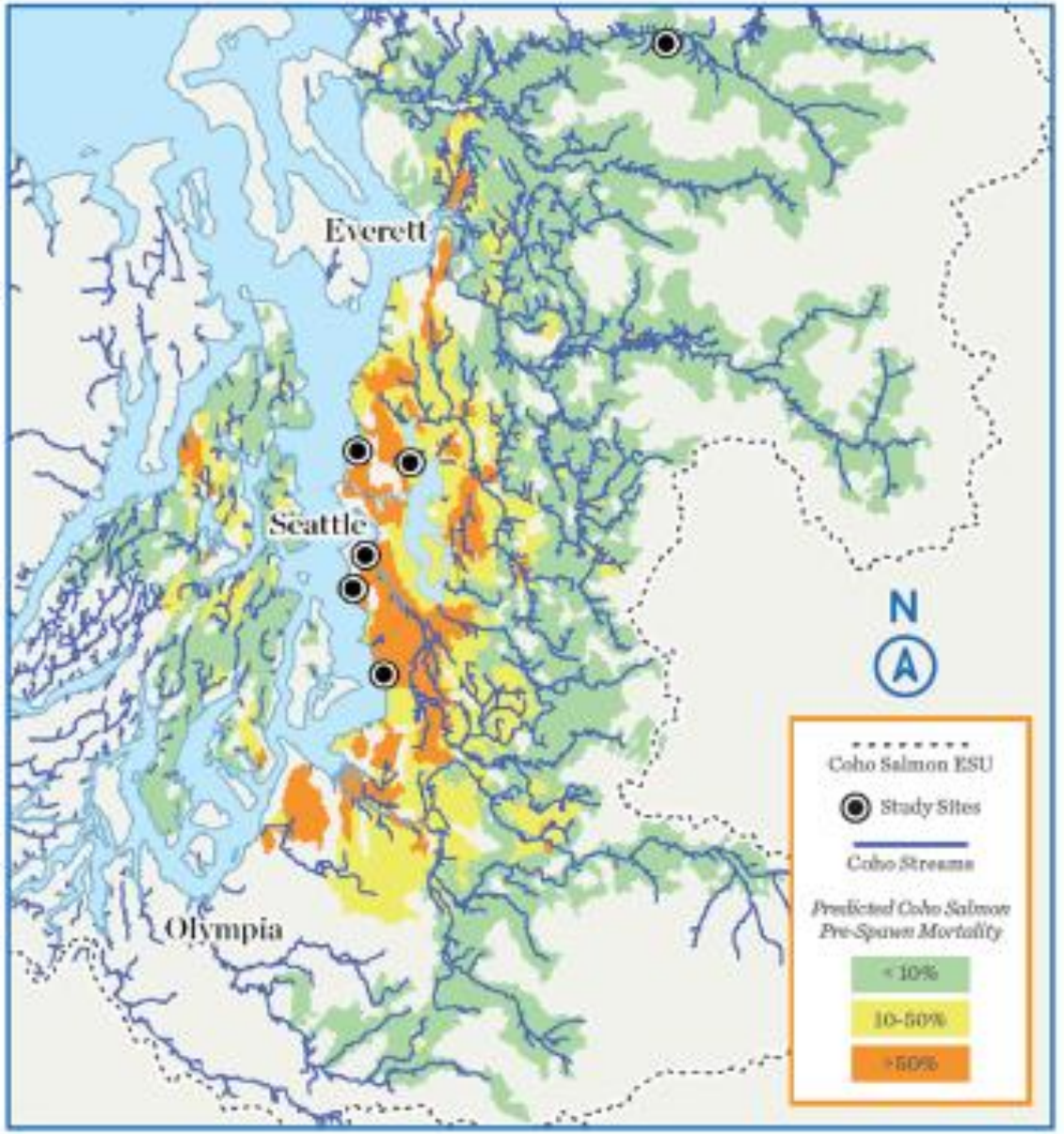
Emily Howe, The Nature Conservancy, emily.howe@tnc.org

Optimizing Green Stormwater Infrastructure for People and Nature

Advancing urban stormwater planning through design thinking, pollution loading, and social equity metrics

