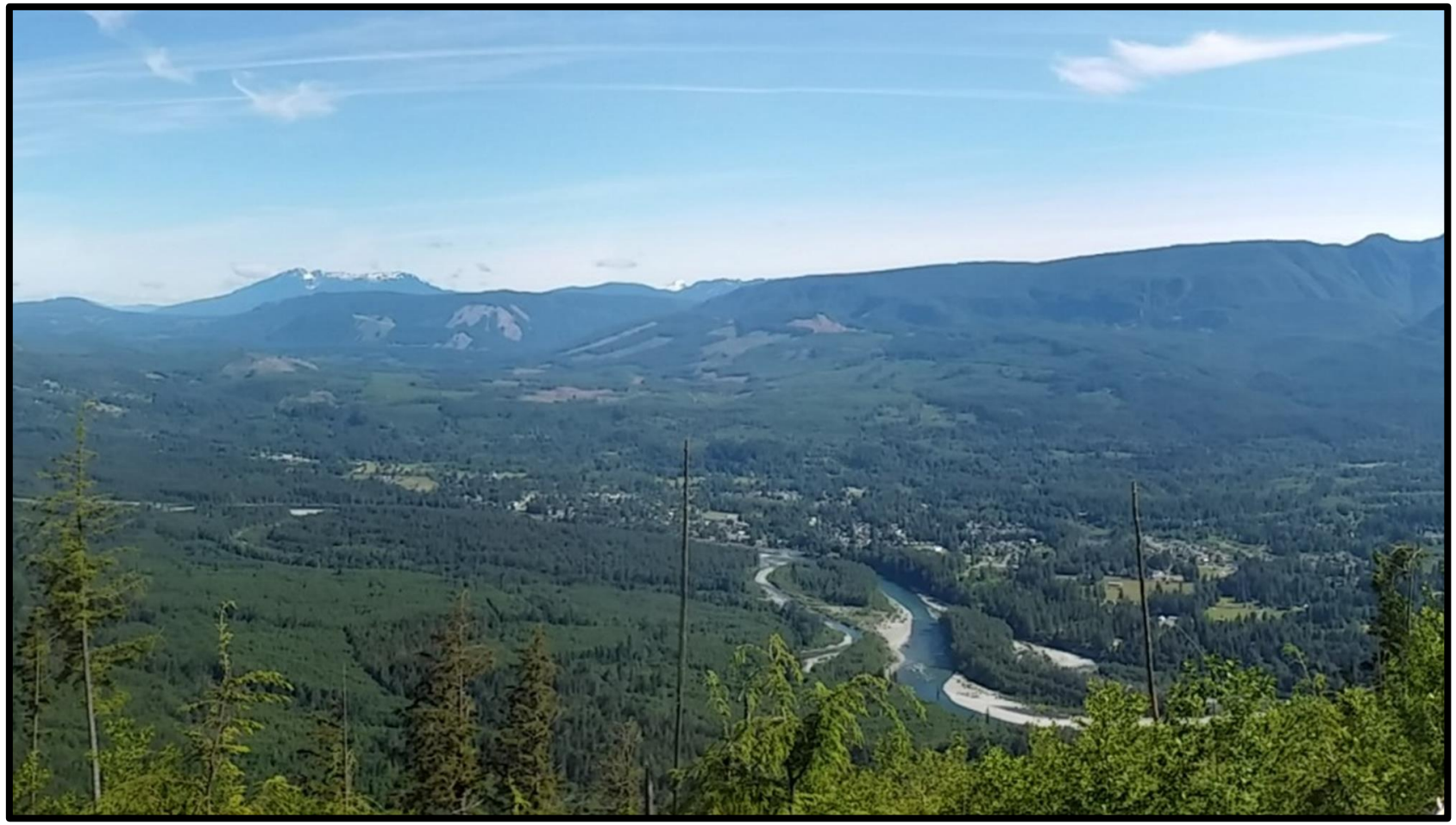
Snohomish Basin Floodplain Acquisition Strategy Phase I



Outline

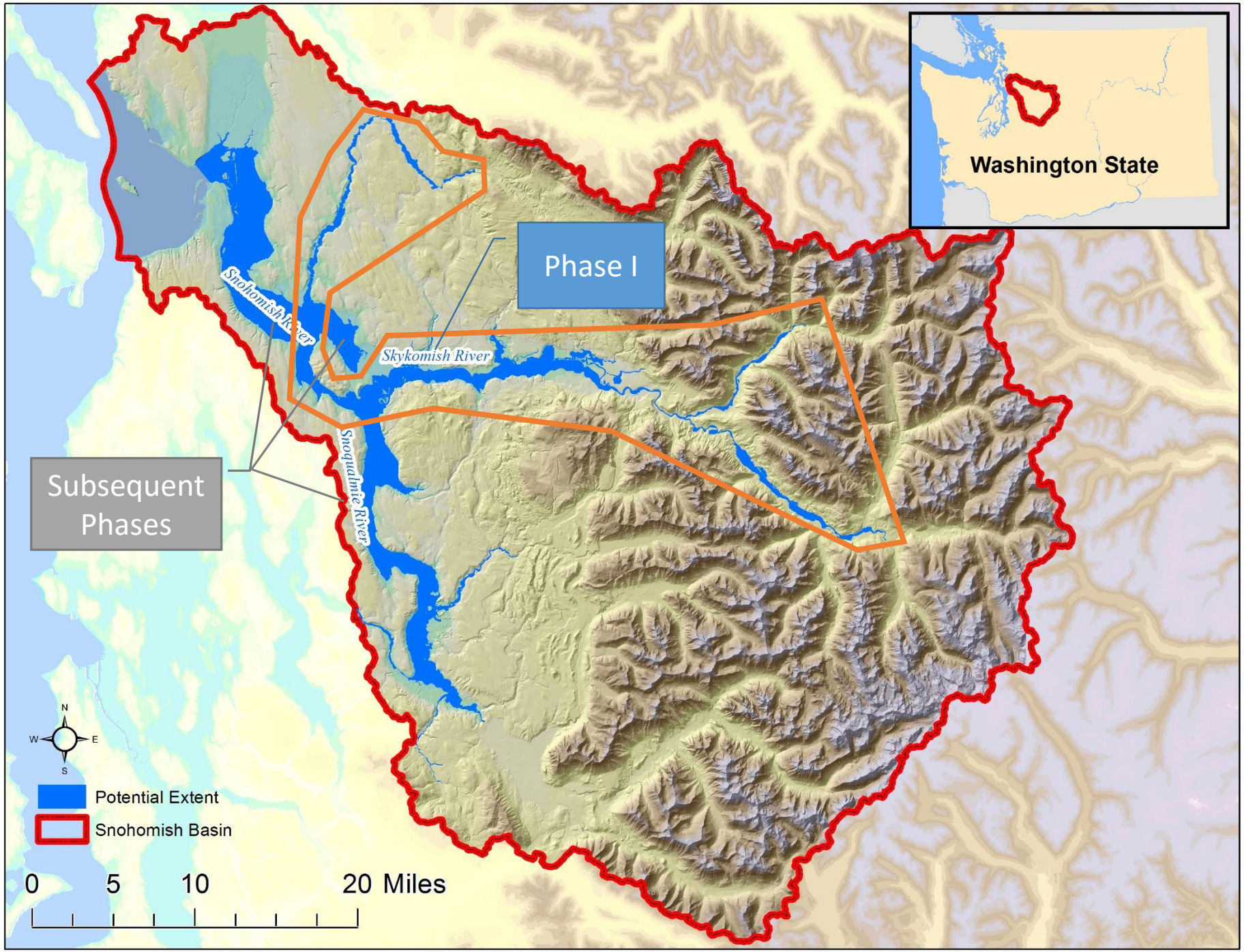
- Strategy Review
- Draft FPU Metric Weighting and Results
- Adjacency and Parcel Scoring
- Next Steps

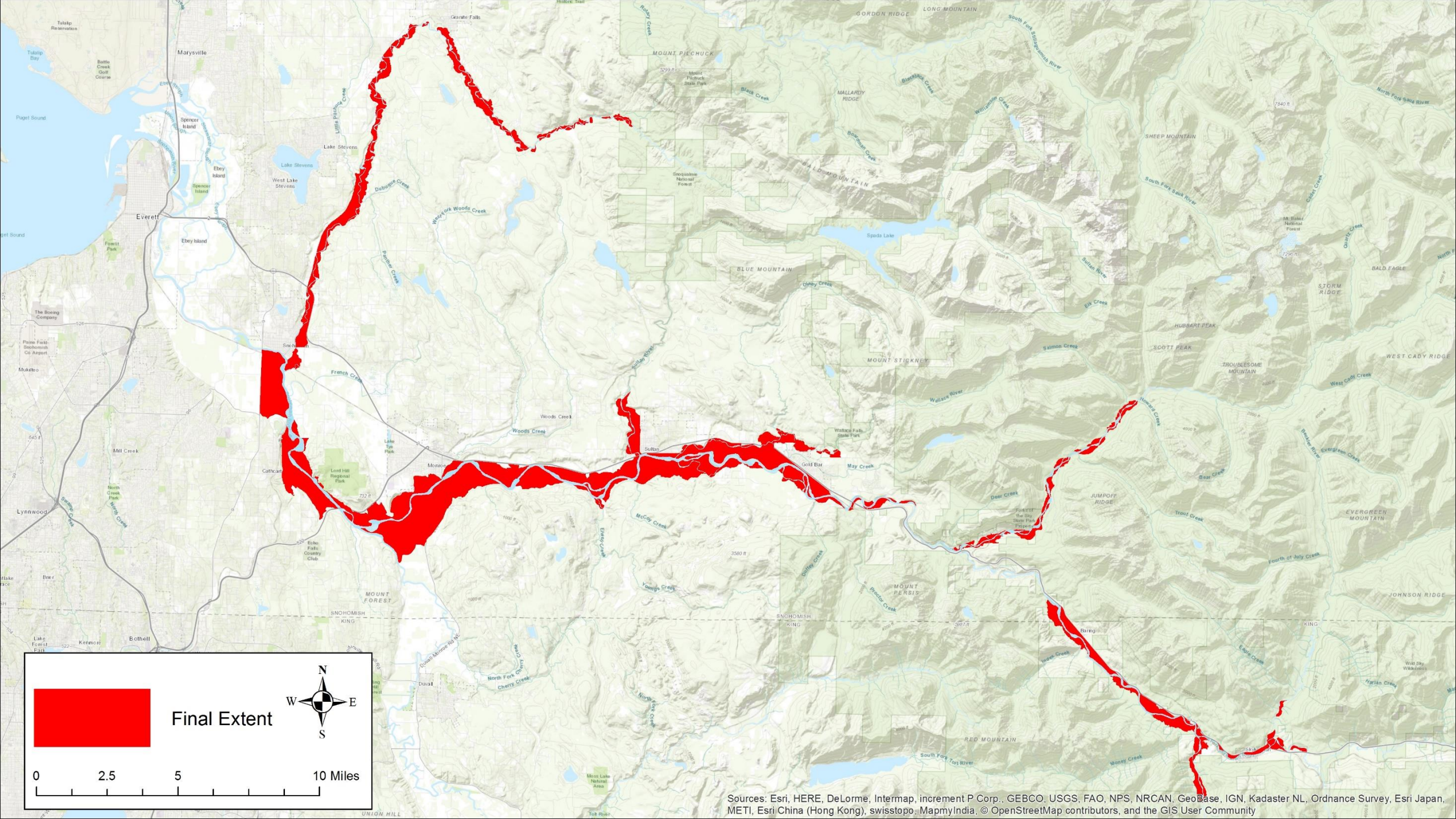
Purpose

- **Guidance for implementation of Salmon Conservation Plan**
- **Prioritize parcels for conservation/restoration of floodplain/instream processes**
- **Potential to obtain proactive acquisition dollars**
- **Capitalize on opportunistic property availability**

Goals

- **Establish corridors of protected floodplains**
- **Accelerate restoration project implementation**
- **Flood storage/conveyance**
- **Human safety**
- **Decrease flood damage claims**


Washington State
Phase I
Subsequent Phases
Snohomish River
Skykomish River
Snoqualmie River
N
W
E
S
Potential Extent
Snohomish Basin
0
5
10
20 Miles

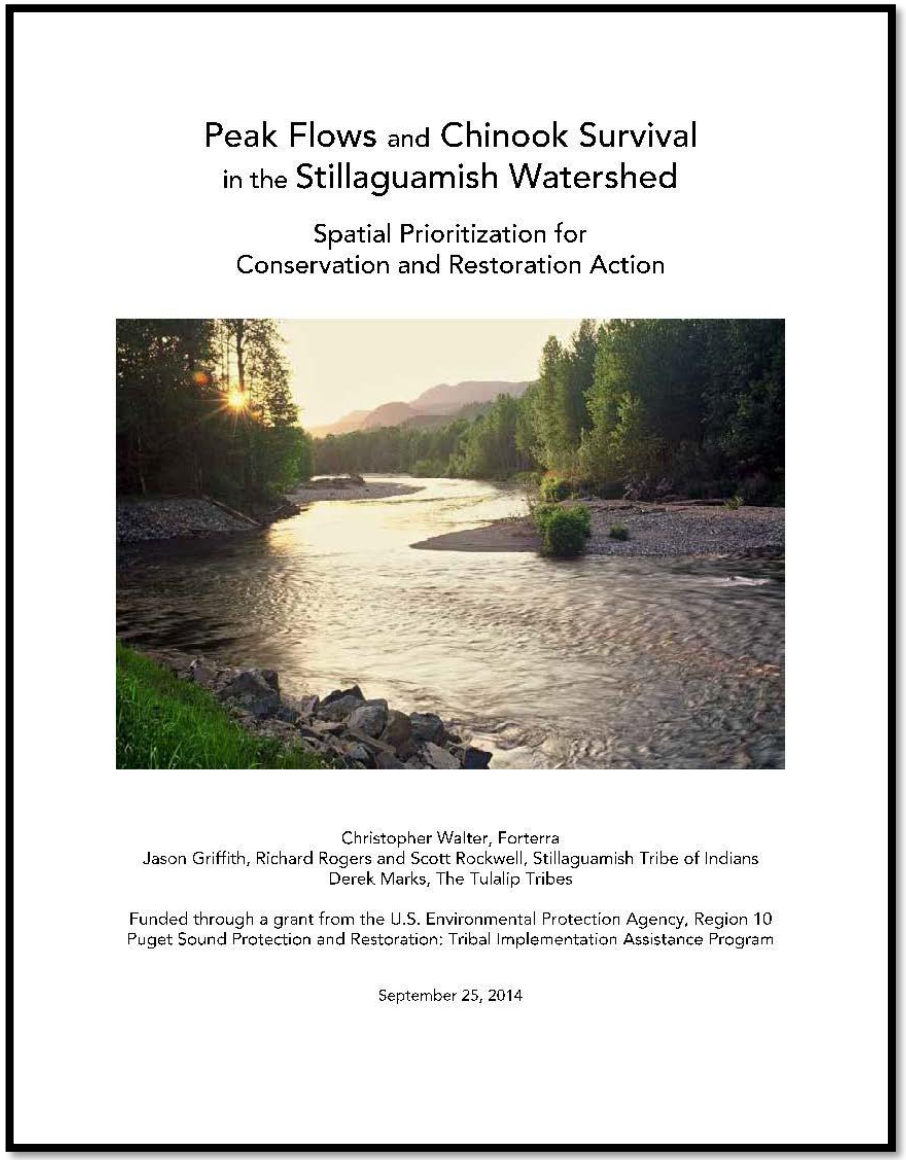

Final Extent
N
W
E
S
0
2.5
5
10 Miles
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Background

- Process based restoration is most effective
  - Channel migration, floodplain forest development, etc.
  - Requires large river adjacent areas and long time frames
- Connectivity is vital
  - Armoring/dike removal, etc.
- Long term opportunistic approach
- Only evaluates properties in a funding limited situation
  - All floodplain properties are high value
  - Prioritizes discrete units to be protected/restored incrementally

The Acquisition Strategy of the Stillaguamish Chinook Recovery Plan

- Draws Heavily from the EPA-funded Stillaguamish Peak Flows study
- Produced a GIS tool to prioritize floodplain areas
- Divides the active floodplain into “floodplain units” (FPUs)
- FPUs were ranked for conservation or restoration acquisitions
- Protected “corridor” approach



Peak Flows and Chinook Survival in the Stillaguamish Watershed

Spatial Prioritization for Conservation and Restoration Action

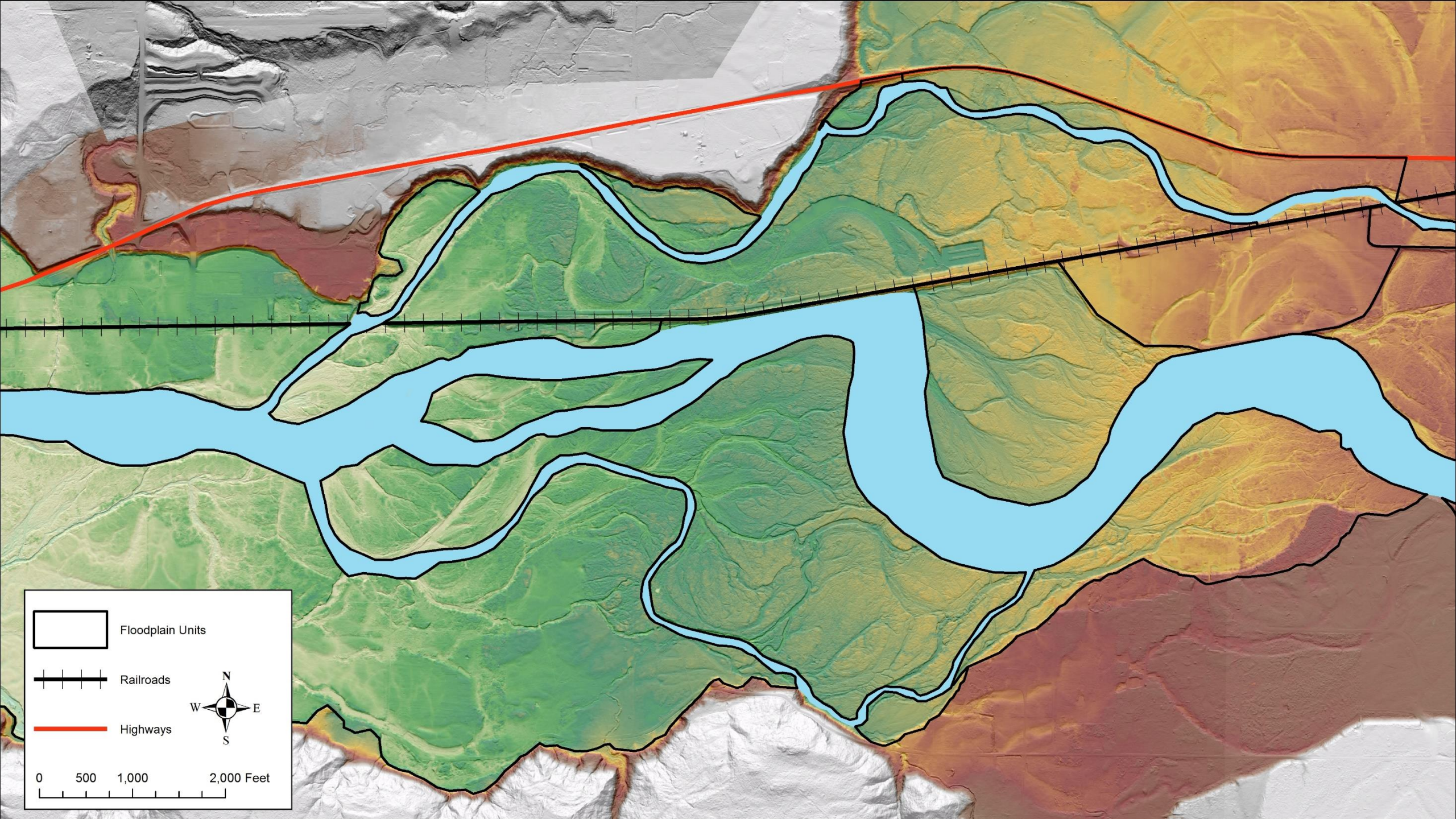
Christopher Walter, Forterra
Jason Griffith, Richard Rogers and Scott Rockwell, Stillaguamish Tribe of Indians
Derek Marks, The Tulalip Tribes

