A Greener Tomorrow in the Duwamish Valley

NOVEL RESTORATION TECHNIQUES TO COMBAT CLIMATE CHANGE

JAMES LEE – UW SCHOOL OF MARINE AND ENVIRONMENTAL AFFAIRS (SMEA)

Thank You

- Support the Duwamish Tribe at RealRentDuwamish.org

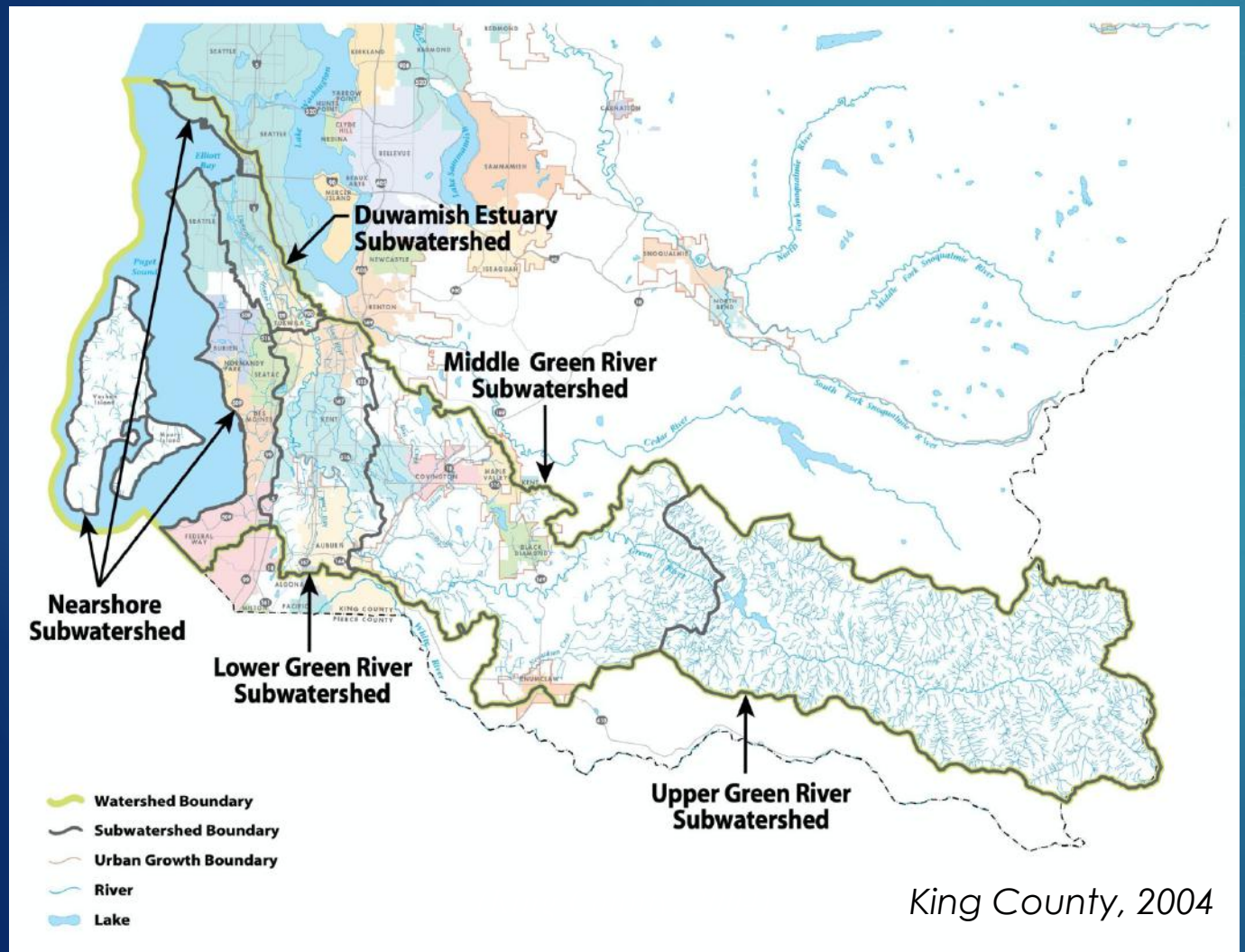
Puget Creek Bioblitz

Today's Roadmap

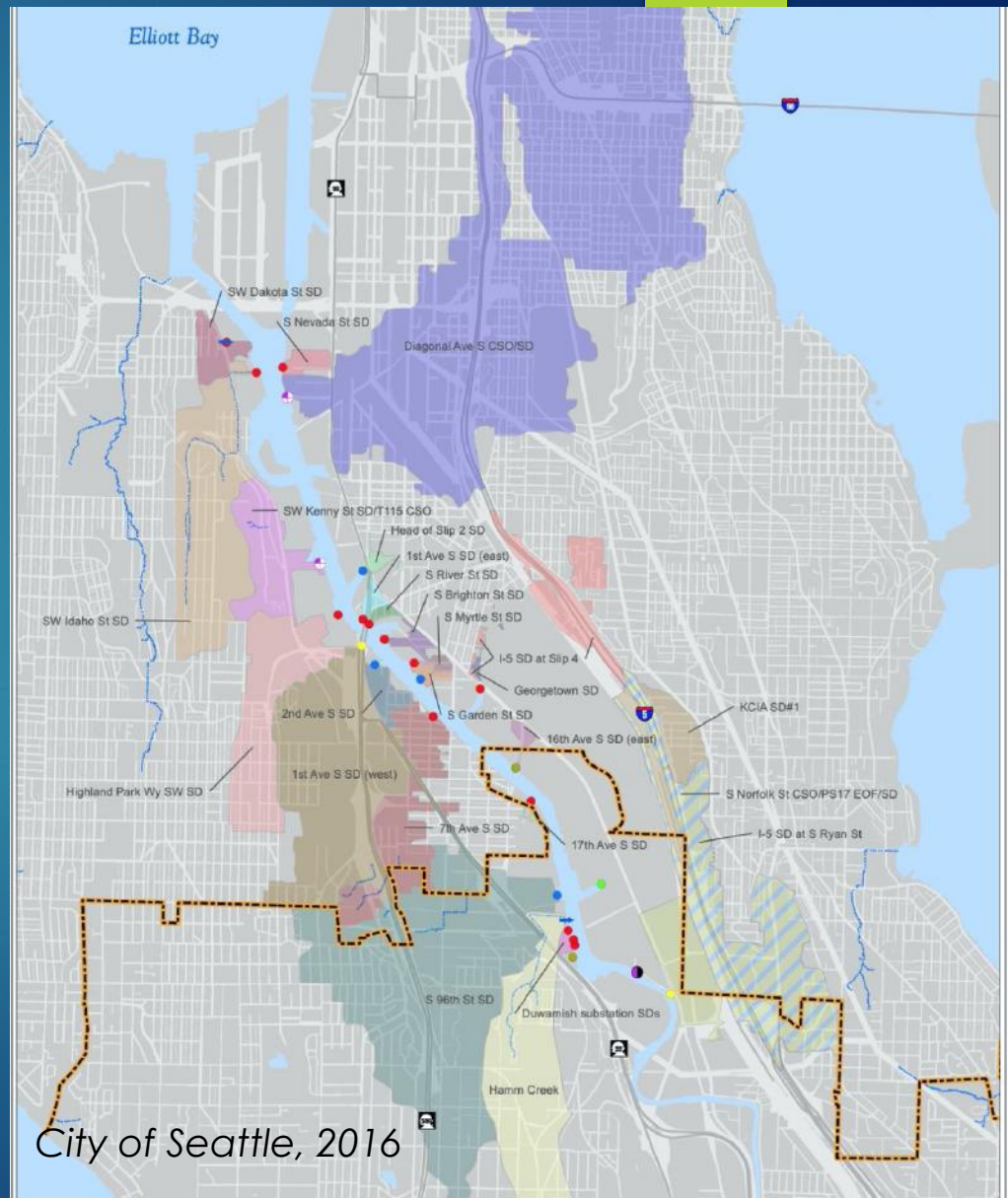
- Duwamish River: historical and current concerns
- A little bit about me
- What about climate change?
- What would a greener future for the Duwamish Valley look like?

