Oregon's Tide Gate Optimization Tool

New Solutions for Tide Gates, Fish Passage and Working Landscapes

Jason Nuckols, The Nature Conservancy

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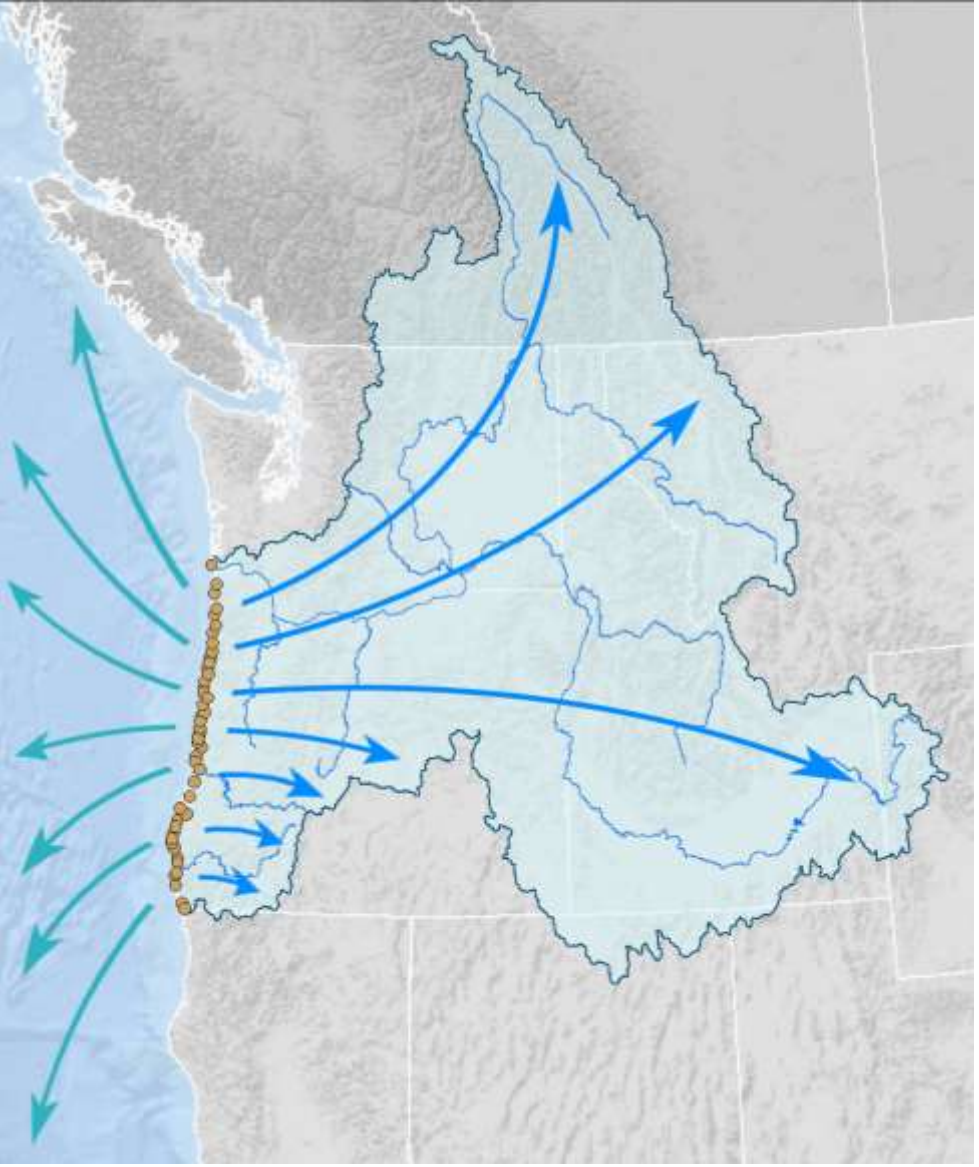

There are 69 estuaries in Oregon.

- The gateway to 172 million acres.
- Eight states and two provinces.

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TIDE GATE OPTIMIZATION TOOL

- Proven Base Model
- Expanded to Consider Estuaries
- Addressing Stakeholder Needs
- Adding Functionality

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STAKEHOLDER INTERESTS

- Fish Habitat
- Agricultural Land
- Private Infrastructure
- Public Infrastructure
- Sea Level Rise

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DATA INVESTIGATION

- Publicly Available
- Best Quality
- Coastwide
- Align with stakeholders

oregontidegates.org

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What is the **set** of tide gates and culverts in the watershed(s) that, if removed or replaced, could maximize **net gains** for a limited financial **budget**?

