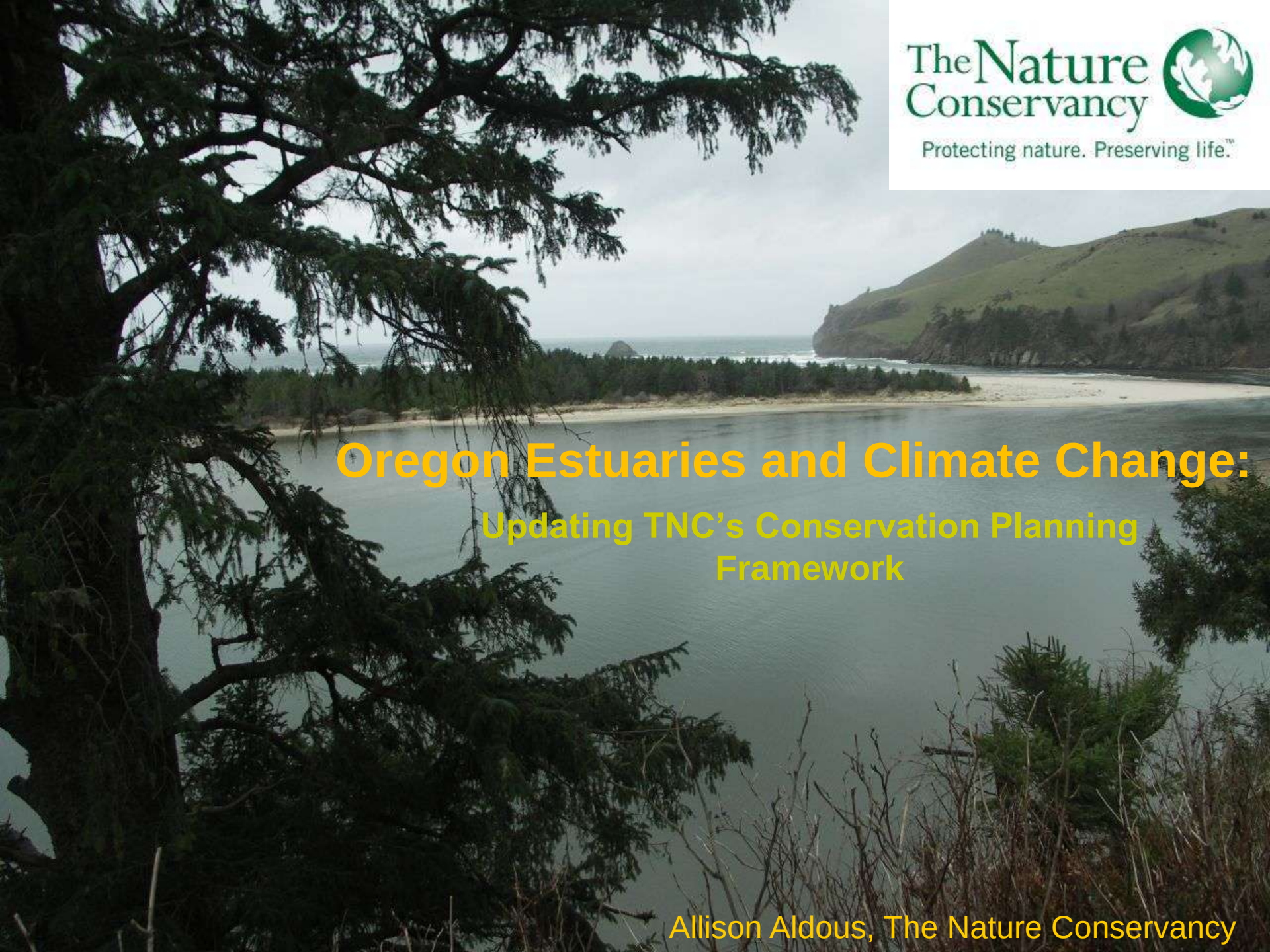


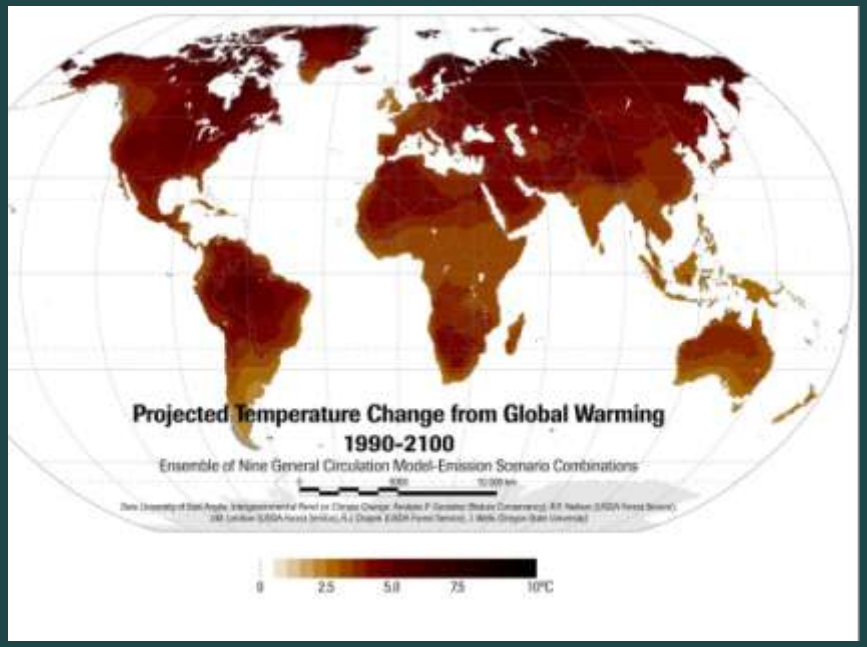
The Nature Conservancy
Protecting nature. Preserving life.™

