Sea Level Rise
Providing Nature A-Right-of Way
Sea-level Rise and Coastal Habitats in the Pacific Northwest
An Analysis for Puget Sound, Southwestern Washington, and Northwestern Oregon
Study Area
Site 2: Skagit Bay

Initial Condition
11.2 Inches by 2050  No Dikes
27.3 Inches by 2100  No Dikes
The Problem

• Loss of coastal wetlands due to submergence

• Wetlands cannot migrate upslope because of human infrastructure or geomorphology
Providing Nature A-Right-of-Way

Conservation Programs

Sea Level-Rise Initiative

No Net Loss Of Coastal Wetlands

Science

Policy
Partners

- Pacific Coast Joint Venture
- Ducks Unlimited
- Oregon Department of Fish and Wildlife
- Northern Pacific LCC
Improvements to NWF Report

- Used LIDAR data
- Better ‘dike layer’ definition
- Separate analysis of major estuary systems
- Simpler wetland classification
- Examining uncertainty in SLAMM
Status of Oregon Work

• Assembling / processing LIDAR data
• Assembling dike layer
• Recoding wetlands – OR geodatabase
• Analyses complete summer 2012
Status of Oregon Work

Nehalem
Tillamook
Sand Lake
Nestucca -- USFWS
Salmon
Siletz -- USFWS

Yaquina
Alsea Bay
Siuslaw
Umpqua
Coos Bay
Coquille -- USFWS
Rogue
## Nearshore Zones

<table>
<thead>
<tr>
<th>Habitat Type in NWF Report</th>
<th>Cowardin et al. (1979) Classification</th>
<th>Nearshore Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estuarine Beach</td>
<td>Estuarine intertidal unconsolidated shore (sand)</td>
<td>Low Tidal</td>
</tr>
<tr>
<td>Tidal Flat</td>
<td>Estuarine intertidal unconsolidated shore (mud)</td>
<td></td>
</tr>
<tr>
<td>Saltmarsh</td>
<td>Estuarine intertidal emergent</td>
<td>Saltmarsh</td>
</tr>
<tr>
<td>Transitional Marsh</td>
<td>Estuarine intertidal scrub shrub</td>
<td>Transitional</td>
</tr>
<tr>
<td>Brackish Marsh</td>
<td>Estuarine intertidal emergent</td>
<td></td>
</tr>
<tr>
<td>Tidal Swamp</td>
<td>Palustrine forested or scrub shrub (tidal modifier)</td>
<td>Freshwater Tidal</td>
</tr>
<tr>
<td>Transitional Fresh Marsh</td>
<td>Palustrine emergent (tidal modifier)</td>
<td></td>
</tr>
<tr>
<td>Riverine Tidal</td>
<td>Riverine aquatic bed (tidal modifier)</td>
<td></td>
</tr>
</tbody>
</table>
Transitional
Freshwater Tidal
Site 2: Skagit Bay

Initial Condition
11.2 Inches by 2050  No Dikes
27.3 Inches by 2100  No Dikes
“Addressing this issue is urgent only because there are inexpensive opportunities to solve the problem now – opportunities that will be prohibitively costly if we wait until housing developments replace our shorefront farms and forests”

James Titus, 1998
• Purchase development rights

• Farm indefinitely

• Place on conservation buyers market based on economic considerations

• Buyer assumes restoration costs
## North Puget Sound

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Current Conditions</th>
<th>0.69 SLR Dikes in Place</th>
<th>0.69 SLR Dikes Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Tidal</td>
<td>10,623</td>
<td>8,723</td>
<td>19,629</td>
</tr>
<tr>
<td>Saltmarsh</td>
<td>5,701</td>
<td>5,836</td>
<td>36,391</td>
</tr>
<tr>
<td>Transitional</td>
<td>637</td>
<td>2,133</td>
<td>9,748</td>
</tr>
<tr>
<td>Freshwater Tidal</td>
<td>1,569</td>
<td>937</td>
<td>716</td>
</tr>
</tbody>
</table>
Skagit Bay, Initial Condition
Skagit Bay, 2100 A1B
Max With Dikes

<table>
<thead>
<tr>
<th>Category</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Tidal</td>
<td>Blue</td>
</tr>
<tr>
<td>Open Water</td>
<td>Dark Blue</td>
</tr>
<tr>
<td>Low Tidal</td>
<td>Gray</td>
</tr>
<tr>
<td>Saltmarsh</td>
<td>Green</td>
</tr>
<tr>
<td>Transitional</td>
<td>Yellow</td>
</tr>
<tr>
<td>Freshwater Tidal</td>
<td>Light Blue</td>
</tr>
</tbody>
</table>
Skagit Bay, 2100 A1B
Max No Dikes
## Gray’s Harbor