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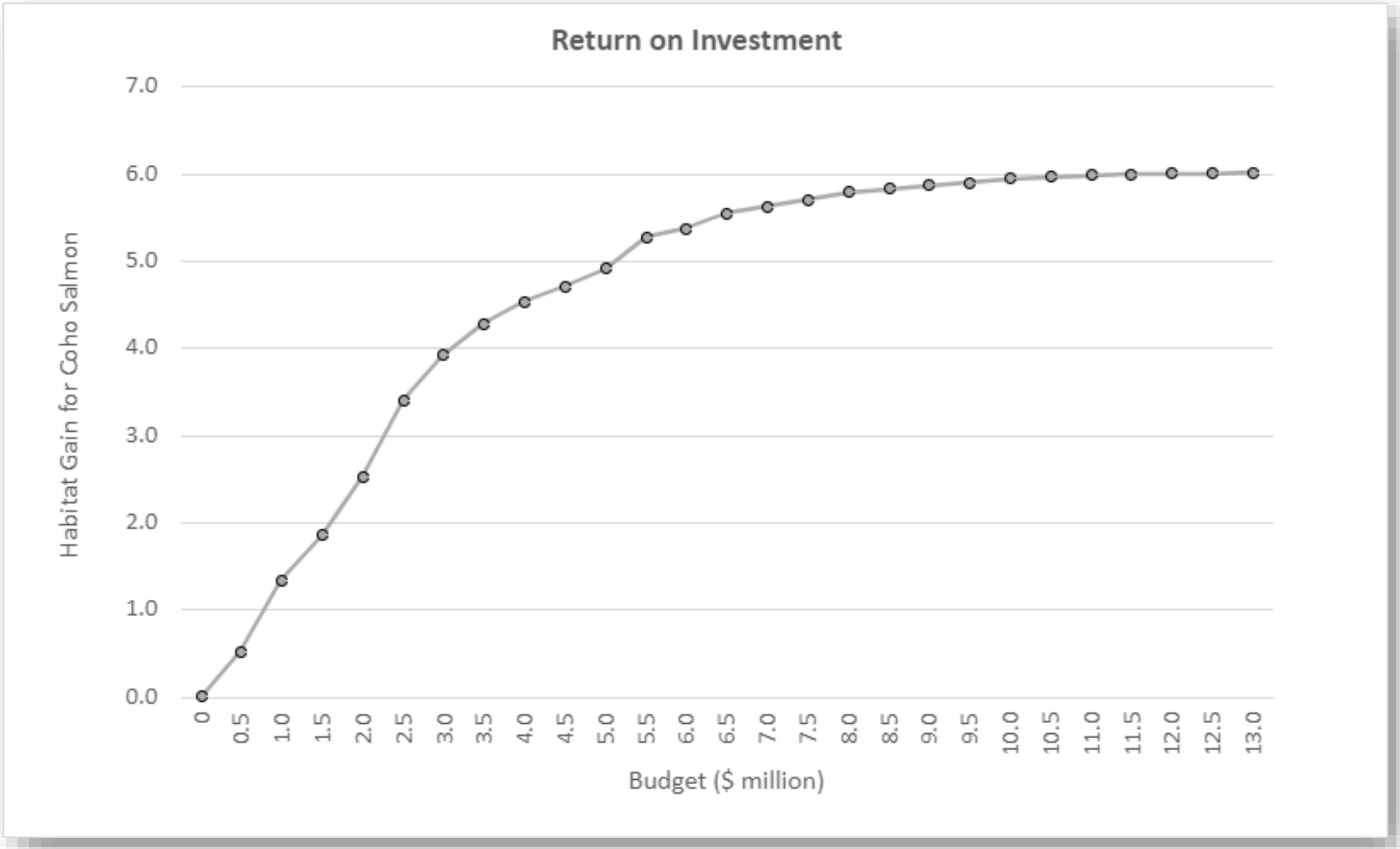

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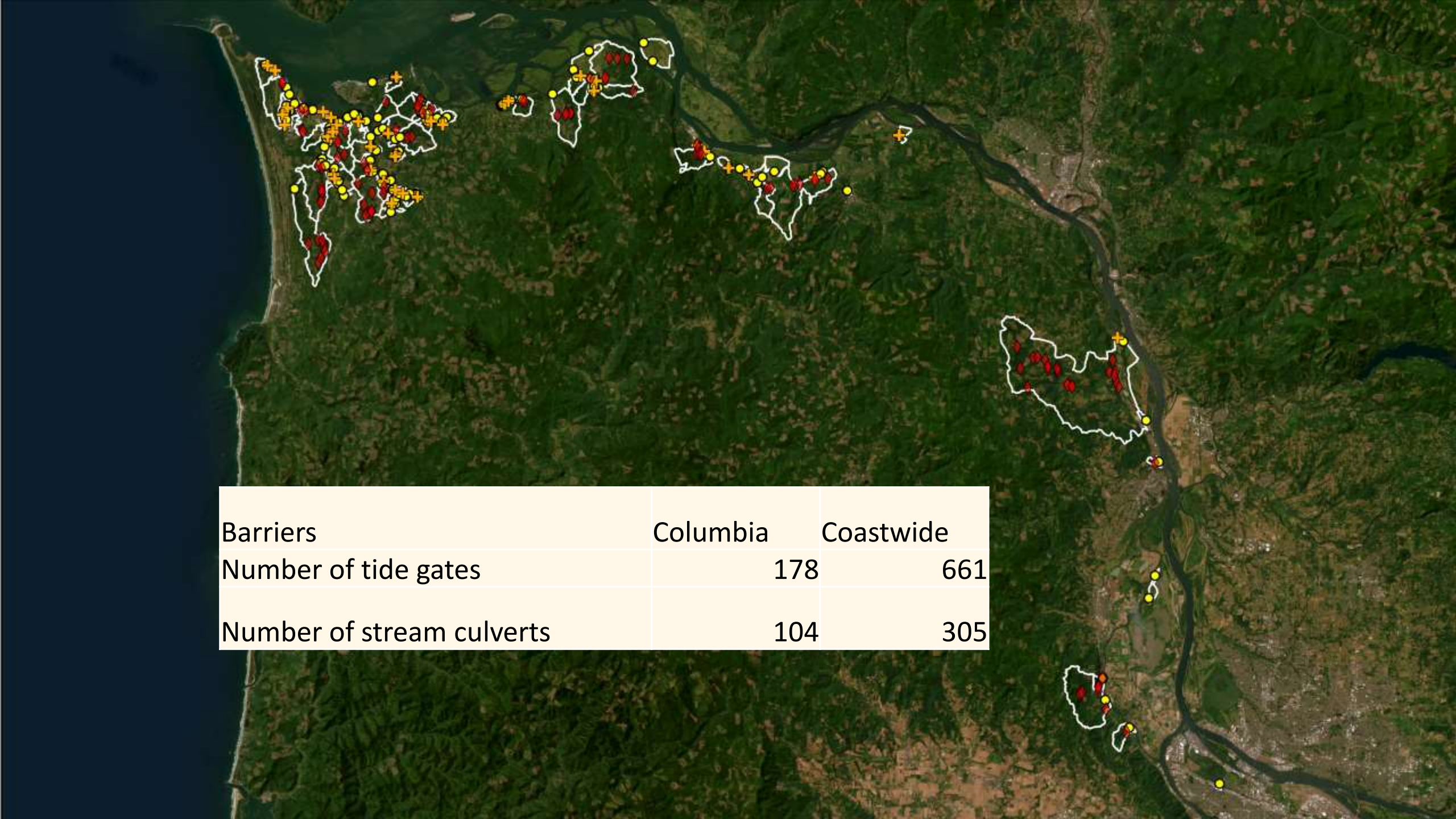
Example Optimization :
Optimizing for acres of agriculture (as defined by the farmland classification) across 41 tide gates