# Oregon Estuaries and Climate Change:

## Updating TNC's Conservation Planning Framework

Allison Aldous, The Nature Conservancy

# Climate models

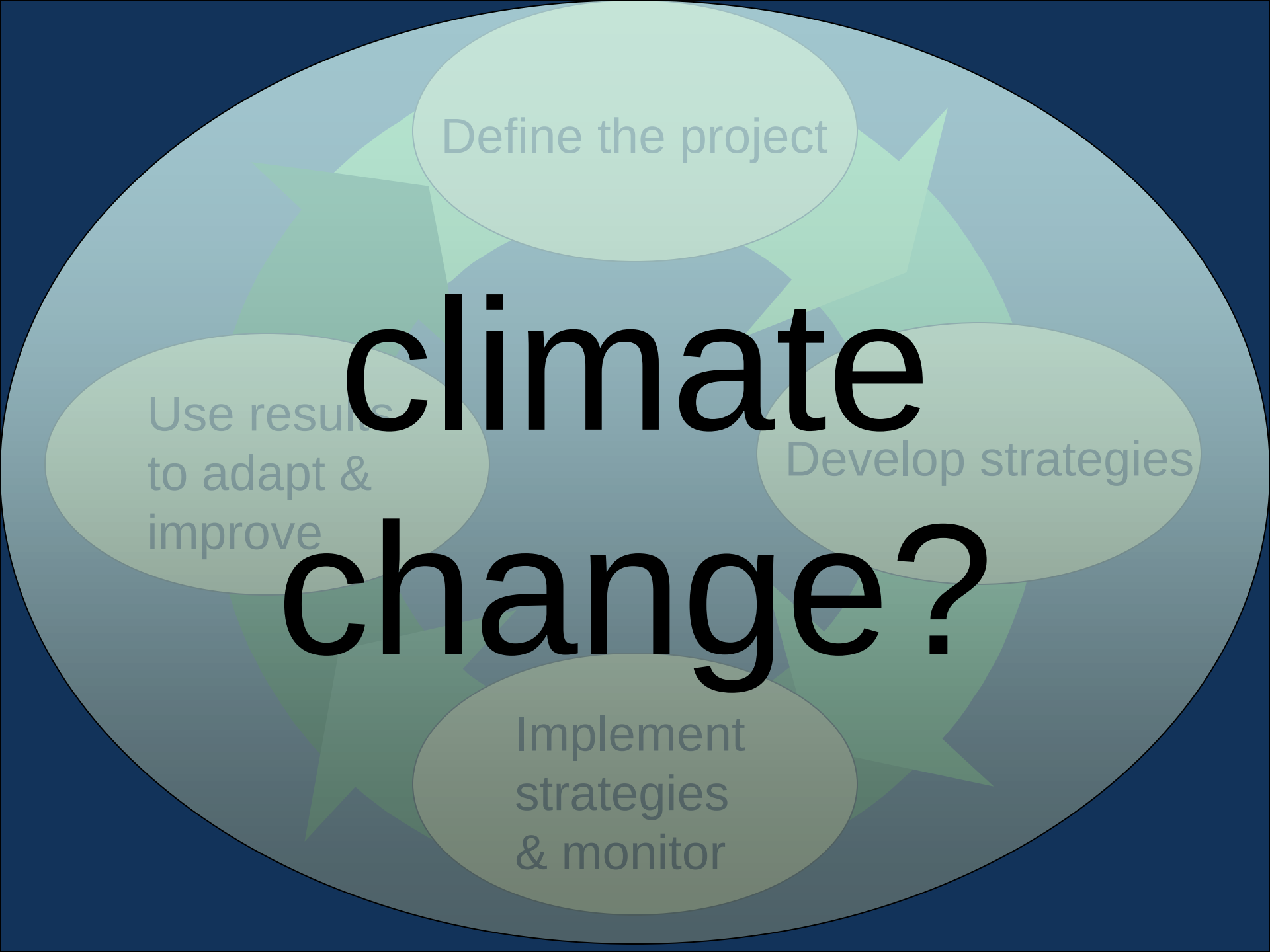


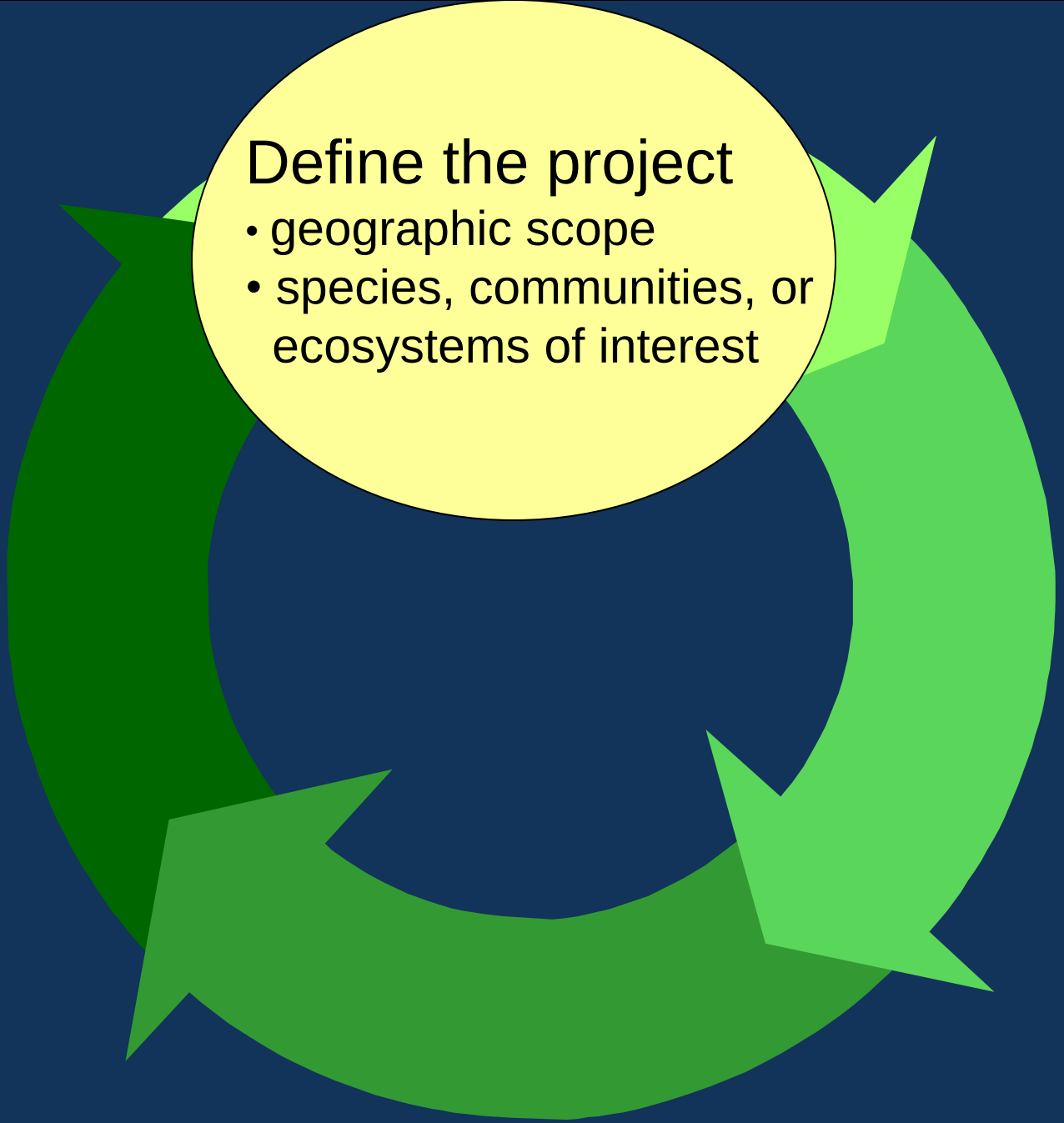

spatial scale

uncertainty

annual averages

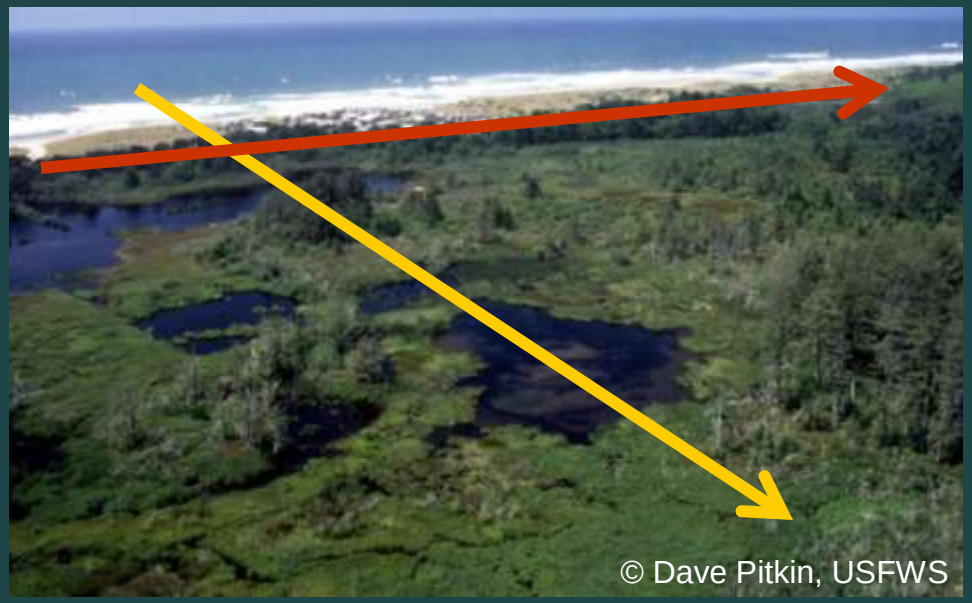
complex responses


Define the project
Develop strategies
Implement strategies & monitor
Use results to adapt & improve
climate change?


Define the project
• geographic scope
• species, communities, or ecosystems of interest

# Project scope: shifting distributions

- How is the species or ecosystem likely to shift in response to climate change?
- Where is it in relation to its potential future distribution?
- How well connected is suitable habitat across the landscape?




- How does the degree of connectivity compare to the species' dispersal capabilities?