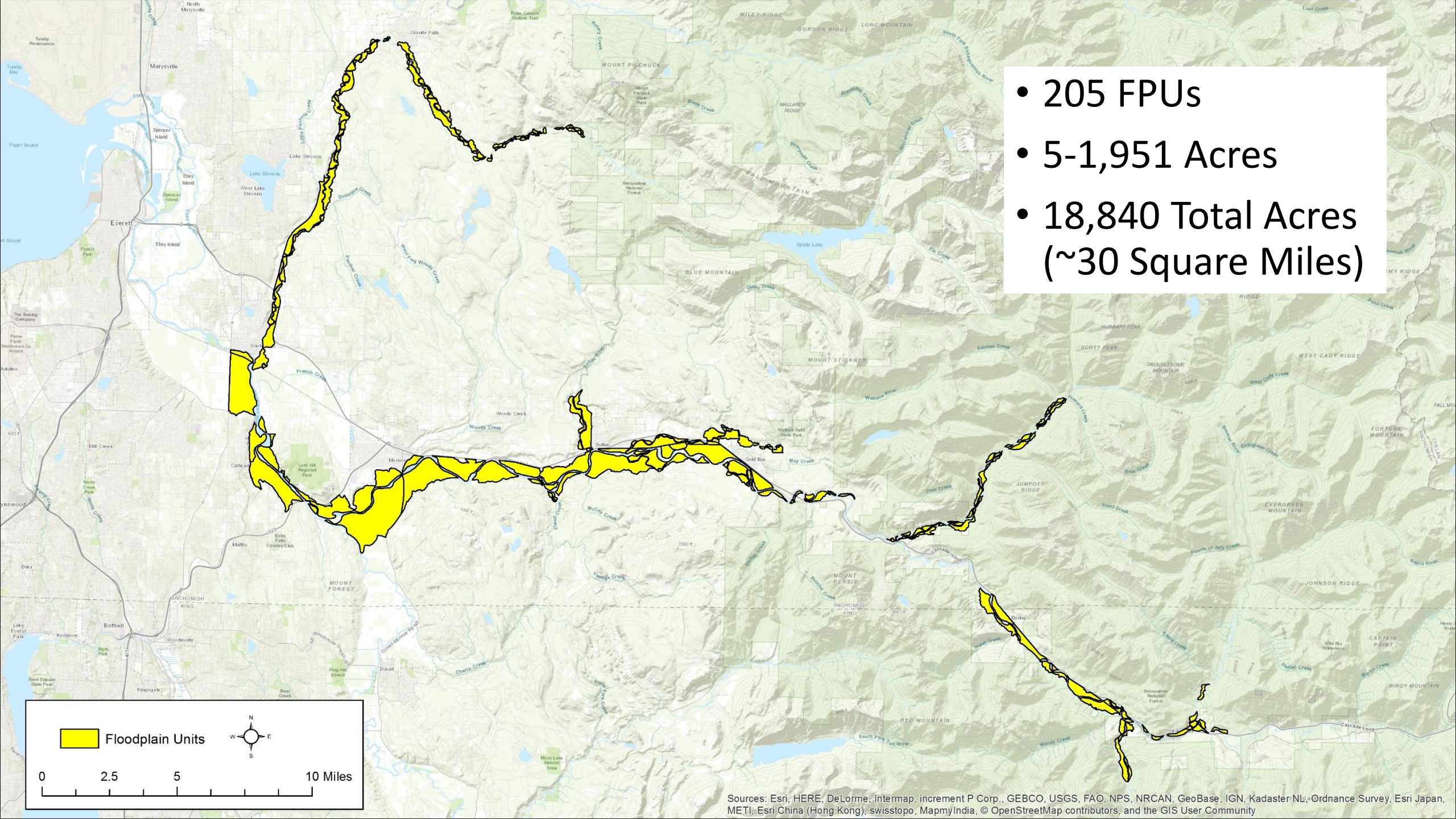
Funded through a grant from the U.S. Environmental Protection Agency, Region 10
Puget Sound Protection and Restoration: Tribal Implementation Assistance Program

September 25, 2014

Floodplain Units

- **Discrete portion of floodplain expected to be affected as a “unit” if channel migration is allowed to resume**
- **≤ 5’ above 100 year floodplain elevation**
- **Do not span the adjacent river**
- **Constrained by major transportation corridors (RR grades, Highways, etc.)**
- **Larger than 5 acres and substantially larger than the adjacent BFW**
- **Split where hydrologically distinct**


Floodplain Units
Railroads
Highways
N
W
E
S
0
500
1,000
2,000 Feet



- 205 FPUs
- 5-1,951 Acres
- 18,840 Total Acres (~30 Square Miles)

Category	FPU Metric	Scoring Criteria
Importance	Relative Elevation	FPU Elevation Relative to the 100-Year Flood Elevation
	Flow Importance	FPU Water Flow Importance (Delivery, Discharge, Recharge, & Surface Storage)
	Sub-Basin Strategy Group	FPU in Primary or Secondary Strategy Group
	Channel Frontage	Length of Potential Floodplain Channels and River Frontage per FPU
Feasibility	Land Use Type	FPU in Land Uses More or Less Compatible with Restoration/Conservation
	Number of Landowners	Number of Landowners in the FPU
	Landowner Density	Density of Landowners in the FPU
Degradation	Armoring	Percentage of FPU River Frontage Armored
	Channel Constriction	Actual BFW Compared to Expected BFW Adjacent to the FPU
	Sinuosity	River Centerline Distance Compared to Straight Line (Euclidean) Distance Adjacent to the FPU
	Water & Vegetation Cover	Percent of the FPU with Course Vegetation and Water Cover
	Flow Degradation	FPU Water Flow Degradation (Delivery, Discharge, Recharge, & Surface Storage)

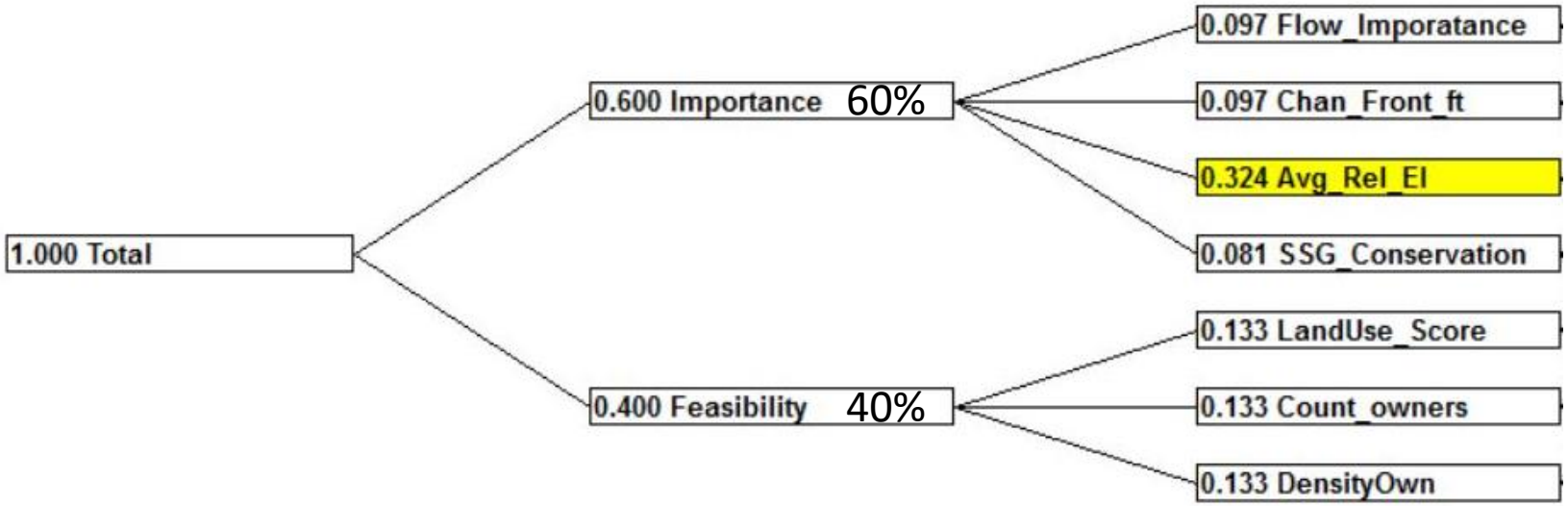
Tier I FPU Acquisition Scoring

- **Restoration Score =** Importance + Feasibility + Degradation + Adjacency

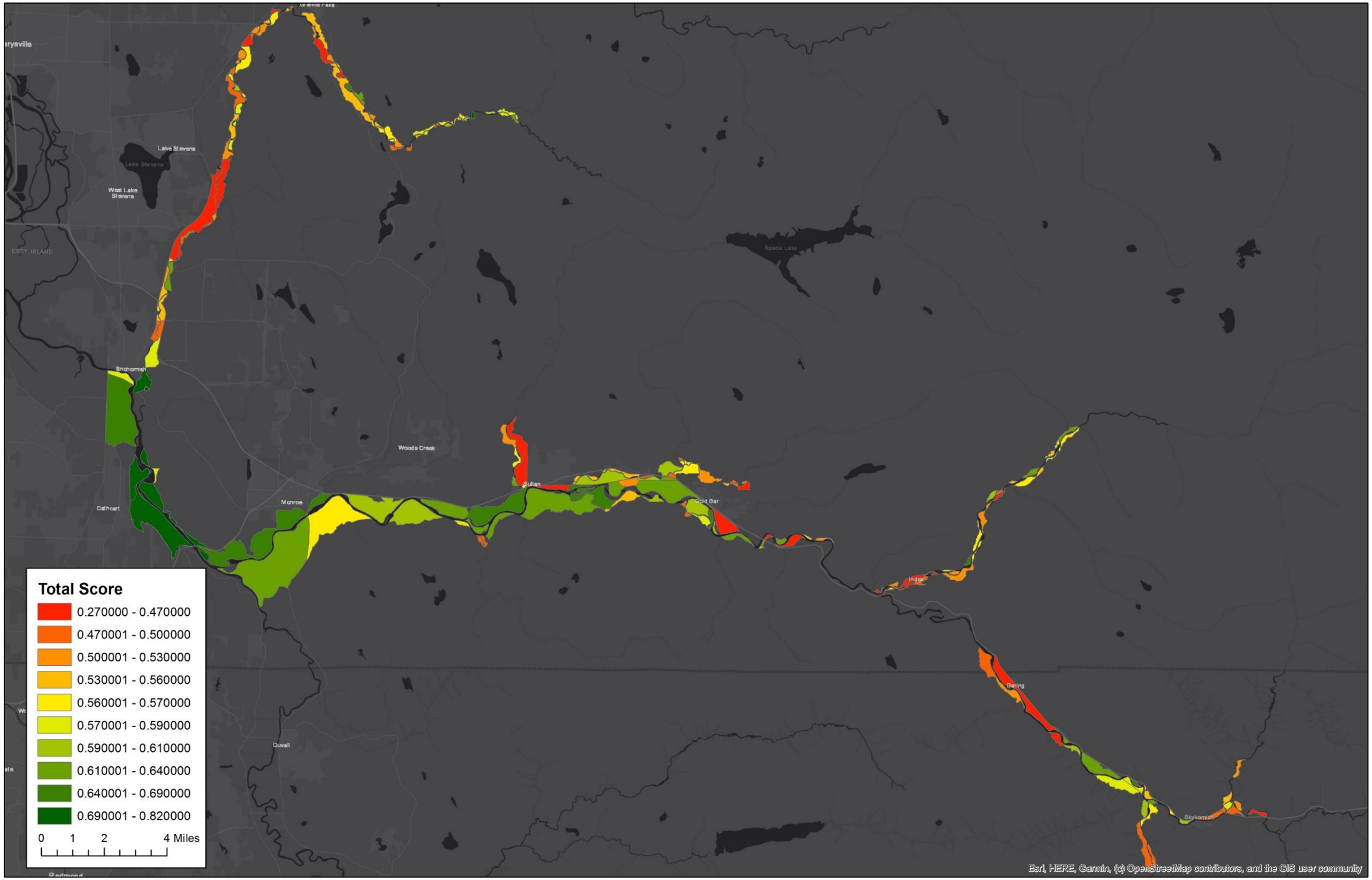
- **Conservation Score =** Importance + Feasibility + Inverse Degradation + Adjacency

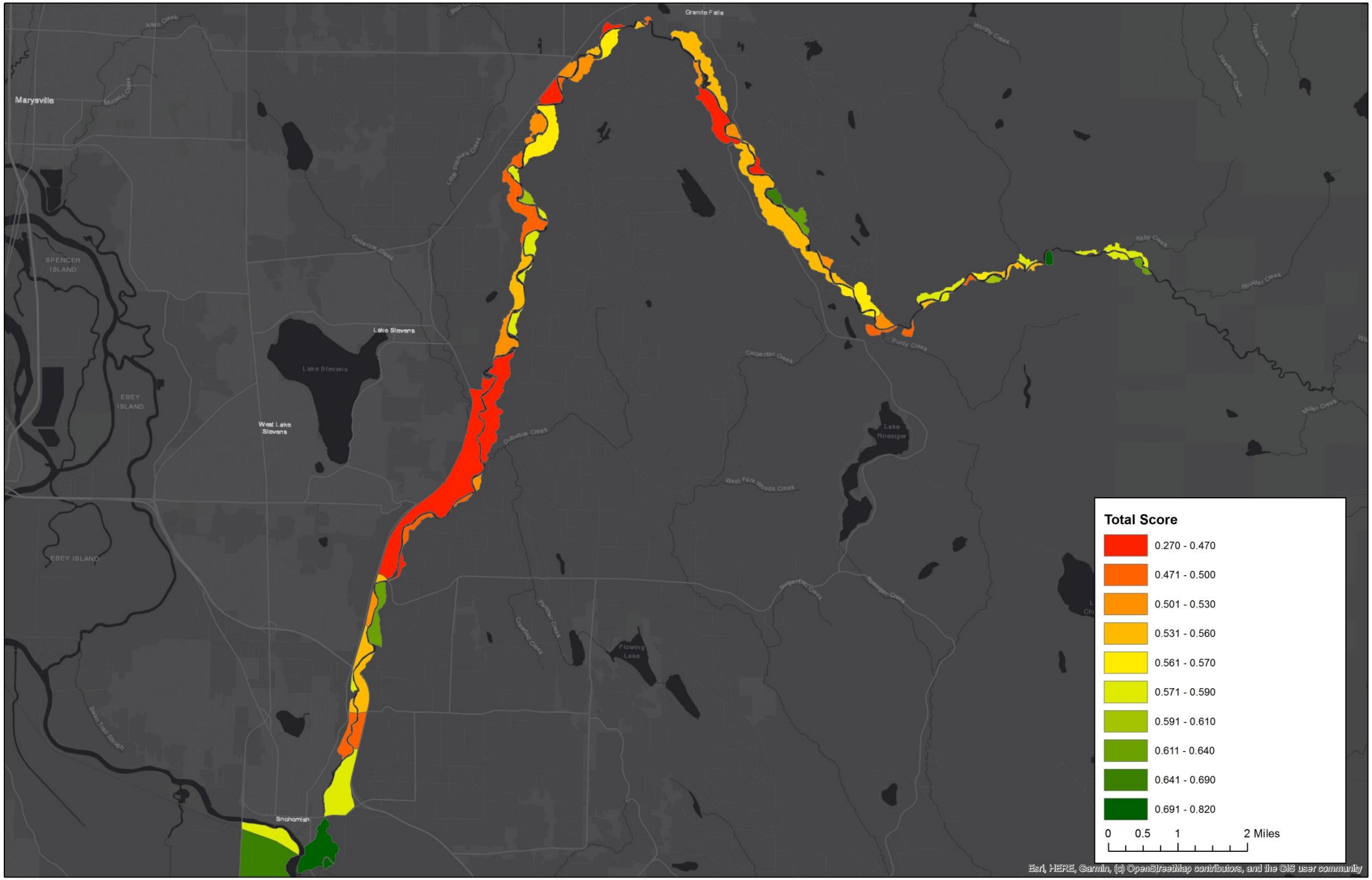
- **Total Score =** Importance + Feasibility + Adjacency

