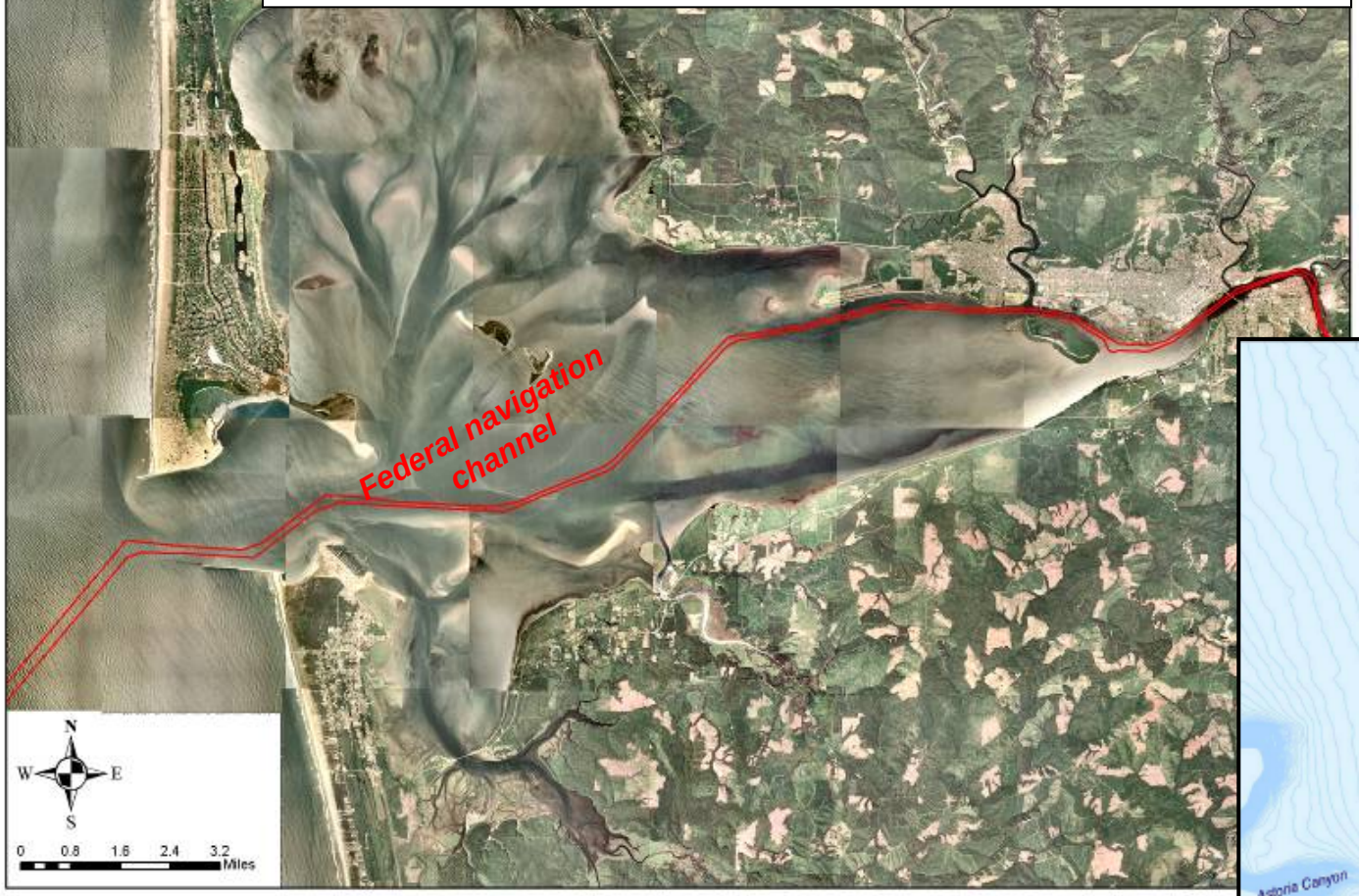
The Long-term management strategy at Grays Harbor, WA : A new perspective

