Presentation Outline

• Review of Erosion Screening Process
• Modifications for LAR Application
• ESP LAR Results
• Recommendations
ESP Background

- AECOM November 17, 2015 Presentation
- General Purpose
- Caveats and Limitations
- Three Tiers or Steps
- Cross Section Based
- Total Erosion (Wind and Waves)
ESP Tier 1 Analysis

- Pass/Fail Analysis
- Soil Erodibility
- Levee Geometry
- Fetch length
- Historical Performance
ESP Tier 1 Levee Geometry

3' freeboard

Median 200-Year Water Surface Elevation

Typical Existing Levee Section

20'

Berm width prior to erosion

Standard Riverine Levee Prism Geometry
Waterside Bank Slope 3H: 1V
Landside Bank Slope 2H: 1V

Overly steep levee slope and receding berm intruding into the levee prism represents an infringement of the levee geometry, requiring a response to repair the intrusion.

Toe or bank scour intruding into the levee prism represents an infringement of the levee geometry, requiring a response to repair the intrusion.

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ESP Tier 2 Analysis

- Pass/Fail Analysis
- Applied vs Critical Velocity
- Applied vs Critical Shear (wind)
- Field Reconnaissance
ESP Tier 2 Example (RM 8.5R)

American River RM 8.5
Right levee

Station (ft)

6500 6550 6600 6650 6700 6750 680

Elevation (ft NAVD88)

40 45 50 55 60

Max WSE (unsteady HEC-RAS)
HEC-RAS cross-section
LiDAR
Min levee template (Max WSE+3 ft)
2H:1V
3H:1V

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ESP Tier 2 Example (RM 8.5)

American River RM 8.5

- Max WSE (unsteady HEC-RAS)
- WSE (RMA2 160K)
- Bed (HEC-RAS)
- Bed (RMA2)
- Vel (HEC-RAS)
- Vel (RMA2 160K)

[Graph showing water level and velocity data for American River RM 8.5]
ESP Tier 3 Analysis

- Applied to Sites that fail Tiers 1 and 2
- Horizontal Extent of Wind Wave Erosion
- Horizontal Extent of Velocity Erosion
- Assigns Priorities based on TE/LW
ESP Tier 3 Risk Categories

Diagram showing:
- 200 Year Water Surface
- 3' Minimum Freeboard
- Levee Width (LW)
- Calculated Total Erosion Thickness (TE)
- Levee Toe

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ESP LAR Modifications

- Separate Wind Wave/Velocity Erosion
- Separate Levee/Bank Toe Erosion
- Analyze encroachment into levee prism to assign priorities
ESP LAR Nomenclature

- Landside slope
- Levee top
- Levee embankment
- Levee foundation
- Bench
- Waterside slope
- Flood stage
- River bank
- Bank toe
- Channel bottom

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ESP LAR Data Requirements

- Levee and River Geometry
- 200-Year Hydrograph
- 200-Year Velocities
- Soil Types (levees/foundation)
- Vegetation and Riprap Protection
ESP LAR Geometry
ESP LAR 200-Year Hydrograph

American River

1st Peak (160,000 cfs) = 39 hrs

2nd Peak (115,000 cfs) = 107 hrs (total)
ESP LAR Soils and Slope Cover

- Based primarily on field investigations
- Supplemented by borings, maps showing extent of bank protection
ESP LAR Tier 1 Results

- All sections failed soil erosion susceptibility and fetch tests
- All sections re-considered in Tier 2
ESP LAR Tier 2 Results

• Nearly all sites failed the wind wave erosion test
• All sites re-considered in Tier 3
ESP LAR Tier 3 Calculations

• Horizontal extent of erosion calculated at levee and bank toe
• Erosion only occurs when applied exceed critical Velocities
• Erodibility coefficient for soils (ft$^3$/lb-hour)
• Difference between Applied and Critical Shear Stress
• Duration of the particular flow
# ESP LAR Levee Toe Erosion

<table>
<thead>
<tr>
<th>Erosion (ft) Class</th>
<th>0</th>
<th>0.1 to 5</th>
<th>5.1 to 10</th>
<th>10.1 to 20</th>
<th>&gt; 20</th>
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<tr>
<td>Number of Observations</td>
<td>35</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>5</td>
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</tbody>
</table>
### ESP LAR Bank Toe Erosion

<table>
<thead>
<tr>
<th>Erosion (ft) Class</th>
<th>0</th>
<th>0.1 to 5</th>
<th>5.1 to 10</th>
<th>10.1 to 20</th>
<th>&gt; 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Observations</td>
<td>27</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
ESP LAR Risk Categories

• Based on erosion encroaching into levee template or prism
• High – encroaches into prism
• Medium – close to prism
• Low – distant from prism
ESP LAR Encroachment Example

Median 200-Year Water Surface Elevation

3' freeboard

Berm width prior to erosion

Typical Existing Levee Section

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ESP LAR Erosion Risks
ESP LAR High Risk Sites

- Main risk is erosion into prism at levee toe
- RM 1.75L to 2.25L
- RM 2.65L to 2.85L
- RM 3.75L to 4.25L
- RM 8.2L to 9.5L
- RM 7.0R to 8.5R
ESP LAR Recommendations

- High Risk Levee Embankment: 4 miles
- Lengths approximate
- Critical velocities an issue
- RM 7.0R to 8.5R: Levee erosion risk also bank erosion occurs.
- RM 7.0R to 8.5R: highest priority site for BPWG from ESP