Lower Duwamish River

Duwamish River Background

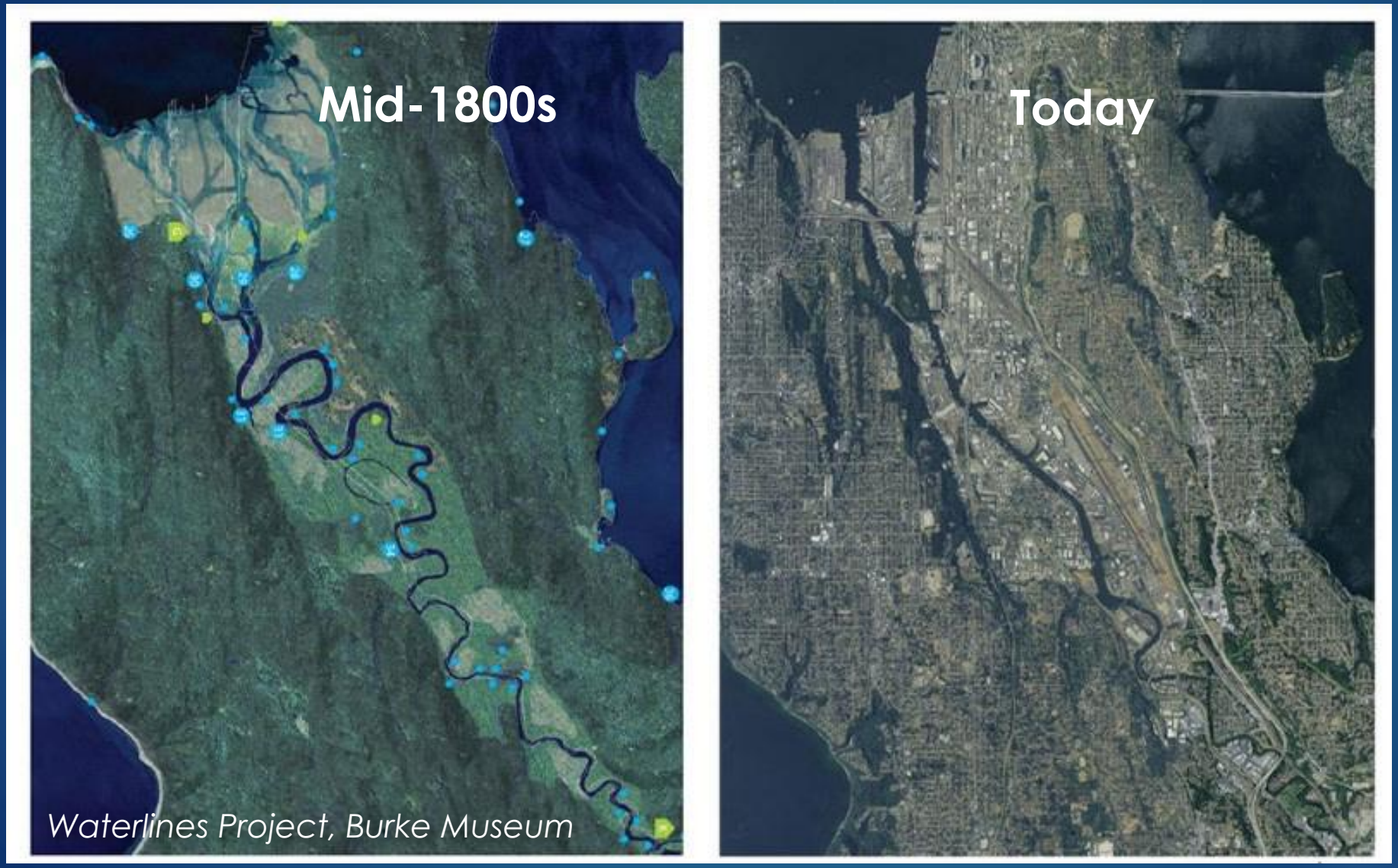


King County, 2004



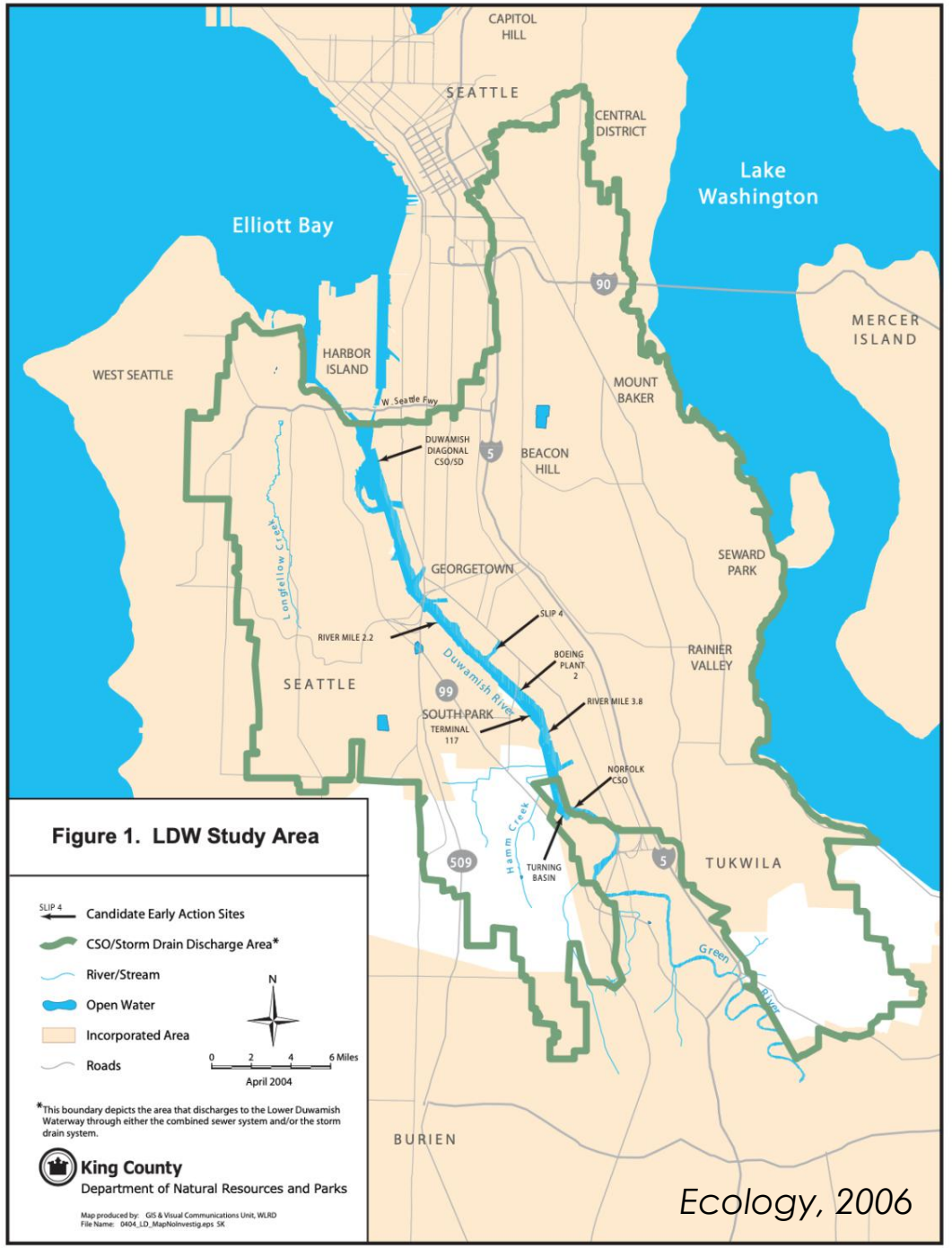
City of Seattle, 2016

Duwamish River Background



Background

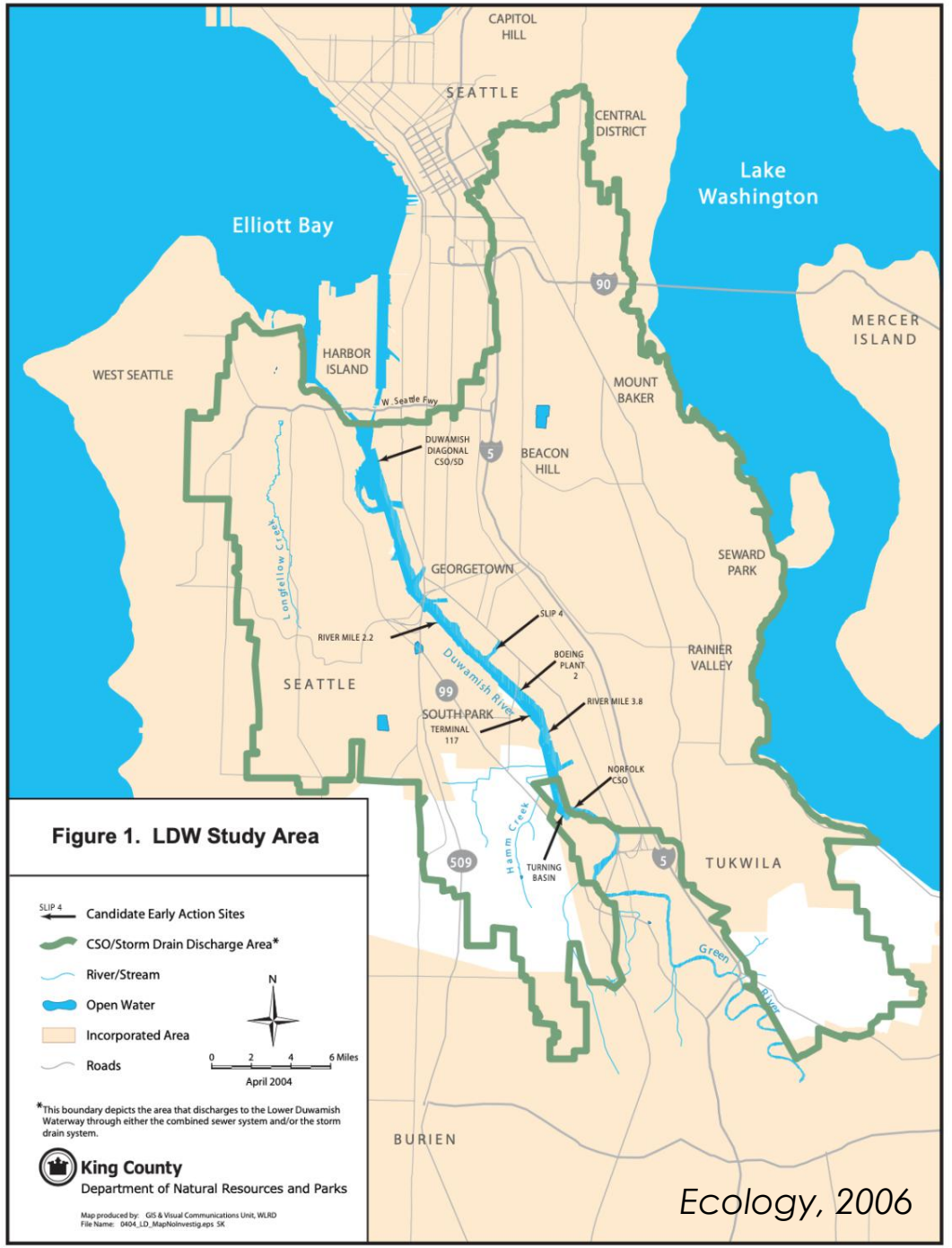
- Significant loss of function
- Lack of shallow-water habitat for juvenile Chinook salmon
- Contaminated river sediments and upland soils
- Industry continues to pollute the river
- Air pollution impacts public health



Ecology, 2006

Background

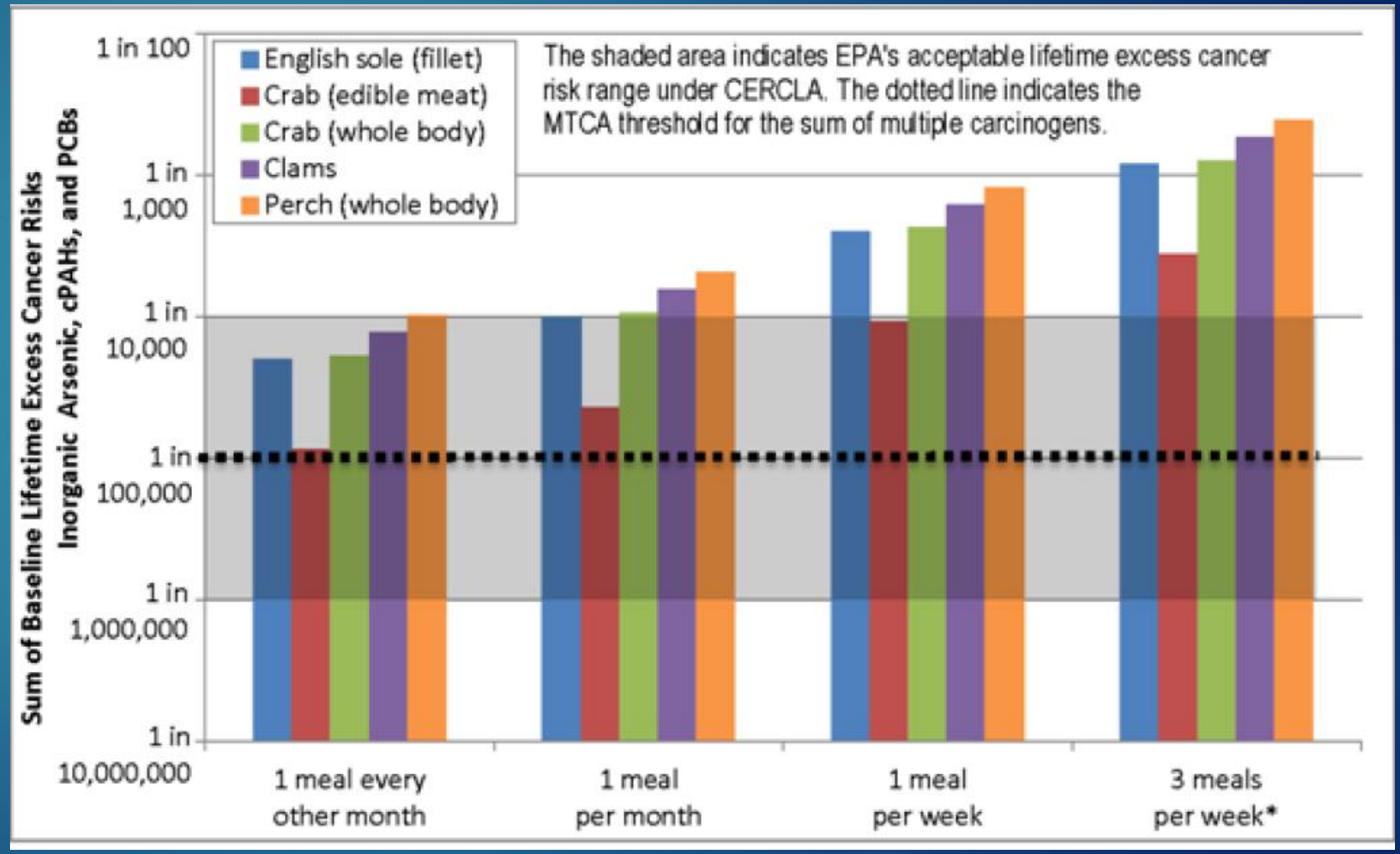
- Puget Sound Chinook salmon listed as threatened under ESA
- EPA Superfund site designation
- Lower Duwamish Waterway Group (LDWG)
  - Sediment cleanup and restoration
- Source Control Work Group (SCWG)
  - Controls pollution inputs



Ecology, 2006

Contamination

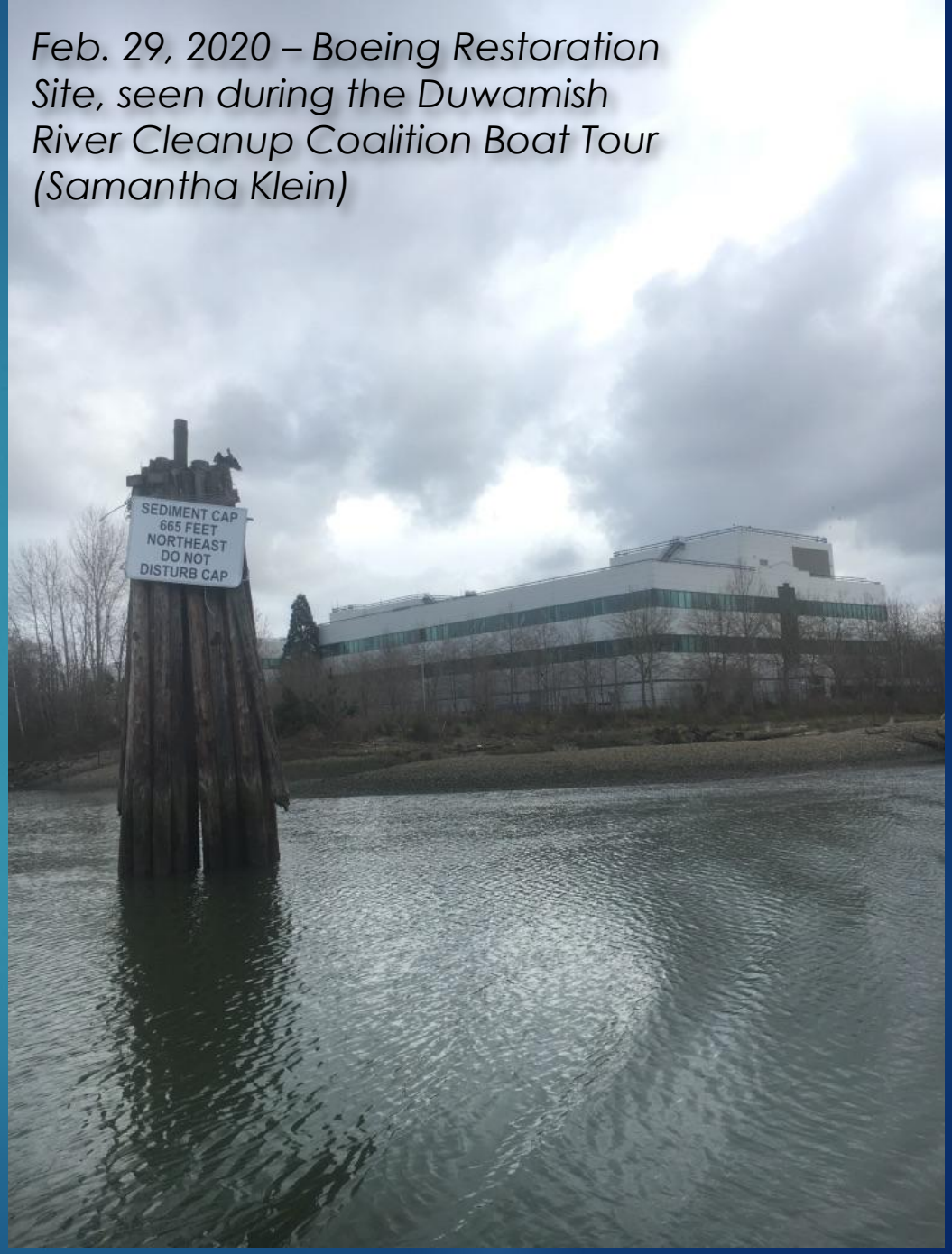
- From industry, past and present
- Dioxins, furans, PCBs, PAHs
- Arsenic, other heavy metals
- Consumption of resident seafood