Develop strategies
Key Ecological Attributes
Threats
Objectives
Actions

# Key ecological attributes

- Critical component of estuary's physical or biological processes, composition, structure, or key species' life history
- Determines species' or ecosystems' temporal and spatial distribution
- Quantified by a measurable indicator

Varies within an "acceptable range of variation"

# TNC – Oregon Estuary Assessment

- Objective: simplify estuary conservation planning
- Extensive literature review and peer review
- Included all estuaries *except Columbia*
- Head of tide to tips of jetties
- Does not include sociopolitical aspects

The Coastal Connection: Assessing Oregon Estuaries for Conservation Planning (Aldous et al. 2008)

# Key ecological attributes for Oregon estuaries

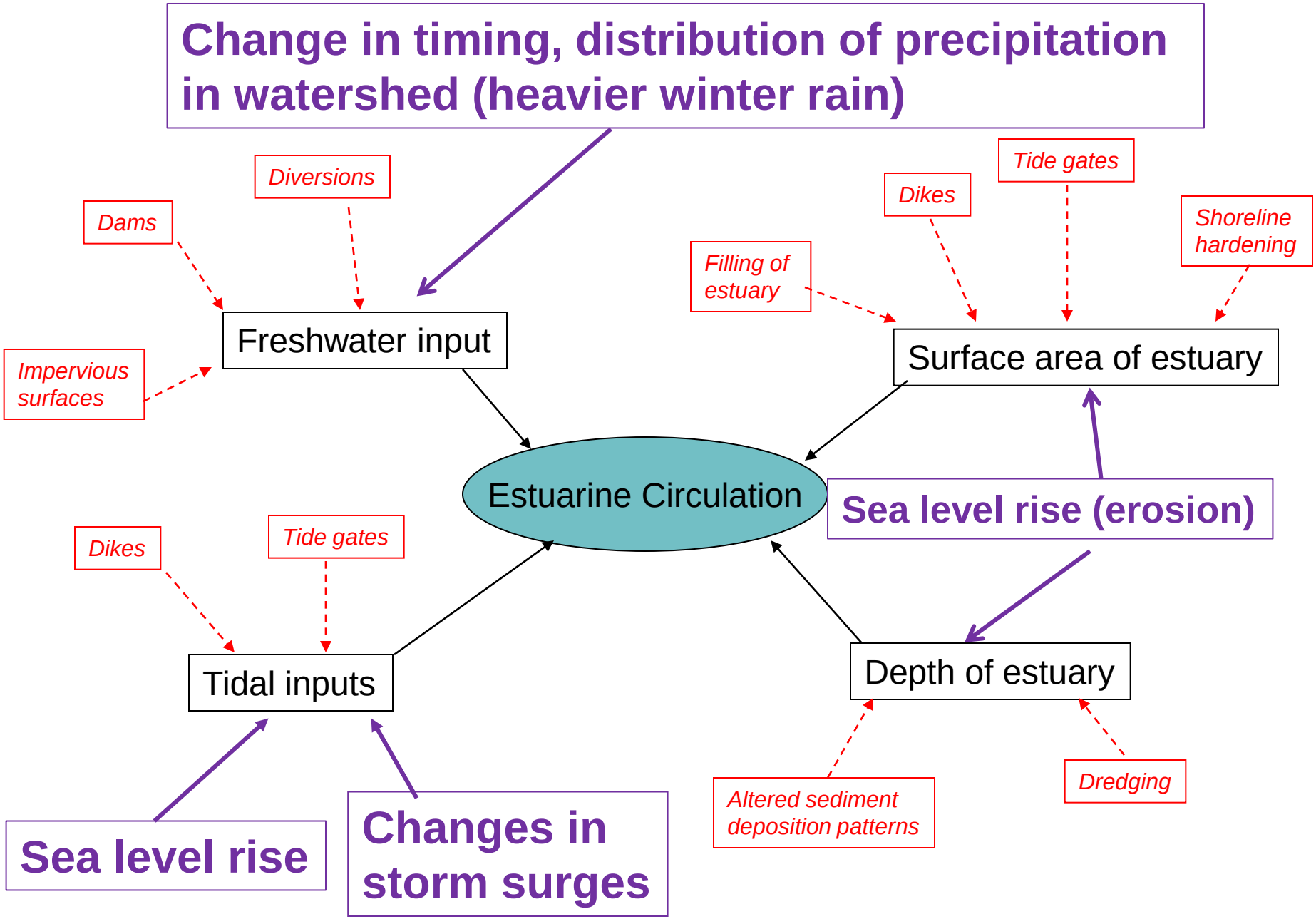
- Sedimentation
- Water flows / hydrology
- Water quality
- Habitat extent and distribution

