Ecosystem Services Inventory and Asset Management Plan
ES Workgroup #2, June 27, 2024 9:00 am to 12:00 PM

Before we get started

- This is a public meeting and is being recorded.

- Only the Work Group members have access to the chat, not members of the public.

- We will have designated times to address questions throughout the meeting.

- Please keep cameras on.

- Please keep microphones off unless speaking.

- Materials, including the meeting recording, will be shared after the meeting and available on the Work Group website.

Agenda

Welcome and Introductions	10 min
Presentation	
Project Overview, Approach and Methodology	10 min
Developing the Geospatial Database & Establishing Land Cover Categories	25 min
Market Landscape Overview – Existing Markets	15 min
Break	10 min
Market Landscape Overview – Emerging Markets	35 min
Discussion	
Existing Markets	15 min
Emerging Markets (including 10 min Break)	60 min
Summary and Next Steps	20 min

Role of the Work Group

- Advise the technical contractor and DNR to guide the technical analyses and development of the ecosystem services asset plan

- Share relevant experiences and applicable expertise

- Provide counsel based on the interests and perspectives of the stakeholder group they represent

- Provide feedback to DNR pertaining to ecosystem services markets

- DNR has the final authority over the analyses, methods, and content of the legislative report

Key Definitions

- **B**eneficiary = A group benefitting from a specific DNR Trust, as defined in statute. For example: a county, a junior taxing district

- **b**eneficiary = A group/individual benefitting from an ecosystem service. For example: a community using river water, a person breathing clean air

- **Ecosystem Service** = "the benefits people obtain from ecosystems" (MEA, 2006)

  - DNR recognizes the existence and validity of multiple worldviews, many of which understand this concept differently. This definition is used to create a common language for discussion.

ES Work Group Members

Name		Organization	Title
Mark	Burrows	Stevens County	Commissioner / Chair
Brenda	Campbell	Snoqualmie Tribe	Climate Program Manager for Snoqualmie Tribe
Matt	Comisky	American Forest Resource Council	Washington Manager
Stephen	Donofrio	Ecosystems Marketplace	Managing Director
Julie Ann	Koehlinger	Hoh Indian Tribe	Director of Natural Resources
David	Onstad	Kitsap Environmental Coalition	President of the Kitsap Environmental Coalition
Mark	Ozias	Clallam County	Commissioner / Chair
Kasia	Patora	Department of Ecology	Lead Ecomomist
Russ	Pfeiffer-Hoyt	Mount Baker School District	School Board of Directors, Chair & WWSDA Trust Lands Advisory Committee, Chair
Mary Jean	Ryan	Center for Responsible Forestry	Board Member
Gareth	Waugh	Port Blakely	Director of Forestry
Jordan	Wildish	Department of Ecology	Cap and Invest Offsets Lead
Kathleen	Wolf	King County	Forest Carbon Manager
Rene	Zamora Cristales	Oregon State University	Faculty

Project Objective

➢ Explore ways DNR can generate revenue through carbon offset programs and other ecosystem services markets, while achieving greenhouse gas emission reductions and removal or enhancing other ecosystem services

Deliverables

➢Inventory of ecosystem services assets on DNR-managed lands

➢Asset management plan for ecosystem services assets

➢Report to legislature

Path forward

Understanding and Valuing Assets

Parcel Level Ecosystem Service Asset Inventory

System to Identify Most Promising Assets for Markets

Understanding the Market Landscape

Evaluate Offset Credit Programs and Market Opportunities

Create Marginal Cost Abatement Curve

Identify Most Feasible Markets for DNR Assets

Getting Ready to Market

Needs Assessment and Marketing Plan

Policy/Regulatory Needs

Dashboard Design

DEVELOPING THE GEOSPATIAL DATABASE
**Establishing Land Cover Categories**

GIS Process

Condense Condense 130+ Landfire/ Natureserve classes for land cover/ ecosystem types to 32 **base classes**

Improve *Conflate* lower-res statewide Landfire data with higher-res NOAA CCAP for western WA + add offshore & canopy height data

Overlay Create contextual themes to overlay with base classes that help better predict provision of ecosystem services based on location

Clip and tabulate Clip data to WA DNR management units or other geographies and tabulate acreages

Ecosystem Services Project

Over 120 categories of land cover in WA from GAP Analysis map. How do we aggregate?
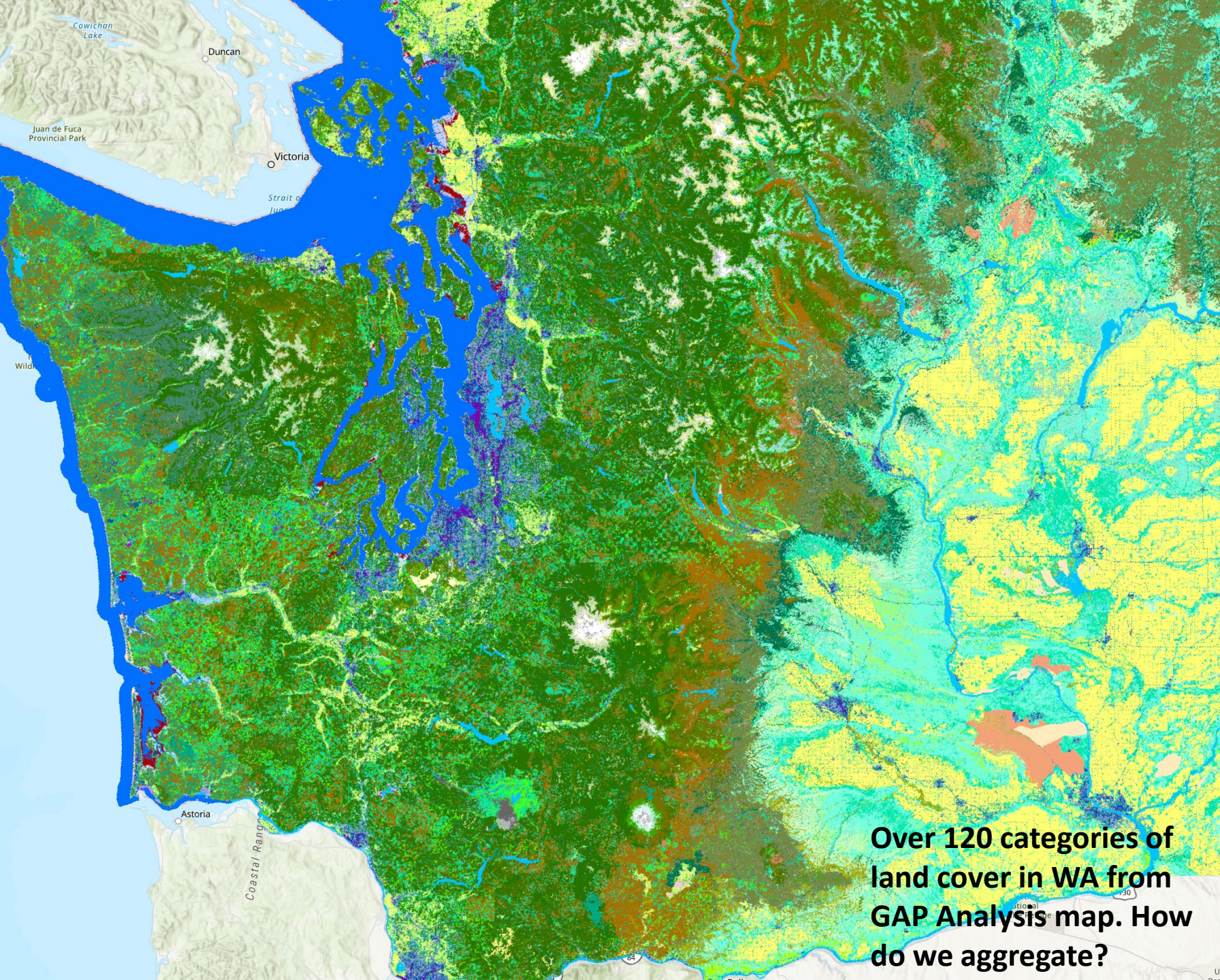
East Cascades Oak-Ponderosa Pine Forest and Woodland",
North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland",
North Pacific Oak Woodland"
East Cascades Mesic Montane Mixed-Conifer Forest and Woodland"
Middle Rocky Mountain Montane Douglas-fir Forest and Woodland
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest
Northern Rocky Mountain Mesic Montane Mixed Conifer Forest
Northern Rocky Mountain Ponderosa Pine Woodland and Savanna"
Northern Rocky Mountain Western Larch Savanna",
Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland
Northern Rocky Mountain Subalpine Woodland and Parkland
Rocky Mountain Aspen Forest and Woodland
Rocky Mountain Lodgepole Pine Forest
Rocky Mountain Poor-Site Lodgepole Pine Forest",
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland"
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
North Pacific Broadleaf Landslide Forest and Shrubland
North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest
North Pacific Hypermaritime Sitka Spruce Forest
North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
North Pacific Lowland Mixed Hardwood-Conifer Forest and Woodland
North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest
North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
North Pacific Mesic Western Hemlock-Silver Fir Forest
North Pacific Wooded Volcanic Flowage
North Pacific Maritime Mesic Subalpine Parkland
North Pacific Mountain Hemlock Forest
Columbia Plateau Western Juniper Woodland and Savanna
Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shr...
East Gulf Coastal Plain Near-Coast Pine Flatwoods - Open Understory M...
Columbia Basin Foothill Riparian Woodland and Shrubland
Great Basin Foothill and Lower Montane Riparian Woodland and Shrubl...
Northern Rocky Mountain Conifer Swamp
Northern Rocky Mountain Lower Montane Riparian Woodland and Shru...
Rocky Mountain Lower Montane Riparian Woodland and Shrubland
Rocky Mountain Subalpine-Montane Riparian Woodland
North Pacific Hardwood-Conifer Swamp
North Pacific Lowland Riparian Forest and Shrubland
North Pacific Montane Riparian Woodland and Shrubland
North Pacific Shrub Swamp
Columbia Basin Foothill and Canyon Dry Grassland

Proposed Class Structure

	Proposed Classification		
	See https://explorer.natureserve.org/ for class descriptions		
Code	**New class name**	**Code**	**New Class Name**
1	Conifer Forest	17	Rock, cliffs, scree, lava, and alkaline
2	Deciduous	18	Developed
3	Mixed tree grass or tree savanna	19	Urban forest-deciduous
4	Meadow, grassland and parkland	20	Urban forest-evergreen
5	Shrub Scrub	21	Urban forest-mixed
6	Mixed forest	22	Urban herbaceous
7	Riparian Forest	23	Urban shrub
8	Riparian Shrub and herbaceous	24	Bare earth-disturbed
9	Wooded and shrubby fresh wetlands	25	Open water
10	Emergent fresh wetlands	26	Aquaculture
11	Fresh herbaceous wetlands/ wet meadows	27	Sand and dunes
12	Salt and tidal wetlands	28	Disturbed forest
13	Vineyards	29	Introduced herbaceous
14	Orchards	30	Coastal mixed dune and shrub or herbaceous
15	Agriculture-other	31	Ruderal forest
16	Ice and snow	32	Ruderal shrub, scrub and herbaceous
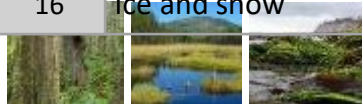
Example of how classes were condensed

Proposed Classification			
See https://explorer.natureserve.org/ for class descriptions			
Code	**New class name**		**Old Class Name**
7	Riparian Forest		North Pacific Lowland Riparian Forest
			North Pacific Montane Riparian Woodland
			Columbia Basin Foothill Riparian Woodland
			Rocky Mountain Subalpine-Montane Riparian Woodland
8	Riparian Shrub and herbaceous		North Pacific Lowland Riparian Shrubland
			North Pacific Montane Riparian Shrubland
			Rocky Mountain Subalpine-Montane Riparian Shrubland
			Columbia Basin Foothill Riparian Herbaceous
			Northern Rocky Mountain Lower Montane Riparian Shrubland
9	Wooded and shrubby fresh wetlands		Northern Rocky Mountain Conifer Swamp
			North Pacific Shrub Swamp
			Northern Rocky Mountain Lower Montane Riparian Woodland
			North Pacific Hardwood-Conifer Swamp
10	Emergent fresh wetlands		Temperate Pacific Freshwater Emergent Marsh
			North American Arid West Emergent Marsh

Class Definitions

Land Class Example		
See https://explorer.natureserve.org/ for class descriptions		
Code	**New class name**	**Old class names**
9	Wooded and shrubby fresh wetlands	Northern Rocky Mountain Conifer Swamp
		North Pacific Shrub Swamp
		Northern Rocky Mountain Lower Montane Riparian Woodland
		North Pacific Hardwood-Conifer Swamp

Northern Rocky Mountain Conifer Swamp

NatureServe Element Code: CES306.803
Summary:

This ecological system occurs in the northern Rocky Mountains from northwestern Wyoming north into the Canadian Rockies and west into eastern Oregon and Washington. It is dominated by conifers on poorly drained soils that are saturated year-round or may have seasonal flooding in the spring. These are primarily on flat to gently sloping lowlands, but also occur up to near the lower limits of continuous forest (below the subalpine parkland). It can occur on steeper slopes where soils are shallow over unfractured bedrock. This system is indicative of poorly drained, mucky areas, and areas are often a mosaic of moving water and stagnant water. Soils can be woody peat, muck or mineral but tend toward mineral. Stands generally occupy sites on benches, toeslopes or valley bottoms along mountain streams. Associations present include wetland phases of *Thuja plicata*, *Tsuga heterophylla*, and *Picea engelmannii* forests. The wetland types are generally distinguishable from other upland forests and woodlands by shallow water tables and mesic or hydric undergrowth vegetation; some of the most typical species include *Athyrium filix-femina*, *Dryopteris* spp., *Lysichiton americanus*, *Equisetum arvense*, *Senecio triangularis*, *Mitella breweri*, *Mitella pentandra*, *Streptopus amplexifolius*, *Calamagrostis canadensis*, or *Carex disperma*.