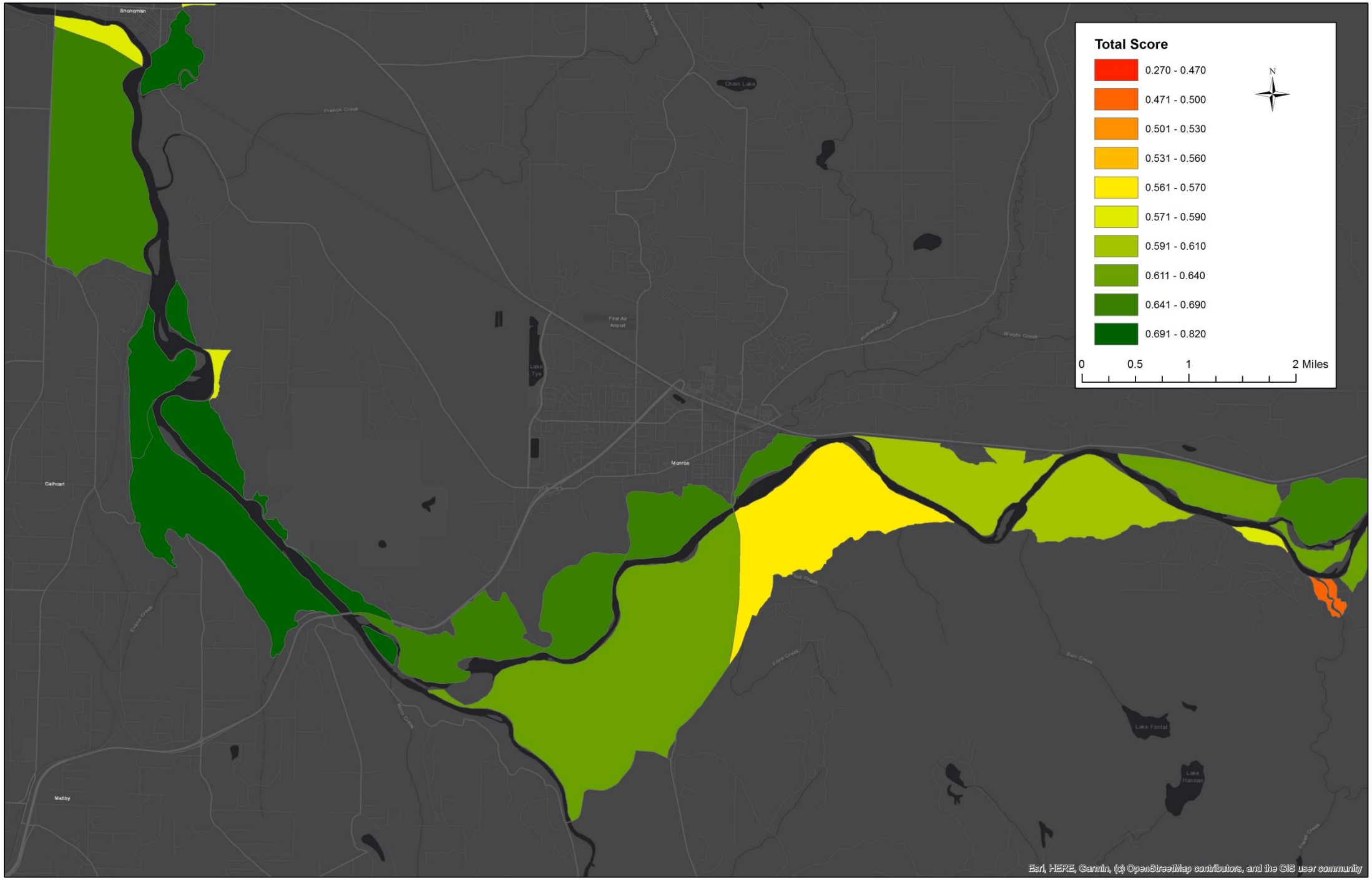
Total FPU Score

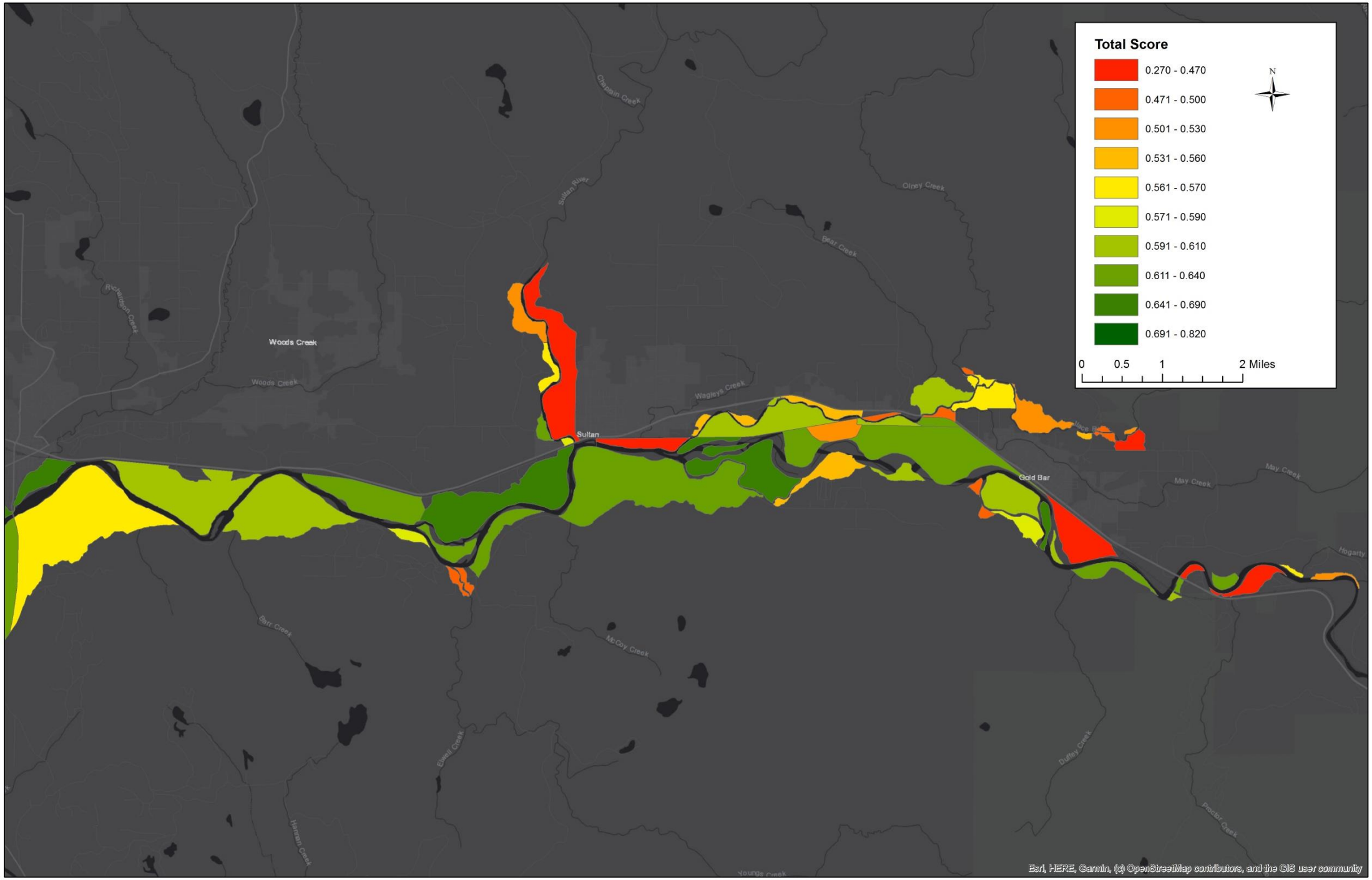


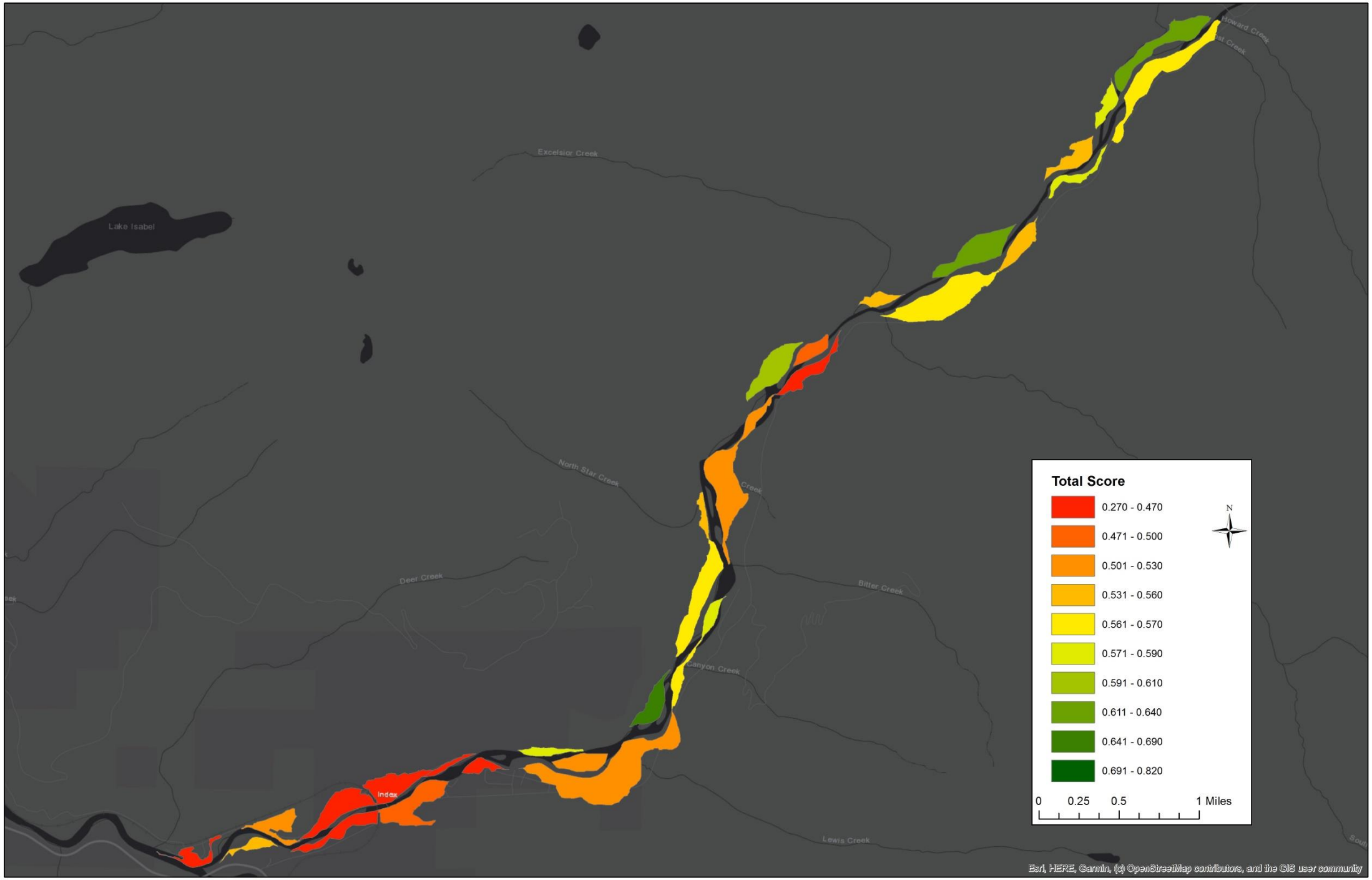
Metric	Weight
Relative Elevation	32.4%
Number Owners	13.3%
Density of Owners	13.3%
Land Use	13.3%
Flow Importance	9.7%
Channel Frontage	9.7%
Sub-Basin Strategy Group	8.1%

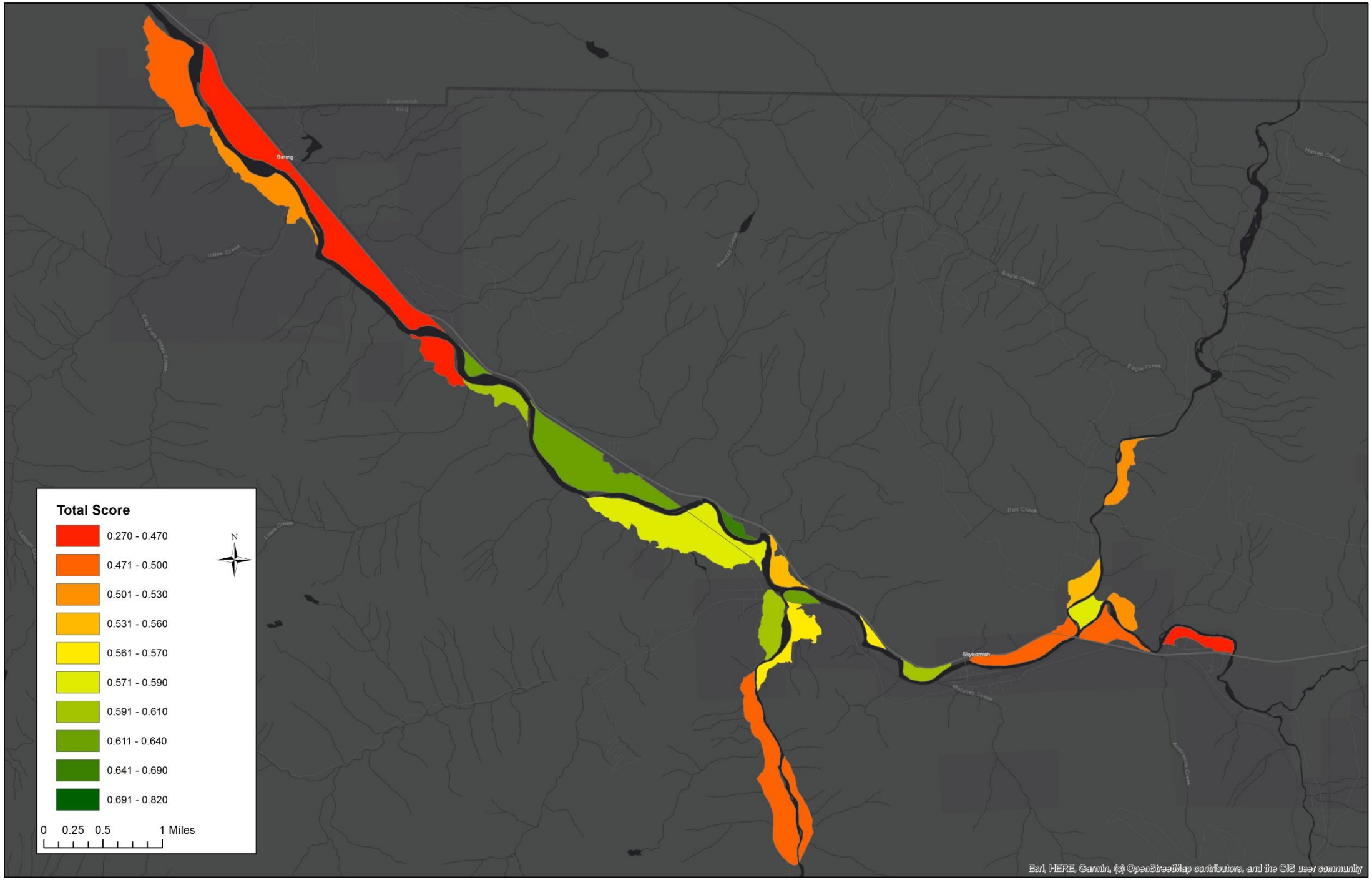

Total Score
0.270000 - 0.470000
0.470001 - 0.500000
0.500001 - 0.530000
0.530001 - 0.560000
0.560001 - 0.570000
0.570001 - 0.590000
0.590001 - 0.610000
0.610001 - 0.640000
0.640001 - 0.690000
0.690001 - 0.820000
0 1 2 4 Miles
Lake Stevens
West Lake Stevens
Snohomish
Woods Creek
Sultan
Monroe
Cathcart
Gold Bar
Spada Lake
Index
Baring
Duvall
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community


Granite Falls
Marysville
Allen Creek
Marysville Creek
Worthy Creek
Trafe Creek
Hawthorn Creek
Little Pilchuck Creek
Catherine Creek
SPENCER ISLAND
Lake Stevens
Lake Stevens
EBEY ISLAND
West Lake Stevens
Kelly Creek
Boulder Creek
Purdy Creek
Carpenter Creek
Dubuque Creek
Lake Roesiger
Miller Creek
West Fork Woods Creek
EBEY ISLAND
Soligenmer Creek
Roesiger Creek
Panther Creek
Crawford Creek
Flowing Lake
Swan Trail Slough
Snohomish
Total Score
0.270 - 0.470
0.471 - 0.500
0.501 - 0.530
0.531 - 0.560
0.561 - 0.570
0.571 - 0.590
0.591 - 0.610
0.611 - 0.640
0.641 - 0.690
0.691 - 0.820
0 0.5 1 2 Miles
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community


Total Score
0.270 - 0.470
0.471 - 0.500
0.501 - 0.530
0.531 - 0.560
0.561 - 0.570
0.571 - 0.590
0.591 - 0.610
0.611 - 0.640
0.641 - 0.690
0.691 - 0.820
N
0
0.5
1
2 Miles
Snohomish
French Creek
Chain Lake
First Air Airport
Lake Tye
Woods Creek
Monroe
Calhoart
Maltby
Lake Fontal
Lake Hannan
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community


Total Score
0.270 - 0.470
0.471 - 0.500
0.501 - 0.530
0.531 - 0.560
0.561 - 0.570
0.571 - 0.590
0.591 - 0.610
0.611 - 0.640
0.641 - 0.690
0.691 - 0.820
N
0
0.5
1
2 Miles
Woods Creek
Woods Creek
Richardson Creek
Chapman Creek
Sultan River
Olney Creek
Bear Creek
Wagleys Creek
Sultan
Gold Bar
May Creek
May Creek
Hogarty
Barr Creek
McCoy Creek
Ewell Creek
Harman Creek
Dufey Creek
Proctor Creek
Young Creek
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community


Excelsior Creek
Lake Isabel
North Star Creek
Deer Creek
Bitter Creek
Canyon Creek
Lewis Creek
Index
Total Score
0.270 - 0.470
0.471 - 0.500
0.501 - 0.530
0.531 - 0.560
0.561 - 0.570
0.571 - 0.590
0.591 - 0.610
0.611 - 0.640
0.641 - 0.690
0.691 - 0.820
N
0 0.25 0.5 1 Miles
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community


Total Score
0.270 - 0.470
0.471 - 0.500
0.501 - 0.530
0.531 - 0.560
0.561 - 0.570
0.571 - 0.590
0.591 - 0.610
0.611 - 0.640
0.641 - 0.690
0.691 - 0.820
N
0 0.25 0.5 1 Miles
Baring
Index Creek
East Fork Index Creek
Lowe Creek
Barclay Creek
Eagle Creek
Bolt Creek
Skykomish
Maloney Creek
Alpine Creek
Harlan Creek
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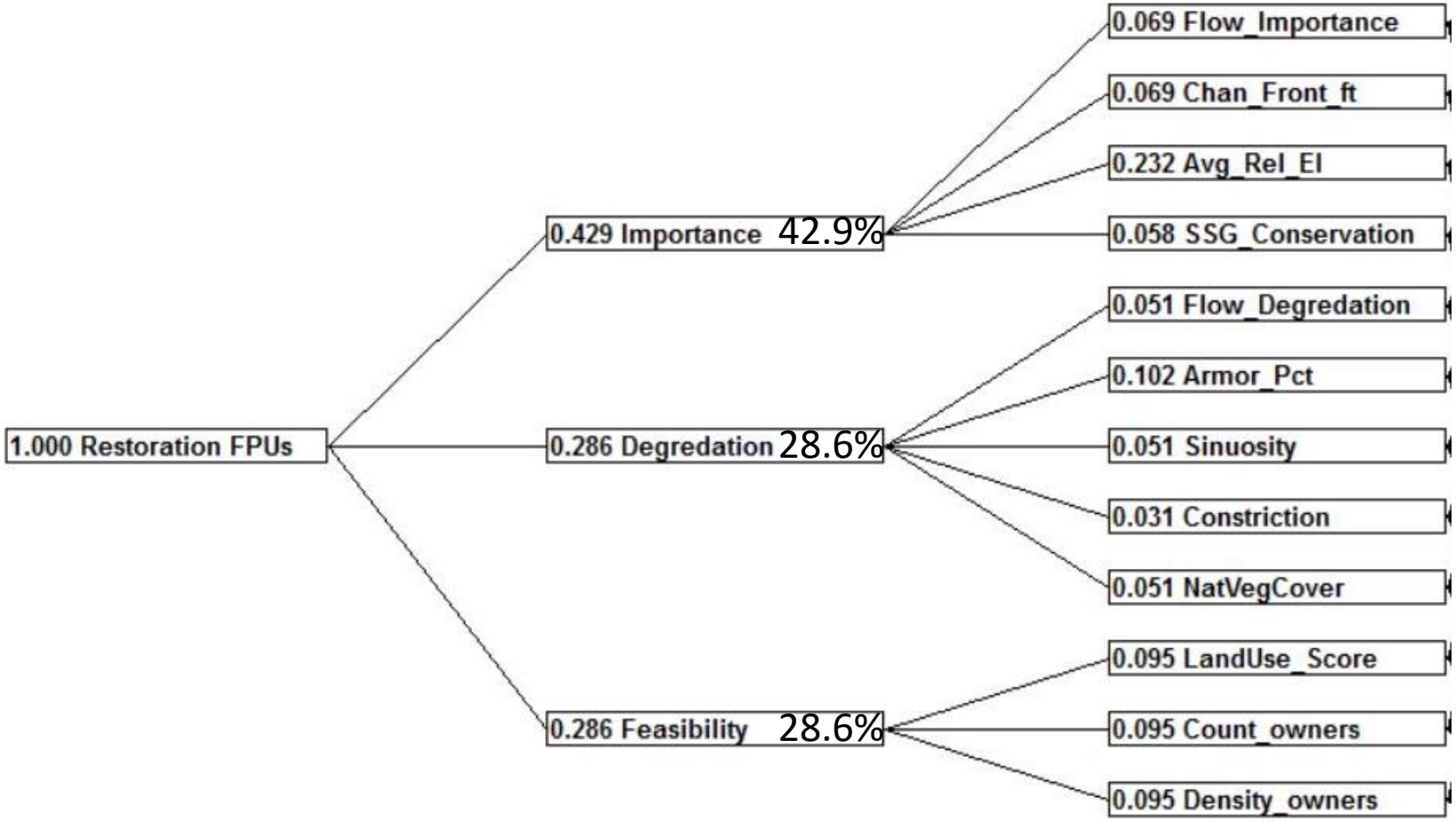
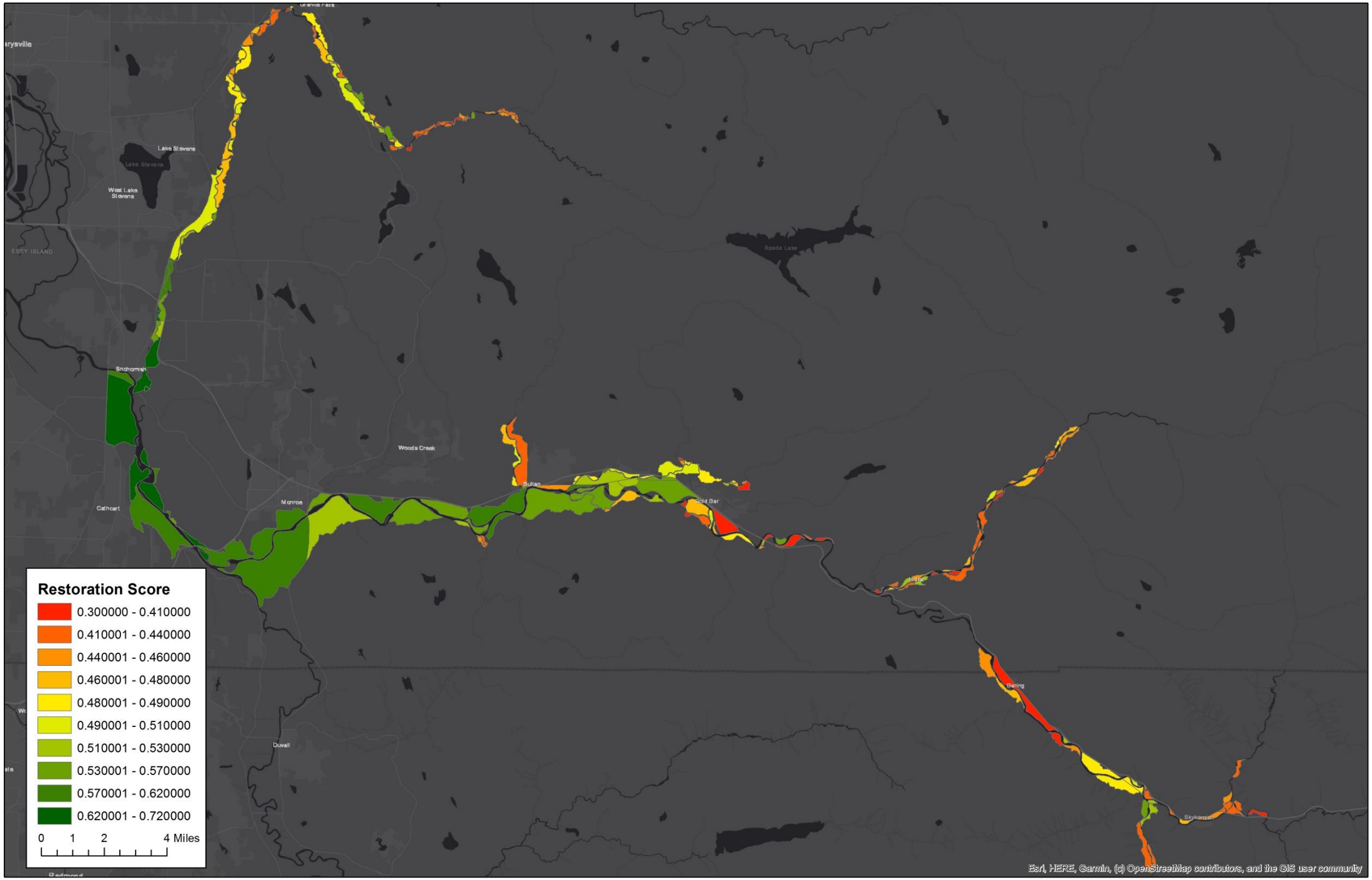
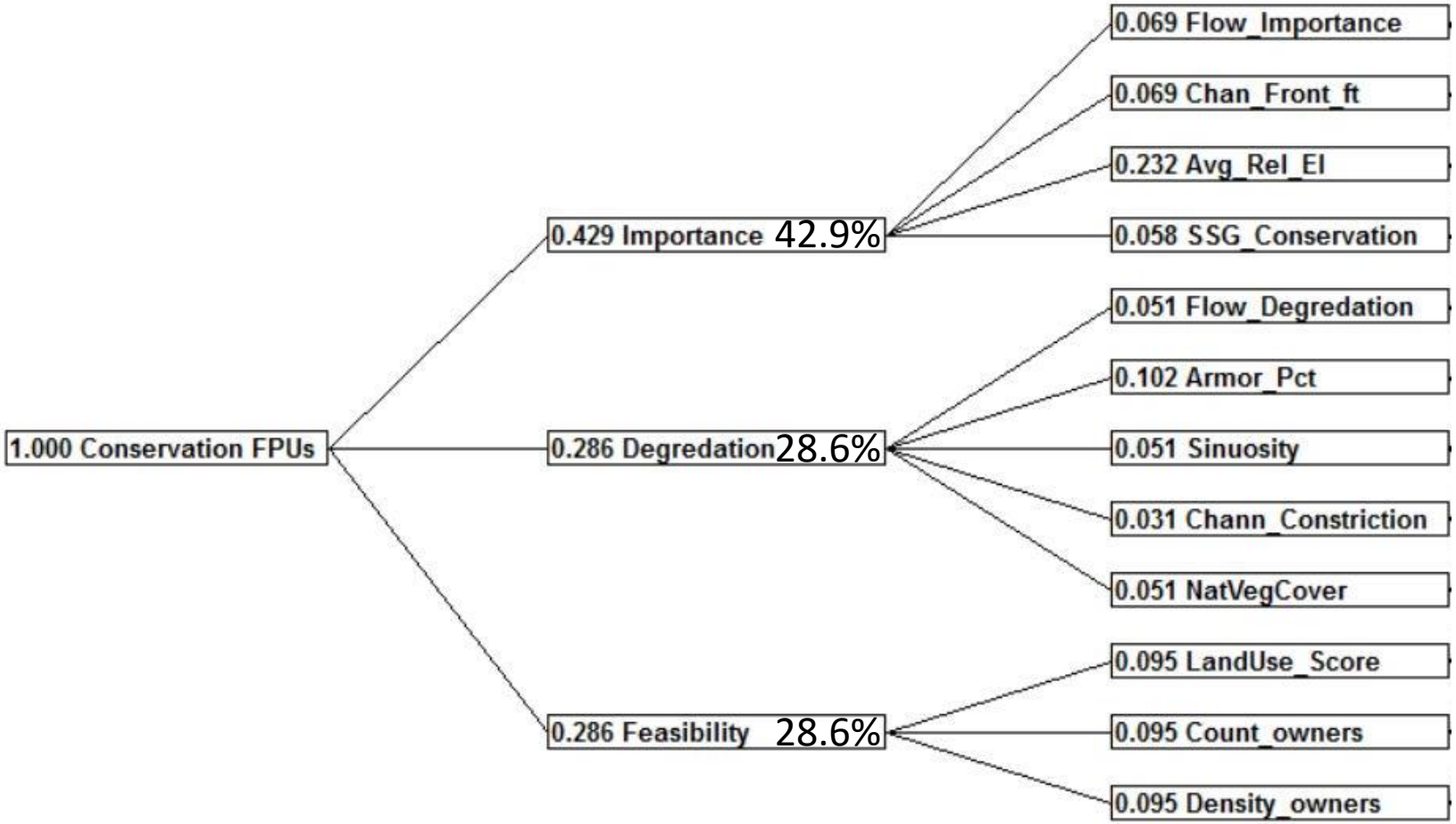
Restoration FPU Score