EPA Record of Decision, 2014

Contamination

- Superfund site since 2001
- Contamination limits access

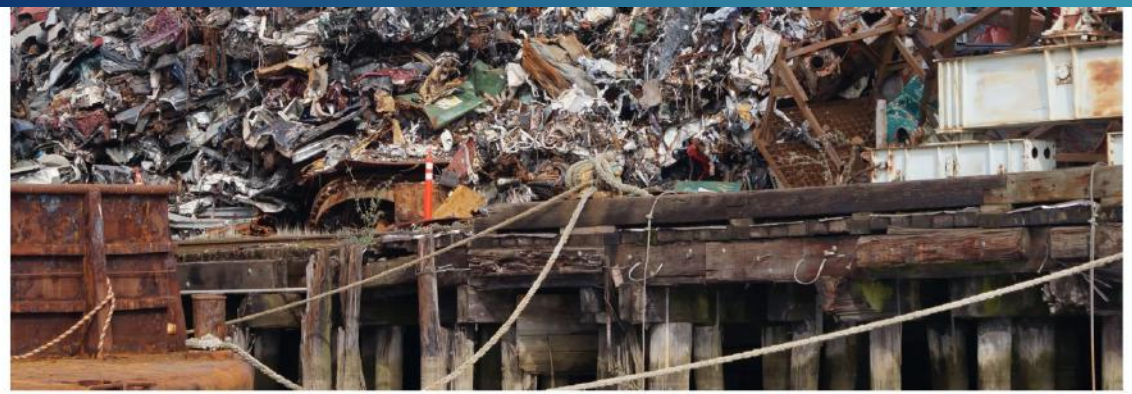


Feb. 29, 2020 – Boeing Restoration Site, seen during the Duwamish River Cleanup Coalition Boat Tour (Samantha Klein)


LAKE WASHINGTON
DOWNTOWN SEATTLE
ELLIOTT BAY
25
27
28
29
30
26
24
32
N

Lynch, et al.

Background



Settlement wins over $1 mil of improvements along Duwamish River

Posted on:

FOR IMMEDIATE RELEASE: January 18, 2019

Duwamish River scrap facility to clean up its act after Puget Soundkeeper forces Clean Water Act settlement

Seattle Iron and Metals Corporation agrees to make over $1 million worth of improvements to its site to prevent air and water pollution.

Puget Soundkeeper, 2019

Environmentalists sue Boeing over Duwamish River contamination

by Joel Moreno | Monday, August 20th 2018

A new lawsuit says Boeing is poisoning the Duwamish River by pumping out pollution that is thousands of times above the legal limit. (Photo: KOMO News)

TUKWILA, Wash. - A new lawsuit says Boeing is poisoning the Duwamish River by pumping out pollution that is thousands of times above the legal limit.

KOMO News, 2018

Background

Settlement wins over $1 mil of improvements along Duwamish River

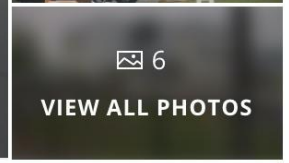
Posted on:

Puget Soundkeeper and Waste Action Project Send Notice of Intent to Sue to Ardagh Glass

Like 25 Share

Environmentalists sue Boeing over Duwamish River contamination

AA



pumping out pollution that is thousands of times above the

it says Boeing is poisoning the
ut pollution that is thousands of times

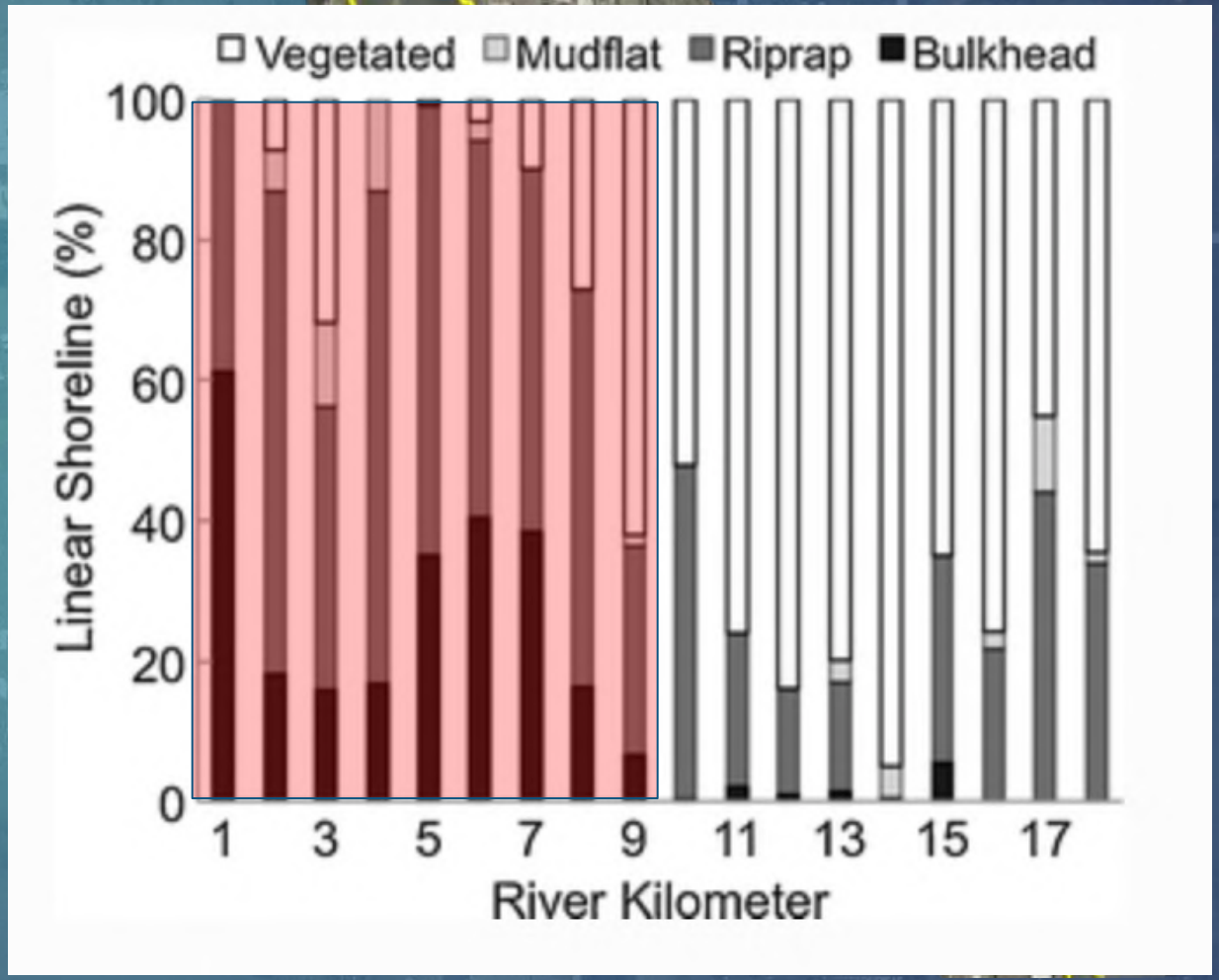
Puget Soundkeeper, 2019 The Skanner News, 2019 KOMO News, 2018

Hierarchical Analysis

Possible causes shown in **green**; plausible causes in **blue**; actionable causes in **orange**.

Cleanup and Restoration E

- Port of Seattle
- WRIA 9 Watershed Ecosystem Forum
- EPA Superfund Early Action Areas
- NRDA (Natural Resource Damage Assessment)



Percent coverage of four major shoreline conditions by river kilometer of the Green-Duwamish River (Morley et al., 2012)

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Redwood City

The Cargill "Salt Ponds"

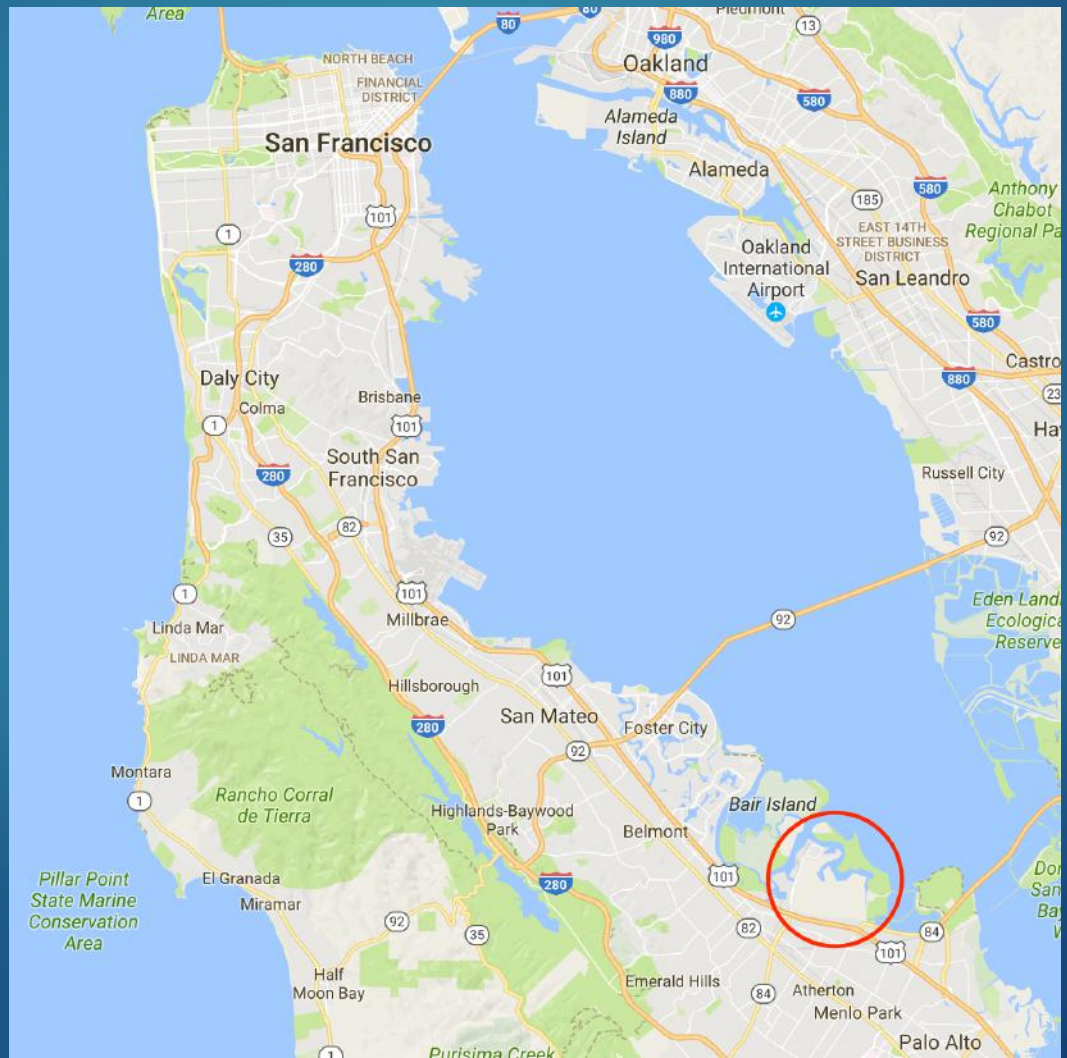


Photo by Google

The Cargill "Salt Ponds"