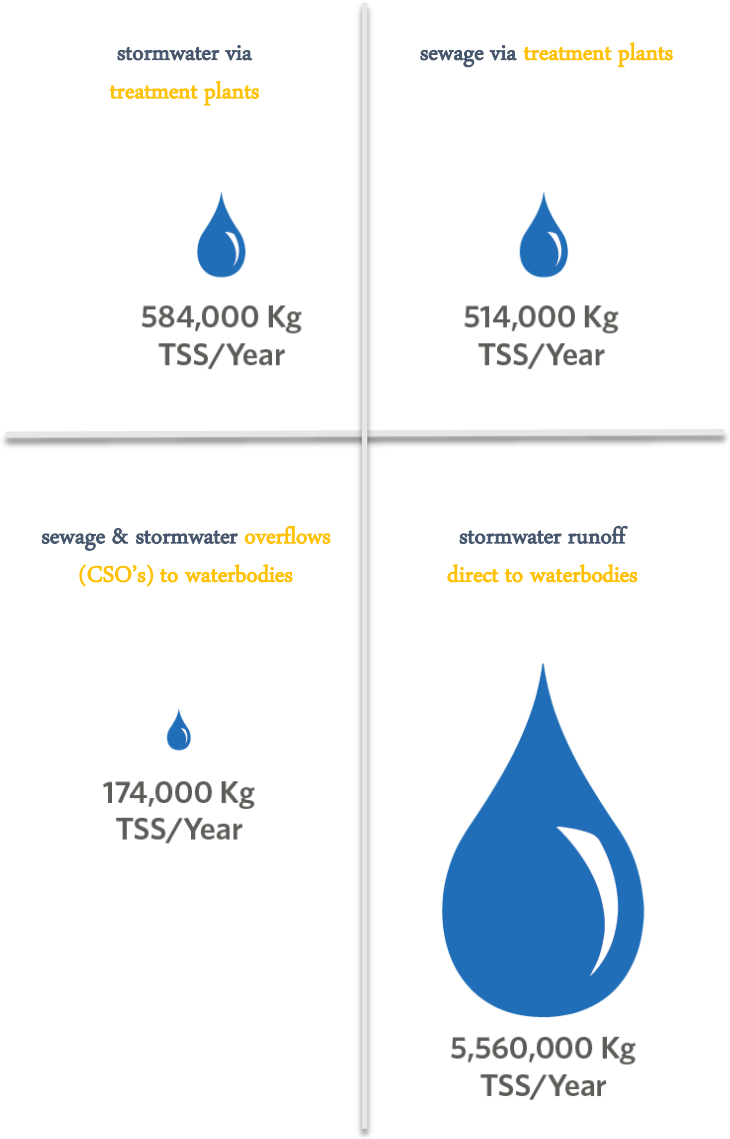
How should we prioritize what to fix?

Up to 90% of Coho in Urban Streams Can Die on Spawning Grounds Before Laying their Eggs