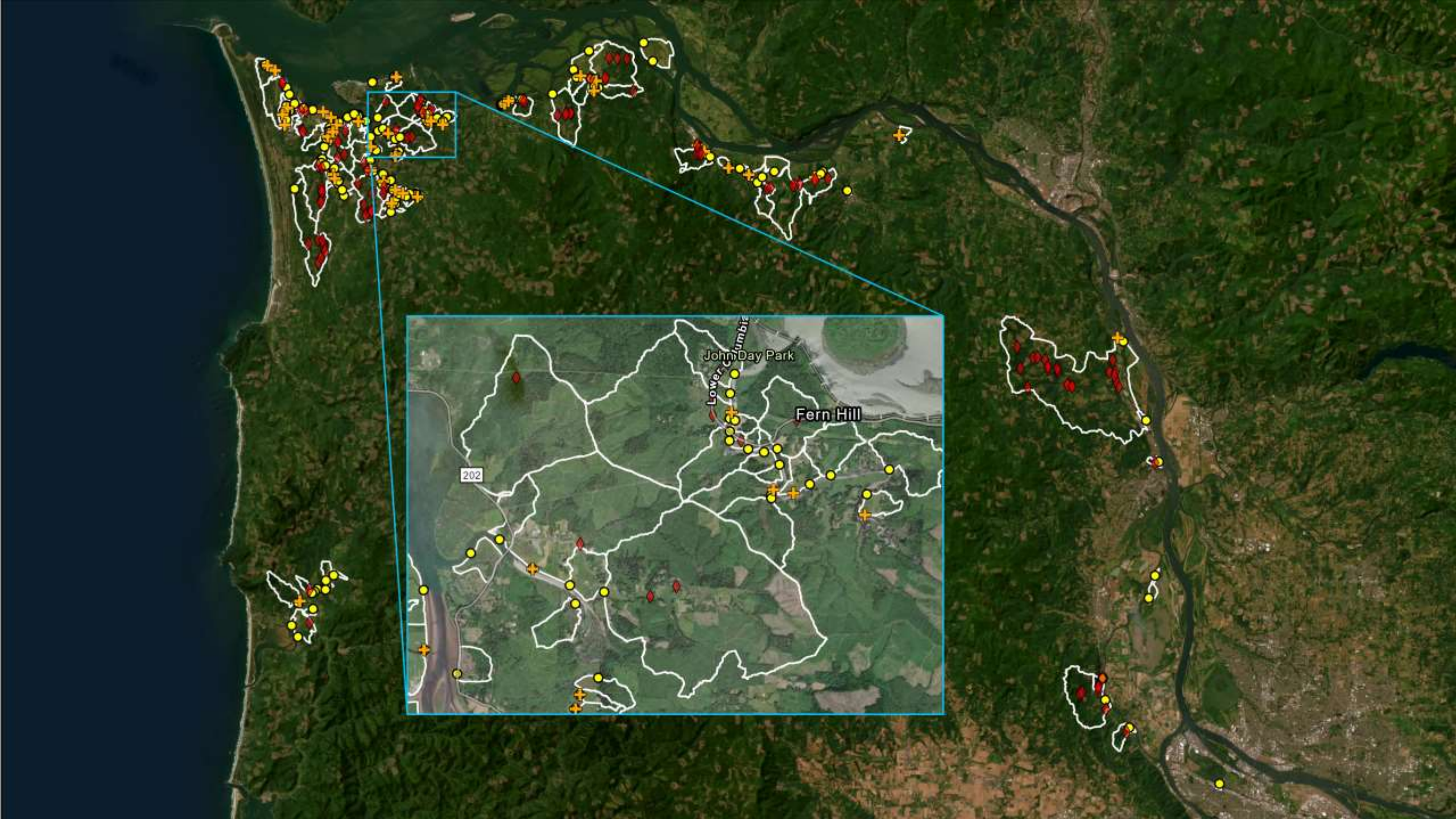
At $450,000 budget level, 4 tide gates are selected for replacement to maximize the protection of agricultural area.

