PSNERP Change Analysis: Understanding Change in Nearshore

Potential Applications for Local Governments

July 15, 2009

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What Will We Discuss?

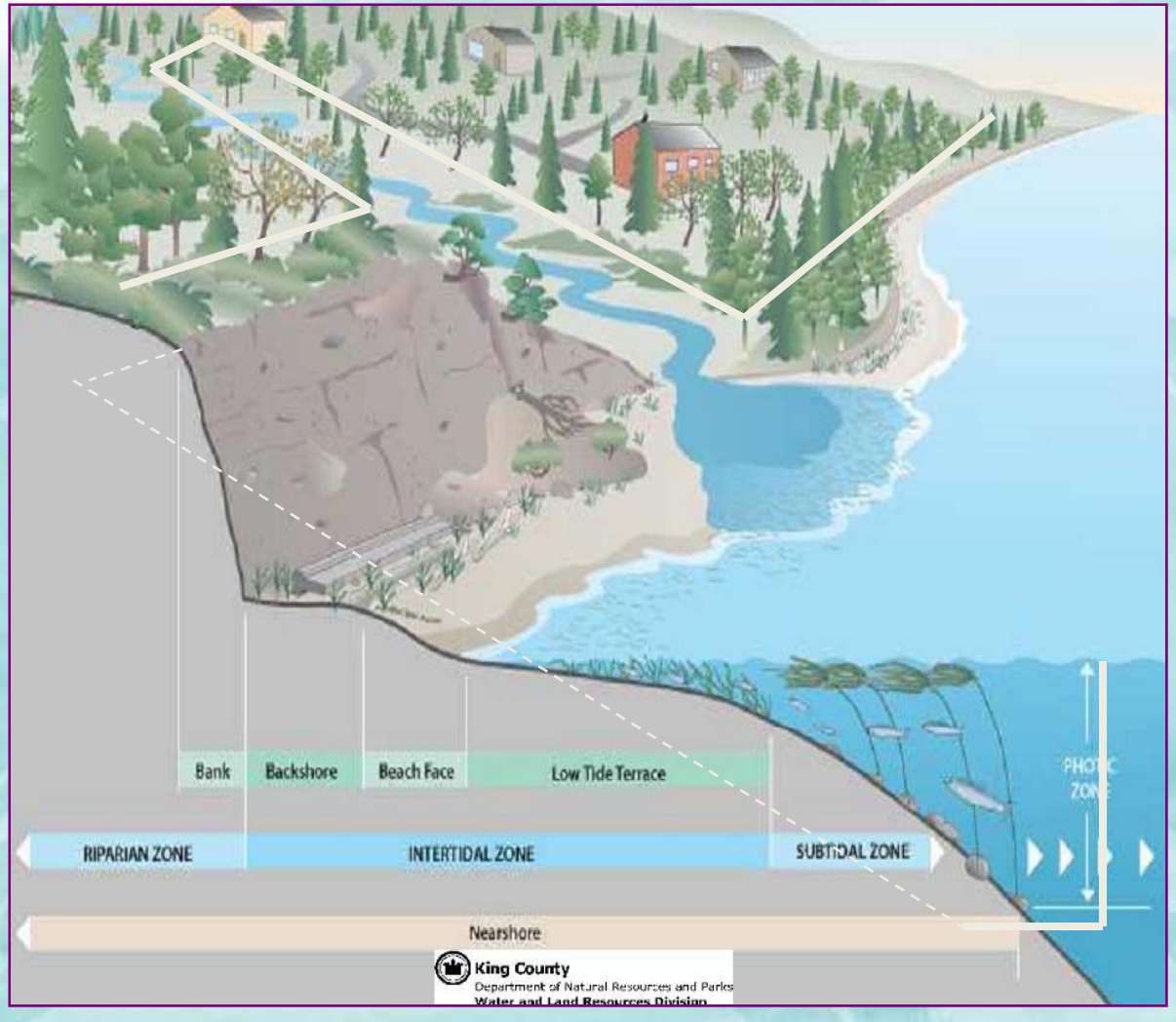
- Overview of PSNERP
- What is the Puget Sound nearshore ecosystem?
- Purpose of the Change Analysis
- Change Analysis methods
- Local government applications
- How to learn more

The Puget Sound Nearshore Ecosystem Restoration Project (PSNERP)…

- …is the nearshore component of the Puget Sound Partnership's strategy to restore Puget Sound
- …is a large-scale initiative to protect and restore natural processes and functions in the nearshore
- …is a general Investigation, jointly sponsored by Army COE and WDFW
  - Began in 2001, completion in 2011
- …can result in Army COE construction authority and funding

What is the Puget Sound Nearshore?