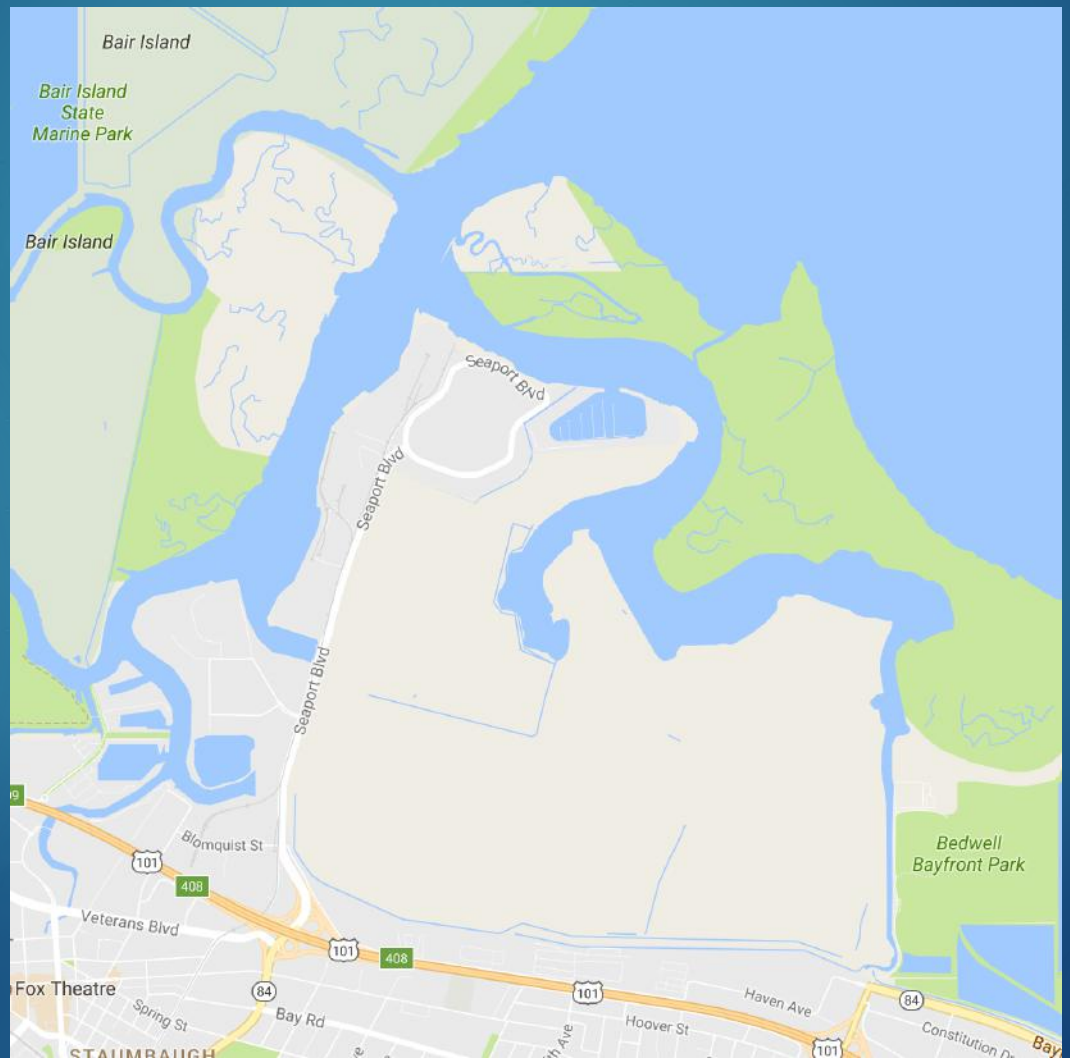


Photo by Google

Is It a Wetland or Not?

Photo by DMB Associates

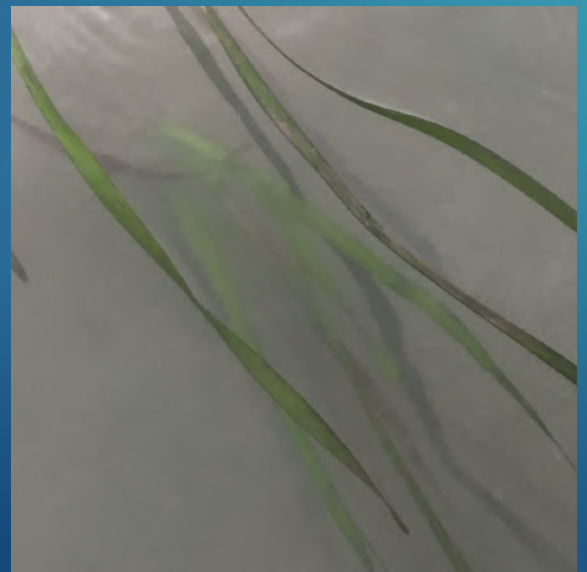
The Cargill "Salt Ponds"

Is It a Wetland or Not?

Wetlands Provide

- Habitat
- Flood control, erosion
- Water quality
- Carbon sequestration


Kaley
James
Stephanie
JULIE
Geana
Melissa
Margot



Today's Roadmap

- Duwamish River: historical and current concerns
- A little bit about me
- What about climate change? (Thank you Dr. Curtis Deutsch!)
- What would a greener future for the Duwamish Valley look like?

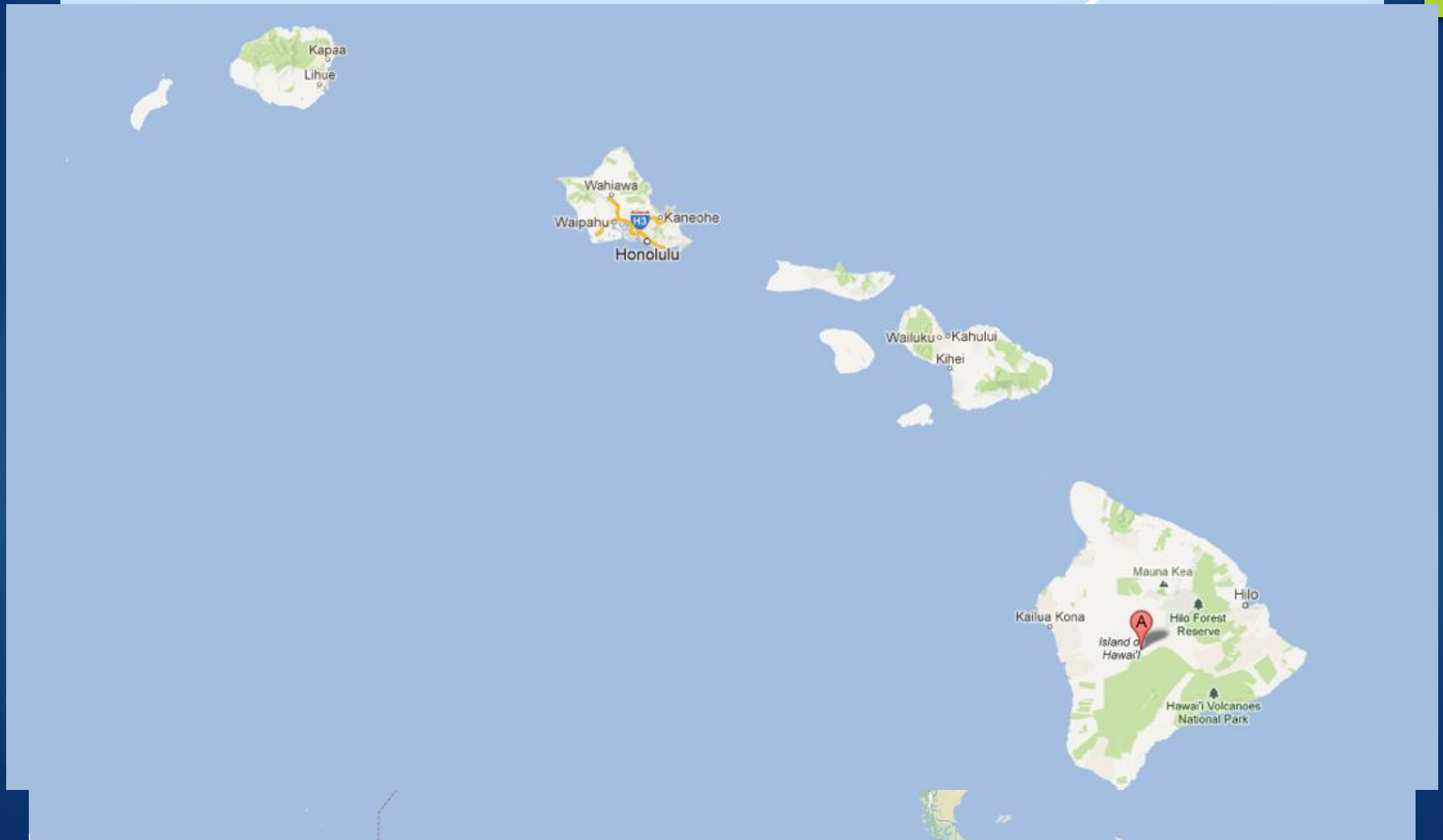
Estimating Global CO_2 sources

- Publications containing historical energy statistics make it possible to estimate fossil fuel CO_2 emissions back to 1751.
- The 1950 to present CO_2 emission estimates are derived primarily from energy statistics published by the United Nations (2012), using the methods of Marland and Rotty (1984). The energy statistics were compiled primarily from annual questionnaires distributed by the U.N. Statistical Office and supplemented by official national statistical publications.

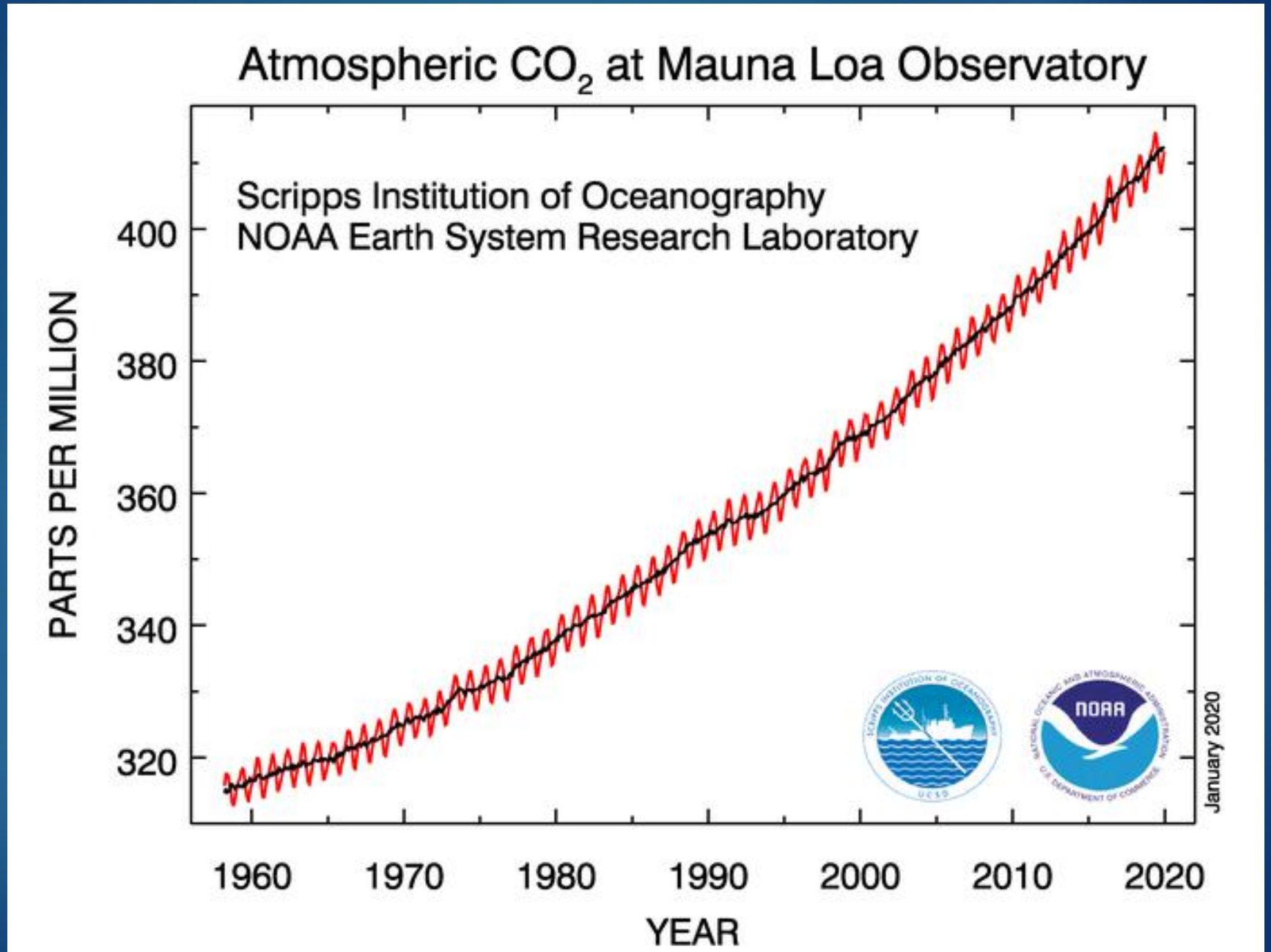
Bottom up estimates based on reporting by countries to the UN