85th Meeting of the Coastal Engineering Research Board

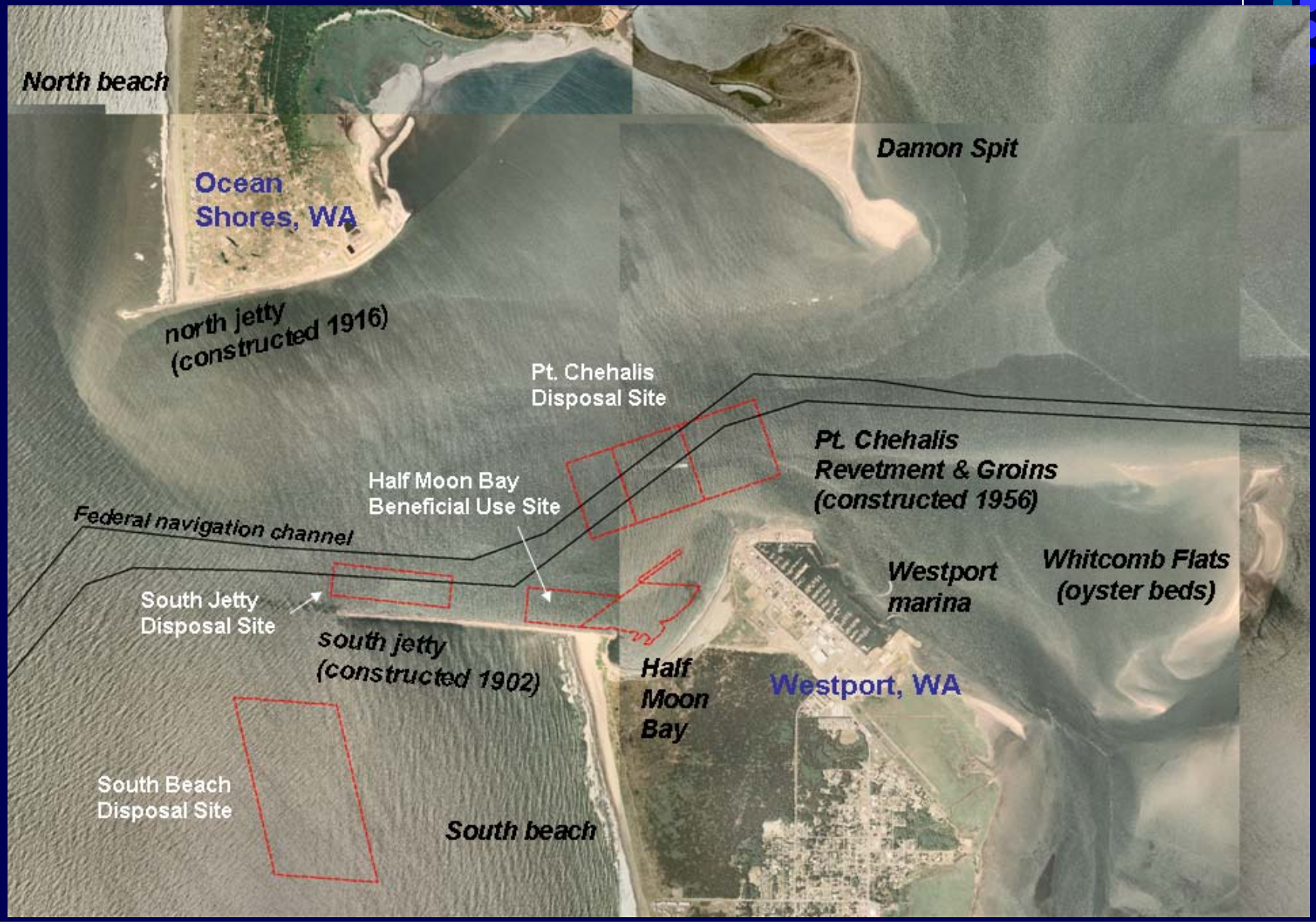
Portland, OR 23-25 September 2008

Grays Harbor Navigation Project

- 24 mile deep draft channel (from Bar to Cosmopolis, WA)
- 2.5 million cu. yd. dredged annually (1.2 mcy from outer harbor)
- 2 rubble mound jetties built near turn of 20th century

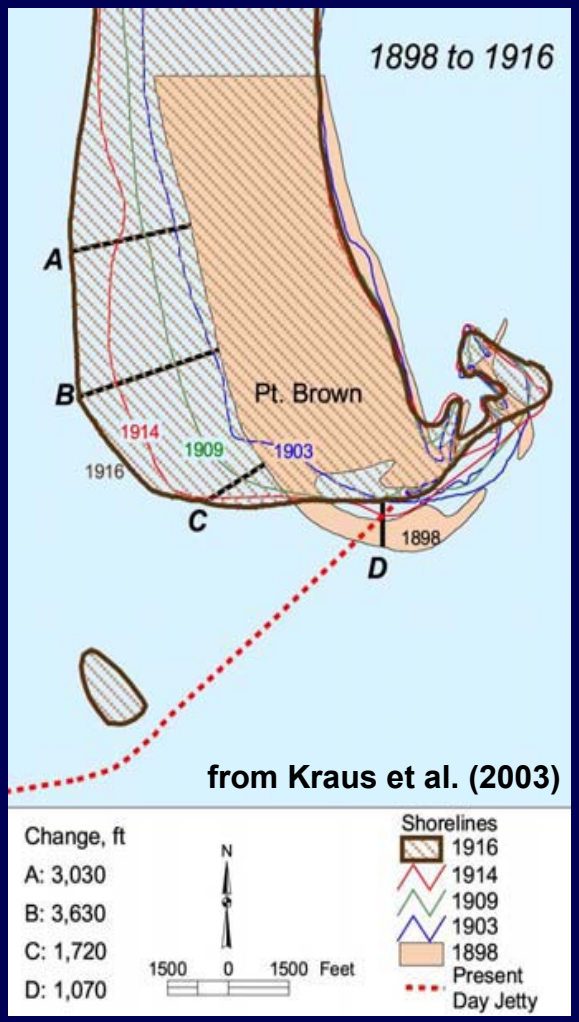


Grays Harbor Entrance Features



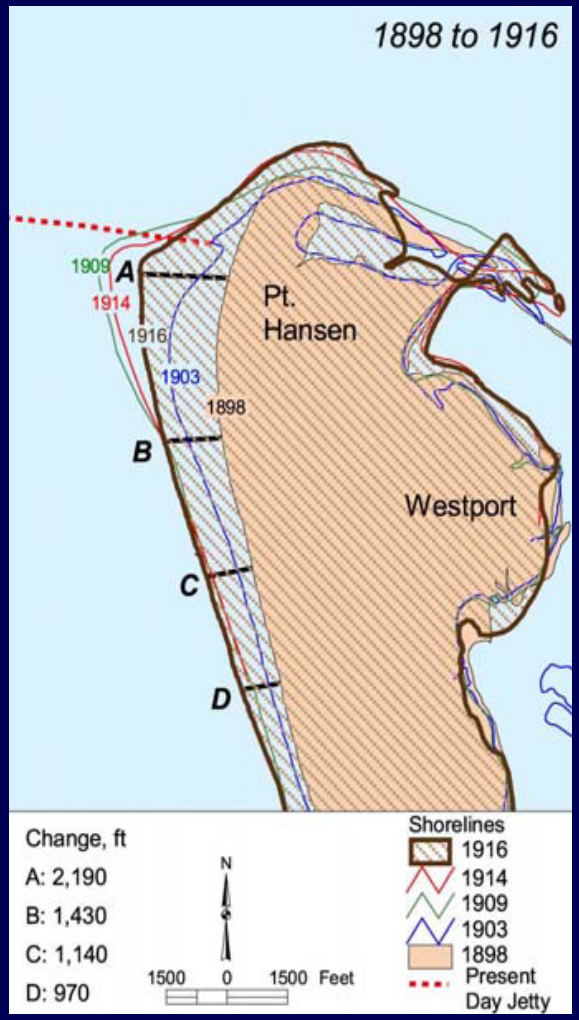
History - Morphologic changes following jetty construction