The shallow water of estuarine deltas & marine shorelines, from the top of the coastal bank to water depths where light supports plant growth and up rivers to the end of tidal influence

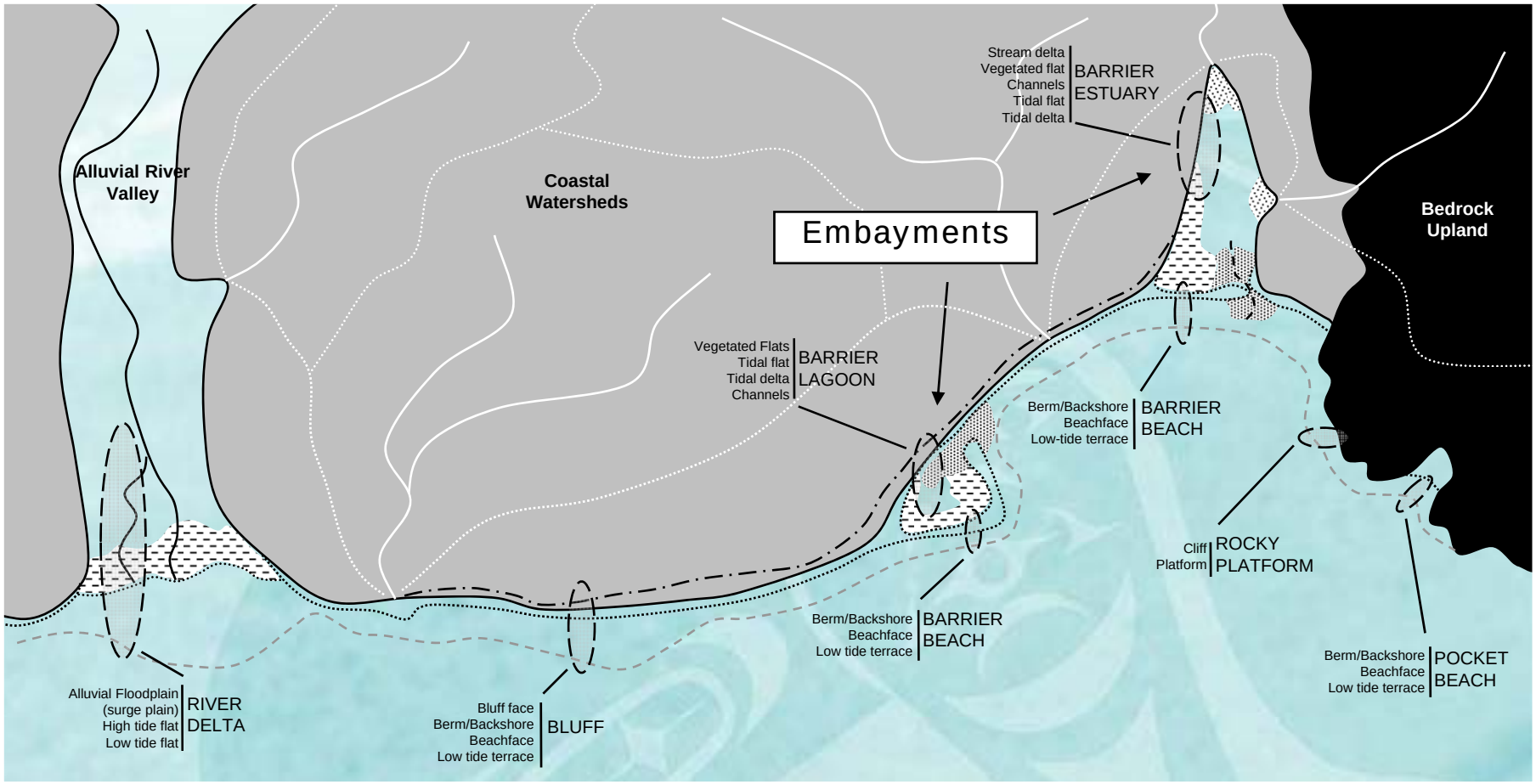


PSNERP Process and Products

Purpose of the Nearshore Change Analysis

- To detect and describe changes in the physical and biological structure of the Sound's deltas, estuaries, and beaches between the past and the present
- To inform a process-based, comprehensive, and spatially-explicit assessment of restoration needs in the nearshore ecosystem of Puget Sound

Change Analysis Methods: Shoreforms



Delta | Beaches | Rocky Coast

Typical coastal shoreforms in Puget Sound (from *Shipman et al.* 2008)

Change Analysis Methods: Tiers

Shoreform Transition (Tier 1)

- Historic shoreforms (A)
- Current shoreforms (B)

Shoreline Alterations (Tier 2)

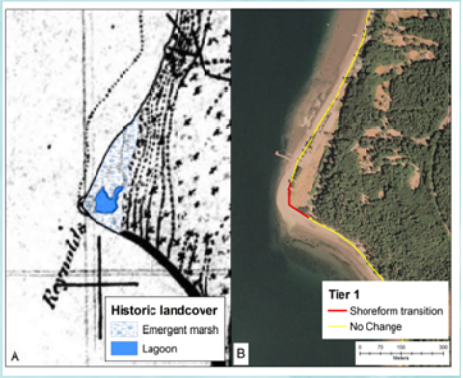
- Loss/gain intertidal classes