New Search

North Pacific Shrub Swamp

NatureServe Element Code: CES204.865
Summary:

Swamps vegetated by shrublands occur throughout the Pacific Northwest Coast, from Cook Inlet and Prince William Sound, Alaska, to the southern coast of Oregon. These are deciduous broadleaf tall shrublands that are located in depressions, around lakes or ponds, or river terraces where water tables fluctuate seasonally (mostly seasonally flooded regime), in areas that receive nutrient-rich waters. These depressions are poorly drained with fine-textured organic, muck or mineral soils and standing water common throughout the growing season. *Alnus viridis ssp. sinuata* often dominates the shrub layer, but many *Salix* species may also occur. The shrub layer can have many dead stems. However, various species of *Salix*, *Spiraea douglasii*, *Malus fusca*, *Cornus sericea*, *Alnus incana ssp. tenuifolia* (= *Alnus tenuifolia*), *Alnus viridis ssp. crispa* (= *Alnus crispa*), and/or *Alnus viridis ssp. sinuata* (= *Alnus sinuata*) can be the major dominants. They may occur in mosaics with marshes or forested swamps, being on average more wet than forested swamps and more dry than marshes. However, it is also frequent for them to dominate entire wetland systems. Hardwood-dominated stands (especially *Fraxinus latifolia*) may be considered a shrub swamp when they are not surrounded by conifer forests but do not occur in Alaska. Typical landscape for the *Fraxinus latifolia* stands were very often formerly dominated by prairies and now by agriculture. Wetland species, including *Carex aquatilis var. dives* (= *Carex sitchensis*), *Carex utriculata*, *Equisetum fluviatile*, and *Lysichiton americanus*, dominate the understory. On some sites, *Sphagnum* spp. are common in the understory (Stikine, Yakutat Forelands, Copper River Delta).
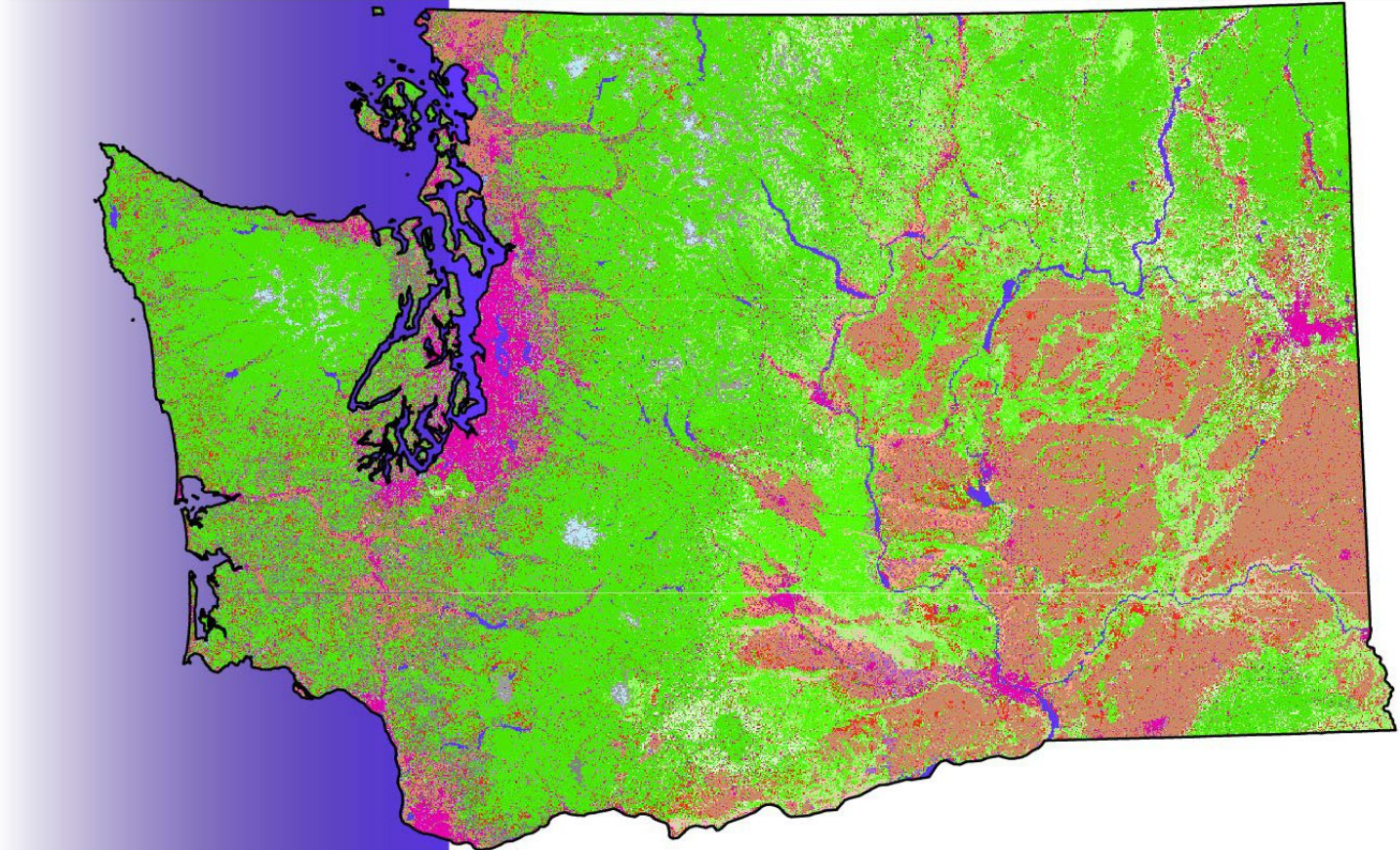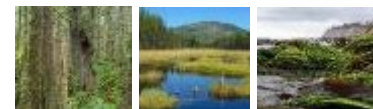
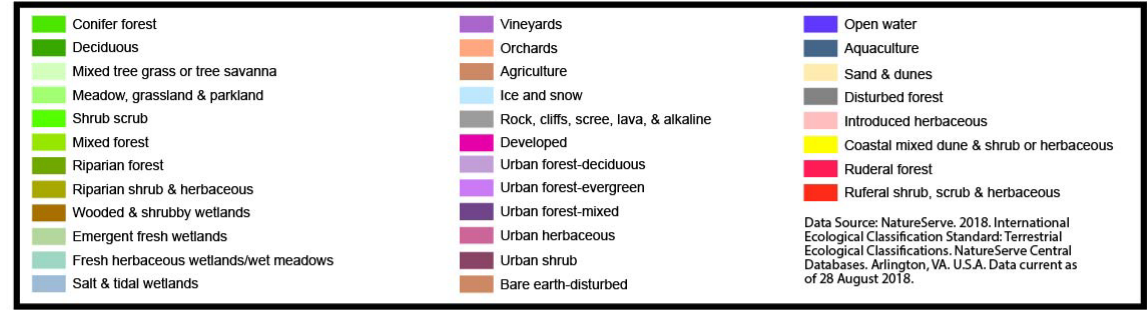**Washington State Land Cover** — Dataset reclassified from 99 to 33 condensed categories — By Mandy Rees amanda.rees@ucdenver.edu

Legend:
- Conifer forest
- Deciduous
- Mixed tree grass or tree savanna
- Meadow, grassland & parkland
- Shrub scrub
- Mixed forest
- Riparian forest
- Riparian shrub & herbaceous
- Wooded & shrubby wetlands
- Emergent fresh wetlands
- Fresh herbaceous wetlands/wet meadows
- Salt & tidal wetlands
- Vineyards
- Orchards
- Agriculture
- Ice and snow
- Rock, cliffs, scree, lava, & alkaline
- Developed
- Urban forest-deciduous
- Urban forest-evergreen
- Urban forest-mixed
- Urban herbaceous
- Urban shrub
- Bare earth-disturbed
- Open water
- Aquaculture
- Sand & dunes
- Disturbed forest
- Introduced herbaceous
- Coastal mixed dune & shrub or herbaceous
- Ruderal forest
- Ruferal shrub, scrub & herbaceous

Data Source: NatureServe. 2018. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 28 August 2018.
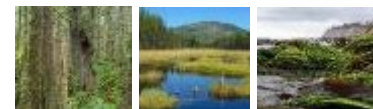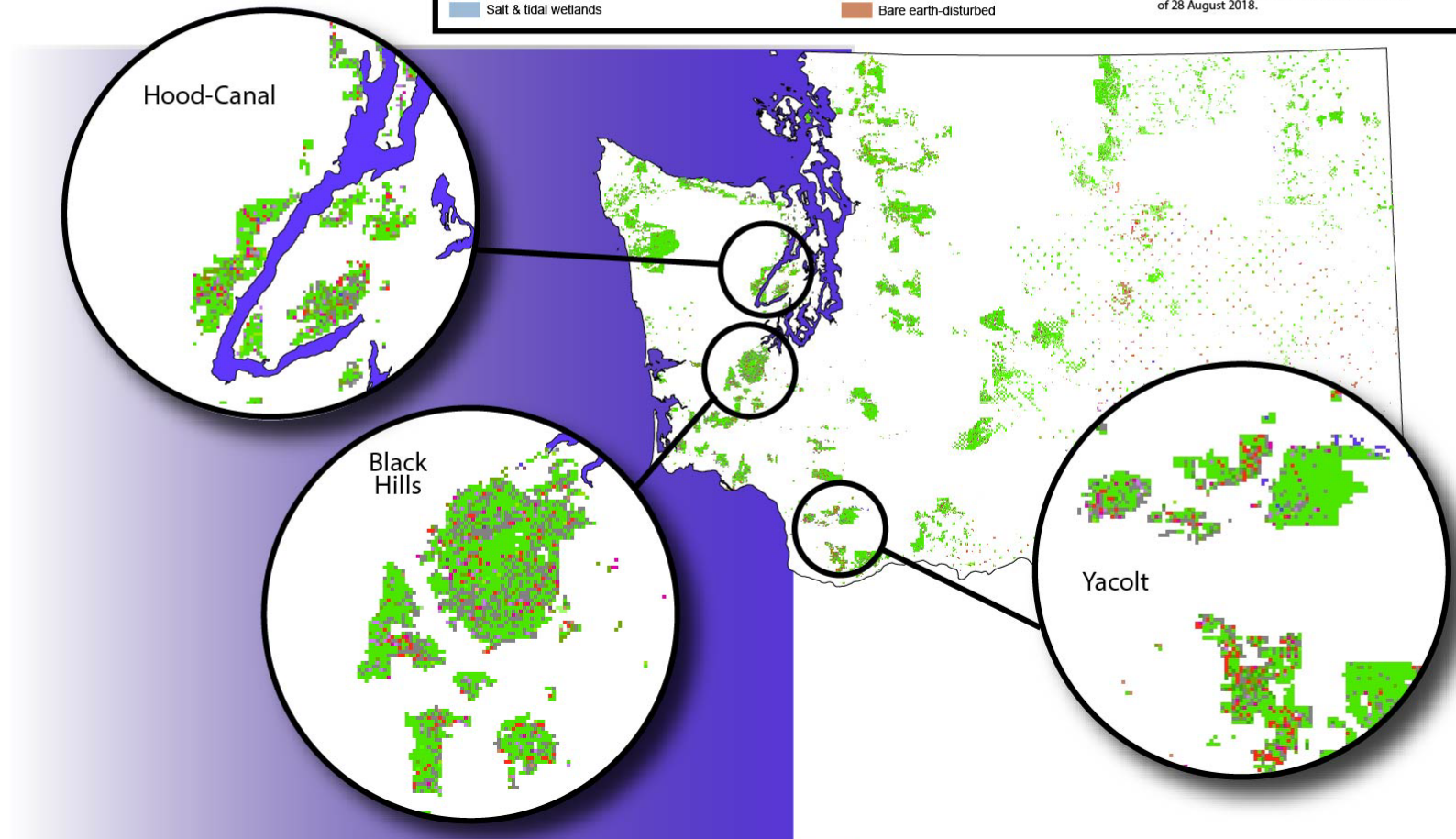
Basemap Creation