city habitats

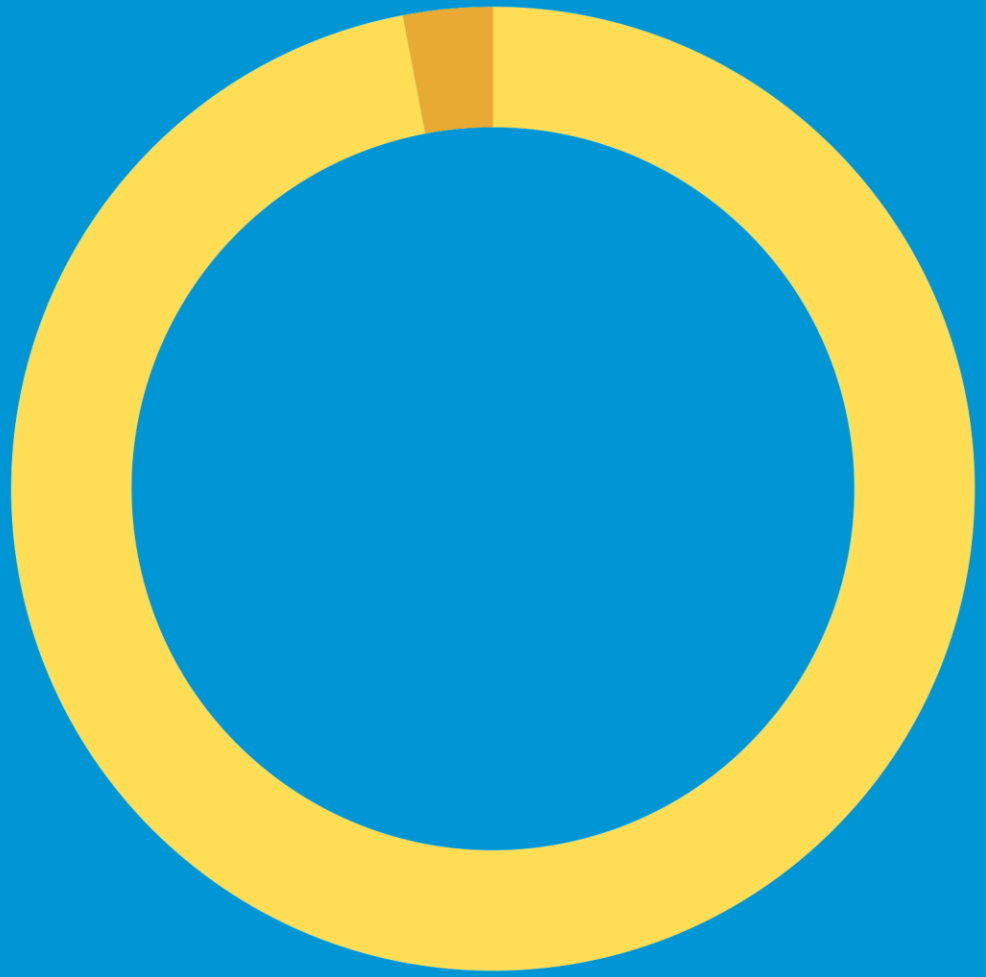
The Nature Conservancy
Washington



Pollutant loading to local water bodies

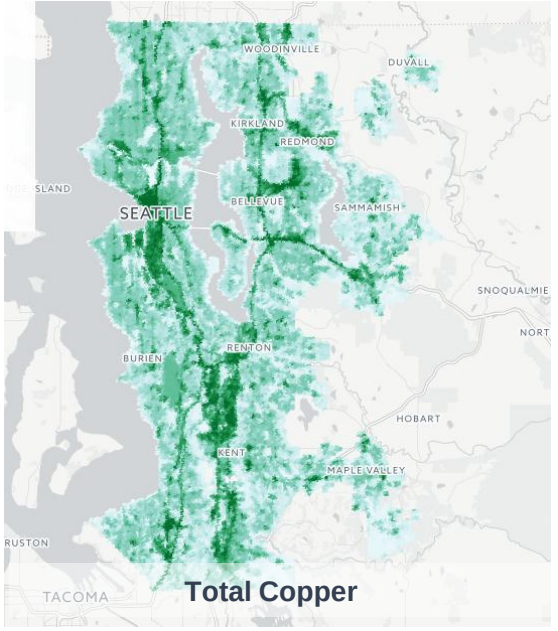
Data from Seattle Public Utilities

With one of the most aggressive stormwater programs in the USA, we are poised to solve less than 4% of the overall pollution problem

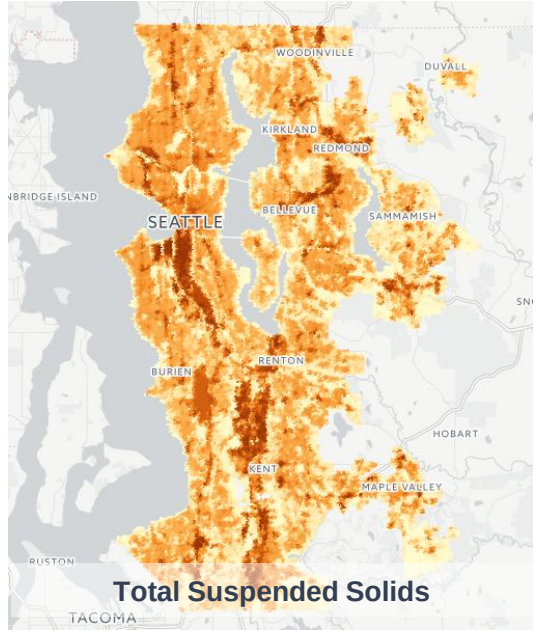


Help Decision Makers Prioritize Investment Where Pollution is Worst, or Ecosystems are Most Sensitive

