

# Climate Change and Cleanup

A vulnerability assessment and adaptation strategy

# Who are we? Toxics Cleanup Program (TCP)



Chance Asher, Ecology



Hugo Froyland, Ecology



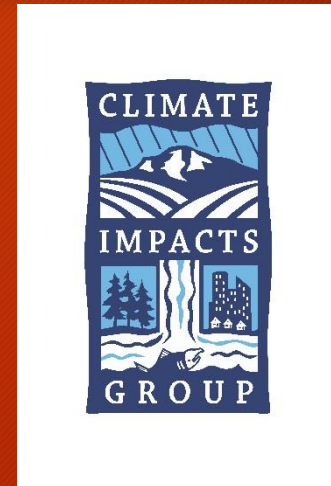
Scott O'Dowd, Ecology



Teresa Michelson, Farallon



# Who are we thankful for?



Individuals:  
Mike Ehlebracht, Hart Crowser  
Kelly Klima, RAND Corporation  
Ian Miller, Sea Grant

# The Adaptation Guidance

## Purpose

1. To survey data and evaluate the potential for climate change impacts to threaten cleanup sites.  
How? A summary of climate science and impacts to NW.
2. To provide site managers and planners with tools to evaluate the potential impacts to specific sites.  
How? A set of GIS tools collect existing data in one place with site data.
3. To provide actions that site managers may apply to the existing cleanup framework.  
How? Risk scenarios for different site types and factors to consider during each phase of cleanup.



# Cleanup as infrastructure

Cleanup is “hidden” infrastructure



VS.





# Goals of cleanup infrastructure





# Cleanup Economics

- Cleanup costs money, BUT ALSO!!
- Cleanup generates/protects money (a.k.a. economic activity)!





# Cleanup infrastructure is vulnerable to extreme weather

San Jacinto River Waste Pits Superfund Site—Houston, TX



After Hurricane  
Harvey

Eric Thayer, New York Times

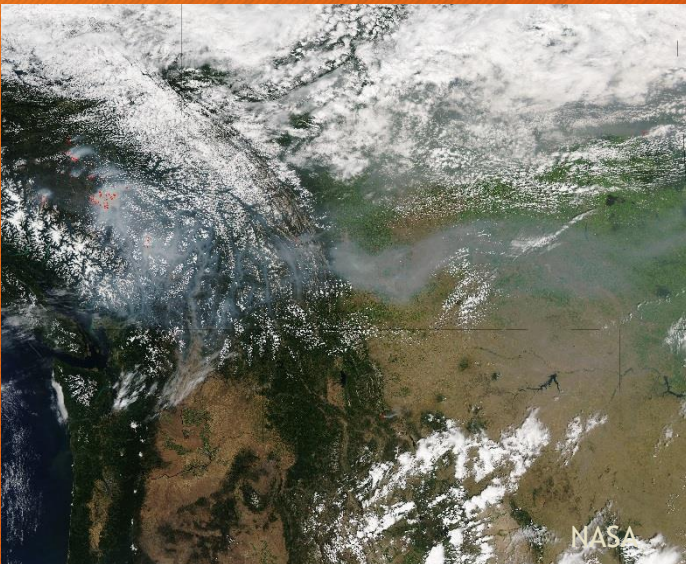


# The Upshot: Why we wrote this

- Adapting cleanup projects to the impacts of climate change has not received as much attention in the literature as other types of infrastructure have.
- What this guidance aims to build upon:
  - Remedy's health- and environmental-protectiveness,
  - Permanence of remedies, and
  - Long-term economics of remediation in a changing environment.

# Understanding the threats

## Four Major Impacts



Aerial of British  
Columbian smoke from  
2017 wildfire



View of Oso  
landslide



Washaway Beach,  
Washington



Extreme storms



# Wildfire



## Harms

- Direct damage of equipment and infrastructure
- Destructive contouring of surface
- Increased potential for erosion, debris flow, and sedimentation
- Potential to restrict site access during widespread fires

## Climate Change Tie

- Changes to precipitation and snowpack affecting water distribution
- Shifts in vegetation that could change existing fire regime



# Geomorphic Change—Landslide and Erosion



## Harms

- Direct damage to equipment and infrastructure
- Destructive contouring of surface and subsurface environments
- Direct spread of contaminated material
- Introduction of new pathways for contamination to spread

## Climate Change Tie

- Coastal landforms impacts by sea level rise and extreme weather
- Link between timing and type of precipitation with landslide triggers



Photo of Port Angeles Landfill  
Accelerated Geotechnical Investigation  
and Design, Aspect Consulting



# Sea level rise and storm surge



## Harms

- Direct damage to equipment infrastructure
- Changes to chemistry and geophysics
- Increased engineering needs for periodic or complete inundation
- Spread of contaminated material

