Sea-Level Rise and Coastal Habitats of the Pacific Northwest:

Application of a Model

A Presentation for the *Climate Change, Natural Resources, and Coastal Management Workshop*

January 29, 2009

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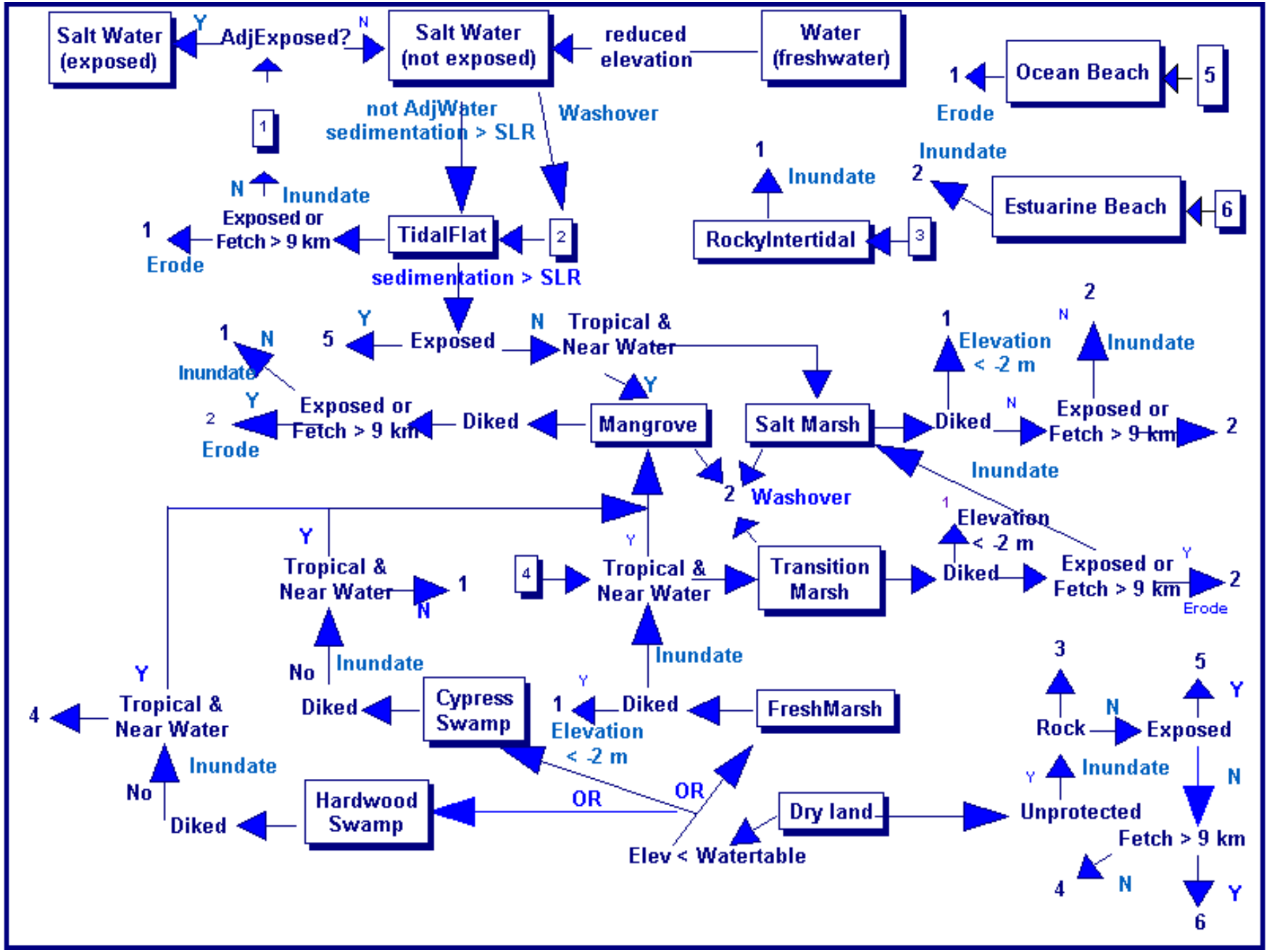
A Focus on Sea-Level Rise

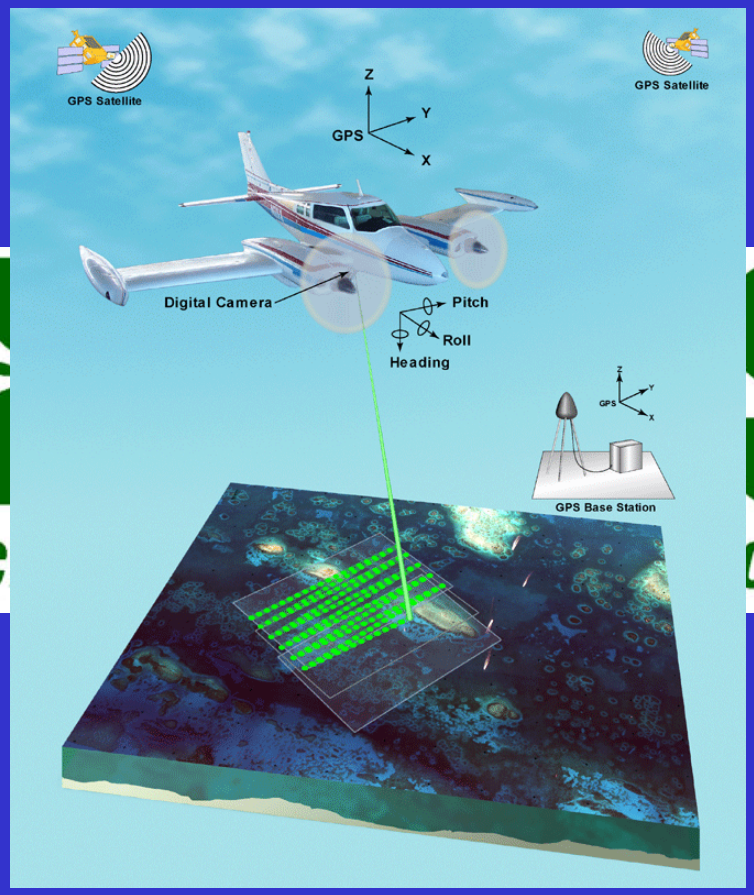
- Sea-level rise is direct and certain
- Coastal communities are at risk
- Important coastal habitats are at risk