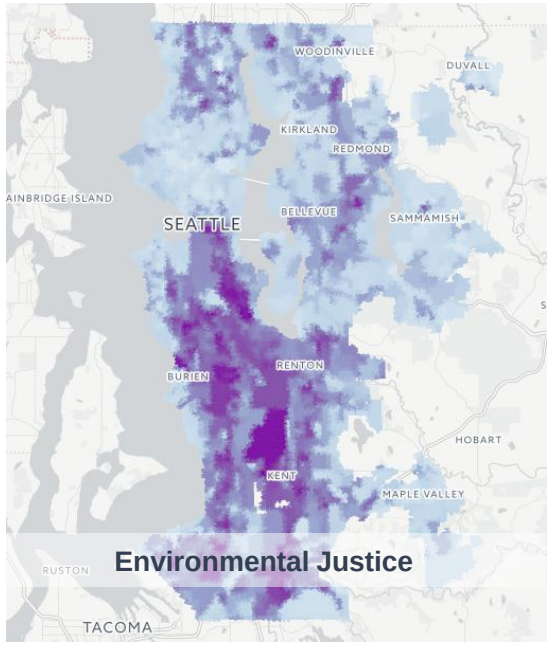
Not Unlike other Areas: Pollution tied to Environmental Justice



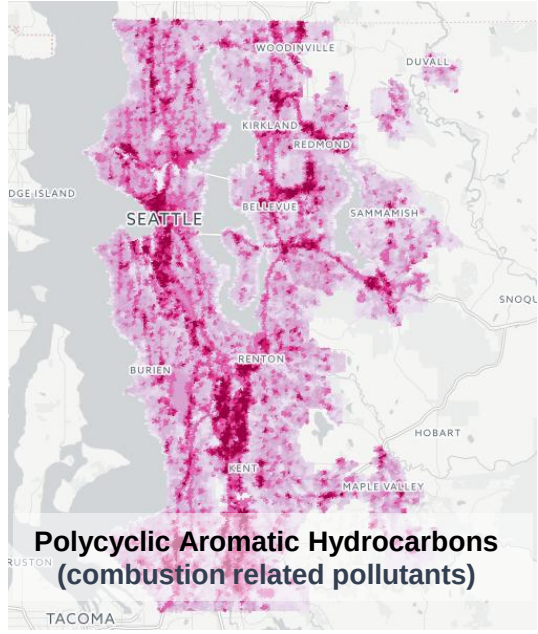
Total Copper



Total Suspended Solids



Environmental Justice



Polycyclic Aromatic Hydrocarbons (combustion related pollutants)

Design Thinking

Design Thinking

Who cares about Stormwater Management?

Regulatory Agencies

Clean Water Act

EPA

Dept. of Ecology

Dept. of Transportation
WSDOT

Endangered Species Act

WRIAs
(salmon recovery)

NOAA

Jurisdictions
(Phase I +Phase II +Tribes +Conservation Districts)

City planners

Stormwater Managers

Stormwater Engineers

Mayor/County Executive

City/County Council

NW Indian Fisheries Commission

Residents

Public Health
(hospitals, etc.)

Local Business Owners

Growers

Real Estate Developers

Environmental Attorneys

Non-Regulatory Professionals

Dept. of Commerce

Puget Sound Partnership
(“Uber planners”)

Scientists/ThinkTanks/
Subject Matter Experts

Climate Resilience/Restoration Professionals

Environmental Educators/Outreach professionals

Funders
(foundations, government, PSRC)

Stormwater management

BE EFFECTIVE

Right Opportunity
(Impact)
Help me understand
the relative value of opportunities
presented

[Leader]

Right Method
(Effectiveness)
Help me solve this problem
in the most effective way.

[Modeler/Engineer]

COMMUNICATE

Inspire/Propose/Defend
(Clarity)
What I'm doing/want to do/already
did…to stakeholders

[Leader]

Initial project aim
Create a tool to **help decision-makers identify green infrastructure intervention opportunities** (location, extent, & type) that most effectively improve water quality and quantity.