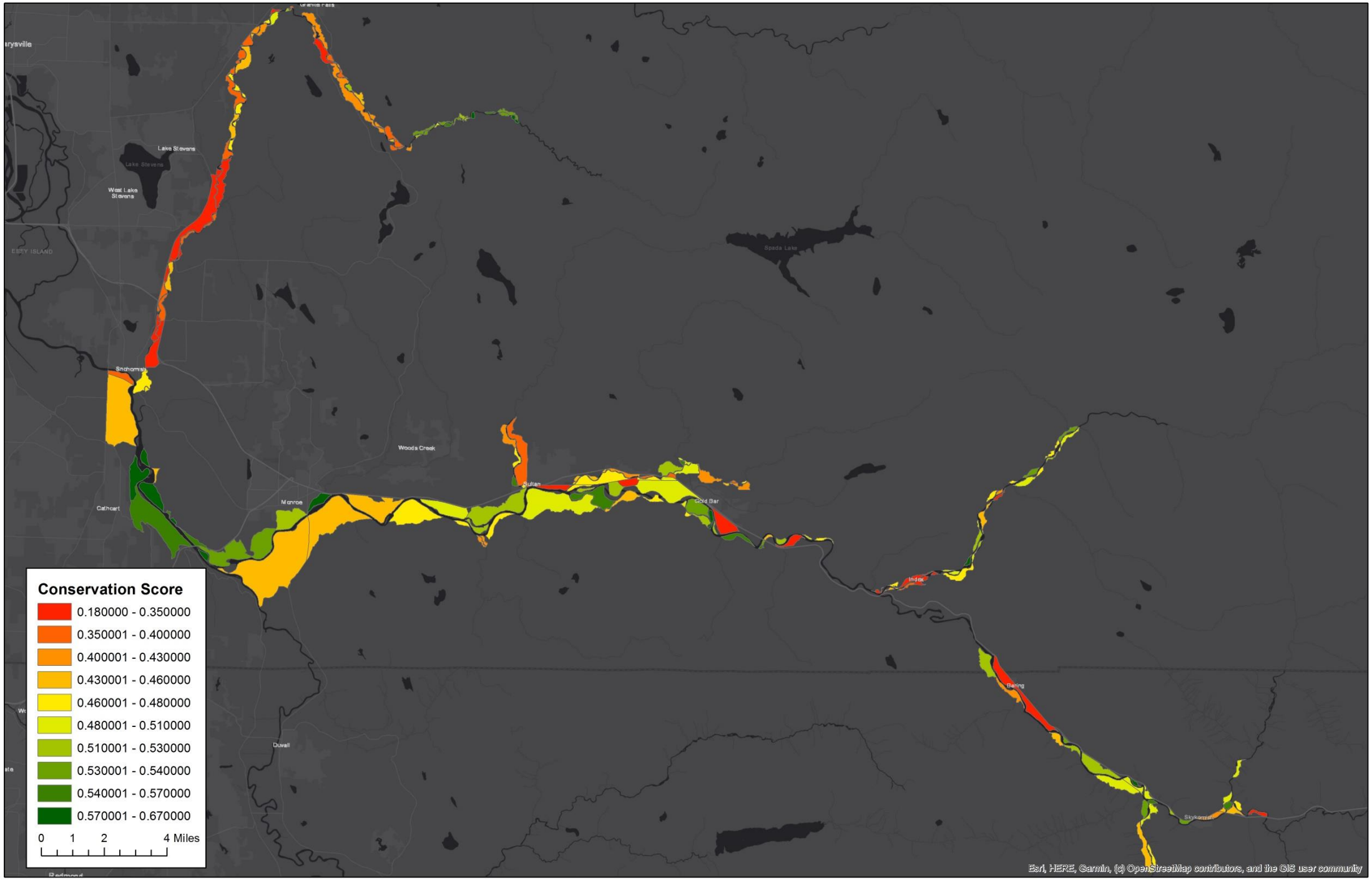
Metric	Weight
Relative Elevation	23.2%
Armoring %	10.2%
Number Owners	9.5%
Density of Owners	9.5%
Land Use	9.5%
Flow Importance	6.9%
Channel Frontage	6.9%
Sub-Basin Strategy Group	5.8%
Flow Degradation	5.1%
Natural Veg Cover	5.1%
Sinuosity	5.1%
Constriction	3.1%


Lake Stevens
West Lake Stevens
Snohomish
Cathcart
Monroe
Woods Creek
Sultan
Gold Bar
Spada Lake
Duvall
Baring
Restoration Score
0.300000 - 0.410000
0.410001 - 0.440000
0.440001 - 0.460000
0.460001 - 0.480000
0.480001 - 0.490000
0.490001 - 0.510000
0.510001 - 0.530000
0.530001 - 0.570000
0.570001 - 0.620000
0.620001 - 0.720000
0 1 2 4 Miles
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Conservation FPU Score



Metric	Weight
Relative Elevation	23.2%
Armoring %	10.2%
Number Owners	9.5%
Density of Owners	9.5%
Land Use	9.5%
Flow Importance	6.9%
Channel Frontage	6.9%
Sub-Basin Strategy Group	5.8%
Flow Degradation	5.1%
Natural Veg Cover	5.1%
Sinuosity	5.1%
Constriction	3.1%


Conservation Score
0.180000 - 0.350000
0.350001 - 0.400000
0.400001 - 0.430000
0.430001 - 0.460000
0.460001 - 0.480000
0.480001 - 0.510000
0.510001 - 0.530000
0.530001 - 0.540000
0.540001 - 0.570000
0.570001 - 0.670000
0 1 2 4 Miles
Lake Stevens
West Lake Stevens
Snohomish
Woods Creek
Sultan
Gold Bar
Monroe
Cathcart
Index
Baring
Duvall
Spada Lake
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Tier II Parcel Acquisition Scoring

- Adjacency
  - Protected Parcels?
  - River/Aquatic Lands?

- Other Project/Parcel Specific Considerations?

Adjacency

- How should we define Adjacency
  - Adjacent to protected parcels
  - Adjacency to the River
- How important is Adjacency?
- How should Adjacency be scored?
  - # of adjacent protected parcels (stilly)
  - % of perimeter adjacent to protected lands
  - Length of perimeter adjacent to protected lands
- Should we refine the strategy maps to the parcel scale?

Protected Parcel Definition

Under a conservation easement, managed under State, Federal, or industrial forest rules, or otherwise owned by a governmental entity <u>AND</u> managed for natural resources protection and long term riverine/floodplain natural process function.

Examples of Protected Parcels

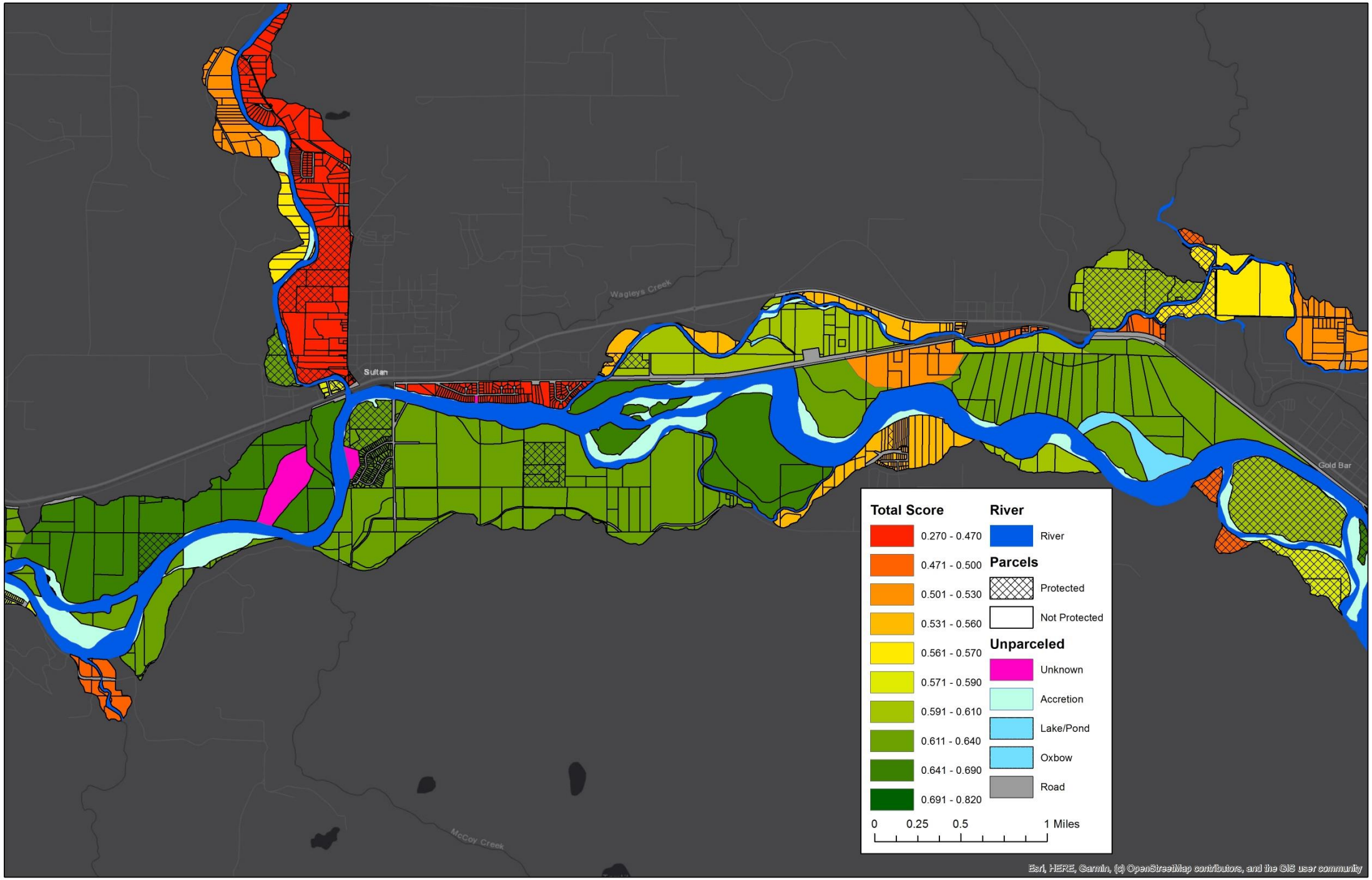
- Most Forest Service Owned
- State Owned AND managed for natural process function
- County Owned AND managed for natural process function
- Industrial Timberland WITH CONSERVATION EASEMENT
- Tulalip Owned AND managed for natural process function
- Utility Owned AND managed for natural process function
- Mitigation Banks
- Land Trust Owned AND managed for natural process function

Examples of NOT Protected Parcels

- Leased Forest Service Lands (Cabins, etc.)
- Farmland INCLUDING farmland protection easements
- Industrial timber land WITHOUT conservation easements
- Public land NOT managed for natural process function
- BNSF Land
- Tulalip land NOT managed for natural process function
- Other Private Land
- Centennial Trail/abandoned railroads

Protected Parcels/Lands?

- Public Lands/Parks not currently managed for natural process function?
- BNSF Land?
- Aquatic Lands/Rivers?
- Parcels without Parcel #s/Owners?
  - Abandoned Historic River Paths/Accretion Areas


Wagleys Creek
Sultan
Gold Bar
McCoy Creek
Total Score
0.270 - 0.470
0.471 - 0.500
0.501 - 0.530
0.531 - 0.560
0.561 - 0.570
0.571 - 0.590
0.591 - 0.610
0.611 - 0.640
0.641 - 0.690
0.691 - 0.820
River
River
Parcels
Protected
Not Protected
Unparceled
Unknown
Accretion
Lake/Pond
Oxbow
Road
0 0.25 0.5 1 Miles
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Project/Parcel Specific Considerations

- Identify a group or committee (tech committee or sub committee?) to prioritize between multiple available parcels based on:
  - Near Term/Pending Projects?
  - Site Specific Habitat Considerations?
  - Cost/Acre?
  - Other Unforeseen Considerations?

Next Steps

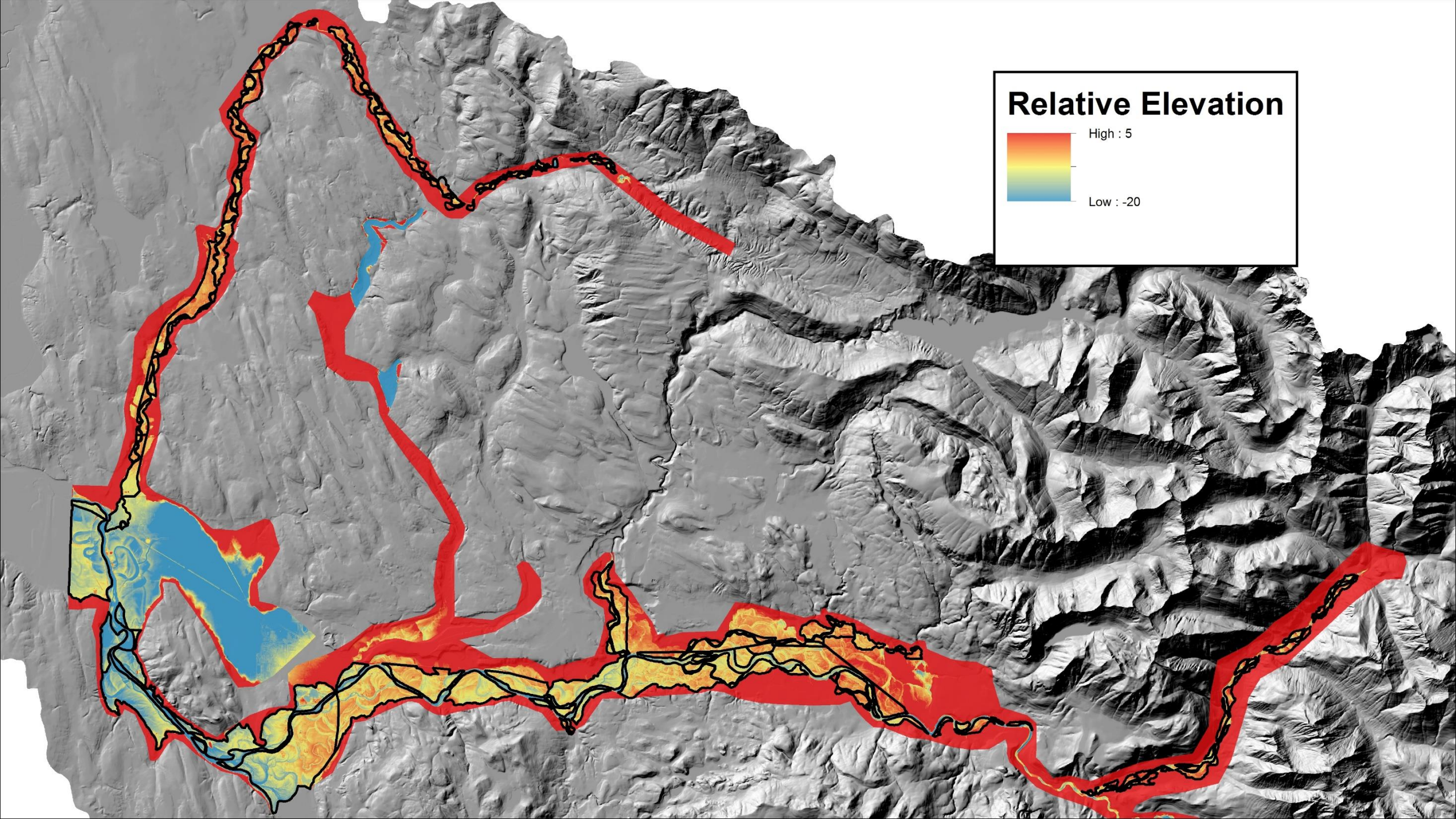
- Finish Weighting, Scoring and Adjacency
- Discuss with Snohomish Basin Salmon Recovery Forum
- Discuss Inclusion in Updated Conservation Plan
- Generate Report and Story Map

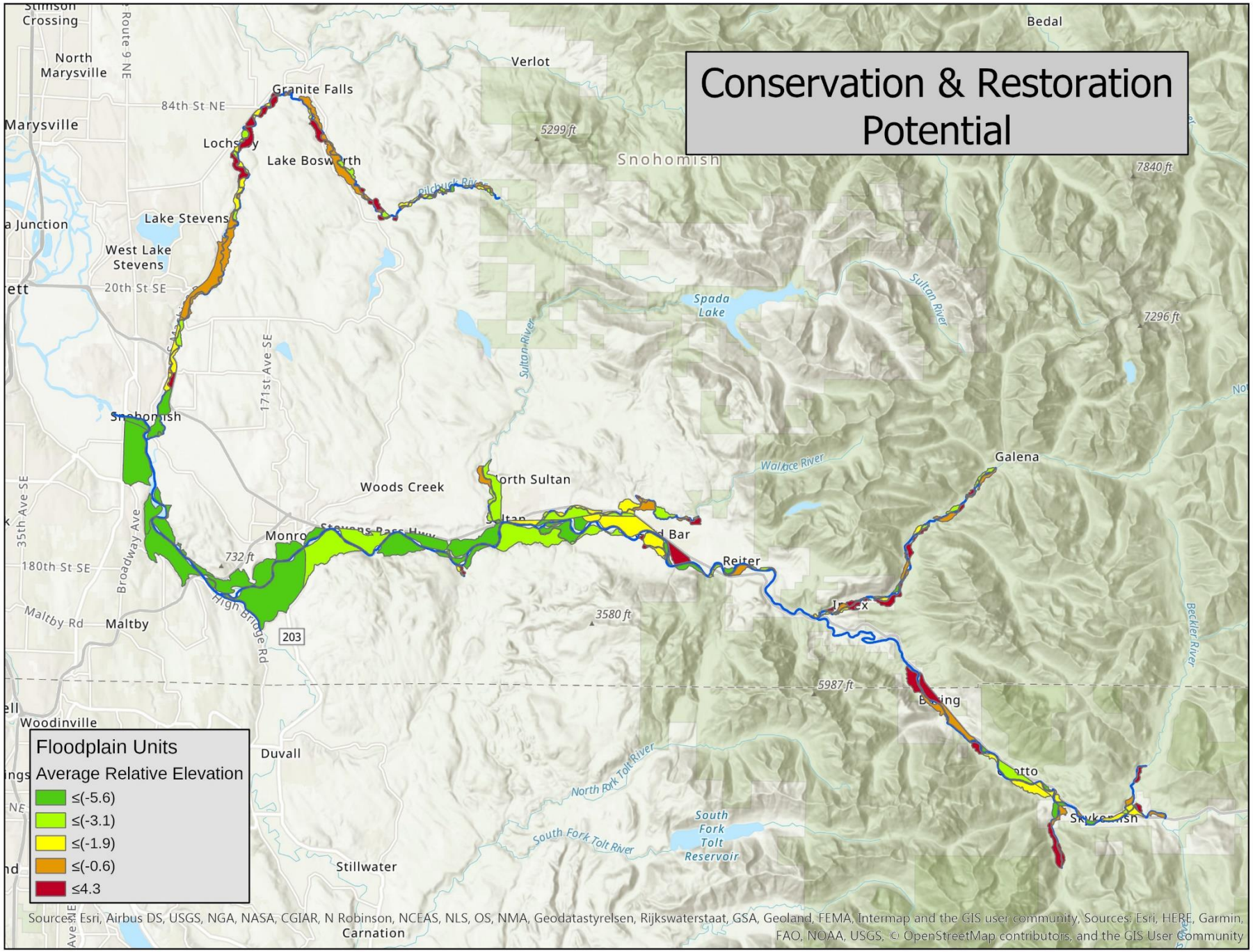
Importance Metrics

- **Relative Elevation**
- **Flow Importance**
- **Sub-Basin Strategy Group**
- **Habitat Potential**

Floodplain Elevation

- Premise: Floodplain Units having a lower average depth relative to the FEMA 100-year flood elevation are more desirable targets for restoration/conservation.


Relative Elevation
High : 5
Low : -20


Conservation & Restoration Potential
Floodplain Units
Average Relative Elevation
≤(-5.6)
≤(-3.1)
≤(-1.9)
≤(-0.6)
≤4.3
Bedal
Verlot
Granite Falls
84th St NE
Marysville
North Marysville
Lake Stevens
West Lake Stevens
20th St SE
Snohomish
Woods Creek
Monroe
Maltby
Maltby Rd
180th St SE
Broadway Ave
171st Ave SE
35th Ave SE
High Bridge Rd
203
Woodinville
Duvall
Stillwater
Carnation
Spada Lake
Sultan River
Galena
Reiter
Index
Baring
Skykomish
South Fork Tolt Reservoir
North Fork Tolt River
South Fork Tolt River
Beckler River
7840 ft
7296 ft
5299 ft
3580 ft
5987 ft
732 ft
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Flow Importance

- Premise: Floodplain Units of more importance to water flow quantity and timing are more desirable targets for restoration/conservation.

