Mouth of the Columbia River Jetties
Three-Phase Construction Plan

Project Overview

October 9, 2012
3 MAR 1999 - Tropical Storm

29 AUG 2005 - Hurricane
UNIQUE CHALLENGES for Jetties & Navigation at the Mouth of the Columbia River

MCR is a zone of interaction between severe forces – regular occurrence

Normal River Flow = 100,000 – 400,000 cfs
Average Tidal Range = 8 ft, occurring 2x daily
Average Wave Height during Oct. – April = 11 ft

OR-WA coast exposed to an average of 4 hurricane-like storms per year
11 such storms may occur in a given year having waves > 22 ft high

Storm Surge = 3 to 5 ft + Transient set-up of 2 to 5 ft
Storms: SUN (13 NOV) and WED (15 NOV) 2006

Tide at 1.5 ft MLLW

Tide at 3 ft MLLW

1100 PST

Hourly-averaged Wave Height
5-DAYS During November 2006
"Open" Coast Storm Surge Comparison
Hurricane (GOM) vs. Extr. Low (PacNW)

Days during Storm

Total Surge Level, ft

Toke Pt, WA
SW Pass, LA
Three-Phase Construction Plan

1. South Jetty dune augmentation/stabilization

2. North Jetty: lagoon fill and critical repairs

3. Major rehabilitation of all three jetties
South Jetty: The Observed Historic Movement of the Shoreline
FY 13 (PBUD): South Jetty
Dune Augmentation/Stabilization

- South Jetty Root & Trestle Bay: $5.5M
- Letter report, P&S, beach material placement
- Without-project condition (separate from major maintenance and rehab construction)
MCR North Jetty - Construction and Repair History

(Has receded approximately 1800’ in length since 1916.)
North Jetty Lagoon Fill

- Losing:
  - 1.14 acres of wetlands
  - 4.71 acres of waters of the U.S.
- Locating, developing mitigation site
  - Replacing jetty road culvert
  - Redirect stream away from lagoon wetlands
  - Redirect overland flow away from jetty root; stabilize foundation
Second Phase of Construction: MCR North Jetty – FY 13 Capability, O&M

Major Maintenance Report supports two separate actions:

(1) Lagoon Fill: $10.84M ➔ stabilizes jetty’s foundation
(2) Critical Repairs: $14.15M ➔ rehabs degraded reach
Major Rehabilitation Plan, CG

- Major Rehabilitation Report (MRR) supported actions for all three jetties
- Based on stochastic, risk-based numerical model using design waves.
- The sequence and magnitude of seven-year rehab plan will be adjusted based on jetty monitoring triggering immediate repairs: 35% remaining x-section above -5 MLLW.
- No spur groins included in the current design—head stabilization for the North Jetty and Jetty A.
- District will obtain environmental permitting per forecasted construction schedule.
- Fully funded, feasibility level design in 2012 dollars: total project costs will be approximately $257M over a seven-year construction schedule—which is funding dependent—from 2014 through 2020.
- Overall costs are estimated as follows: North Jetty at $80M; South Jetty at $147M; and Jetty A at $30M.
Major Rehabilitation Plan, CG

Benefit-to-Cost Ratio (BCR), Major Rehabilitation Report

North Jetty:  1.09
South Jetty:  1.00 ➔ ➔ ➔ System BCR: 1.10
Jetty A:  1.42

• The project’s base condition theoretically prevents a jetty breach; project navigation benefits aren’t at risk.

• The major rehab effort doesn’t produce a high benefit-to-cost ratio because the project prevents a jetty breach and sediment from blocking the navigation channel.

• With inclusion of the base condition as the recommended plan for the South Jetty, project feature benefits are essentially treated as equaling costs, despite substantial benefits of maintaining navigation at the project.

• Protecting the Columbia River navigation channel entrance (105 miles, 43 feet deep; $182M channel-deepening project completed in 2010) and the Columbia/Snake River system is paramount.