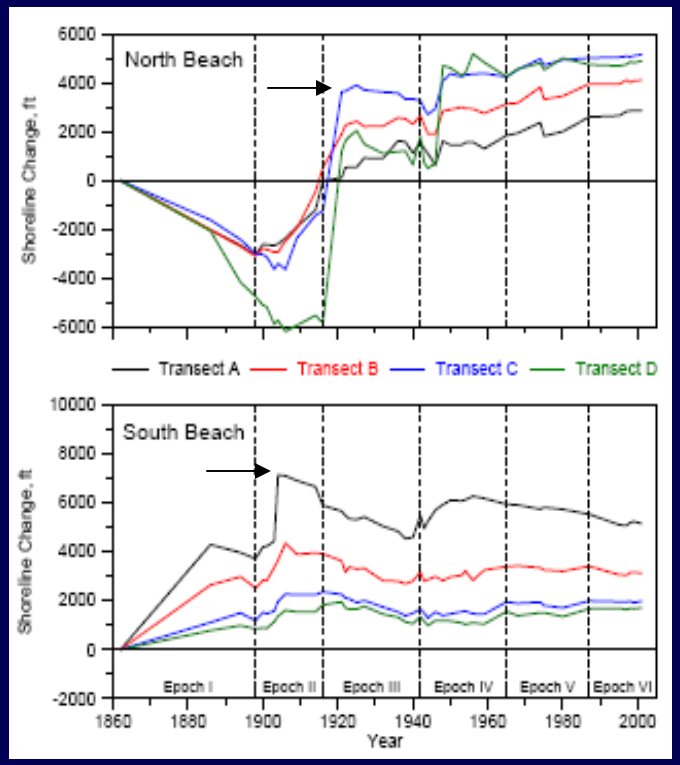
North Beach



from Kraus et al. (2003)

