

## ASSESSING WATERSHED INTEGRITY IN THE MATANUSKA-SUSITNA BASIN

10th Annual Mat-Su Salmon Science and Conservation Symposium

8 November 2017

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**Definition** *the capacity of a watershed to support and maintain the full range of ecological processes ... and services provided to society*

**Watershed Integrity** on a scale where a value of 1 represents a watershed absent of anthropogenic stress

**Human Health** approach to evaluate the condition of vital systems

ARENA PAPER

A WATERSHED INTEGRITY DEFINITION AND ASSESSMENT APPROACH TO SUPPORT STRATEGIC MANAGEMENT OF WATERSHEDS

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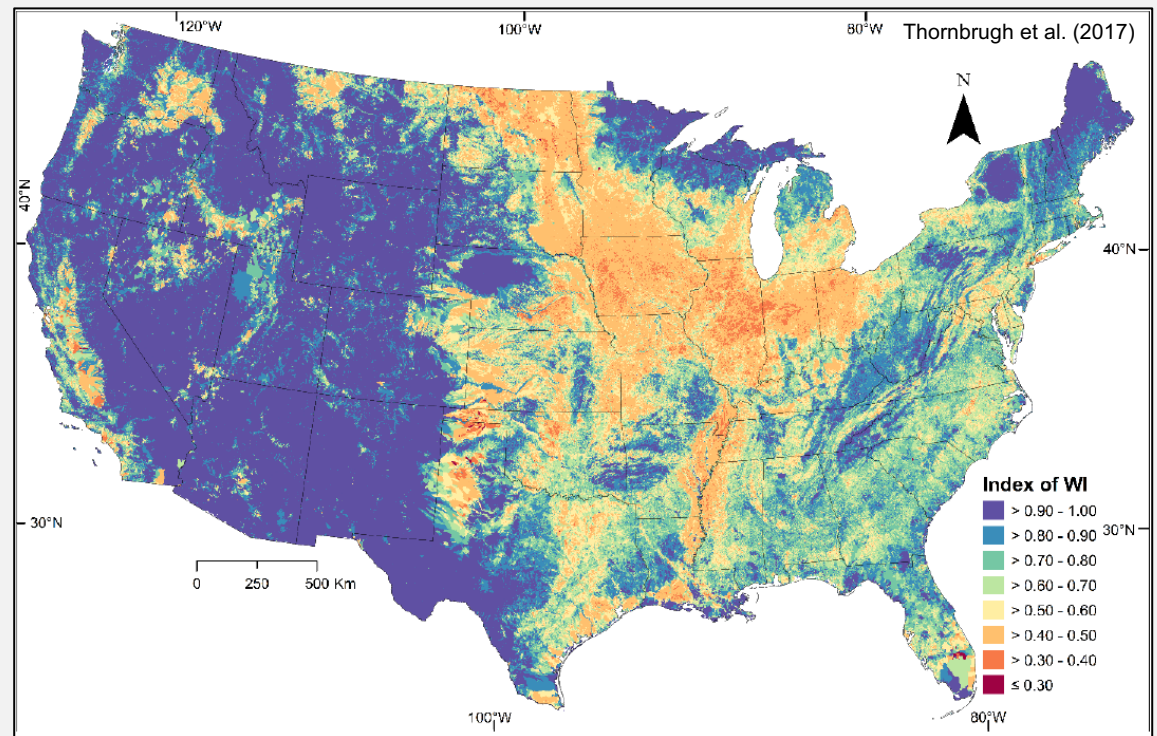
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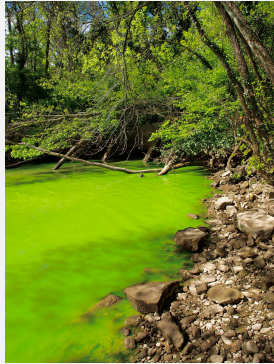
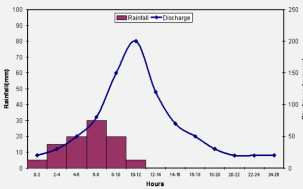
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Hydrologic  
Regulation