Pollution Loading Heatmap for Puget Sound: INPUTS

INPUTS
Mean Annual Precipitation
Pollutant Concentrations

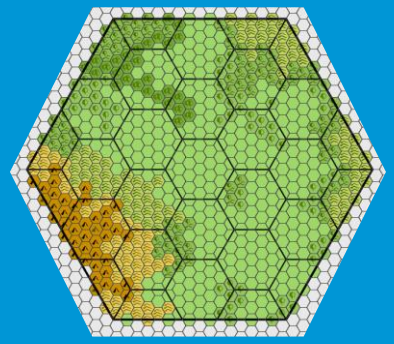
<u>Metals</u>
Total Copper
Dissolved Copper
Total Zinc
Dissolved Zinc

<u>Nutrients</u>
Nitrite-Nitrate
Total Kjeldahl Nitrogen
Total Phosphorous

<u>Other</u>
Fecal Coliform
Total Suspended Solids

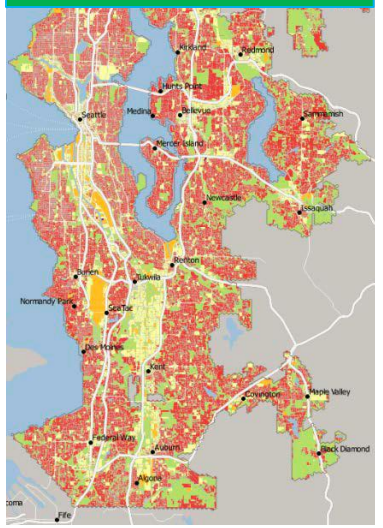
<u>Estimated Total PAH</u>
Benz(a)anthracene
Chrysene
Fluoranthene
Phenanthrene
Pyrene

GRID DATA

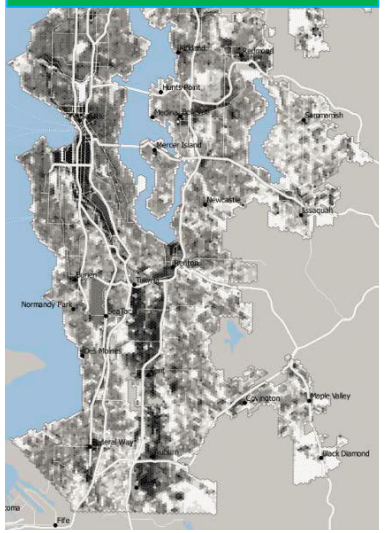


Impervious surface area
Social Justice Score
Land use type
Precipitation

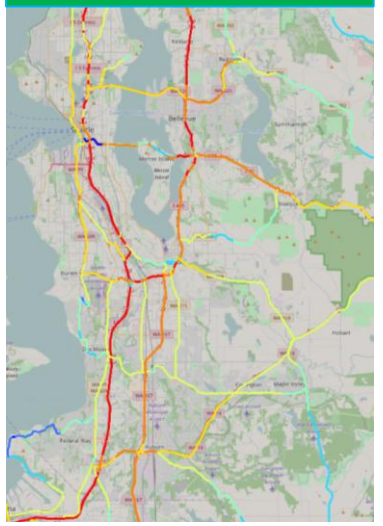
LANDUSE



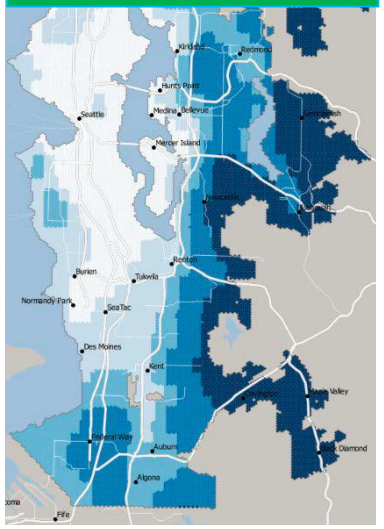
LANDCOVER



ROADWAYS



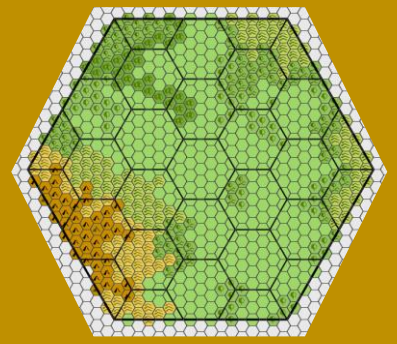
PRECIPITATION



Data sources:
Model pollutant load inputs were derived from NPDES Phase 1, S8.D monitoring data (Hobbs et al. 2015), WSDOT, S7.8 monitoring data (WSDOT Stormwater and Watersheds Program 2015), and the National Stormwater Quality Database (Pitt et al. 2015).

