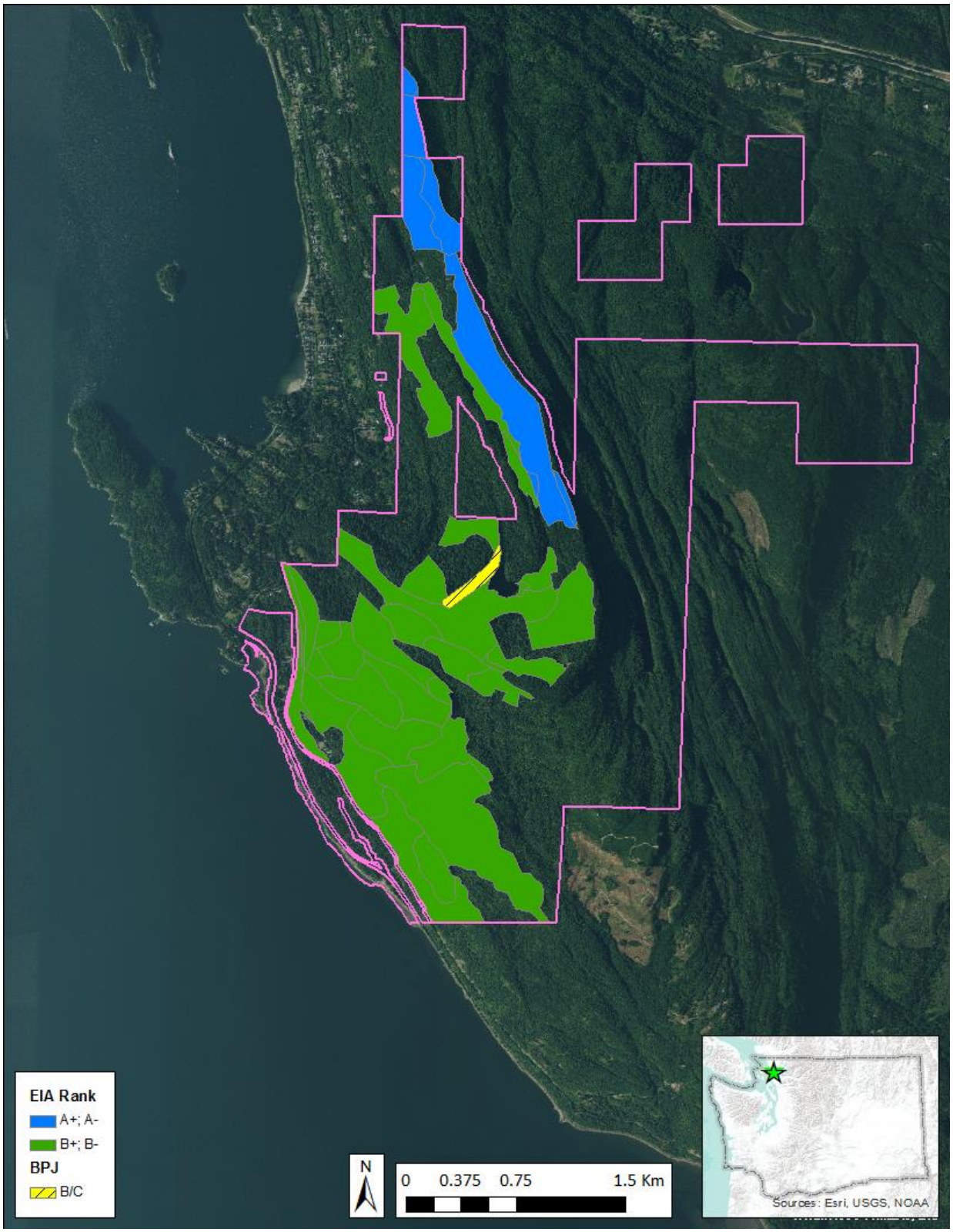

Figure M-6. EIA Ranks for all polygons assessed at Larrabee State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

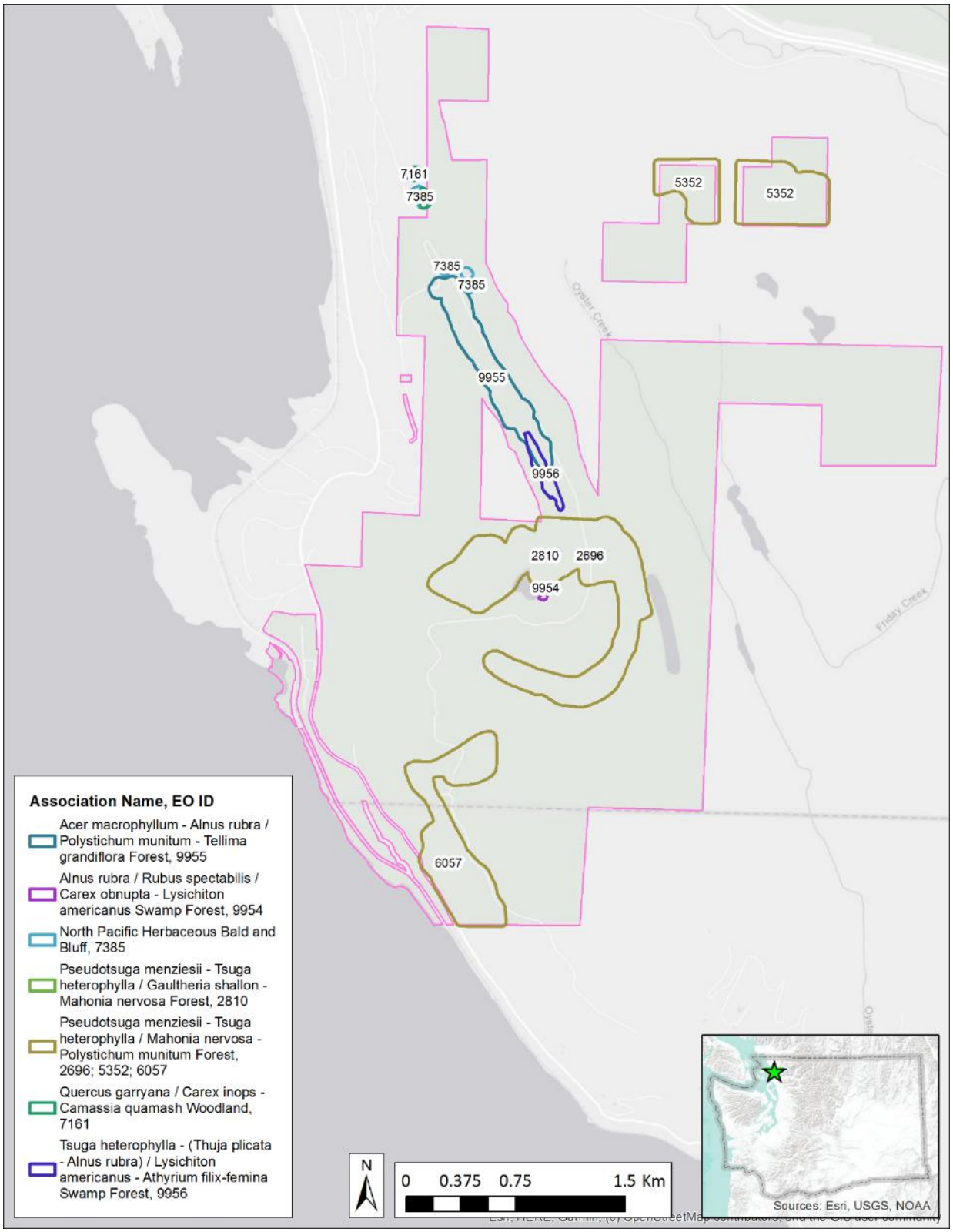

Figure M-7. Element occurrences at Larrabee State Park

Appendix N. Millersylvania

Figure N-1. A large *Pseudotsuga menziesii* at Millersylvania State Park.

The Ecological Integrity Assessment for Millersylvania State Park is presented below (Figure N-5). WNHP staff previously surveyed vegetation at the park in 2001 (Beck & Arnett, 2001) and a subsequent conservation assessment was completed by Chris Chappell (2001). This mapping was the basis for the assessment areas used in our surveys.

There was one previously documented community EO at the park. Parks identified 14 polygons (177 hectares) of 4 different ecological systems as priorities for assessment (Figure N-6). All maps (Figure N-5 through Figure N-8) are presented at the end of the appendix for ease of reading.

EIA Results

All but three priority polygons were surveyed at Millersylvania. Two wetlands and one upland forest polygon were left incomplete when the phenology became an issue for sampling a few higher priority parks. Table N-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table N-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table N-1. EIA Summary for Millersylvania. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
291	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	C	B	B-
293	North Pacific Hardwood-Conifer Swamp	B	B	B+
294	North Pacific Shrub Swamp	C	B	B+
296	North Pacific Shrub Swamp	C	B	B-
297	North Pacific Shrub Swamp	C	B	B-
298	North Pacific Ruderal Riparian and Swamp Forest	C	C	C+
299	North Pacific Hardwood-Conifer Swamp	C	B	C+
301	North Pacific Hardwood-Conifer Swamp	B	B	B-
302	North Pacific Hardwood-Conifer Swamp	B	B	B+
303	North Pacific Hardwood-Conifer Swamp	B	B	B+
304	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+

Table N-2. Individual EIA Metric Ranks for Millersylvania.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
291	C	C	B	B	B	A-	A	A	B	B	B				A	D
293	C	C	B	B	B	A-	A	A	B	A	B	B	B	B	A	A
294	C	C	C	C	B	A-	C	A	A	A		B	B	B	A	
296	C	C	B	C	B	C	C-	B	B	A		B	B	B	B	A
297	C	C	B	C	B	B	C	B	B	A		B	C	C	B	
298	C	C	C	C	B	D	D	C	C	B	C	B	B	B	B	
299	C	C	C	C	C	C	C-	C	C	B	C	B	B	B	B	
301	C	B	B	B	B	B	C-	B	C	A	B	B	C	C	C	BC
302	C	B	B	C	B	A-	B	A	C	A	B	B	B	B	A	BC
303	C	B	B	C	B	A-	B	A	C	A	B	B	B	B	A	
304	C	C	B	B	A	A-	B	A	B	B	B				A	

Figure N-2 and Figure N-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure N-7.

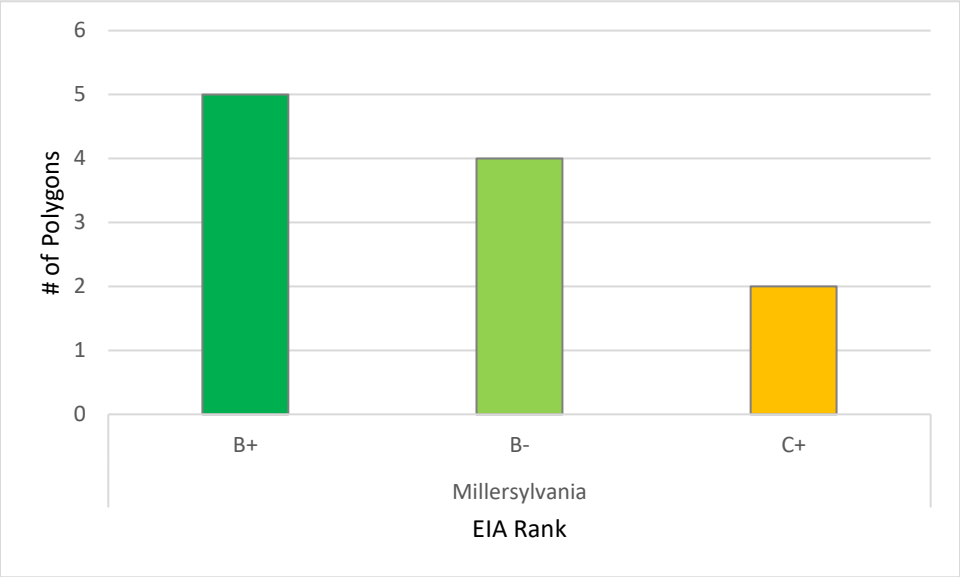

Figure N-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

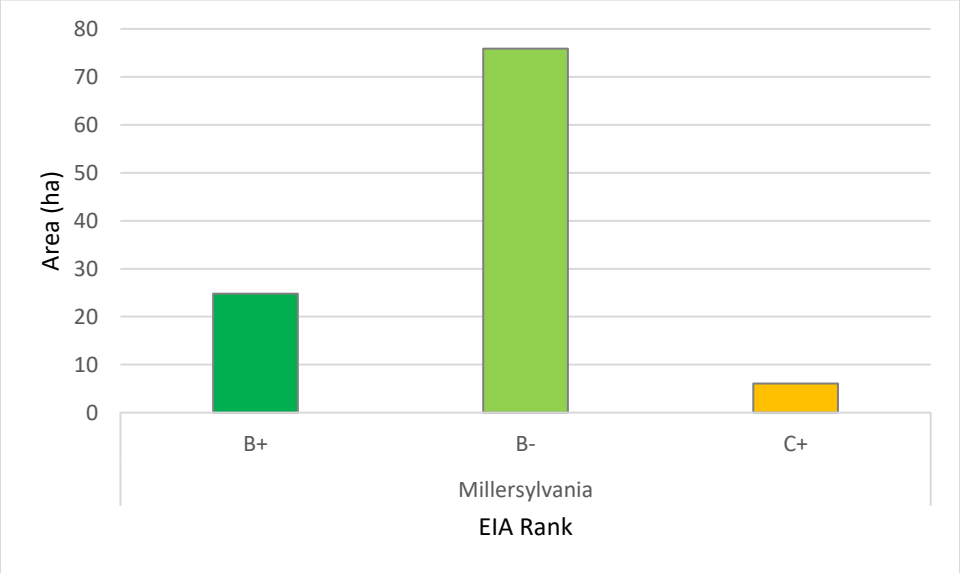

Figure N-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Two new element occurrences were documented in the large wetland complexes at Millersylvania (Table N-3, Figure N-8). For additional information, see the accompanying Excel workbook.

Table N-3. Summary of new element occurrences at Millersylvania State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9957	293	CEGL003388	Alnus rubra / Athyrium filix-femina - Lysichiton americanus Swamp Forest	G3G4/S3	A-
9958	296	CWWA000199	Salix spp. - Spiraea douglasii / Carex (aquatilis var. dives, obnupta, utriculata) Wet Shrubland	G3G4/S2Q	B-

Summary and Discussion

Figure N-4. Invasive *Phalaris arundinacea* is the primary threat in the wetlands of Millersylvania.

Overall Conditions

All of the polygons assessed at Millersylvania are currently in good condition (B+ or B- EIA Ranks), aside from two fair-condition forested wetlands on the southern end of the park (Figure N-7). At the metric level, exotic/invasive species (Table N-4, VEG1, VEG2) are not a significant threat in the forested uplands, but are abundant across many of the wetlands. *Phalaris arundinacea* is the dominant invasive, with *Ilex aquifolium*, *Ranunculus repens*, *Agrostis capillaris*, *Cytisus*

scoparius, *Hypericum perforatum*, and *Rubus bifrons* common in more mesic areas, or along trails. Native plant species composition (VEG3) is good to excellent over most of the park, wherever invasive have not significantly reduced diversity or the cover of diagnostic species.

Table N-4. Summary of EIA metric ratings by area (ha) at Millersylvania State Park.

	Metric Rating			
Metric	A/A-	B	C	C-/D
VEG1	**80**	4	18	4
VEG2	**67**	6	9	24
VEG3	**80**	21	6	
VEG4	6	**91**	10	
VEG5	42	**65**		
VEG6		**75**	6	
HYD1		**48**		
HYD2		**43**	4	
HYD3		**43**	4	
SOI1	**80**	26		

The two North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest polygons that were assessed received good (B) ratings for structure (VEG4), as they have only been selectively logged. Both polygons are in the late Maturation II stand development stage (Van Pelt, 2007), with some large—but not technically old-growth—individual trees. Areas outside the natural range of variability (C) are generally forested wetlands that were once logged of all of their large conifers. The history of logging has also reduced ratings for woody regeneration (VEG5) and coarse woody debris, snags, and litter (VEG6), but these mostly remain within the natural range of variability due to the time that has passed and the selective nature of the harvests.

Hydrologically (HYD1-HYD3), all of the surveyed wetlands display some degree of impact from development in the surrounding landscape (roads impounding water, potential nutrient input from the golf course, etc.). These impacts appear to be minor, however. Soil disturbance (SOI1) is also minor at Millersylvania. Most disturbance is from social trails or channel dredging.

Recommendations for Enhancing / Maintaining Ecological Integrity

The late-mature upland forest stands at Millersylvania are in good onsite condition, but have poor long-term viability due to their landscape context and small size. By monitoring for invasive species such as *Hedera hibernica* and *Ilex aquifolium*, however, they may be maintained as small examples of these formerly matrix ecosystems.

Phalaris arundinacea is the main threat to the high-quality wetlands at Millersylvania (Figure N-4). This devastating invasive is ubiquitous in the surrounding landscape and the wetlands in which it occurs are large and difficult to access—control will be quite difficult.

Future Assessment / Survey Recommendations

As noted above, three priority polygons were not sampled as part of this project. This includes a *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Mahonia nervosa* / *Polystichum munitum* Forest EO (ID 6742) that was last assessed in 1994.

Maps

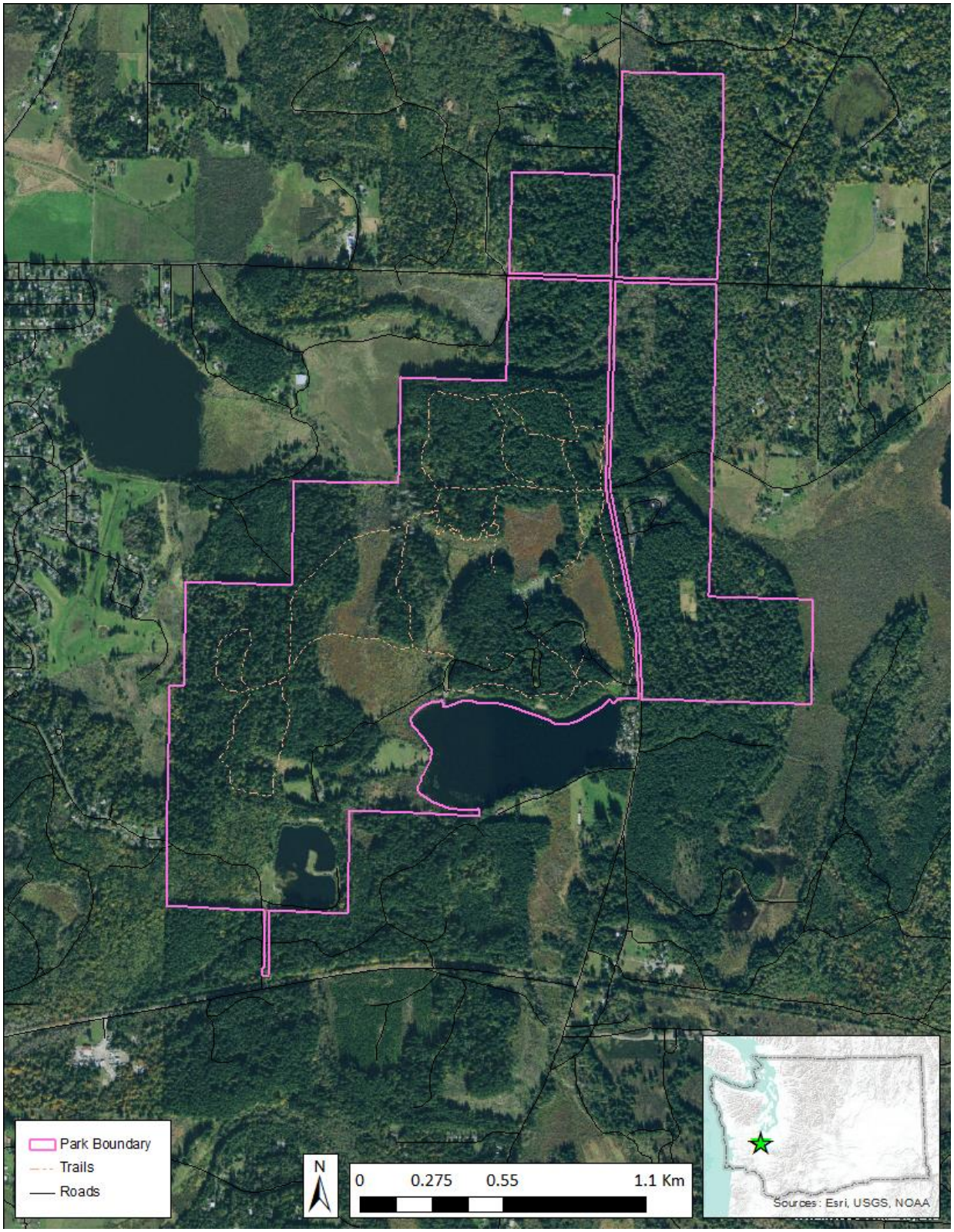

Figure N-5. Overview of Millersylvania State Park

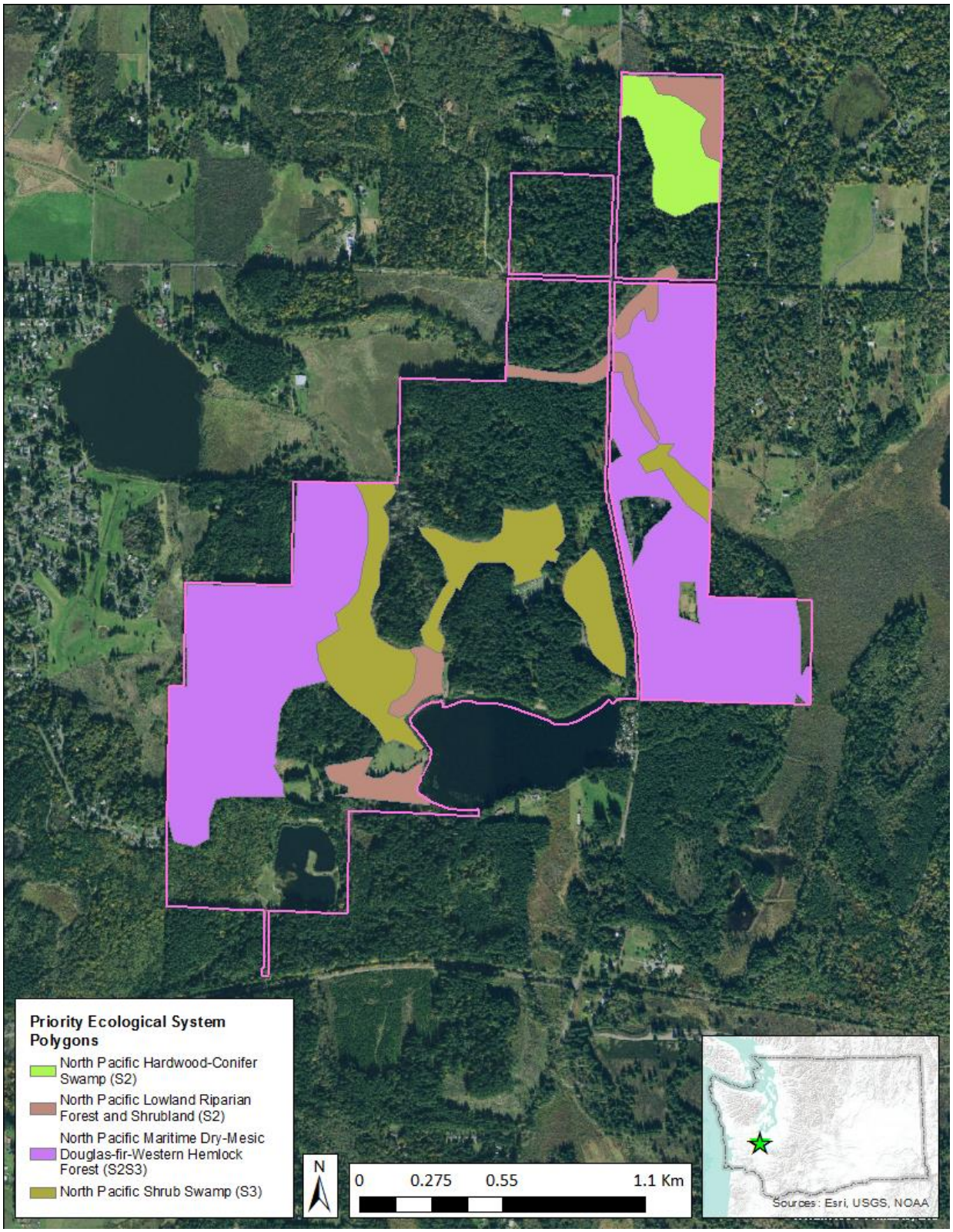

Figure N-6. Priority ecological systems polygons for assessment at Millersylvania State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