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Current Conditions</th>
<th>0.69 SLR Dikes in Place</th>
<th>0.69 SLR Dikes Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Tidal</td>
<td>37,646</td>
<td>12,271</td>
<td>12,271</td>
</tr>
<tr>
<td>Saltmarsh</td>
<td>2,758</td>
<td>3,716</td>
<td>3,716</td>
</tr>
<tr>
<td>Transitional</td>
<td>1,135</td>
<td>6,373</td>
<td>7,826</td>
</tr>
<tr>
<td>Freshwater Tidal</td>
<td>6,993</td>
<td>5,317</td>
<td>5,317</td>
</tr>
</tbody>
</table>
Gray’s Harbor,
Initial Condition
Gray’s Harbor, 2100 A1B Max with Dikes
Gray’s Harbor, 2100 A1B Max without Dikes
## Willapa Bay

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Current Conditions</th>
<th>0.69 SLR Dikes in Place</th>
<th>0.69 SLR Dikes Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Tidal</td>
<td>50,268</td>
<td>16,889</td>
<td>17,609</td>
</tr>
<tr>
<td>Saltmarsh</td>
<td>7,806</td>
<td>7,307</td>
<td>9,251</td>
</tr>
<tr>
<td>Transitional</td>
<td>1,972</td>
<td>6,046</td>
<td>6,721</td>
</tr>
<tr>
<td>Freshwater Tidal</td>
<td>1,653</td>
<td>724</td>
<td>692</td>
</tr>
</tbody>
</table>
Willapa Bay

The graph shows the change in acres of various marsh types from 2010 to 2100. The categories include Low Tidal, Salt Marsh, T. Marsh, and F. Tidal. The graph indicates a decrease in Low Tidal acres over time, while the other categories show a slight increase or no significant change.
Willapa Bay, Initial Condition
Willapa Bay, 2100 A1B Max with Dikes
Willapa Bay, 2100 A1B Max without Dikes
## Lower Columbia

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Current Conditions</th>
<th>0.69 SLR Dikes in Place</th>
<th>0.69 SLR Dikes Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Tidal</td>
<td>5,545</td>
<td>5,433</td>
<td>9,703</td>
</tr>
<tr>
<td>Saltmarsh</td>
<td>5,975</td>
<td>4,848</td>
<td>13,990</td>
</tr>
<tr>
<td>Transitional</td>
<td>810</td>
<td>2,103</td>
<td>4,218</td>
</tr>
<tr>
<td>Freshwater Tidal</td>
<td>6,370</td>
<td>5,654</td>
<td>5,587</td>
</tr>
</tbody>
</table>
Lower Columbia

- **Acres**
- **Low Tidal**
- **Freshwater Tidal**
- **Saltmarsh**
- **Transitional Marsh**

Graph showing the change in acres of different tidal marsh types from 2010 to 2100.
Lower Columbia, 2100 A1B Max with Dikes
Lower Columbia, 2100 A1B Max without Dikes
New SLAMM Uncertainty Component

• Ducks Unlimited has funded creation of a new SLAMM uncertainty component that allows for site-specific information about model uncertainty.
• Coding is underway
• Product expected to be available in early 2011
Uncertainty Simulation

Model Inputs
Represented as Distributions

Model Outputs
Saltmarsh (ha)

Figure 28: Salt Marsh in 2100 over 500 iterations
Long-Term Regional Changes

Low Tidal

Saltmarsh

Transitional Marsh
Skagit Bay
Initial Conditions

Legend
- Grey: Non Tidal
- Blue: Open Water
- Green: Low Tidal
- Yellow: Saltmarsh
- Orange: Transitional
- Light Blue: Freshwater Tidal
Skagit Bay
2100 No Dikes

Legend
- Non Tidal
- Open Water
- Low Tidal
- Saltmarsh
- Transitional
- Freshwater Tidal
Web-Based Planning Tool

LT = Low Tidal
SM = Saltmarsh
TM = Transitional Marsh
Uncertainty Viewer

• Work in progress

• Most significant technical challenges complete
  – Capability to interface with shape-files such as PLAT Maps
  – User can draw polygon of choice and analyze uncertainty data based on that shape
  – Pie-chart, map output, and interface refinements are pending
Easement Uncertainty
(Dominance Class)
Funding a Shoreline Easement Program
Opportunities to Adapt
Opportunities to Adapt
Present & Future
Our Solutions Shouldn’t be One-Dimensional
The “Ideal” Project

• Adds Low Tidal Habitat in the long-term (2100)

• Saltmarsh gains in the short-term (2050)

• Providing Transitional Marsh habitat not a priority
Long-Term Project Changes

- **Saltmarsh**
- **Low Tidal**
- **Transitional Marsh**
Adapting to SLR

• Understanding long-term regional changes
• Shorefront easement programs centered on agricultural lands
• Predicting long-term changes at the project scale (will the project’s evolution help offset habitat loss at the larger scale)
• Providing upslope migration opportunities at the project scale
Brant Initiative

- Develop brant – specific carrying capacity model

- Sea level rise impacts on eelgrass distribution and abundance

- Alaska to Mexico

- PCJV, SJV, AGJV