Salt Water (exposed)
Y
AdjExposed?
N
Salt Water (not exposed)
reduced elevation
Water (freshwater)
1
Ocean Beach
5
Erode
1
not AdjWater
sedimentation > SLR
Washover
1
Inundate
2
Estuarine Beach
6
N
Inundate
Exposed or Fetch > 9 km
1
Erode
TidalFlat
2
RockyIntertidal
3
sedimentation > SLR
1
N
Inundate
5
Y
Exposed
N
Tropical & Near Water
1
Elevation < -2 m
2
N
Inundate
Y
Exposed or Fetch > 9 km
2
Erode
Diked
Mangrove
Salt Marsh
Diked
N
Exposed or Fetch > 9 km
2
Inundate
2
Washover
1
Elevation < -2 m
Y
Tropical & Near Water
1
N
4
Y
Tropical & Near Water
Transition Marsh
Diked
Exposed or Fetch > 9 km
Y
2
Erode
No
Inundate
Inundate
3
5
Y
Y
4
Tropical & Near Water
Diked
Cypress Swamp
1
Y
Diked
FreshMarsh
Rock
N
Exposed
Elevation < -2 m
Inundate
Y
Inundate
N
No
Hardwood Swamp
OR
OR
Dry land
Unprotected
Diked
Elev < Watertable
Fetch > 9 km
4
N
Y
6

Sea Level Affecting Marshes Model (SLAMM), Version 5.0

Data inputs:

- NOAA Tidal Data
- FWS National Wetlands Inventory data
- USGS Digital Elevation Model data
- Regional Light-imaging Detection and Ranging (LiDAR) data

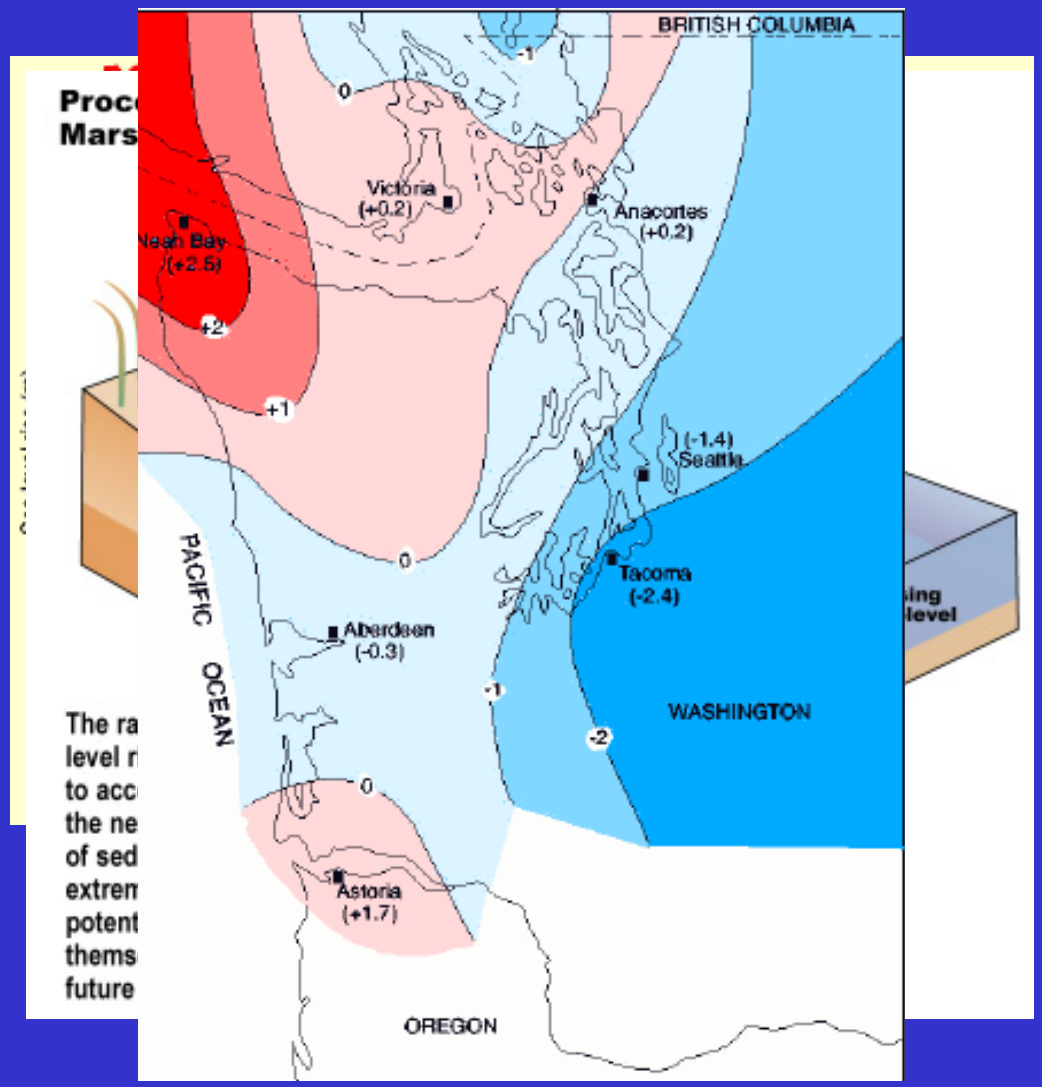


Sea Level Affecting Marshes Model (SLAMM), Version 5.0

Multiple Scenarios, Localized Changes

- Accelerated sea-level rise (25-year time steps) (eustatic sea-level rise)