South Beach



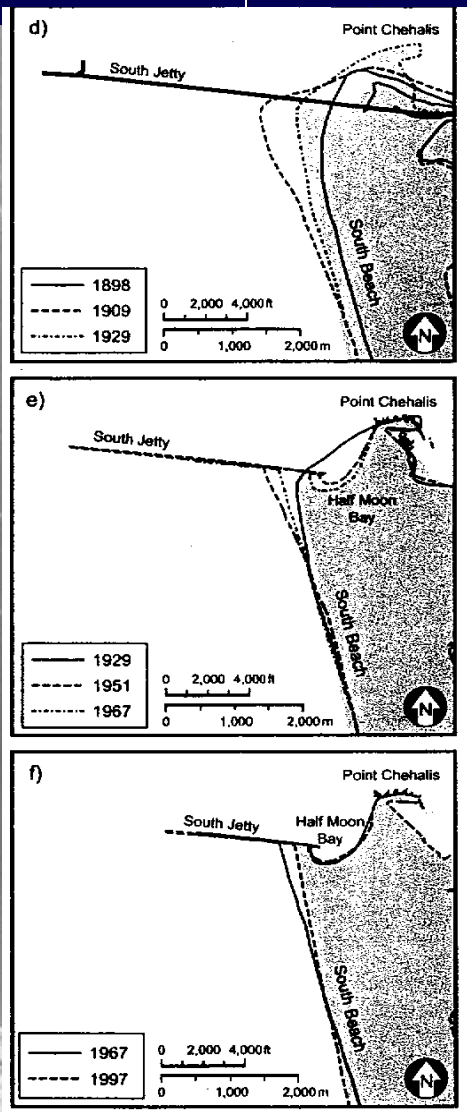


<u>Accretion after jetty construction</u>

North Beach ≈ 3000 ft

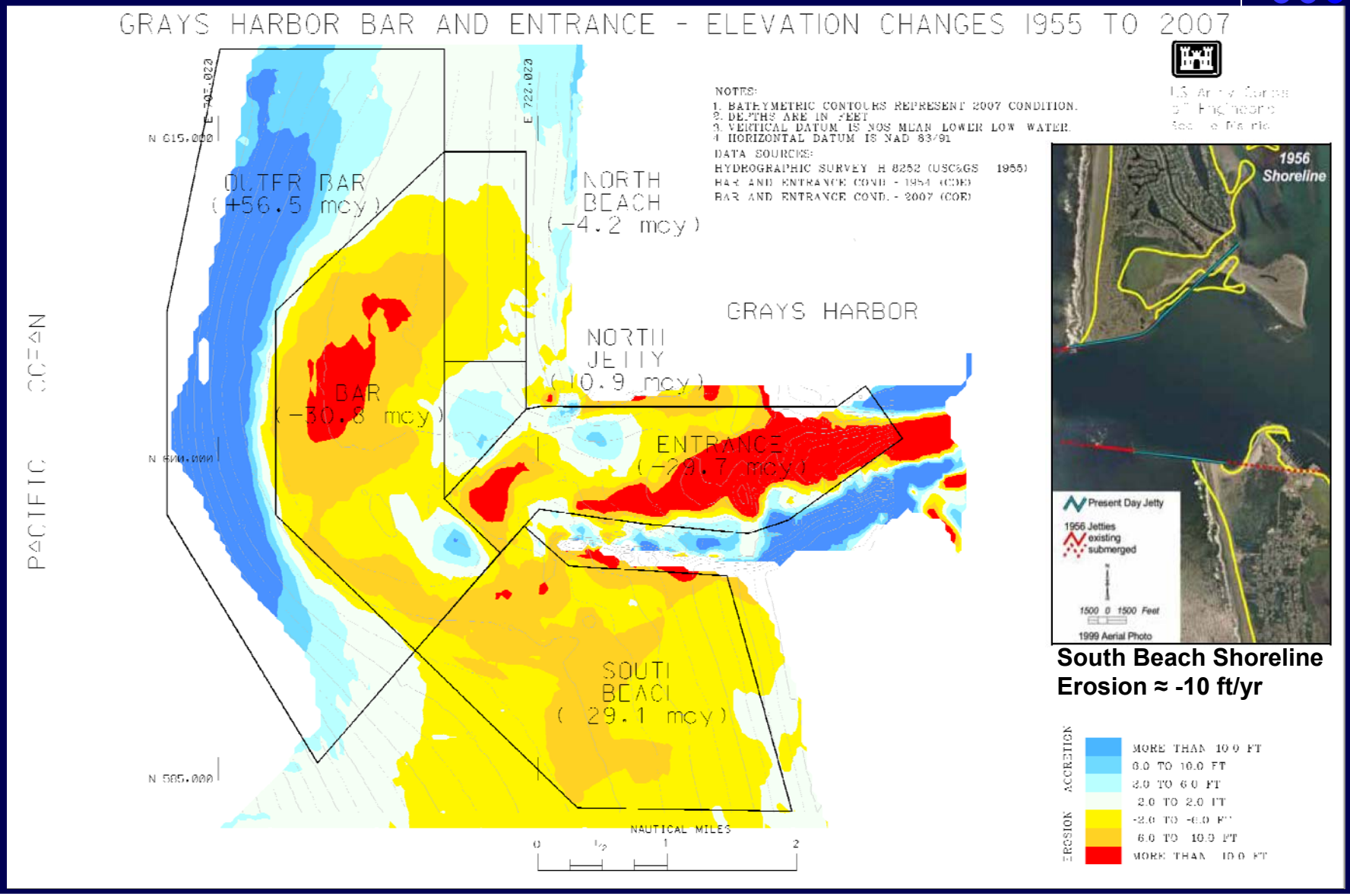
South Beach ≈ 7500 ft

History – Formation of Half Moon Bay



from Buijsman et al. (2003)

Recent morphology



South Beach Shoreline Erosion ≈ -10 ft/yr

History – Breach occurs in December 1993

STEADY NARROWING OF SPIT CULMINATES WITH BREACH THROUGH SOUTH BEACH ADJACENT TO SOUTH JETTY

History – Observed impacts of breach

- Large flood tidal shoal forms in Half Moon Bay
- Scour channel adjacent to terminus of south jetty develops

History - Local concerns pressure breach fill (March 1994)

U.S. Army
NEWS RELEASE
Army Public Affairs
Washington, D.C. 20310

FOR IMMEDIATE RELEASE

No. 94-22
March 23, 1994

U. S. ARMY CORPS OF ENGINEERS REPAIRS SOUTH JETTY, WESTPORT

The Department of the Army announced today that the U.S. Army Corps of Engineers will fill a breach in the South Jetty of Gray's Harbor near Westport, Wash., which was caused by the December winter storm surges. The announcement was made by Dr. John H. Zirschky, Acting Assistant Secretary of the Army (Civil Works). The work will be accomplished under the Protection of Navigation Structures authority in the Corps Operations and Maintenance General Program.

Dr. Zirschky said, "This project is not an emergency, but it will alleviate local concerns that the more than 600-foot breach is carving beach frontage away from the Westhaven State Park." The Corps will fill the breach with dredged material, assuming all environmental coordination and permits can be obtained by the local Westport community within approximately 60 days.

Along with filling the breach with dredged material, the Army will ask the Coastal Engineering Research Board and Waterways Experiment Station to conduct a comprehensive study to determine the most appropriate long term solution. Without additional measures the breach may reopen. This interim measure will help protect the beach while additional studies are completed.

-END-

Corps agrees to repair breach at South Jetty

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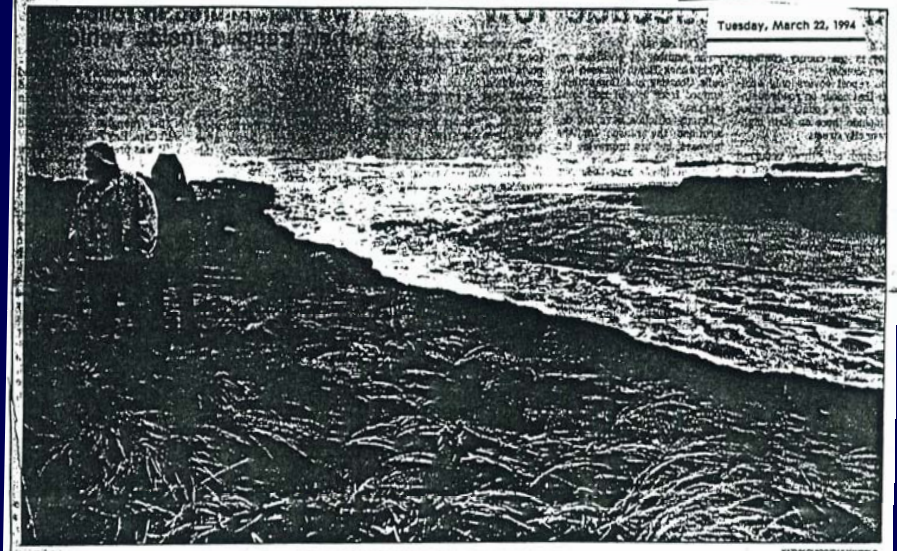
Tuesday, March 22, 1994



KATHY QUIGG/DAILY WORLD

Curious onlookers gathered in December to see the channel that savage waves carved between the South Jetty and the mainland.