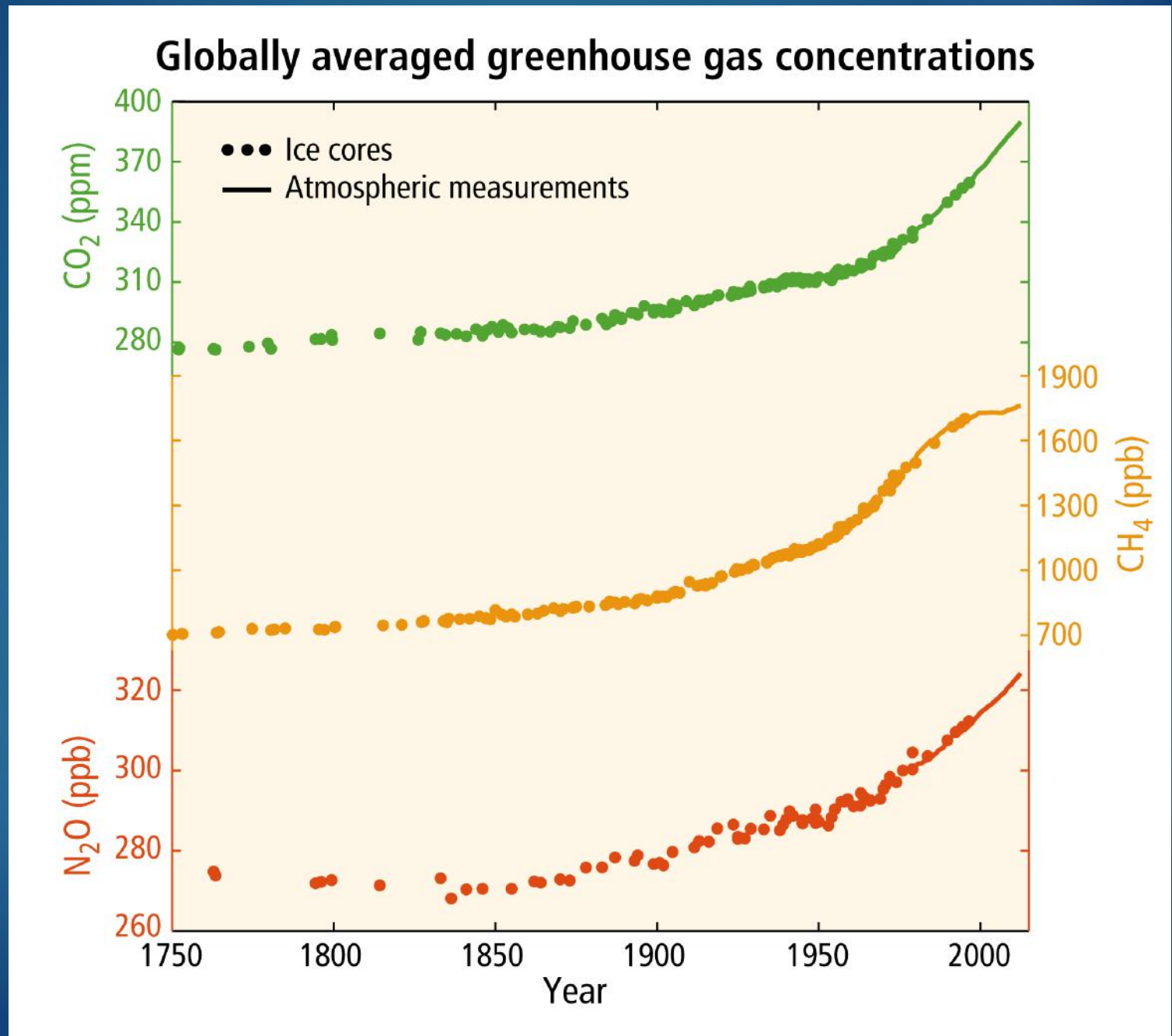
http://cdiac.ornl.gov/trends/emis/overview_2009.html

Atmospheric CO_2 measurements at Mauna Loa

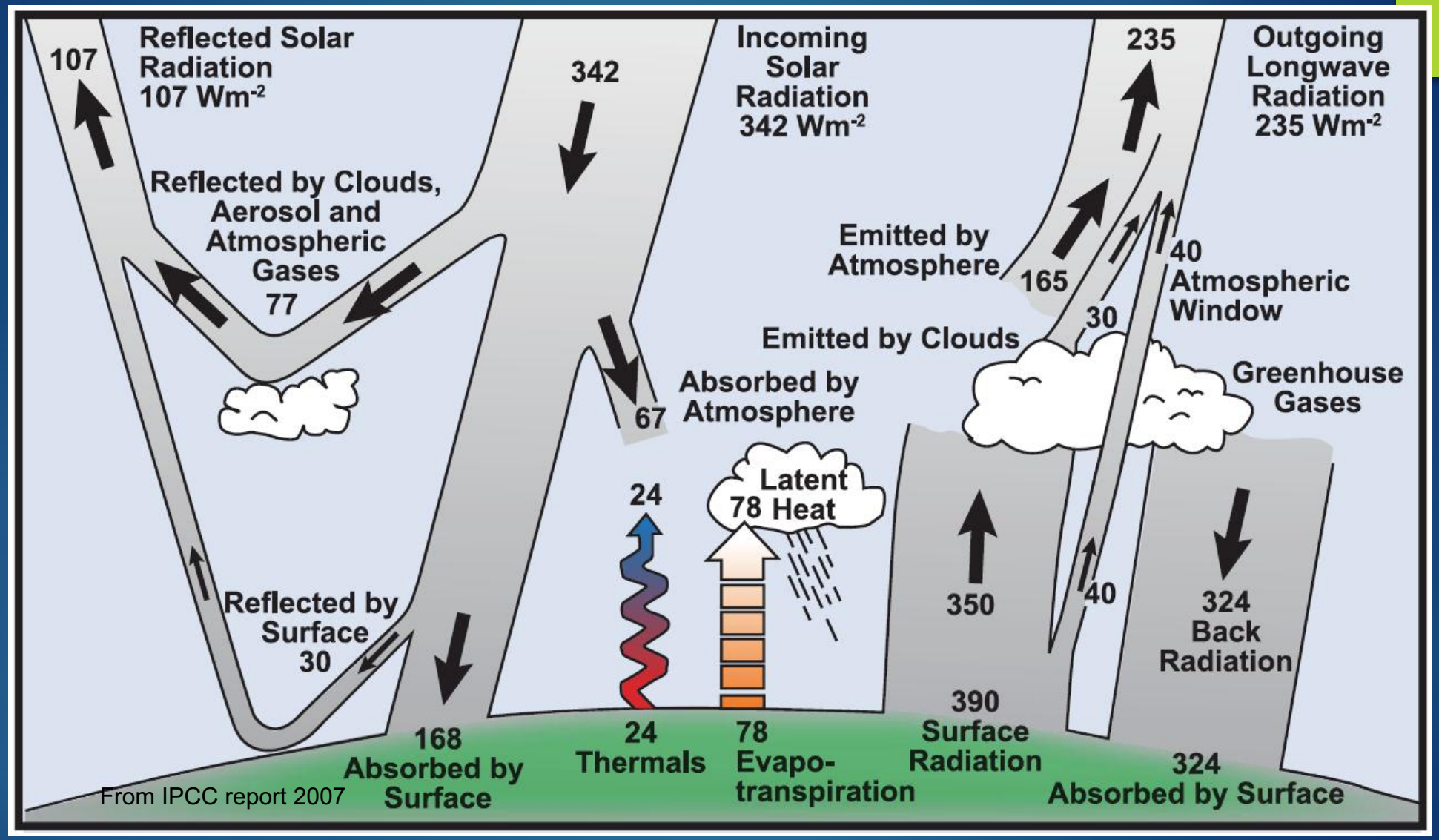


Atmospheric CO_2 measurements at Mauna Loa


Atmospheric CO_2 at Mauna Loa Observatory
Scripps Institution of Oceanography
NOAA Earth System Research Laboratory
PARTS PER MILLION
400
380
360
340
320
1960
1970
1980
1990
2000
2010
2020
YEAR
January 2020


Globally averaged greenhouse gas concentrations
Ice cores
Atmospheric measurements
CO_2 (ppm)
400
370
340
310
280
CH_4 (ppb)
1900
1600
1300
1000
700
N_2O (ppb)
320
300
280
260
1750
1800
1850
1900
1950
2000
Year

Annual and global mean energy balance



From IPCC report 2007

NO TIME TO WASTE.

The Intergovernmental Panel on Climate Change's Special Report on Global Warming of 1.5°C and Implications for Washington State.

CLIMATE IMPACTS GROUP
UNIVERSITY of WASHINGTON
An EarthLab Member Organization

2015

Temperature: ~2.7°C (4.8°F) warmer than pre-industrial
Snowpack: ~70% below normal (1970-1999 average)

FISHERIES

Low summer streamflow & warm waters resulted in fishery closures

>250,000 Columbia River sockeye salmon died

RECREATION

Low snowpack led to reductions in winter & summer recreation

42% shorter ski season at Stevens Pass

WILDFIRE

The most severe wildfire season in Washington's recorded history

>1,000,000 acres burned

>$253 million fire supression

AGRICULTURE

Warm temperatures & reduced water availability stressed WA agriculture

17 major crops with reduced yields

$633-733 million economic losses

River flooding

Costly stormwater management and

CLIMATE CHANGE IMPACTS

- Higher peak flows and more frequent flooding in fall and winter could adversely affect fish populations and challenge City Light's objectives for restoring and protecting fish habitat.

- Lower low flows in summer and warmer stream temperatures could adversely affect fish populations and challenge City Light's ability to meet objectives for restoring and protecting fish habitat.

Damage to coastal infrastructure and communities

Bluff erosion

What about the Duwamish Valley?

- Sea level rise
  - Rising river, changing shorelines
  - Rising groundwater
- Warming temperatures
  - Less hospitable waters for salmon
  - Greater health risk from poor air quality

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- Flood control, erosion
- Water quality
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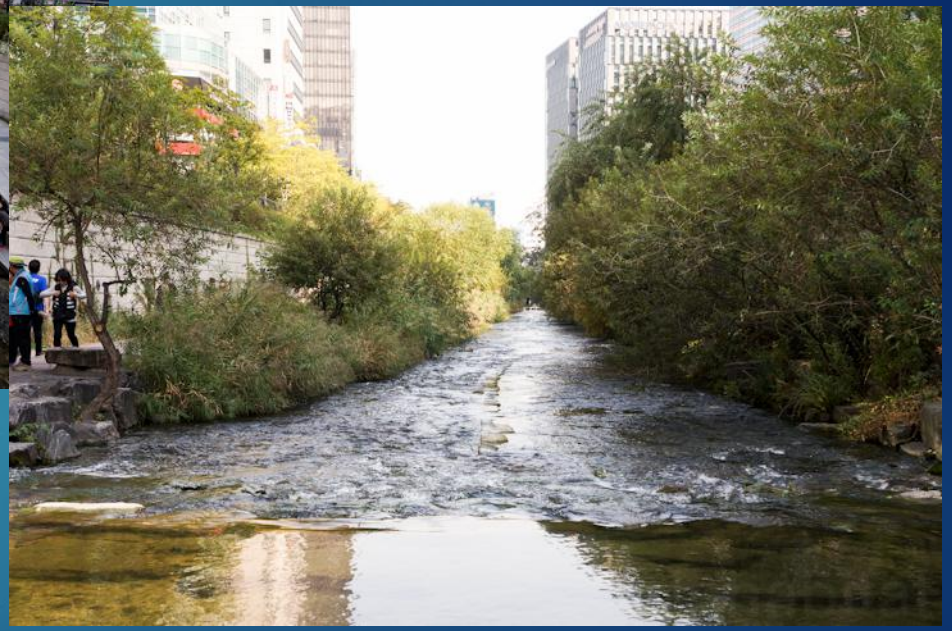
Restoration in an Urban Context

Restoration in an Urban Context



Novel Restoration in the Lower Duwamish River

SAMANTHA KLEIN, JAMES LEE, AND GEORGE THOMAS JR.

Constructed Floating Wetlands (CFWs)

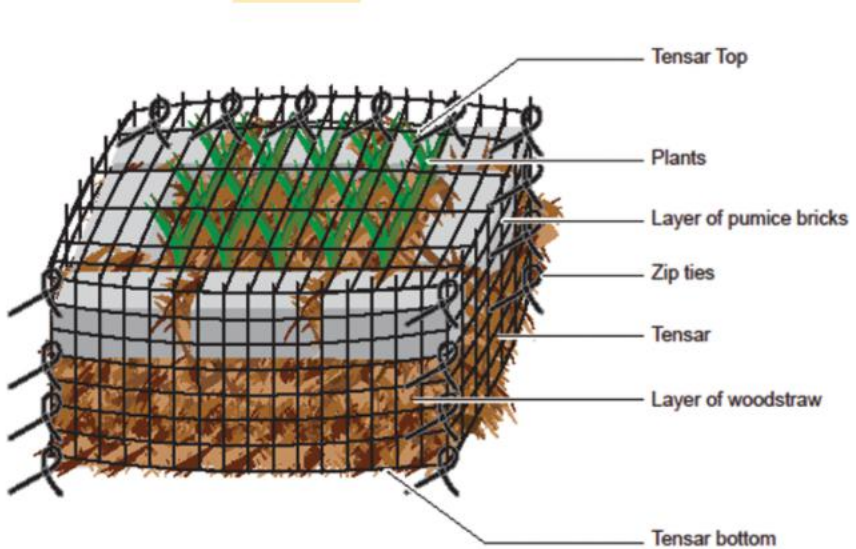
- Natural FWs exist
- FWs used in wastewater treatment
- Deployed in 2019 and again this summer
- Made with mostly natural materials
- Two sites

Duwamish Floating Wetlands Project

- Green Futures Lab, UW
- 2019 pilot project, 2020
  BioBarges + Biofilter 2.0s
- Provide habitat
- Produce invertebrates
- Improve water quality
- Uptake heavy metals

Wetland biofilter 1.0 design. Diagram courtesy of the Green Futures Lab.