Washington State Land Cover & DNR Land — Reclassified LandFire land cover dataset clipped to DNR land

By Mandy Rees
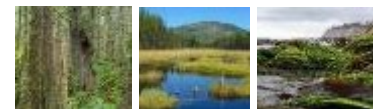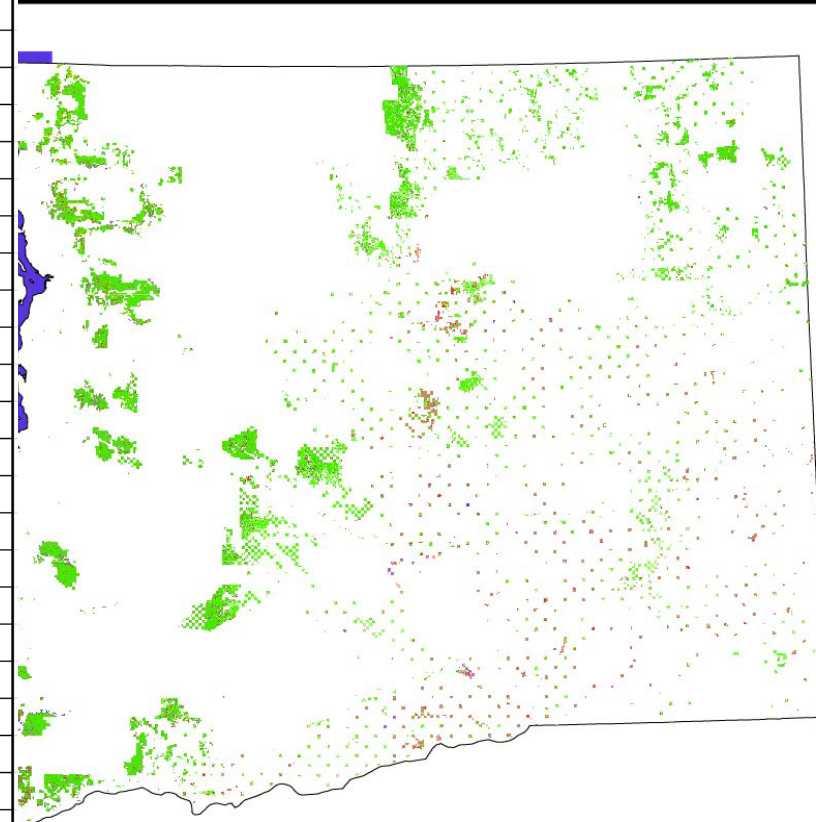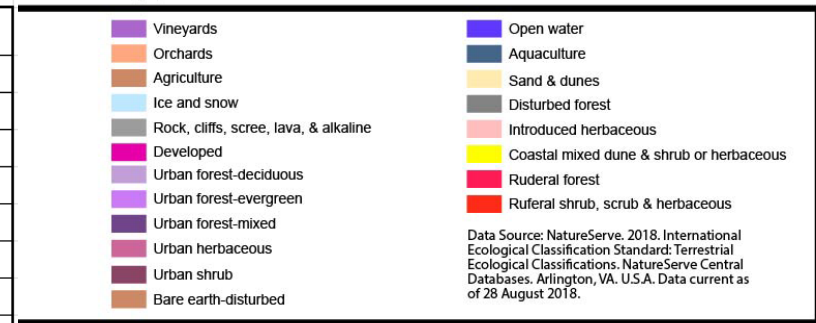amanda.rees@ucdenver.edu

DNR LDO Clipping: Zooming in

Acreage by land cover for DNR LDO areas

Washington State Land Cover & DNR Land

Reclassified LandFire land cover dataset clipped to DNR land

By Mandy Rees
amanda.rees@ucdenver.edu

Land Cover	Acreage
Conifer Forest	1,641,484
Deciduous	4,975
Mixed tree grass or tree savanna	129,900
Meadow, grassland and parkland	196,240
Shrub scrub	360,923
Mixed forest	48,074
Riparian forest	74,620
Riparian shrub and herbaceous	2,230
Wooded and shrubby fresh wetlands	5,783
Emergent fresh wetlands	3,814
Fresh herbaceous wetlands/ wet meadows	838
Salt and tidal wetlands	346
Vineyards	8,405
Orchards	11,282
Agriculture - other	165,332
Ice and Snow	99
Rock, cliffs, scree, lava, and alkaline	26,505
Developed	54,099
Urban forest-deciduous	5,991
Urban forest-evergreen	46,955
Urban forest-mixed	3,464
Urban herbaceous	2,605
Urban shrub	5,593
Bare earth-disturbed	180
Open Water	9,715
Sand and dunes	817
Disturbed forest	206,199
Introduced herbaceous	30,789
Coastal mixed dune and shrub or herbaceous	3
Ruderal forest	243
Ruderal shrub, scrub and herbaceous	88,280
Total	**3,135,781**

Legend:
- Vineyards
- Orchards
- Agriculture
- Ice and snow
- Rock, cliffs, scree, lava, & alkaline
- Developed
- Urban forest-deciduous
- Urban forest-evergreen
- Urban forest-mixed
- Urban herbaceous
- Urban shrub
- Bare earth-disturbed
- Open water
- Aquaculture
- Sand & dunes
- Disturbed forest
- Introduced herbaceous
- Coastal mixed dune & shrub or herbaceous
- Ruderal forest
- Ruferal shrub, scrub & herbaceous

Data Source: NatureServe. 2018. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 28 August 2018.

Full table:

District	Conifer Forest	Decid-uous	Mixed tree grass or tree savanna	Meadow, grassland and parkland	Shrub scrub	Mixed forest	Riparian forest	Riparian shrub and herbaceous	Wooded and shrubby fresh wetlands	Emergent fresh wetlands	Fresh herbaceous wetlands/wet meadows	Salt and tidal wetlands	Vineyards	Orchards	Agriculture - other	Ice and Snow	Rock, cliffs, scree, lava, and alkaline	Developed	Urban forest-deciduous	Urban forest-evergreen	Urban forest-mixed	Urban herbaceous	Urban shrub	Bare earth-disturbed	Open Water	Sand and dunes	Disturbed forest	Introduced herbaceous	Coastal mixed dune and shrub or herbaceous	Ruderal forest	Ruderal shrub, scrub and herbaceous	Total
ALPINE	171,007	1	42,529	22,056	124,299	-	4,028	280	-	381	394	-	20	660	1,666	-	5,769	12,795	114	2,784	146	187	1,729	49	324	-	-	4,095	-	-	2,644	397,957
ARCADIA	38,509	2	19,566	6,019	9,584	-	1,134	122	1,140	167	23	-	-	5	5,950	-	247	854	52	177	5	35	124	-	378	-	-	395	-	-	2,170	86,659
BAKER	96,821	-	-	291	782	19,721	2,878	25	36	178	4	1	-	9	679	-	69	591	515	2,012	334	68	54	5	220	-	6,639	-	-	-	4,075	136,007
BLACK_HILLS	62,112	43	-	392	529	861	3,568	8	260	103	1	6	-	78	1,002	-	31	1,368	532	2,201	249	68	118	-	82	2	31,317	-	-	-	4,658	109,588
CASCADE	102,682	-	-	855	1,317	7,682	6,844	36	36	167	3	-	-	10	440	99	2,567	631	430	2,489	294	60	56	67	325	-	10,169	-	-	-	4,101	141,360
CLEAR_LAKE	66,560	-	-	194	630	11,510	3,767	33	13	230	2	-	-	6	399	-	298	1,672	393	3,071	275	68	48	-	352	-	7,903	-	-	-	3,466	100,892
COAST	149,056	-	-	46	460	76	9,552	30	550	159	3	29	-	-	36	-	52	1,408	311	4,474	128	69	58	11	471	-	5,529	-	-	-	1,537	174,045
COLUMBIA_BASIN	487	-	1,512	63,732	105,615	-	716	1,130	-	457	-	-	3,162	3,251	92,346	-	4,528	6,228	225	106	19	729	1,239	-	2,921	700	-	9,434	-	177	16,641	315,354
HIGHLANDS	109,093	870	26,898	24,475	29,503	-	2,442	93	315	88	249	-	0	81	364	-	4,810	4,641	49	749	19	57	315	6	39	-	-	179	-	-	773	206,108
HOOD_CANAL	45,376	-	-	416	339	1,473	5,970	31	285	225	-	39	-	22	148	-	503	2,144	197	2,053	110	32	41	-	243	3	12,782	-	-	-	2,323	74,755
KLICKITAT	75,292	6	9,494	5,793	8,895	0	3,040	57	163	441	9	-	6	82	3,676	-	195	4,223	172	3,468	164	68	308	10	163	-	0	2,004	-	-	3,922	121,653
LEWIS	78,904	-	-	-	896	988	7,908	62	150	192	-	130	-	21	768	-	19	1,142	657	3,719	388	80	68	-	598	1	30,798	-	-	-	6,582	134,071
NORTH_COLUMBIA	107,292	20	18,500	5,405	7,379	-	4	18	1,918	37	52	-	0	4	234	-	652	631	13	222	3	3	23	3	469	-	-	-	-	-	569	143,452
ORCA	5,863	-	-	3	4	118	179	3	-	29	-	21	-	-	50	-	3	29	10	131	8	2	4	-	73	13	399	-	3	-	30	6,979
OZETTE	87,864	-	-	1	748	50	5,955	26	571	50	0	0	-	0	19	-	12	997	167	2,705	89	31	18	-	157	2	8,824	-	-	-	2,031	110,319
RAINIER	140,872	1	-	370	799	3,393	6,352	27	39	301	5	-	-	2	78	-	443	1,233	570	4,479	357	59	105	15	531	-	15,590	-	-	-	3,544	179,164
SNAKE_RIVER	2,825	70	1,326	32,549	27,393	-	178	86	7	15	1	-	5,157	5,630	54,689	-	2,347	2,629	87	101	10	487	606	10	186	89	-	11,697	-	66	9,722	157,963
SOUTH_OKANOGAN	27,508	1	10,074	33,459	39,295	-	1,018	112	64	291	74	-	5	1,379	1,261	-	3,619	3,292	26	503	18	291	413	-	155	-	-	2,985	-	-	1,361	127,204
ST_HELENS	106,284	101	-	-	1,177	673	3,249	33	113	141	18	97	-	10	432	-	62	2,984	965	6,592	525	149	133	-	140	1	23,697	-	-	-	5,397	152,972
STRAITS	59,236	-	-	151	654	1,078	3,224	8	75	77	-	23	-	3	75	-	113	1,306	241	1,952	144	26	55	-	180	6	26,362	-	-	-	2,912	97,902
YACOLT	107,841	3,860	-	32	625	449	2,613	8	45	85	-	-	54	28	1,019	-	166	3,302	266	2,967	178	37	79	3	1,710	-	26,188	-	-	-	9,821	161,377
TOTAL	1,641,484	4,975	129,900	196,240	360,923	48,074	74,620	2,230	5,783	3,814	838	346	8,405	11,282	165,332	99	26,505	54,099	5,991	46,955	3,464	2,605	5,593	180	9,715	817	206,199	30,789	3	243	88,280	3,135,781
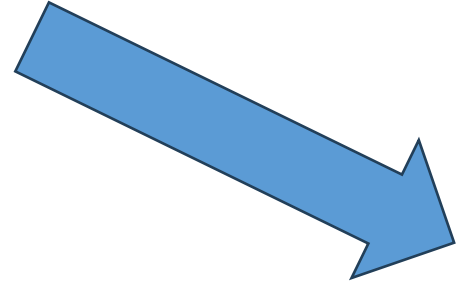
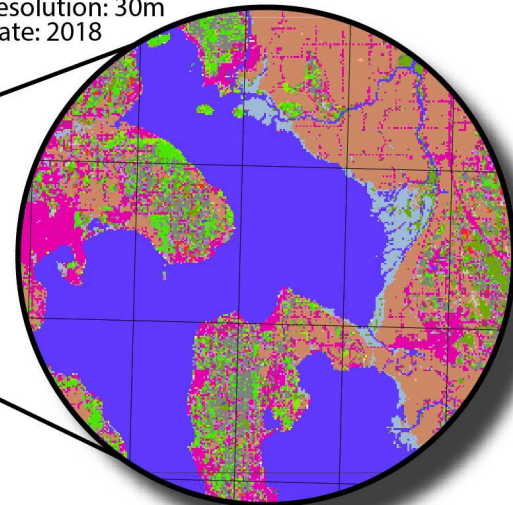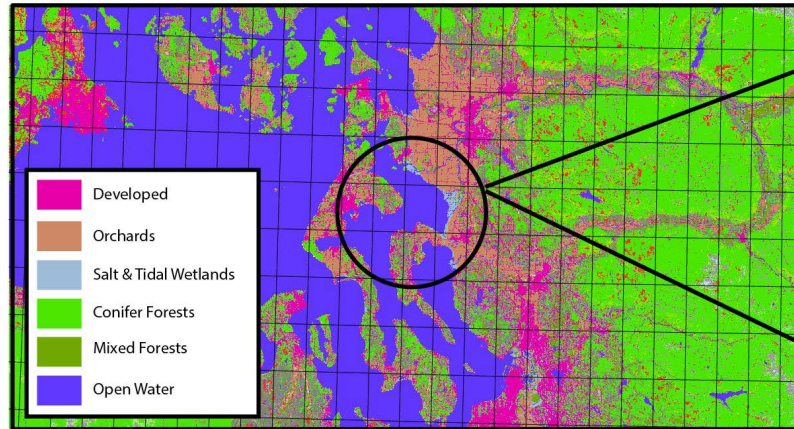# Acreage of landcover types tabulated by DNR Management District