Regulation  
of Water  
Chemistry

Sediment  
Regulation

Hydrologic  
Connectivity

Temperature  
Regulation

Habitat  
Provision

Hydrologic Regulation	Regulation of Chemistry	Sediment Regulation	Hydrologic Connectivity	Temperature Regulation	Habitat Provision
Presence and volumes of reservoirs (NABD)	Presence and volumes of reservoirs (NABD)	Presence and volumes of reservoirs (NABD)	Presence and volumes of reservoirs (NABD)	Presence and volumes of reservoirs (NABD)	Presence and volumes of reservoirs (NABD)
Stream channelization and levee construction (NA)	Stream channelization and levee construction (NA)	Stream channelization and levee construction (NA)	Stream channelization and levee construction (NA)	Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)	Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)
Percent of the watershed comprising agricultural land use (NLCD)	Atmospheric deposition of anthropogenic sources of nitrogen and acid rain (NADP)	Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)	Road/stream intersections (TIGER/ NHD) weighted by stream reach slope (NHD)	Percent of watershed composed of agricultural land uses (NLCD)	Density of housing unit developments within riparian zones (TIGER)
Total length and density of canals/ditches (NHD)	Percent of watershed composed of urban or agricultural land uses (NLCD)	Presence and density of mines (MINES), forest cover loss (GFC), and roads (TIGER)	Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)	Percent of watershed composed of urban land uses in the riparian zone (NLCD)	Percent of watershed composed of agricultural land uses (NLCD)
Percent imperviousness of human-related landscapes (NLCD)	Fertilizer application rates (FERT)	Agriculture (NLCD) weighted by soil erodibility (CONUS-SOIL)	Density of ditches/canals (NHD)	Groundwater use (NA)	Density of road/stream intersections (TIGER/NHD)
Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)	Presence and density of wastewater treatment facilities (NPDES), industrial facilities (TRI), superfund sites (SUPERFUND), or mines (MINES)		Groundwater use (NA)	Presence and density of wastewater discharge sites (NPDES)	Density of roads within riparian zones (TIGER)
Boundaries, depths, and flows of aquifers (NA)	Cattle density (NA)		Presence and density of wastewater discharge sites (NPDES)		
Groundwater use (NA)	Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)		Percent of riparian zone composed of urban or agricultural land uses (NLCD)		
	Chemical constituents of groundwater (NA)				

## Habitat Provision

Presence and volumes of reservoirs (NABD)