Important Area for Water Process =

Delivery X **Movement** X **Loss**

Surface Storage X **Recharge, & Discharge**

P - Precipitation

RS – Snow & rain-on-snow area

WLS – Depressional Wetlands & Lakes

STS – Unconfined & Moderately Confined Floodplains

I_R – High Perm Deposits

I_DI – High Perm Floodplains & Slope Wetlands

All areas assumed to be forested & have equal evapotranspiration

$$I_DE\left[\frac{P}{MV} + \frac{RS}{MV}\right] \times I_SS\left[\frac{WLS}{\text{Max Value}} + \frac{STS}{\text{Max Value}}\right] \times I_GW\left[\frac{I_R}{\text{Max Value}} + \frac{I_DI}{\text{Max Value}}\right]$$

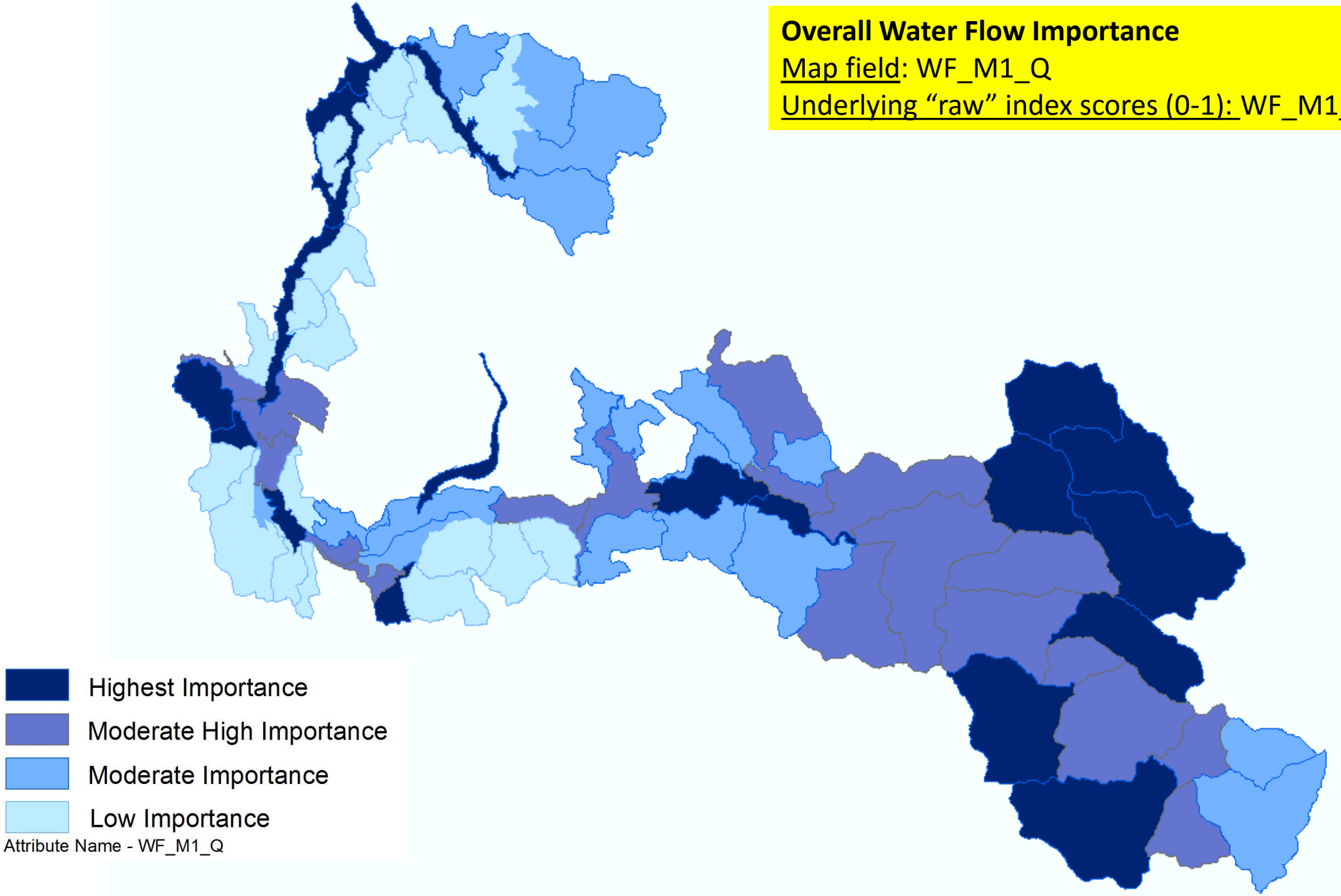
Max Score = 1 X **Max Score = 1** X **Max Score = 1** = **Max 8**

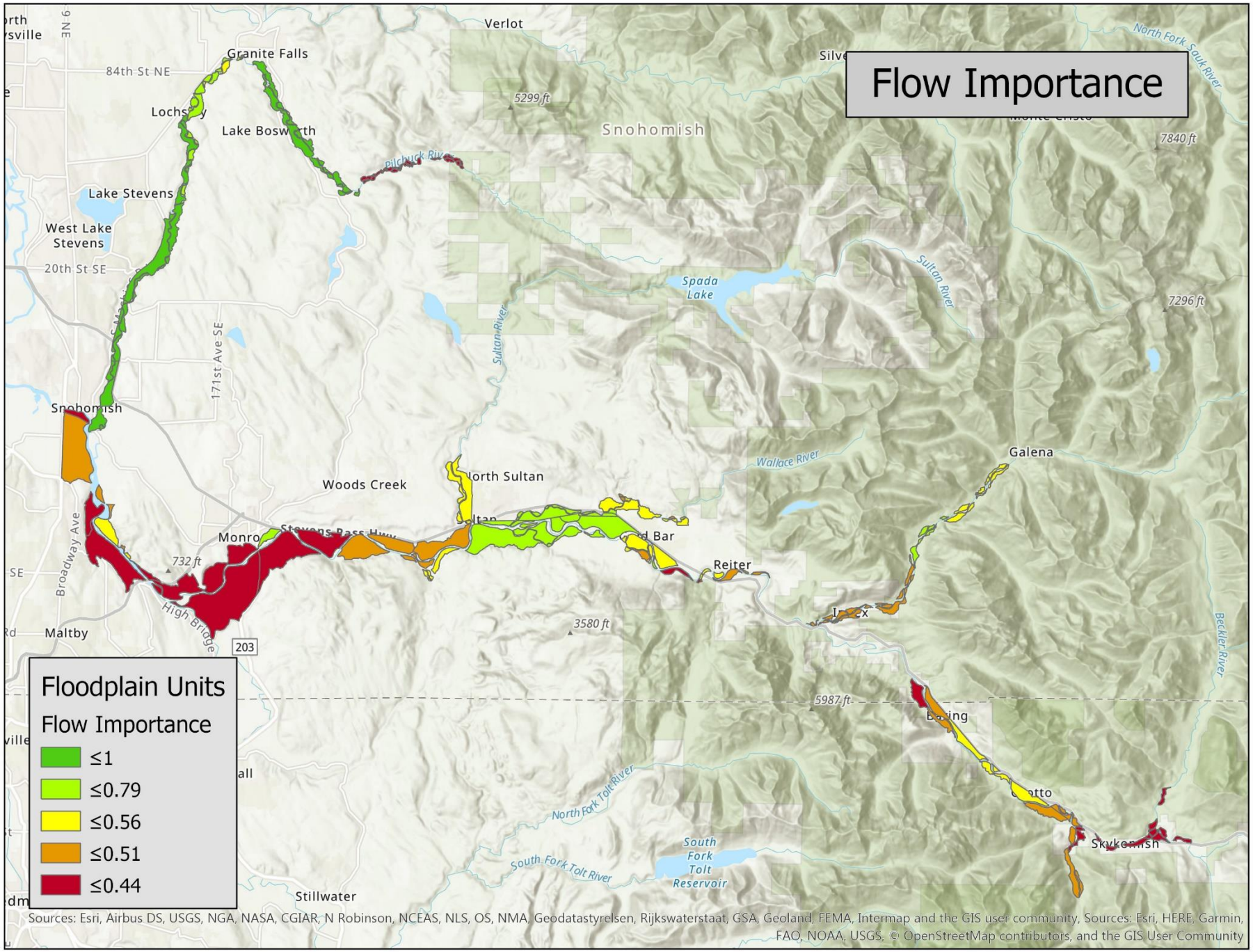
Model 1

Overall Water Flow Importance

Map field: WF_M1_Q

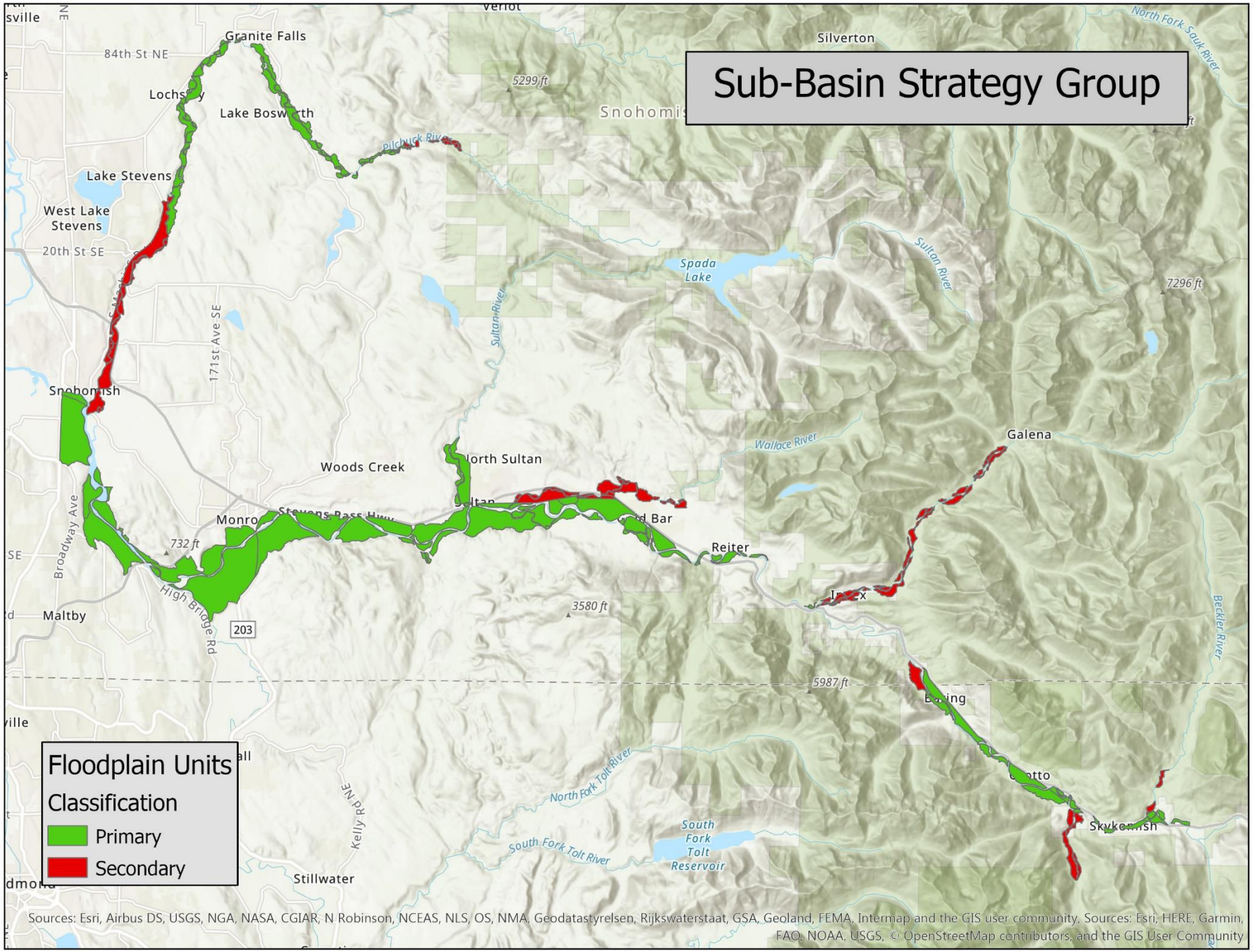
Underlying "raw" index scores (0-1): WF_M1_Cal




Flow Importance
Floodplain Units
Flow Importance
≤1
≤0.79
≤0.56
≤0.51
≤0.44
Granite Falls
Verlot
Snohomish
Lake Stevens
West Lake Stevens
Spada Lake
Woods Creek
Galena
Reiter
Maltby
Stillwater
Skykomish
Sultan River
Wallace River
Pilchuck River
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Beckler River
North Fork Skykomish River
84th St NE
20th St SE
171st Ave SE
Broadway Ave
High Bridge
Stevens Pass Hwy
5299 ft
7840 ft
7296 ft
732 ft
3580 ft
5987 ft
203
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

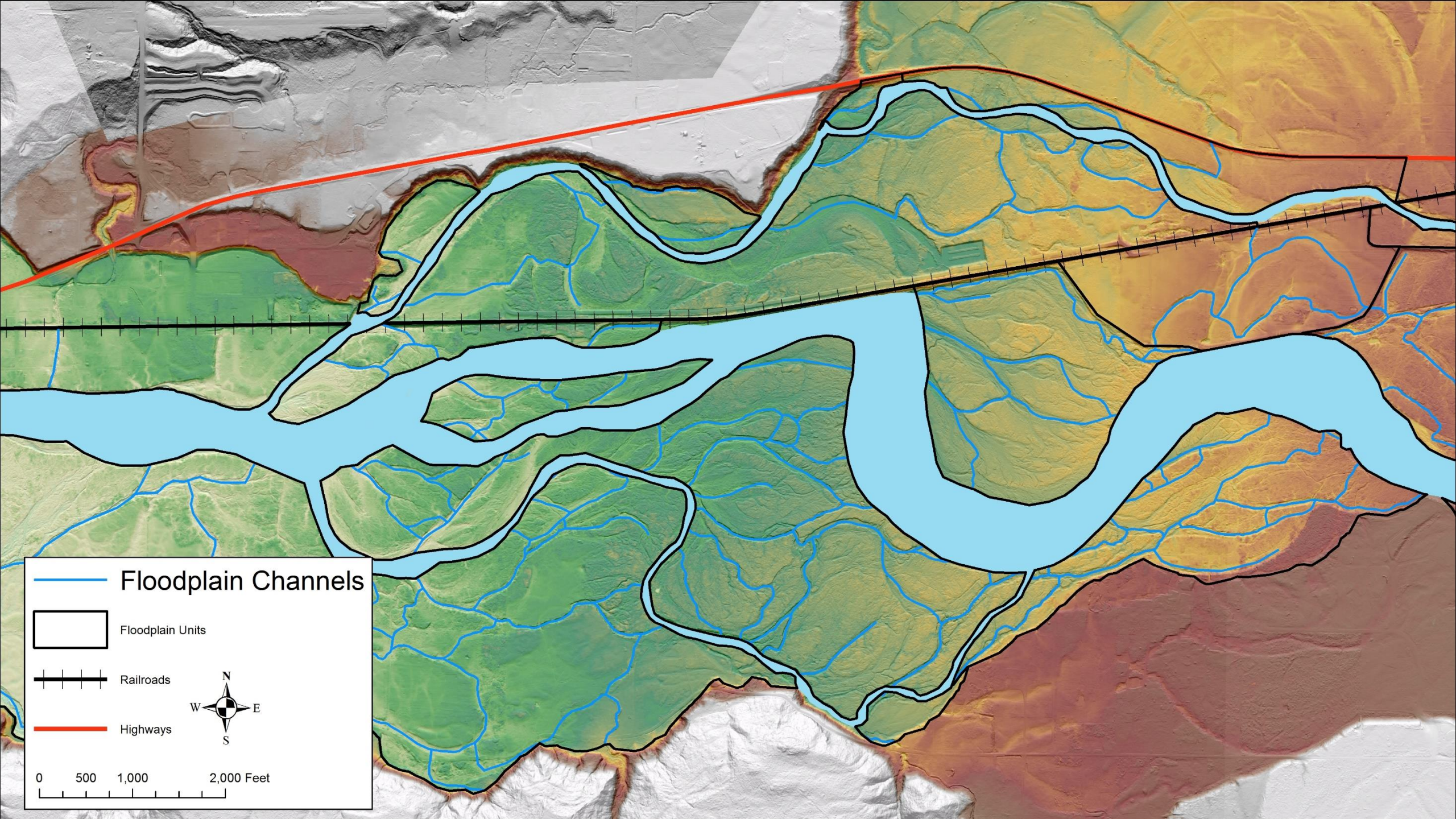
Sub Basin Strategy Group

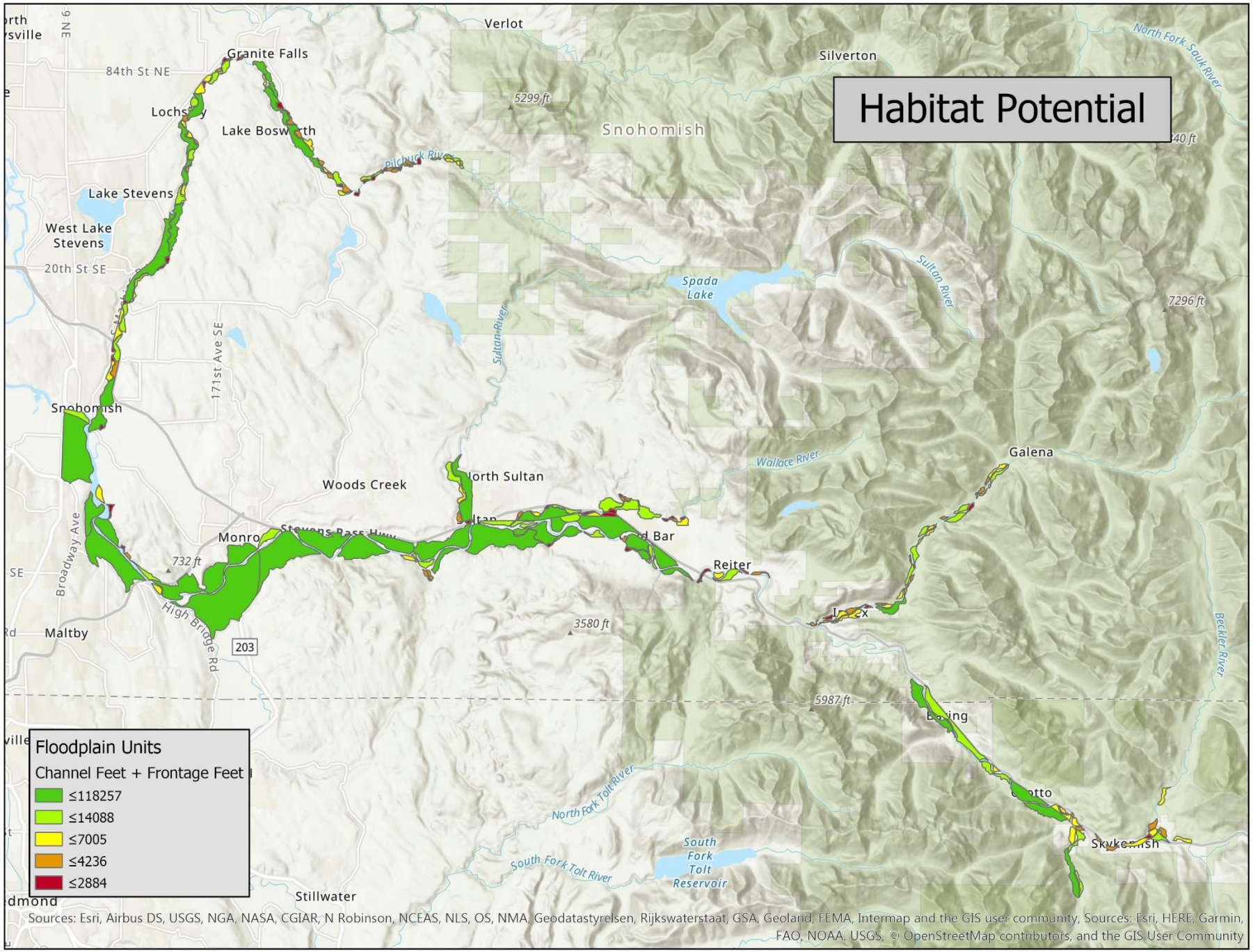
- Premise: Primary strategy groups are more desirable targets for restoration/conservation than secondary groups.


Sub-Basin Strategy Group
Floodplain Units
Classification
Primary
Secondary
Granite Falls
84th St NE
Lake Bosworth
Lake Stevens
West Lake Stevens
20th St SE
171st Ave SE
Snohomish
Silverton
5299 ft
Spada Lake
Sultan River
7296 ft
North Fork Sauk River
Wallace River
Galena
Woods Creek
North Sultan
Monroe
Stevens Pass Hwy
Bar
Reiter
Broadway Ave
732 ft
High Bridge Rd
203
Maltby
3580 ft
Beckler River
5987 ft
Baring
Gotto
Skykomish
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Kelly Rd NE
Stillwater
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Habitat Potential

- Premise: Floodplain Units with a higher length of river frontage and potential floodplain channels are more desirable targets for restoration/conservation.