Zoomed detail:

District	Conifer Forest	Decid-uous	Mixed tree grass or tree savanna	Meadow, grassland and parkland	Shrub scrub	Mixed forest	Riparian forest
ALPINE	171,007	1	42,529	22,056	124,299	-	4,028
ARCADIA	38,509	2	19,566	6,019	9,584	-	1,134
BAKER	96,821	-	-	291	782	19,721	2,878
BLACK_HILLS	62,112	43	-	392	529	861	3,568
CASCADE	102,682	-	-	855	1,317	7,682	6,844
CLEAR_LAKE	66,560	-	-	194	630	11,510	3,767
COAST	149,056	-	-	46	460	76	9,552
COLUMBIA_BASIN	487	-	1,512	63,732	105,615	-	716
HIGHLANDS	109,093	870	26,898	24,475	29,503	-	2,442
HOOD_CANAL	45,376	-	-	416	339	1,473	5,970
KLICKITAT	75,292	6	9,494	5,793	8,895	0	3,040
LEWIS	78,904	-	-	-	896	988	7,908
NORTH_COLUMBIA	107,292	20	18,500	5,405	7,379	-	4
ORCA	5,863	-	-	3	4	118	179
OZETTE	87,864	-	-	1	748	50	5,955
RAINIER	140,872	1	-	370	799	3,393	6,352
SNAKE_RIVER	2,825	70	1,326	32,549	27,393	-	178
SOUTH_OKANOGAN	27,508	1	10,074	33,459	39,295	-	1,018
ST_HELENS	106,284	101	-	0	1,177	673	3,249
STRAITS	59,236	-	-	151	654	1,078	3,224
YACOLT	107,841	3,860	-	32	625	449	2,613
TOTAL	1,641,484	4,975	129,900	196,240	360,923	48,074	74,620

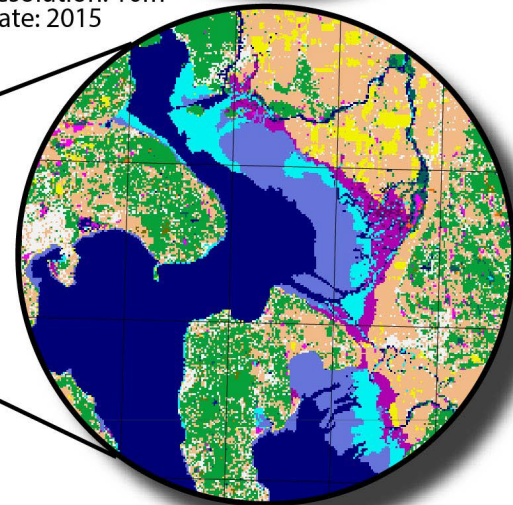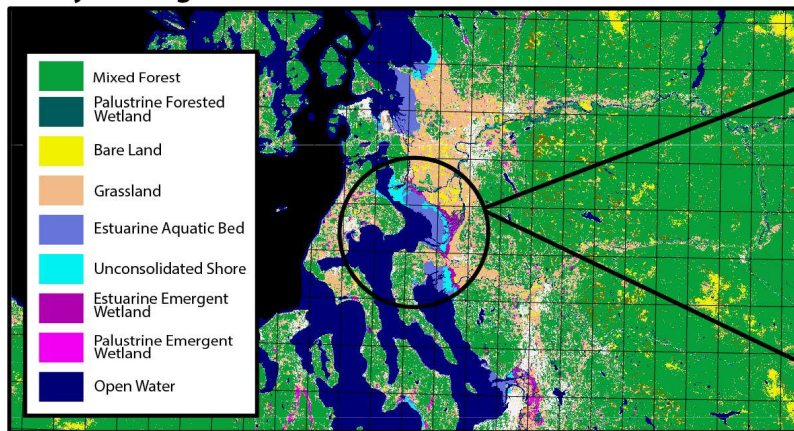**Next Steps:** Improved resolution & wetland classes for western WA

LandFire Basemap Terrestrial Ecological Systems on the LANDFIRE Existing Vegetation Type

Resolution: 30m
Date: 2018

Legend:
- Developed
- Orchards
- Salt & Tidal Wetlands
- Conifer Forests
- Mixed Forests
- Open Water

Coastal Change Analysis Program NOAA Office for Coastal Management

Resolution: 10m
Date: 2015

Legend:
- Mixed Forest
- Palustrine Forested Wetland
- Bare Land
- Grassland
- Estuarine Aquatic Bed
- Unconsolidated Shore
- Estuarine Emergent Wetland
- Palustrine Emergent Wetland
- Open Water

GIS for Ecosystem Services

Basemap Creation Steps
1) Reclassify land uses from 99 to 33 condensed classes
2) Resample10m raster and aggregate cells to 30m
3) Replace values in LandFire basemap with NOAA CCAP

Next Steps
1) Use LDO boundaries to clip basemap for analysis
2) Create overlays that enhance understanding of ecosystem services at varying scales (e.g. land management unit, land manegment type, parcel, land use category)

By Mandy Rees
amanda.rees@ucdenver.edu

Next Steps:
Improved offshore and nearshore mapping

Washington State Coastline NOAA Coastal Change Analysis Program (C-CAP) 10-Meter & Seagrass distribution

	Developed		Palustrine Emergent Wetland
	Grassland		Estuarine Emergent Wetland
	Mixed Forest		Unconsolidated Shore
	Scrub/Shrub		Bare Land
	Palustrine Forested Wetland		Seagrass
	Palustrine Scrub/ Shrub Wetland		DNR Land

Data Sources:
1) NOAA, 2016. Coastal Change Analysis Program, NOAA Office for Coastal Management.
2) Washington State Department of Natural Resources. 2024. LDO Database.
3) Washington State Department of Natural Resources. 2024. Seagrass Inventory.

By Mandy Rees
amanda.rees@ucdenver.edu

Next Steps:
DNR Forest Inventory (for Carbon)

Tree Height = 1 meter
Tree Height = 2 meters
Tree Height = 3 meters
Tree Height = 4 meters
Tree Height = 5 meters
Tree Height = 6 meters
Tree Height = 7 meters
Tree Height = 8 meters
Tree Height = 9 meters
Tree Height = 10 meters
Tree Height = 11 meters
Tree Height = 12 meters
Tree Height = 13 meters
Tree Height = 14 meters
Tree Height = 15 meters
Tree Height = 16 meters
Tree Height = 17 meters
Tree Height = 18 meters
Tree Height = 19 meters
Tree Height = 20 meters
Tree Height = 21 meters
Tree Height = 22 meters
Tree Height = 23 meters
Tree Height = 24 meters
Tree Height = 25 meters
Tree Height = 26 meters
Tree Height = 27 meters

Next Steps:

Contextual overlays

Potential overlays to base classes

- Fish species by stream segment
- Water supply importance/ areas of water quality concern
- Habitats, including "critical" + T&E
- Recreation and Culture
- Agriculture and Pollination

ESTABLISHING the MARKET LANDSCAPE

Understanding the Market Landscape

Existing Markets
- Timber, Grazing and Agriculture, Aquatic, Mining

Emerging Markets
- Carbon, Water, Blue Carbon, Habitat and Biodiversity

High ES Value, Lower Market Potential
- Recreation, Culture

GREENE ECONOMICS

Existing Markets for Ecosystem Services

Timber
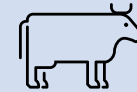
Grazing and Agriculture
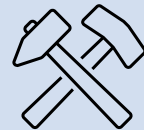
Mineral Extraction

Aquatic Lands

Timber

Market Definition:

- Revenue generated from timber serves various purposes, including funding public K-12 schools, universities, state facilities, and supporting local services in numerous counties

Market Vulnerabilities and Risks:

- Timber prices are volatile, wildfire and climate change, international policies/sanctions

Timber Sale Removals ($ Millions)

- 2014: $170.7
- 2015: $180.9
- 2016: $190.3
- 2017: $172.6
- 2018: $196.5
- 2019: $222.9
- 2020: $201.1
- 2021: $195.7
- 2022: $187.5
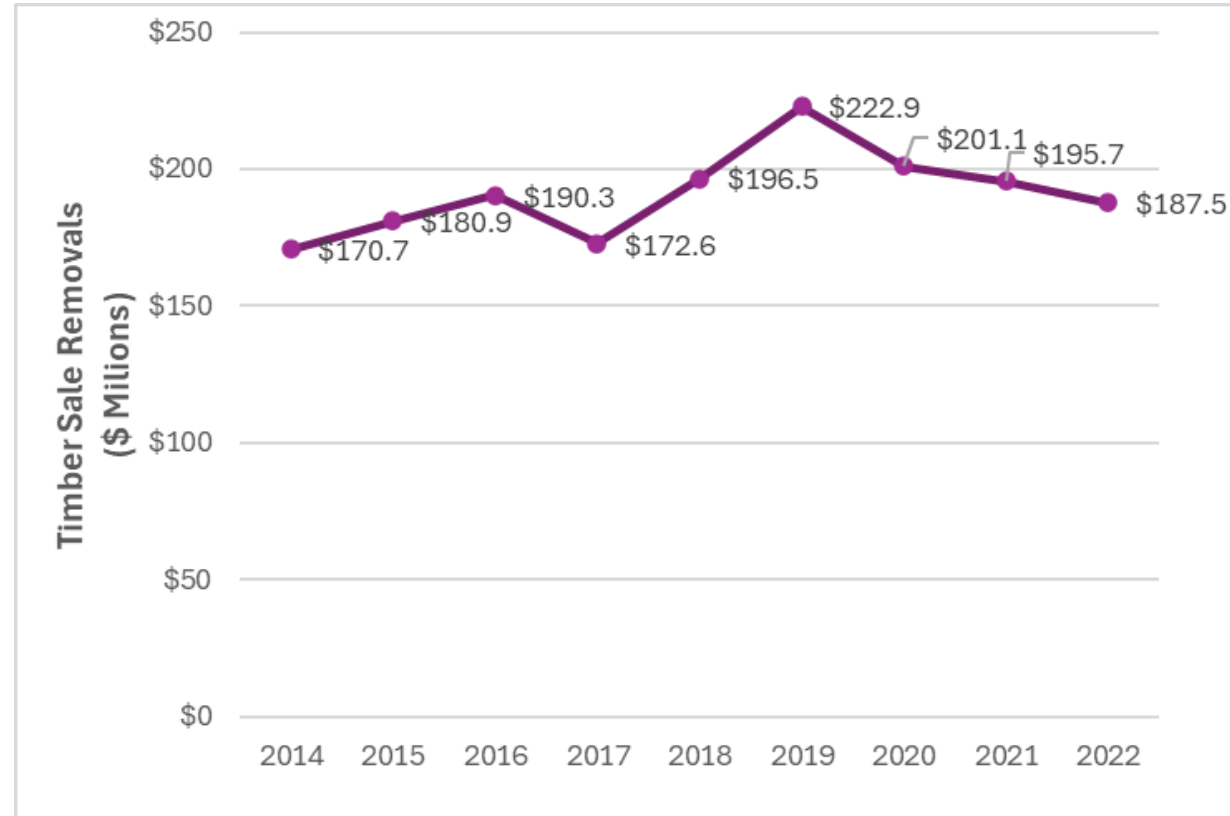
* Note: The graphic above was created using **Timber Revenue data** made available through DNR Annual Reports. The most recent report was published for the 2022 fiscal year.