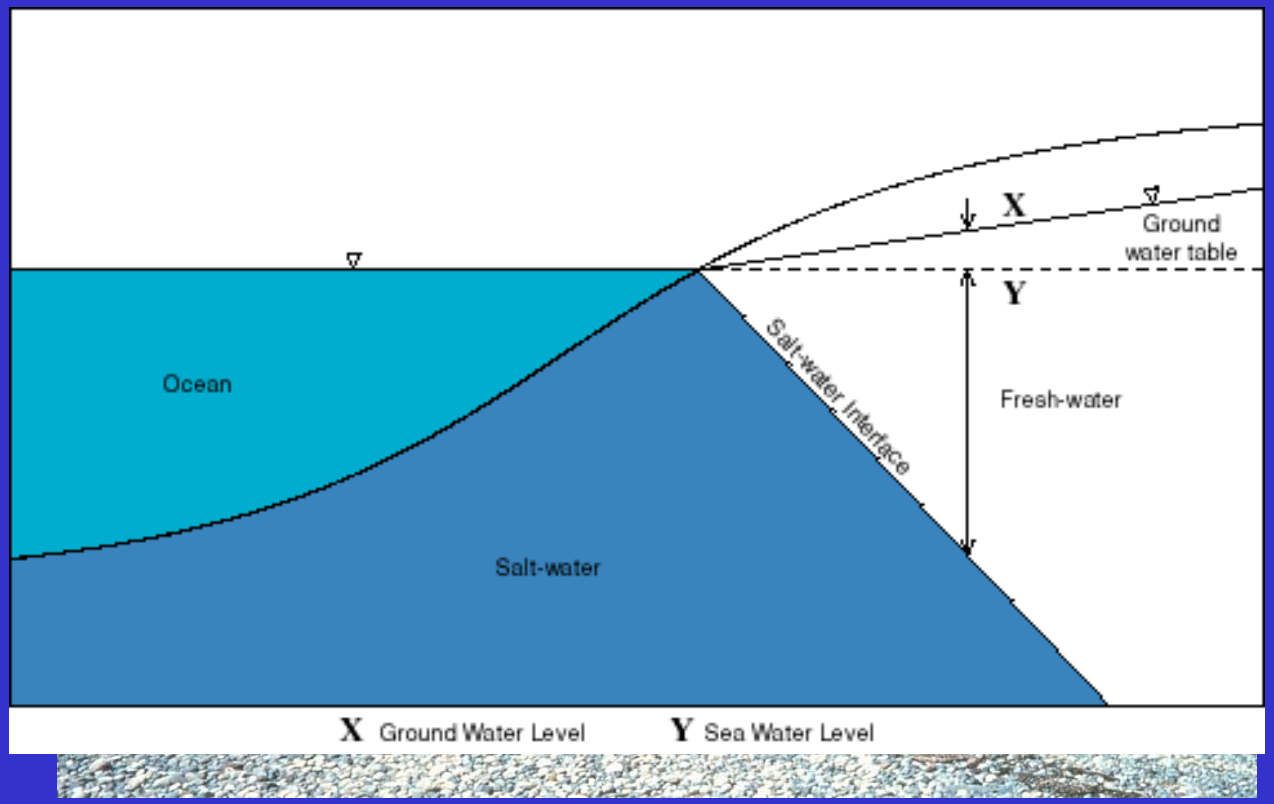
- Site-specific sedimentation, accretion rates and geological factors (relative sea-level rise)



Sea Level Affecting Marshes Model (SLAMM), Version 5.0

Addresses four primary processes that affect coastal habitat:

- Inundation
- Erosion
- Overwash
- Saturation
- Estuarine Salinity (NEW)



Examples of Habitat Types

Coastal Marshes/Swamps

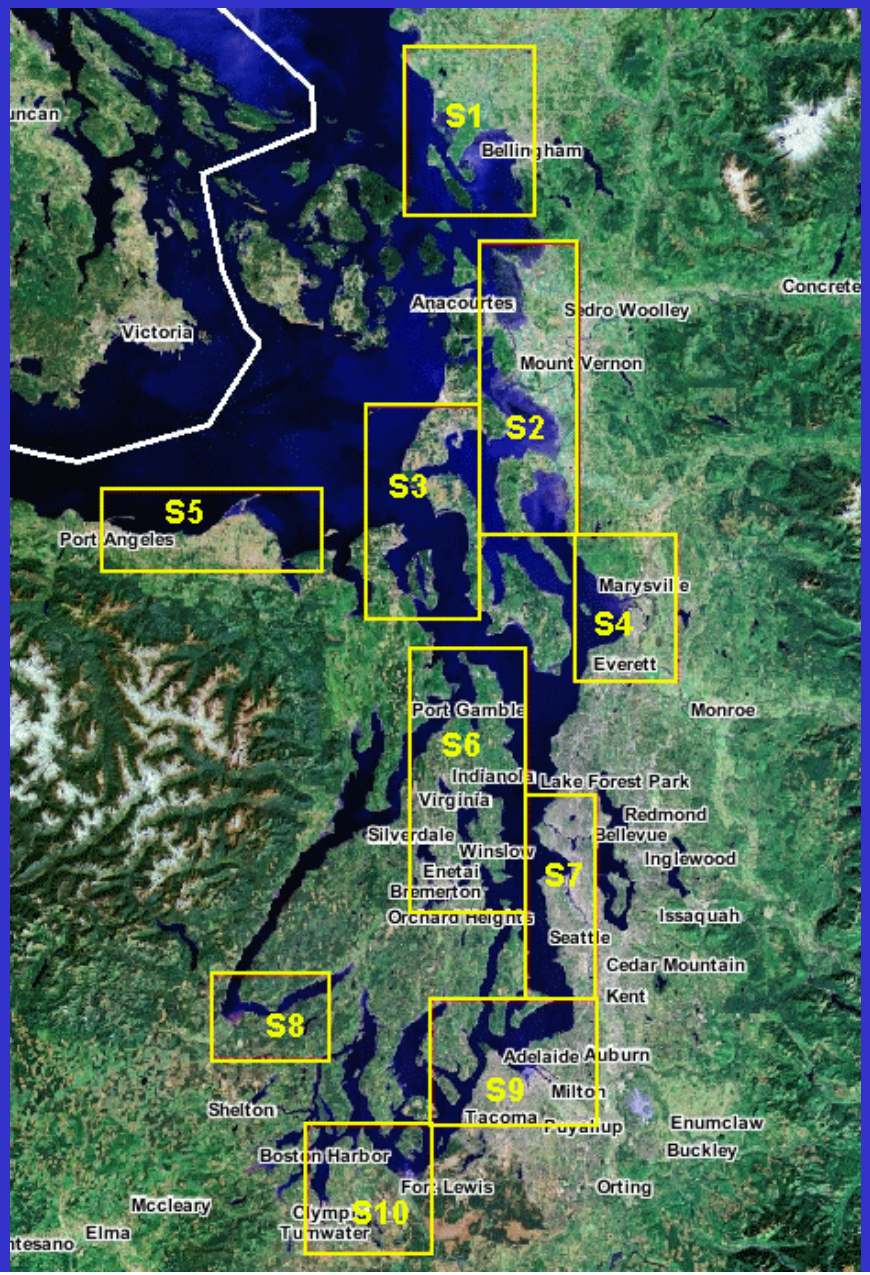
- Inland Fresh Marsh
- Tidal Fresh Marsh
- Brackish Marsh
- Transitional Marsh
- Saltmarsh
- Swamp/Tidal Swamp