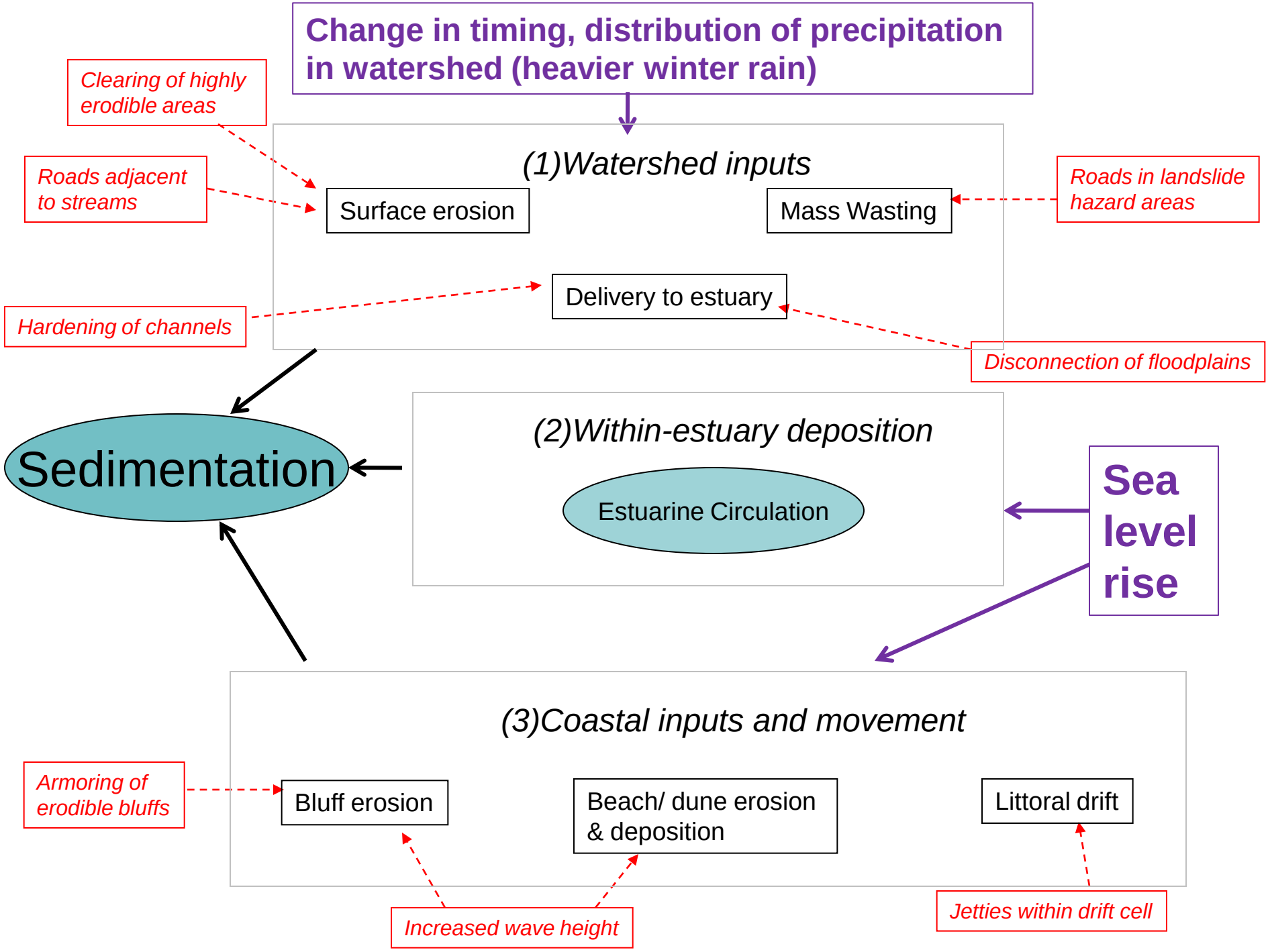
from Aldous et al. 2008

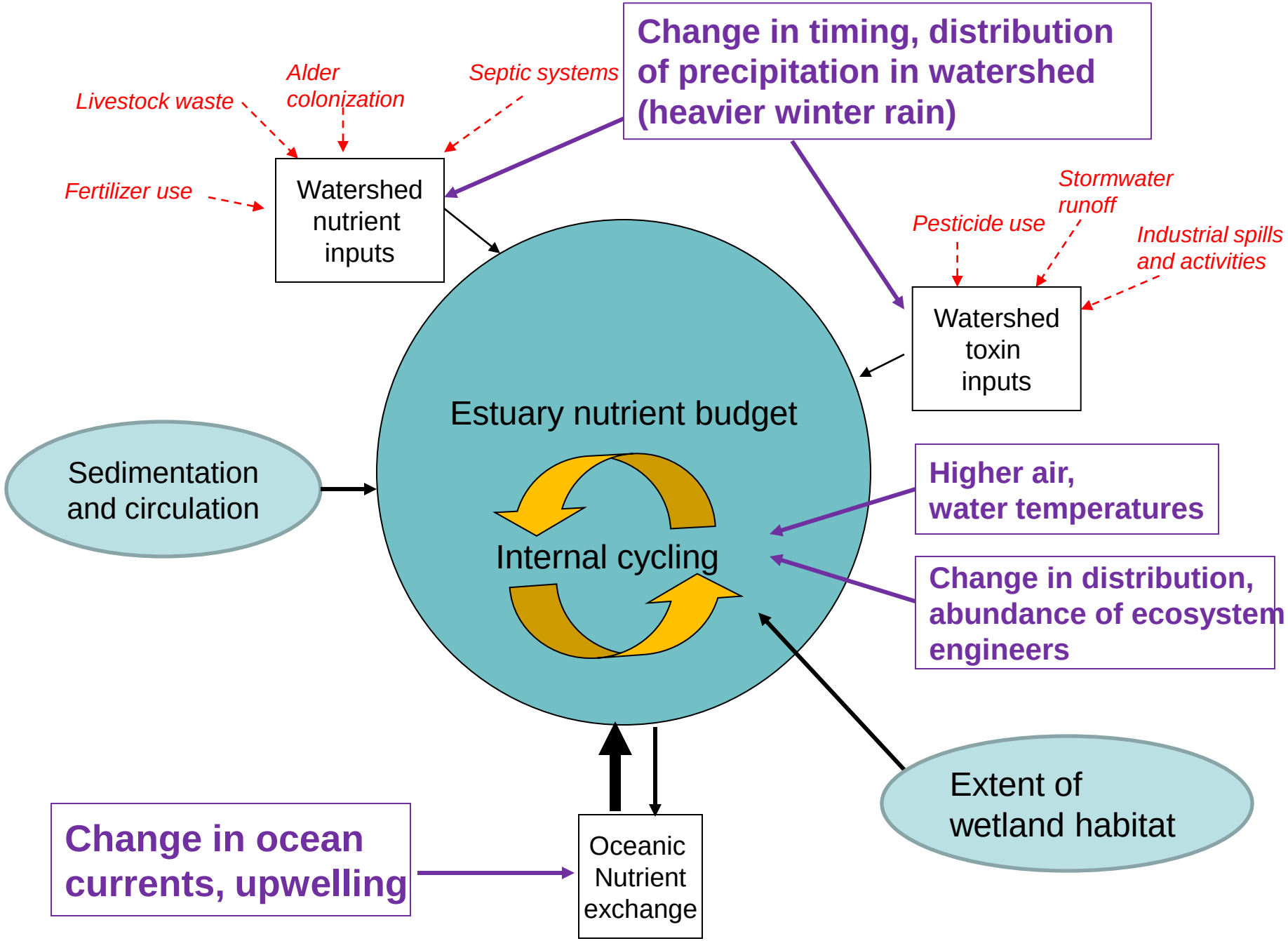
# Key Ecological Attributes and Threats

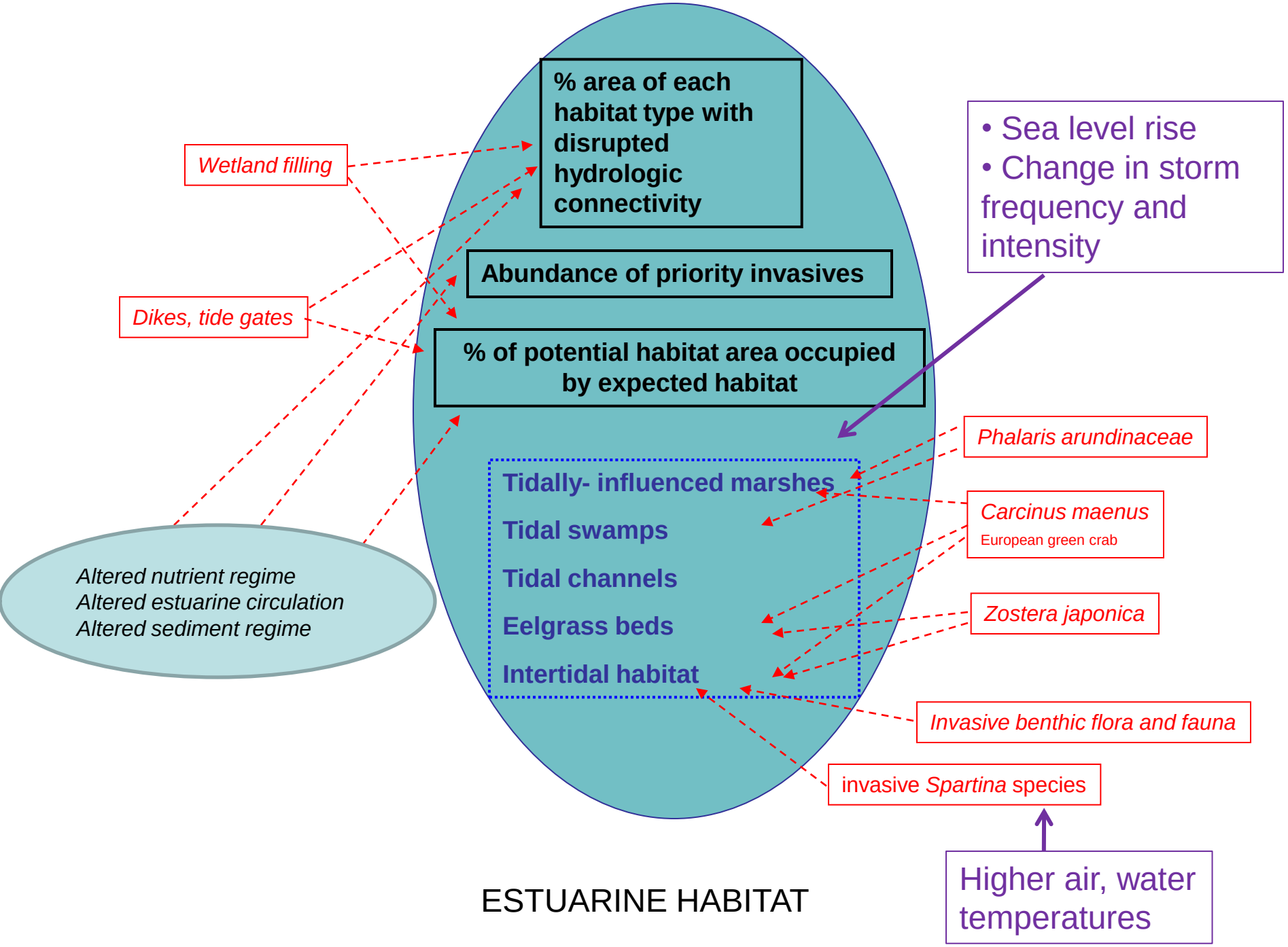
1. What are the expected impacts of climate change to each key ecological attribute?
2. Will these impacts produce any novel threats to the ecosystem?
3. How will climate change threats exacerbate existing threats?