Constructed Floating Wetlands (CFWs)



2020 Deployment and Monitoring

- Two sites:
  1) Waste Management
  2) Tukwila Dock
- March to August monitoring

Sam and George at BioBarge A during low tide.

The Lower Duwamish River with River Mile markers (Duwamish Blueprint).

Constructed Floating Wetlands (CFWs)

- Will juvenile salmon utilize this habitat?
- Are there concerns about predator fish?
- Will our wetland plants grow and flourish?
- Are there benefits to water quality?
- Are there more invertebrates?

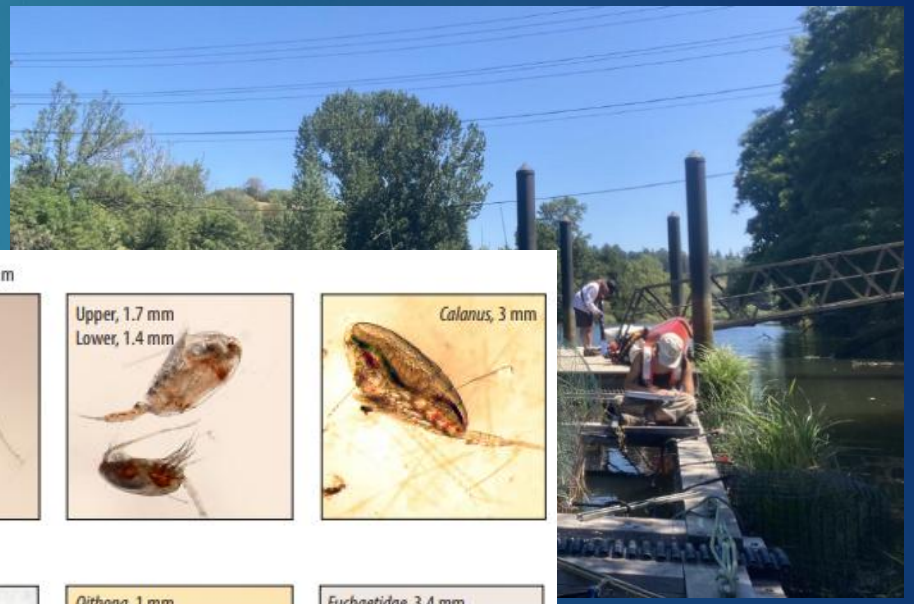
Constructed Floating Wetlands (CFWs)

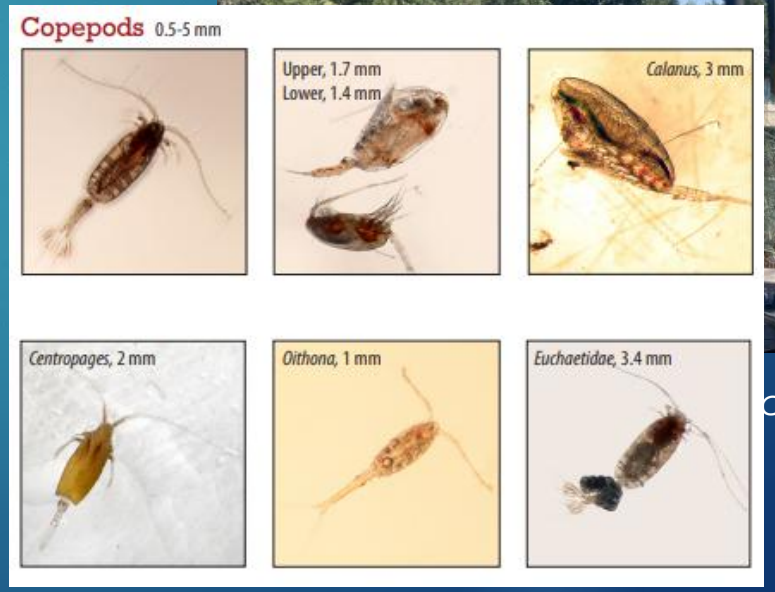
Constructed Floating Wetlands (CFWs)

Results

- **Fish usage:** Fish seen, no significant difference
- **Plant performance**: Placement determined success
- **Invertebrates:** Produced food for salmon
- **Water Quality:** Adequate conditions, heavy metals absorbed, river flow

GoPro capture of juvenile Chinook salmon swimming and feeding next to Biofilter 1.0 at BioBarge C Tukwila 6/26/2020





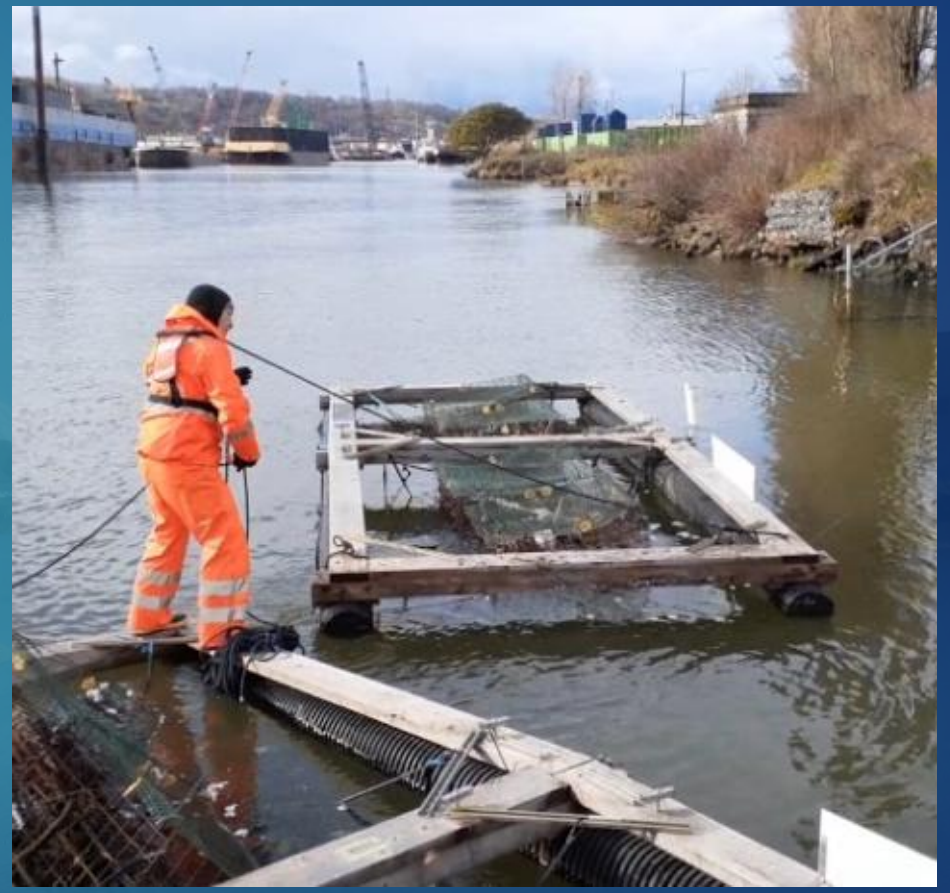
cting data at Tukwila

Policy Analysis

- Interviews with Key Informants
- Decision-Making Frameworks
- Policy Evaluation
- Ecosystem Restoration and Community Health
- Feasibility Analysis

Restoration Practitioner Perspectives

- **One environmental scientist**
  - King County
- **One community liaison**
  - 2020 floating wetlands project
- **Two representatives**
  - Duwamish River Cleanup Coalition (DRCC)



Deploying the floating wetlands at Waste Management.

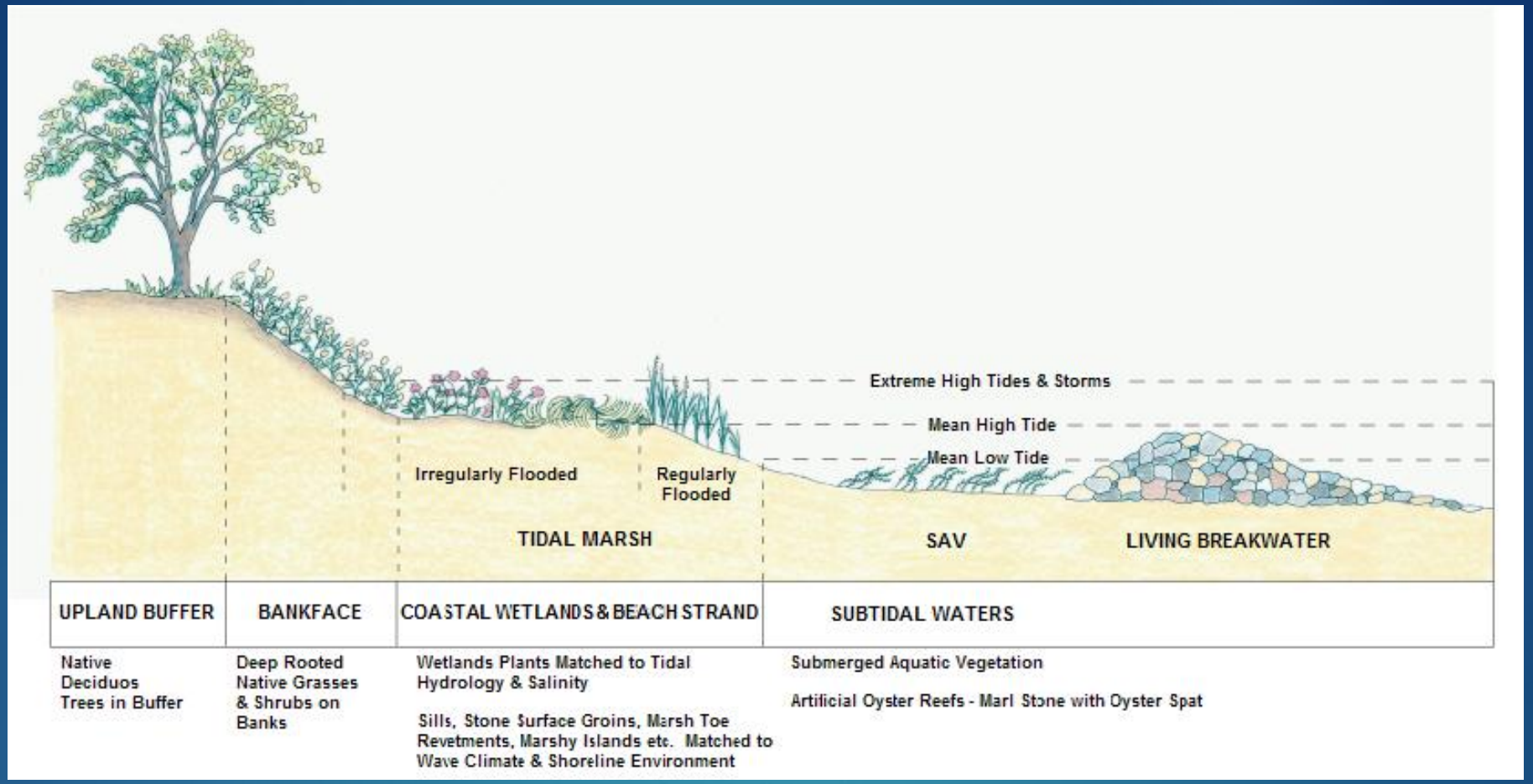
Living Shorelines vs. Novel Ecosystems

"[There's] regulatory support for [living shorelines] under the Clean Water Act and Nationwide Permit #54."