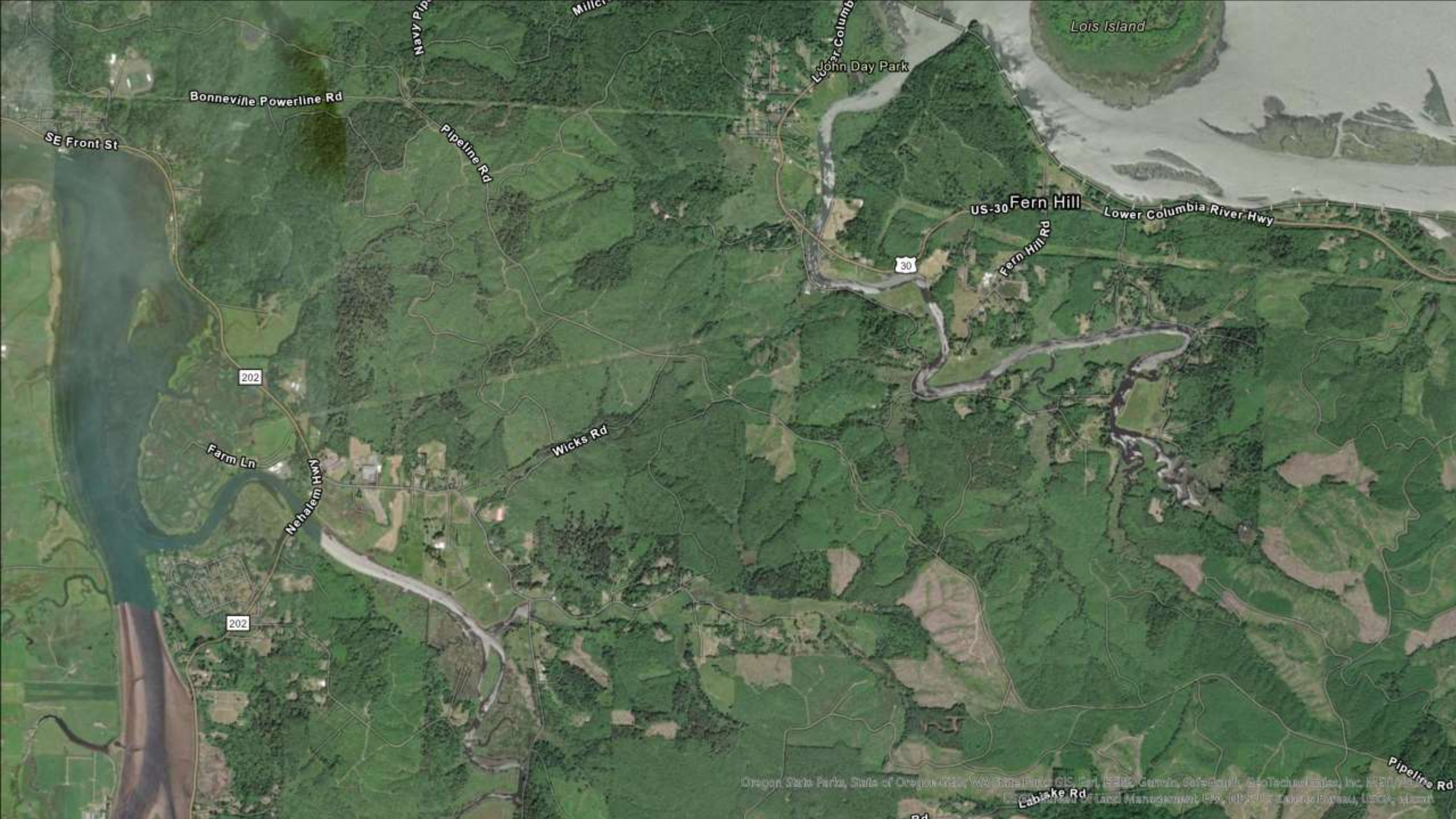
ID	Farmland (acres)
1ts2	131.31
2ts2	64.35
82ts2	140.46
152ts2	127.54

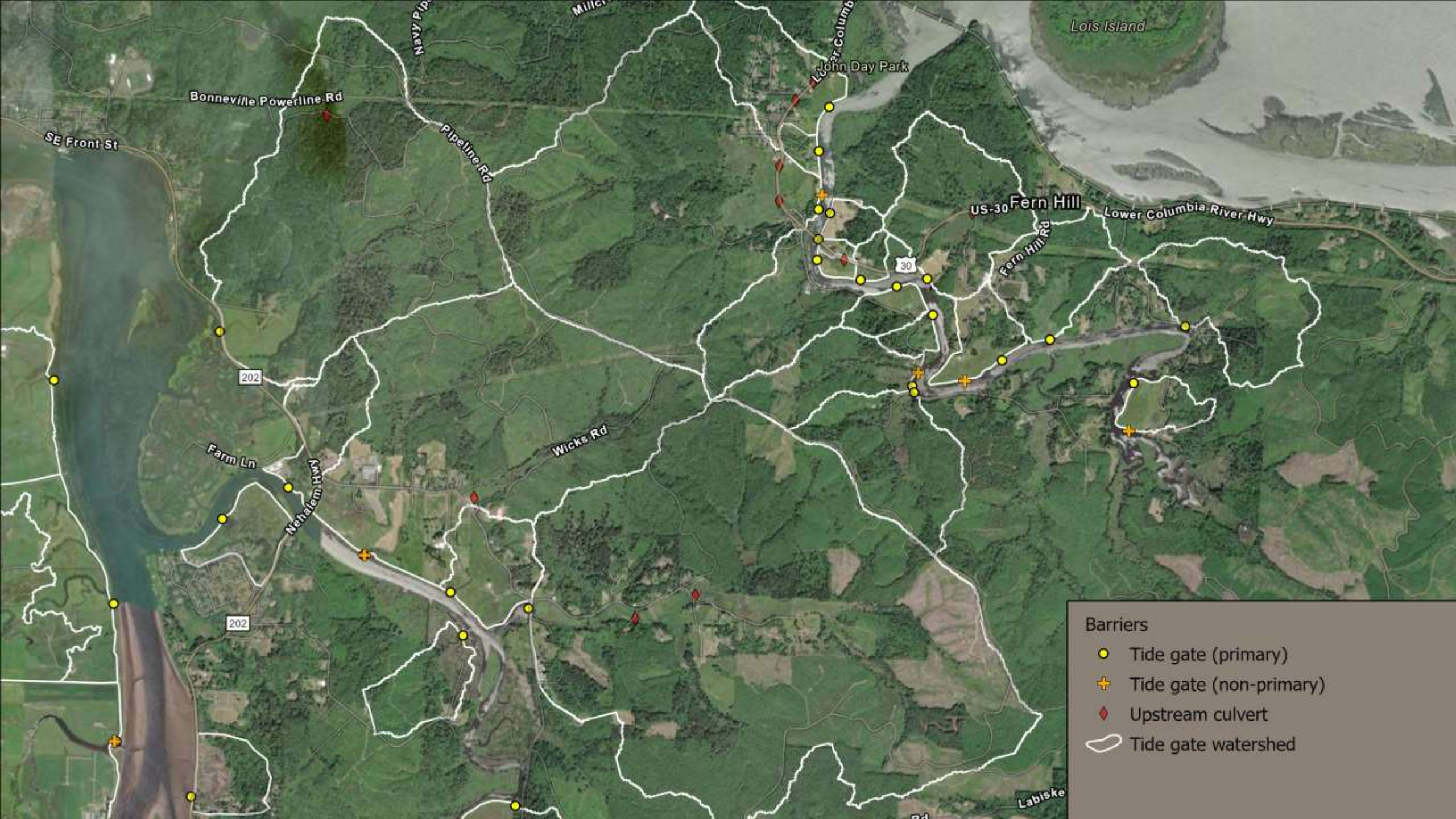
BUDGET:	50,000	100,000	150,000	200,000	250,000	300,000	350,000	400,000	450,000	500,000	550,000	600,000	650,000	700,000
STATUS:	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT	OPT
%OPTGAP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTNL_HAB	0	0.058	0.087	0.087	0.121	0.15	0.15	0.178	0.207	0.207	0.225	0.243	0.261	0.273
NETGAIN:	0	0.058	0.087	0.087	0.121	0.15	0.15	0.178	0.207	0.207	0.225	0.243	0.261	0.273
BARID	ACTION	ACTION	ACTION	ACTION	ACTION	ACTION	ACTION	ACTION	ACTION	ACTION	ACTION	ACTION	ACTION	ACTION
1ts2	0	1	1	1	1	1	1	1	1	1	1	1	1	1
2ts2	0	0	1	1	0	1	1	0	1	1	1	1	1	1
82ts2	0	0	0	0	1	1	1	1	1	1	1	1	1	1
152ts2	0	0	0	0	0	0	0	1	1	1	1	1	1	1
79ts2	0	0	0	0	0	0	0	0	0	0	1	0	1	1
29ts2	0	0	0	0	0	0	0	0	0	0	0	1	1	1
161ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	1
9ts2	0	0	0	0	0	0	0	0	0	0	0	1	1	0
8ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
106ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83ts2	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Barriers	Columbia	Coastwide
Number of tide gates	178	661
Number of stream culverts	104	305