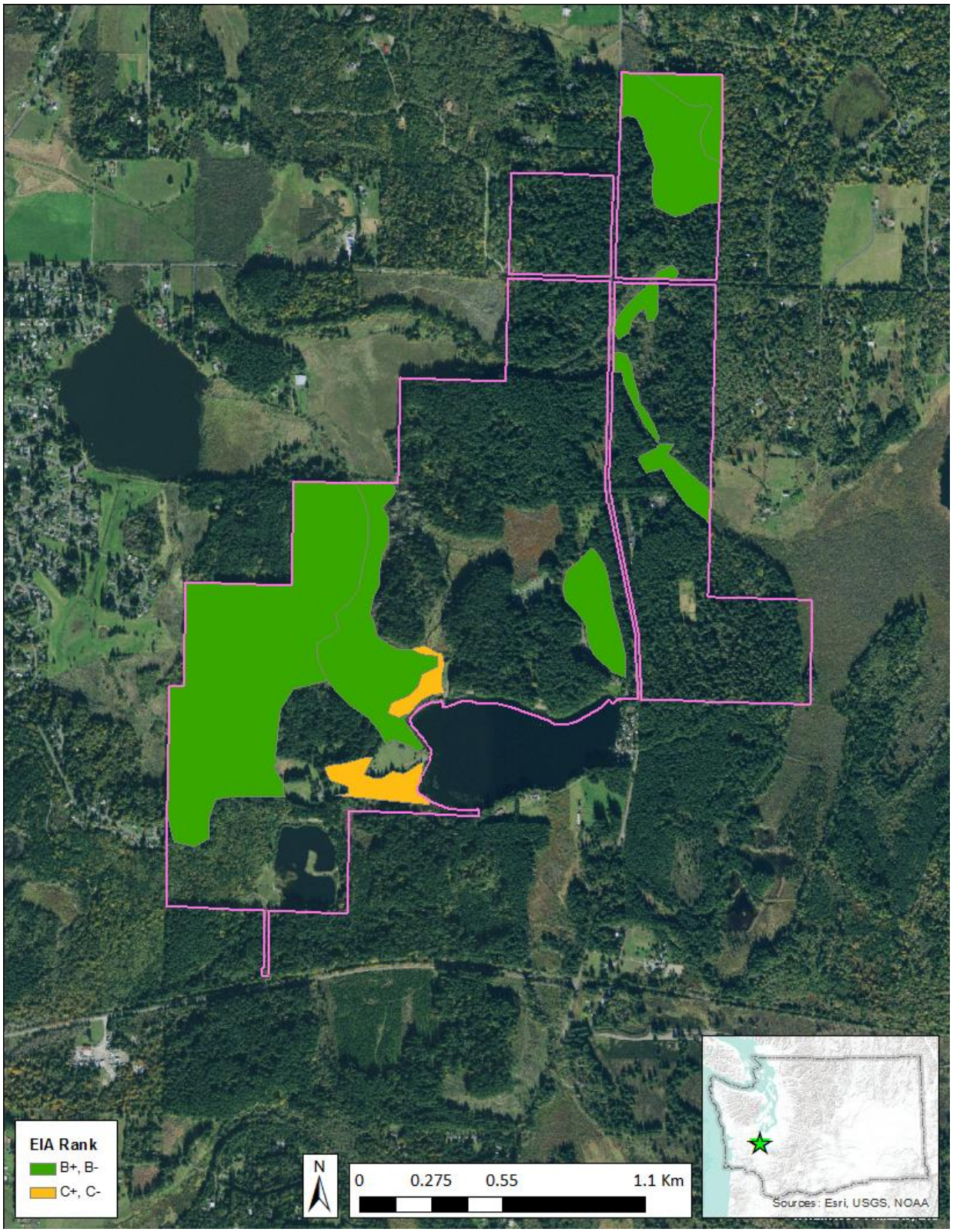

Figure N-7. EIA Ranks for all polygons assessed at Millersylvania State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

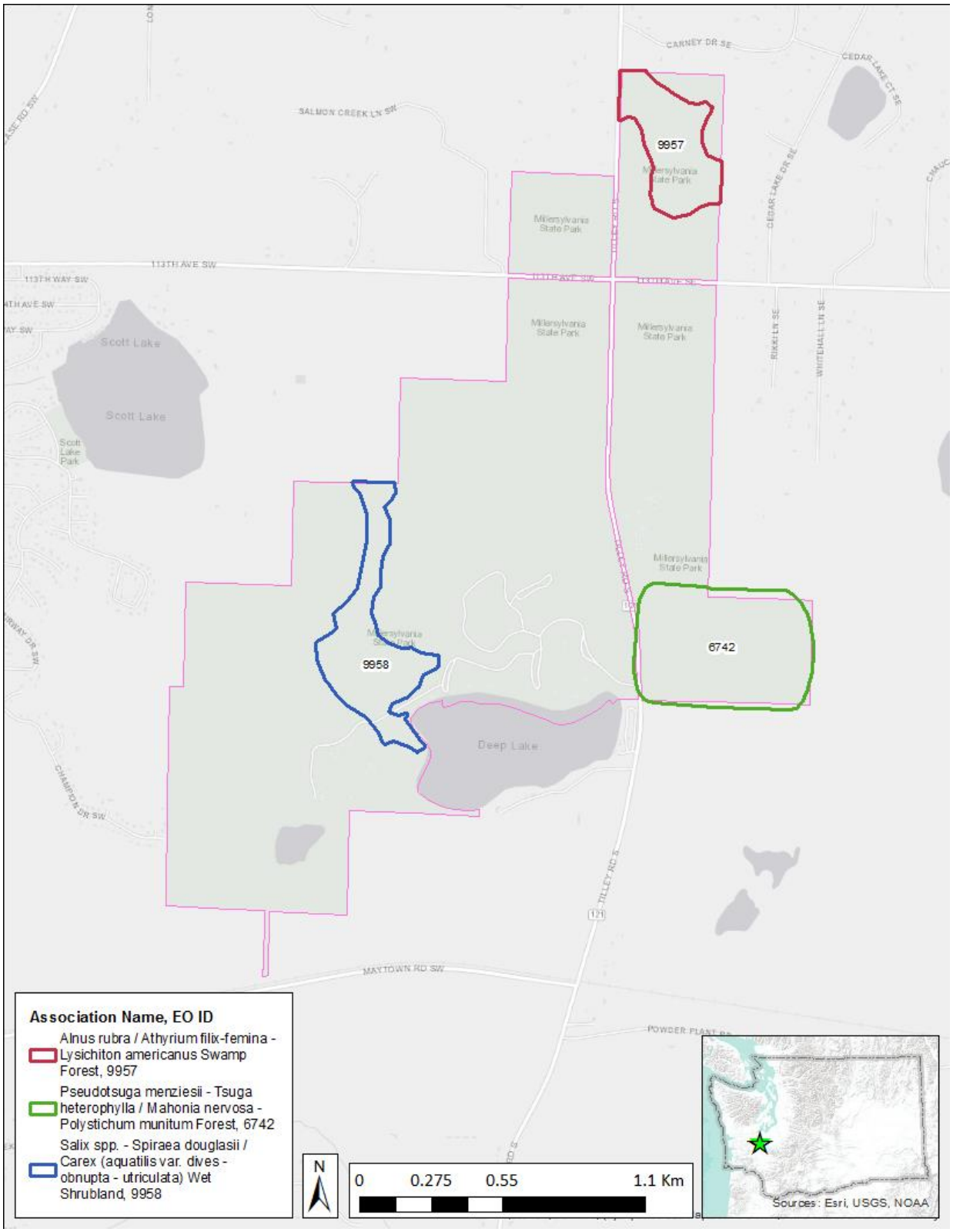

Figure N-8. Element occurrences at Millersylvania State Park

Appendix O. Forks of the Sky

Figure O-1. *Acer macrophyllum* / *Rubus spectabilis* Riparian Forest (G4/S3S4) at Forks of the Sky State Park.

The Ecological Integrity Assessment for Forks of the Sky State Park is presented below (Figure O-4). A vegetation survey was completed by URS (2009e). This mapping was the basis for the assessment areas used in our surveys.

There were no previously documented community EOs at the park. Parks identified 11 polygons (417 hectares) of 4 different ecological systems as priorities for assessment (Figure O-5). All maps (Figure O-4 through Figure O-7) are presented at the end of the appendix for ease of reading.

EIA Results

Nearly all of the priority polygons at Forks of the Sky were surveyed. Access to WNHP ES Poly ID 133 (ForksoftheSky_16) was limited, so this polygon was assessed based only on a visits to the western most portion. We were unable to obtain access to the areas behind the locked logging gate and the river was running too high for safe fording, on the eastern end. ForksoftheSky_36 was skipped entirely because of these same access issues.

Because of the fragmented ownership of this park, we divided park property into western, central, and eastern clumps for the purposes of calculating landscape metrics. Table O-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table O-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table O-1. EIA Summary for Forks of the Sky. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
132	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
133	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	C	B	B-
134	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	C	B	C+
135	North Pacific Lowland Riparian Forest and Shrubland	C	B	C+
136	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	C	C	C-
137	North Pacific Lowland Riparian Forest and Shrubland	C	B	B+
138	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	C	C	C+
139	North Pacific Lowland Riparian Forest and Shrubland	B	B	B-
141	North Pacific Lowland Riparian Forest and Shrubland	C	C	C+
142	North Pacific Lowland Riparian Forest and Shrubland	C	B	B-

Table O-2. Individual EIA Metric Ranks for Forks of the Sky.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
132	C	C	A	A	B	D	D	C	A	B	C	A	A	A	A	
133	C	C	B	B	A	A-	A	A	C	C	B				A	
134	C	C	C	C	B	A-	B	B	C	C	C				A	
135	C	C	C	C	C	B	C	B	D	A	D	A	B	C	B	
136	C	C	C	C	B	B	C	D	D	B	D				C	
137	C	C	C	C	B	A-	B	A	C	A	C	A	A	B	A	C
138	C	C	B	B	B	A	A	D	D	B	D				D	
139	C	B	A	B	B	B	B	A	C	B	D	A	A	B	B	C
141	C	C	C	C	C	D	D	C	C	C	D	A	B	B	B	
142	C	C	A	C	C	C	C-	C	C	C	D	A	A	B	A	D

Figure O-2 and Figure O-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure O-6.

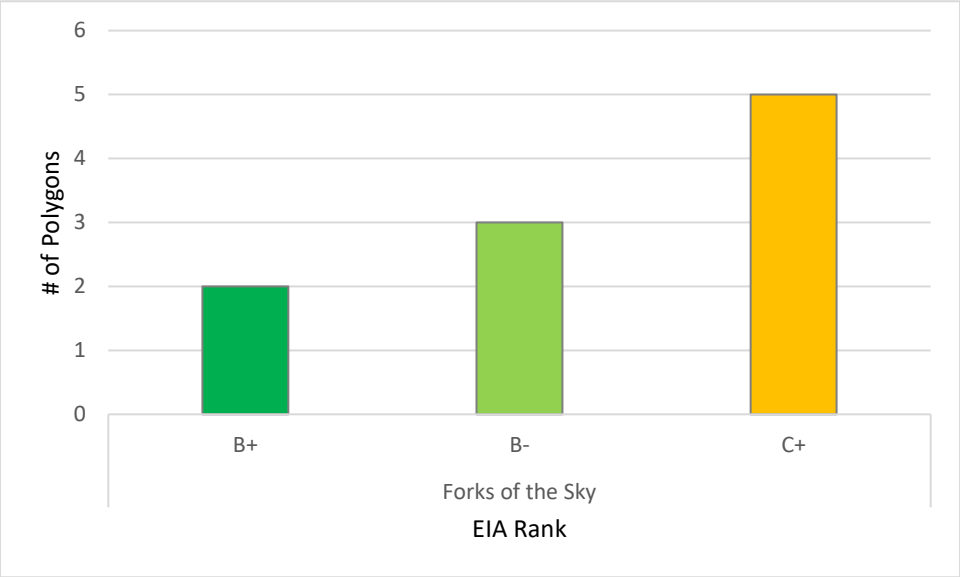

Figure O-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

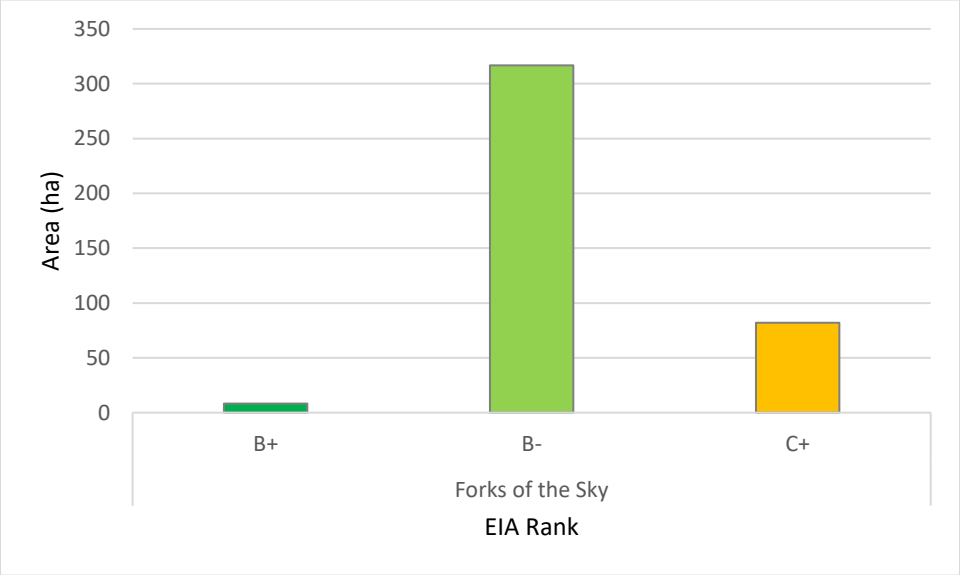

Figure O-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

One new element occurrence was documented on the far eastern edge of the Forks of the Sky complex (Table O-3, Figure O-7). Similar communities elsewhere on park property were either

smaller, in relatively poor condition, or represented less imperiled plant associations. For additional information, see the accompanying Excel workbook.

Table O-3. Summary of new element occurrences at Forks of the Sky State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9910	139	CEGL003395	Acer macrophyllum / Rubus ursinus Riparian Forest	G3/SNR	B-

Summary and Discussion

Overall Conditions

Much of the land area at Forks of the Sky is regenerating upland forest with relatively few exotic/invasive plants (Table O-4, VEG1, VEG2), but many of the riparian forests have concentrated patches of invasive. *Rubus bifrons* and *Fallopia ×bohemica* are the most extensive nonnative invaders, along with *Leucanthemum vulgare, Phalaris arundinacea, Agrostis capillaris*, *Geranium robertianum*, and *Ranunculus repens*.

Table O-4. Summary of EIA metric ratings by area (ha) at Forks of the Sky State Park.

	Metric Rating			
Metric	A/A-	B	C	C-/D
VEG1	**392**	5	3	7
VEG2	**313**	84	1	10
VEG3	**319**	75	10	3
VEG4	3		**400**	4
VEG5	6	10	**391**	
VEG6		**310**	83	14
HYD1	**19**			
HYD2	**15**	4		
HYD3	3	**15**	1	
SOI1	**396**	7	1	2

In riparian communities, invasive species are the most common stressor impacting native plant species composition (VEG3), while most upland communities have recovered enough from logging disturbance to be within the natural range of variability. On the other hand, vegetation structure (VEG4) and woody regeneration (VEG5) are outside that natural range across almost the entire park. Both riparian and upland communities have been logged of large conifers and have simplified, homogeneous canopies. Much of the woody regeneration in the upland forests consists of planted *Pseudotsuga menziesii*. Relative to VEG4 and VEG5, coarse woody debris, snags, and litter (VEG6) shows fewer contemporary impacts from that extensive logging history, although snags and the largest downed wood size classes are nearly absent.

Observed hydrologic stressors primarily impact the hydrologic connectivity (HYD3) of the riparian systems. Roads and railroad prisms have at least some impact on the connectivity between many stands of North Pacific Lowland Riparian Forest and Shrubland and neighboring higher terraces and/or uplands. When present in the floodplain, these features appear to be set far enough back to have minimal impact on the plant communities within park boundaries. Unnatural soil disturbance (SOI1) is not a significant issue at Forks of the Sky, aside from old skid trails in the upland forests.

Recommendations for Enhancing / Maintaining Ecological Integrity

Eradicating *Fallopia ×bohemica* and *Rubus bifrons* infestations along the riparian corridor should be a priority for enhancing ecological integrity. Of course, this may prove difficult due to the size of the watershed and its fragmented ownership (many potential upstream sources for re-establishment within the park). Alternatively, recreation access may be funneled to more degraded areas and away from stands with relatively few invasive. Higher integrity stands would ideally be monitored for new invasions, as well.

Riparian stands along the North Fork Skykomish are in better condition than those below the confluence, presumably because of the limited development in that sub-watershed. Encouragement of recreation and/or construction of park infrastructure would less impactful below the confluence.

Upland forests that used to be intensively managed for timber should be evaluated for restoration thinning, but enhancing their ecological integrity will mostly be a function of the passage of time.

Future Assessment / Survey Recommendations

Vegetation Survey Database polygon ForksoftheSky_36 should be a priority for any future assessments. This polygon is on the opposite side of the Skykomish River from the one EO that was documented within the park. Its relative isolation—surveys would likely require fording the river—bodes well for its onsite condition.