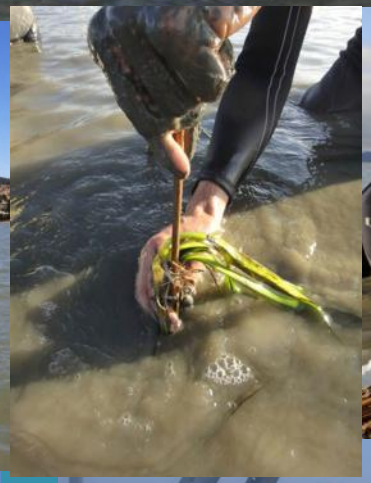
FOLLOW POLICY PRECEDENT

Lewes, Delaware Living Shoreline, Creative Commons License

Generalized Living Shorelines Concept (from the Boyer Lab)



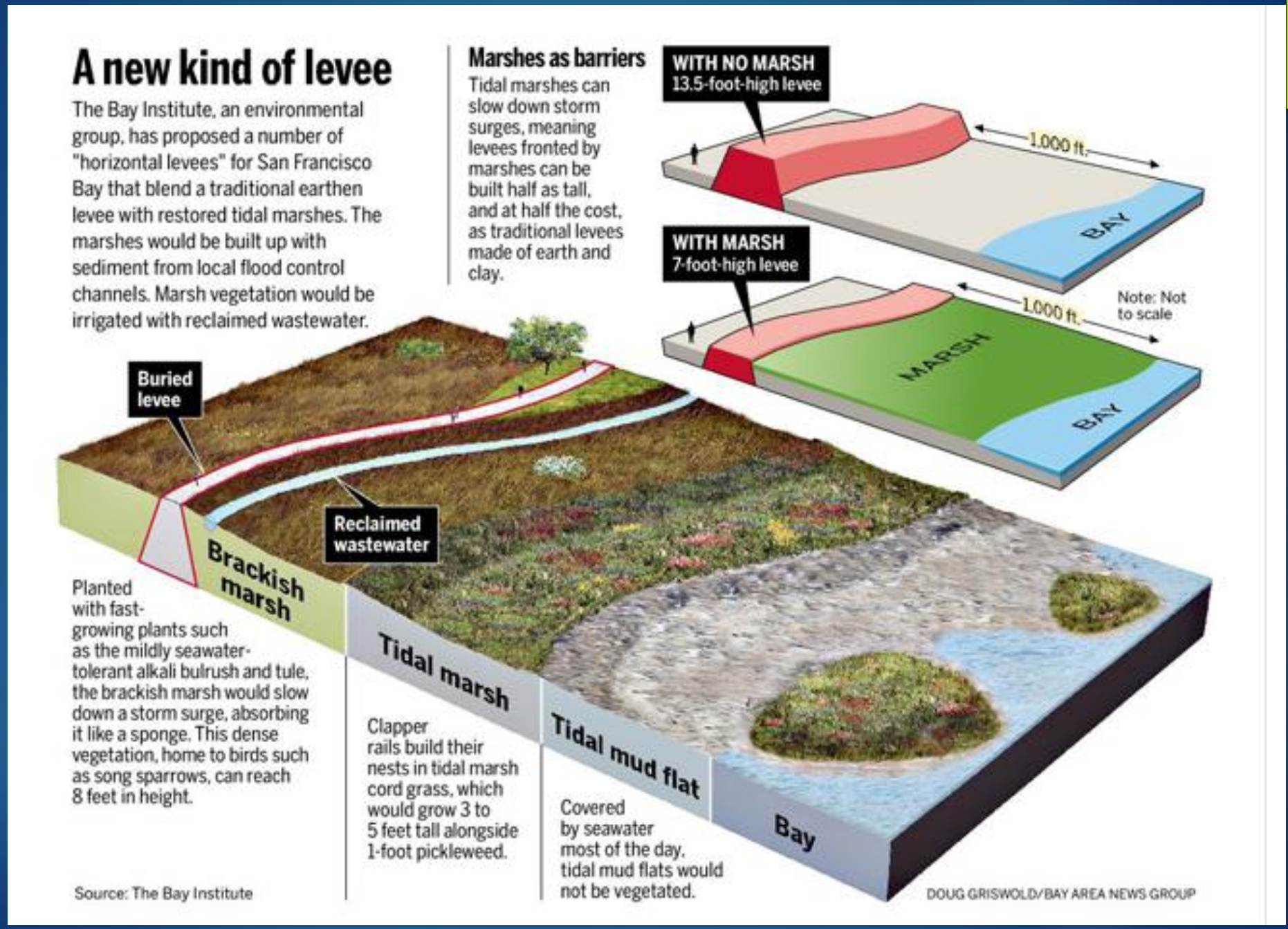
Construction



Construction Prep: Pacific Oyster Shell Bags

Photos by M. Latta

The "Horizontal Levee" concept (Spring 2013), by Peter Baye and ESA for the Bay Institute



Land-based Restoration vs. Floating Wetlands

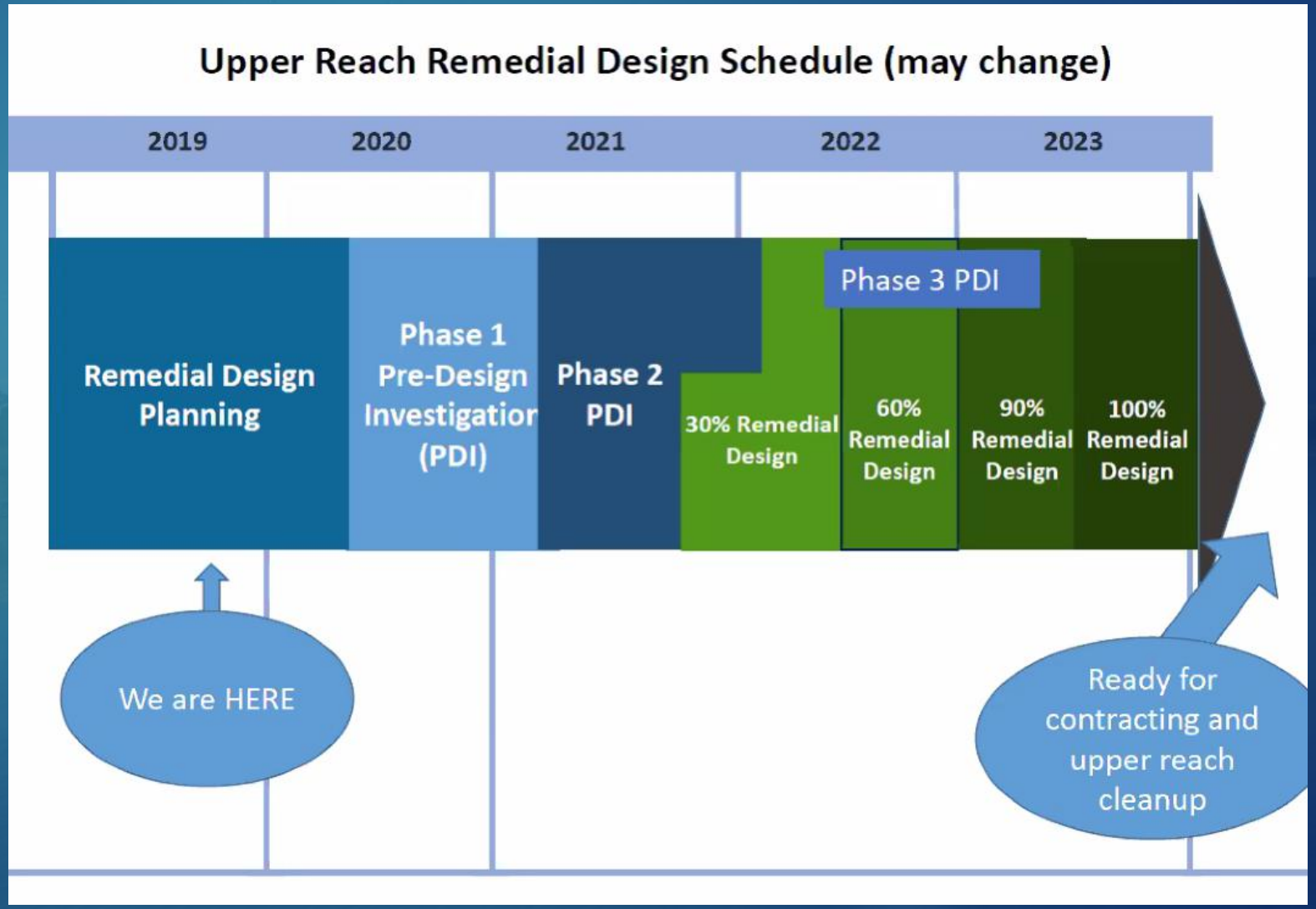
"The challenge with land-based restoration is that everything is contaminated, so every time you touch the soil it's considered a release of contaminants by Ecology."

RESTORATION IN A SUPERFUND AREA

"They spend five years doing studies instead of getting [restoration] done, and in the meantime they could have populated the whole bank with [floating wetlands] that provide ecosystem function."

NEED FOR SPEED

Land-based Restoration Takes Forever



Upper Reach Remedial Design Schedule. Diagram for the EPA Superfund clean-up program, from 2019. (Elly Hale, Duwamish Round Table)

Placement

"Having [structures] that can be seen matters. Access to the river is still an ongoing environmental justice issue. In creating [floating wetlands], we need to think about the whole picture."

VISIBILITY MATTERS

"In South Park, [at] Duwamish Waterway Park, maybe we can use that area. The water is calm. Also, there's new park construction. Place [floating wetlands] near the new rain garden."

DEPLOYMENT AT PARKS AND RESTORATION AREA

Community Benefits or Lack Thereof

"It's a good project because UW involved the community. It had a good methodology and was easy to understand... The [community's] skills improved—in Excel and in using the instruments."

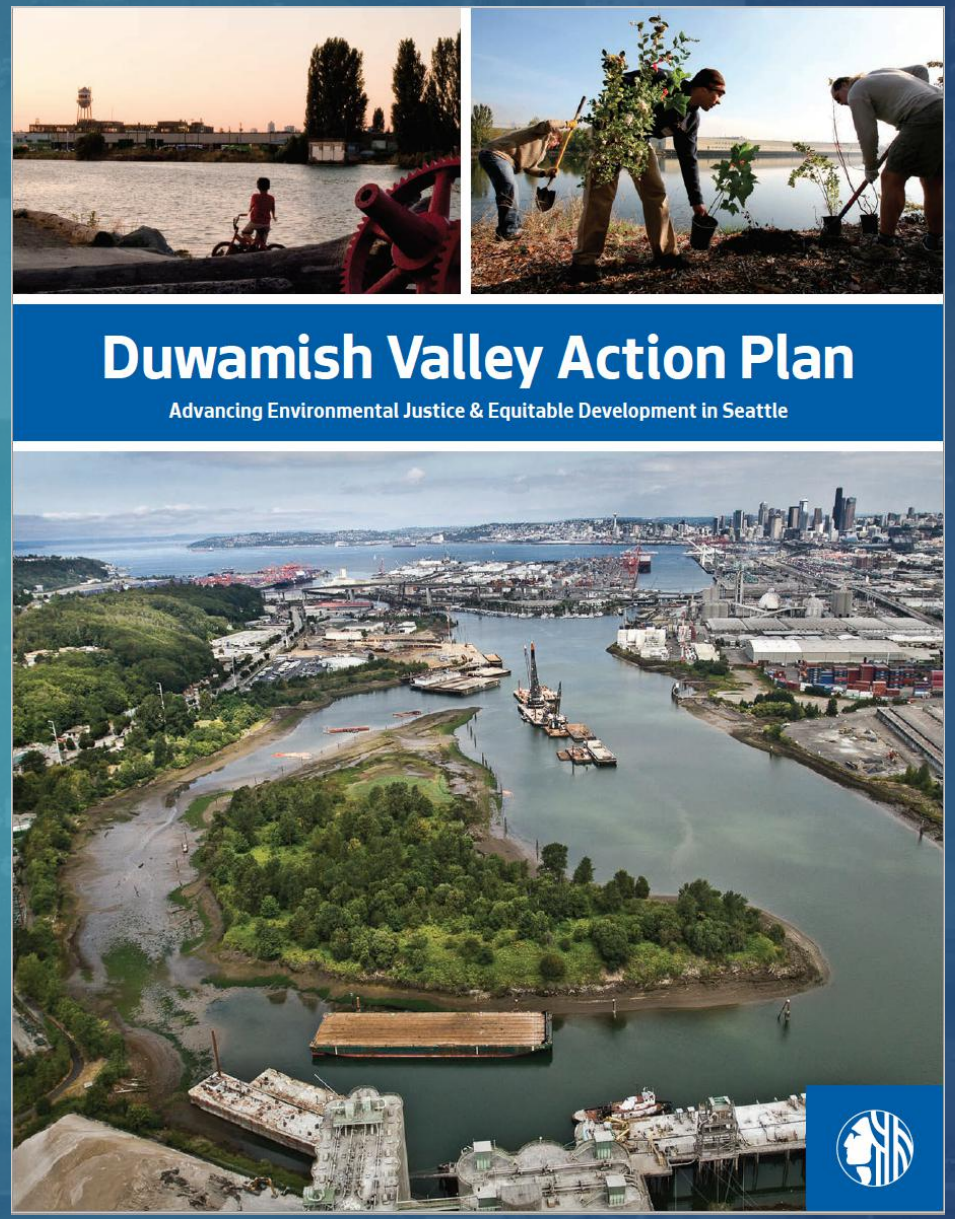
COMMUNITY SCIENCE

"How can we expect a floating wetland to improve someone's health?"