John Day Park
Lower Columbia
Fern Hill
202


Lois Island
John Day Park
Bonneville Powerline Rd
SE Front St
Pipeline Rd
US-30
Fern Hill
Lower Columbia River Hwy
Fern Hill Rd
30
202
Wicks Rd
Farm Ln
Nehalem Hwy
202
Pipeline Rd
Labiske Rd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US-30
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Lower Columbia River Hwy
Fern Hill Rd
30
202
Farm Ln
Nehalem Hwy
Wicks Rd
202
Barriers
Tide gate (primary)
Tide gate (non-primary)
Upstream culvert
Tide gate watershed


Lois Island
John Day Park
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SE Front St
Pipeline Rd
US-30
Fern Hill
Lower Columbia River Hwy
Fern Hill Rd
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202
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Nehalem Hwy
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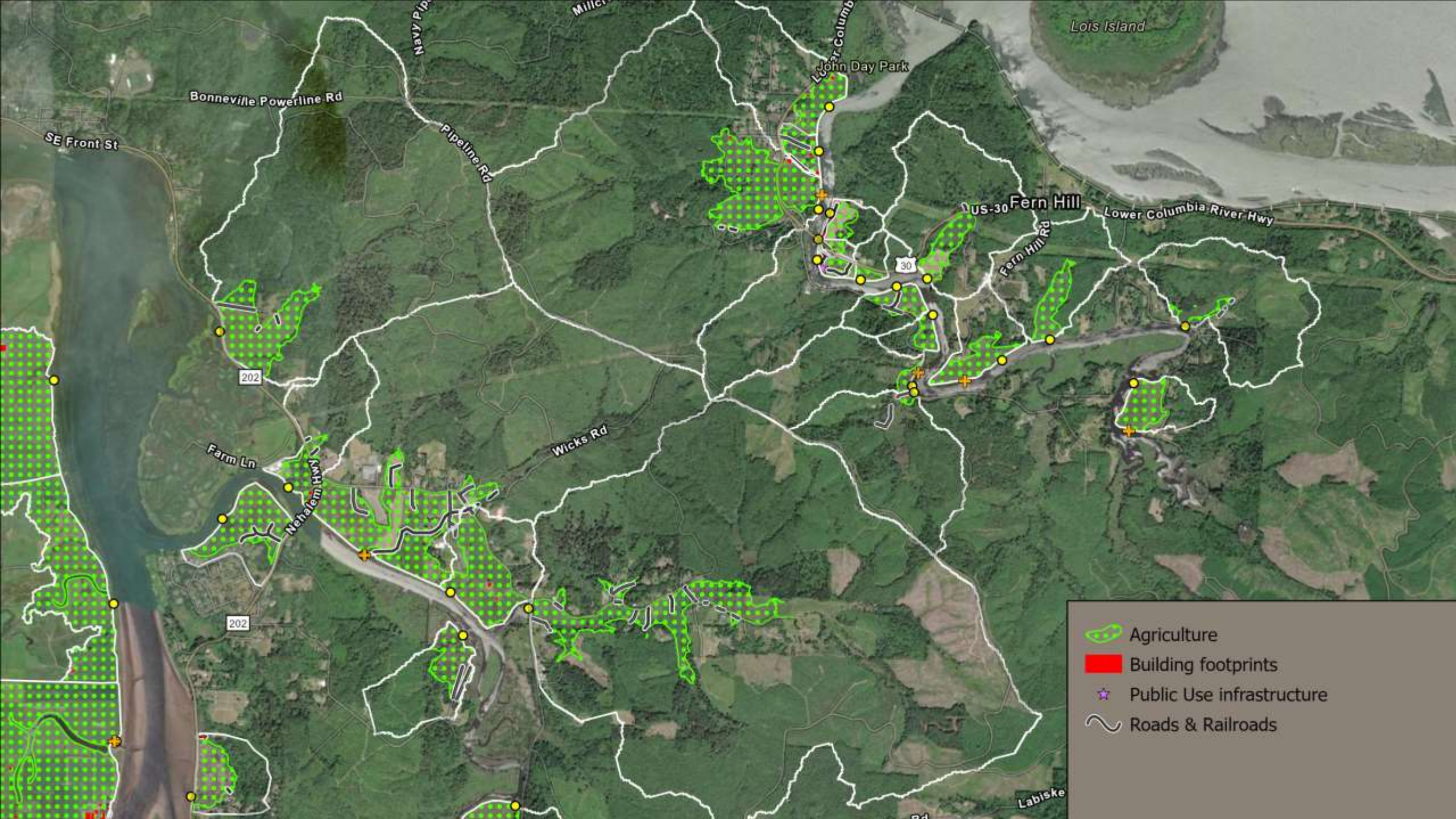
Labiske
Fish Habitat
Chinook salmon
Chum salmon
Coastal cutthroat trout
Coho salmon
Steelhead
Inundation area
Other streams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Wicks Rd
Nehalem Hwy
202
Labiske
Agriculture
Building footprints
Public Use infrastructure
Roads & Railroads

