Envelope Curves for Assessing Scour in South Carolina

by

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Envelope Curves for Assessing Scour in South Carolina

- Project Overview -

- Data Collection -

- Predicted vs. Observed -

- Envelope Curves -

Project Objectives

- **Collection of clear-water bridge-scour data**
  - Lower Coastal Plain
    - Swampy
    - Noncohesive sandy materials
  - Piedmont
    - Scour on overbanks
- **Analysis of the data**
  - Compare theoretical scour to observed scour
  - Investigate relations in the observed data
- **Obtain a snap shot of scour in SC**

Historic scour is a good indicator of future scour

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Focused on CLEAR-WATER scour

- Scour hole does not refill
- Allowed site visits at any time (low-flow)
- Focus on older bridges or bridges known to have experienced a significant flood
- Advantage
  - Data collection not dependent on floods
  - Data reflects maximum historic scour
- Disadvantage
  - Uncertainty associated with conditions that caused the scour

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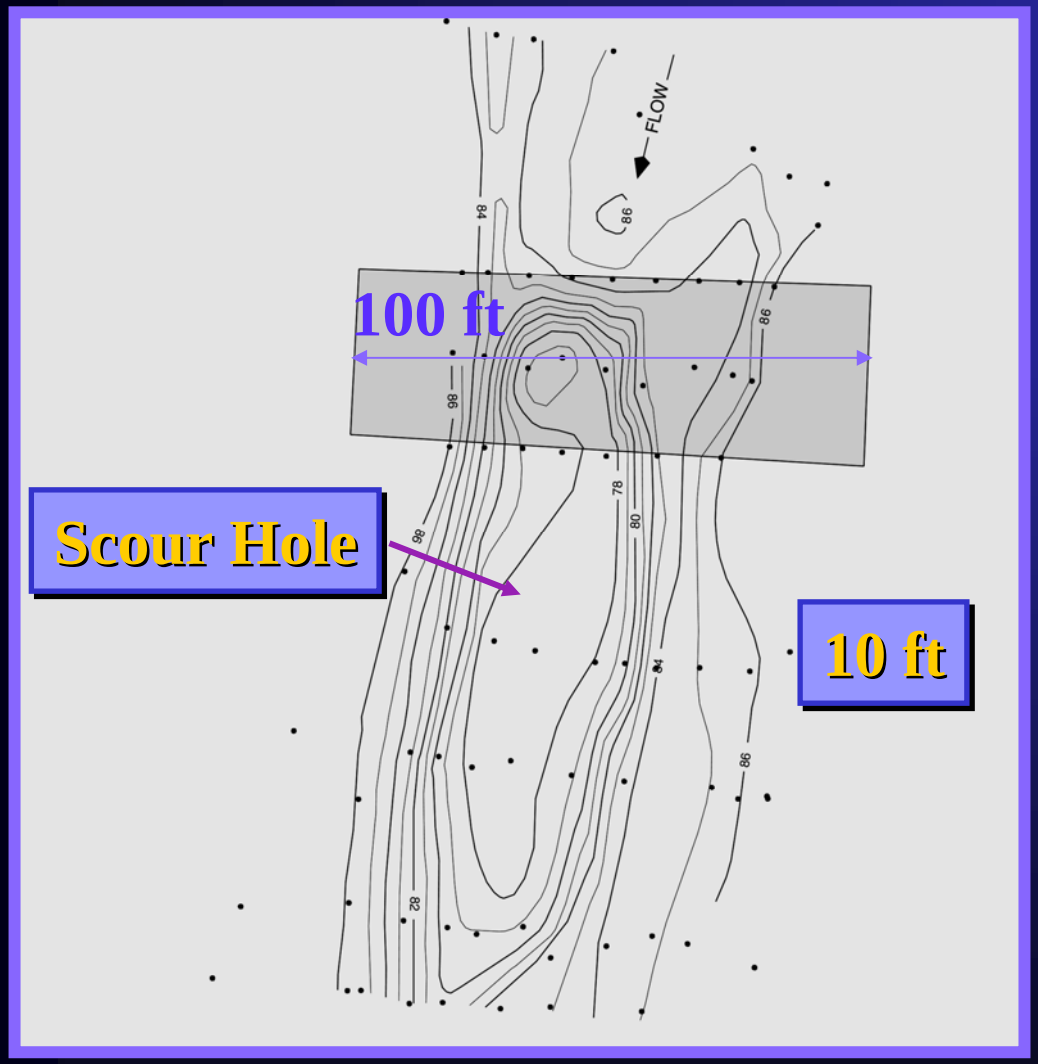
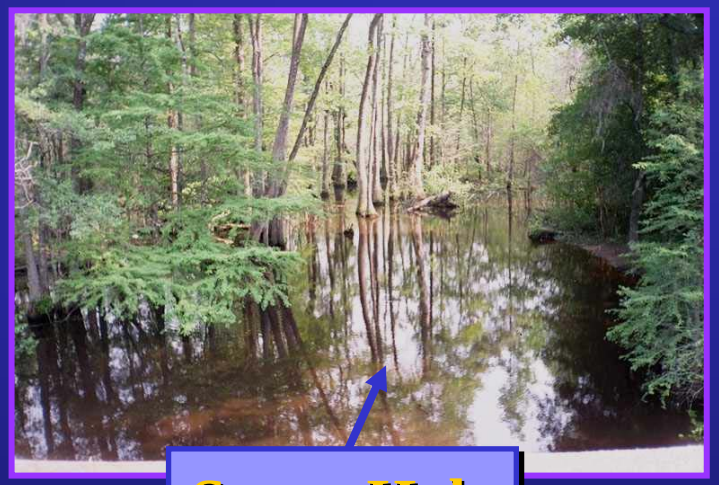
Data Collection