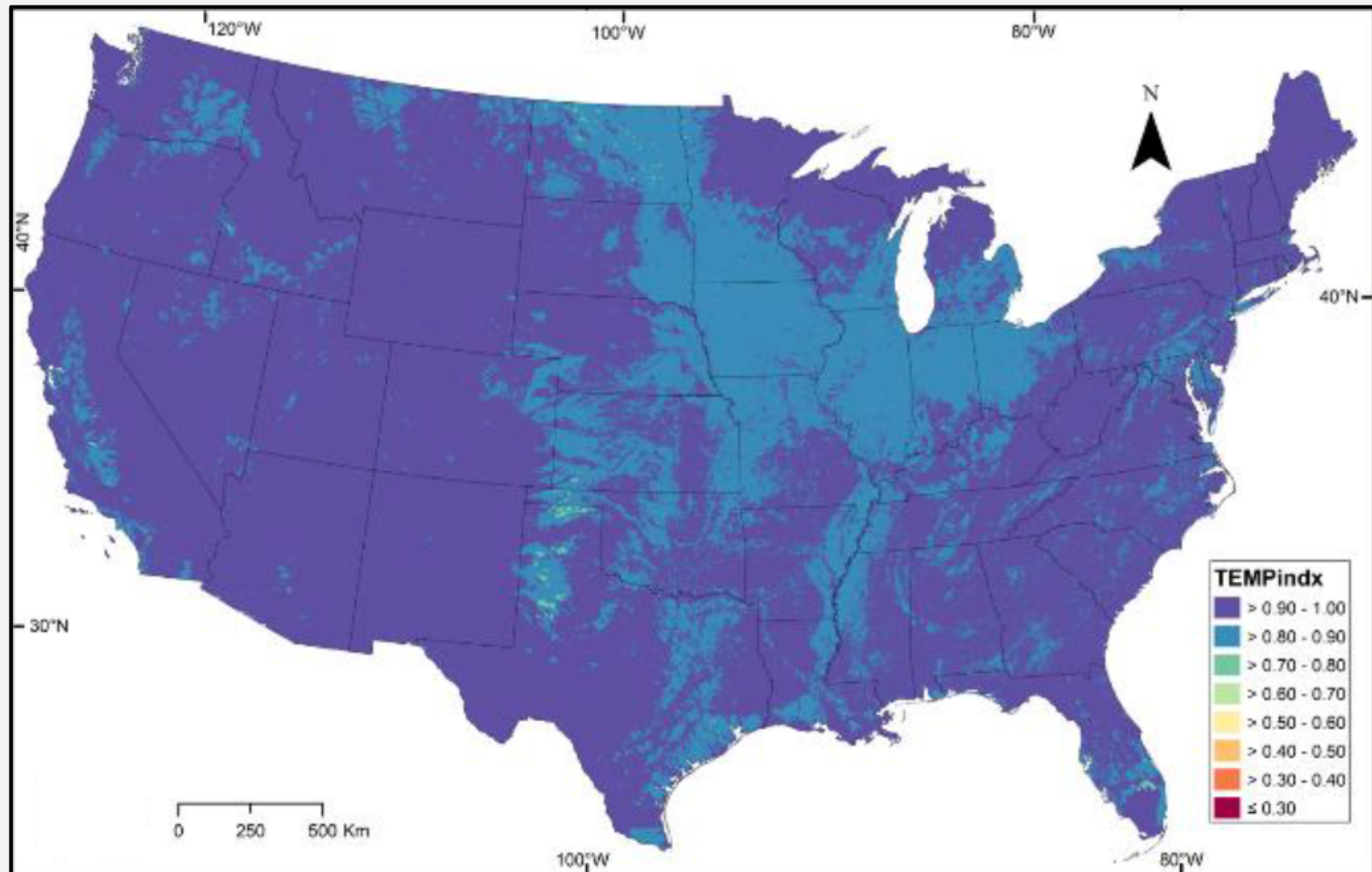
Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)

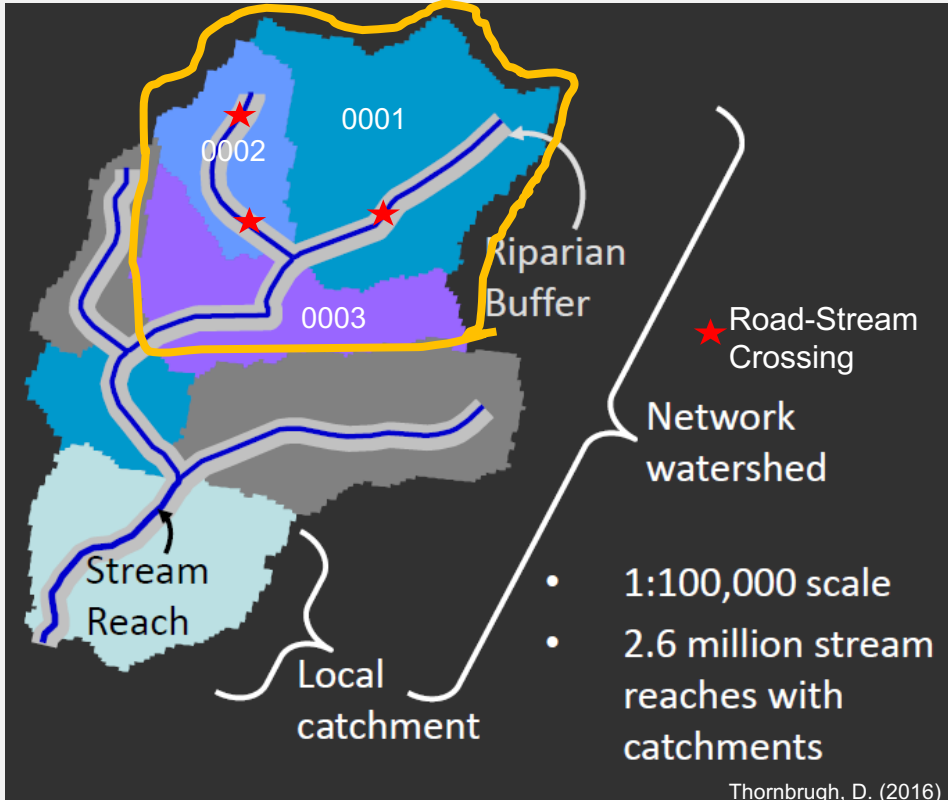
Density of housing unit developments within riparian zones (TIGER)