Maps

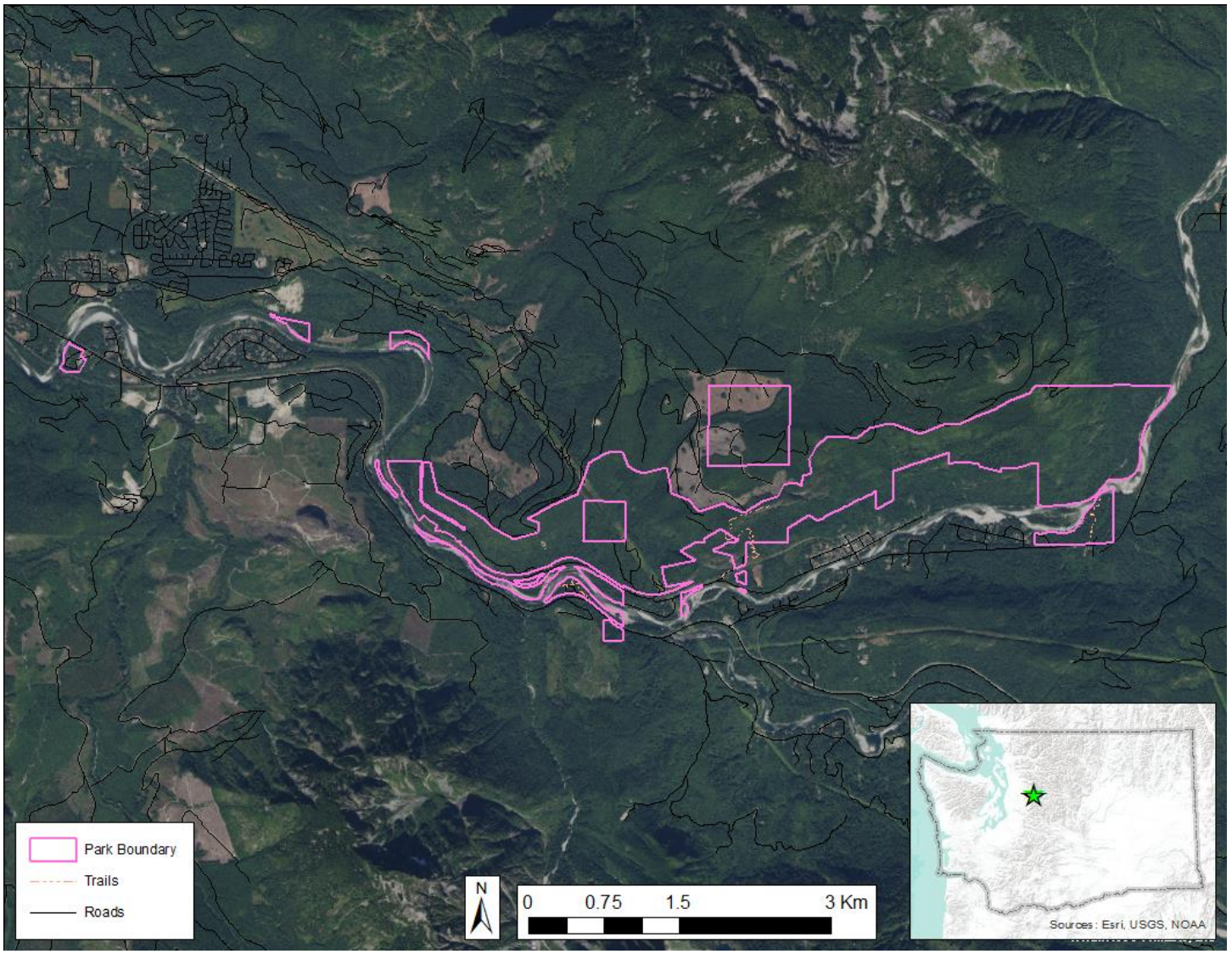

Figure O-4. Overview of Forks of the Sky State Park

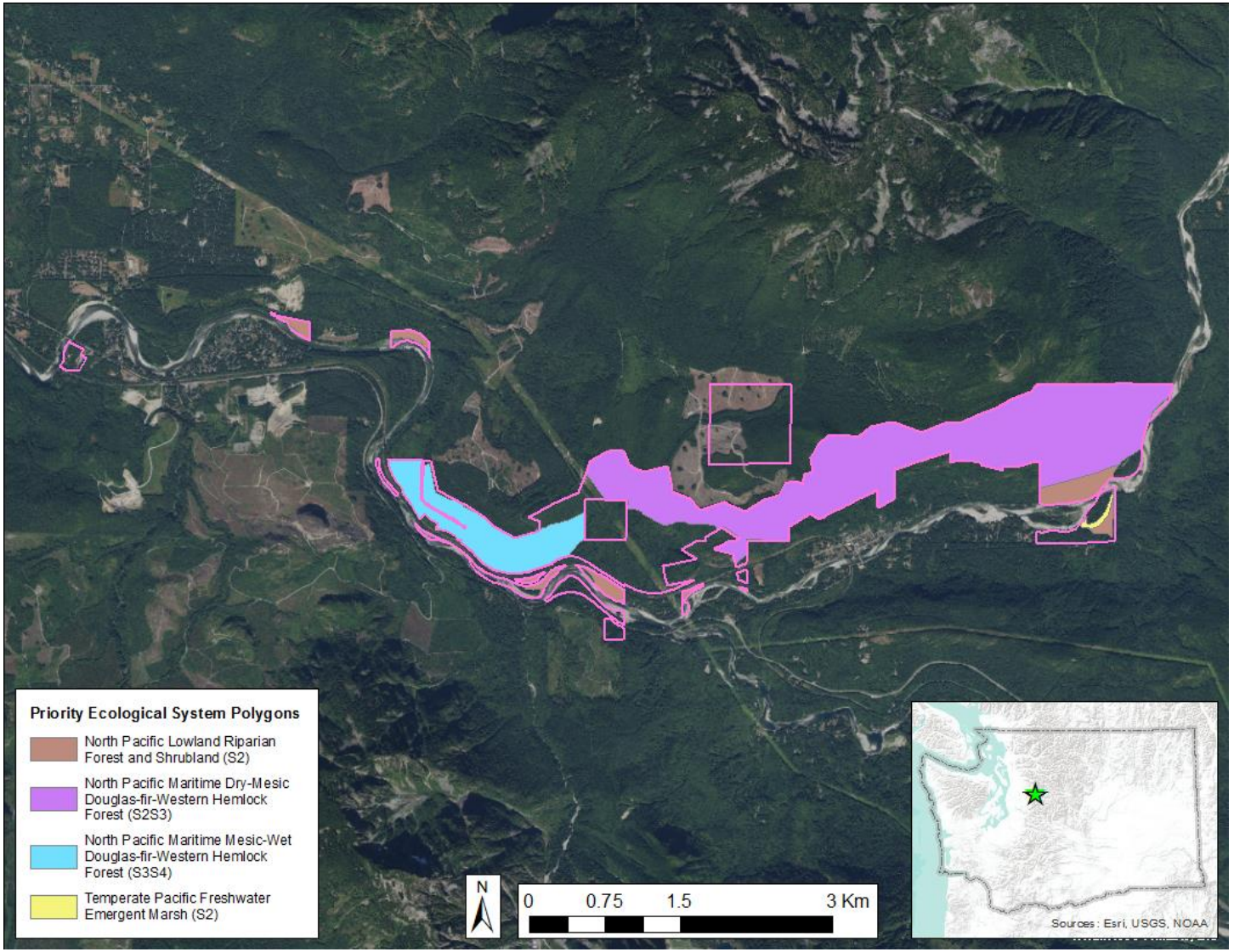

Figure O-5. Priority ecological systems polygons for assessment at Forks of the Sky State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

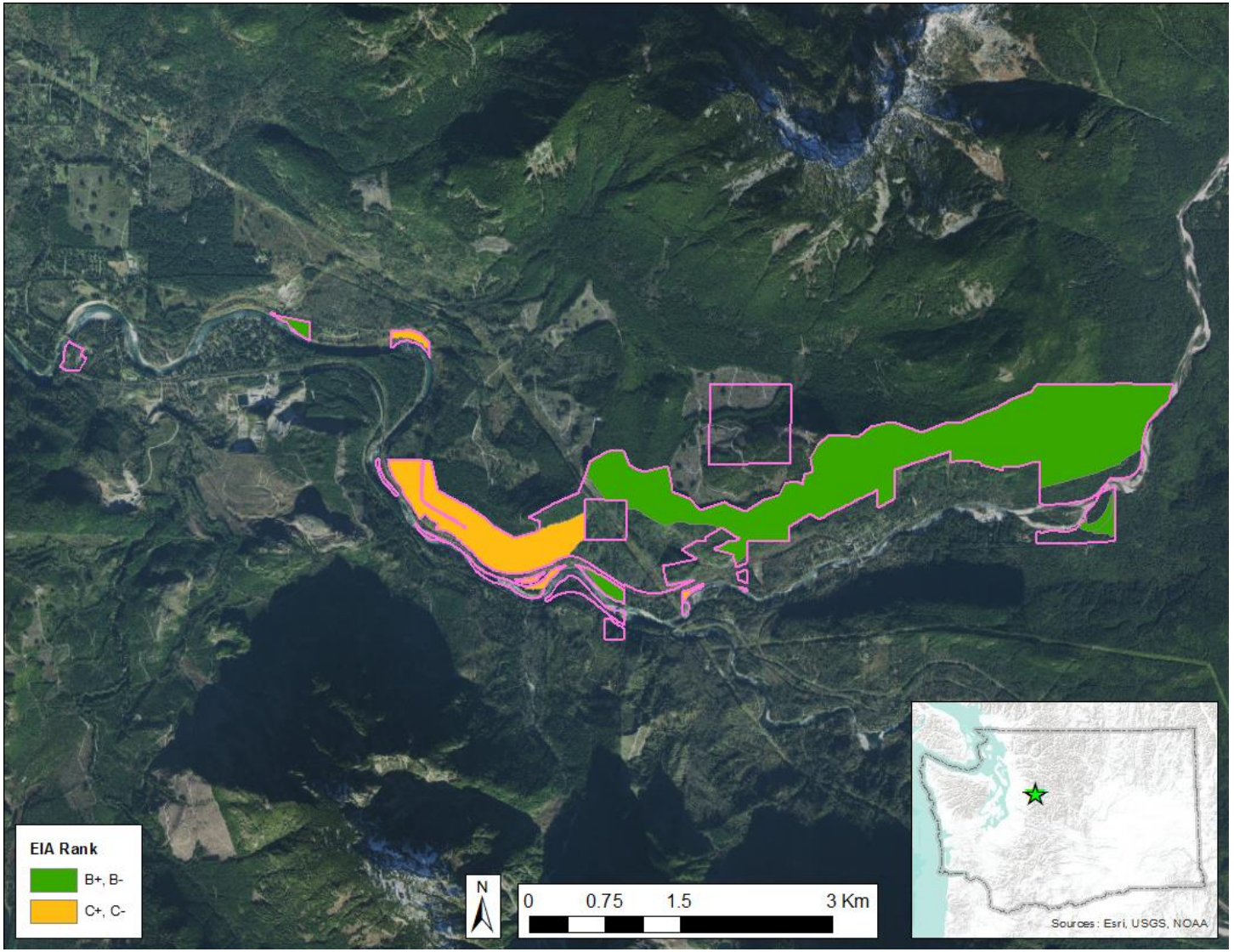

Figure O-6. EIA Ranks for all polygons assessed at Forks of the Sky State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

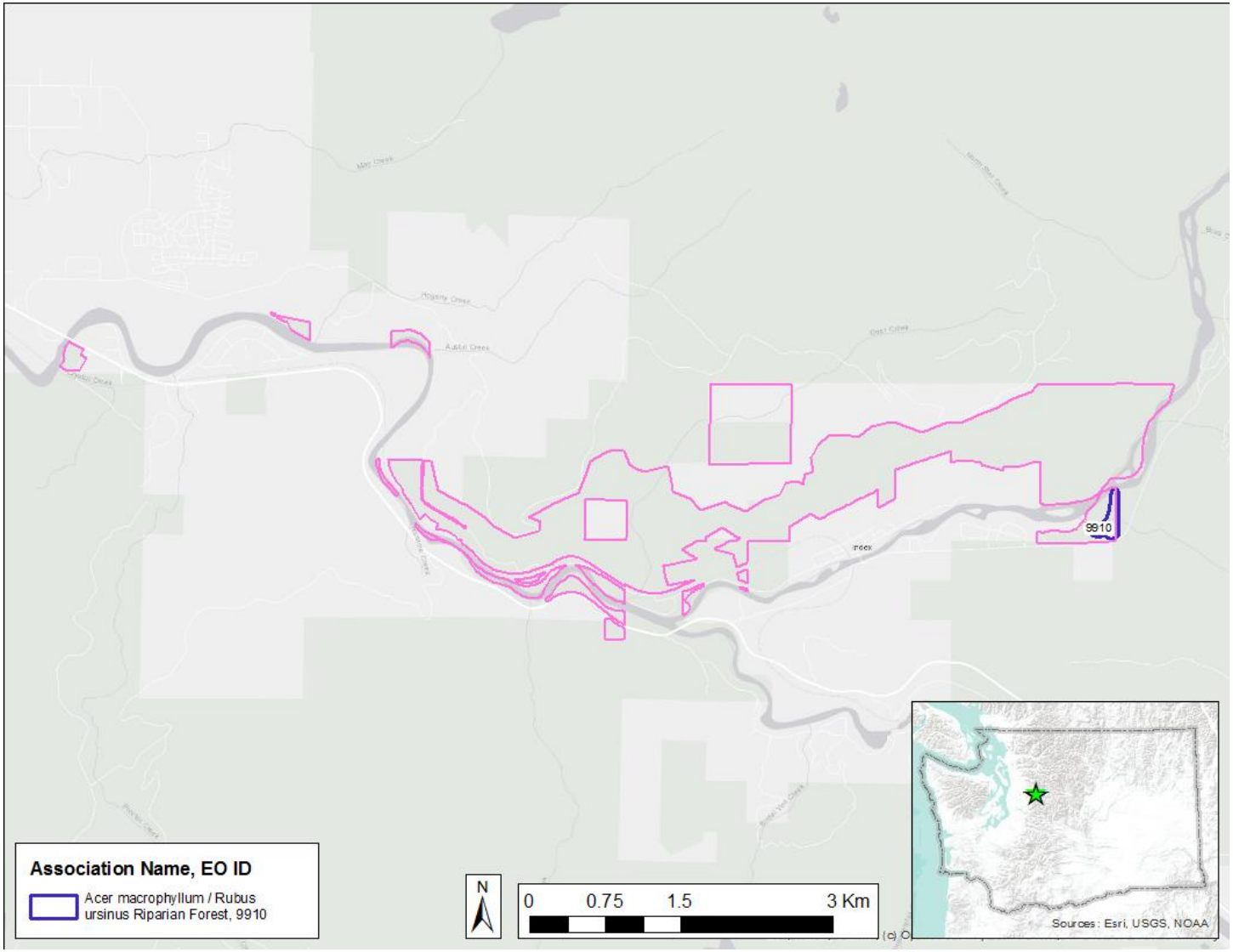

Figure O-7. Element occurrences at Forks of the Sky State Park

Appendix P. Fort Flagler

Figure P-1. A small patch of *Carex macrocephala* Grassland (G1G2/S1) at Fort Flagler State Park.

The Ecological Integrity Assessment for Fort Flagler State Park is presented below (Figure P-4). A rare plant and vegetation survey was completed by Visalli et al. (2006). This mapping was the basis for the assessment areas used in our surveys.

There was one previously documented community EO at the park. Parks identified 7 polygons (241 hectares) of 6 different ecological systems as priorities for assessment (Figure P-5). All maps (Figure P-4 through Figure P-7) are presented at the end of the appendix for ease of reading.

EIA Results

All priority polygons were surveyed at Fort Flagler. Table P-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table P-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table P-1. EIA Summary for Fort Flagler.

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
143	North Pacific Maritime Coastal Sand Dune	B	C	B-
144	North Pacific Maritime Coastal Sand Dune	B	B	B-
146	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	D	B	C+
147	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	B	B-
148	North Pacific Shrub Swamp	B	A	A-
149	Temperate Pacific Tidal Salt and Brackish Marsh	C	C	C+
145-10,27,37	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B+
145-24	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	B	B	B+
145-6,7	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	C	B	B-

Table P-2. Individual EIA Metric Ranks for Fort Flagler.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
143	B	B	B	B	A	C	C-	B	C						B	D
144	B	B	C	C	A	C	C	B	B						B	
146	D	C	D	D	D	A-	A	A	C	A	C				B	D
147	B	B	C	C	B	B	C	B	C	A	D				B	C
148	C	A	A	B	A	A	A	A	A			B	A	A	A	B
149	B	C	C	C	C	C	C-	B	B			B	D	D	C	D
145-10,27,37	B	B	C	C	A	A	A	A	C	A	B				B	A
145-24	C	B	C	C	A	A	A	A	C	A	B				B	C
145-6,7	C	C	C	C	A	A	A	A	C	A	C				B	D

Figure P-2 and Figure P-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure P-6.

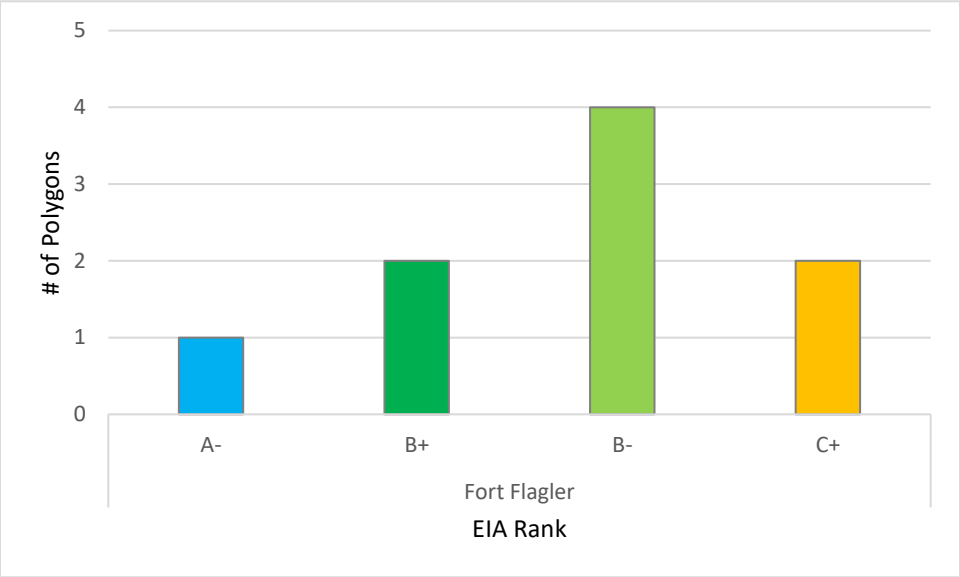

Figure P-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

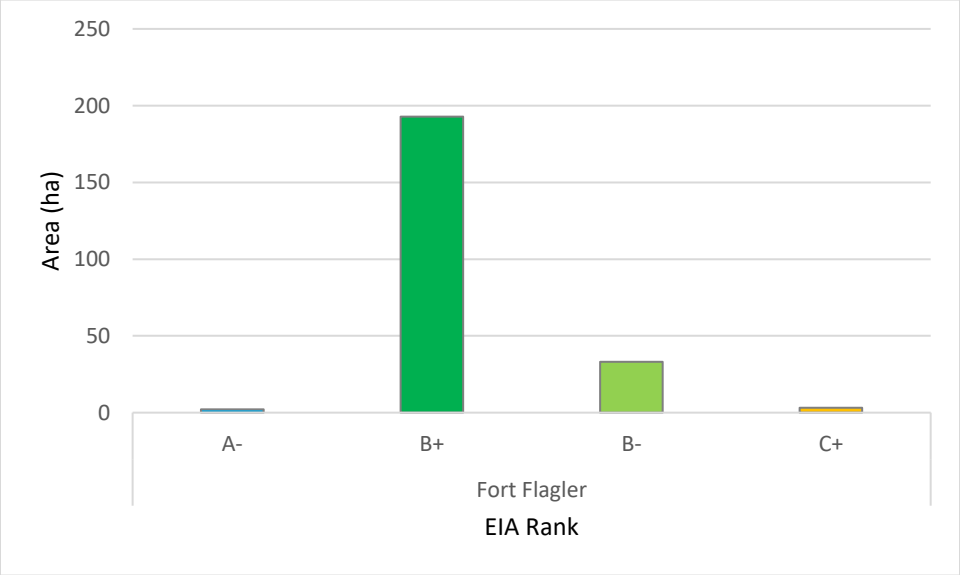

Figure P-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Six new element occurrences were documented at Fort Flagler (Table P-3, Figure P-7). Notably, these plant association EOs represent five different ecological systems: North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest, North Pacific Maritime Mesic-Wet Douglas-fir-

Western Hemlock Forest, North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland, North Pacific Shrub Swamp, and North Pacific Maritime Coastal Sand Dune. Nearly all of the forests at Fort Flagler represent element occurrences.

The *Malus fusca* Shrub Swamp (G3/S2S3, EO ID 9948) in particular is in excellent condition.

The *Pseudotsuga menziesii* - (*Abies grandis, Thuja plicata*) / *Mahonia nervosa* - *Gaultheria shallon* Forest EO received an EO Rank of "D", indicating poor long-term viability. This EO is in good (B) condition, but landscape context (C) and its very small size (for a matrix forest community) bring down the overall EO Rank. As a G2/S1 community, however, the bar for inclusion in our database is very low.

For additional information, see the accompanying Excel workbook.

Table P-3. Summary of new element occurrences at Fort Flagler State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9946	145-6,7	CEGL002845	Pseudotsuga menziesii - (Abies grandis, Thuja plicata) / Mahonia nervosa - Gaultheria shallon Forest	G2/S1	D
9947	143	CEGL001796	Leymus mollis - Abronia latifolia Grassland	G2?/S2	C-
9948	148	CEGL003385	Malus fusca Shrub Swamp	G3/S2S3	A+
9949	147	CEGL005531	Pseudotsuga menziesii / Gaultheria shallon - Holodiscus discolor Forest	GNR/S2	C-
9950	145-10,27,37	CEGL000468	Thuja plicata - (Abies grandis) / Polystichum munitum Forest	G1/S1	B+
9951	145-24	CEGL002848	Thuja plicata - Pseudotsuga menziesii - Abies grandis / Mahonia nervosa / Polystichum munitum Forest	G1/S1	B-

Summary and Discussion

Overall Conditions

Relative native plant cover (Table P-4, VEG1) is generally excellent across Fort Flagler. Invasive plants (VEG2) are not an issue in the forests (aside from one fragmented stand near park developments), but salt marsh and sand dune communities face significant threats from these invaders. In the salt marshes, *Agrostis stolonifera* is prevalent and *Holcus lanatus* and *Cytisus scoparius* are also present, particularly in areas with impacted hydroperiods and hydrologic connectivity. Coastal dune strands have *Bromus* (*diandrus*, *hordeaceus*, *commutatus*), *Rosa rugosa*, *Rubus bifrons*, *Schedonorus pratensis*, *Poa bulbosa*, *Agrostis gigantea*, and *Cirsium arvense*. *Ammophila arenaria* is present, but not nearly as extensive as at parks on the outer coast. Native plant species composition is good to excellent in all surveyed areas.