## Climate Change Tie

- Warmer temperatures leading to sea level rise
- Increased potential for extreme weather events



# Inland flooding (Storms & Change in Precipitation Patterns/Form)



## Harms

- Direct damage to equipment and infrastructure
- Changes to site geophysics
- Spread of contaminated materials

## Climate change tie

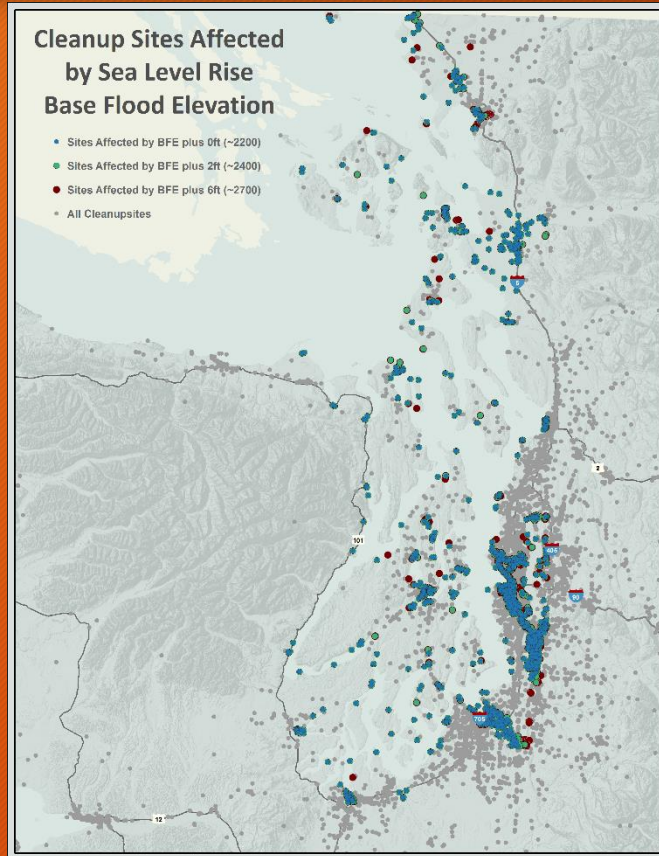
- Increased potential for extreme weather events
- Changes to snow pack and glacial storage of precipitation
- Non-extreme changes to weather patterns



Bridge in Ferry County that washed out during the April 2017 storms. Ferry County Sherriff's office.

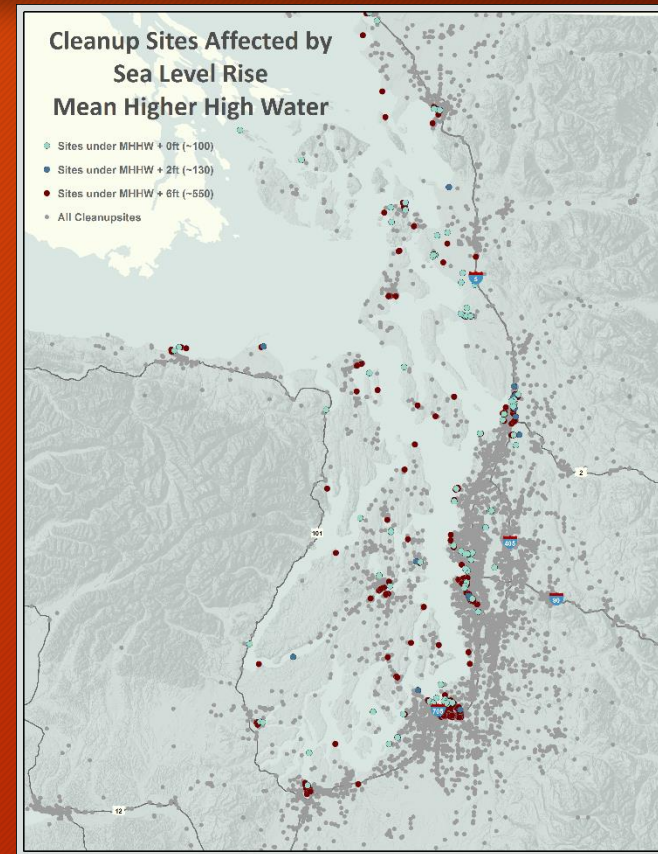


# Visualizing the threat—Sea Level Rise



100-Year Storm Risk

Puget Sound



Tidal Risk

# Planning for uncertainty: A Framework



**RISK = HAZARD x EXPOSURE**

Toxicology Education Foundation



# Adapting investigations, plans, and designs

## Adaptive Management

Planning and design that includes additional options if contingencies occur during cleanup.

A non-cleanup example: Seattle's Elliot Bay Seawall includes features that will allow modification in the future if conditions require more protection.



# Questions or Comments?

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