Percent of watershed composed of agricultural land uses (NLCD)

Density of road/stream intersections (TIGER/NHD)

Density of roads within riparian zones (TIGER)



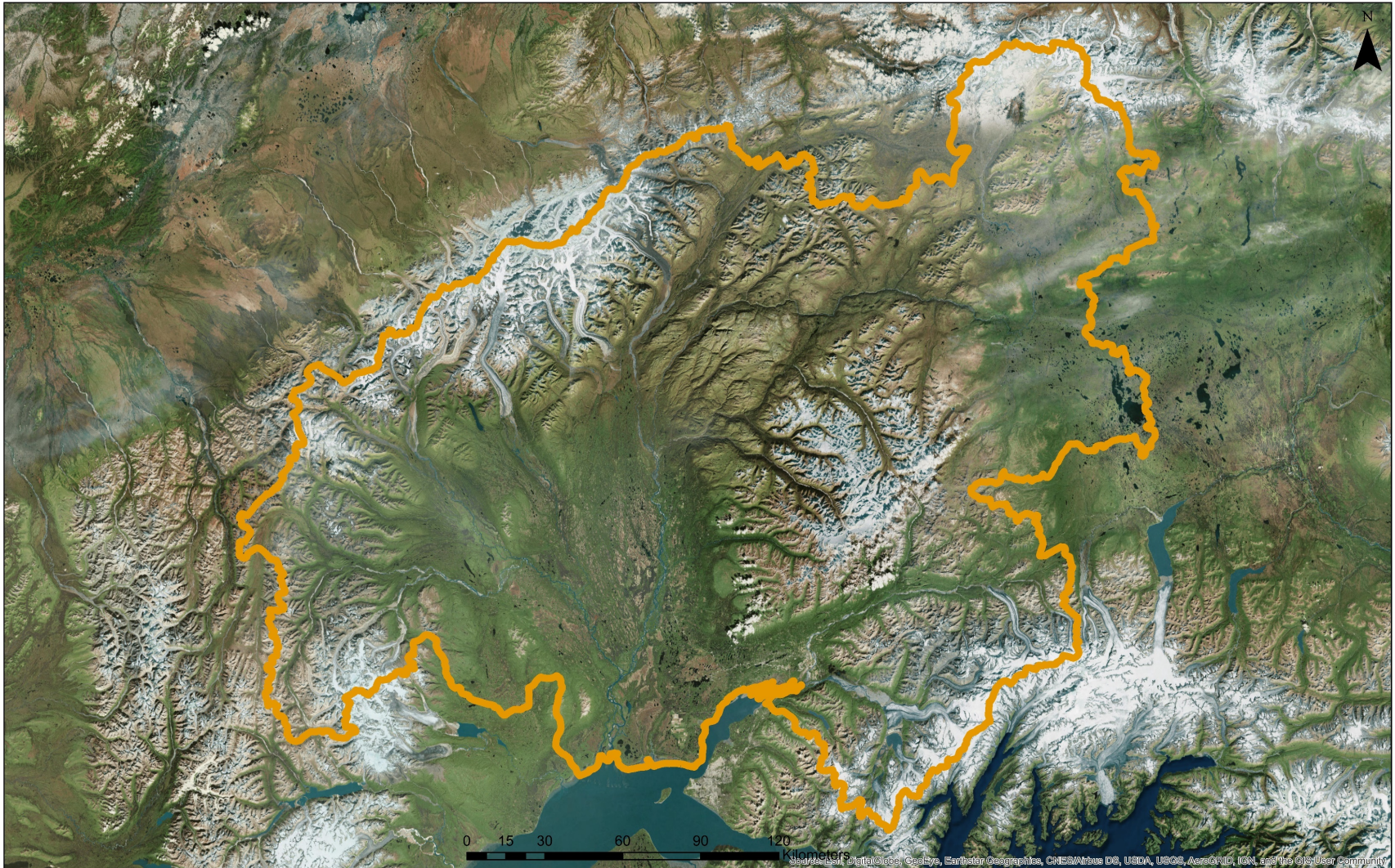


## 1) Local Stress

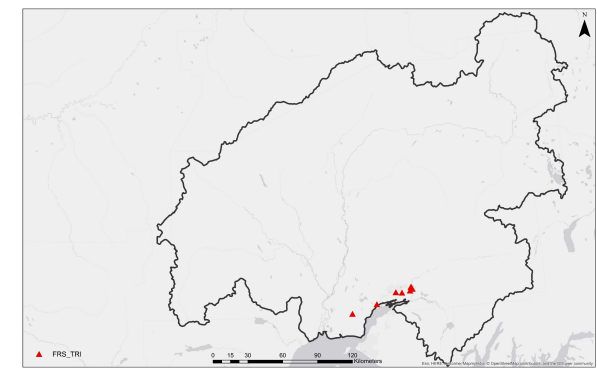
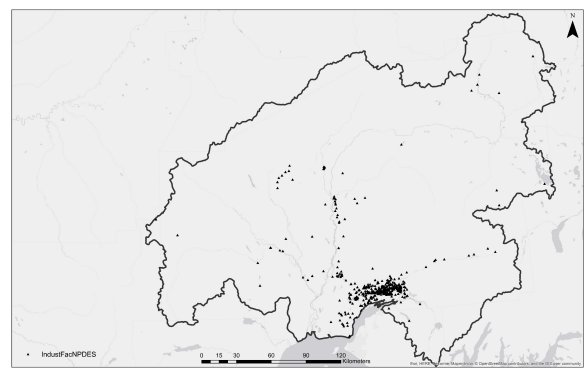
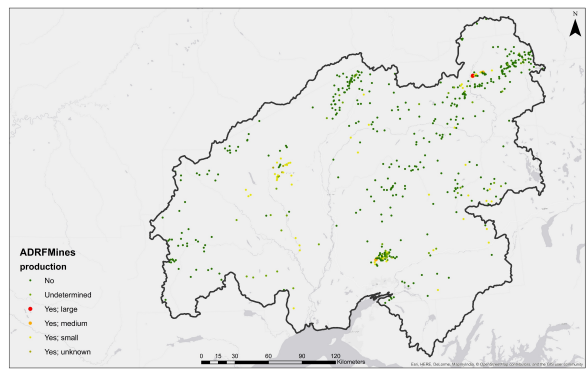