While nearly all of Fort Flagler has been logged, past harvests on the interior (away from bunkers and other military structures) predated modern practices of clearcutting and replanting. Additionally, the property was transferred to State Parks in 1955, so it has had 75 years in which

to recover further. All told, vegetation structure (VEG4) remains outside of the natural range of variability within forested areas because of the anthropogenic absence of large, old trees (which appear to have been "high-graded"), but coarse woody debris, snags, and litter (VEG6) has been less impacted and woody regeneration (VEG5) is excellent. There are few snags and forests lack the largest size classes of coarse woody debris.

Table P-4. Summary of EIA metric ratings by area (ha) at Forks of the Sky State Park.

	Metric Rating			
Metric	A/A-	B	C	C-/D
VEG1	**225**	5	1	
VEG2	**225**		5	1
VEG3	**225**	7		
VEG4	2	1	**229**	
VEG5	**228**			
VEG6		**193**	30	5
HYD1		**2**		
HYD2	**2**			< 1
HYD3	**2**			< 1
SOI1	2	**229**	< 1	

The sizeable *Malus fusca* Shrub Swamp in the center of the park is hydrologically intact (HYD1-HYD3), but the small salt marshes that were assessed scored very poorly in hydroperiod (HYD2) and hydrologic connectivity (HYD3). These salt marsh fragments have muted tidal prisms due nearby roads, pathways, and dikes. Soil disturbance (SOI1) is minor, aside from social trails and some areas of excavation.

Recommendations for Enhancing / Maintaining Ecological Integrity

The salt marsh areas on Marrowstone Point are degraded, but also small and not a priority for restoration. Improving the ecological integrity of these would probably require removal or modification of infrastructure (road, buildings) from the spit. *Ammophila arenaria* covers limited areas along the beaches and could likely be eliminated with a focused effort.

Nearly all of the forests at Fort Flagler are element occurrences, though none are very large. Any reduction in size in order to build additional park facilities, campgrounds, etc. is not recommended. These forests currently receive little visitation and will continue to recover from past logging stressors with time.

The North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland stands at Fort Flagler are restricted to steep bluffs along the straits and are unlikely to require prescribed fire. They appear to be maintained by erosion, dry landscape positions, and perhaps salt spray. These stands did have the only significant infestations of exotic plants among Fort Flagler forests and they should continue to be targeted for invasive species removal.

Future Assessment / Survey Recommendations

Nearly all of Fort Flagler was surveyed as part of this project. Further assessments are not a priority at this time.

Maps

Figure P-4. Overview of Fort Flagler State Park

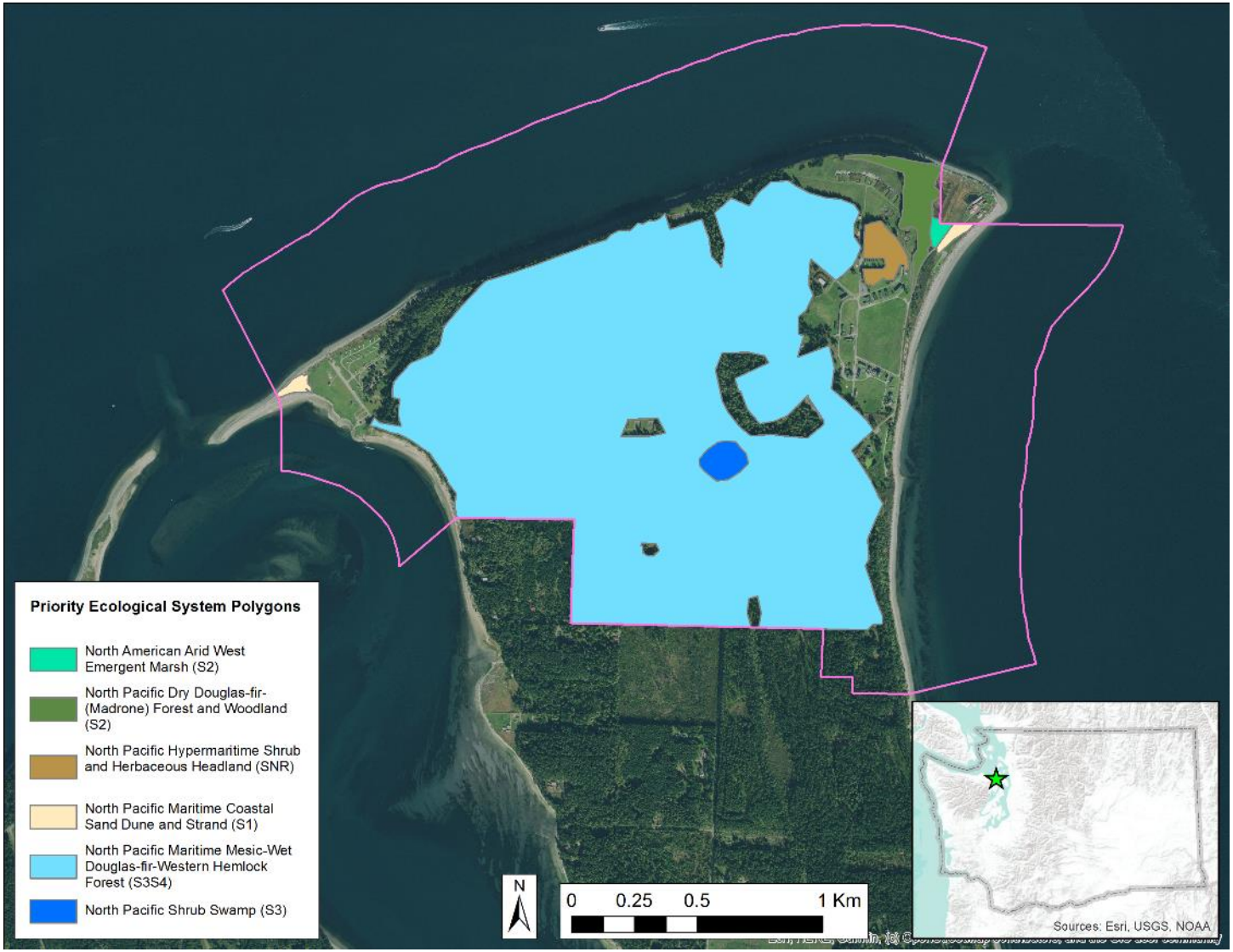

Figure P-5. Priority ecological systems polygons for assessment at Fort Flagler State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

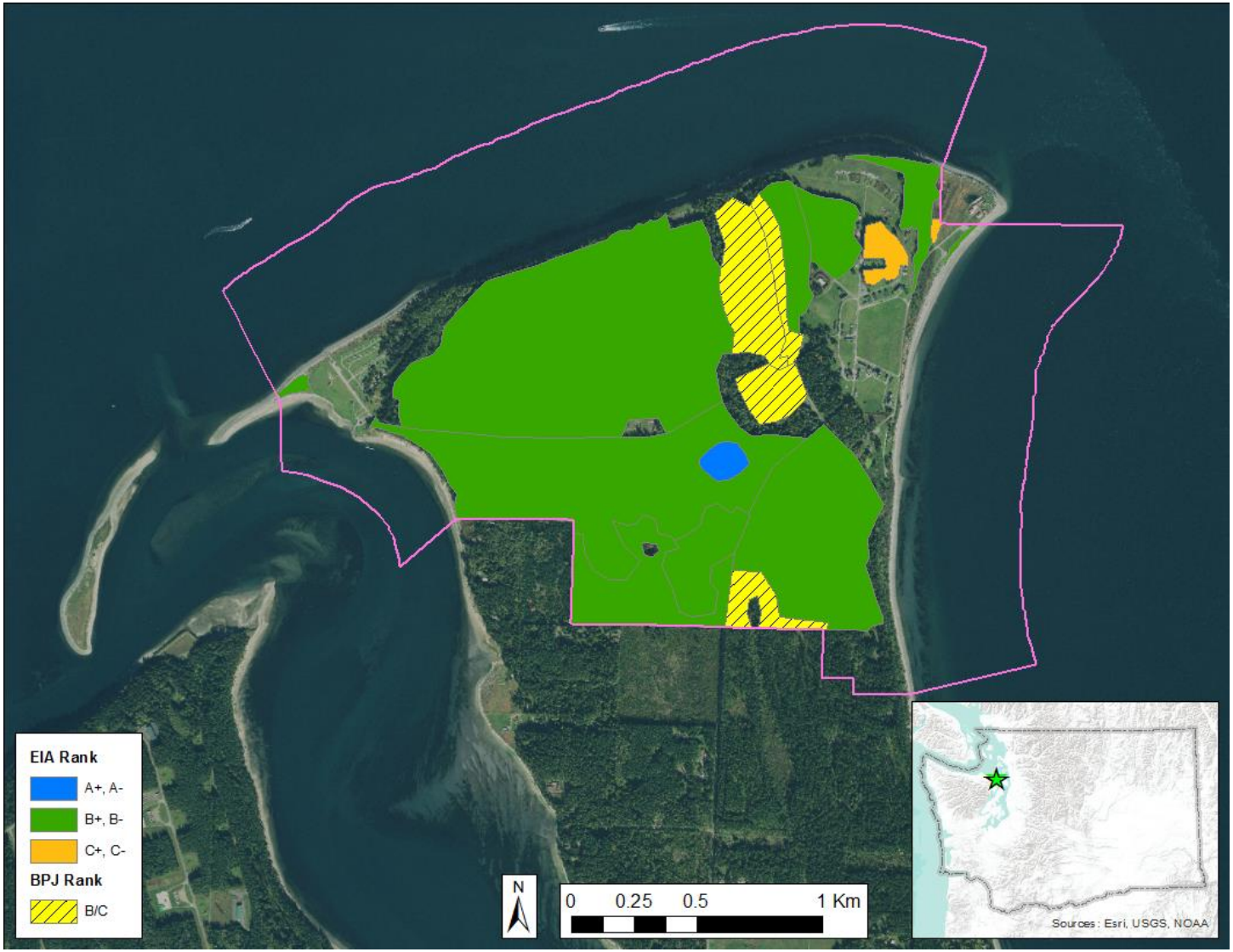

Figure P-6. EIA Ranks for all polygons assessed at Fort Flagler State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

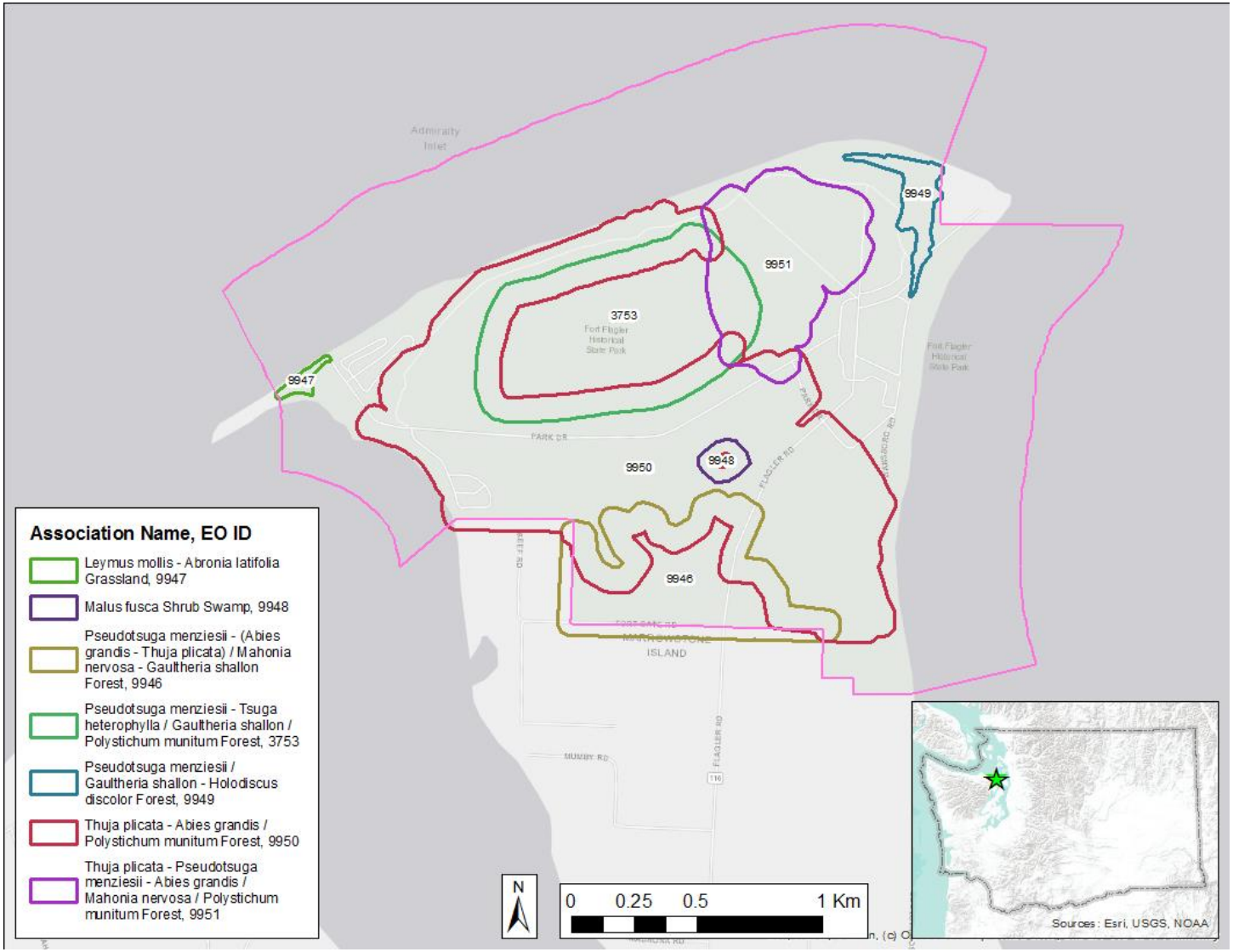

Figure P-7. Element occurrences at Fort Flagler State Park

Appendix Q. Green River Gorge

Figure Q-1. *Salix* spp. - *Spiraea douglasii* / *Carex (aquatilis* var. *dives, obnupta, utriculata*) Wet Shrubland (G3G4/S2Q) at Green River Gorge State Park Conservation Area.

The Ecological Integrity Assessment for Green River Gorge State Park Conservation Area is presented below (Figure Q-5). A rare plant and vegetation survey was previously completed by Smith IV et al. (2007). This mapping was the basis for the assessment areas used in our surveys.

There were no previously documented community EOs at the park. Parks identified 14 polygons (222 hectares) of 3 different ecological systems as priorities for assessment (Figure Q-6). All maps (Figure Q-5 through Figure Q-8) are presented at the end of the appendix for ease of reading.

EIA Results

All priority polygons were surveyed at Green River Gorge. Forested polygons that had previously been crosswalked to North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest were all found to be Mesic-Wet when surveyed in the field. Table Q-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table Q-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table Q-1. EIA Summary for Green River Gorge. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
217	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
218	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
219	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
220	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
221	North Pacific Broadleaf Landslide Forest and Shrubland	C	B	C+
222	North Pacific Broadleaf Landslide Forest and Shrubland	C	C	C+
223	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
224	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
225	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
226	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
227	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
222-4	North Pacific Broadleaf Landslide Forest and Shrubland	C	B	B-
228-229	North Pacific Lowland Riparian Forest and Shrubland	B	B	B-
230-PHYCAP	North Pacific Shrub Swamp	C	B	B+
230-SPIDOU	North Pacific Shrub Swamp	C	B	B-

Table Q-2. Individual EIA Metric Ranks for Green River Gorge.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
217	B	C	B	B	B	B	B	A	C	A	B				B	D
218	B	C	B	B	B	A-	B	A	C	B	C				B	B
219	B	C	B	B	B	C	C-	B	C	A	C				B	D
220	B	C	B	C	B	B	C	B	C	A	C				B	
221	C	C	C	C	B	C	C-	B	C	B	B				B	
222	B	C	B	B	C	D	D	D	C	B	C				C	B
223	B	C	A	A	B	B	C	A	B	A	B	B	B	B	A	
224	B	C	A	A	B	B	C	A	C	A	B	B	B	B	B	
225	B	C	A	A	B	A-	B	A	C	C	B	B	B	B	A	
226	B	C	A	A	B	B	C-	B	B	A	B	B	B	B	A	
227	B	C	A	B	B	A-	B	A	C	A	B	A	A	B	A	
222-4	B	C	B	B	C	B	B	A	B	A	B				B	C
228-229	B	C	B	B	B	B	C	B	B	B	C	A	B	B	C	
230-PHYCAP	C	C	B	C	B	A-	B	A	A			A	C	C	A	C
230-SPIDOU	C	C	B	C	B	B	C	C	B			A	C	C	A	B

Figure Q-2 and Figure Q-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure Q-7.

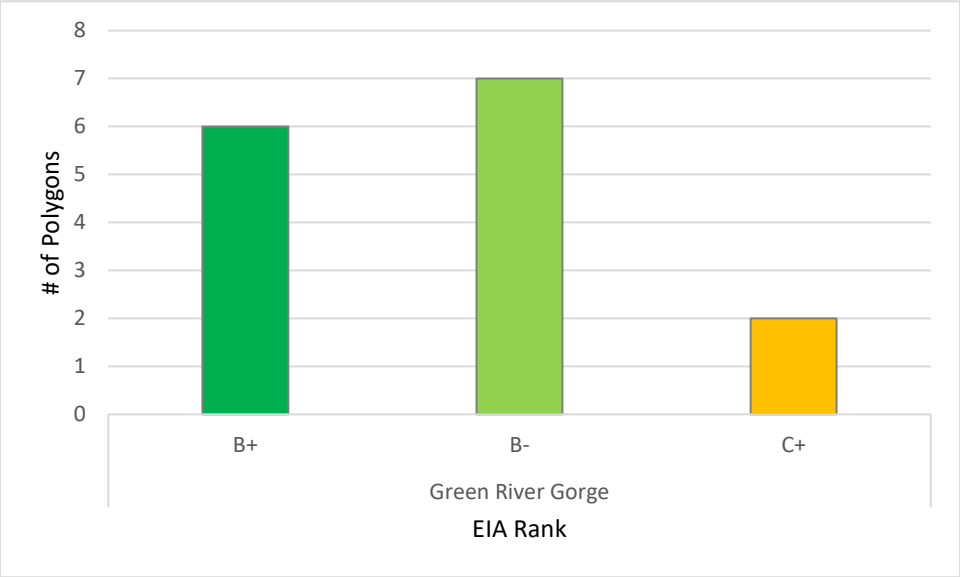

Figure Q-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

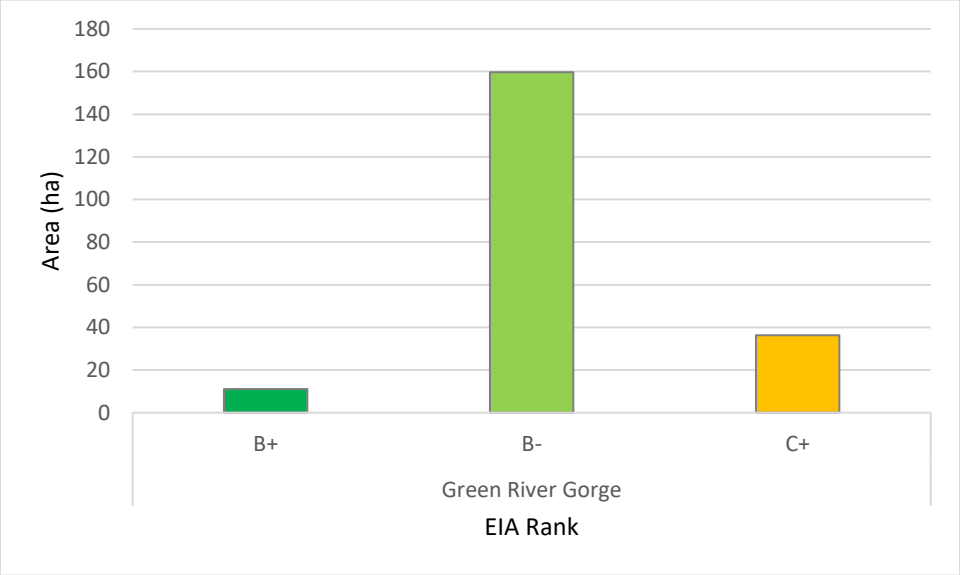

Figure Q-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Four new element occurrences were documented in the Green River Gorge complex (Table Q-3, Figure Q-8), representing two small shrub swamps, a landslide forest, and a relatively large-patch

of second-growth mesic-wet conifer forest. For additional information, see the accompanying Excel workbook.

Table Q-3. Summary of new element occurrences at Green River Gorge State Park Conservation Area. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9901	230-PHYCAP	CWWA000232	Physocarpus capitatus Wet Shrubland	GNR/SUQ	B-
9902	230-SPIDOU	CWWA000199	Salix spp. - Spiraea douglasii / Carex (aquatilis var. dives, obnupta, utriculata) Wet Shrubland	G3G4/S2Q	B-
9903	218	CEGL005576	Tsuga heterophylla - (Pseudotsuga menziesii, Thuja plicata) / Polystichum munitum - Athyrium filix-femina Forest	G3G4/S3	B-
9904	222-4	CEGL003334	Acer macrophyllum - Alnus rubra / Polystichum munitum - Tellima grandiflora Forest	G2G3/S2	B-

Summary and Discussion

Figure Q-4. A decaying stump in a *Tsuga heterophylla* - (*Pseudotsuga menziesii*, *Thuja plicata*) / *Polystichum munitum* - *Athyrium filix-femina* Forest (G3G4/S3) forest in otherwise good condition (B- EIA Rank).