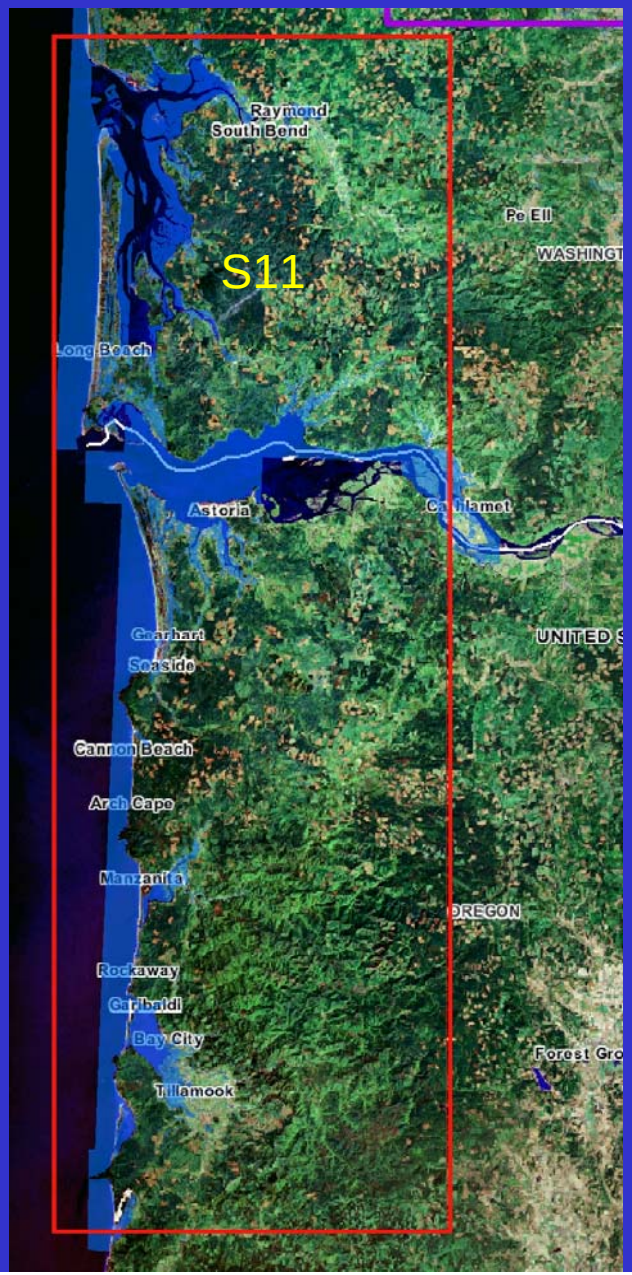
Tidal Flats

Ocean and Estuarine Beach

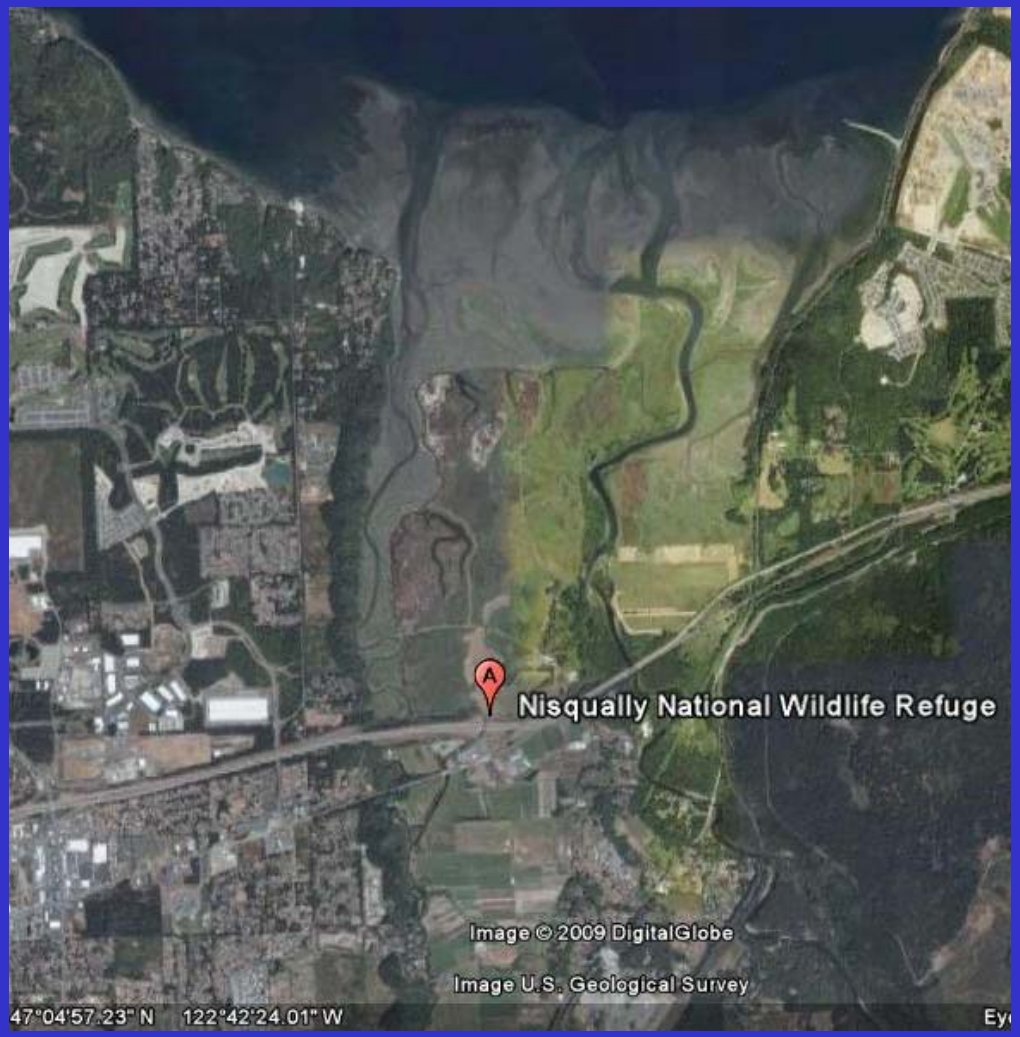
Riverine Tidal

Study Sites


S1
Bellingham
Anacortes
Sedro Woolley
Concrete
Victoria
Mount Vernon
S2
S3
S5
Port Angeles
Marysville
S4
Everett
Port Gamble
Monroe
S6
Indianola
Lake Forest Park
Virginia
Redmond
Silverdale
Bellevue
Winslow
Inglewood
Enetai
S7
Bremerton
Issaquah
Orchard Heights
Seattle
Cedar Mountain
Kent
S8
Adelaide
Auburn
S9
Milton
Shelton
Tacoma
Puyallup
Enumclaw
Buckley
Boston Harbor
Fort Lewis
Orting
Mccleary
Olympia
S10
Tumwater
Elma