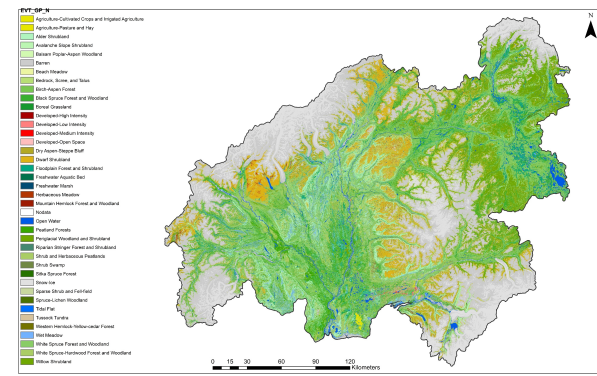
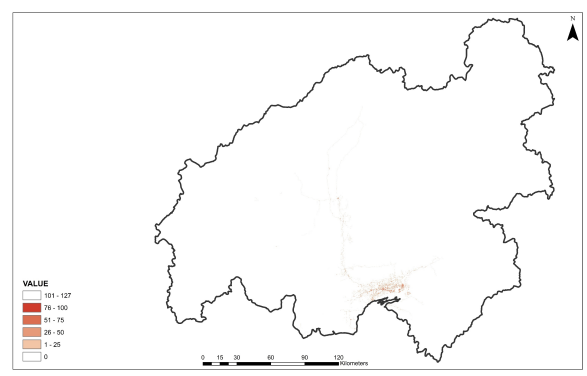
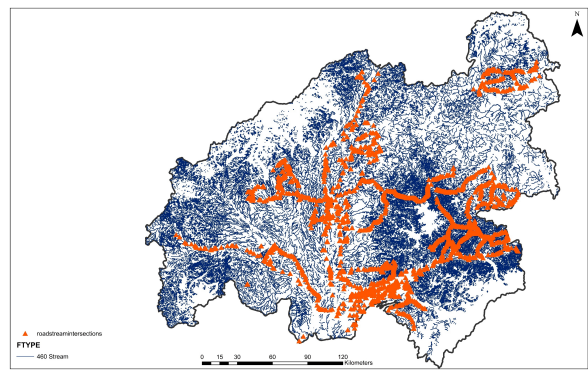
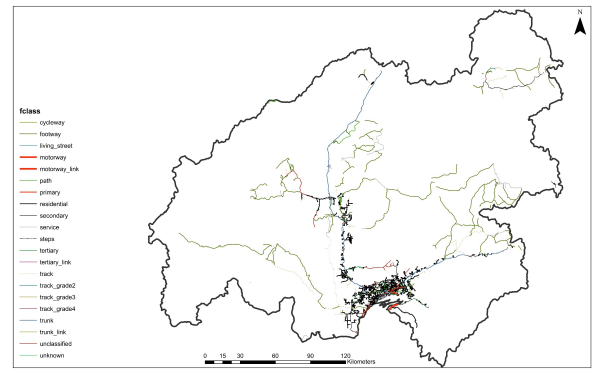
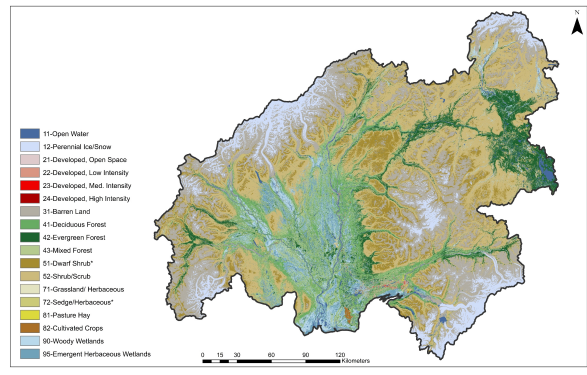
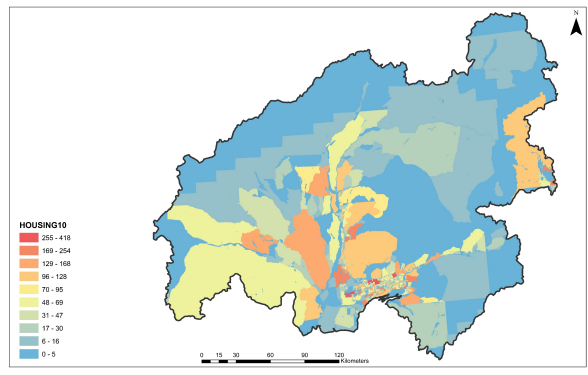
Catchment	Road-Stream Crossings	Area (km <sup>2</sup> )	Density
0001	1	2	.5
0002	2	1	2
0003	0	1.5	0