GREENE ECONOMICS

Grazing & Agriculture

Market Definition:

- Revenue from the 1.1 million acres of state trust lands that DNR leases for agriculture and grazing helps fund public school construction across Washington state.

Market Vulnerabilities and Risks:

- 10-year leases (limited flexibility), may be volatility in farming and changing cropping and agricultural use patterns through time
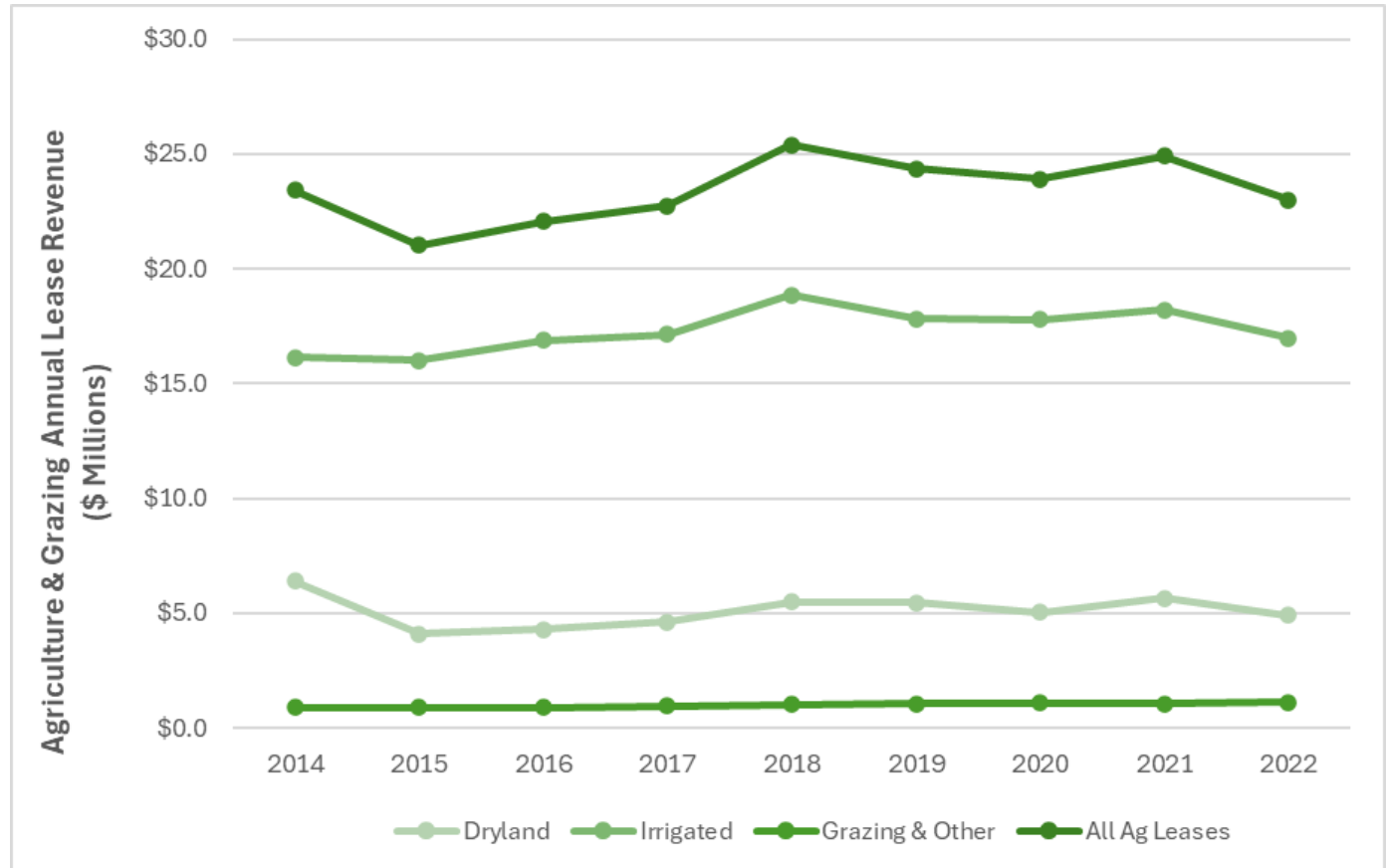
* Note: The graphic above was created using **Agriculture Revenue data** made available through DNR Annual Reports. The most recent report was published for the 2022 fiscal year.

Aquatic Lands

Market Definition:

DNR manages 2.6 million acres of aquatic lands, some of which are leased for a variety of different purposes (aquaculture, public/private docks and marinas, and moorage) on an application-by-application basis

Market Vulnerabilities and Risks:

- Water quality changes
- Health risks in aquaculture
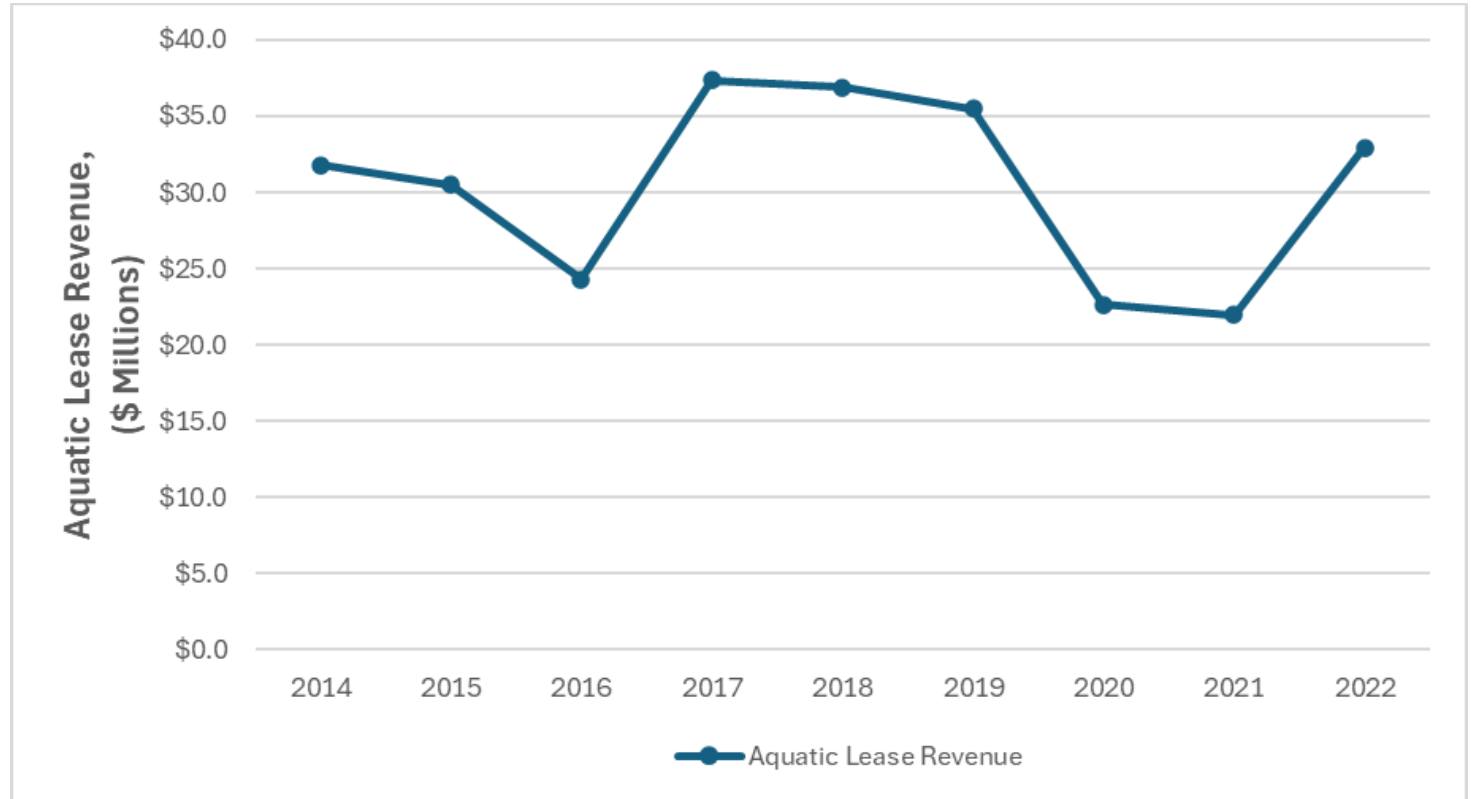
* Note: The graphic above was created using **Aquatic Lease Revenue data** made available through DNR's Annual Reports. The most recent report was published for the 2022 fiscal year.

Mineral Extraction

Market Definition:

- DNR leases land for surface mining and reclamation; coal, metallic and mineral resources; oil and gas resources; and geothermal resources

Market Vulnerabilities and Risks:

- Environmental concerns,
- Market volatility
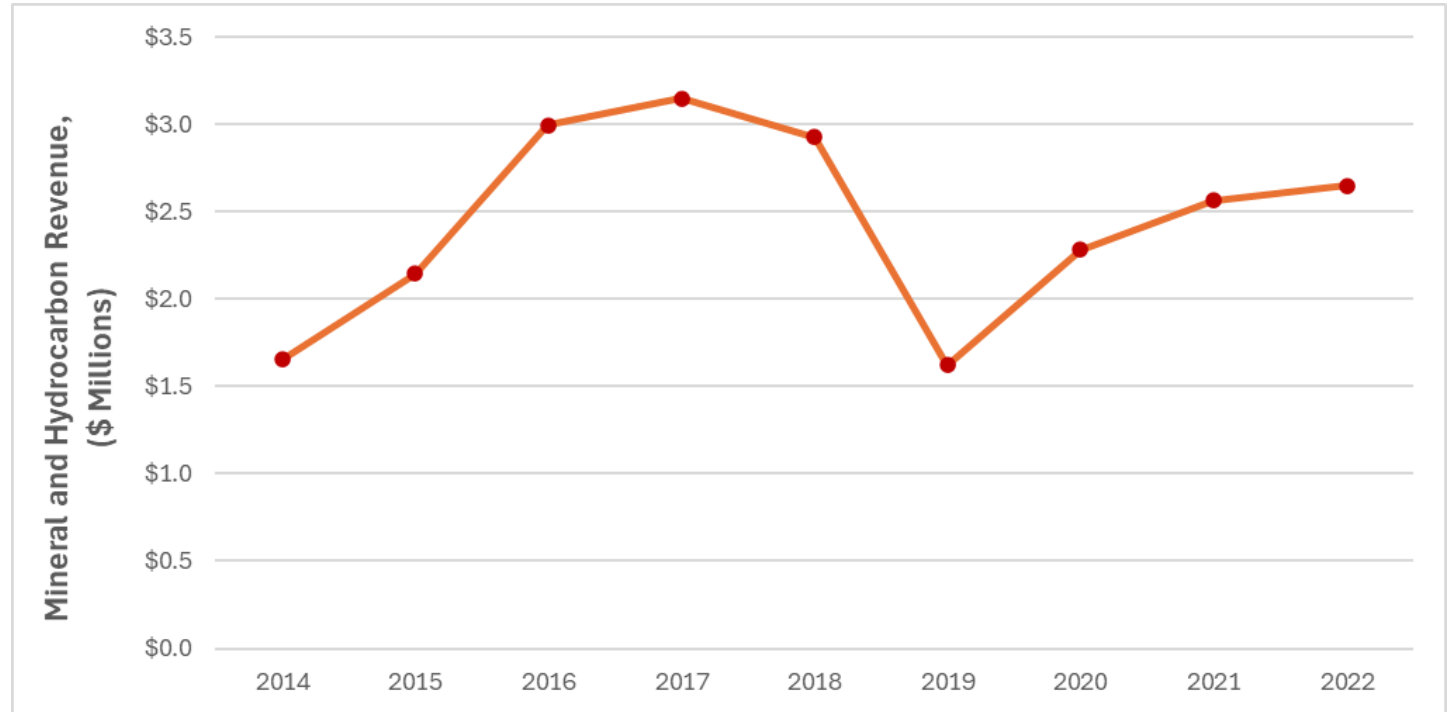
* Note: The graphic above was created using **Mineral & Hydrocarbon Revenue data** made available through DNR's Annual Reports. The most recent report was published for the 2022 fiscal year.