Floodplain Channels
Floodplain Units
Railroads
Highways
N
W
E
S
0
500
1,000
2,000 Feet


Habitat Potential
Floodplain Units
Channel Feet + Frontage Feet
≤118257
≤14088
≤7005
≤4236
≤2884
Granite Falls
Verlot
Silverton
Snohomish
Lake Stevens
West Lake Stevens
Lake Bosworth
Spada Lake
Woods Creek
North Sultan
Monroe
Reiter
Galena
Maltby
Stillwater
Sultan River
Wallace River
Pilchuck River
North Fork Sauk River
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Beckler River
Broadway Ave
171st Ave SE
84th St NE
20th St SE
High Bridge Rd
Stevens Pass Hwy
5299 ft
7296 ft
732 ft
3580 ft
5987 ft
203
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Feasibility Metrics

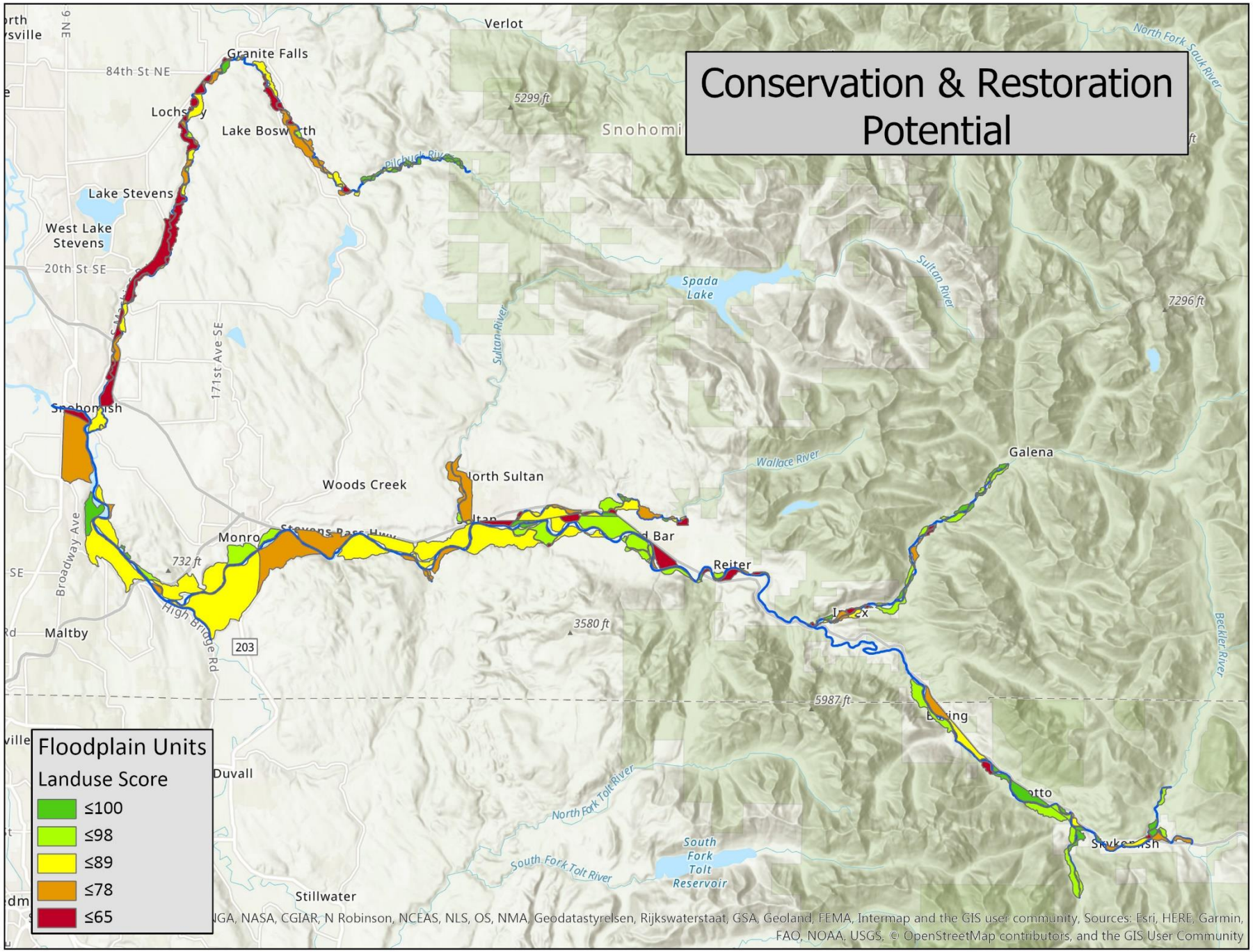
- **Land Use Type**
- **Number of Landowners**
- **Landowner Density**

Land Use Types

- Premise: Floodplain Units having a larger percentage of area in land uses more compatible with restoration/conservation (i.e. forestry, open space, agricultural, etc.) are more desirable targets for restoration/conservation.

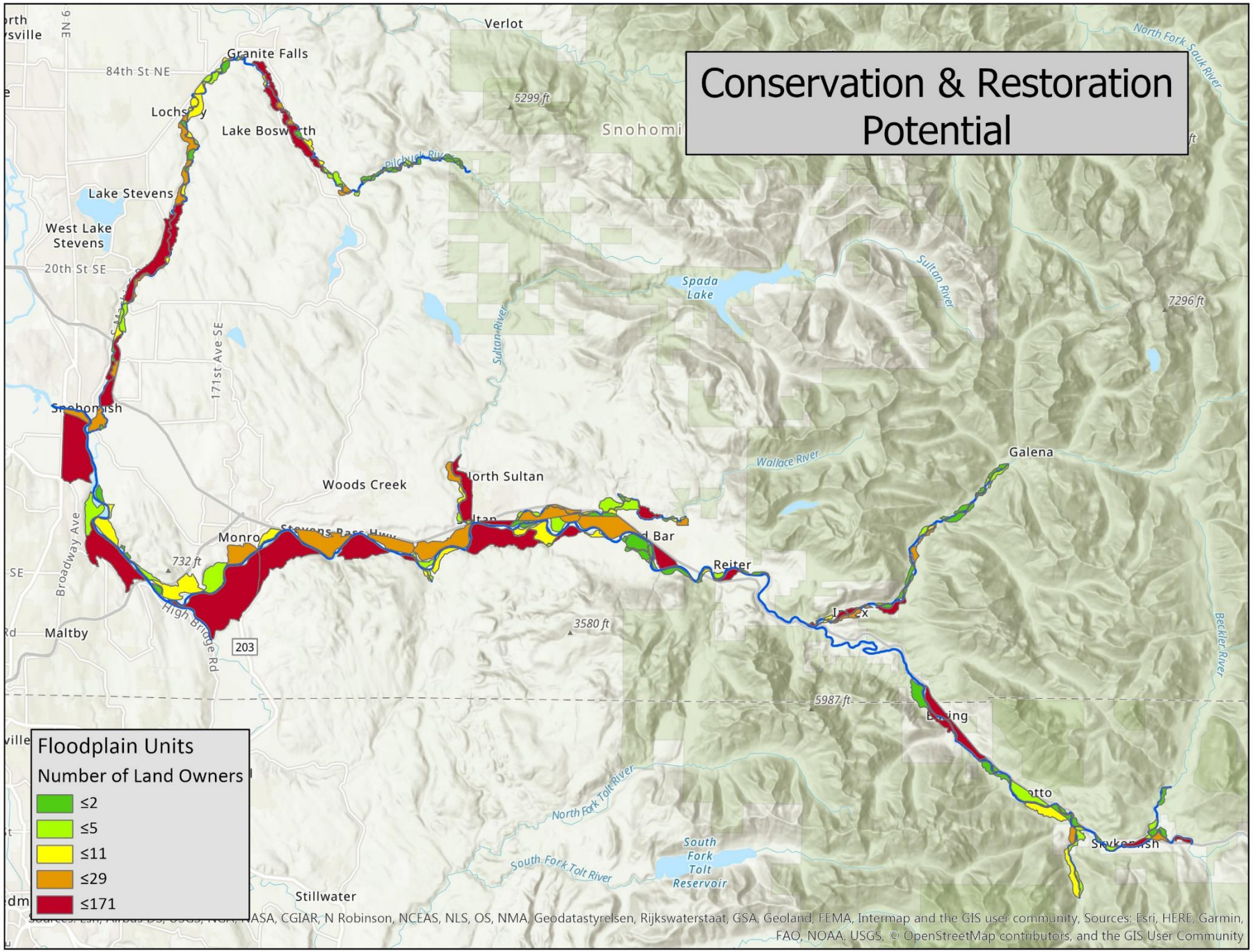
Land Use Types

- 100 = Water Area
- 100 = Undeveloped/Vacant
- 100 = Mining
- 90 = Forestry
- 90 = Park/Open Space
- 80 = Agriculture (current tax use)
- 70 = Recreation
- 50 = Agriculture (other than current use)
- 50 = Residential
- 30 = Social or Governmental Services
- 20 = Infrastructure (transportation/utility)
- 10 = Commercial
- 10 = Industrial


Conservation & Restoration Potential
Floodplain Units
Landuse Score
≤100
≤98
≤89
≤78
≤65
Verlot
Granite Falls
84th St NE
Lake Stevens
West Lake Stevens
20th St SE
171st Ave SE
Snohomish
Woods Creek
Monro
Maltby
Broadway Ave
High Bridge Rd
203
732 ft
5299 ft
Spada Lake
Sultan River
Wallace River
Galena
Reiter
3580 ft
5987 ft
7296 ft
North Fork Skykomish River
Beckler River
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Duvall
Stillwater
NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

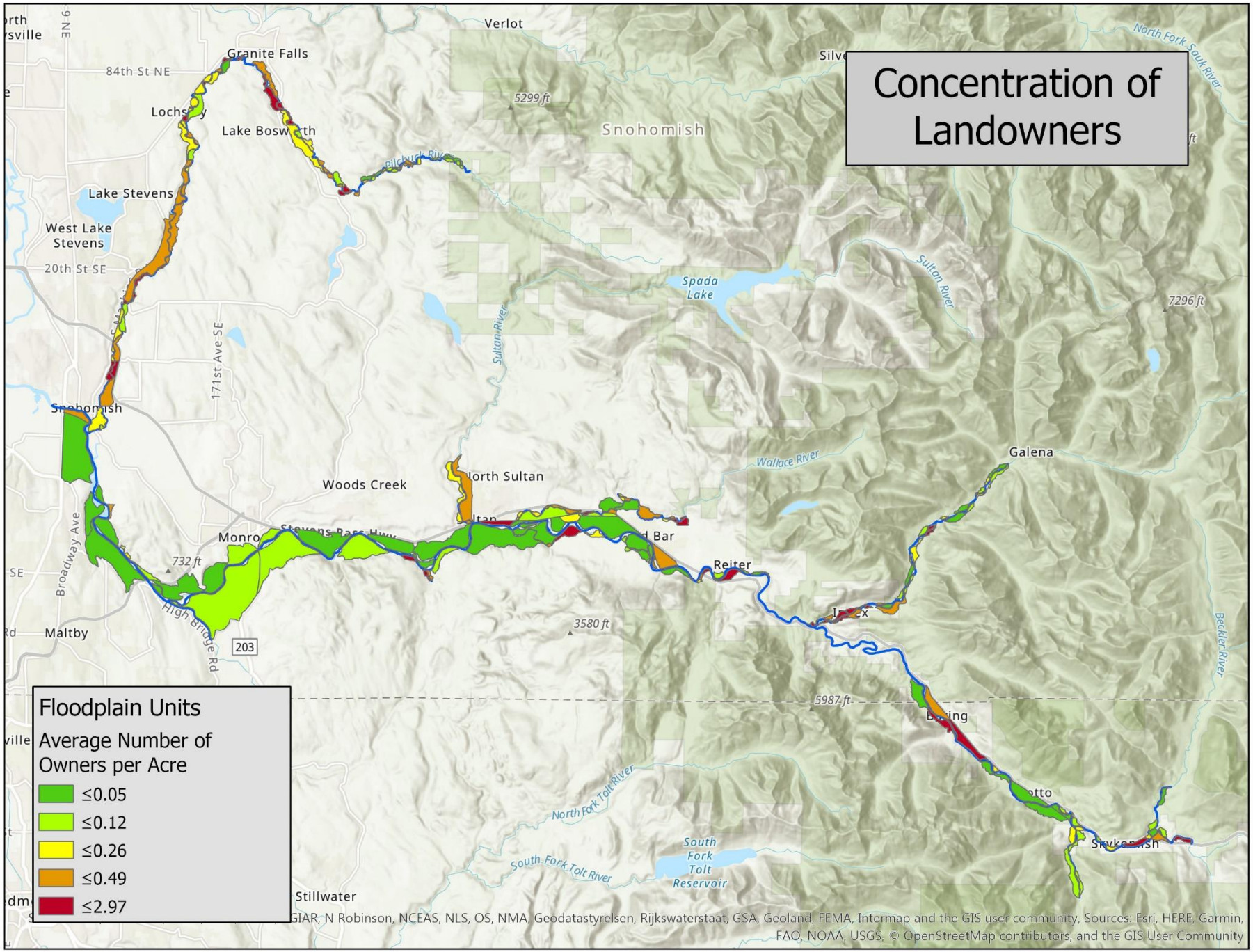
Number of Landowners

- Premise: Floodplain Units held by fewer landowners are more desirable targets for conservation/restoration.


Conservation & Restoration Potential
Floodplain Units
Number of Land Owners
≤2
≤5
≤11
≤29
≤171
Verlot
Granite Falls
84th St NE
Lake Stevens
West Lake Stevens
20th St SE
171st Ave SE
Snohomish
Woods Creek
Monro
Stevens Pass Hwy
Broadway Ave
Maltby
High Bridge Rd
203
732 ft
5299 ft
Spada Lake
Sultan River
Wallace River
Galena
Reiter
3580 ft
5987 ft
7296 ft
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Stillwater
Beckler River
North Fork Skykomish River
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Landowners Density

- Premise: Floodplain Units with a lower density of landowners are more desirable targets for conservation/restoration.

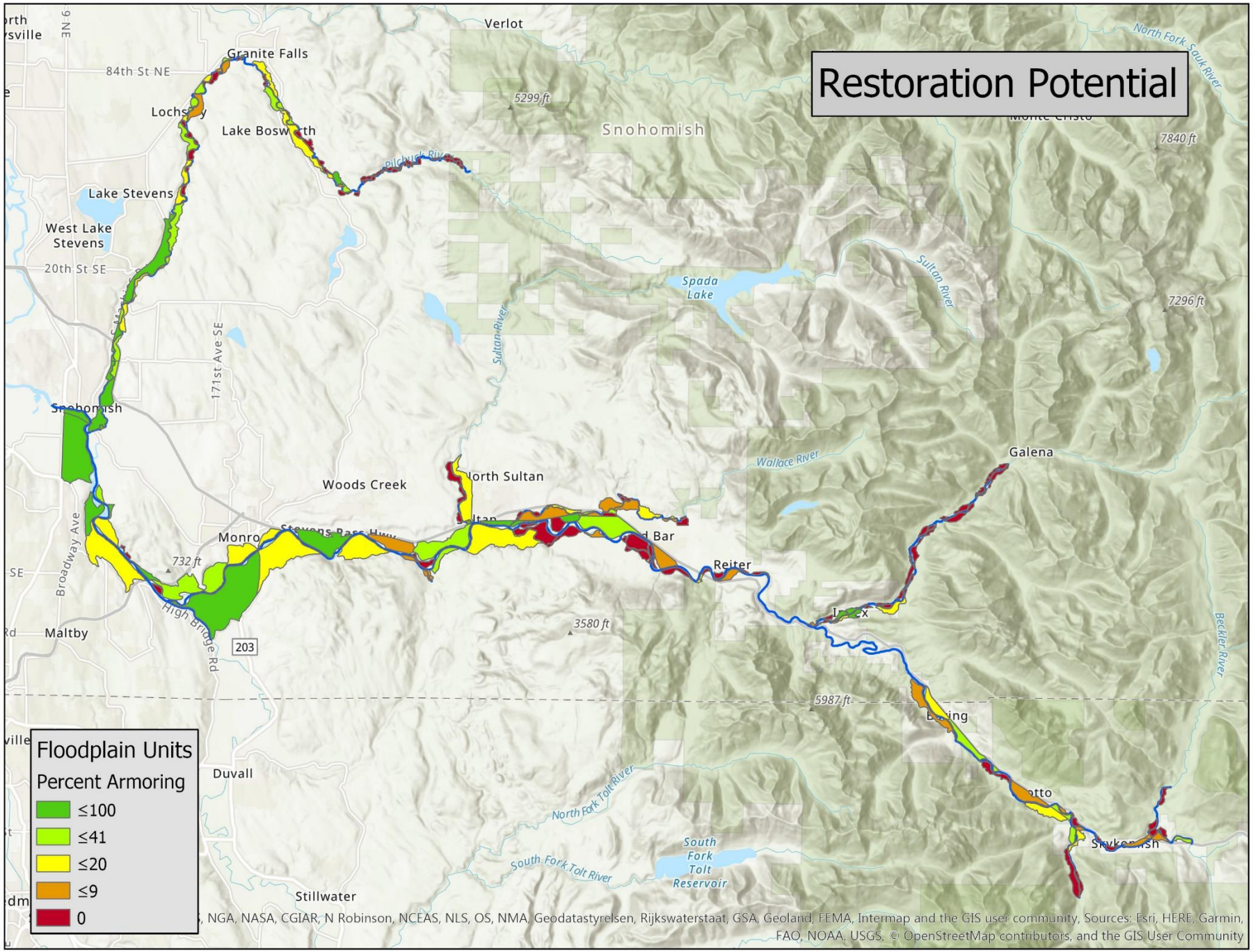

Concentration of Landowners
Floodplain Units
Average Number of Owners per Acre
≤0.05
≤0.12
≤0.26
≤0.49
≤2.97
Granite Falls
Verlot
Snohomish
Lake Stevens
West Lake Stevens
Spada Lake
Woods Creek
Galena
Reiter
Maltby
Stillwater
Sultan River
Wallace River
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Beckler River
North Fork Skykomish River
5299 ft
7296 ft
732 ft
3580 ft
5987 ft
203
GIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

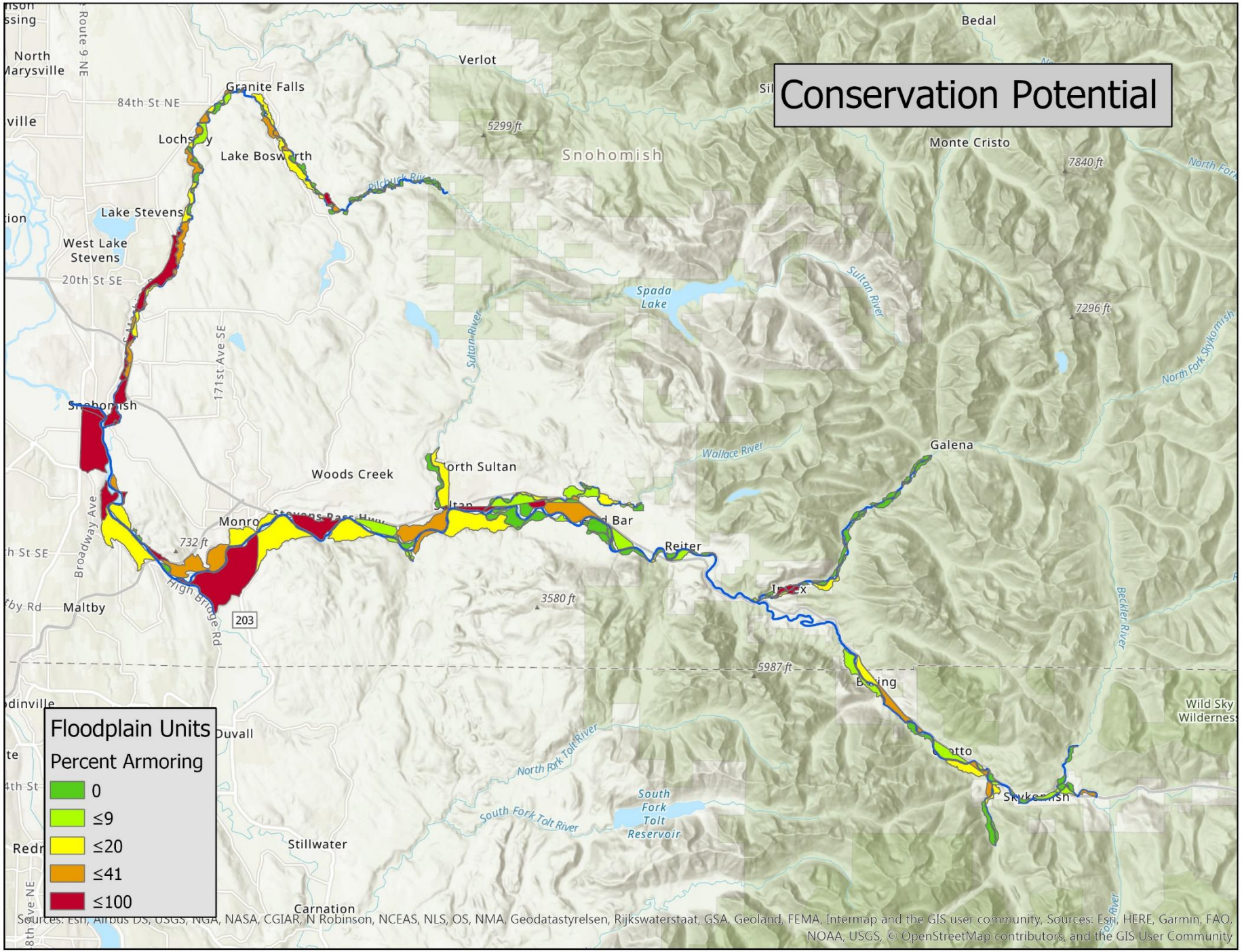
Degradation Metrics

- **Armoring**
- **Channel Constriction**
- **Sinuosity**
- **Water and Vegetation Cover**
- **Flow Degradation**

Armoring

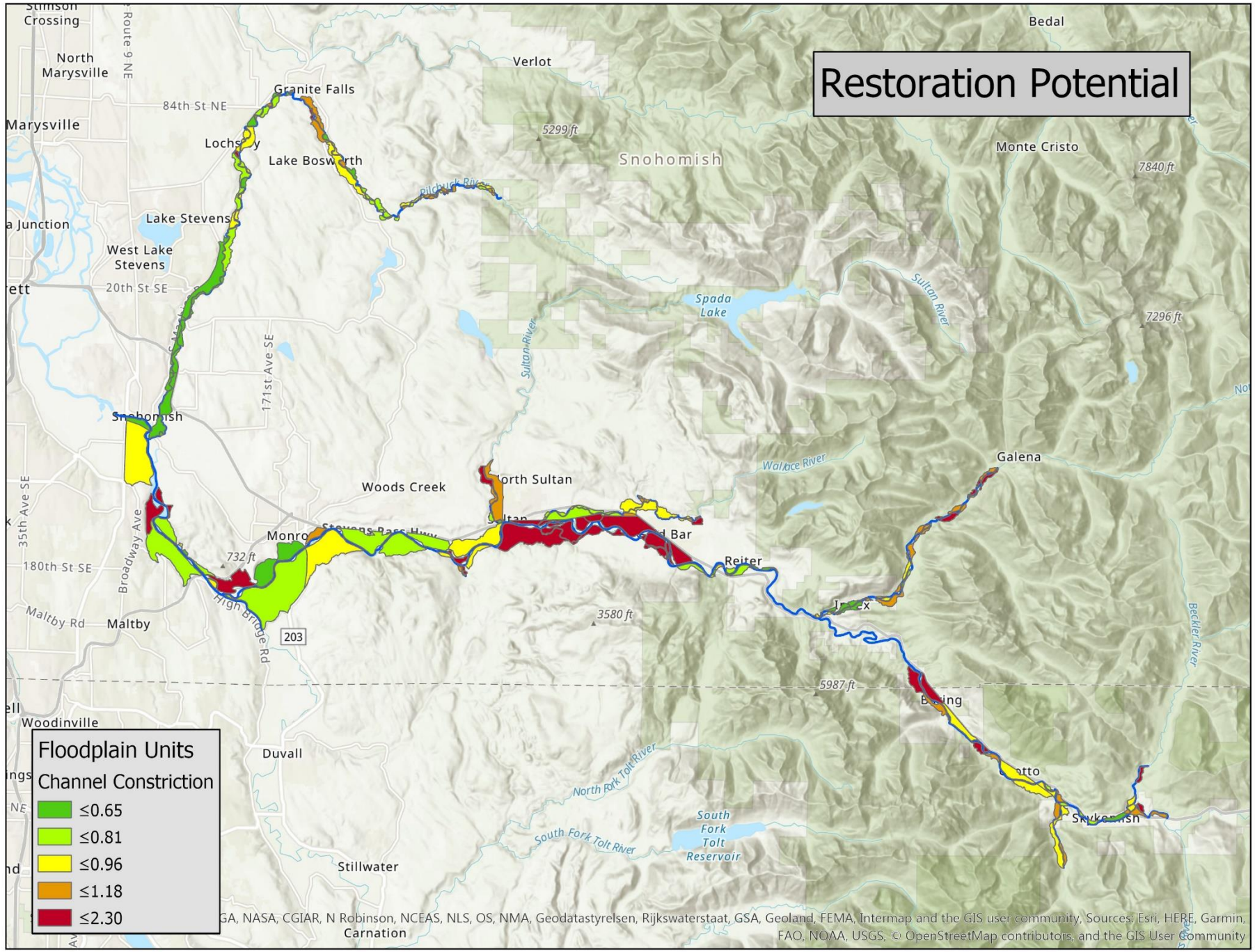
- Premise: Floodplain Units with a greater proportion of armoring are more desirable targets for restoration. Floodplain units with a lesser proportion of armoring are more desirable targets for conservation.