- Armoring
- Tidal barriers
- Breakwaters/jetties
- Overwater structures
- Nearshore fill
- Marinas
- Roads
- Railroads active
- Railroads abandoned

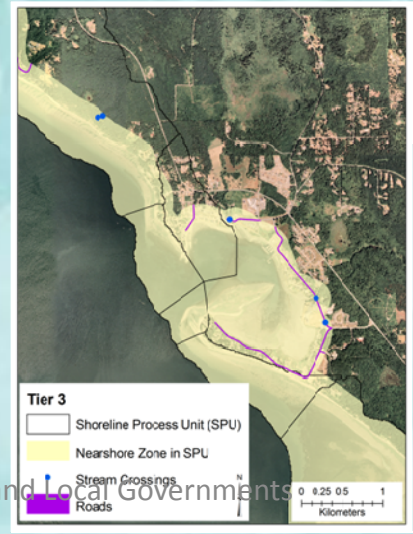
Adjacent Upland Change (Tier 3)

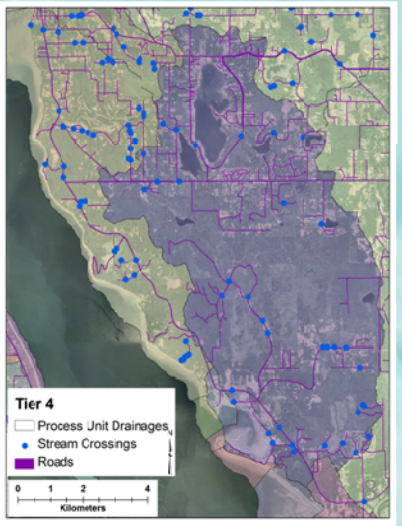
- Roads
- Railroads active
- Railroads abandoned
- Land cover
- Impervious surface
- Stream crossings

Watershed Area Change (Tier 4)

- Roads
- Railroads active
- Railroads abandoned
- Land cover
- Impervious surface
- Stream crossings
- Impounded drainage area (dams)
- Current drainage extent based on historic drainage extent







Example Results: Whidbey Sub-basin

Summary Statistics

Process Unit Features		
Drainage Area	14,607.8 km²	5,63
Nearshore Zone Area	599.2 km²	23
Shoreline Length	548.1 km	34
Stream Confluences	227	

Drift Cell Summary (%)	
Convergence Zone	
Divergence Zone	
No Appreciable Drift	3
Transport Zone, Left to Right	2
Transport Zone, Right to Left	3