Existing Markets- Opportunities and Insights

	Timber (TM pp. 15-17)	Grazing/Ag Leases (TM pp. 17-19)	Aquatic Lands (TM pp. 19-21)	Mineral Extraction (TM pp. TBD)
Market Description	• Auctioning of standing timber through auctions & bids • Can be volatile, but tends to be linked with housing market	• DNR leases land for irrigated & dry cropping, and grazing • Stable market, leases generally have a 10-year term	• DNR incurs revenue through aquatic land leases, licenses and right of ways • Includes aquaculture, mainly commercial oyster production	• Includes a variety of natural resource extraction practices • A includes oil, coal, and minerals
Market Value	• Average price/MBF: $334.15 • DNR timber sales revenue from July 2023-May 2024: $119 million	• DNR usually brings in between $21-25 million in revenue for all grazing and ag leases • Average value of $138 per acre across all ag/grazing lease types	• Aquatic land revenue in 2022 was $33 million	• DNR usually brings in between $1.5-3 million in revenue for all mineral and hydrocarbon extraction

10 min break

Emerging Ecosystem Service Markets

Carbon Offset Markets
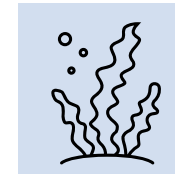
Blue Carbon Offset Markets

Water Markets

Habitat & Biodiversity Markets

GREENE ECONOMICS

Carbon Markets – Regulated (Compliance)

Market Definition:
- Carbon credit market in Washington is governed by the 2021 Climate Commitment Act (CCA). The "cap-and-invest" program creates a carbon offset marketplace for Washington businesses. In addition, California and Quebec have carbon offset markets that are derived from similar cap and trade systems.

Market Maturity:
- Carbon credit market in Washington under CCA is new. Cap-and-invest went into effect on January 1, 2023.

Requirements to Offer Credits:
- Offsets need to be **real, permanent, quantifiable, verifiable, enforceable, and additional**. Detailed modeling is needed, verifications, and on-going approvals and monitoring are required.

Projected Emissions Cap Over Time
* million metric tons of CO_2 equivalent

| Period 1 2023 - 2026 | Period 2 2027 - 2030 | Period 3 2031 - 2034 | Period 4 2035 - 2038 | Period 5 2039 - 2042 | Period 6 2043 - 2046 | Period 7 2047 - 2050 |

We are here

45% 70% 95%
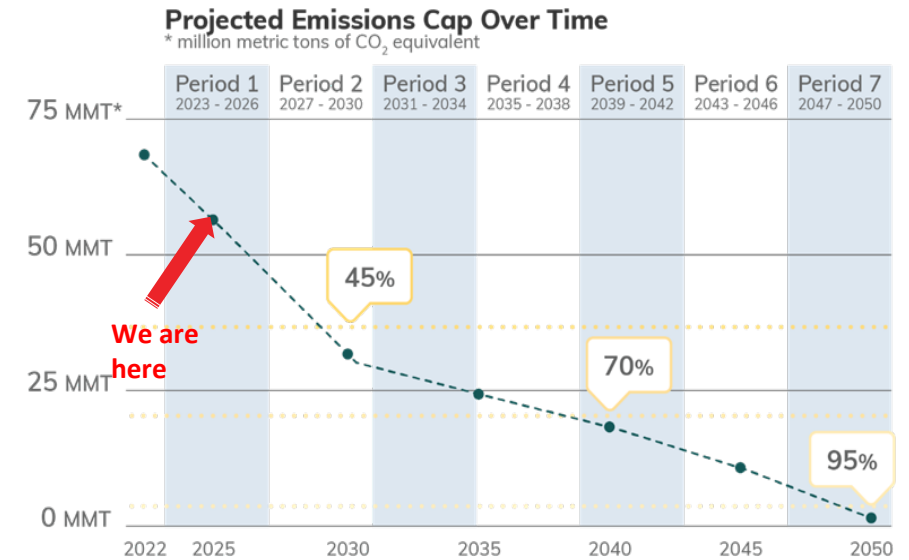
Emissions Year	Total Covered Emissions (WA) (MT CO2e)	Maximum Allocation for Offset Credits (MT CO2e)		
		Tribal (3%)	Other (5%)	TOTAL (8%)
2023	63,288,565	1,898,657	3,164,428	5,063,085
2024	58,524,909	1,755,747	2,926,245	4,681,993
2025	53,761,254	1,612,838	2,688,063	4,300,900
2026	48,997,598	1,469,928	2,449,880	3,919,808

GREENE ECONOMICS

Carbon Markets – Regulated (Compliance)

Market Vulnerabilities and Risks:

- Efforts are underway to repeal the CCA through a ballot measure (I-2117). The market is still in its **early stages** and the allowance prices are higher compared to more established markets; offsets decline as we move towards Net Zero; protocols are regularly revised; regulatory question surrounding DNR the sale of credits.

Opportunities for DNR:

- If the Washington State legislature develops the necessary framework, DNR will be able to lease its forested lands for participation in regulated carbon market cap-and-trade schemes due to their high sequestration potential.
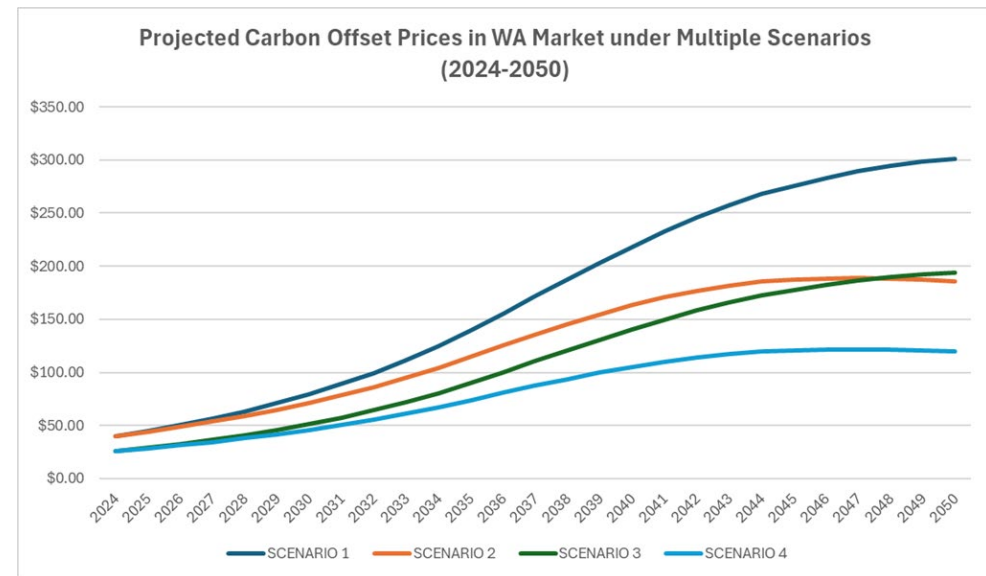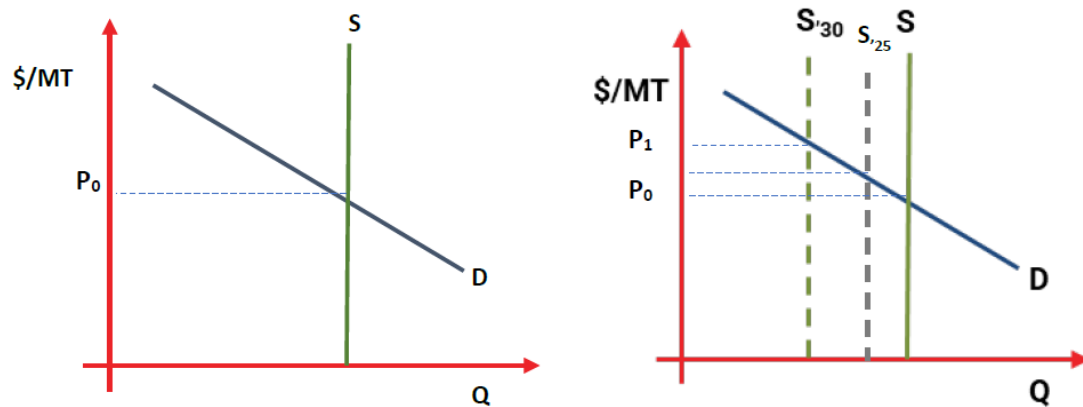
Carbon Markets – Voluntary

Market Definition:
- Firms, organizations, and entities wish to purchase credits even though they are not mandatory. Market is unregulated and broad variety of quality levels in this arena.

Market Maturity:
- Voluntary carbon credit market in Washington has been in existence longer than the compliance market.

Requirements to Offer Credits:
- Offset projects must result in greenhouse gas reductions that are **real, permanent, quantifiable, verifiable, enforceable, and additional.** Requirements for participation are largely unregulated.

GREENE ECONOMICS
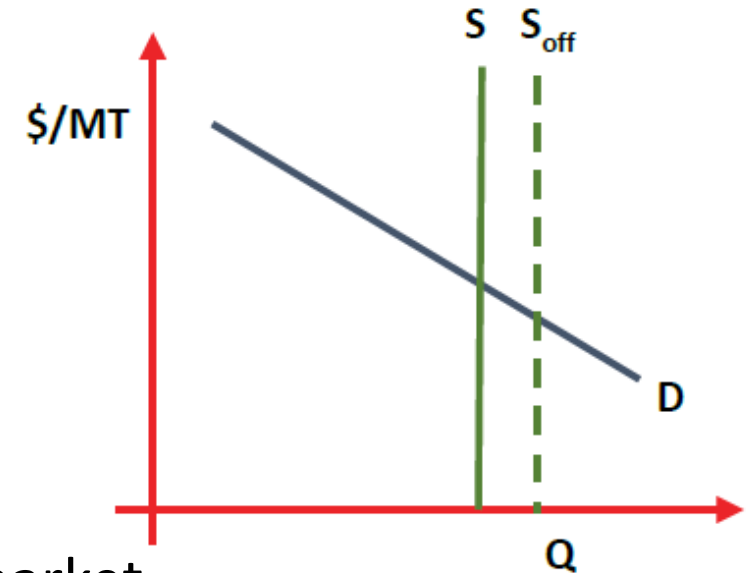
Carbon Markets – Voluntary

Market Vulnerabilities and Risks:

- The regulated market in Washington is developing under the CCA. As that matures, the voluntary market could become less popular. Other regulated (compliance) markets might also begin to be more fruitful. However, all compliance markets decrease in volume over time to 2050... voluntary offsets can persist.

Opportunities for DNR:

- Strong support for this market going forward. The Integrity Council for the Voluntary Carbon Market (ICVCM) has received strong support which could mitigate quality concerns. Other opportunities include collaboration with Universities is a means of creating genuine credits at lower cost to producers, while providing education for students. Also there may be opportunities for premium prices (e.g. social cost of carbon).

GREENE ECONOMICS

Blue Carbon Market

Market Definition:

- The voluntary blue carbon market was developed in response to rising concerns about the loss of marine ecosystems worldwide.

Market Maturity:

- Blue carbon credit schemes have only become a viable investment opportunity within the last decade and are usually limited in their scope.

Requirements to Offer Credits:

- Most organizations that engage in blue carbon credit trading are primarily focused on working with small communities in developing countries which means that there is at present a lack of definitive rules or guidelines for larger scale operations.

Coastal Blue Carbon

GREENE ECONOMICS
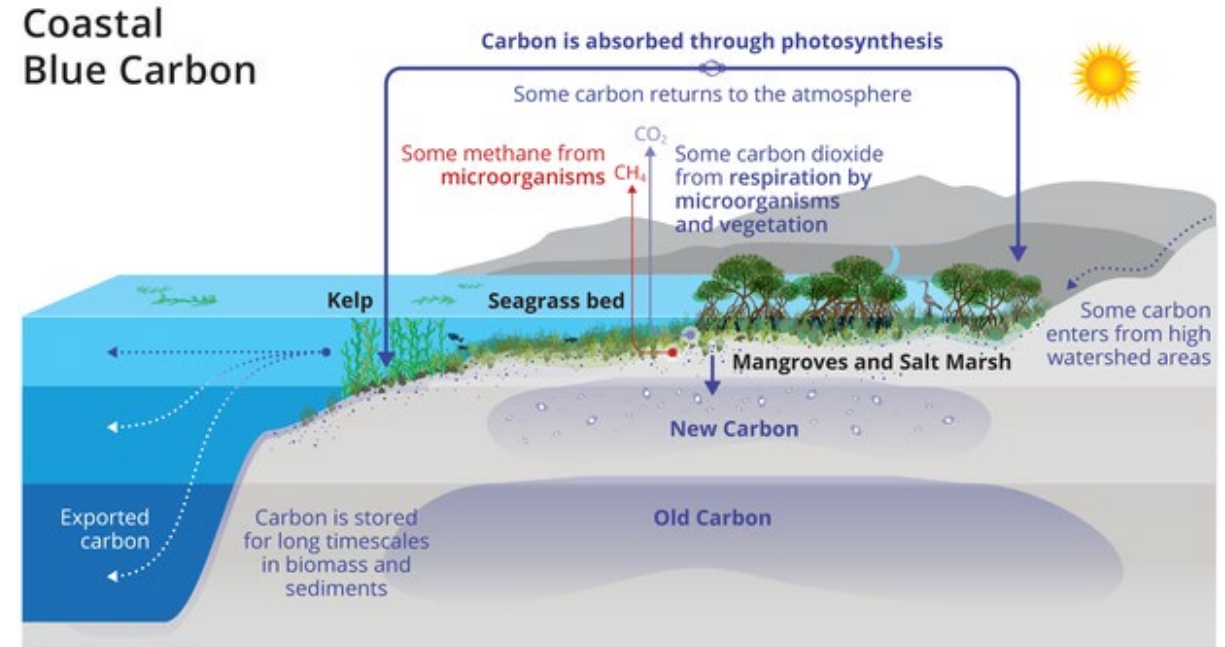
Blue Carbon Market

Market Vulnerabilities and Risks:

- Blue carbon markets currently suffer from a **shortage of both supply and demand** despite the relative solidity of the science supporting them.