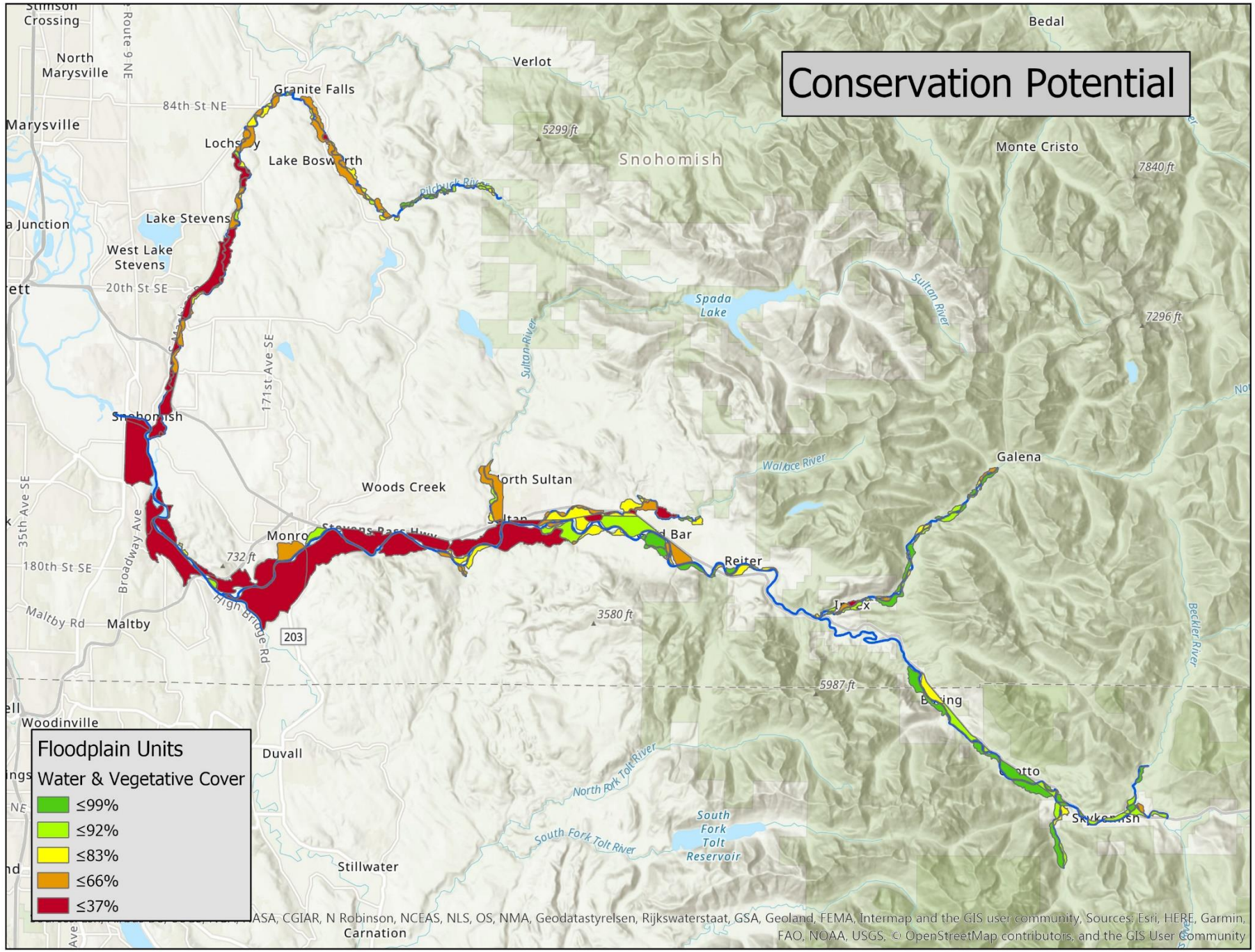

Restoration Potential
Floodplain Units
Percent Armoring
≤100
≤41
≤20
≤9
0
Verlot
Granite Falls
84th St NE
Lake Bosworth
Lake Stevens
West Lake Stevens
20th St SE
171st Ave SE
Snohomish
Woods Creek
Monroe
Maltby
Broadway Ave
High Bridge Rd
203
732 ft
5299 ft
Snohomish
Spada Lake
Sultan River
Wallace River
North Sultan
Reiter
Galena
3580 ft
5987 ft
7840 ft
7296 ft
North Fork Skykomish River
Beckler River
Duvall
Stillwater
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community


Conservation Potential
Floodplain Units
Percent Armoring
0
≤9
≤20
≤41
≤100
Granite Falls
Verlot
Bedal
Monte Cristo
Snohomish
Lake Stevens
West Lake Stevens
Lake Bosworth
Spada Lake
Sultan River
Wallace River
Galena
Woods Creek
Reiter
Maltby
Duvall
Stillwater
Carnation
South Fork Tolt Reservoir
North Fork Tolt River
South Fork Tolt River
Wild Sky Wilderness
Beckler River
North Fork Skykomish
84th St NE
20th St SE
171st Ave SE
Broadway Ave
High Bridge Rd
203
5299 ft
7840 ft
7296 ft
732 ft
3580 ft
5987 ft
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Channel Constriction

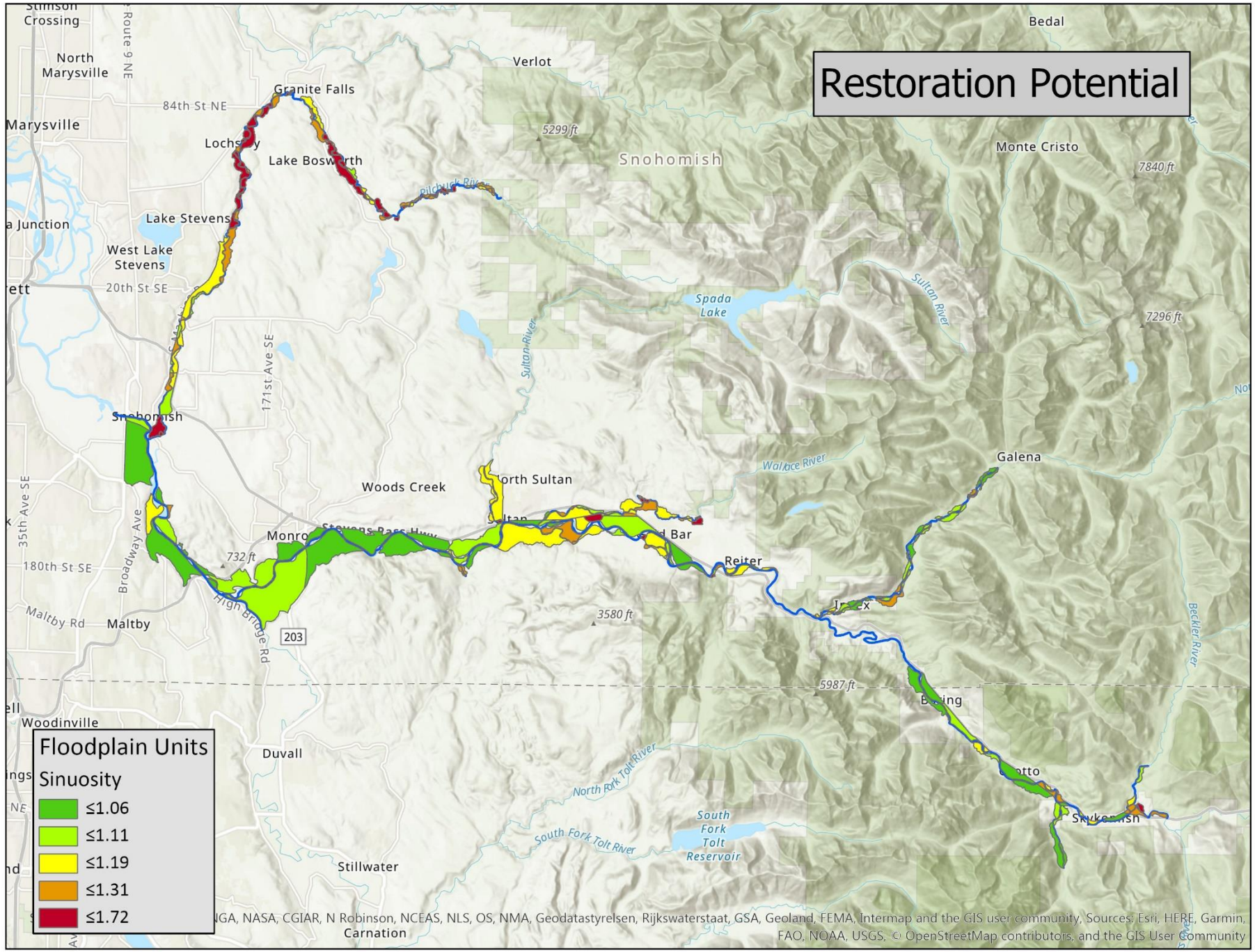
- Premise: Floodplain Units along more constricted river channels are more desirable targets for restoration. Floodplain units along less constricted river channels are more desirable targets for conservation.

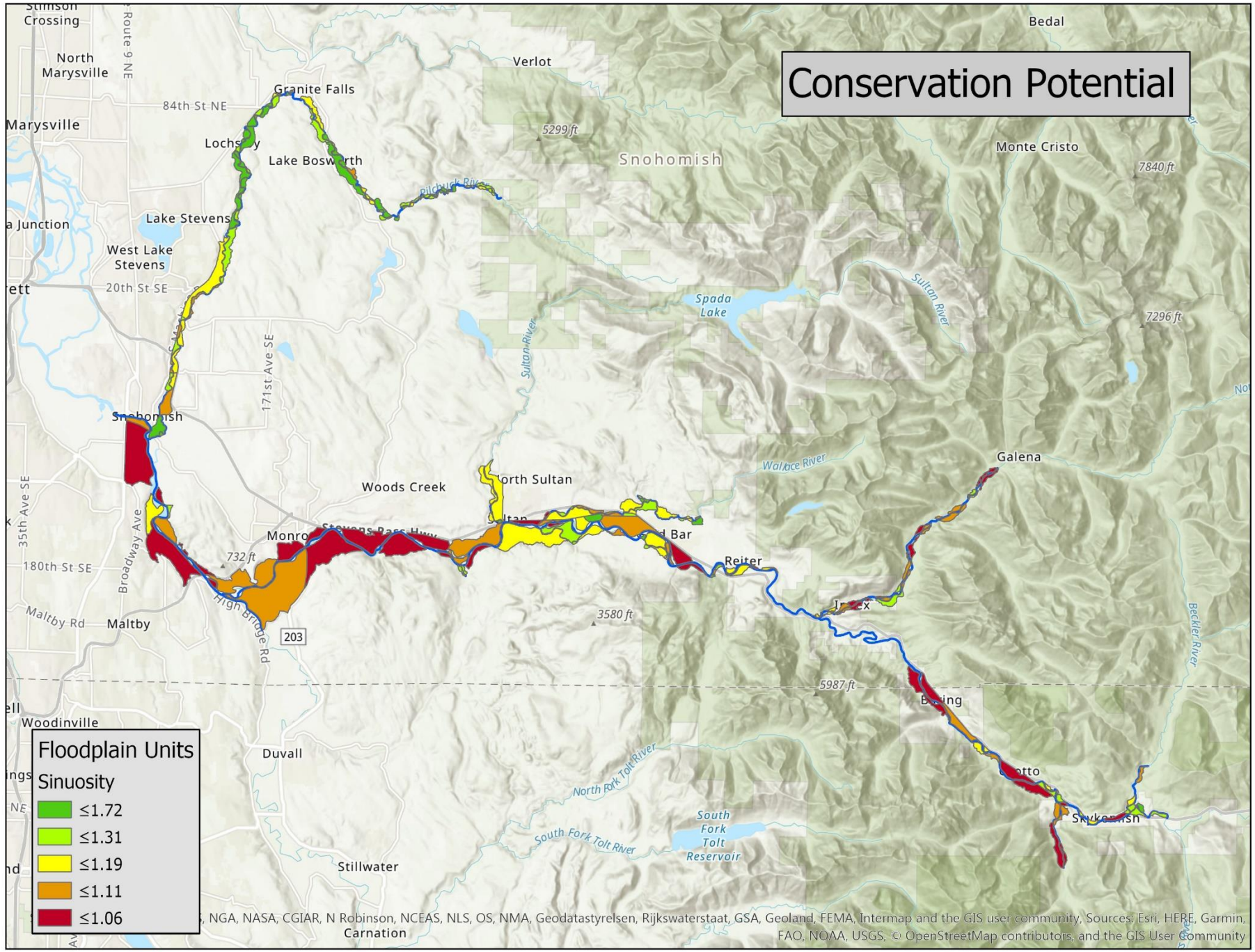

Restoration Potential
Floodplain Units
Channel Constriction
≤0.65
≤0.81
≤0.96
≤1.18
≤2.30
Stimson Crossing
North Marysville
Marysville
Route 9 NE
84th St NE
Granite Falls
Verlot
Bedal
Monte Cristo
Snohomish
Lake Stevens
West Lake Stevens
20th St SE
Spada Lake
Sultan River
Pilchuck River
171st Ave SE
Woods Creek
North Sultan
Wallace River
Galena
Monroe
Stevens Pass Hwy
Reiter
Index
Baring
Skykomish
35th Ave SE
Broadway Ave
180th St SE
Maltby Rd
Maltby
High Bridge Rd
203
732 ft
3580 ft
5299 ft
7840 ft
7296 ft
5987 ft
Beckler River
Woodinville
Duvall
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Stillwater
Carnation
GA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community


Conservation Potential
Floodplain Units
Water & Vegetative Cover
≤99%
≤92%
≤83%
≤66%
≤37%
Stimson Crossing
North Marysville
Marysville
Route 9 NE
84th St NE
Granite Falls
Lochsley
Lake Bosworth
Verlot
5299 ft
Snohomish
Bedal
Monte Cristo
7840 ft
Lake Stevens
West Lake Stevens
20th St SE
Spada Lake
Sultan River
7296 ft
171st Ave SE
Snohomish
Woods Creek
North Sultan
Wallace River
Galena
Monroe
Stevens Pass Hwy
Bar
Reiter
732 ft
180th St SE
Broadway Ave
35th Ave SE
Maltby Rd
Maltby
High Bridge Rd
203
3580 ft
Index
Beckler River
5987 ft
Baring
Woodinville
Duvall
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Skykomish
Stillwater
Carnation
ASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Sinuosity

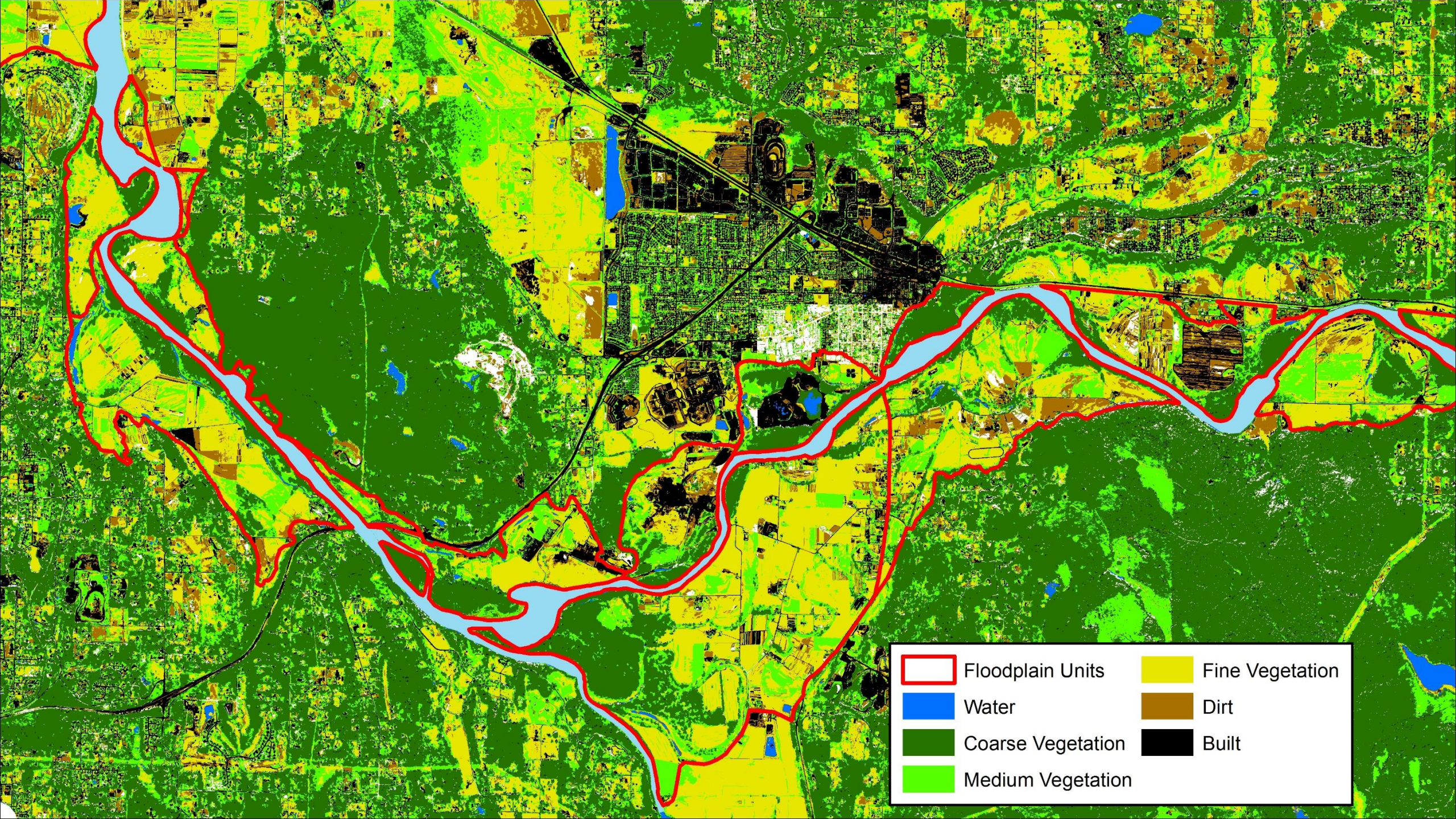
- Premise: Floodplain Units along less sinuous river channels are more desirable targets for restoration. Floodplain units along more sinuous river channels are more desirable targets for conservation.