Overall Conditions

The Green River Gorge State Park Conservation Area has an extensive history of logging and mining (Figure Q-4.) It is one of only two parks we surveyed in western Washington that did not have excellent (A) relative native plant cover over the majority of its area (Table Q-4, VEG1) and the only western park in which there were no polygons that received excellent marks for invasive cover (VEG2). The most prevalent invasive plants are *Rubus bifrons*, *Hedera hibernica*, *Ilex aquifolium*, *Geranium robertianum*, and *Ranunculus repens*, with *Phalaris arundinacea* prominent along waterways. North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forests retain excellent native plant species composition (VEG3) despite the exotic plants, while North Pacific Broadleaf Landslide Forests are more likely to have diagnostic natives excluded by invasive and increaser species. This is particularly true for the landslide forests regenerating on the old Franklin Mine. One North Pacific Shrub Swamp polygon was also outside the natural range of variability for VEG3, with *Cicuta douglasii*, *Oenanthe sarmentosa*, and *Spiraea douglasii* apparently acting as increaser species.

Table Q-4. Summary of EIA metric ratings by area (ha) at Green River Gorge State Park Conservation Area.

	Metric Rating			
Metric	A/A-	B	C	C-/D
VEG1	52	**108**	20	27
VEG2	0	**128**	31	48
VEG3	**133**	42	5	27
VEG4	1	19	**187**	
VEG5	**111**	87	3	
VEG6		95	**105**	
HYD1	**10**	9		
HYD2	1	**13**	6	
HYD3		**13**	6	
SOI1	13	**164**	30	

Vegetation structure (VEG4) and coarse woody debris, snags, and litter (VEG6) are predictably degraded due to logging and mining. Most upland stands are artificially young, homogeneous, and lacking in large woody debris and snags. The exceptions are on inaccessible and relatively stable portions of the gorge walls. While *Pseudotsuga menziesii* trees may have been planted to initiate some conifer stands, woody regeneration (VEG5) is within the natural range of variability across most of the park unit, with naturally establishing *Tsuga heterophylla* and *Thuja plicata* dominant.

The water source metric (HYD1) was scored primarily based on conspicuous stressors such as nearby impervious surfaces. We are not aware of documented persistent water quality impacts from the coal and mercury mines in this watershed, but if such impacts exist, we would certainly revise these ratings downward. The two shrub swamps that surveys had moderately altered hydroperiods (HYD2) and hydrologic connectivity (HYD3) due to road grades, while all of the riparian forests were marked down in these metrics due to impacts from the Howard Hanson Dam.

Anthropogenic soil disturbance (SOI1) is more common at Green River Gorge than at most other park units. While the Franklin Mine was capped in 1984, it operated for over 70 years and disruption in that area is extensive. Elsewhere, soil disturbance mostly consists of old skid trails and foot trails. One landslide forest was marked down slightly because a road just above the stand likely stabilizes the slope to some degree.

Recommendations for Enhancing / Maintaining Ecological Integrity

As with many parks, our primary recommendation for enhancing ecological integrity at Green River Gorge is the removal of invasive plants. Treatments should be prioritized with the element occurrences before moving on to other areas. These EOs receive minimal visitation, so diverting access does not appear to be necessary.

The integrity of the shrub swamps on the north end of the park (Vegetation Survey Database polygon GRGJellum_2, WNHP ES Poly IDs = 230-PHYCAP and 230-SPIDOU) would be enhanced via modifications to 290th Ave SE (not owned by Parks). Replacing the road prism with

a bridge, or minimally improving the size, number, and/or positioning of culverts would improve the hydroperiod and hydrologic connectivity of these significant wetlands. Hydrologic enhancement for the Green River riparian forests would essentially require the removal of the Howard Hanson Dam.

Improving the ecological integrity of the mesic-wet conifer forests will mostly be a function of time, with vegetation structure gradually improving as subcanopies further develop in the understories. Snags and coarse woody debris will return to the natural range of variability as trees continue to mature and die.

Future Assessment / Survey Recommendations

We surveyed most of the areas likely to be of significant conservation interest as part of this project. Remaining areas are difficult to access, but may contain stands of relatively undisturbed forest.

Parks may already have this information, but if not, it would be useful to investigate water quality impacts from the decommissioned mines within and near park parcels.

Maps

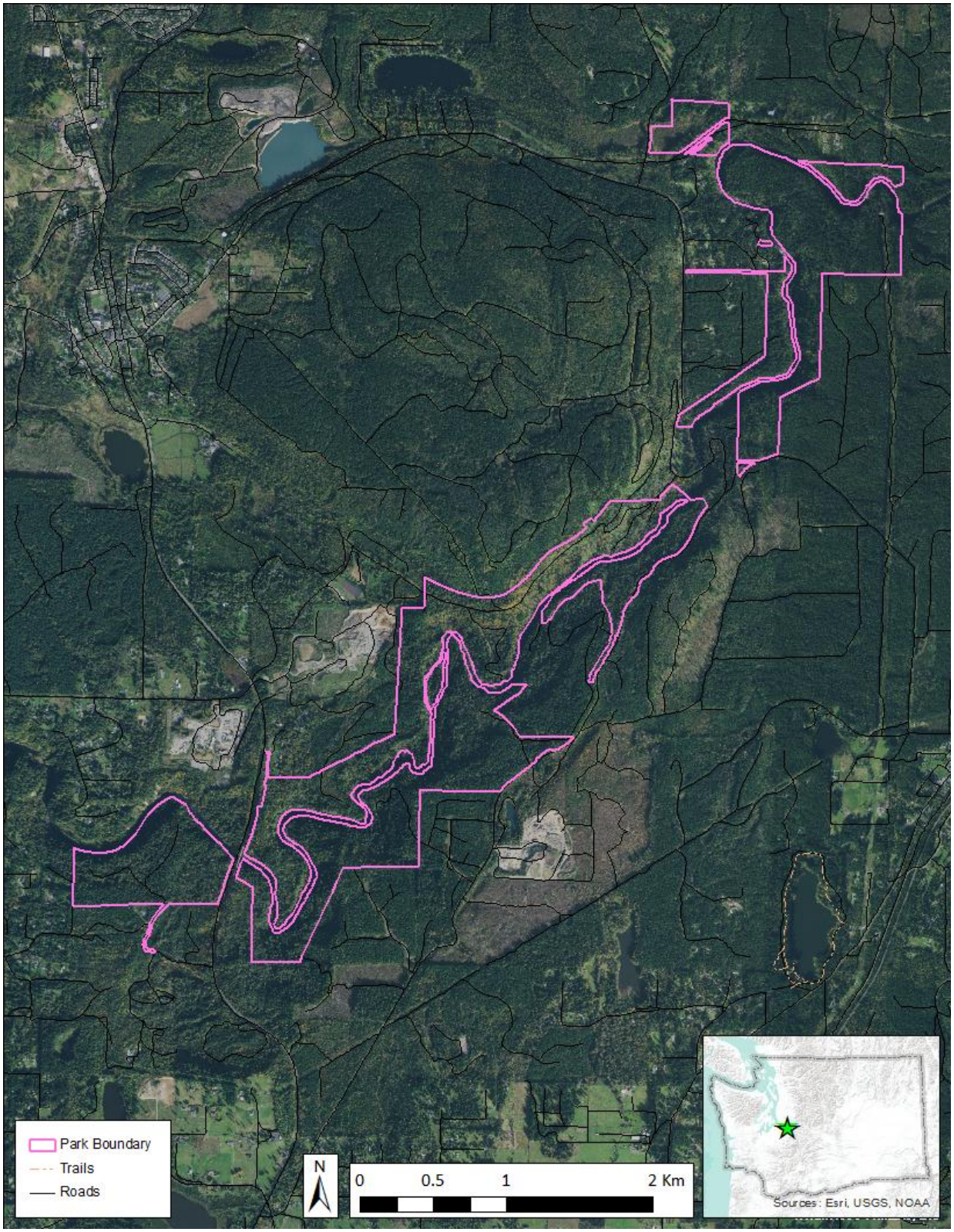

Figure Q-5. Overview of the majority of Green River Gorge State Park Conservation Area

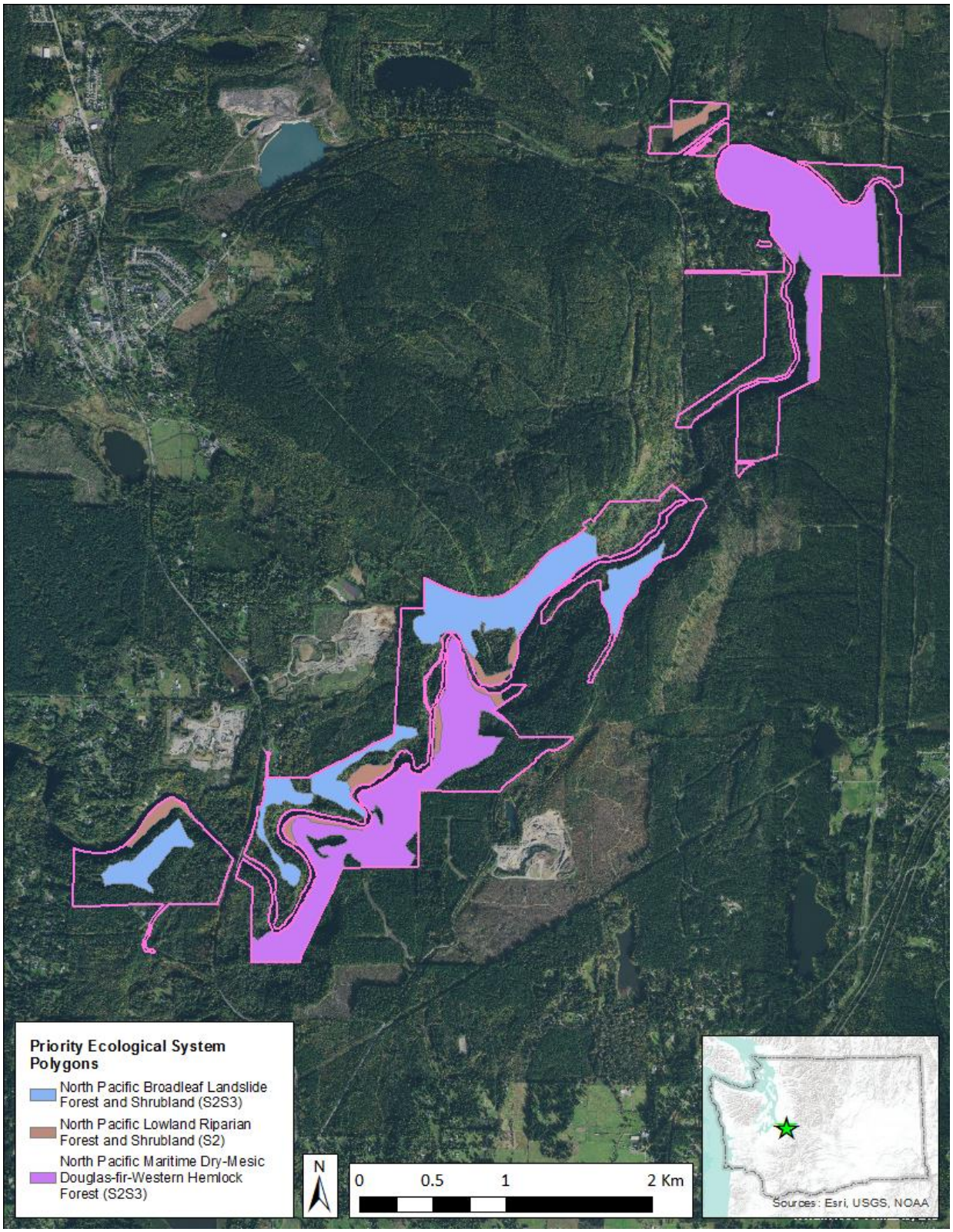

Figure Q-6. Priority ecological systems polygons for assessment at Green River Gorge State Park Conservation Area. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

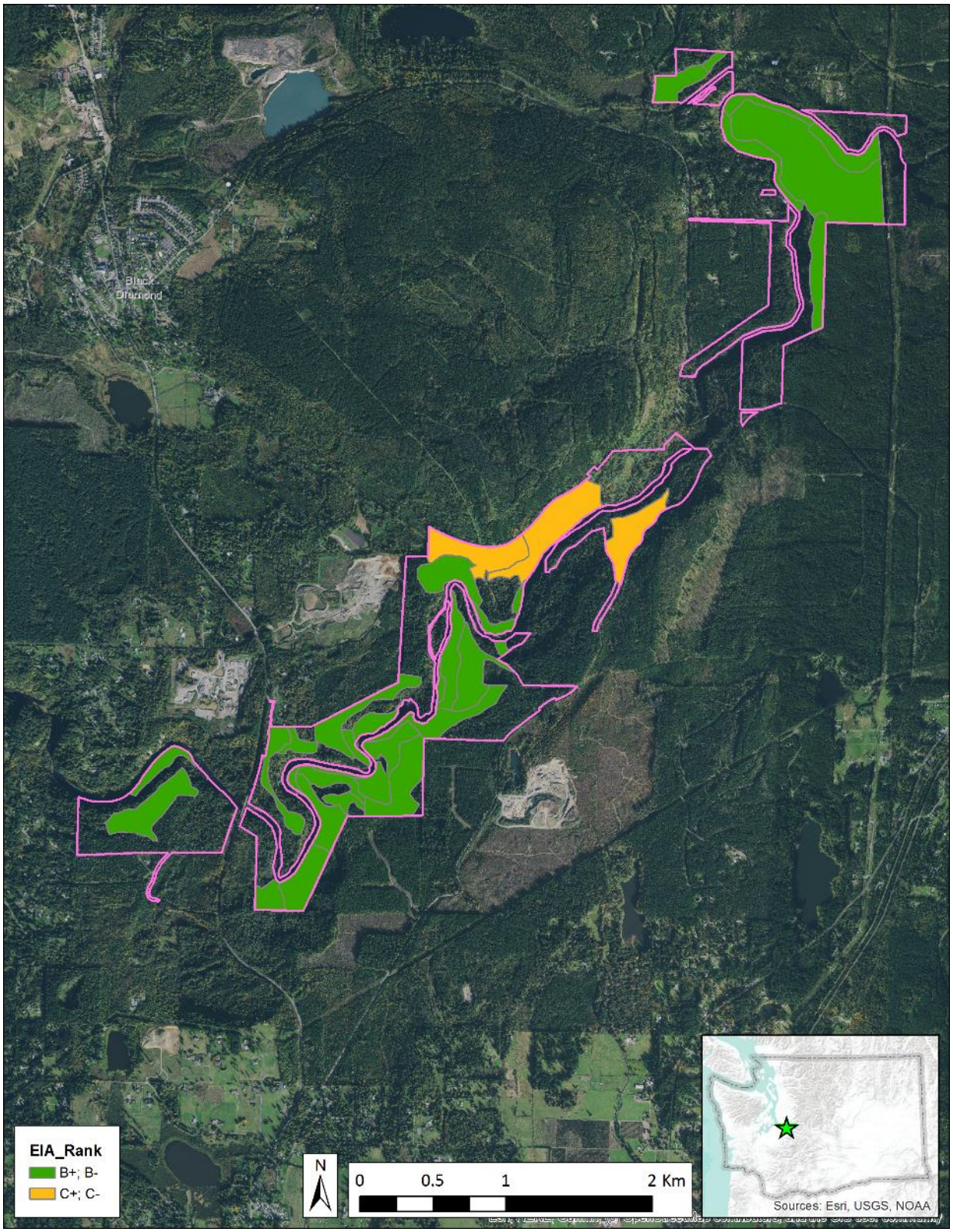

Figure Q-7. EIA Ranks for all polygons assessed at Green River Gorge State Park Conservation Area. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, "best professional judgment" rank (not EIA).

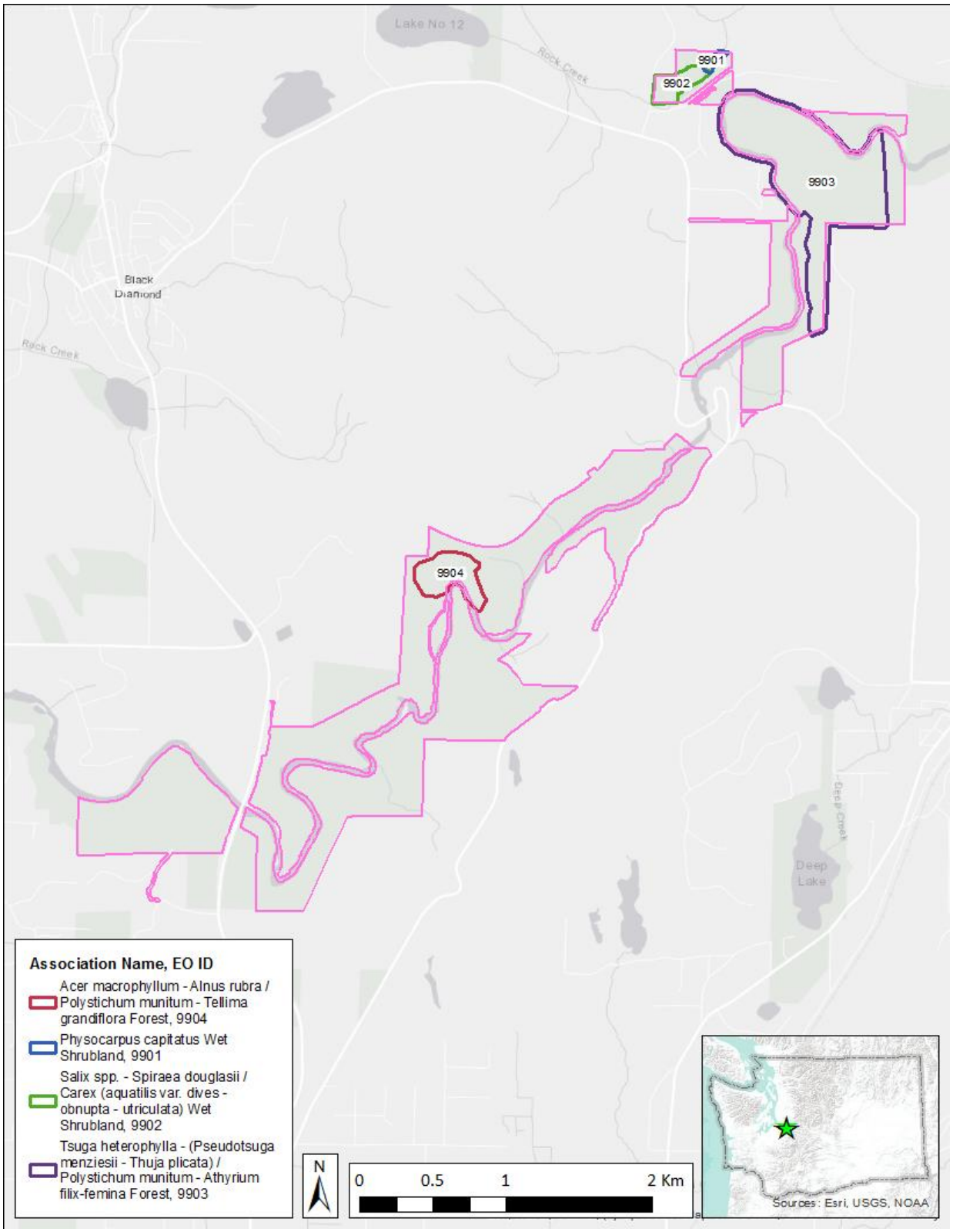

Figure Q-8. Element occurrences at Green River Gorge State Park Conservation Area

Appendix R. Nisqually State Park

Figure R-1. A young stand of *Fraxinus latifolia* / *Carex obnupta* Swamp Forest (G4/S2?) at Nisqually State Park.

The Ecological Integrity Assessment for Nisqually State Park is presented below (Figure R-5). A rare plant and vegetation survey was completed by Luginbuhl and Darrach (2006). This mapping was the basis for the assessment areas used in our surveys.

There were no previously documented community EOs at the park. Parks identified 11 polygons (282 hectares) of 4 different ecological systems as priorities for assessment (Figure R-6). All maps (Figure R-5 through Figure R-8) are presented at the end of the appendix for ease of reading.

EIA Results

We surveyed most priority polygons at Nisqually, with the exception of Vegetation Survey Database polygon NisquallyMashel_7, which was the only one on the south side of the Nisqually River. Previous surveyors classified that polygon as a fair-condition occurrence of a very common association, so we decided not invest the time drive to the other side of the river.

Table R-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table R-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table R-1. EIA Summary for Nisqually. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
331	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	C	C	C-
332	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	C	C+
333	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	C	C	C+
334	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	C	C	C+
336	North Pacific Lowland Riparian Forest and Shrubland	B	B	B-
337	North Pacific Lowland Riparian Forest and Shrubland	C	B	B-
338	North Pacific Hardwood-Conifer Swamp	B	B	B+
329-328	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	C	D	D
330-11	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	B	B	B-
330-12	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	C	C	C+
330-16,17,24	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	C	C	C+
330-41,46	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-

Table R-2. Individual EIA Metric Ranks for Nisqually.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
331	C	C	C	C	B	B	C	C	D	D	D				B	
332	C	C	A	B	B	B	C	C	D	D	D				C	
333	D	B	C	C	A	A-	B	A	D	D	C				B	C
334	C	C	C	C	B	C	C	B	D	D	C				B	
336	C	C	A	A	C	D	D	C	A	B	B	A	C	C	A	C
337	D	C	B	C	C	B	B	B	C	A	C	A	C	C	B	C
338	C	C	A	B	B	A-	B	A	B	A	C	A	B	B	B	B
329-328	C	C	D	D	D	D	D	D	D	D	D				C	
330-11	B	B	A	B	B	B	C	B	C	C	C				A	
330-12	C	C	C	C	B	B	B	C	D	C	D				B	
330-16,17,24	C	C	C	C	B	B	B	B	D	C	D				B	
330-41,46	C	B	B	B	B	A-	A	A	C	B	C				B	B

Figure R-2 and Figure R-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure R-7.