Opportunities for DNR:

- **Seagrasses** and **tidal wetlands** are the natural resources which are currently most viable for use in blue carbon market credit schemes with the **possibility of kelp forests** being implemented at some point in the future.
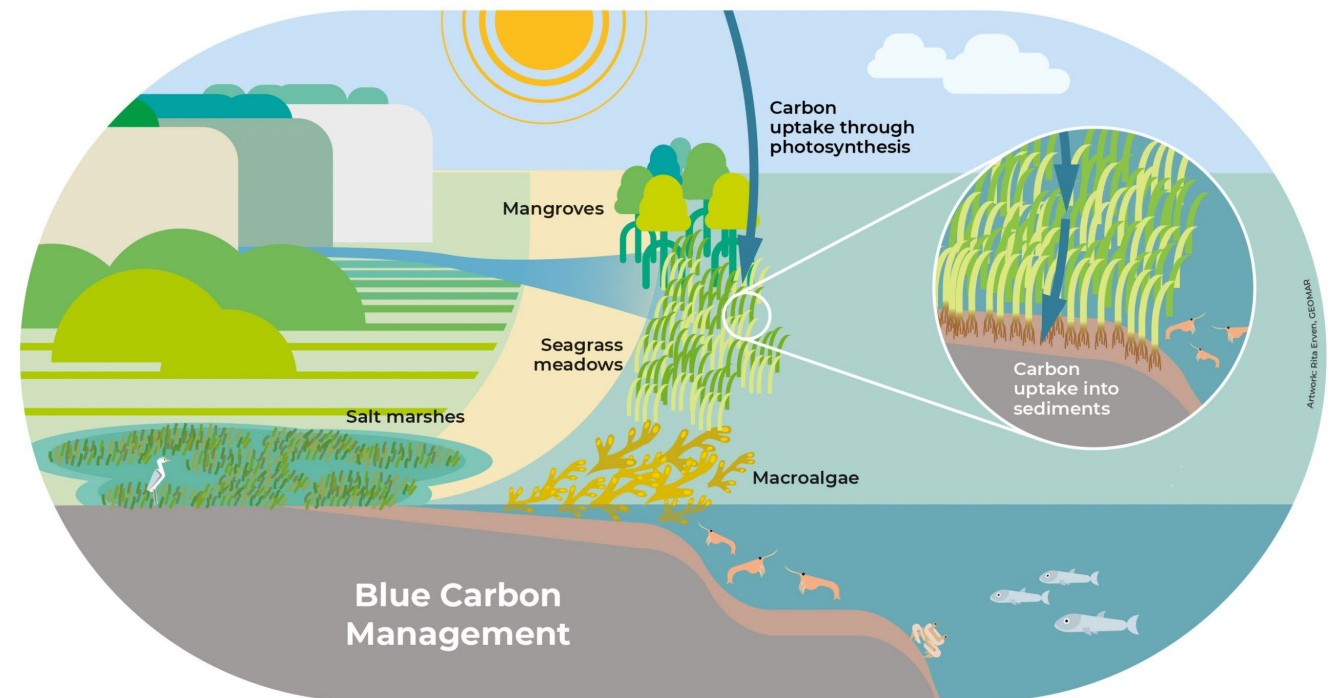
Habitat and Biodiversity Markets – Biodiversity Offsets

Market Definition:
- The regulation-based biodiversity offset market in the US is intended to balance direct environmental damage with environmental improvement to the same habitat/species through mitigation banking and conservation banking (Federal and state regulated).

Market Maturity:
- The biodiversity-offset market in US is well established and should remain so unless there is a drastic change in legislation, which is unforeseen.

Mitigation Banks in Washington – Approved (green) and Under Review (blue)
From Ecology, Mitigation Bank Projects website

Requirements to Offer Credits:
- To become a mitigation banks, one must work with lots of state agencies and organizations. The process takes years, but state lands are eligible to become mitigation banks.

GREENE ECONOMICS

Habitat and Biodiversity Markets – Biodiversity Offsets

Market Vulnerabilities and Risks:

- Biodiversity off-set market is stable but smaller than the global biocredit market, and in Washington, is very wetland focused.
- Also, those seeking mitigation for impacting endangered species habitat have options outside the mitigation/conservation banking market space, meaning that though mitigation is required, participation in the offset market is not required.
- DNR lands are already well managed (HCP), so creating uplift and proving additionality may be challenging for certain parcels of land

Opportunities for DNR:

- State lands are eligible for mitigation banking
- Riparian habitat, thinning for old growth and/or a specific species

GREENE ECONOMICS

Habitat and Biodiversity Markets – Biodiversity Credits

Market Definition:

- The biocredit market is voluntary and has been initiated due to global reports and summits that have shown the importance of investing in biodiversity and habitats. More holistic approach.

Market Maturity:

- Biocredit markets are young and there are numerous schemes in development around the world. There are many groups working now to bring these markets to fruition – growing fast.

Requirements to Offer Credits:

- Biocredit markets lack standardization and there are many schemes in action so requirements depends on the market scheme chosen. There are many organizations and taskforces that are currently creating guidelines and standardized biocredit market frameworks.
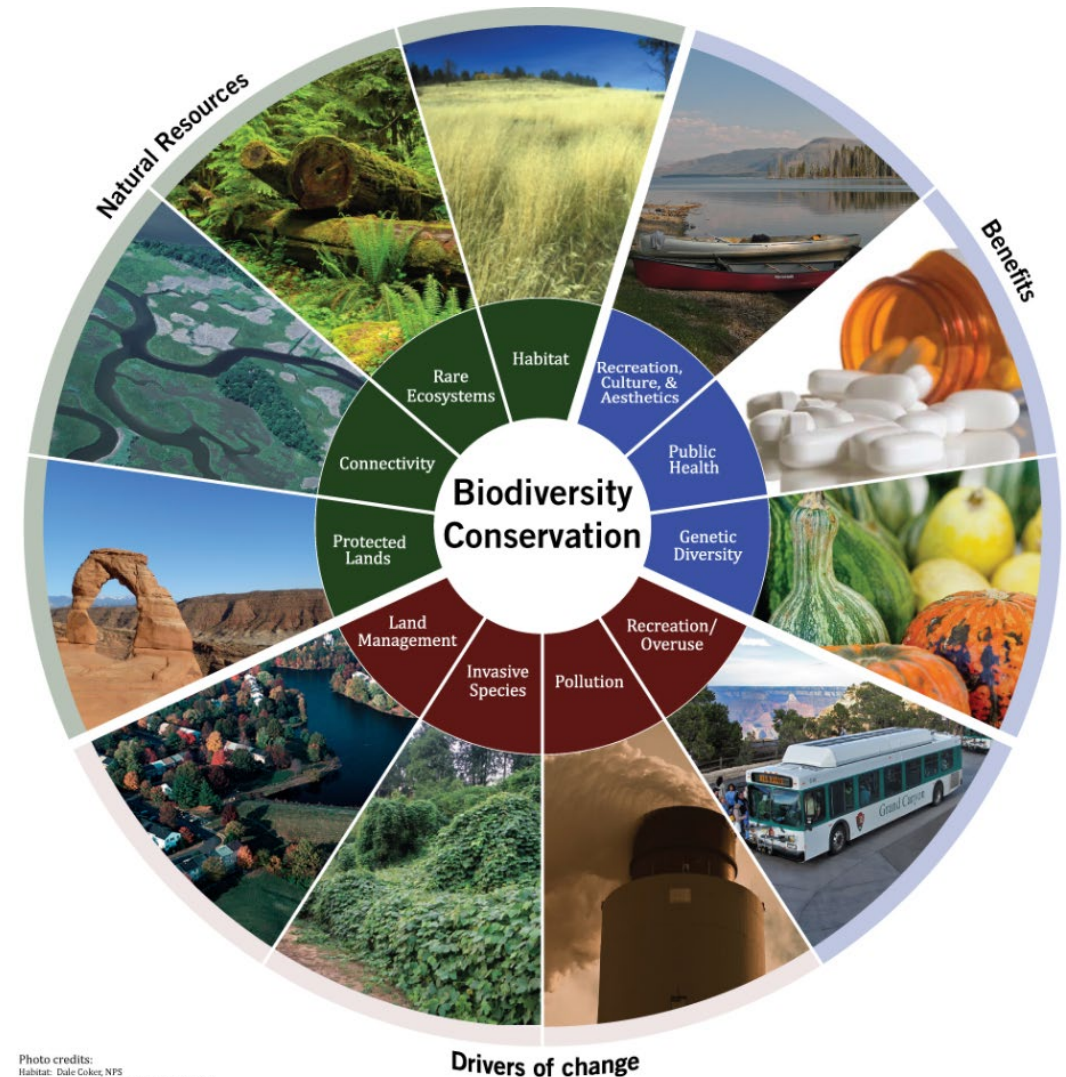
Photo credits:
Habitat: Dale Coker, NPS
Rare ecosystems: Jessica Jahre, EPA contractor
Connectivity: Paul Fusco, NRCS
Protected lands: Jessica Jahre, EPA contractor
Land management: Tim McCabe, NRCS
Invasive species: Bill Johnson, NPS
Pollution: Eric Vance, EPA
Recreation/Overuse: Michael Quinn, NPS
Genetic diversity: Eric Vance, EPA
Public health: Amanda Mills, CDC
Recreation, culture, & aesthetics: Jim Peaco, NPS

This EnviroAtlas eco-wheel was created by Jessica Jahre, EPA contractor

GREENE ECONOMICS

Habitat and Biodiversity Markets – Biodiversity Credits

Market Vulnerabilities and Risks:

- Biocredit markets have similar risks and vulnerabilities as the voluntary carbon market; there is not yet a standard for credits (area, timeframe, metrics for determining quality, geographic scale)
- Additional concerns regarding standards and metrics since biodiversity is inherently complex and it's difficult to compare one habitat to another.

Opportunities for DNR:

- Potential for biodiversity as an add on to carbon credits, here additionality is less of a concern
- Improving habitat on marginal lands not utilized for other activities (higher additionality)

GREENE ECONOMICS

Water-Related Markets

Market Definition:

- Water, or **water rights** are purchased and sold through markets, although the water belongs to the public and cannot be owned.
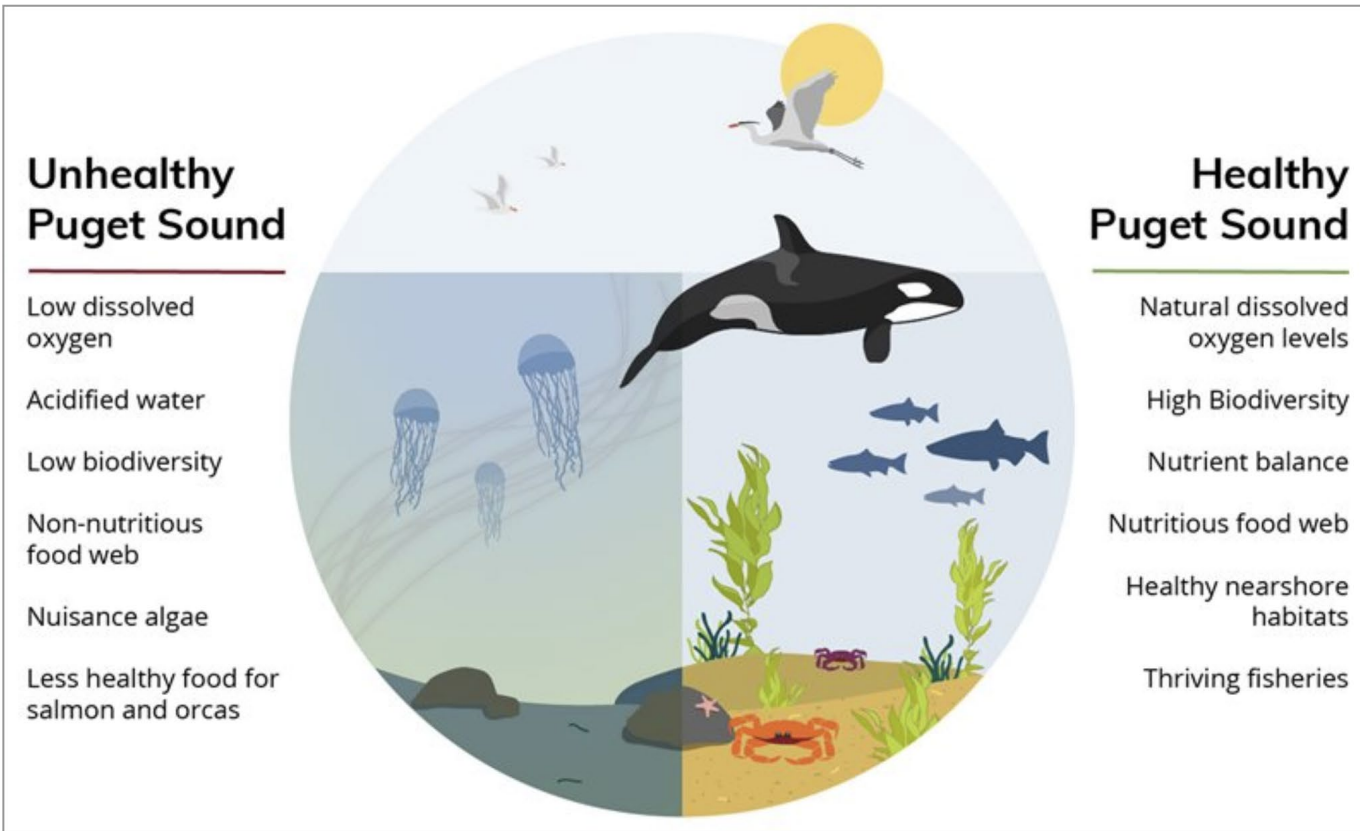- Markets for **water quality** continue to be of interest as means of harnessing market forces to assist in enforcing regulations and bring about better outcomes. For example, Ecology has been directed to explore nutrient credit trading in Puget sound.

Market Maturity:

- Water rights markets are mature – for sale or lease
- Water quality markets are all newer in PNW, however stormwater credit trading and nutrient other systems are more widely used elsewhere in the U.S.

GREENE ECONOMICS

43

Water-Related Markets

Unhealthy Puget Sound

- Low dissolved oxygen
- Acidified water
- Low biodiversity
- Non-nutritious food web
- Nuisance algae
- Less healthy food for salmon and orcas

Healthy Puget Sound

- Natural dissolved oxygen levels
- High Biodiversity
- Nutrient balance
- Nutritious food web
- Healthy nearshore habitats
- Thriving fisheries

Market Vulnerabilities and Risks:

- Changing climate
- Changing surface/GW rule (Hearst decision and net ecological benefit)
- Tribal requirements re: fish and environmental flows
- Regulatory limitations

Opportunities for DNR:

- Potential participation in water quality markets – flood risk reduction, ground water recharge, hydraulic connectivity benefits, etc. Payments for Ecosystem Services (PES)
- Exploring lease potential for under utilized water rights

GREENE ECONOMICS

High Value ES,
Low Market Potential
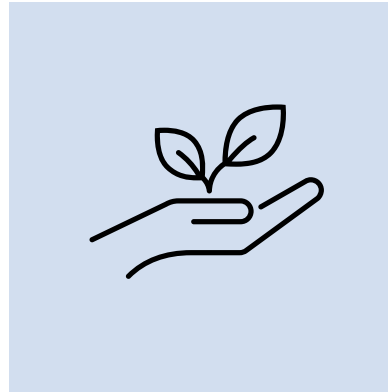
CULTURAL   RECREATION

GREENE ECONOMICS

Cultural Value

Market Definition:

Cultural ecosystem services, as described in the Millenium Ecosystem Assessment, include **cultural identity**, **cultural heritage**, **inspirational services**, **aesthetic services**, and **recreation** and **tourism**. Cultural heritage in terms of tribes is of critical for DNR lands.

Market Maturity:

Unclear whether there are, or should be, improved market interaction for cultural ecosystem services.

Market Vulnerabilities:

DNR already manages cultural resources consistent with the Cultural Resource Protection and Management Plan (CRPMP) which carefully protects and manages cultural resources.

Importance:

Understanding this **value** will be important for the ESIAP as the CRPMP guidance encourages protection of the resources.

GREENE ECONOMICS
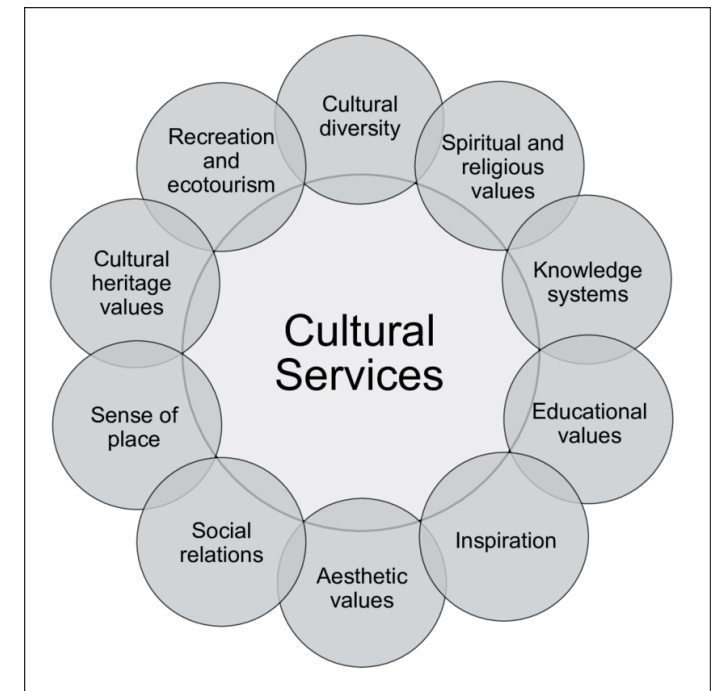
Recreation Value

Market Definition:
- Recreation is one of greatest ecosystem services provided by Washington lands. Typically, states and municipalities charge little for the public to participate in recreation, although licenses and fees are collected. Citizens and visitors benefit from the **value** they place on the experience and citizens and visitors also **spend** a lot in **local economies**, so the activity also increases incomes, output, and jobs.

Market Maturity:
- Although recreational fees might be adjusted to increase revenue, this is not a new or emerging ecosystem service market. It is not clear that this is an opportunity of interest for DNR.

Importance:
- Understanding this **value** will be important for the ESIAP as recreation overlaps with other ecosystem service revenue opportunities. Also key equity importance.

GREENE ECONOMICS

EVALUATING EXISTING MARKETS

Existing Markets- Opportunities and Insights

	Timber	Grazing	Aquatic Lands	Mineral Extraction
Market Description	• Auctioning of standing timber • Can be volatile, but tends to follow housing market	• DNR leases land for irrigated & dry cropping, & grazing • Stable market, leases generally are 10 years	• DNR incurs revenue through aquatic land leases, licenses and right of ways • Includes aquaculture, mainly commercial oyster production	• Includes a variety of natural resource extraction practices • A includes oil, coal, and minerals
Market Value	• Avg price/MBF: $334.15 • DNR timber sales revenue from July 23 -May 24: $119 million	• DNR usually brings in between $21-25 million in revenue • Average value of $138 per acre	• Aquatic land revenue in 2022 was $33 million	• DNR usually brings in between $1.5-3 million in revenue for all mineral and hydrocarbon extraction
Market Future				
Areas of Concern				

Discussion

- Are there additional **trends** you are observing relative to these markets?

- Are there additional **risks** you are observing relative to these markets?

EVALUATING EMERGING MARKETS

Emerging Markets Discussion

- Looking forward, which markets seem poised for further development, based on your experience?
  - In 5 years?
    - ...10 years?
      - ...30 years?

(What are the trends?)

Emerging Markets Discussion

- Are there other ecosystem services market opportunities you are familiar with that are <u>not</u> reflected here?

Emerging Markets Discussion

- What concrete <u>opportunities</u> do you see in each of these markets in Washington State?
  - Biodiversity & Habitat
  - Carbon
  - Water-related
  - Blue Carbon
  - Others?

10 min break

Emerging Markets Discussion

- What <u>risks & constraints </u>do you see in each of these markets in Washington State?
    - Biodiversity & Habitat
    - Carbon
    - Water-related
    - Blue Carbon
    - Others?

Emerging Markets Discussion

- Are there relevant programs/activities related to these markets that are currently underway in Washington (or elsewhere)?
  - Biodiversity & Habitat
  - Carbon
  - Water-related
  - Blue Carbon
  - Others?

(Who can we learn from?)

Emerging Markets Discussion

- What are we missing?

Summary & Next Steps

Insights & Next Steps

Existing Market Insights
- Breakout grazing and dryland- different value
- Trend line of Acreage available
- Biomass-
- Eastern/Western WA differences
- Management fees- markets have different management costs (important for next steps, looking at net revenue/net value/net gain)- Delloitte report
- Commercial business line- timber/non timber assets
- Water rights- existing rights-nexus with emerging ES markets (e.g. Ag)

Emerging Market Insights
5-10-30 year question
- Linkage between habitat/biodiversity and carbon in the voluntary space, 5-10 years till consensus on biodiversity-
- White House- integrity and quality in voluntary market- trend, signals from USG- paying closer attention to voluntary markets
- Who's buying these? Voluntary vs regulatory- risk/vulnerability - King County- guidelines, can set guidelines, choose who buys/sells
- Linkage between existing (ag) and emerging (soil carbon sequestration)- leases
- Lots of nuance in voluntary market evolution,- opportunities for further clarity
- Any that have failed to live up to expectations?
- Importance of understanding relationship between existing revenue generation and potential, also understanding value of intangible services

Any we're not thinking about-no additional insights
Concrete Opportunities
- Forest protocols need to be made more practical for WA
- Protocols beyond forest carbon (blue, pasture) allow for credit generation – consider those
- Additionality- lands not forested that could be suitably forested- carbon capture and forest product growth
- DNR Carbon pilot proposal- example of offset use, stacking revenue streams, buying replacement lands- protecting lands at risk of conversion...carbon offset revenue to support- improved forest management … additionality
- Home grown credits for home-town buyers (from the chat) engage with WA HQ corps

Insights & Next Steps

- **Risk and Constraints for Emerging Markets**
  - Rulemaking
  - Additionality- are they real – "John Oliver Test"
  - National Security
  - Noxious Weeds- concern wrt biodiversity and habitat markets (Natual England's tool), 10,0000 Years Institute- biochar- threat and opportunity , idea of uplift that wouldn't otherwise happen…
  - Regulatory Stability/Instability
  - Unintended consequences (ag land)

- **Other programs/Activities we should be aware of, learn from**
  - King County – Kathleen
  - 10K years
  - Port Blakley Project- Lewis County
  - Carbon Offset – TNC_ Emerald Edge
  - Chelan County- green bonds- (also other states)
  - Sandor Toth UW ES services professor
  - Small Forest Landowner Carbon Working Group- Farm/
- **Regulatory stability**
- **Unintended Consequences**

- **Other Insights**
  - Opportunities to better define additional attributes- (eg, stand structure, species number etc)
  - Science Based Targets

Emerging Markets Opportunities and Insights

	Carbon Offset	Blue Carbon	Habitat & Biodiversity	Water	Recreation	Cultural
Questions/ Data Gaps						
Land Cover Categories						
Opportunities for DNR						
Major Risks						
Overlaps						

Path forward

Understanding and Valuing Assets

Parcel Level Ecosystem Service Asset Inventory

System to Identify Most Promising Assets for Markets

Understanding the Market Landscape

Evaluate Offset Credit Programs and Market Opportunities

Create Marginal Cost Abatement Curve

Identify Most Feasible Markets for DNR Assets

Getting Ready to Market

Needs Assessment and Marketing Plan

Policy/Regulatory Needs

Dashboard Design

Work Group Meetings

- Held via zoom

Meeting	Date	Time	Topic
1	April 25th, 2024	9am-12pm	Introductions & project overview
2	June 27th, 2024	9am-12pm	Inventory & preliminary market landscape
3	August 29th, 2024	9am-12pm	Market opportunities and challenges
4	October 17th, 2024	9am-12pm	Marginal cost abatement modeling
5	November 4th, 2024	9am-12pm	Draft roadmap, inventory, and dashboard
6	January 23rd, 2025	9am-12pm	Review legislature progress report
7	March 13th, 2025	9am-12pm	Review draft asset plan and inventory

Our mission: *Manage, sustain, and protect the health and productivity of Washington's lands and waters to meet the needs of present and future generations.*