## 2) Accumulated Stress

<b>Total</b>	<b>3</b>	<b>4.5</b>	<b>0.667</b>
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National fish Habitat Partnership, Matanuska Susitna Basin Salmon Habitat Partnership,  
United States Geological Survey



Hydrologic  
Regulation

Regulation of  
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Sediment  
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Habitat  
Provision

Cold-Climate  
Hydrology



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**Seasonal**

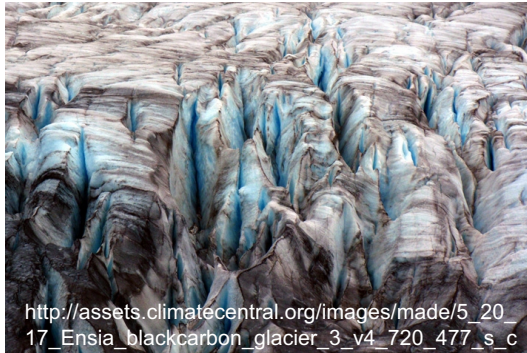
e.g., Lake and River Ice Cover



<https://mgcwpnfm.files.wordpress.com/2015/03/0000019.jpg?w=650>

**Surface**

e.g., Glaciers



[http://assets.climatecentral.org/images/made/5\\_20\\_17\\_Ensia\\_blackcarbon\\_glacier\\_3\\_v4\\_720\\_477\\_s\\_c1\\_c\\_c.jpg](http://assets.climatecentral.org/images/made/5_20_17_Ensia_blackcarbon_glacier_3_v4_720_477_s_c1_c_c.jpg)