Lawmakers team up to push project

By Barbara Henry
Daily World writer

WESTPORT — The ever-growing gap between the South Jetty and Westhaven State Park will be plugged, four federal lawmakers promised today.

The U.S. Army Corps of Engineers gave final approval this morning to a plan to fill the 600-foot wide channel between the jetty and the park with sand collected during harbor dredging this year, the lawmakers announced.

The Corps' decision to fill the breach was prodded by Sens. Patty Murray and Slade Gorton and Reps. Norm Dicks and Jolene Unsoeld. They demanded a solution to the problem in a March 7 letter addressed to the assistant secretary of the Army, which oversees the Corps.

The lawmakers called the situation "potentially devastating" and called for immediate action.

The letter followed a Washington, D.C., visit from Westport Mayor Doug Merino, Public Works Director Fred Chapman and Cliff Muller, executive director of the Port of Grays Harbor.

Since March 7, Gorton, Murray, Unsoeld and Dicks have held two conference calls with John Zirschky, the assistant secretary of the Army. The final decision came this morning, they said.

"Finally," said Unsoeld, "the delays and foot-dragging are over and there is a realization that it's cost effective to act today rather than spend huge amounts of money on a bigger problem tomorrow.

"We've cut through the bureaucracy to keep the potentially devasting breach at Westport from getting wider and deeper," the Democrat from Olympia added. "The people of Westport are the winners here, and now we're ready to make this situation better instead of worse."

Dicks, the Bremerton Democrat who represents the 6th District, said the situation was "an emergency case in which prompt federal action was both necessary and justified. The damages that could have resulted would have been devastating to Westport."

Sen. Murray, the freshman Democrat from Seattle, said, "We had to make it clear to the Corps that the ship channel, and public and private property the jetty protects are too important to wait and see if nature could correct the problem."

Sen. Gorton, the two-term Republican from Olympia, commented, "I expect the delegation to keep the pressure on the Corps to implement a long-term solution to the entire problem."

The channel between the jetty and the park at Half Moon Bay was created in mid-December during a savage storm. It has continued to grow and now threatens the city's sewer treatment plant and wells.

Unsoeld's press aide, Doug Levy, said the lawmakers hope this will be the start of longterm solution to fix the erosion problem.

"The Corps has agreed to act and that's a huge step forward for the community," Levy said, adding that lawmakers would continue to work with the Corps on the problem.

The four lawmakers said that other issues they will continue to discuss with the Corps include realigning the entrance channel to the Harbor and extending the revetment from the marina to the South Jetty.

The Corps' decision involves only this year's dredging, Levy said, adding that the Corps will use existing funds to pay for the project.

Lt. Col. Randall Inouye of the office of the assistant secretary's of the Army confirmed today that the Corps planned to fill the gap, but said the responsibility now lies with the city to secure the needed permits.

Dredging may not begin until the summer, Inouye said.

Mayor Merino and the public works director were in conference this morning discussing what their next steps will be.

"If it were to fall under an emergency (category), then the permit

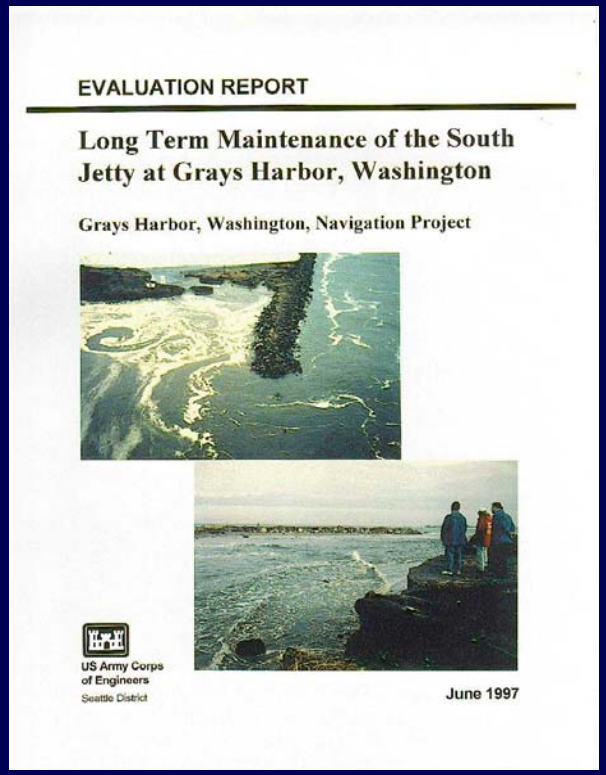
See CORPS, A-6

History – Breach filled late 1994

Grays Harbor Long-term Management Study (LTMS)

Problem Statement:

Assess the threat of a breach to the federal navigation project and recommend the most appropriate long-term strategy to maintain and protect federal navigation project features.


EVALUATION REPORT

Long Term Maintenance of the South Jetty at Grays Harbor, Washington

Grays Harbor, Washington, Navigation Project

US Army Corps of Engineers
Seattle District

June 1997

Challenges

- Large uncertainty involving breach dynamics
  - Estimated threat to the navigation features has largely relied on engineering judgment
- O&M Authority
  - 1993 breach occurred on accreted land
  - Protective measures for storm damage reduction is limited to historic land (not accreted land) without local cost-sharing
- Environmental constraints
  - Prior plan to extend jetty was halted in 1997
- Low public trust