Pollution Loading Heatmap for Puget Sound: OUTPUTS

GRID DATA



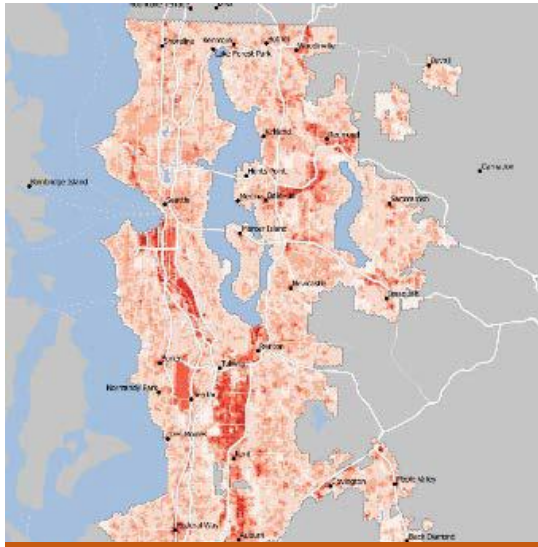
Impervious surface area
Social Justice Score
Land use type
Precipitation

OUTPUTS

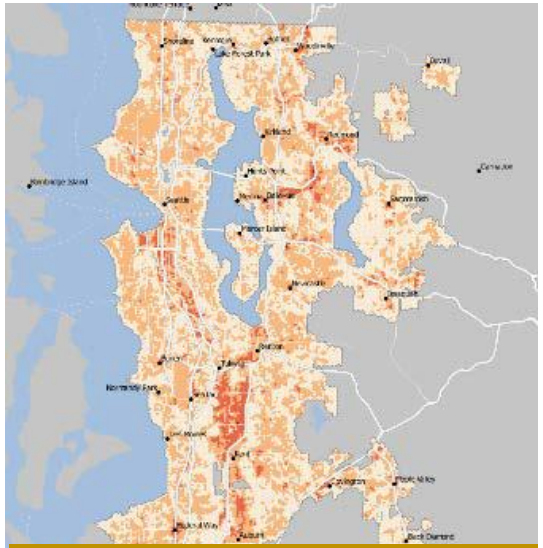
Mean Annual Pollutant Load
Mean Annual Runoff
Social Justice Score

Social Justice Score Components
Percent low income
Percent minority
Percent less than high school education
Linguistic isolation
Individuals < 5 yrs of age
Individuals > 64 yrs of age

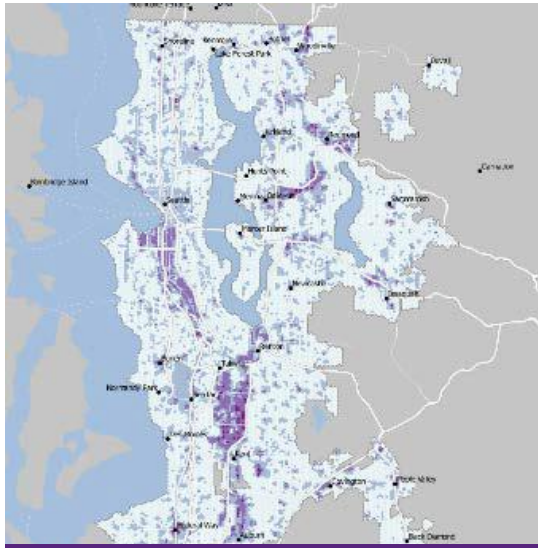
Total Phosphorous



Total Suspended Solids



Nitrogen (TKN)



Total Copper

Color ramp gradations indicate successive STDEV bins (1 SD each) above the mean pollution load for each pollutant. For cells falling below the mean, color ramps indicate -0.5 and less than -0.5 SD below the mean, which effectively captures green space separately from low levels of development.

Grid Cell Prioritization

Multi-criteria prioritization of retrofit locations are based on user rankings of:

1) Importance of different pollutants
2) Age of development
3) TMDL boundaries

Ecological and Social Prioritization is in the works!