**Sub-Surface**

e.g., Permafrost



<https://highlatitudestyle.files.wordpress.com/2015/05/highlatitudestyle-612.jpg>

ANTHROPOGENIC

Hydrologic  
Regulation

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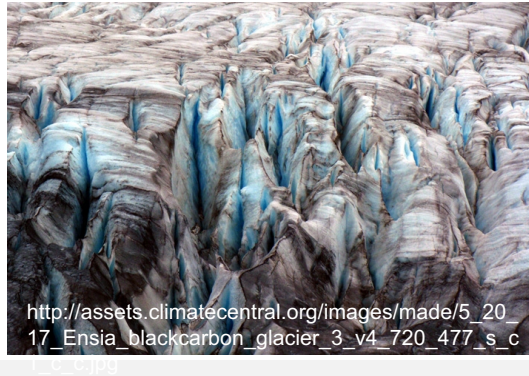
**Seasonal**

e.g., Lake and River Ice Cover



**Surface**

e.g., Glaciers



**Sub-Surface**

e.g., Permafrost



ANTHROPOGENIC

CLIMATIC



## I. Index of Watershed Integrity

## II. Mat-Su Application

## III. Management Uses

### Hydrologic Regulation

Presence and volumes of reservoirs (NABD)

Stream channelization and levee construction (NA)

Percent of the watershed comprising agricultural land use (NLCD)

Total length and density of canals/ditches (NHD)

Percent imperviousness of human-related landscapes (NLCD)

Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)

Boundaries, depths, and flows of aquifers (NA)

Groundwater use (NA)

### Regulation of Chemistry

Presence and volumes of reservoirs (NABD)

Stream channelization and levee construction (NA)

Atmospheric deposition of anthropogenic sources of nitrogen and acid rain (NADP)

Percent of watershed composed of urban or agricultural land uses (NLCD)

Fertilizer application rates (FERT)

Presence and density of wastewater treatment facilities (NPDES), industrial facilities (TRI), superfund sites (SUPERFUND), or mines (MINES)

Cattle density (NA)

Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)

### Sediment Regulation

Presence and volumes of reservoirs (NABD)

Stream channelization and levee construction (NA)

Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)

Presence and density of mines (MINES), forest cover loss (GFC), and roads (TIGER)

Agriculture (NLCD) weighted by soil erodibility (CONUS-SOIL)

### Hydrologic Connectivity

Presence and volumes of reservoirs (NABD)

Stream channelization and levee construction (NA)

Road/stream intersections (TIGER/NHD) weighted by stream reach slope (NHD)

Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)

Density of ditches/canals (NHD)

Groundwater use (NA)

Presence and density of wastewater discharge sites (NPDES)

Percent of riparian zone composed of urban or agricultural land uses (NLCD)

### Temperature Regulation

Presence and volumes of reservoirs (NABD)

Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)

Percent of watershed composed of agricultural land uses (NLCD)

Percent of watershed composed of urban land uses in the riparian zone (NLCD)

Groundwater use (NA)

Presence and density of wastewater discharge sites (NPDES)

### Habitat Provision

Presence and volumes of reservoirs (NABD)

Alteration to and spatial arrangement of riparian vegetation (LANDFIRE)

Density of housing unit developments within riparian zones (TIGER)

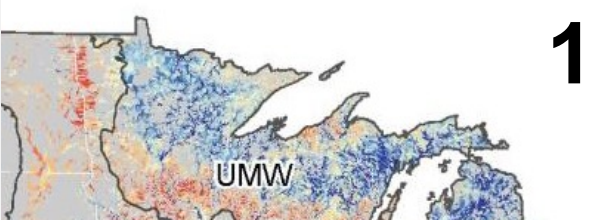
Percent of watershed composed of agricultural land uses (NLCD)