Please see the accompanying PSNERP Tabulati

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Tier 1: Shoreform Composition

Shoreform Composition	Historic Shoreform Length (km)	Current Shoreform Length (km)	Historic Shoreform Length (mi)
Bluff-Backed Beach	203.65	194.80	126.47
Barrier Beach	62.59	58.71	38.87
Delta	331.18	208.05	205.66
Barrier Estuary	37.07	17.38	23.02
Barrier Lagoon	31.79	18.02	19.74
Closed Lagoon/Marsh	32.87	9.05	20.41
Open Coastal Inlet	0.55	0.49	0.34
Plunging Rocky Shoreline	3.30	3.12	2.05
Rocky Platform	11.49	11.71	7.13
Pocket Beach	1.54	1.51	0.96
Artificial	1.34	43.89	0.83

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Tier 1: Shoreform Composition: Transition Matrix

Shoreform Transition	*Current* ---------->					
Historic	Bluff-Backed Beach	Barrier Beach	Delta	Barrier Estuary	Barrier Lagoon	Clos Lago Mars
Bluff-Backed Beach	0	8				
Barrier Beach	3	0				
Delta			0			
Barrier Estuary				0		
Barrier Lagoon					0	1
Closed Lagoon/Marsh						0
Open Coastal Inlet						
Plunging Rocky Shoreline						
Rocky Platform						
Pocket Beach						
Artificial						
Shoreform Not Present					2	3
Total	3	8	0	0	2	4

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Tier 2: Shoreline Modifications

Intertidal Classes	Historic Area (km²)	Current Area (km²)	Historic Area (mi²)	Current Area (mi²)	Gain or Loss from Historic (%)
Tidal freshwater	88.0	8.9	34.0	3.4	-89.9
Oligohaline transition	46.1	0.6	17.8	0.2	-98.7
Estuarine mixing	55.1	29.2	21.3	11.3	-47.0
Euryhaline unvegetated	107.1	109.5	41.3	42.3	2.2

Shoreline Feature	% Shoreline Length
Tidal Barriers	36.2
Roads	51.2
Abandoned Railroads	0.0
Active Railroads	4.3
Armoring	19.4

Shoreline Feature	Area or Length			
Breakwater/Jetty Length	7.92	km	4.92	mi
Marina Area	0.76	km²	0.29	mi²
Nearshore Fill Area	6.71	km²	2.59	mi²
Overwater Structure Area	0.66	km²	0.26	mi²

Shoreline Feature	Count
Breakwater/Jetties	49
Marinas	25
Waterfront Parcels (number per 10,000 m of waterfront parcel length):	184.4

Tiers 3 and 4: Nearshore Zone and Drainage Area Modifications

Modifications	Count in Nearshore Zone Area	Count in Drainage Area
Dams	--	103
Stream Crossings	244	20,005
Fish Passage Barriers	141	1,913

Modifications	% of Nearshore Zone Area	% of Drainage Area
Watershed Impounded Above Dams	--	42.94
Stream Crossings Area	0.01	0.02
Roads	1.47	1.52
Railroads, Abandoned	0.00	0.04
Railroads, Active	0.22	0.03
Developed Land Cover	25.3	9.1
Natural Land Cover	74.7	90.9
Impervious Surface (0-10%)	92.5	95.2
Impervious Surface (10-30%)	3.2	2.9
Impervious Surface (30-50%)	2.0	1.0
Impervious Surface (50-100%)	2.3	0.9
Historical Watershed Area		
Public Lands	5.8	66.7
Private Lands	91.6	32.6
Tribal Lands	2.5	0.7
Protected Lands	11.2	67.6