Barriers	Columbia	Coastwide
Potential Influence		
Total tide gate watershed area (acres)	75,865	254,354
Total upstream length (miles)	615	2,403
Stream Habitat (miles)		
Chinook salmon	12	92
Coho salmon	69	333
Steelhead	31	236
Chum	18	28
Cutthroat trout	182	739
Benefit Summaries		
Agriculture - Current (acres)	15,776	37,482
Agriculture - Future	16,696	41,760
Inundation Habitat - Current (acres)	17,739	38,418
Inundation Habitat - Future	17,745	39,768
Road & Railroad - Current (miles)	75	117
Road & Railroad - Future	100	196
Buildings - Current (number)	2,083	3,027
Buildings - Future	2,373	4,404
Public Use Infrastructure - Current (number)	112	200
Public Use Infrastructure - Future	132	360

ESTUARIES

What difference does make?

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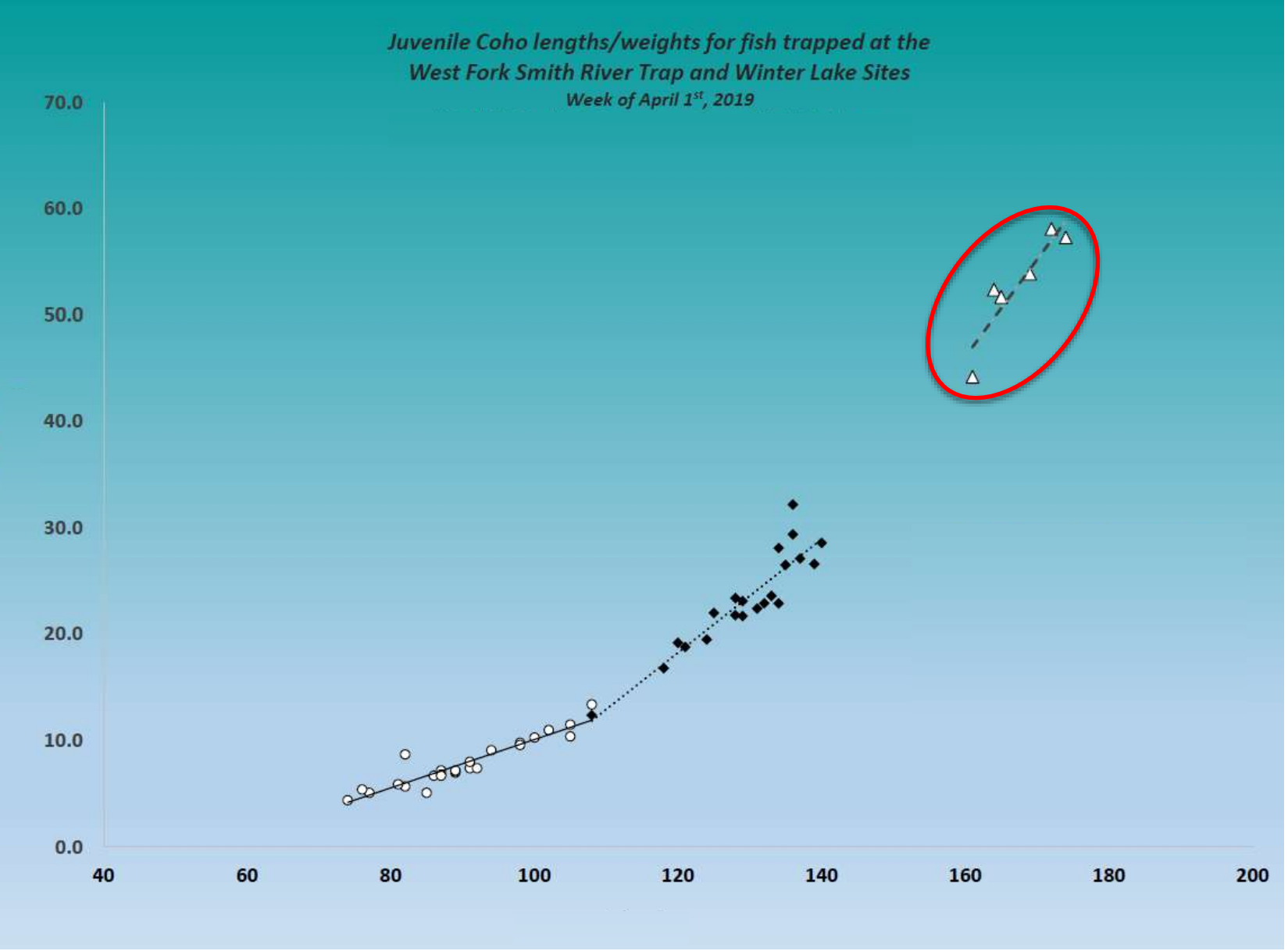

ESTUARIES

Coquille Results.