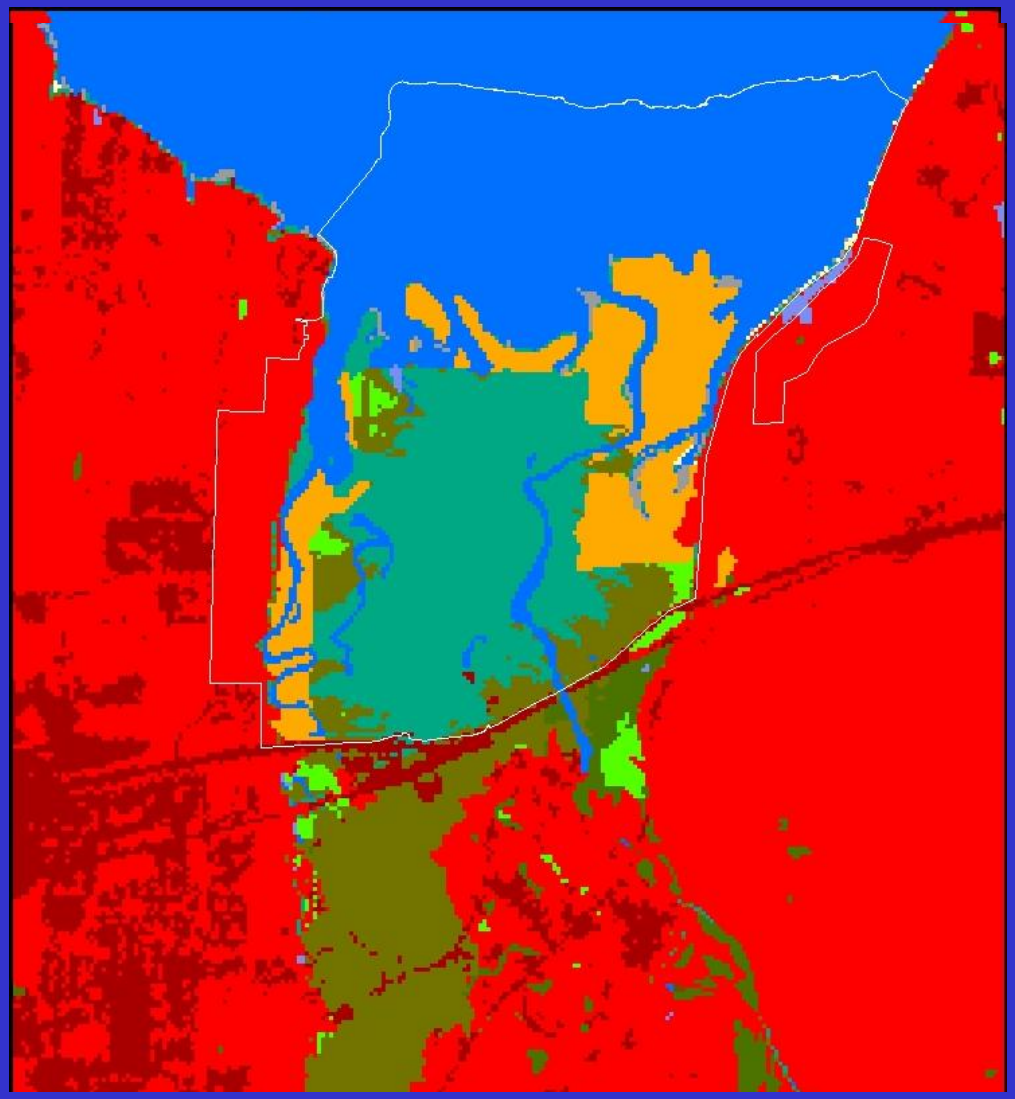

Raymond
South Bend
Pe Ell
S11
Long Beach
Astoria
Cathlamet
Gearhart
Seaside
Cannon Beach
Arch Cape
Manzanita
Rockaway
Garibaldi
Bay City
Tillamook