• Over $20B of cargo annually travels through the entrance protected by MCR Jetties; and over $900M in new infrastructure investment has been made to date in the Pacific Northwest since 2010.
Mouth of the Columbia River Jetty System Rehabilitation - Selected Plan
(Construction Schedule: For stone placement on Jetties and existing stone re-work)

Tons of Stone (1000 tons)

- Year 2015: 92
- Year 2016: 99
- Year 2017: 53
- Year 2018: 104
- Year 2019: 102
- Year 2020: 91
- Year 2021: 99
- Year 2022: 103

Does NOT include stone tonnage associated with North Jetty root stabilization (lagoon fill) and jetty spur-groins for North Jetty, South}

Construction Year


- Jetty A - Scheduled Repairs Hold Length
- North Jetty - Scheduled Repairs Hold Length
- South Jetty - Base Condition
NORTH Jetty
Actual Year by Tons Placed
Previous and Future Project Conditions

Initial Construction
Rehabilitation
Repair
Repair

Selected Plan - MRR
JETTY "A"
Actual Year by Year Tons Placed
Previous and Future Project Conditions

Initial Construction
Rehabilitation
Repair
SCHEDULED REPAIR
Selected Plan - MRR

Year

Tons
0 50,000 100,000 150,000 200,000 250,000

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SOUTH Jetty
Actual Year by Year Tons Placed
Previous and Future Project Conditions

Added Construction (sta. 250-375)

Rehabilitation

Repairs

Repair

Repairs

Initial Construction (sta. 2-250)

Year

Tons

0  100,000  200,000  300,000  400,000  500,000  600,000


FUTURE BASE CONDITION

Selected Plan - MRR
MCR Major Rehab
North Jetty, Pacific County, Washington
Potential Offloading, Staging, Storage & Causeway Facilities

Legend
- Wetlands Impacted
- Study Area
- Causeway
- Construction, Staging & Storage Areas
- Crane Selpads
- Turnouts
- Dredging Area
- Potential Offloading Facility
- Wetlands (Tetra Tech Delineation)
- Ocean Disposal Area

Notes:
1. Location of dredging area and offloading facility may vary within work area.
2. Habitat areas are to be avoided where feasible during construction.

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Jetty Cross-Section Damage
Documented Using Jetty Topography
Developed from Aerial photography

Example for Assessing Condition of MCR Jetties using Survey data:
- Evaluate Need to Initiate Repairs (based on damage threshold)
- Calculate the Amount of Jetty Damage (for Repair Estimate)
Example of Undamaged Jetty Surface (design template) - Contour Lines
Plan View

**Channel Side of Jetty**

**Ocean Side of Jetty**

BLUE Lines indicate surface elevation of FULL Undamaged Jetty Template for -10 ft, 0 ft, and 25 ft elevation
Example of Damaged Jetty Surface - Contour Lines
Plan View

RED Lines indicate elevation of DAMAGED jetty surface for 0 ft, 10 ft, and 25 ft elevations

Elevation in ft MLLW OR SPCS, north NAD83, ft

3,200 ft
Example of Comparing
Undamaged Jetty Surface to Damaged Jetty Surface Contour Lines
Plan View

Channel Side of Jetty

Ocean Side of Jetty

3,200 ft

BLUE Lines indicate surface elvation of FULL UndamagedJetty Template
for -10 ft, 0 ft, and 25 ft elevation

RED Lines indicate elevation of DAMAGED jetty surface
for 0 ft, 10 ft, and 25 ft elevations
Example of Calculating Damage to Jetty
By subtracting the Damaged Jetty Surface from the Undamaged Condition Plan View

BLUE Lines indicate surface elvation of FULL Undamaged Jetty Template for -10 ft, 0 ft, and 25 ft elevation

Elevation in ft MLLW
OR SPCS, north NAD83, ft
Jetty Cross Section Status

--- Continue to Assess Jetty Condition with Bi-annual Monitoring Surveys ---

- **FULL Jetty Template**
- **Observed Jetty Condition: 20% Damage**

**80% of the cross-section remaining**
Above -5 ft MLLW (upper cross-section)

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Elevation, ft, MLLW
Distance, ft

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Damage to Jetty Cross-section
Missing Material

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Jetty Cross Section Status **AMBER**

------------- Initiate 2-year Planning Sequence for Jetty Repairs at 40% DAMAGE ------------

**Damage To Jetty Cross-section**

- Observed Jetty Condition: 35% Damage

- 65% of the cross-section remaining Above -5 ft MLLW (upper cross-section)

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[Graph showing the jetty cross-section and damage status]
Jetty Cross Section Status  RED