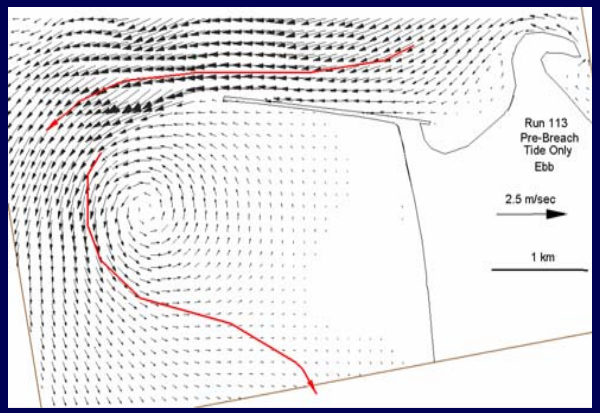
Opportunities

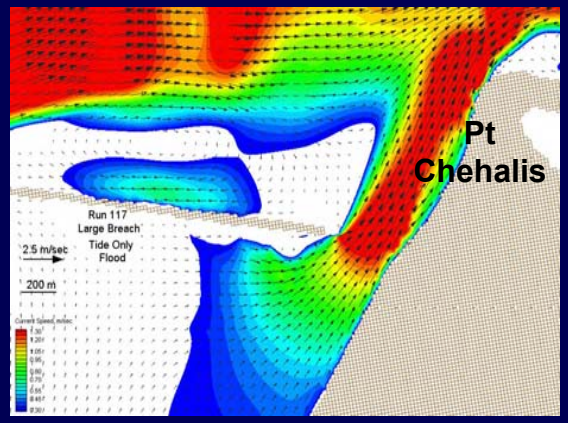
- Evaluate plan alternatives while incorporating uncertainties surrounding a breach
- Address potential system-wide consequences
- Risk-Informed Decision Framework (RIDF)
  - Example: Louisiana Coastal Protection and Restoration (LACPR)
- Multi-Criteria Decision Analysis (MCDA)

Risk Analysis

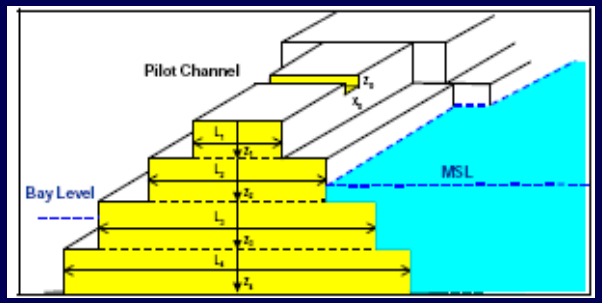
Potential consequences of a breach

(1) Damage to the south jetty.
(2) Damage to the Pt. Chehalis revetment and groins.
(3) Increases in annual O&M dredging.
(4) Adverse impacts to navigation safety.
(5) Large scale changes to sediment pathways impacting the sediment supply to the north jetty.





from Wamsley et al. 2006



Time to develop into threat?
ITR concludes: limited data available to calibrate breaching model. Uncertainties regarding breach evolution remain.

LTMS Plan Alternatives

- Current practice (periodic breach fill maintenance)
- Beach nourishment of South Beach and Half Moon Bay
- Modified jetty extension
- No preventative action (i.e. close breach when threat to navigation features are observed)

<u>Metrics used for plan evaluation</u>

1. Annual maintenance costs
2. Residual risk
3. Sustainability
4. Environmental acceptability
5. Local acceptability

Risk analysis for without project condition (Scenario Analysis)

Scenario development

Scenario 1: Present condition

Scenario 2: Re-aligned channel

Scenario 3: Larger storm intensity

Scenario 4: Sea level rise

Scenario 1: A breach occurs through South Beach into Half Moon Bay and the navigation channel is its current alignment. The breach is defined as a hydraulic connection between the ocean and bay during mean tide. The following summarize plausible consequences to the navigation project in the event of a breach. The associated probability and severity of the consequence are listed to convey the likelihood of occurrence and the magnitude of the consequence should it occur

Risk	**Severity of Consequence** lo 1	2	3	4	hi 5	**Probability** hi 5	4	3	2	low 1
1. The breach prohibits safe navigation before annually scheduled dredging commences					X					
2. Increased shoaling in the navigation channel occurs from the breach requiring greater volumetric quantities of maintenance dredging		X								
3. Currents through the breach begin to undermine the root of the south jetty creating jetty failure					X					
4. Pt. Chehalis revetment and groins are damaged from greater wave/current energy associated with the breach					X					
5. Westport marina breakwaters are damaged from increased wave energy				X						
6. New flow patterns alter sediment bypassing around the head of the south jetty. Littoral drift to the north is disturbed resulting in adverse impacts to the north jetty (i.e. scour, larger waves, etc.) .				X						

Risk-Informed Decision Framework

Inventory and forecast conditions

Qualitative (Scenario Analysis) **Quantitative (Beach-fx, Monte Carlo, etc.)**

PRESENT → **FUTURE**

- Relies on engineering judgment
- Subjective
- Can be difficult to estimate and communicate residual risk
- Can be subject to scrutiny