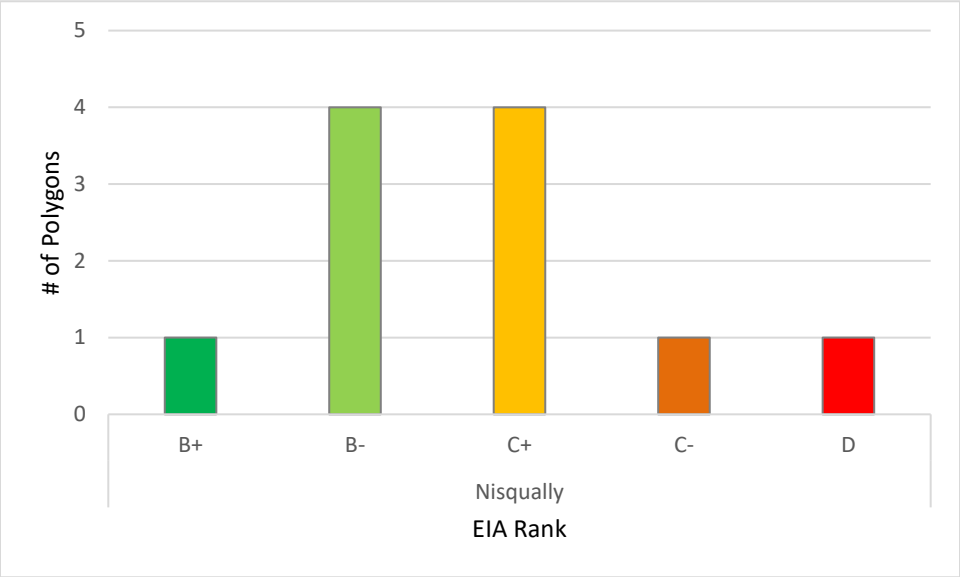

Figure R-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

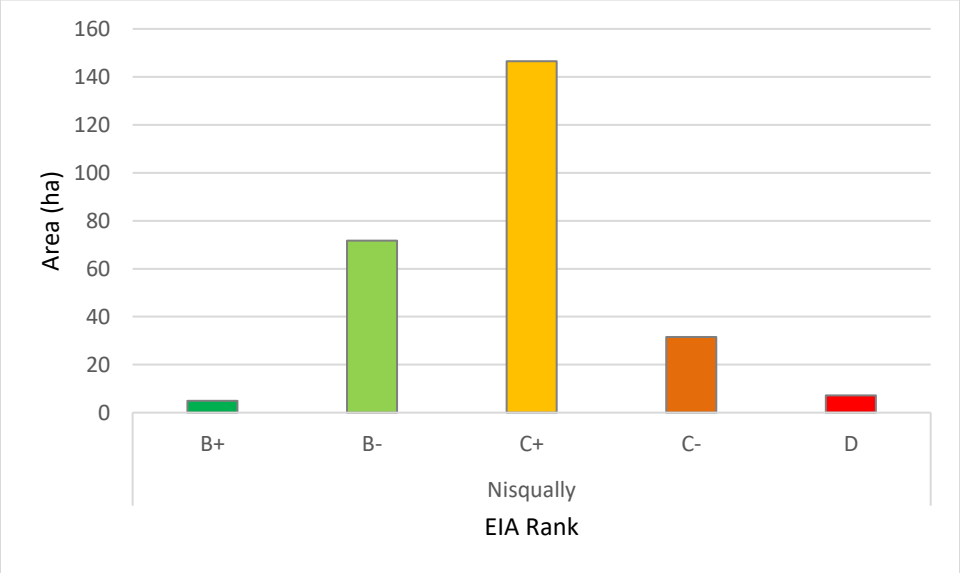

Figure R-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Three new element occurrences were documented at Nisqually (Table R-3, Figure R-8). One is a stand of mature North Pacific Maritime Mesic-Wet Doug-fir - Western Hemlock Forest recovering from historic logging. It is located adjacent to an existing EO, on the eastern edge of the park. The

two wetlands include a floodplain forest dominated by *Populus trichocarpa* and a young hardwood basin swamp codominated by *Fraxinus latifolia* and *Populus tremuloides*. Additionally, one existing EO is found just east of the park boundary. For additional information, see the accompanying Excel workbook.

Table R-3. Summary of new element occurrences at Nisqually State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9908	338	CEGL000640	Fraxinus latifolia / Carex obnupta Swamp Forest	G4/S2?	B+
9909	337	CEGL003407	Populus balsamifera ssp. trichocarpa - Alnus rubra / Rubus spectabilis Riparian Forest	G2G3/S2?	C+
9969	330-41,46	CEGL005568	Pseudotsuga menziesii - Tsuga heterophylla / Polystichum munitum - Oxalis oregana Forest	G3G4/S3	B-

Summary and Discussion

Figure R-4. A *Pseudotsuga menziesii* plantation at Nisqually State Park.

Overall Conditions

Conditions vary greatly between the intensively managed upland plateau at Nisqually and the relatively undisturbed river canyons. The only polygon with good ecological integrity (EIA Rank = B) on the plateau is the *Fraxinus latifolia* / *Carex obnupta* Swamp Forest EO mentioned above. The remainder are young plantation forests harvested in the last 20-50 years (Luginbuhl & Darrach, 2006). Some have small, disturbed wetland inclusions within. The youngest stands have significant exotic/invasive plant cover (Table R-4, VEG1, VEG2) from a diverse array of species: *Cytisus scoparius*, *Rubus bifrons*, *Hypericum perforatum*, *Holcus lanatus*, *Cirsium arvense*, *Ranunculus repens*, *Geranium robertianum*, *Phalaris arundinacea*, *Leucanthemum vulgare*, and more. Native plant species composition (VEG3) may be within the natural range of variability in slightly older stands, but most areas have at least slightly reduced diversity and cover of diagnostic species due to invasive and the legacy of intensive management (e.g., *Pseudotsuga menziesii* monocultures). Native increaser species that respond positively to logging (e.g., *Elymus glaucus*, *Rubus ursinus*, *Populus trichocarpa* (= *P. balsamifera* ssp. *trichocarpa*), and *Fraxinus latifolia*) are common in upland settings. Vegetation structure (VEG4) is very poor, with young, homogeneous canopies and frequently depauperate understories. All canopy conifers were planted (VEG5) and there are essentially no snags or large woody debris (VEG6).

The river canyons contain significantly higher integrity, mature stands of North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest with pockets of early old-growth trees. *Geranium robertianum* is widespread, but has low overall cover, and native plant species composition is excellent. Timber has been extracted from these sites, but not as recently nor at the industrial scale applied to the rest of the park, so vegetation structure, woody regeneration, and coarse woody debris, snags, and litter are all within the natural range of variability.

Along the Nisqually and Mashel Rivers themselves, the riparian forests face significant threats from diverse invasive species. The confluence is particularly infested, with *Phalaris arundinacea*, *Rubus bifrons*, *Cytisus scoparius*, *Buddleja davidii*, and at least nine other invasive species combining to exceed 60% absolute cover and largely replace the native understory. These stands are also directly downstream from a major dam, which significantly modulates the timing and intensity of flooding (HYD2, HYD3).

Table R-4. Summary of EIA metric ratings by area (ha) at Nisqually State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	59	**153**	38	11
VEG2	48	**119**	83	11
VEG3	59	**153**	43	7
VEG4	4	5	67	**185**
VEG5	18	52	**101**	90
VEG6		4	117	**141**
HYD1	**22**			
HYD2		5	**17**	
HYD3		5	**17**	
SOI1	11	**237**	14	

Recommendations for Enhancing / Maintaining Ecological Integrity

Previous surveys mapped much of the plateau at Nisqually as North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland. With documentation of historical prairie vegetation at the site (Mashel Prairie), it is possible that some of the stands within the state park represent that ecological system. However, the heavily managed nature of the landscape and the park itself (i.e. repeated clearcuts) makes it difficult to classify these young, planted stands accurately. If the goal of the park is to manage the landscape towards recovery of functioning Dry Douglas-fir, then reintroduction of prescribed fire will be a critical element of ongoing management. Management towards a long-term equilibrium of North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest will necessitate less fire, but restoration thinning to diversify structural and species diversity would still be recommended.

Luginbuhl and Darrach (2006) recommended monitoring and ensuring the health and development of what they classified as *Pinus contorta* var. *contorta* - *Pseudotsuga menziesii* / *Gaultheria shallon* Forest (NisquallyMashel_35, WNHP ES Poly ID = 329-328), a G1G2/S1 community. While it is possible for that association to occur in this landscape setting (flat outwash of the Rainier glaciers), all of the conifers in this clearcut were planted and no natural (unplanted) *Pinus contorta* were found anywhere else in the park. This stand does not appear to be a greater priority for restoration than any of the other ex-plantations, particularly with the overwhelming dominance of invasive species.

Luginbuhl and Darrach (2006) also noted a stand of *Pseudotsuga menziesii* - *Arbutus menziesii* / *Gaultheria shallon* Forest (NisquallyMashel_11, WNHP ES Poly ID = 330-11). USNVC revisions since 2006 have combined that classification unit into *Arbutus menziesii* - (*Pseudotsuga menziesii*) / *Gaultheria shallon* Forest (CEGL007332, GNR/SNR). The stand has abundant invasive and part of it has been clearcut/replanted, so it is not currently EO-quality. However, focused treatment of invasive species along with application of prescribed fire could significantly improve the integrity of this stand.

Future Assessment / Survey Recommendations

We surveyed most of the areas likely to be of significant conservation interest, but did not access the park property south of the Nisqually River. While not a critical priority, this area may have additional mesic-wet conifer forests in fair-to-good condition.

Maps

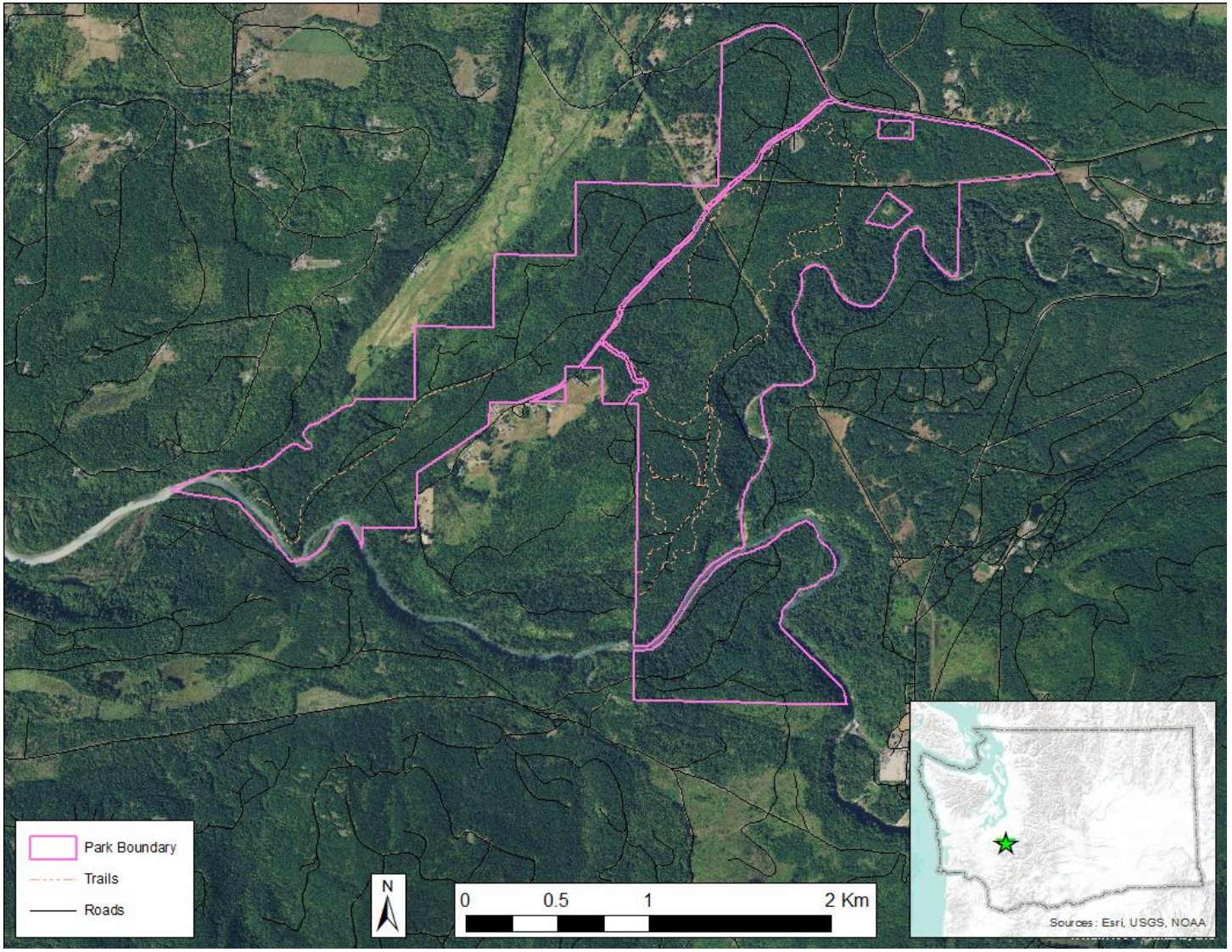

Figure R-5. Overview of Nisqually State Park

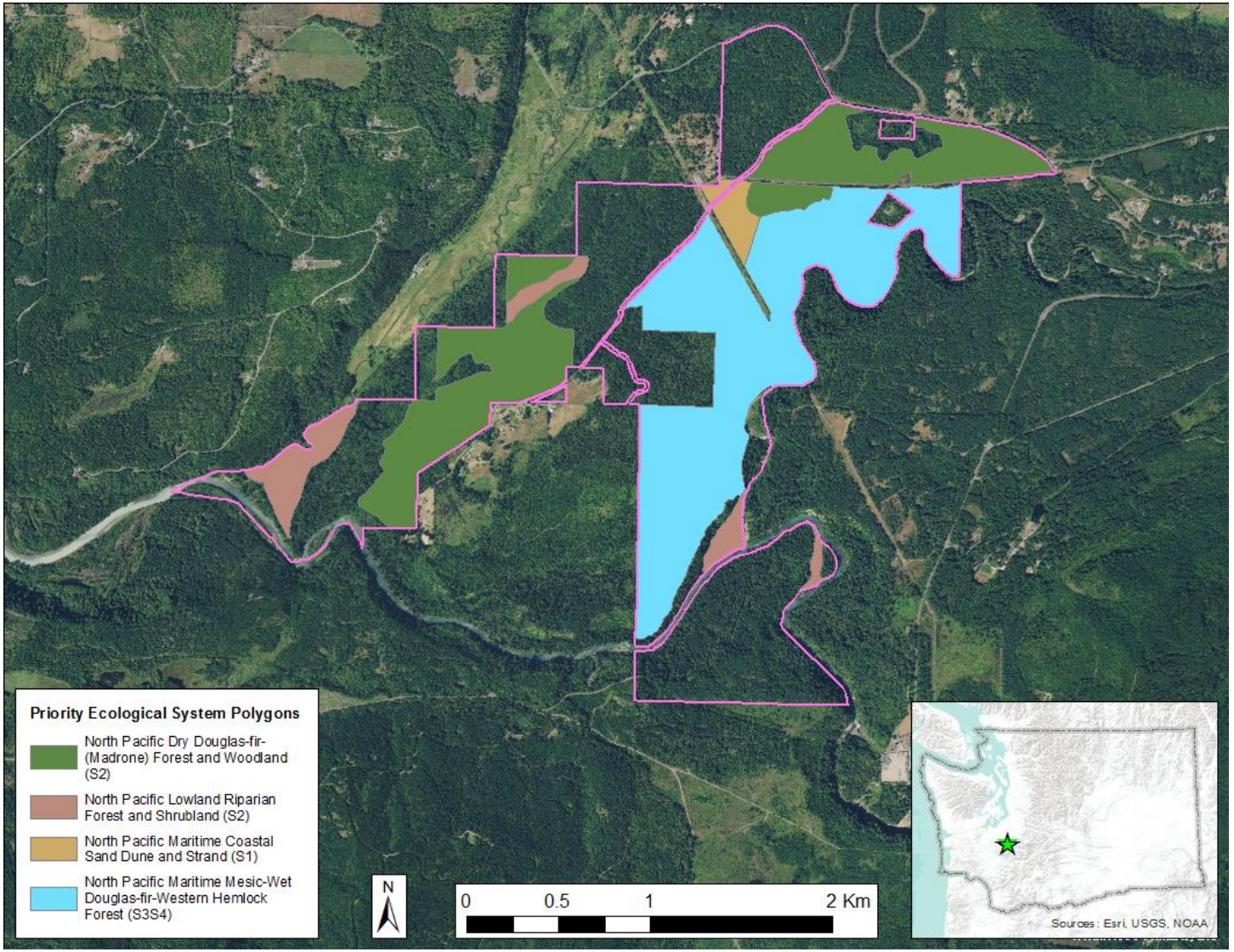

Figure R-6. Priority ecological systems polygons for assessment at Nisqually State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

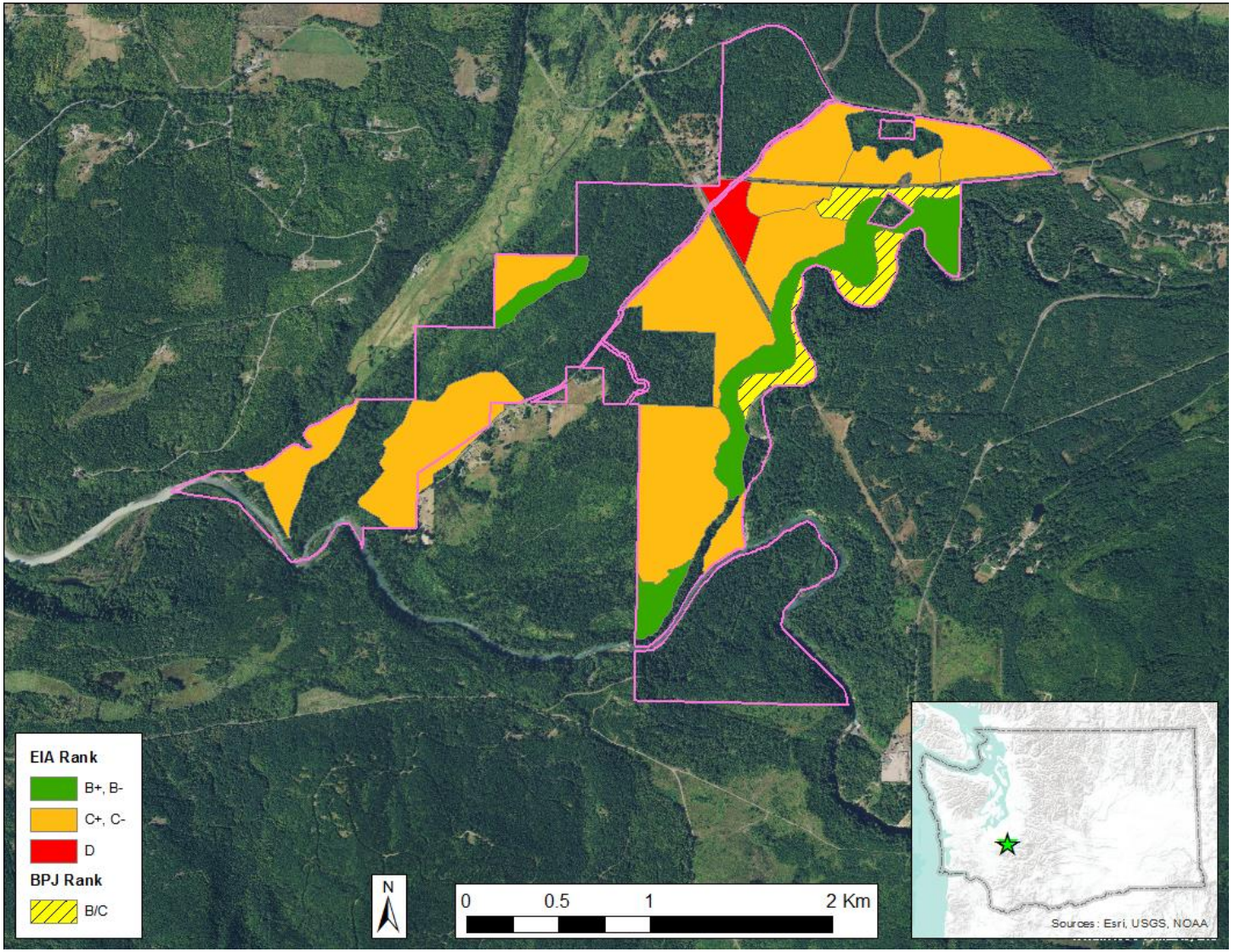

Figure R-7. EIA Ranks for all polygons assessed at Nisqually State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