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NEXT STEPS

- Share the tool
- Stakeholder trainings
- Export to WA and BC (Europe?)
- Future additions
  - ODFW estuary channel layer
  - Lamprey
- TG Monitoring Protocols

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- TNC Team: Jena Carter, Shonene Scott, Claire Ruffing, Jason Nuckols

- Acknowledgements: Oregon Tide Gate Partnership, our Coastal Watershed Associations, ODFW, NRCS, CREST, Nehalem Marine, Porior Engineering, OR Farm Bureau, OR Cattlemen's Association, OR Dairy Farmers Association, DLCD, TerrainWorks, Wild Salmon Center, Institute for Applied Ecology, and Jesse O'Hanley.

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Thank you

Jason Nuckols, jnuckols@tnc.org

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Fish Habitat

- Inundation area (acres of estuary extent) - the amount of potential off-channel habitat that is important as rearing and refugia for juvenile salmonids
- Stream (miles) above a tide gate - based on species ODFW fish distribution and ODF fish presence data

Note: inundation area also represents the area at risk to land and infra-structure inundation should a tide gate fail.

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Agricultural land

- The tool considers all coastal farmland as equal - does not assign a value
- Use NRCS Farm-land Classification (Soil Survey Staff, NRCS 2019) includes High-Value Farmland (Oregon Revised Statute [ORS] 215.710)
- Data were aggregated into two classes: farmland and not farmland.

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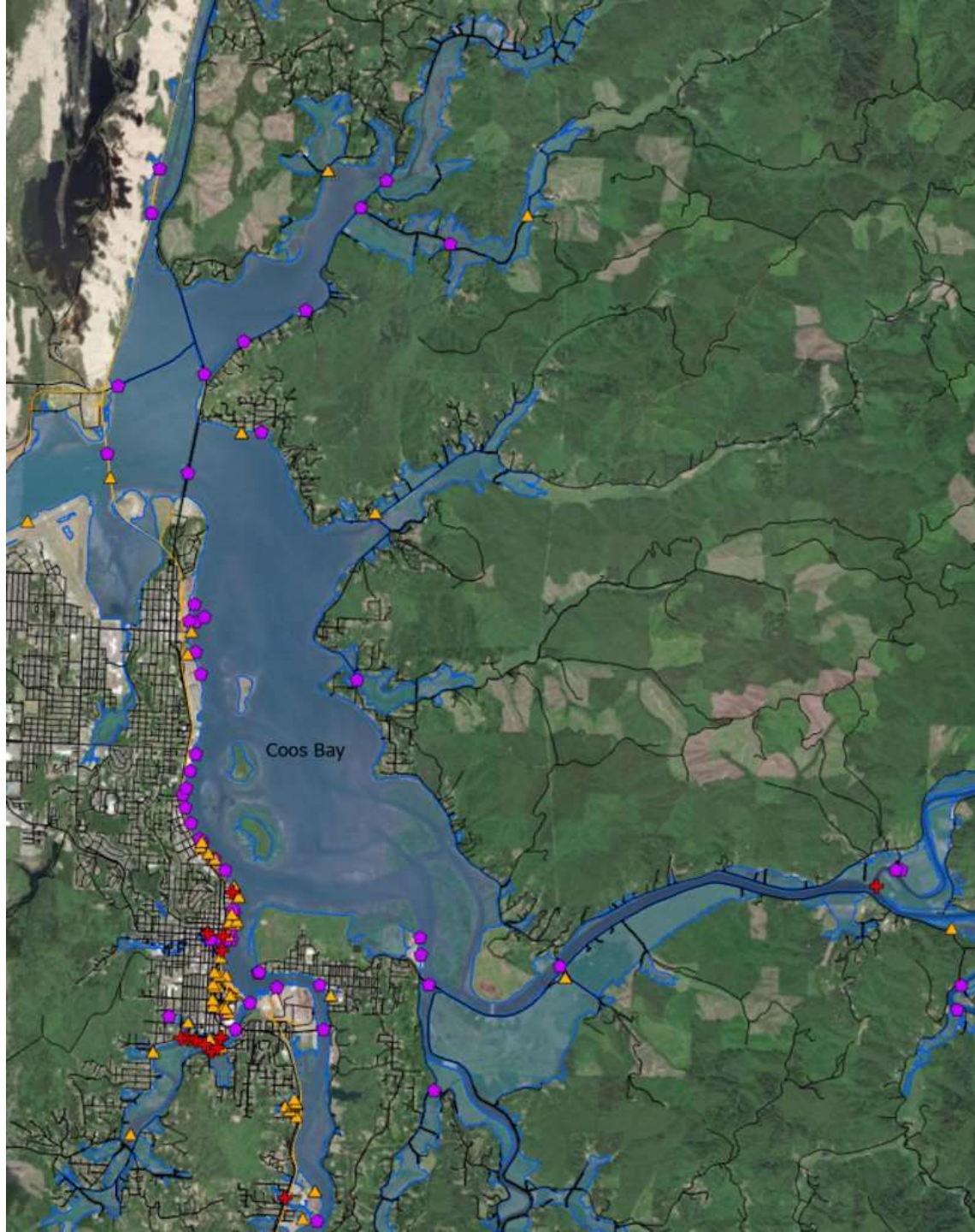
PUBLIC infrastructure

The Oregon Incidence Response Information System (OR-IRIS) geodatabase is used to represent the location and type of public use infrastructure.