GOOD

- Probability based
- Robust
- Confidence of residual risk bounded

GREAT

Risk based support tool needs

- <u>Coastal structure and dune reliability</u>

1. Better understanding of time component of damage progression for different failure modes

2. Validate and implement physics-based beach/dune response models forcing life-cycle tools (i.e. Beach-fx)

3. Re-think use of stationary probability distributions functions for extreme value waves and water levels.

4. Invest in long-term morphological predictors (analytical & numerical)

Risk based support tool needs

- <u>Performance metrics & limit states</u>

1. Minimum acceptable levels need to be determined
   - Coastal structure damage
   - Navigation safety
   - Flood risk

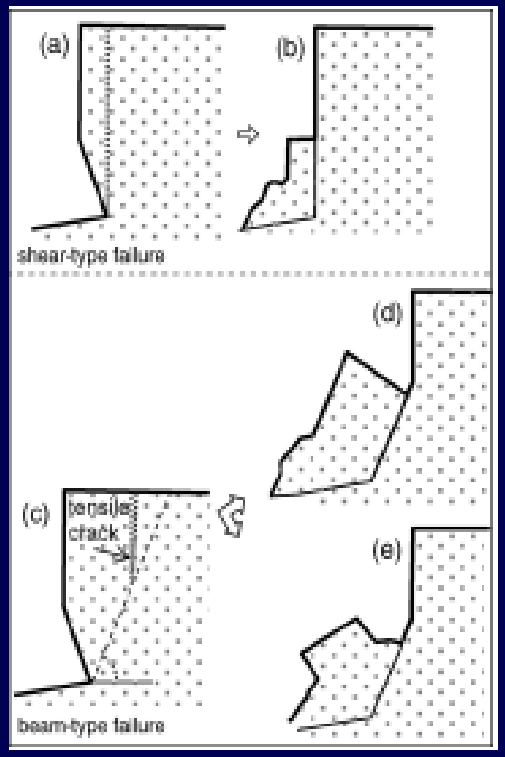
Seek input from FEMA, U.S. Coast Guard, PIANC, and ASCE

Questions?

Back-up slides

Damage Types – Dune Failure

Toe undercutting by wave notching



Eriikson et al (2007)

Half Moon Bay Shoreline

South Beach shoreline

Dune overwash / breaching

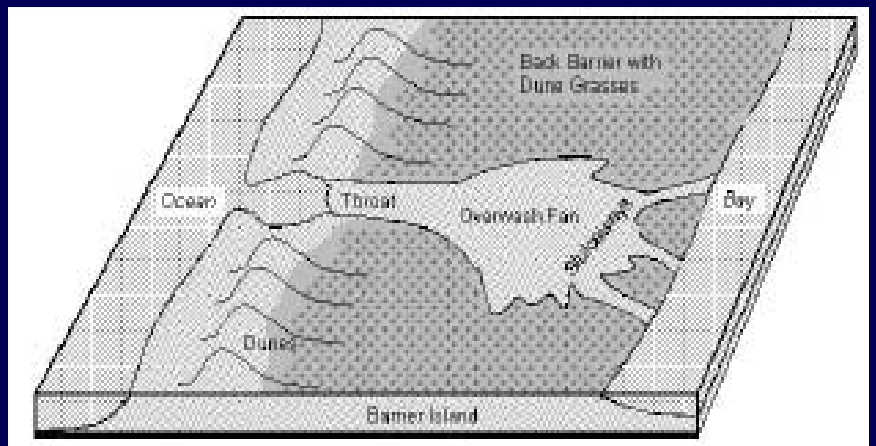
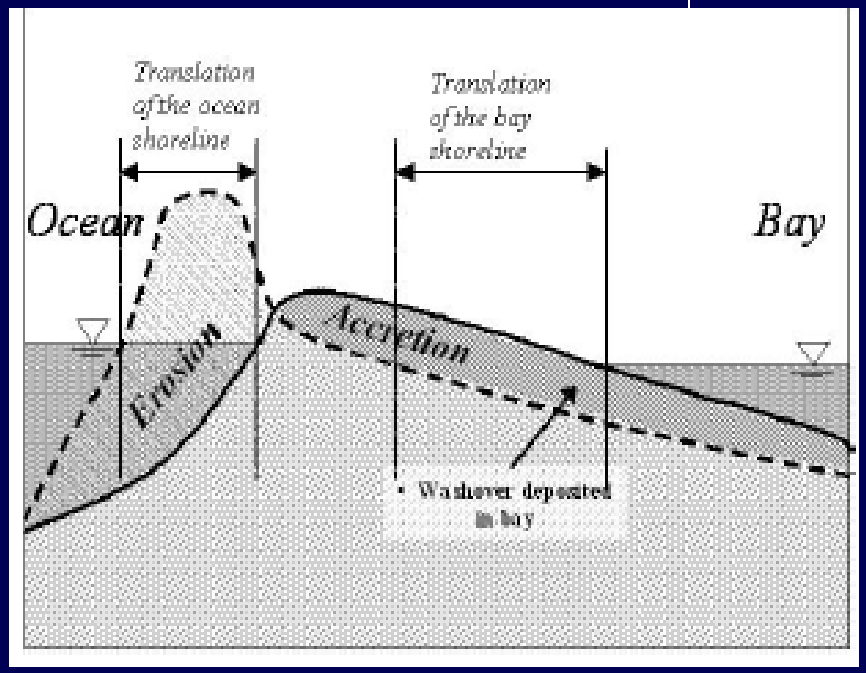


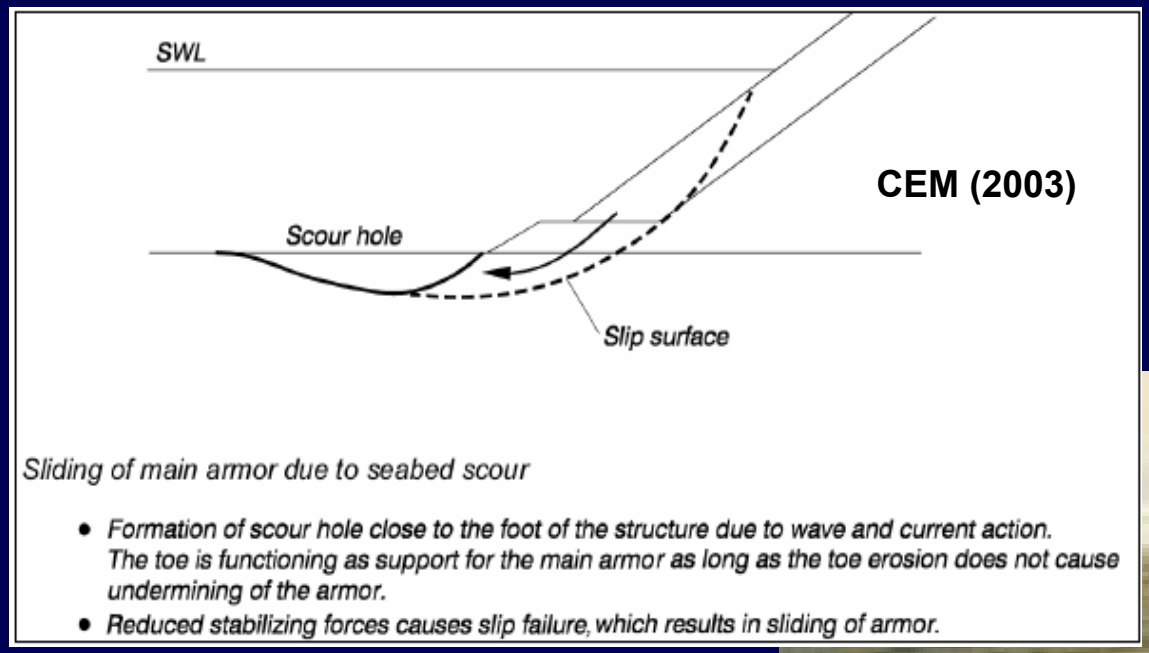
Figure 6. Schematic showing typical overwash fan morphology.