Density of road/stream intersections (TIGER/NHD)

Density of roads within riparian zones (TIGER)

### Cold Climate Hydrology

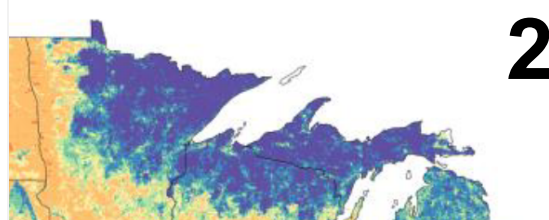
**Low** predicted probability of good biological condition (NRSA)



**1**

Need for Restoration

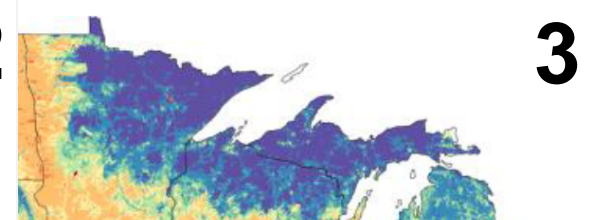
**Low** Index of Catchment Integrity



**2**

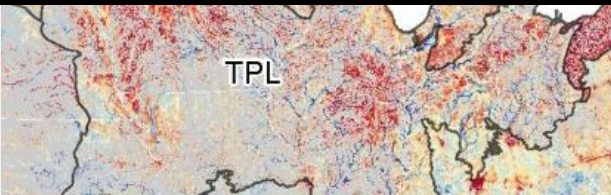
Local factors contributing to impairment

**High** Index of Watershed Integrity



**3**

Suggesting intact contributing watershed

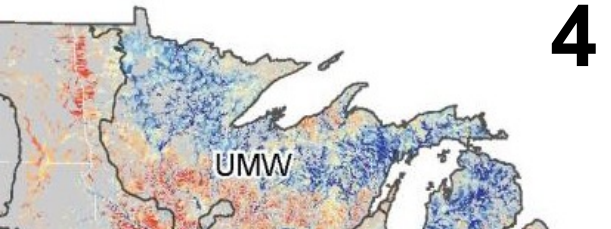
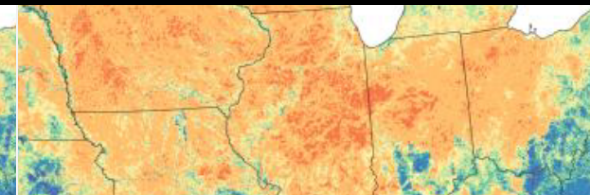


TPL

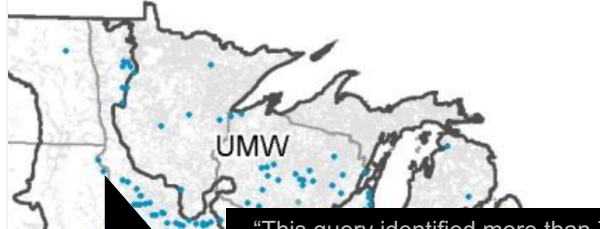
Neighboring streams with **high** predicted probability of good biological condition (NRSA)



**Candidate streams for restoration!**



UMW



UMW

High likelihood of dispersal of native taxa

"This query identified more than 7,300 km of streams... and were almost entirely comprised of 1st order catchments, suggesting that **local restoration efforts could substantially improve biological conditions** within the upper Mississippi Basin" (Hill et al. 2017).



TPL



SAF

1. We are in the first stages of adapting the Index of Watershed Integrity (IWI) to the stressors unique to the Mat-Su's cold-climate hydrology
2. The IWI could be used for aquatic restoration or conservation
- 3. We are seeking feedback on the region's stressors and management topics that can be addressed by the Mat-Su IWI!**

A scenic landscape photograph of a mountain valley. The foreground is filled with dense, low-lying vegetation in shades of green and yellow, suggesting autumn. A winding river flows through the center of the valley, reflecting the light. The middle ground shows steep, rocky slopes covered in sparse vegetation. In the background, majestic mountains rise against a cloudy sky, with a soft glow of light breaking through the clouds near the horizon. The overall atmosphere is serene and natural.

Thank you for your attention

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