Nisqually NWR



Initial Condition

Nisqually NWR



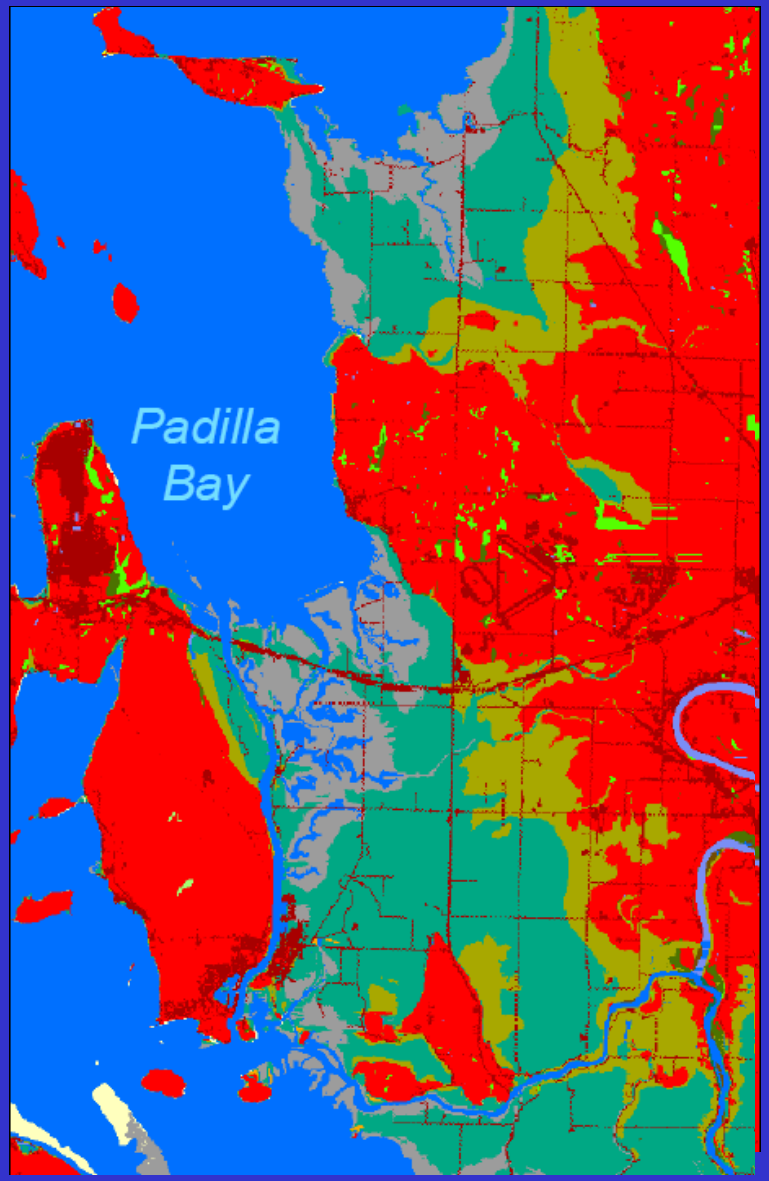
Initial Condition

11.2 In. by 2050 No Dikes

27.3 In. by 2100 No Dikes

- Developed Dry Land
- Undeveloped Dry Land
- Swamp
- Inland Freshwater Marsh
- Tidal Freshwater Marsh
- Transitional Saltmarsh
- Saltmarsh
- Estuarine Beach
- Tidal Flats
- Ocean Beach
- Rocky Intertidal
- Inland Open Water
- Open Water
- Inland Shore
- Tidal Swamp
- Brackish Marsh

Padilla Bay, WA



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Additional Information Needs

- Localized geomorphology, dynamic accretion processes
- Specific impacts on species and ecosystems
- Interaction with additional climate and non-climate stressors
- More detailed coastal elevation data (LiDAR) (some areas)

We Cannot Let Remaining Uncertainty Delay Action!

Adaptation Strategies

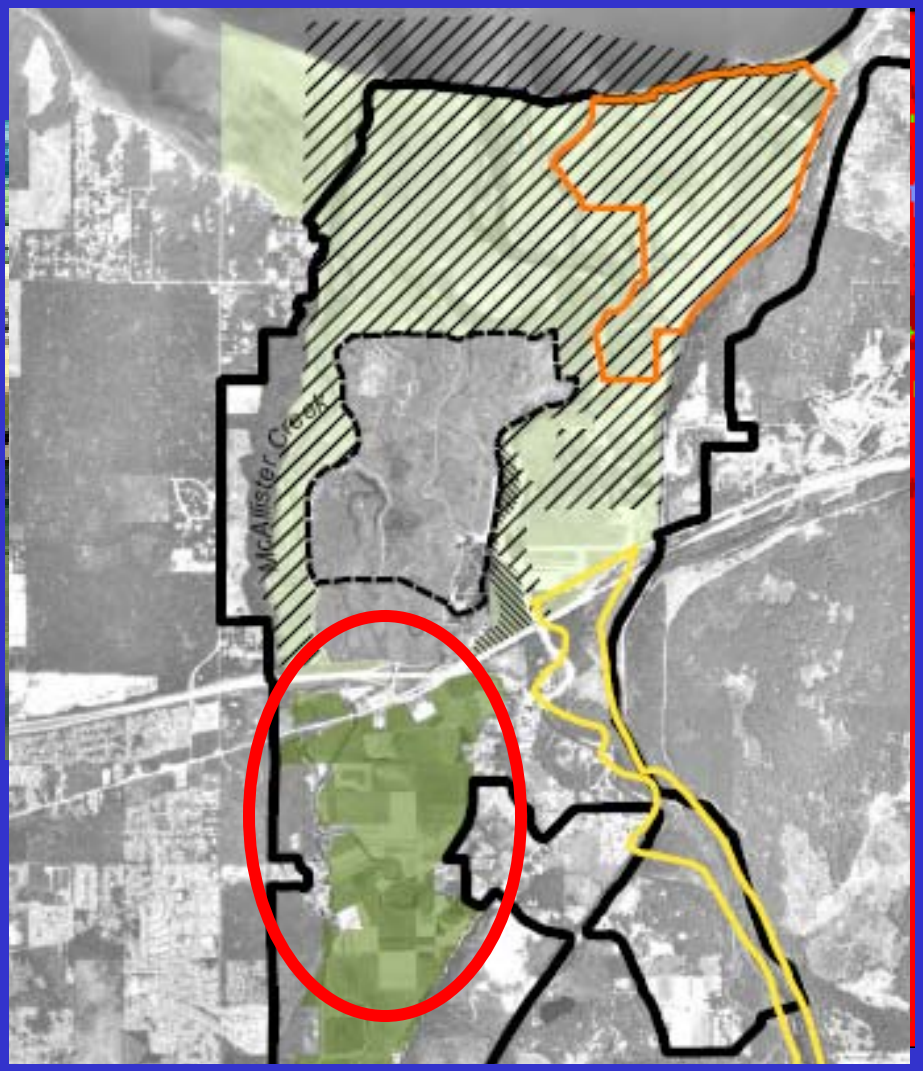
Prioritize protection and restoration project sites