From Donnelly et al. (2006)

Grays Harbor Breach (Aug 1994)

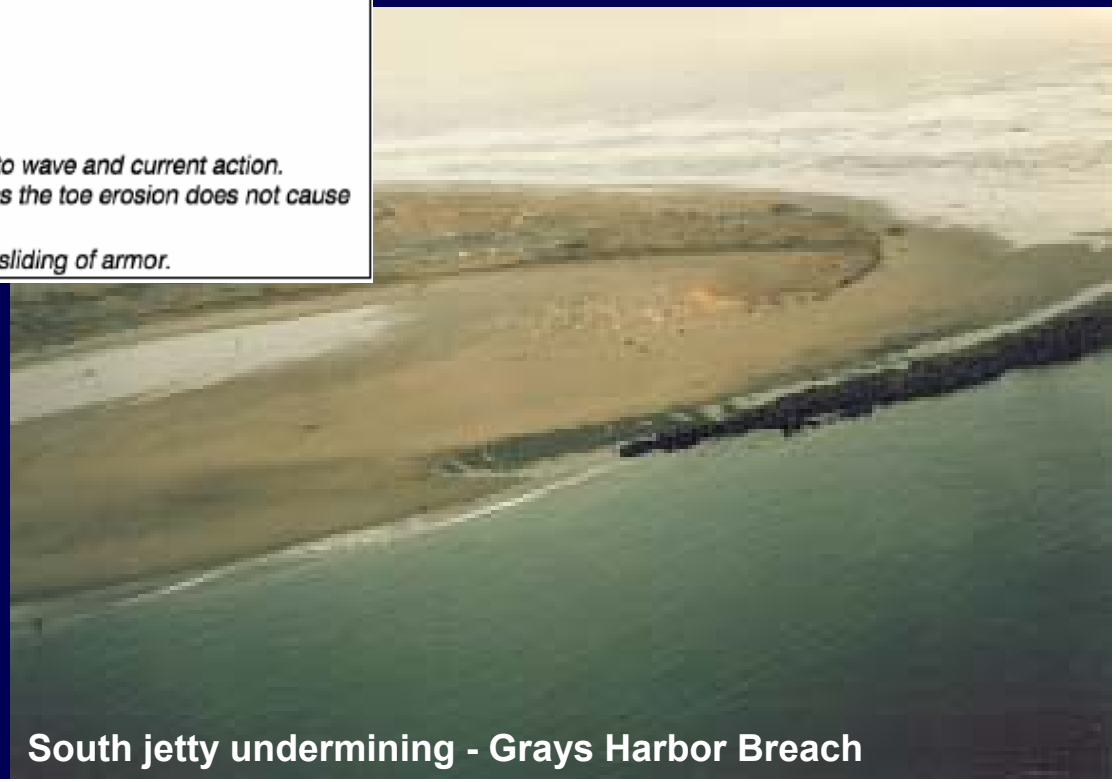
Coastal Structure Failure – Toe undermining



CEM (2003)

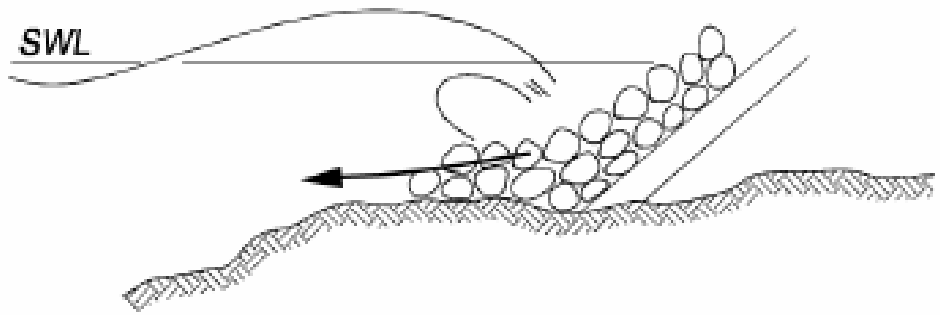
Sliding of main armor due to seabed scour

- *Formation of scour hole close to the foot of the structure due to wave and current action. The toe is functioning as support for the main armor as long as the toe erosion does not cause undermining of the armor.*
- *Reduced stabilizing forces causes slip failure, which results in sliding of armor.*



South jetty undermining - Grays Harbor Breach

Coastal Structure Failure – Toe displacement



CEM (2003)

Instability of toe and foot of armor in shallow water when placed on hard seabeds and exposed to wave breaking

- *The forces from breaking waves cause displacement of the blocks unless they are several times heavier than conventional toe blocks and heavier than the main armor blocks. On smooth rock surfaces it is necessary to bolt or anchor the toe block if a trench is not made.*