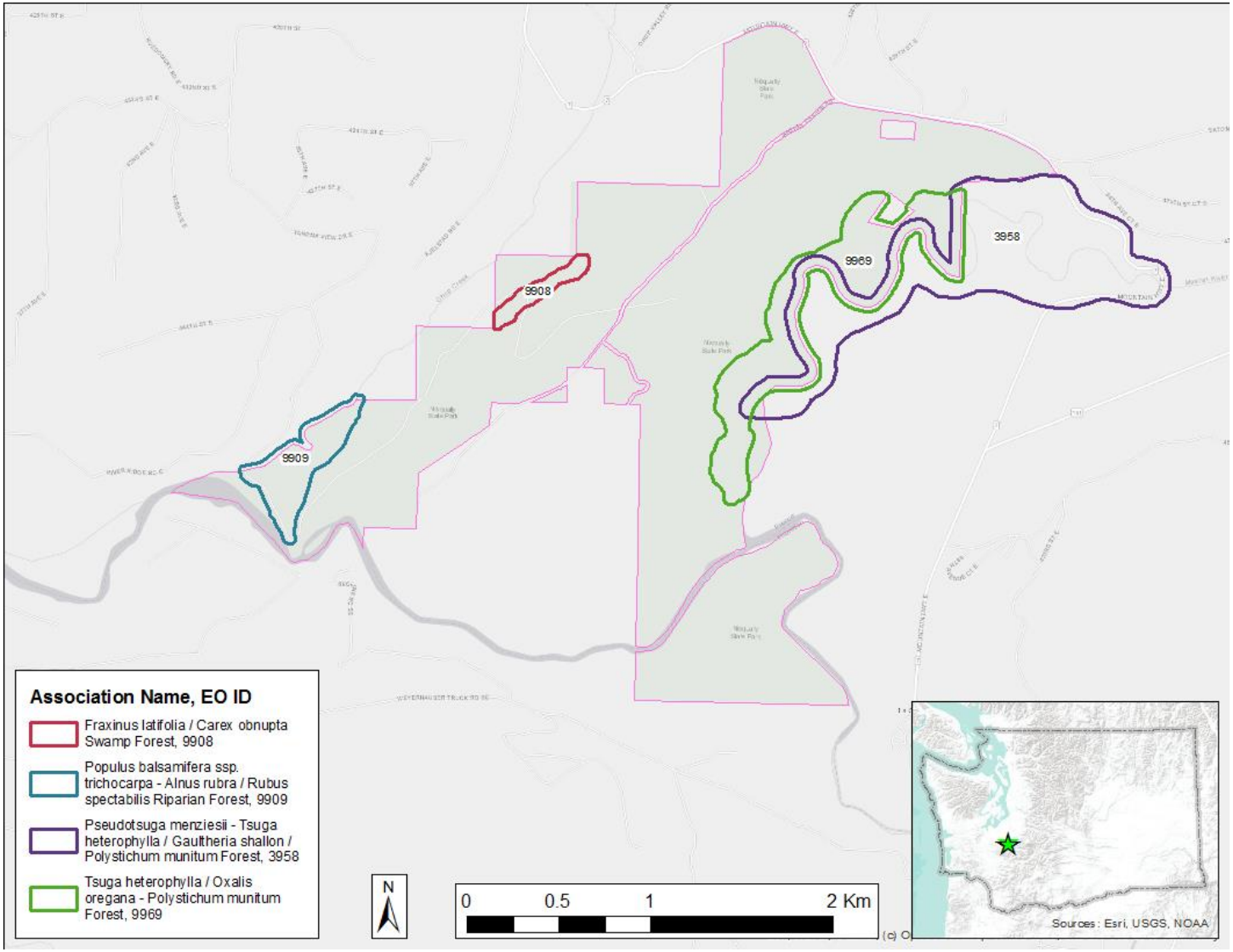

Figure R-8. Element occurrences at Nisqually State Park.

Appendix S. Squak Mountain

Figure S-1. A *Pseudotsuga menziesii - Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum* Forest (G4G5/S4) at Squak Mountain State Park.

The Ecological Integrity Assessment for Squak Mountain State Park is presented below (Figure S-4). A vegetation survey was previously completed by URS (2009f). This mapping was the basis for the assessment areas used in our surveys.

There were no previously documented community EOs at the park. Parks identified 5 polygons (618 hectares) of 2 different ecological systems as priorities for assessment (Figure S-5). All maps (Figure S-4 through Figure S-6) are presented at the end of the appendix for ease of reading.

EIA Results

All priority polygons were surveyed at Squak Mountain. Table S-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table S-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table S-1. EIA Summary for Squak Mountain State Park. Landscape Context ranks in gray cells were rolled up using LAN1 and LAN2 assessments done at the park boundary scale. The remaining landscape context ranks were calculated at the polygon scale, because they represented potential EOs (see section 2.3).

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
418	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	C	B	B-
419	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	B	B	B-
420	North Pacific Lowland Riparian Forest and Shrubland	B	A	B+
421	North Pacific Lowland Riparian Forest and Shrubland	B	B	B+
422	North Pacific Lowland Riparian Forest and Shrubland	B	A	B+

Table S-2. Individual EIA Metric Ranks for Squak Mountain.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
418	C	C	C	B	A	B	C	A	C	A	C				A	
419	B	C	B	C	A	A-	B	A	C	A	B				B	
420	C	C	B	C	A	A	A	A	C	A	B	A	A	A	B	
421	C	C	B	B	A	A-	A	A	C	A	B	A	A	B	B	
422	C	C	B	B	A	A-	A	A	C	A	B	A	A	A	A	

Figure S-2 and Figure S-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure S-6.

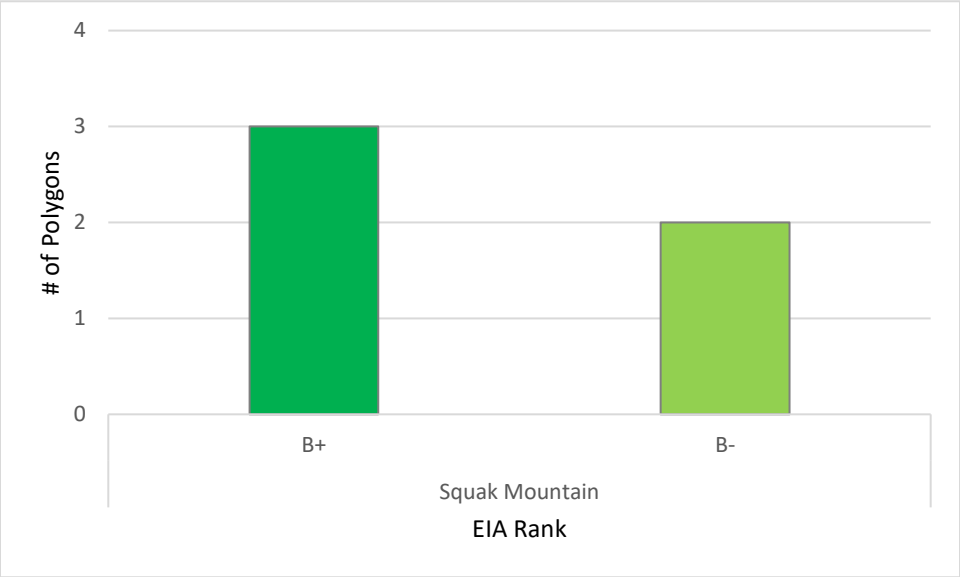

Figure S-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

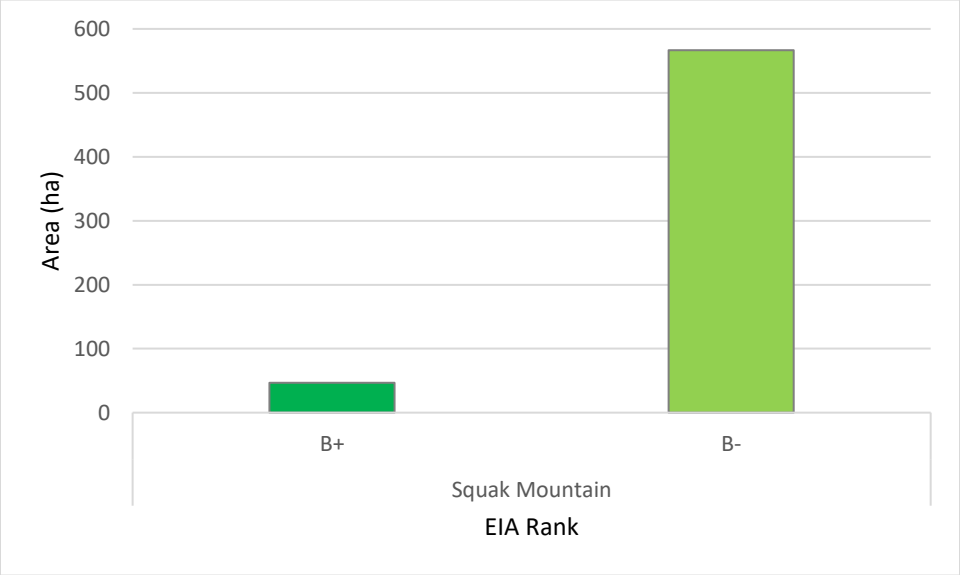

Figure S-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

No element occurrences were documented at Squak Mountain. While surveyed polygons have good (B) ecological integrity, they represent plant associations that are apparently secure to secure (G4/S4 or G4G5/S4S5) and thus did not meet the benchmark for element occurrences.

Summary and Discussion

Overall Conditions

The entirety of what is now Squak Mountain State Park was logged circa 1915 to 1935 (URS, 2009f). Besides the long-lasting structural impacts of those timber harvests (Table S-3, VEG4), the surveyed polygons at Squak Mountain are in good condition, with regenerated upland forests having reached maturation stages (Van Pelt, 2007). Somewhat surprisingly, the North Pacific Lowland Riparian Forest and Shrubland stands that were surveyed have few exotic/invasive species (VEG1, VEG2), while both North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest polygons were marked down for small to moderate infestations of *Ilex aquifolium*, *Geranium robertianum*, *Rubus laciniatus*, *Ranunculus repens*, and *Phalaris arundinacea*. Note that upland stands were mapped as North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest by previous surveyors (URS, 2009f). Stand establishment predated the widespread use of post-harvest replanting, so woody regeneration is assumed to be natural (VEG5). The largest size classes of coarse woody debris and snags (VEG6) are absent from the park, though most of the upland and riparian forests retain enough smaller diameter material to be considered within the natural range of variability.

Table S-3. Summary of EIA metric ratings by area (ha) at Squak Mountain State Park.

	Metric Rating			
Metric	A/A-	B	C	C-/D
VEG1	**453**	161		
VEG2	47	**406**	161	
VEG3	**613**			
VEG4			**613**	
VEG5	**613**			
VEG6		**453**	161	
HYD1	**47**			
HYD2	**47**			
HYD3	17	**30**		
SOI1	176	**437**		

The hydrology of the riparian stands is intact (HYD1-HYD2), with only hydrologic connectivity (HYD3) marked down slightly in one stand due to minor trail system impacts. The majority of the park shows some soil disturbance (SOI1) from past logging and mining, but with minimal modern impacts.

Recommendations for Enhancing / Maintaining Ecological Integrity

Besides treating invasive species, enhancing ecological integrity at Squak Mountain will mostly be a function of time, with vegetation structure and coarse woody debris gradually improving as subcanopies continue to develop in the understories and trees continue to mature and die. A very large proportion of Squak Mountain is accessible via trails, but aside from trailside weeds, such stressors have minimal impacts on the ecosystems present.

Future Assessment / Survey Recommendations

Nearly all of Squak Mountain was surveyed as part of this project. Further assessments are not a priority at this time.

Maps

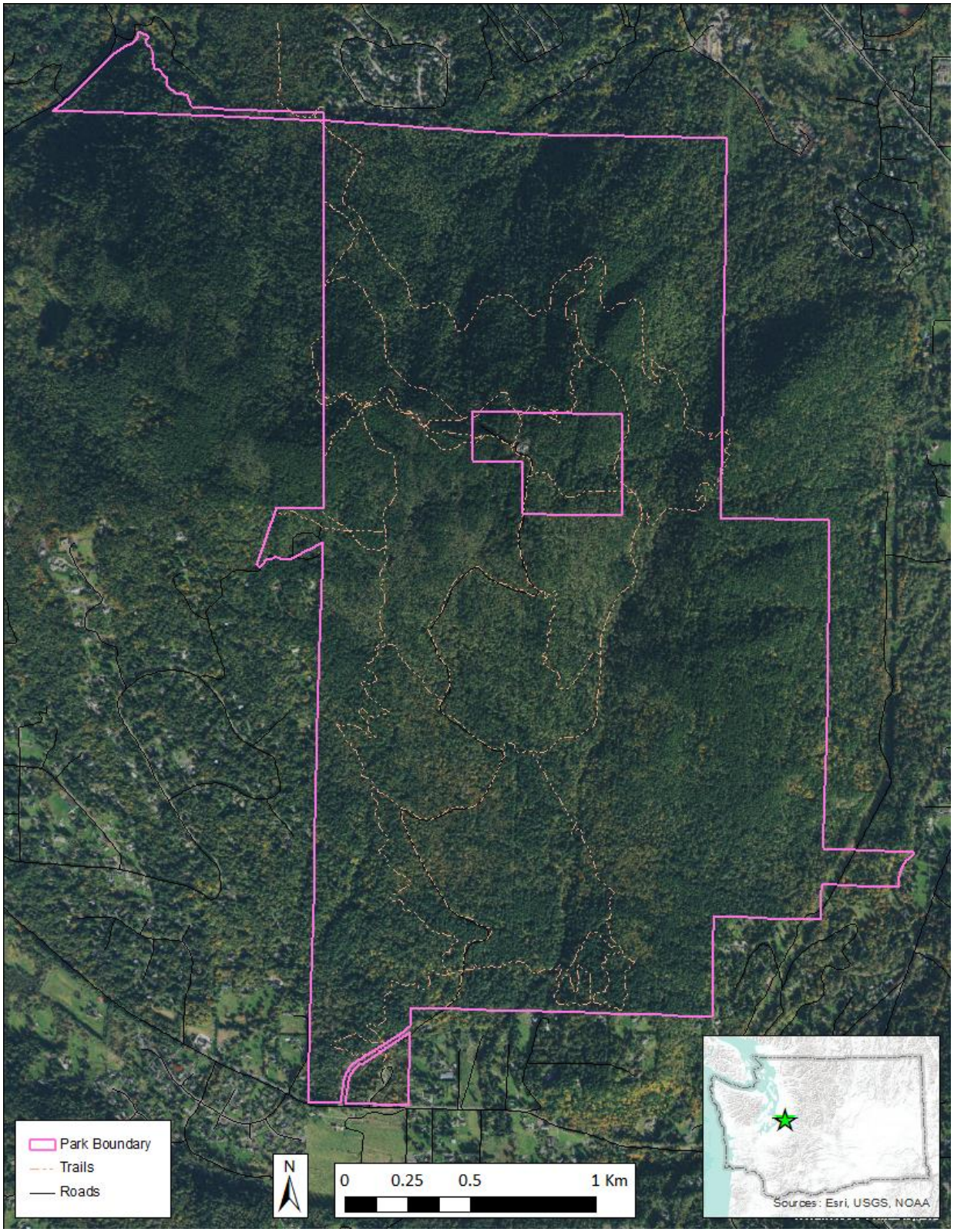

Figure S-4. Overview of Squak Mountain State Park

Figure S-5. Priority ecological systems polygons for assessment at Squak Mountain State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

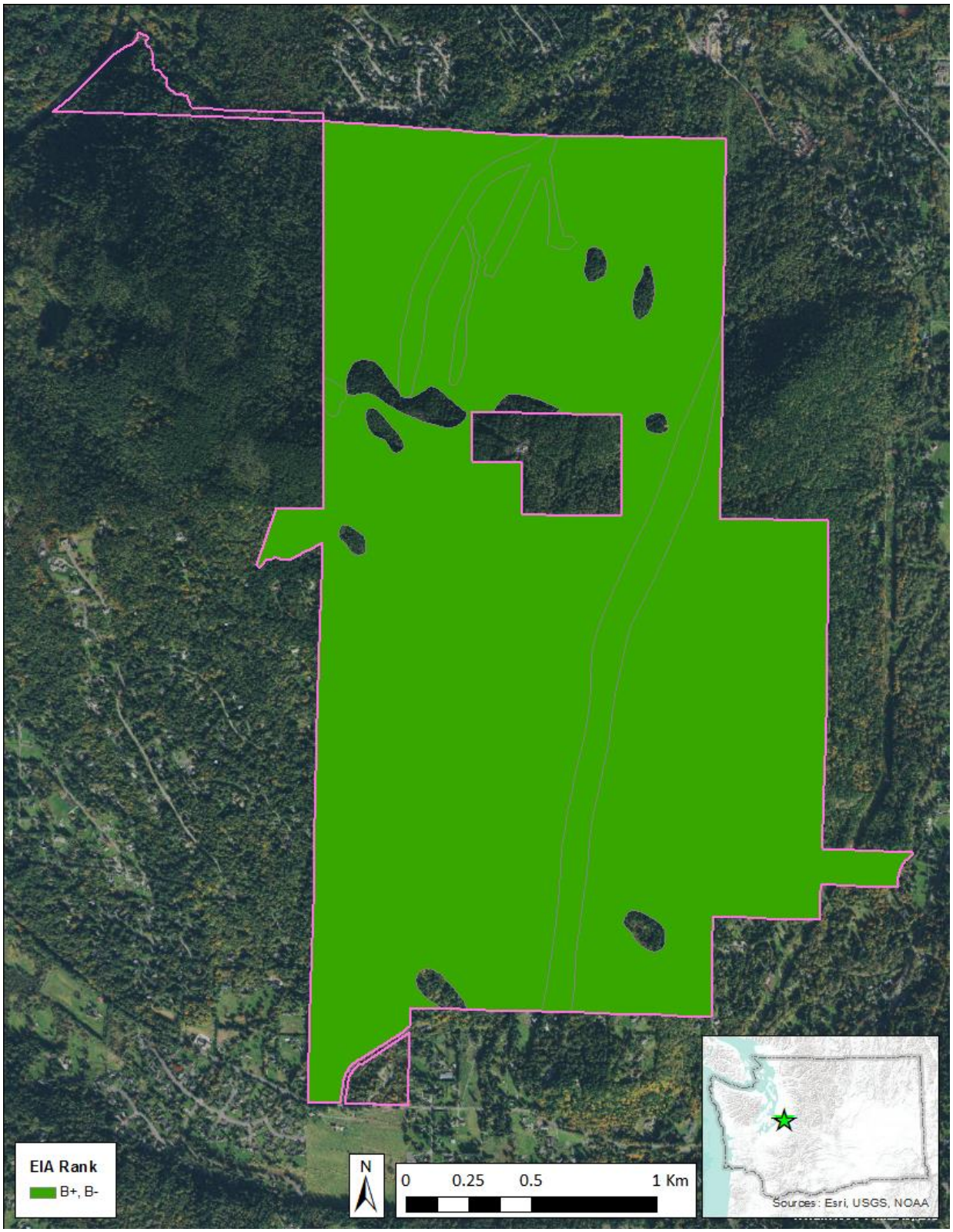

Figure S-6. EIA Ranks for all polygons assessed at Squak Mountain State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

Appendix T. Grayland Beach

Figure T-1. *Juncus falcatus* - *Juncus* (*lesueurii*, *nevadensis*) Wet Meadow (G3/S1?) at Grayland Beach State Park

The Ecological Integrity Assessment for Grayland Beach State Park is presented below (Figure T-4). A rare plant and vegetation survey was previously completed by Morrison et al. (2007). This mapping was the basis for the assessment areas used in our surveys.

There was one previously documented community EO at the park. Parks identified 13 polygons (91 hectares) of 3 different ecological systems as priorities for assessment (Figure T-5). All maps (Figure T-4 through Figure T-7) are presented at the end of the appendix for ease of reading.

EIA Results

A partial survey was completed at Grayland Beach. The following Vegetation Survey Database polygons were not surveyed as part of this project, as parts or all of them were previously assessed with EIA methodology in 2012 by Rex Crawford (WNHP): Grayland_10, _12, _13, _16, and _17. Together, they constitute element occurrence ID 8834 and are presented in the EIA data for this project under WNHP ES Poly ID 8834. Additionally, Grayland_15, _18, and _27 were not assessed as part of this project, in order to prioritize assessments at other parks. Grayland_18 is

likely the same plant association as WNHP ES Poly ID 214 and in similar condition, based on aerial imagery and landscape context. Grayland_15 and _27 are a matrix of *Picea sitchensis* / *Rubus spectabilis* / *Carex obnupta* - *Lysichiton americanus* Swamp Forest and *Picea sitchensis* / *Vaccinium ovatum* Forest. Those polygons are also likely to be in the same condition as WNHP ES Poly ID 214.

Table T-1 summarizes the landscape context and condition primary factor ranks and overall EIA ranks for these polygons. Table T-2 lists the individual metric ranks for each assessed polygon. The accompanying Microsoft Excel workbook contains the full list of metric scores, ranks, and associated comments.

Table T-1. EIA Summary for Grayland Beach.

WNHP ES Poly ID	Ecological System	Landscape Context Rank	Condition Rank	EIA Rank
213	North Pacific Hardwood-Conifer Swamp	C	B	B-
214	North Pacific Hardwood-Conifer Swamp	B	A	B+
215	North Pacific Shrub Swamp	C	B	B+
522	North Pacific Shrub Swamp	C	A	B+
8834	North Pacific Shrub Swamp	B	A	B+
205-EM	North Pacific Coastal Interdunal Wetland	C	B	B+
205-SS	North Pacific Coastal Interdunal Wetland	C	B	B+

Table T-2. Individual EIA Metric Ranks for Grayland Beach.