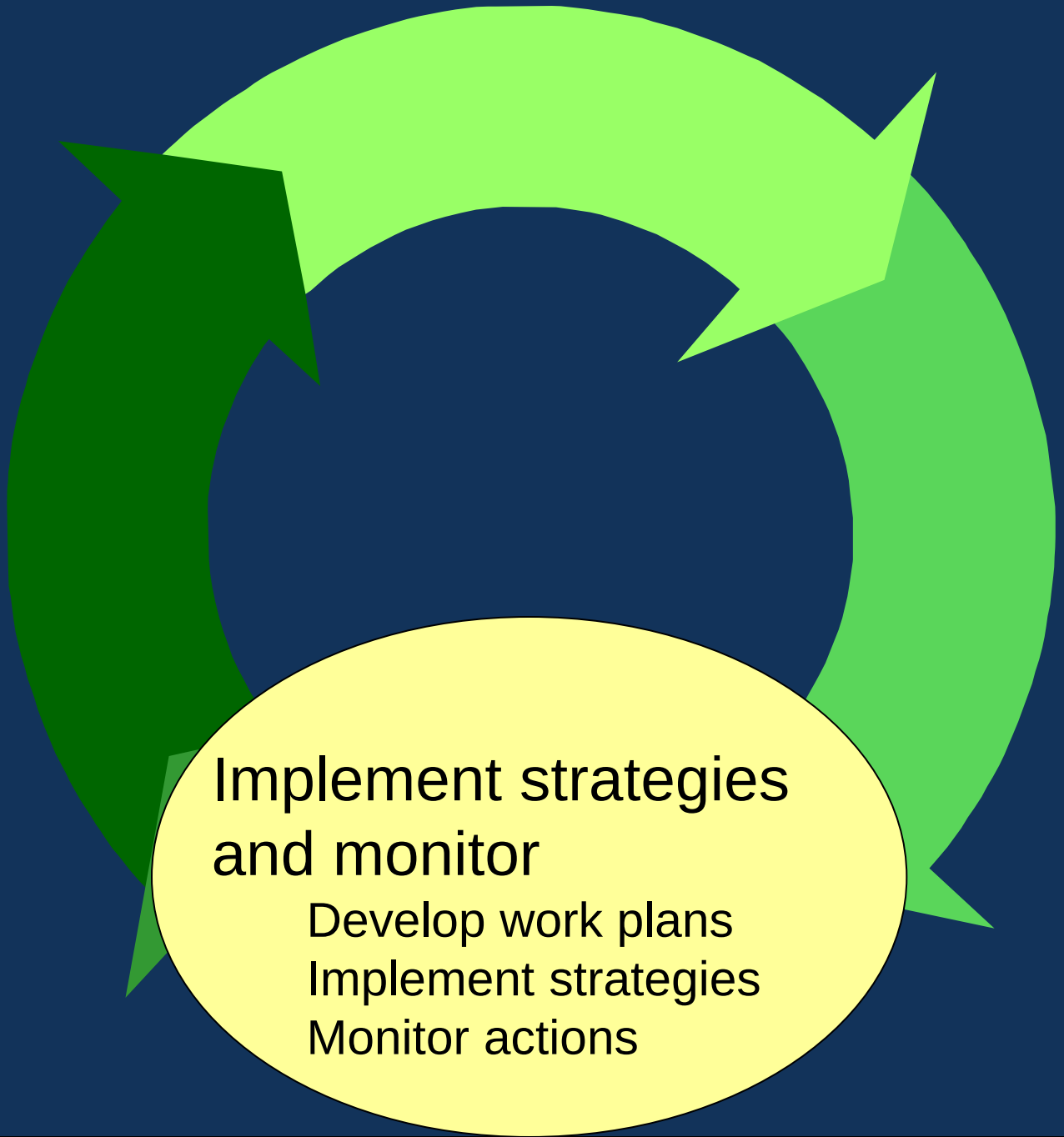
- ✓ Focus on climate change impacts with relatively low uncertainty
- ✓ Be cautious using historic ranges of variation to project future distributions


Change in timing, distribution of precipitation in watershed (heavier winter rain)
Diversions
Dams
Tide gates
Dikes
Shoreline hardening
Filling of estuary
Freshwater input
Surface area of estuary
Impervious surfaces
Estuarine Circulation
Sea level rise (erosion)
Dikes
Tide gates
Tidal inputs
Depth of estuary
Sea level rise
Changes in storm surges
Altered sediment deposition patterns
Dredging


Change in timing, distribution of precipitation in watershed (heavier winter rain)
Clearing of highly erodible areas
Roads adjacent to streams
(1)Watershed inputs
Surface erosion
Mass Wasting
Roads in landslide hazard areas
Delivery to estuary
Hardening of channels
Disconnection of floodplains
Sedimentation
(2)Within-estuary deposition
Estuarine Circulation
Sea level rise
(3)Coastal inputs and movement
Armoring of erodible bluffs
Bluff erosion
Beach/ dune erosion & deposition
Littoral drift
Increased wave height
Jetties within drift cell


Change in timing, distribution of precipitation in watershed (heavier winter rain)
Livestock waste
Alder colonization
Septic systems
Fertilizer use
Watershed nutrient inputs
Stormwater runoff
Pesticide use
Industrial spills and activities
Watershed toxin inputs
Estuary nutrient budget
Internal cycling
Sedimentation and circulation
Higher air, water temperatures
Change in distribution, abundance of ecosystem engineers
Extent of wetland habitat
Change in ocean currents, upwelling
Oceanic Nutrient exchange


% area of each habitat type with disrupted hydrologic connectivity
Abundance of priority invasives
% of potential habitat area occupied by expected habitat
Tidally- influenced marshes
Tidal swamps
Tidal channels
Eelgrass beds
Intertidal habitat
Wetland filling
Dikes, tide gates
Altered nutrient regime
Altered estuarine circulation
Altered sediment regime
• Sea level rise
• Change in storm frequency and intensity
Phalaris arundinaceae
Carcinus maenus
European green crab
Zostera japonica
Invasive benthic flora and fauna
invasive Spartina species
Higher air, water temperatures
ESTUARINE HABITAT


Implement strategies and monitor
Develop work plans
Implement strategies
Monitor actions

# Adaptation strategies

| Climate change impact | Key ecological attributes affected | Potential adaptation strategies |
|---|---|---|
| **Sea level rise** | 1. **Habitat** (habitat shifts)<br>2. **Circulation** (tidal inputs, estuary surface area and depth)<br>3. **Sedimentation** (coastal inputs, within estuary deposition) | **a) Replace hard infrastructure with "green" infrastructure**<br>b) Improved coastal zoning<br>c) rolling easements |
| **Heavier winter rain** | 1. **Nutrient budget** (watershed nutrient and toxin inputs)<br>2. **Circulation** (freshwater input)<br>3. **Sedimentation** (watershed sediment inputs) | Upland land management<br>a) decrease impervious surfaces<br>b) timber harvest management<br>c) road placement |

# Recommendations

(Artistic rendition)

## Restoration of Tidal Marsh

- Continue to work with the Gnos family towards restoration of the marsh upstream of the highway.
- Wetland mitigation banking and other funds are available to compensate for the change.