--------- Jetty has been DAMAGED >> 40%, Initiate Elevated Status for Executing Jetty Repairs ---------

Damage To Jetty Cross-section
Missing Material

30% of the cross-section remaining
Above -5 ft MLLW (upper cross-section)
North Jetty CROSS SECTION Life-Cycle Evolution (1917-2006) for STA =84.5

- **Dynamic Stability**
  - Direct Wave Attack (channel side)
  - Overtopping Damage (channel side)
  - Wave Overtopping Damage (ocean side)
  - Direct Wave Attack (ocean side)

- **Slope Failure**

- **Toe Scour**

- **Static Stability**

**Blue = initial condition (IC) 1917**

**Distance from Centerline, ft**
-150 to 150

**Elevation, MLLW, ft**
-60 to 0

**UPPER Cross-section**

**LOWER Cross-section**

**CHANNEL SIDE**

**OCEAN/BEACH SIDE**
### Jetty Maintenance Scenario

<table>
<thead>
<tr>
<th>Jetty</th>
<th>Template Area* ft², above WAV_EL = -5 ft</th>
<th>WAV_EL, ft MLLW</th>
<th>Crest Elevation, ft MLLW</th>
<th>Crest Width, ft</th>
<th>Side slope (rise,v : run,h) Channel / Ocean</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Jetty</td>
<td>2250</td>
<td>max(-5 , TE+2)</td>
<td>25</td>
<td>30</td>
<td>1:1.5 / 1:1.5</td>
</tr>
<tr>
<td>South Jetty</td>
<td>2475</td>
<td>max(-5 , TE+2)</td>
<td>25</td>
<td>30</td>
<td>1:2 / 1:1.5</td>
</tr>
<tr>
<td>Jetty A</td>
<td>1687</td>
<td>max(-5 , TE+2)</td>
<td>20</td>
<td>30</td>
<td>1:1.5 / 1:1.5</td>
</tr>
</tbody>
</table>

**Thresholds for Jetty Maintenance – Based on Remaining % of Cross-Section Area**

<table>
<thead>
<tr>
<th>Jetty Maintenance Scenario</th>
<th>Normal Jetty Segment REPAIR</th>
<th>Jetty Segment Hardship</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UPPER Threshold to Enact Repair</td>
<td>LOWER Threshold to Enact Repair</td>
</tr>
<tr>
<td>Just-in-Time (fix-as-fails)</td>
<td>25 - 30%</td>
<td>n/a</td>
</tr>
<tr>
<td>Scheduled –V</td>
<td>Variable (25 – 65%)</td>
<td>4 yrs</td>
</tr>
<tr>
<td>Interim Repairs</td>
<td>25 - 40%</td>
<td>n/a</td>
</tr>
<tr>
<td>Scheduled – F</td>
<td>62 - 72%</td>
<td>4 yrs</td>
</tr>
</tbody>
</table>
MCR Jetties: Key Messages

(1) FY 13: South Jetty dune stabilization/augmentation; PBUD (O&M) -- $5.5M
   • South Jetty Root & Trestle Bay
   • Detailed Design Report, P&S, placement of beach material
   • Without-project condition (separate from 7-year construction plan)

(2) FY 13: North Jetty lagoon fill, Capability (O&M) -- $10.84M
   • Stabilizes North Jetty root
   • Supported by FY 11 Major Maintenance Report

(3) FY 13: North Jetty critical repairs, Capability (O&M) -- $14.15M
   • Repairs to STA 86 – 99, authorized cross-section
   • Supported by FY 11 Major Maintenance Report
(4) FY 14: Jetty A Rehabilitation, Capability (CG) -- $22.90M
   • Detailed Design Report, Plans & Specifications, Contract Award
   • Construction in FY 15, STA 48-84
   • Supported by FY 12 Major Rehabilitation Report

(5) FY 14: North Jetty Rehabilitation, Capability (CG) -- $23.65M
   • Detailed Design Report, Plans & Specifications, Contract Award
   • Construction staging and delivery of rock; FY 15-17 construction
   • Supported by FY 12 Major Rehabilitation Report

(6) FY 14: Jetty head stabilization, Capability (CG) -- $550k
   • Physical wave tank modeling for optimizing jetty head design
   • Supported by FY 12 Major Rehabilitation Report