The full dataset was reduced to those elements potentially impacted by tidal flooding:

- Emergency response resources
- Transportation (roads and railroads)
- Infrastructure
- Potential toxic sources



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PRIVATE infrastructure

Buildings are represented by the Microsoft Building Footprints (Microsoft 2018) dataset.

- provides location and footprint shape but not private or public ownership or building type.
- When combining agricultural land and buildings, assumes buildings are part of the agriculture operation, such as homes, barns, and outbuildings.

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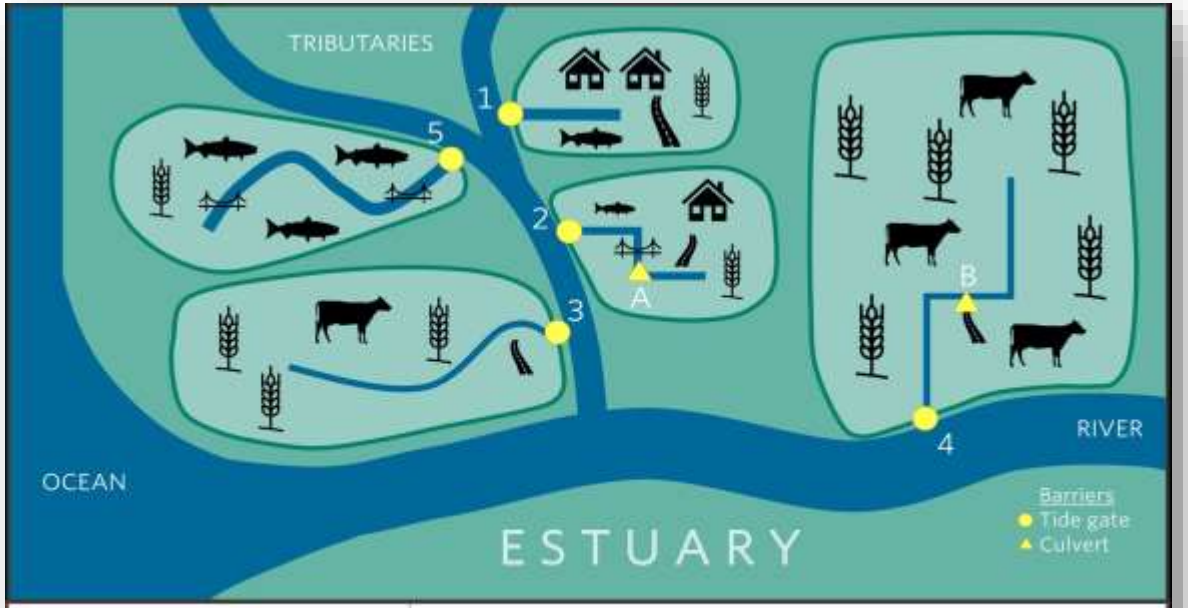
Future Scenario - Sea Level Rise

- For Fish Habitat – Use NOAA's 5-foot SLR extent (NOAA 2017) (consistent coverage throughout the state).
  - aligns with Brophy and Ewald 2017 LMZ
  - Approximate boundary for future fish habitat.

- For Ag and Infrastructure - DLCD Oregon Coastal Management Program future flooding vulnerability and risk assessments dataset .
  - extends projected sea level rise landward by adding probability estimates for extreme water levels
  - Reflects an increase in water level due to sea level rise (4.7 feet) with an additional 2.3 to 2.7 feet flood event height (flood elevations vary by estuary).

- The OCMP dataset does not include the Columbia River, so the NOAA 7-foot sea level rise layer (NOAA 2017) is used for the Columbia.

EXAMPLE OPTIMIZATION SCENARIO



A. Optimization parameters	Barriers				
Benefit targets	**1**	**2, A**	**3**	**4, B**	**5**
Tidal inundation (ac)	200	250	550	825	510
Stream habitat (mi)	3	< 1	0	0	10
Agricultural Land (ac)	200	225	500	800	150
Buildings (#)	25	10	0	0	0
Bridges (#)	0	1	0	0	2
Roads (mi)	1	< 1	< 1	< 1	0
Cost ($1,000s)	300	600 & 100	400	525 & 75	800

B. Optimization Scenarios		$1 mil budget				
Scenario	**Benefit targets**	**1**	**2, A**	**3**	**4, B**	**5**
1	Coho habitat (tidal & stream habitat)					✓
2	Inundation habitat			✓	✓	
3	Agricultural land & buildings	✓	✓			
4	Agricultural land only			✓	✓	
5	Roads & bridges	✓	✓			

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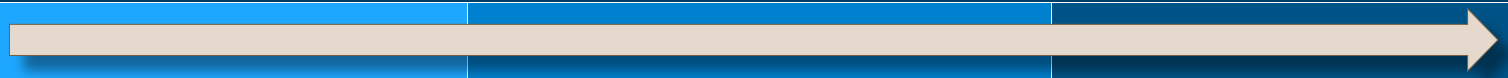
Tide Gate Optimization Tool Actions



Data Collection

Tide Gate Inventory

- Location
- Spatial context
- Area of influence

Local Knowledge

GIS

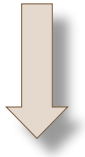
Spatial Data

- Benefit targets
- Tidal levels
- Reference data

Optimization

User Input

- Region
- Benefit targets
- Climate scenario



OptiPass Software

- Benefit targets
- Replacement costs
- Barrier locations
- Budget level
- Weights

Decision Support

Net gain for benefit targets of interest

Return on investment

Budgeting and fundraising support

Spatially dynamic replacement priorities

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