ENVIRONMENTAL JUSTICE AND HEALTH OUTCOMES

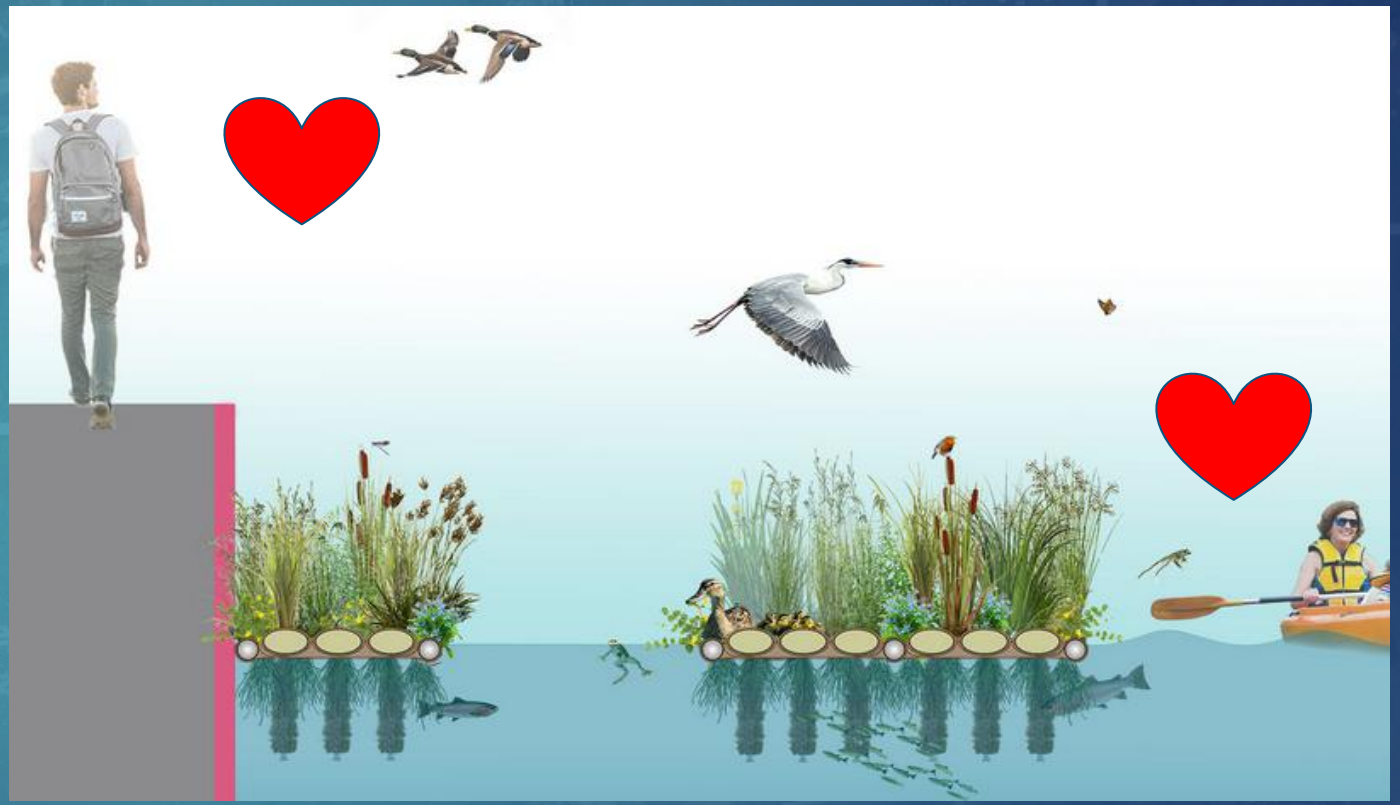
Policy Evaluation

- Duwamish Valley Action Plan (City of Seattle, 2018)



Policy Recommendations - Ecosystem Restoration

- Deploy in targeted locations
- Tangible community benefits
- Update policies for deployment



biomatrixwater.com

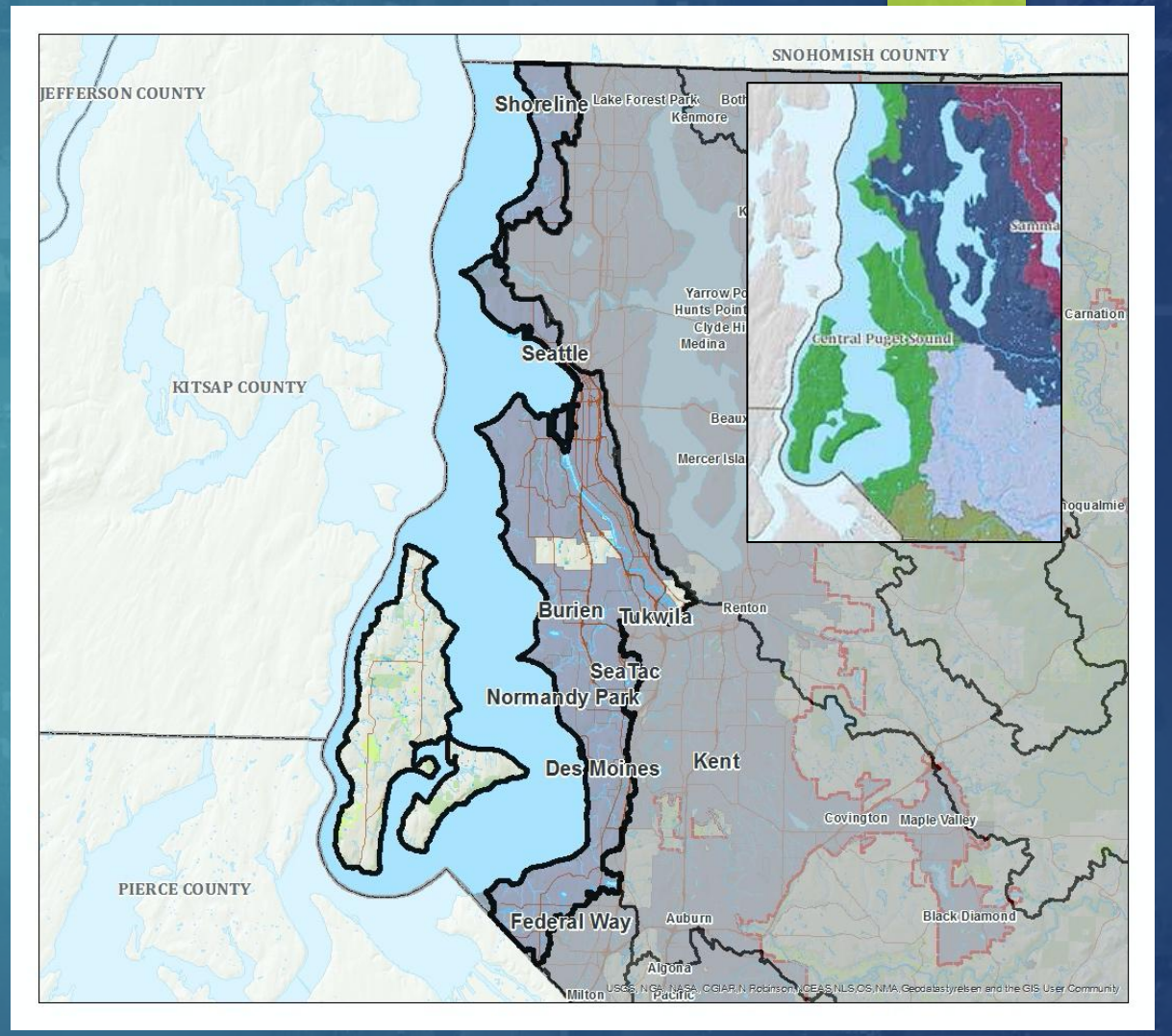
Policy Recommendations - Community Health

- Address community health first
- Low resources constrain action
- Recommendation: payroll tax

Duwamish Valley Program Community Meeting (Tom Reese, Duwamish Valley Action Plan)

Feasibility Analysis

- **Policy 1: Expand the King County Mitigation Reserves Program (MRP)**
  - King County, Army Corps, Ecology
  - Revise in-lieu fee instrument
  - Include floating wetlands in mitigation



Central Puget Sound MRP Service Area (King County)

Feasibility Analysis

- **Policy 2: Reintroduce and pass an amended WA House Bill 2948**
  - King County payroll tax
  - Reintroduce with two amendments:
    - No preemption clause
    - Raise rate by 0.1%

Duwamish Valley Youth Corps students discuss asthma and other health risks from pollution. (Office of Governor Inslee, Creative Commons License)

Conclusions

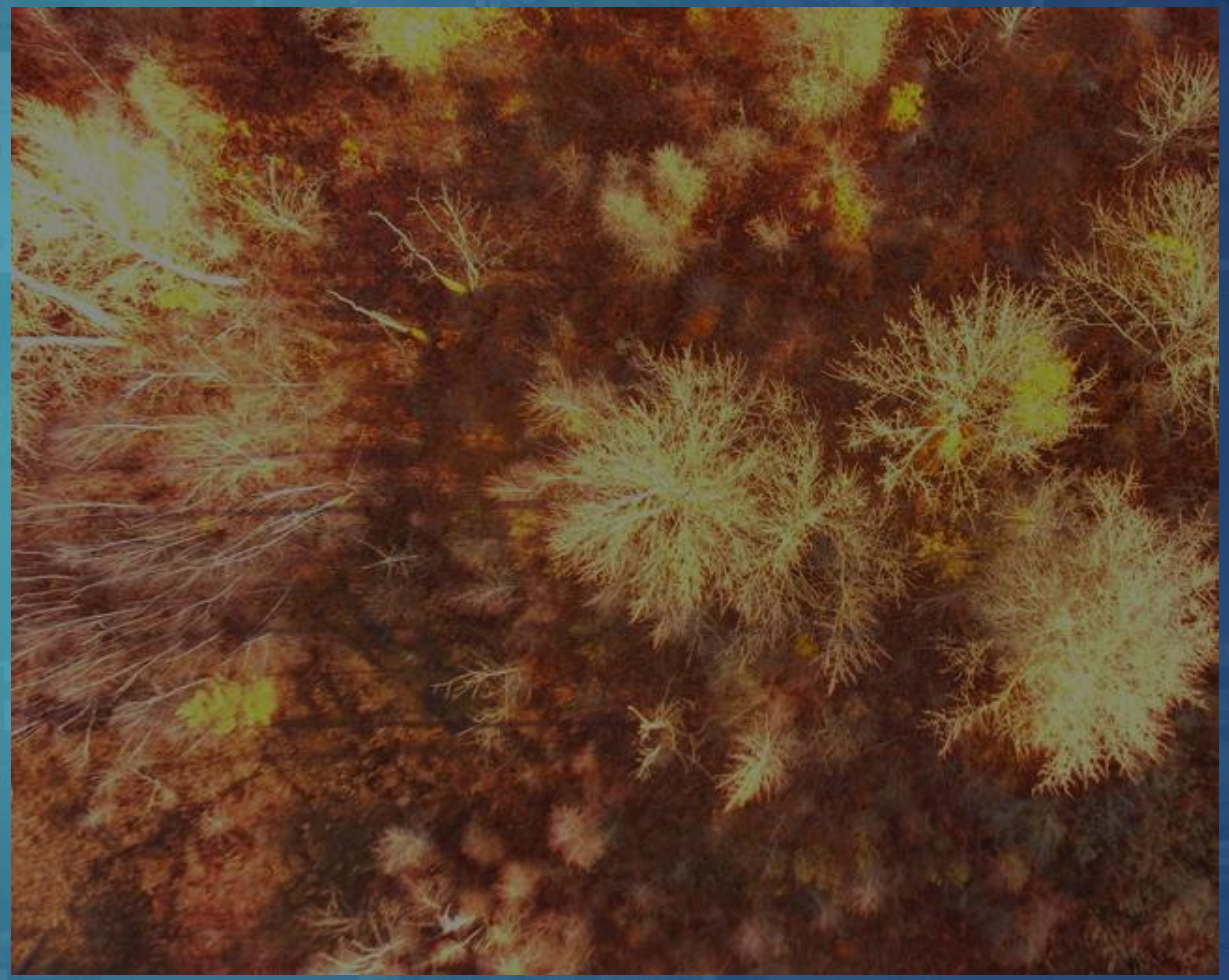
- Community involvement is key
- Commit to the challenge
- Return wealth and power
- Join the growing momentum

Duwamish Valley Program Community Meeting (Tom Reese, Duwamish Valley Action Plan)

Next Steps

Urban@UW Spark Grant:

- Trail restoration (Duwamish Tribal Services)
- Research Coordination Network
- Community science event



Drone image of the Puget Creek Watershed in the Duwamish River Valley. (Credit: Melanie Malone and Catherine De Almeida)

Simple, But Effective

Suaeda climbing oaks (above) and a fence (below) in Morro Bay

Photos by Peter Baye

Sarcorcornia climbing a fence

Acknowledgments

- Duwamish, Muckleshoot, and Suquamish Tribes
- Community scientists and key informants – thank you!
- Green Futures Lab (P.I. Nancy Rottle, project managers Leann Andrews and Emma Petersen, community science coordinator Ashley Mocorro Powell, graduate student Jenn Engelke)
- Russell Beard (Duwamish Tribal Services)
- Sam Klein, George Thomas Jr., Daniel Roberts (School of Marine and Environmental Affairs)
- Drs. Cleo Woelfle-Erskine, Dave Fluharty (School of Marine and Environmental Affairs) and FRESH Lab colleagues
- Dr. Kathy Boyer (San Francisco State University)
- King County and the Rose Foundation
- All human and more-than-human communities in the Duwamish Valley

GREEN FUTURES RESEARCH + DESIGN LAB

SCHOOL OF Marine & Environmental Affairs
College of the Environment • University of Washington

King County

ROSE FOUNDATION for COMMUNITIES and the ENVIRONMENT