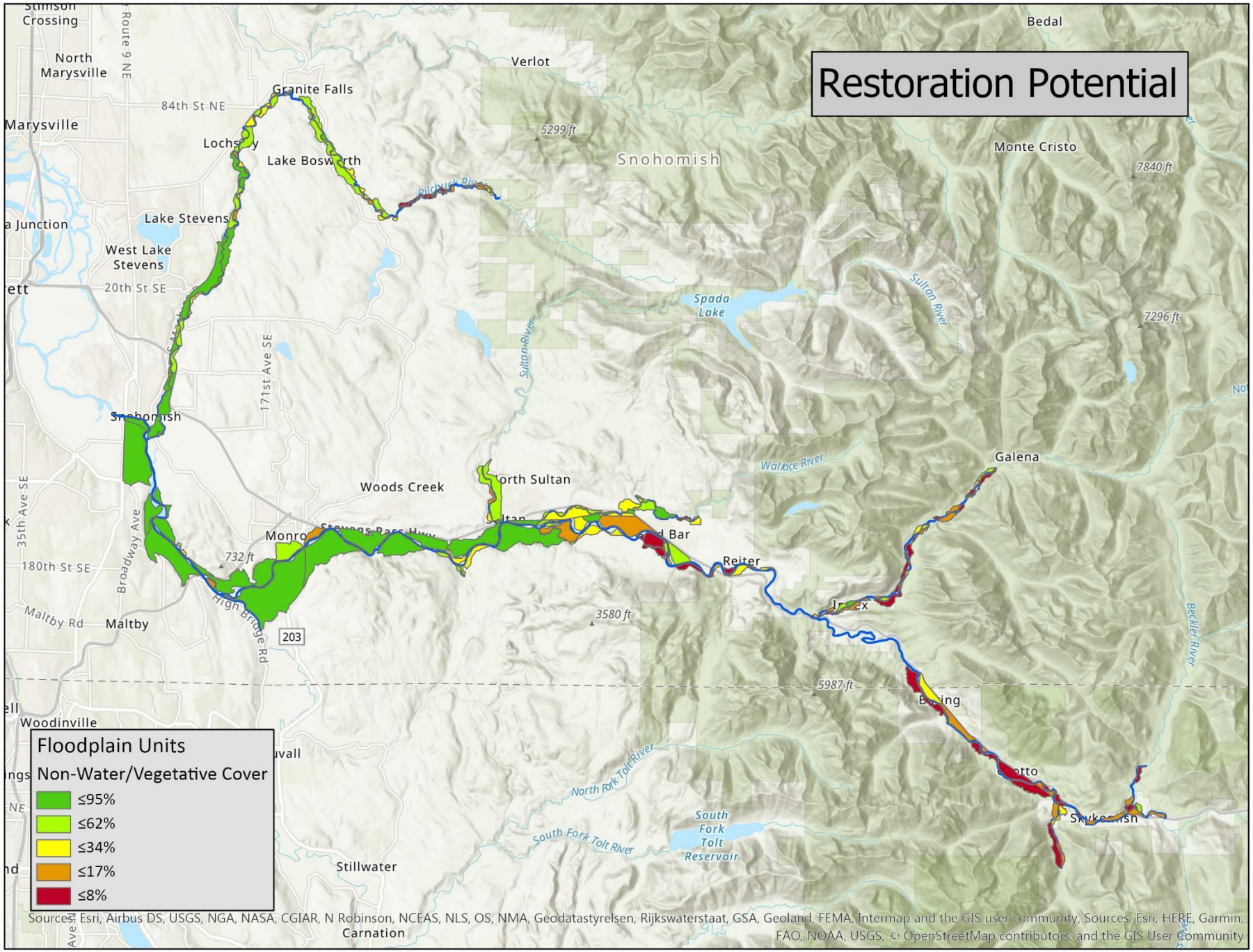

Restoration Potential
Floodplain Units
Sinuosity
≤1.06
≤1.11
≤1.19
≤1.31
≤1.72
Stimson Crossing
North Marysville
Route 9 NE
84th St NE
Marysville
Granite Falls
Lake Bosworth
Lake Stevens
West Lake Stevens
20th St SE
171st Ave SE
Snohomish
Verlot
5299 ft
Snohomish
Monte Cristo
7840 ft
Spada Lake
Sultan River
7296 ft
Galena
Wallace River
Woods Creek
North Sultan
Monroe
Stevens Pass Hwy
Bar
Reiter
732 ft
180th St SE
Broadway Ave
35th Ave SE
Maltby Rd
Maltby
High Bridge Rd
203
3580 ft
Beckler River
5987 ft
Woodinville
Duvall
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Stillwater
Carnation
Bedal
NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

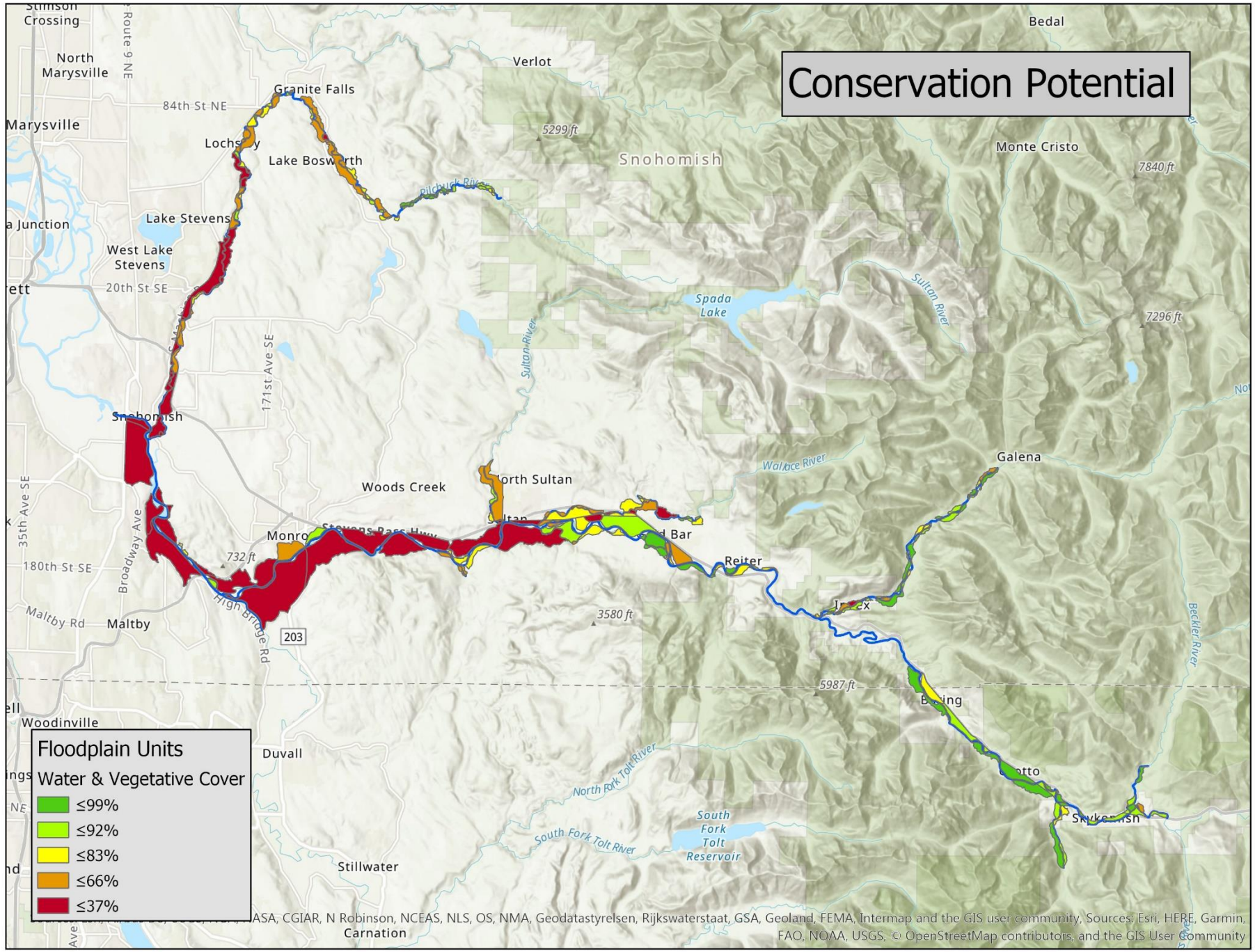

Conservation Potential
Floodplain Units
Sinuosity
≤1.72
≤1.31
≤1.19
≤1.11
≤1.06
Stimson Crossing
North Marysville
Marysville
Route 9 NE
84th St NE
Granite Falls
Verlot
Bedal
Lake Bosworth
Lake Stevens
West Lake Stevens
20th St SE
171st Ave SE
Snohomish
Pilchuck River
5299 ft
Monte Cristo
7840 ft
7296 ft
Spada Lake
Sultan River
Wallace River
Galena
Woods Creek
North Sultan
Monroe
Stevens Pass Hwy
Reiter
Index
Baring
Skykomish
Broadway Ave
35th Ave SE
180th St SE
Maltby Rd
Maltby
High Bridge Rd
732 ft
203
3580 ft
5987 ft
Beckler River
Woodinville
Duvall
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Stillwater
Carnation
, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Water and Vegetation Cover

- Premise: Floodplain Units with lower water and course vegetation coverage are more desirable targets for restoration. Floodplain units with higher water and course vegetation coverage are more desirable targets for conservation.


Floodplain Units
Water
Coarse Vegetation
Medium Vegetation
Fine Vegetation
Dirt
Built


Restoration Potential
Floodplain Units
Non-Water/Vegetative Cover
≤95%
≤62%
≤34%
≤17%
≤8%
Stimson Crossing
North Marysville
Marysville
Granite Falls
Verlot
Bedal
Monte Cristo
Snohomish
Lake Stevens
West Lake Stevens
Lake Bosworth
Spada Lake
Sultan River
Woods Creek
North Sultan
Galena
Reiter
Maltby
Woodinville
Stillwater
Carnation
South Fork Tolt Reservoir
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community


Conservation Potential
Floodplain Units
Water & Vegetative Cover
≤99%
≤92%
≤83%
≤66%
≤37%
Stimson Crossing
North Marysville
Marysville
Route 9 NE
84th St NE
Granite Falls
Lochsley
Lake Bosworth
Verlot
5299 ft
Snohomish
Bedal
Monte Cristo
7840 ft
Lake Stevens
West Lake Stevens
20th St SE
Spada Lake
Sultan River
7296 ft
171st Ave SE
Snohomish
Woods Creek
North Sultan
Wallace River
Galena
Monroe
Stevens Pass Hwy
Bar
Reiter
732 ft
180th St SE
Broadway Ave
35th Ave SE
Maltby Rd
Maltby
High Bridge Rd
203
3580 ft
Index
Beckler River
5987 ft
Baring
Woodinville
Duvall
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Skykomish
Stillwater
Carnation
ASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Flow Degradation

- Premise: Floodplain Units with more degraded water flow quantity and timing are more desirable targets for restoration. Floodplain Units with less degraded water flow quantity and timing are more desirable targets for conservation.

Degradation to Water Process =

Delivery | **Movement** | **Loss**

Timing X **Surface Storage** X **Recharge, Lateral Flow, & Discharge** X

IMP – Impervious Cover

FL –Forest Loss

D_WS- Depressional Wetland Loss From Urban & Rural Land Cover

D_STS – Loss of Floodplains

D_R – Loss of Recharge from Urban Land Cover

D_DI – Loss of Discharge From Roads & Wells, Floodplains, & Slope Wetlands

IMP – Impervious cover

$$D_DE\left[\frac{IMP + FL}{Max\ Value}\right] \times D_SS\left[\frac{D_WS}{Max\ Value} + \frac{D_STS}{Max\ Value}\right] \times D_GW\left[\frac{D_R}{Max\ Value} + \frac{D_DI}{Max\ Value}\right] \times D_L\left[\frac{IMP}{MV}\right]$$

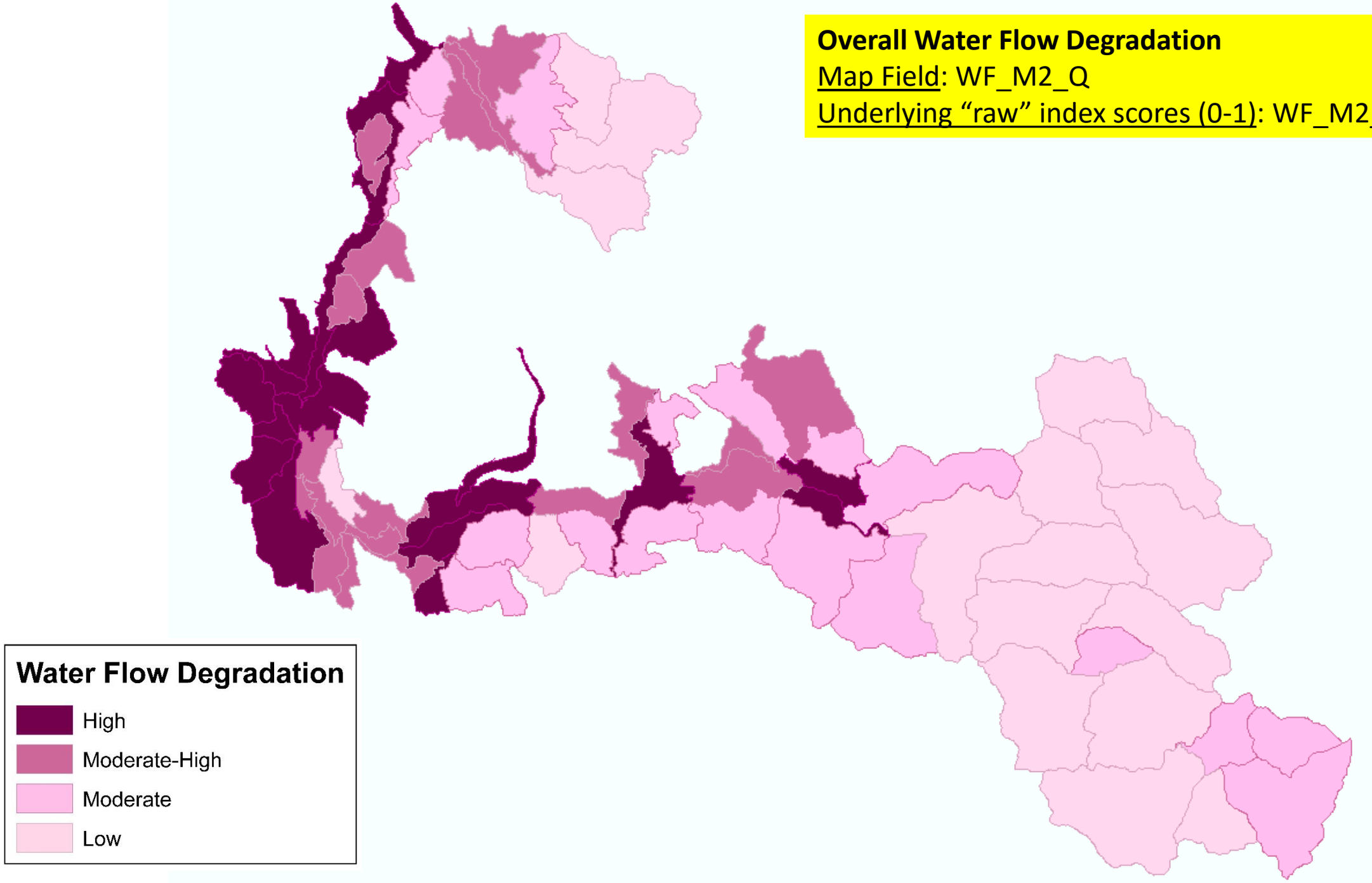
Max Score = 1 X Max Score = 1 X Max Score = 1 X Max Score = 1 = Max 16

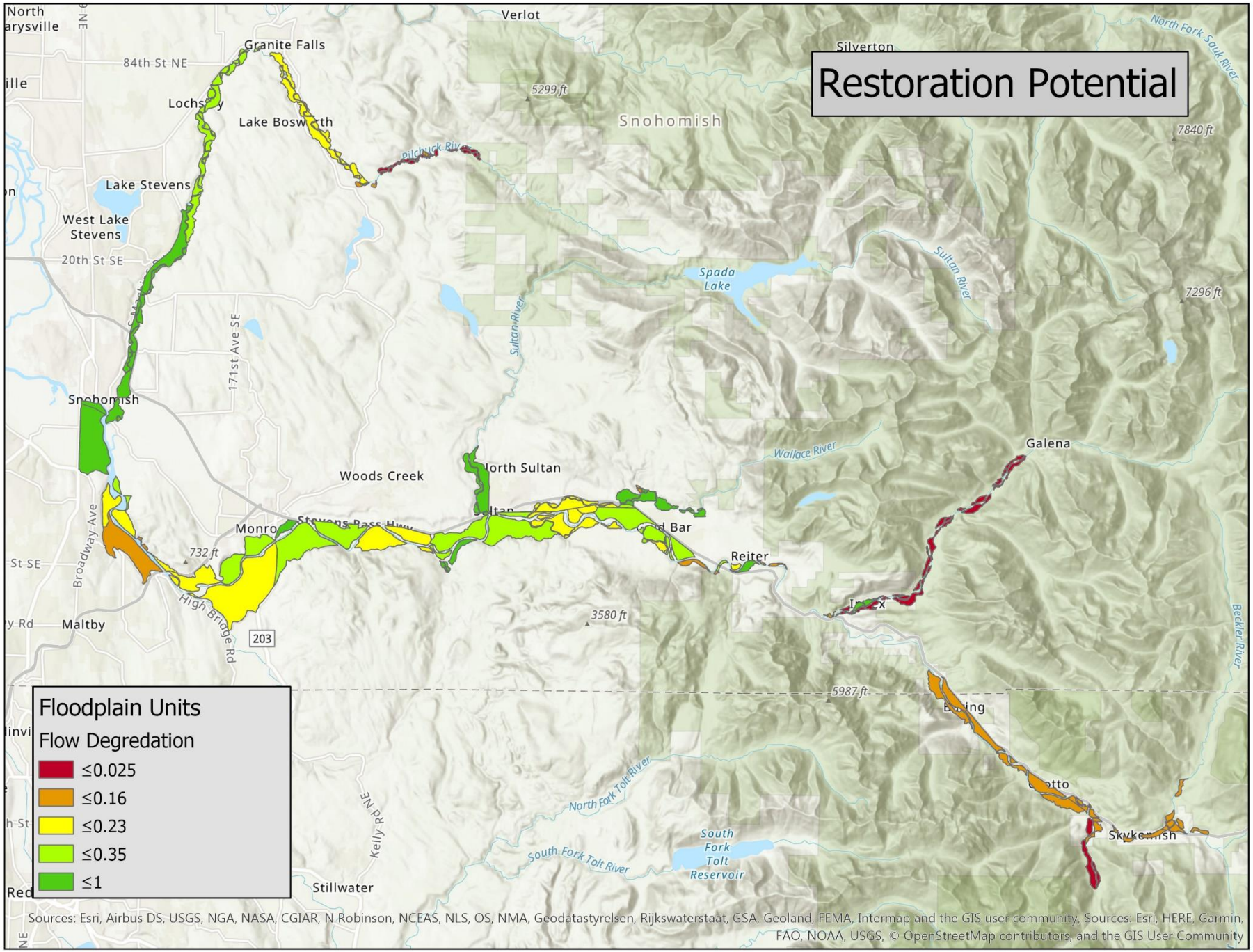
Model 2

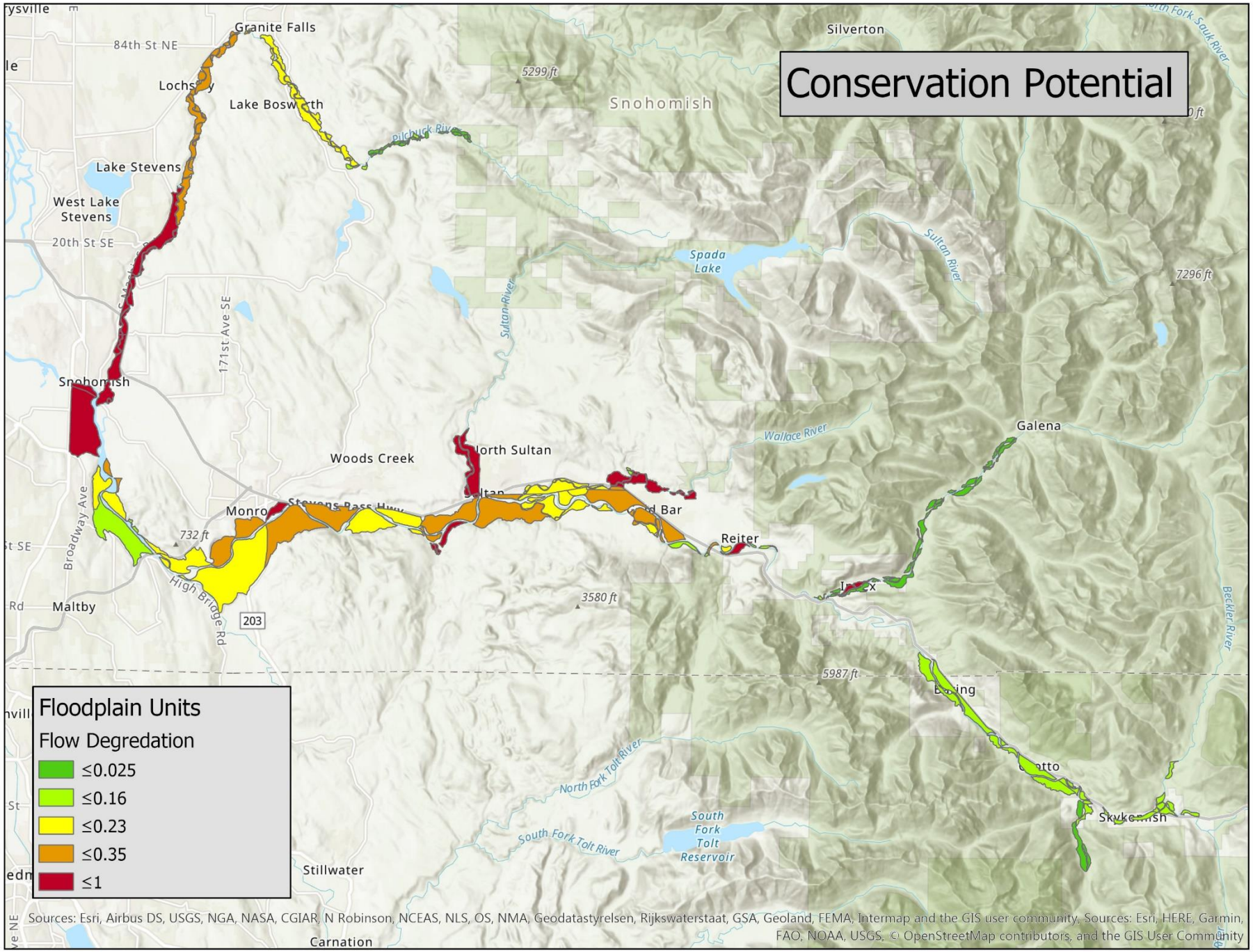
Overall Water Flow Degradation

Map Field: WF_M2_Q

Underlying "raw" index scores (0-1): WF_M2_Cal




Restoration Potential
Floodplain Units
Flow Degredation
≤0.025
≤0.16
≤0.23
≤0.35
≤1
Verlot
Granite Falls
Silverton
North Fork Sauk River
84th St NE
Lake Stevens
West Lake Stevens
20th St SE
Snohomish
Spada Lake
Sultan River
Wallace River
Galena
Woods Creek
Monroe
Reiter
Maltby
Broadway Ave
High Bridge Rd
Stillwater
Kelly Rd NE
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Beckler River
Skykomish
Snohomish
7840 ft
7296 ft
5299 ft
3580 ft
5987 ft
732 ft
203
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community


Conservation Potential
Floodplain Units
Flow Degredation
≤0.025
≤0.16
≤0.23
≤0.35
≤1
Granite Falls
84th St NE
Lake Stevens
West Lake Stevens
20th St SE
171st Ave SE
Snohomish
Lake Bosworth
Pilchuck River
5299 ft
Silverton
South Fork Sauk River
Snohomish
Spada Lake
Sultan River
7296 ft
Wallace River
Galena
Woods Creek
North Sultan
Monroe
Stevens Pass Hwy
Bar
Reiter
Broadway Ave
732 ft
High Bridge Rd
Maltby
203
3580 ft
Beckler River
5987 ft
North Fork Tolt River
South Fork Tolt River
South Fork Tolt Reservoir
Stillwater
Carnation
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community