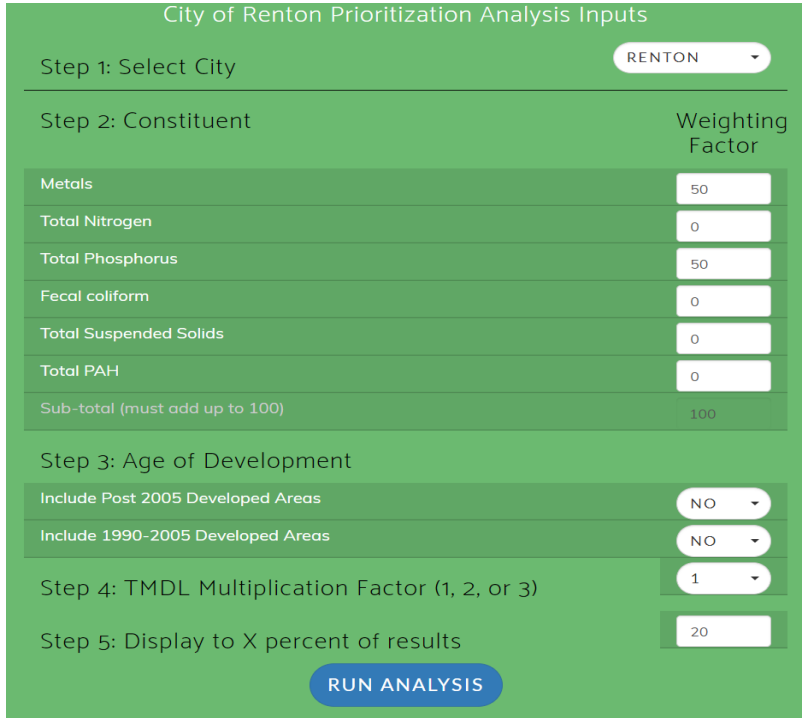
Freshwater systems (coho psm)