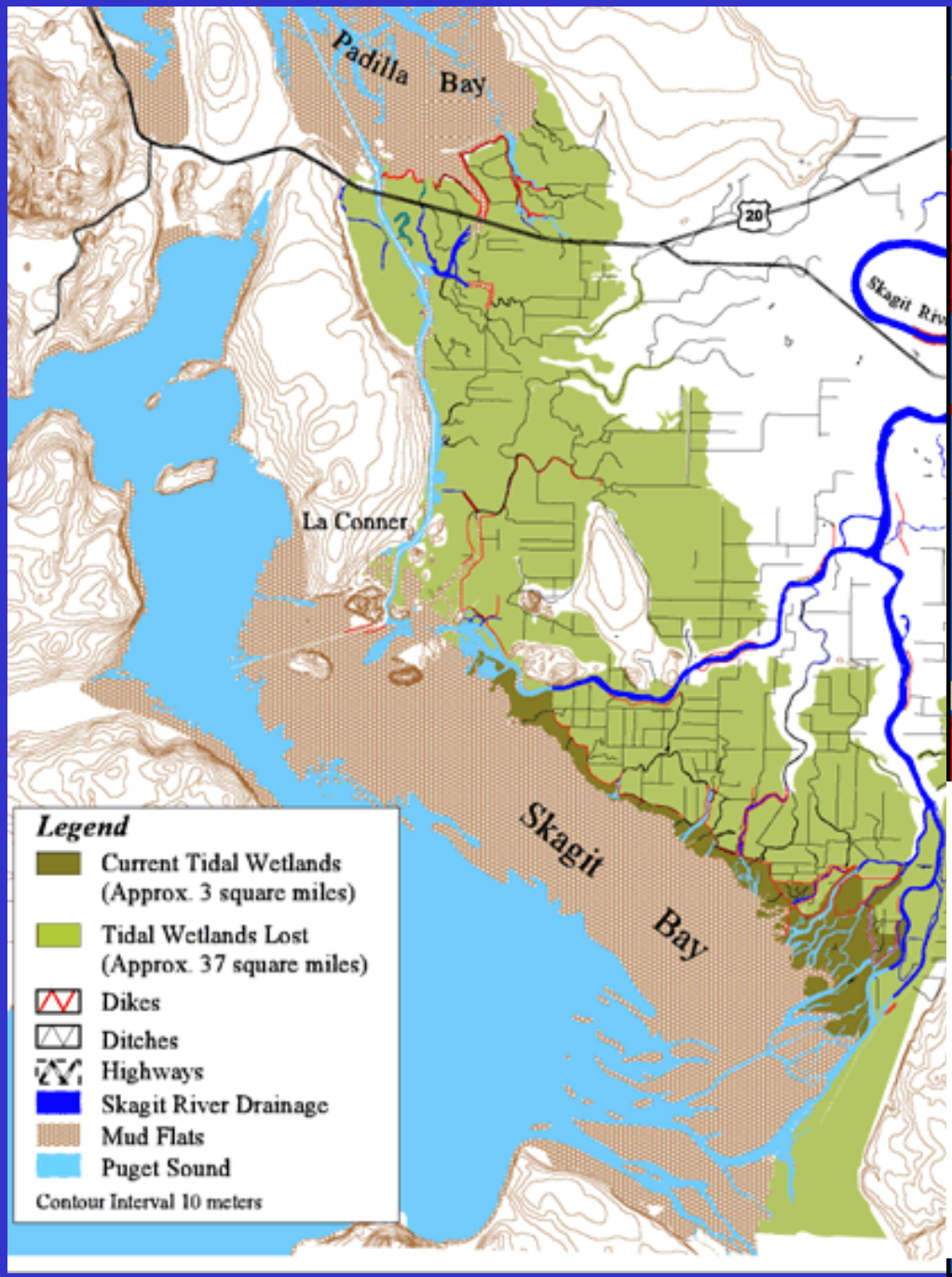
- Identify sites based on ecological/economic importance and vulnerability to sea-level rise

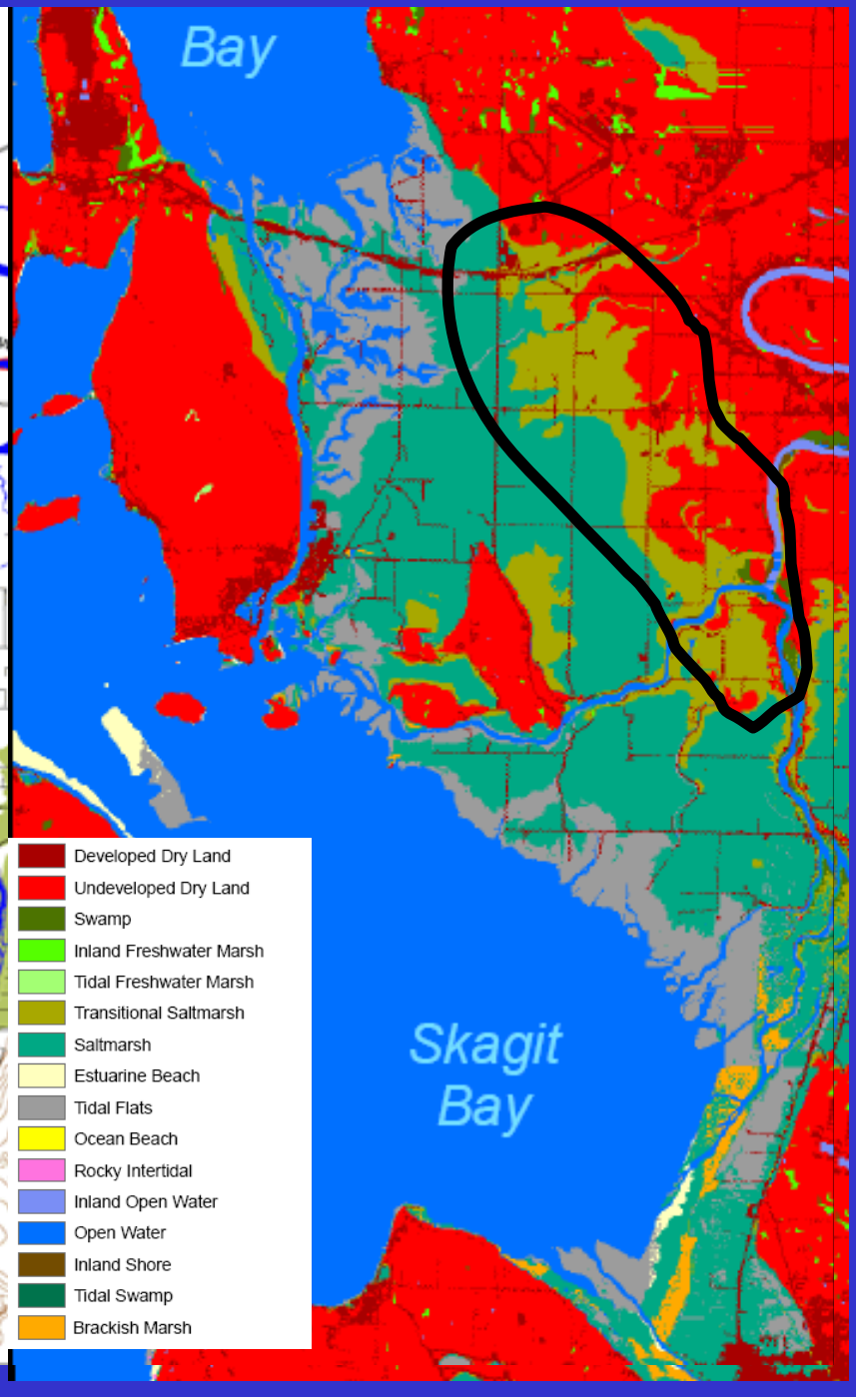
Adaptation Strategies

Establish and/or preserve ecological buffers

- Identify potential for upland protection (e.g., marginal agricultural land)