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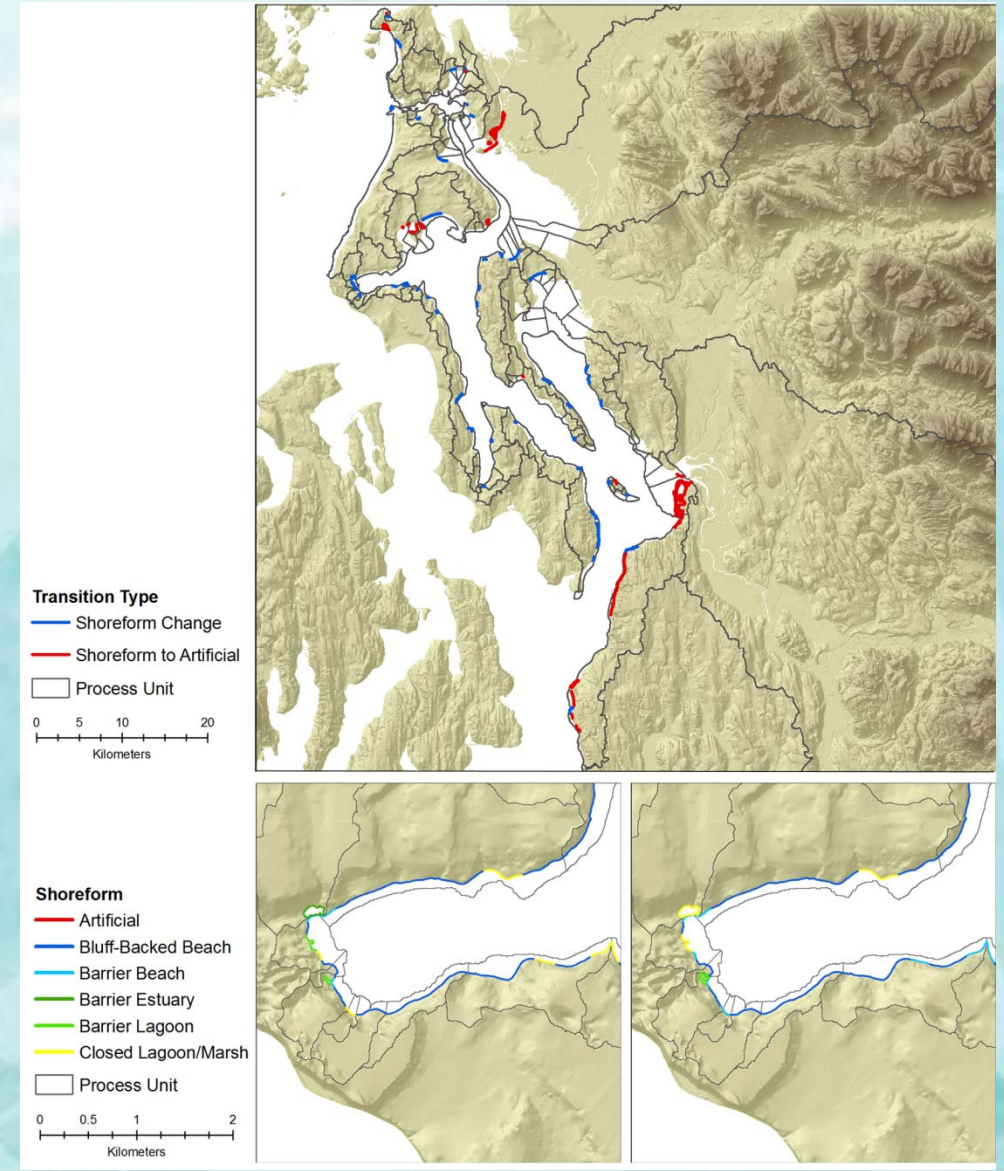
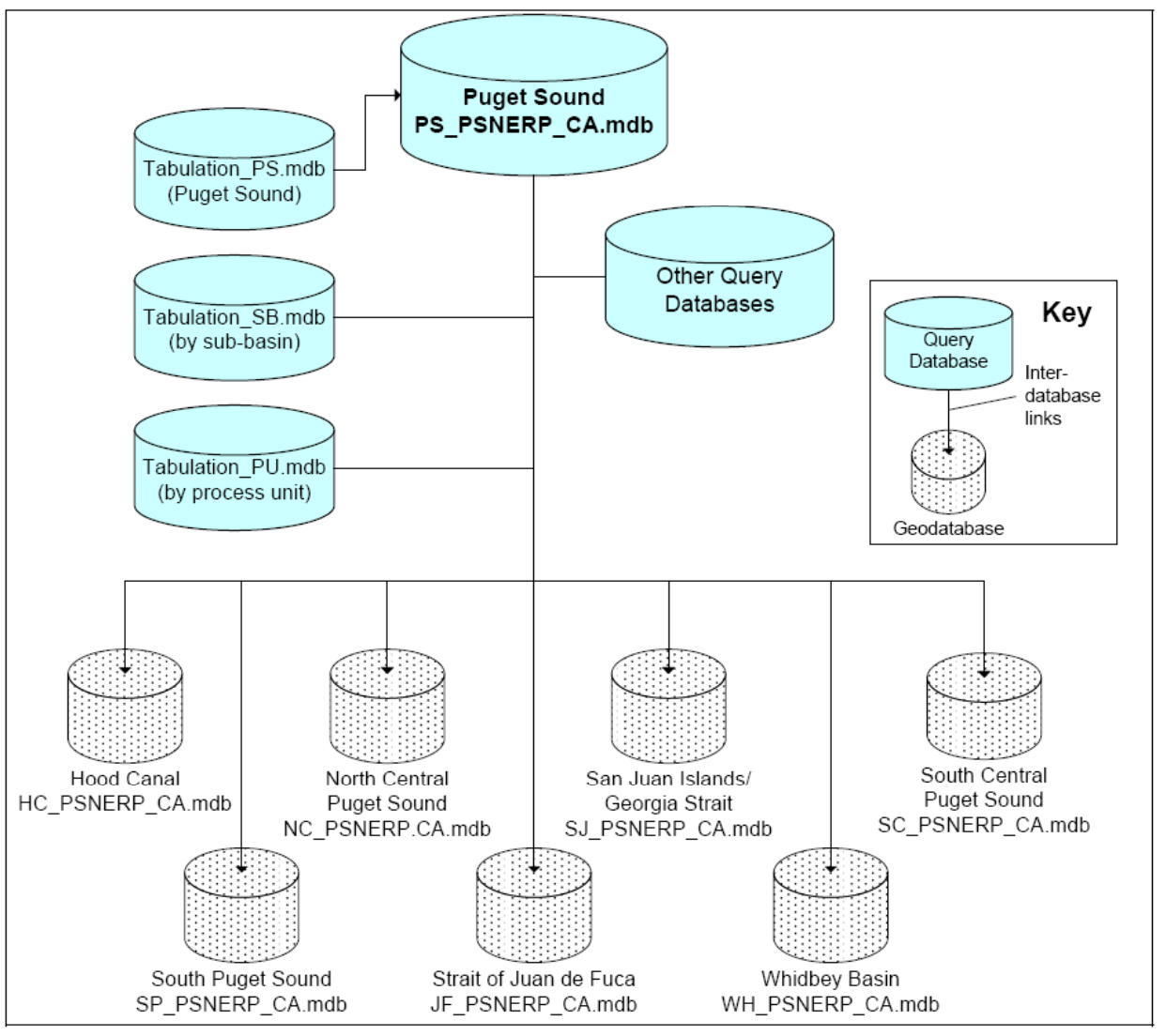


Change Analysis Geodatabase

- Geodatabase structure facilitates looking at change at several scales
  - Puget Sound
  - Sub-basins
  - Process units
- PSNERP uses this tool to understand and analyze nearshore restoration needs



Local Government Applications of Change Analysis Data

- Shoreline Master Program
  - Shoreline Inventory, Analysis & Characterization
  - Shoreline Environment designations
  - Cumulative Effects Analysis
  - Restoration Plan
- Critical Area Ordinances
  - Best Available Science

Local Government Applications of Change Analysis Data

- GMA Comprehensive Plan
  - Zoning and density analysis
- Watershed Area Planning & Implementation
  - Salmon restoration
  - Biodiversity
  - Surface Water

Learn More By…

- Attending PS Local Government workshops planned for Fall 2009
  - More detail on PSNERP, watershed assessments, and Ecology and WDFW technical assistance
- Visiting the PSNERP website to learn about the project and download data from the geodatabase
  - www.pugetsoundnearshore.org
- Contacting PSNERP staff
  - Margen Carlson for general questions: margen.carlson@dfw.wa.gov or 360-902-2229
  - Scott Campbell regarding the geodatabase: scott.w.campbell@usace.army.mil or 206-764-6560