## Viaduct

- Optimally, the viaduct will stretch from the reconstructed Gnos dike to Tamara Quays.
- The Viaduct should be elegant, blend with the landscape, and allow for maximum sheet flow beneath.
- Construction should be sturdy and tall enough to withstand seismic activity, a tsunami, or predicted sea-level rise.
- The road should include a wide bike and pedestrian pathway.
- Some form of access to the Salmon River should be allowed, either in the form of stairs or a path from the side.
- In the interim, blackberries should be mowed to allow viewing of the estuary

## Salmon Creek Channel

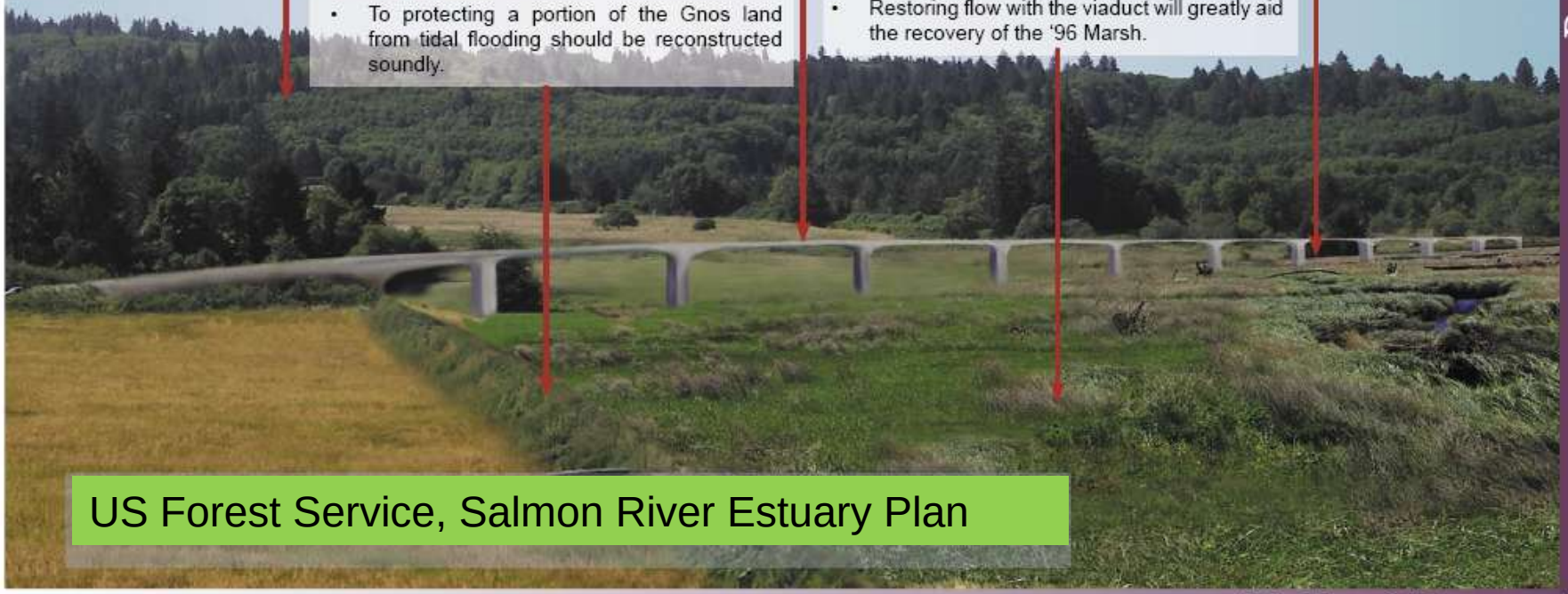
- Salmon Creek will be reconnected to its historical channel downstream of the highway.
- Sinuosity and depth should be restored in the channel upstream of the highway.
- The ditch currently routing salmon creek should be disconnected from Salmon Creek or filled entirely.
- Fraser Creek will also be allowed to return to its historic sinuous channel

## Reconstruct the Gnos Dike and Culvert

- To protecting a portion of the Gnos land from tidal flooding should be reconstructed soundly.

## Passive Recovery of the '96 Marsh

- Restoring flow with the viaduct will greatly aid the recovery of the '96 Marsh.



US Forest Service, Salmon River Estuary Plan

| Potential adaptation strategies | # key ecological attributes affected | Extent of effect | Uncertainty of modeled impact | If we are wrong? |
|---|---|---|---|---|
| a) **Replace hard infrastructure with "green" infrastructure**<br>b) Improved coastal zoning<br>c) rolling easements | 3 of 4 | All inundated habitats | High (direction) Medium (degree) | OK |
| Upland land management<br>a) decrease impervious surfaces<br>b) timber harvest management<br>c) road placement | 3 of 4 | Upper estuary | Medium | OK |

# Monitoring

- Uncertainties of climate projections
- Model validation
- Potential impacts to biodiversity are large
- Interactions of climate change with current threats (e.g. water quality impairment, habitat loss, loss of connectivity)



Use results to adapt & improve
Analyze
Interpret
Adapt
Share

# Planning Recommendations

1. Incorporate potential spatial shifts in species' ranges into plans
2. Be wary of historic ranges of variation
3. Explicitly incorporate a small number of well-defined climate change impacts into the plan
4. Set objectives that are robust across a majority of climate change scenarios
5. Use climate change information to prioritize strategy implementation
6. Monitoring is crucial