Padilla Bay
20
Skagit Riv
La Conner
Skagit Bay
Legend
Current Tidal Wetlands (Approx. 3 square miles)
Tidal Wetlands Lost (Approx. 37 square miles)
Dikes
Ditches
Highways
Skagit River Drainage
Mud Flats
Puget Sound
Contour Interval 10 meters


Bay
Skagit Bay
Developed Dry Land
Undeveloped Dry Land
Swamp
Inland Freshwater Marsh
Tidal Freshwater Marsh
Transitional Saltmarsh
Saltmarsh
Estuarine Beach
Tidal Flats
Ocean Beach
Rocky Intertidal
Inland Open Water
Open Water
Inland Shore
Tidal Swamp
Brackish Marsh

Adaptation Strategies

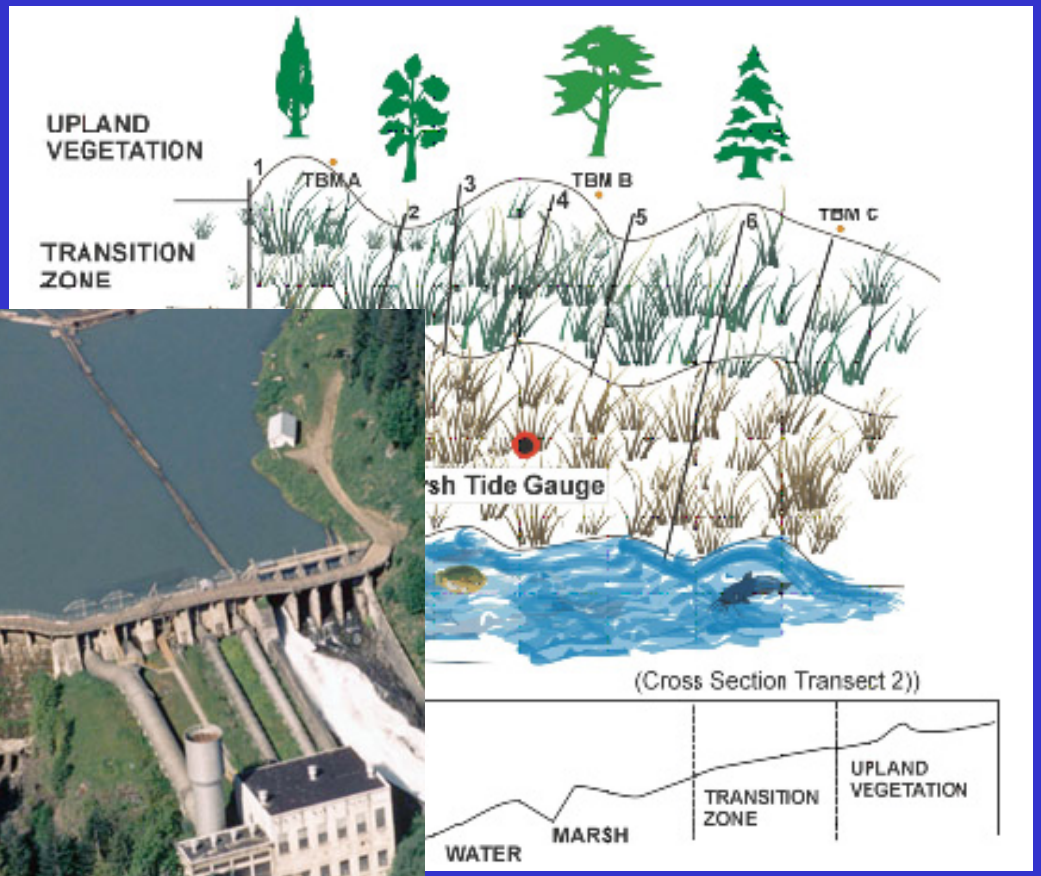
Establish and/or preserve ecological buffers

- Focus restoration on "protective" habitats such as dunes, riparian vegetation

Adaptation Strategies

Restore diverse array of habitat types, protect ecosystem services

- Support principles of representation and redundancy
- Protect and restore habitat connectivity



Adaptation Strategies

Move, abandon, and/or maintain shoreline infrastructure

- Consider tradeoffs between protected development, agricultural lands and protected habitat

Adaptation Strategies

Move, abandon, and/or maintain shoreline infrastructure

- Promote “soft armoring” approaches, discourage hard armoring

Adaptation Strategies

Discourage development in coastal high hazard areas

- Revise local, state, and federal policies:

  Reduce or eliminate incentives for harmful and vulnerable development

  Promote incentives for sound coastal management

Adaptation Strategies

Incorporate sea-level rise projections in coastal management decisions

- Revise land use and shoreline planning statutes and regulations

Adaptation Strategies

Selectively implement “artificial” adaptation measures

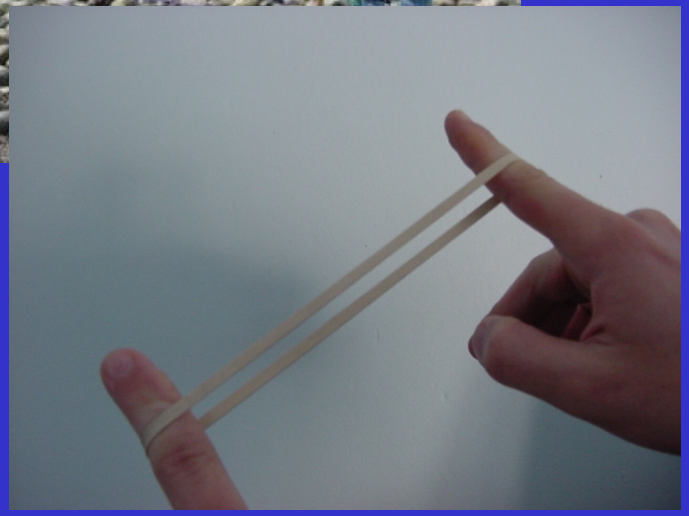
- Assess potential for assisted accretion/beach “re-nourishment” through use of dredged materials

Adaptation Strategies

Learn As You Go

- Support and conduct additional research and monitoring

- Revise strategies as necessary (adaptive management)



www.nwf.org/sealevelrise

And

http://www.spea.indiana.edu/wetlandsandclimatechange/SLAMM-View.htm