Metrics: LAN1. Contiguous Natural Land Cover; LAN2. Land Use Index; BUF/EDG 1. Perimeter with Natural Buffer; BUF/EDG2. Width of Natural Buffer; BUF/EDG3. Condition of Natural Buffer; VEG1. Relative Cover of Native Plants; VEG2. Absolute Cover of Invasive Nonnative Plants; VEG3. Native Plant Composition; VEG4. Vegetation Structure; VEG5. Woody Regeneration; VEG6. Coarse Woody Debris, Snags, and Litter; HYD1. Water Source; HYD2. Hydroperiod; HYD3. Hydrological Connectivity; SOI1. Soil Condition; SIZ1. Comparative Size.
EIA Ranks: A = excellent ecological integrity; B = good ecological integrity; C = fair ecological integrity; and D = poor ecological integrity.
See Rocchio et al. (2020b, 2020c) for further details.

WNHP ES Poly ID	LAN1	LAN2	BUF1/ EDG1	BUF2/ EDG2	BUF3/ EDG3	VEG1	VEG2	VEG3	VEG4	VEG5	VEG6	HYD1	HYD2	HYD3	SOI1	SIZ1
213	D	C	C	D	B	A-	B	A	A	A	A	B	B	C	B	A
214	C	C	B	B	B	A	A	A	A	A	A	B	B	C	A	A
215	B	B	C	C	C	A-	B	A	A			B	B	C	A	A
522	C	C	D	D	B	A	A	A	A			A	B	C	A	A
8834	C	C	B	B	B	A-	A	A	A			A	B	B	A	A
205-EM	A	A	B	B	D	B	B	A	A			A	B	B	A	B
205-SS	A	A	B	B	D	B	B	A	A			A	B	B	A	B

Figure T-2 and Figure T-3 show the breakdown of EIA ranks by number of polygons and by area. The distribution of ranks across the park is shown in Figure T-6.

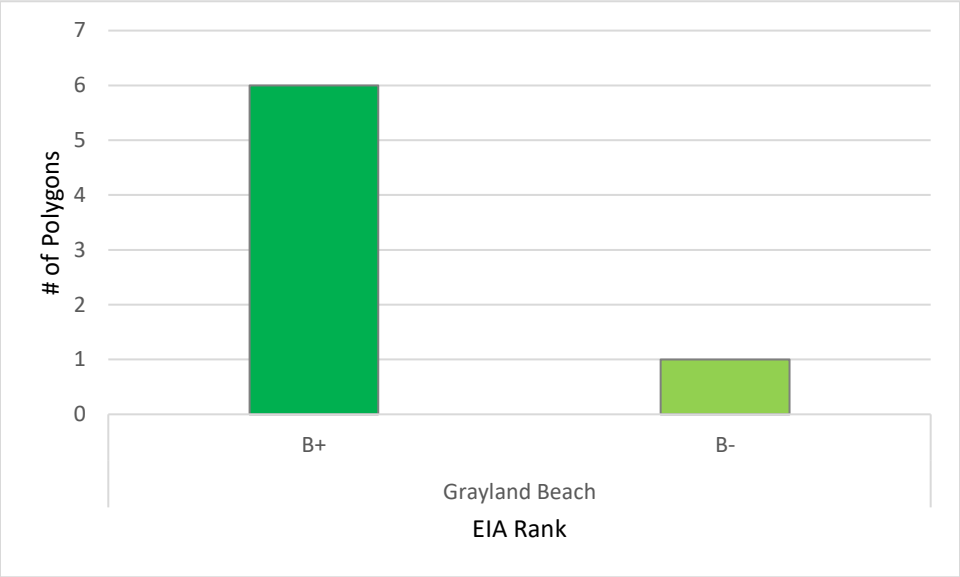

Figure T-2. EIA Ranks by number of polygons assessed. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

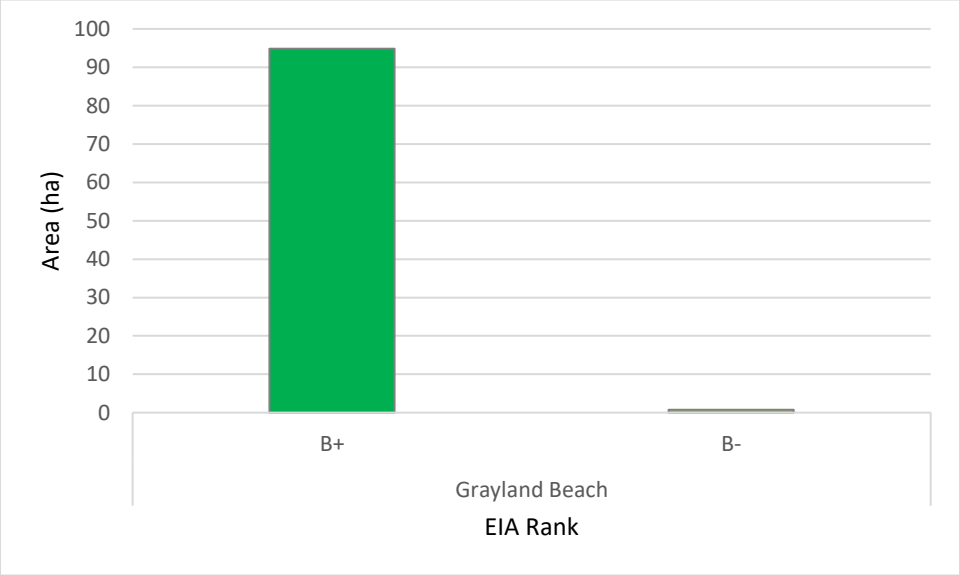

Figure T-3. EIA Ranks by area. This does not include non-EIA "best professional judgement" scores that were assigned outside of priority ecological systems polygons.

Element Occurrences

Four new element occurrences were documented at Grayland Beach (Figure T-7, Table T-3), all of which have good estimated viability (B+). Additionally, one existing EO (ID 8834) was expanded. Notably, the four new EOs represent three different ecological systems: North Pacific

Hardwood-Conifer Swamp, North Pacific Coastal Interdunal Wetland, and North Pacific Shrub Swamp. An EO-quality occurrence of *Juncus falcatus - Juncus* (*lesueurii*, *nevadensis*) Wet Meadow (G3/S1?) was also observed just east of the established park boundary on aggraded sand flats. For additional information, see the accompanying Excel workbook.

Table T-3. Summary of new element occurrences at Grayland Beach State Park. For additional information, see the accompanying Excel workbook.

EO ID	WNHP ES Poly ID	EL Code	NVC Plant Association(s)	Conservation Status Rank	EO Rank
9965	214	CEGL000400	Picea sitchensis / Rubus spectabilis / Carex obnupta - Lysichiton americanus Swamp Forest	G2G3/S2	B+
9966	205-SS	CWWA000140	Salix hookeriana / Carex obnupta - (Argentina egedii ssp. egedii) Shrub Swamp	G4/S1?	B+
9963	205-EM	CEGL001820	Carex obnupta - Argentina egedii ssp. egedii Wet Meadow	G4/S2?	B+
9964	205-EM	CEGL003382	Argentina egedii - Juncus balticus Salt Marsh	G3G4/S2	B+

Summary and Discussion

Overall Conditions

Grayland Beach shares many features in common with Ocean City State Park, on the opposite side of Grays Harbor. Most of the wetlands at Grayland occur in old dune landforms that are no longer active, functional dune systems (see Appendix H). Instead, they function as shrub or hardwood-conifer swamps and we chose to assess them as such, despite the semi-natural original (jetty-induced sand aggradation) of their successional arc. Also like at Ocean City, young forested swamps with no stumps were considered "naturally" early seral and were scored as such (VEG4, VEG6). In other words, these are young stands not because they were logged, but because the land itself has been recently deposited and stabilized.

With those classification and interpretation considerations out of the way, the ecosystem occurrences we surveyed at Grayland Beach have good integrity. Exotic/invasive plants (Table T-4, VEG1, VEG2) have minimal cover, with some patches of *Ilex aquifolium*, *Hedera hibernica*, *Iris pseudacorus*, *Phalaris arundinacea*, *Lythtrum salicaria* in the wetlands and *Cytisus scoparius* and *Holcus lanatus* in areas of higher relief. However, *Cytisus scoparius* and *Ammophila arenaria* are pervasive on the foredunes that were not surveyed as part of this project. Many of the wetlands are difficult to access and there were few observed stressors besides invasive plants. Native plant species composition (VEG3), vegetation structure (VEG4), woody regeneration (VEG5), and coarse woody debris, litter, and snags (VEG6) are all excellent when the early successional status of the forested woodlands is taken into account.

Table T-4. Summary of EIA metric ratings by area (ha) at Grayland Beach State Park.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
VEG1	**88**	8		
VEG2	**80**	16		
VEG3	**96**			
VEG4	**96**			
VEG5	**41**			
VEG6	**41**			
HYD1	48	**48**		
HYD2		**96**		
HYD3		42	**54**	
SOI1	**95**	1		

Hydrology at Grayland Beach has been impacted in a few ways. While no point-source discharges were found, some wetlands are nearly surrounded by roads, yards, and other artificial surfaces, which are presumed to impact water quality (HYD1). Aside from impoundments caused by road beds, the hydroperiod (HYD2) and hydrologic connectivity (HYD3) of several wetlands at Grayland Beach have also been affected by *Ammophila*-driven dune stabilization, which impedes drainage towards the ocean. Soil disturbance (SOI1) was rarely observed at Grayland Beach.

Recommendations for Enhancing / Maintaining Ecological Integrity

As noted above, many of the wetlands at Grayland Beach are difficult to access, so visitor impacts are minimal--further discouragement is not required. *Ammopila* infestations of the foredunes are the primary stressor at the park, just like most of the southwestern coast of Washington. On the other hand, stabilized dunes have also promoted the development of large wetlands dominated by native species.

Future Assessment / Survey Recommendations

Vegetation Survey Database polygons Grayland_15, _18, and _27 were originally included within priority ecological system polygons, but ended up not being assessed as part of this project. Their condition can likely be inferred from similar, nearby polygons. Most of the remaining unsurveyed polygons represent ruderal dune communities dominated by *Ammophila* spp. and *Cytisus scoparius*. Further assessments are not a priority at this time.

Maps

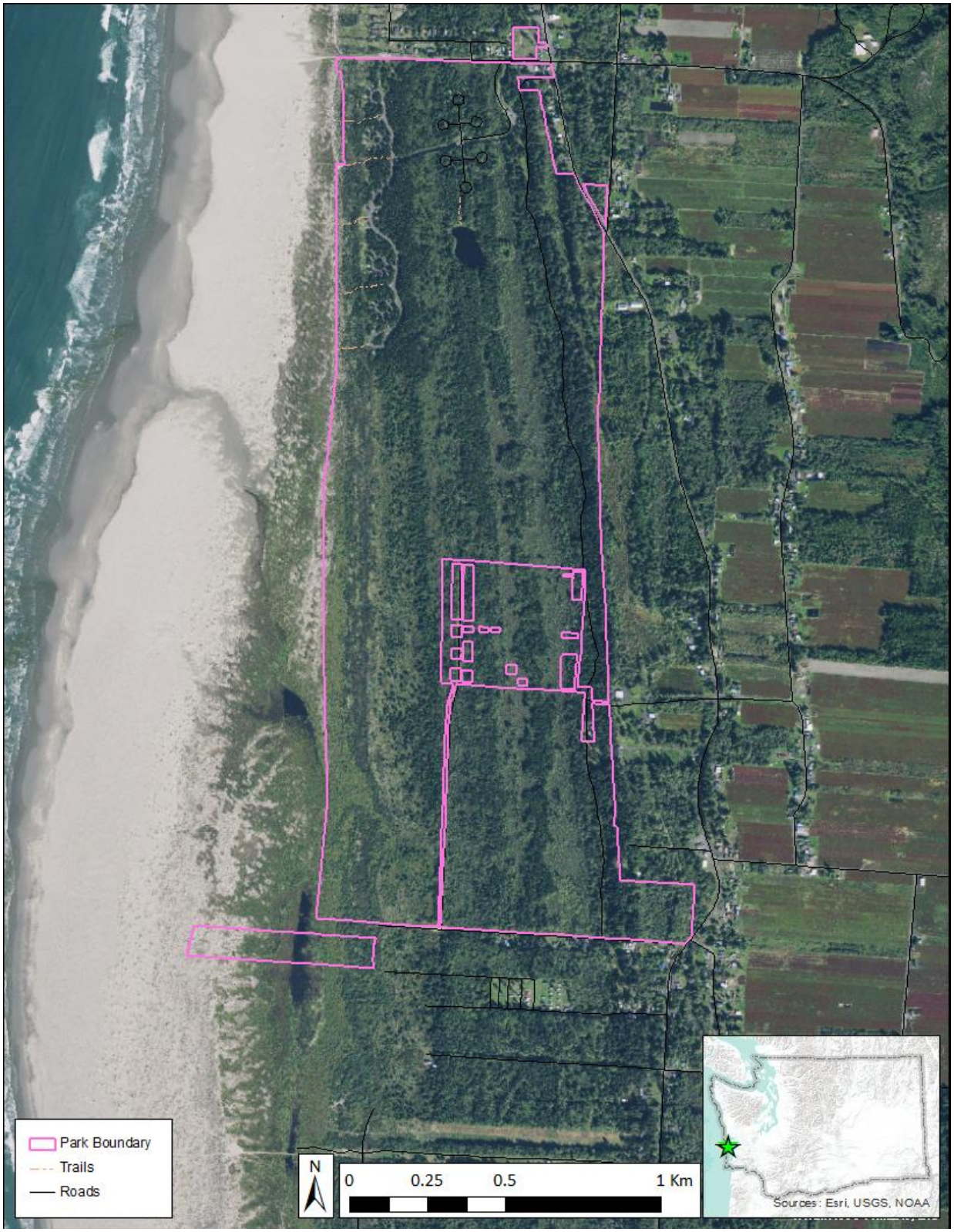

Figure T-4. Overview of Grayland Beach State Park

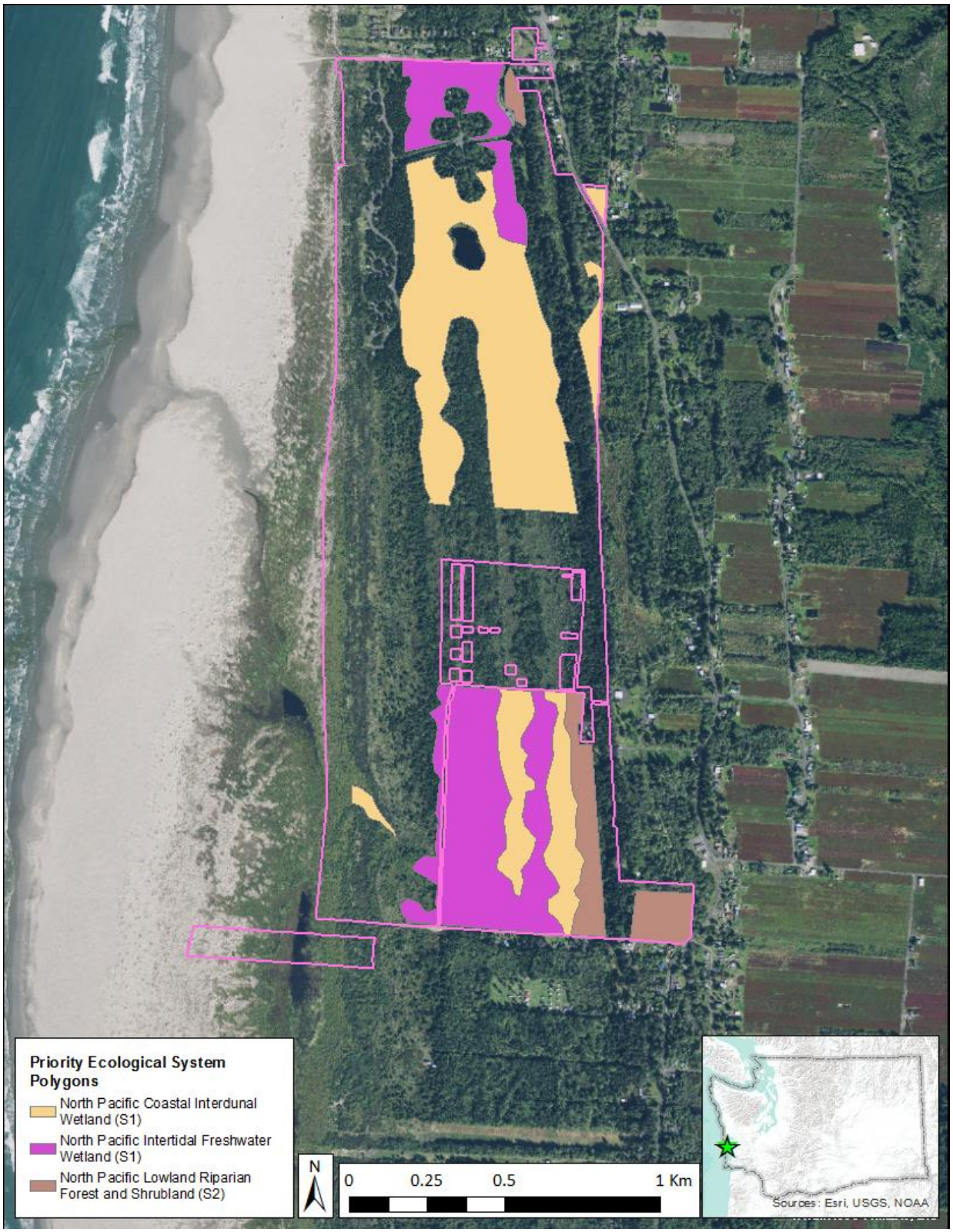

Figure T-5. Priority ecological systems polygons for assessment at Grayland Beach State Park. Note that these represent aggregates of association-level mapping done by previous surveyors. Priority polygons were selected by Parks staff.

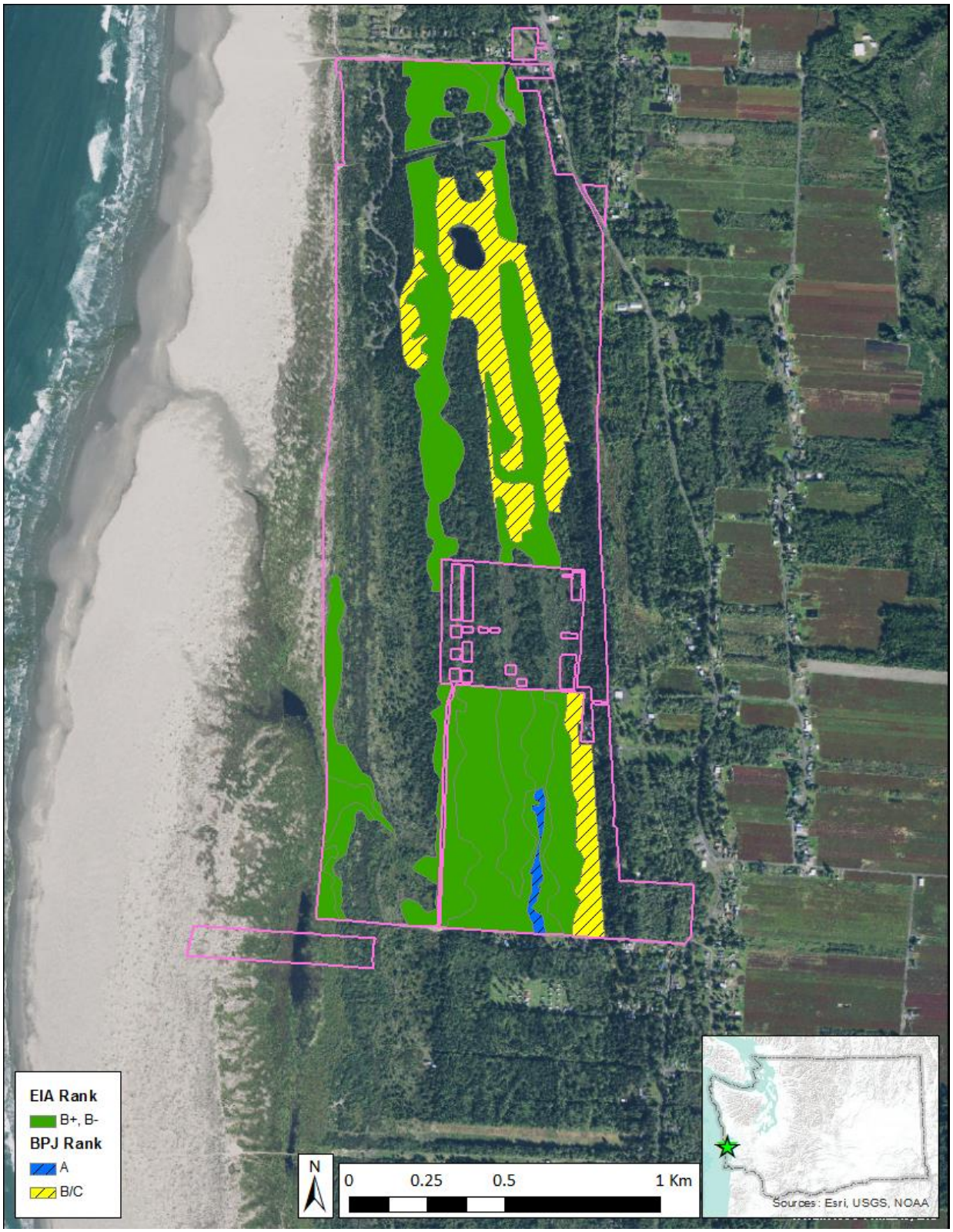

Figure T-6. EIA Ranks for all polygons assessed at Grayland Beach State Park. EIA Rank is an assessment of landscape context + condition and does not factor in size. BPJ = rapid, “best professional judgment” rank (not EIA).

Figure T-7. Element occurrences at Grayland Beach State Park.