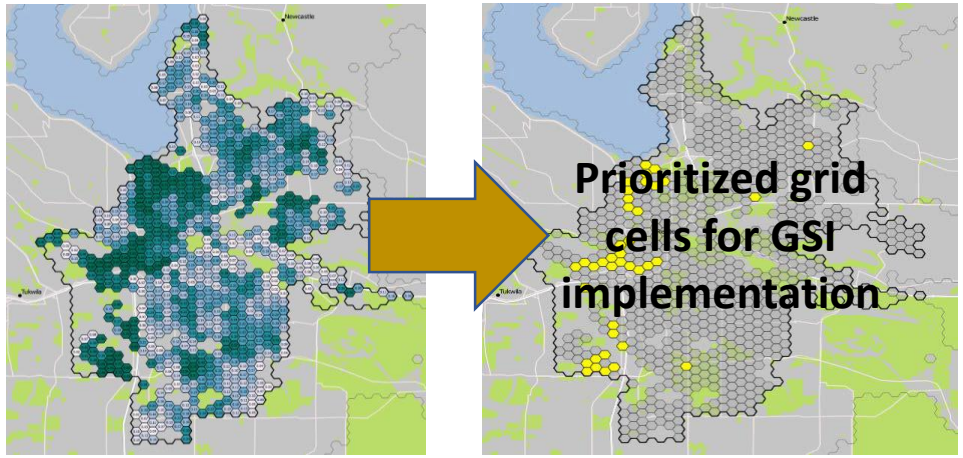
Marine systems

estuaries, eelgrass, shellfish beds, forage fish, low DO

Social systems

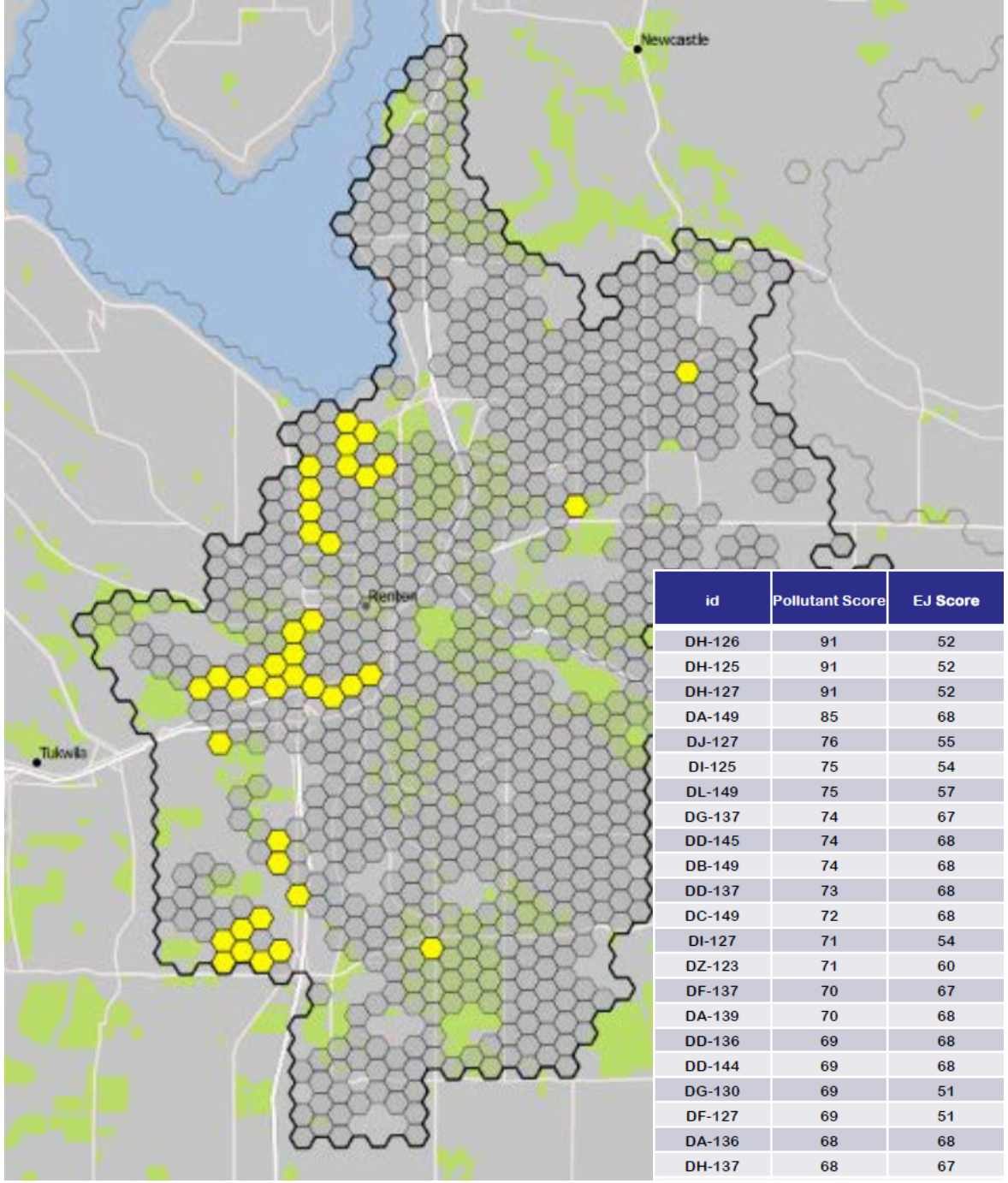
Shellfish harvest, recreational beaches, EJ score





- Score assigned to each grid cell based on user ranking of pollutants
- Recently developed areas are screened out

Prioritization



id	Pollutant Score	EJ Score
DH-126	91	52
DH-125	91	52
DH-127	91	52
DA-149	85	68
DJ-127	76	55
DI-125	75	54
DL-149	75	57
DG-137	74	67
DD-145	74	68
DB-149	74	68
DD-137	73	68
DC-149	72	68
DI-127	71	54
DZ-123	71	60
DF-137	70	67
DA-139	70	68
DD-136	69	68
DD-144	69	68
DG-130	69	51
DF-127	69	51
DA-136	68	68
DH-137	68	67

https://igeowater.com/dev/tnc/#/prioritization

Feedback needed! Sticky Notes!

Big picture

What scale is relevant to you?

What social/ecological prioritization questions should we answer?

How might *you* use this?

Metrics

What reporting metrics would you need/want?

Do you want a combined pollution metric?

What data format is useful to you?

Other?

Design features, work flow?