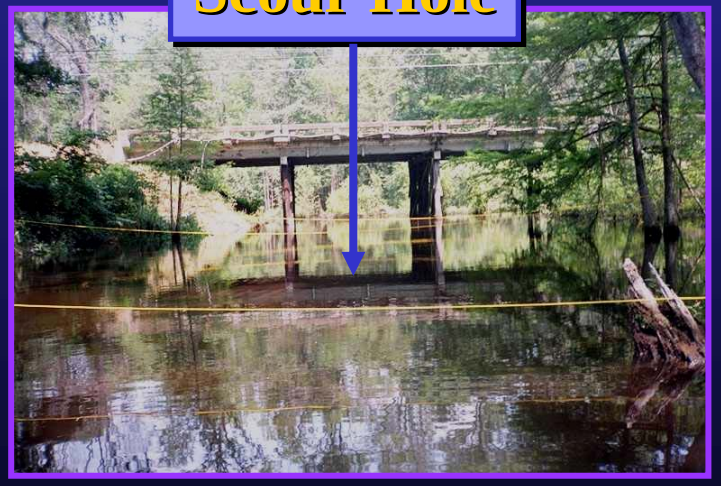
- Abutment Scour
  - Bridges < 240 ft in length
    - 1 scour hole
  - Bridge > 240 ft in length
    - 2 scour holes

Big Swamp at Route SC 51
Florence County, South Carolina

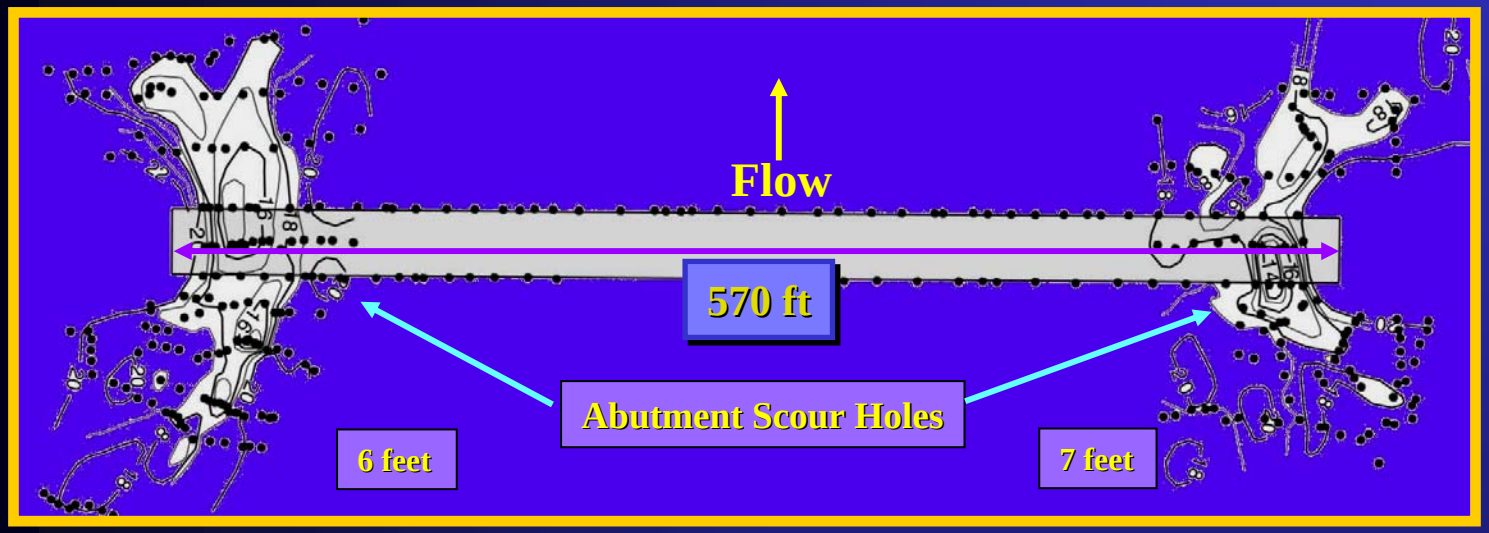


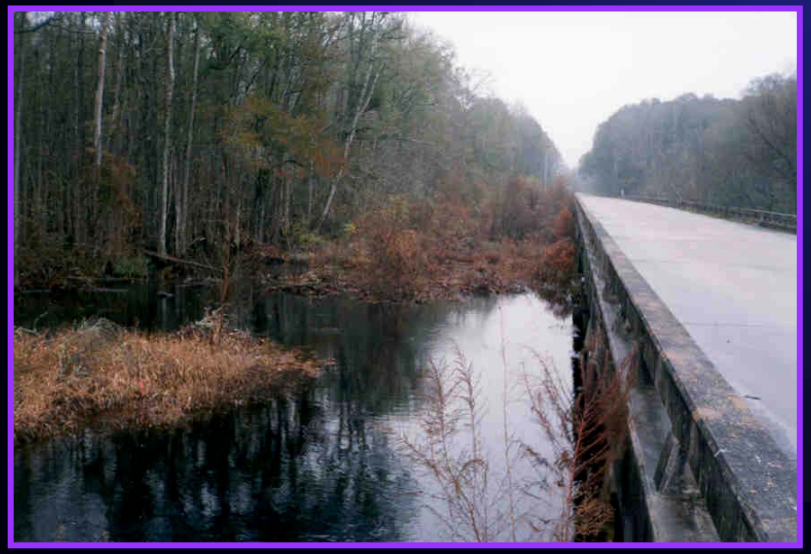


Scour Hole



Coosawhatchie River at Road S-87
Jasper County, South Carolina

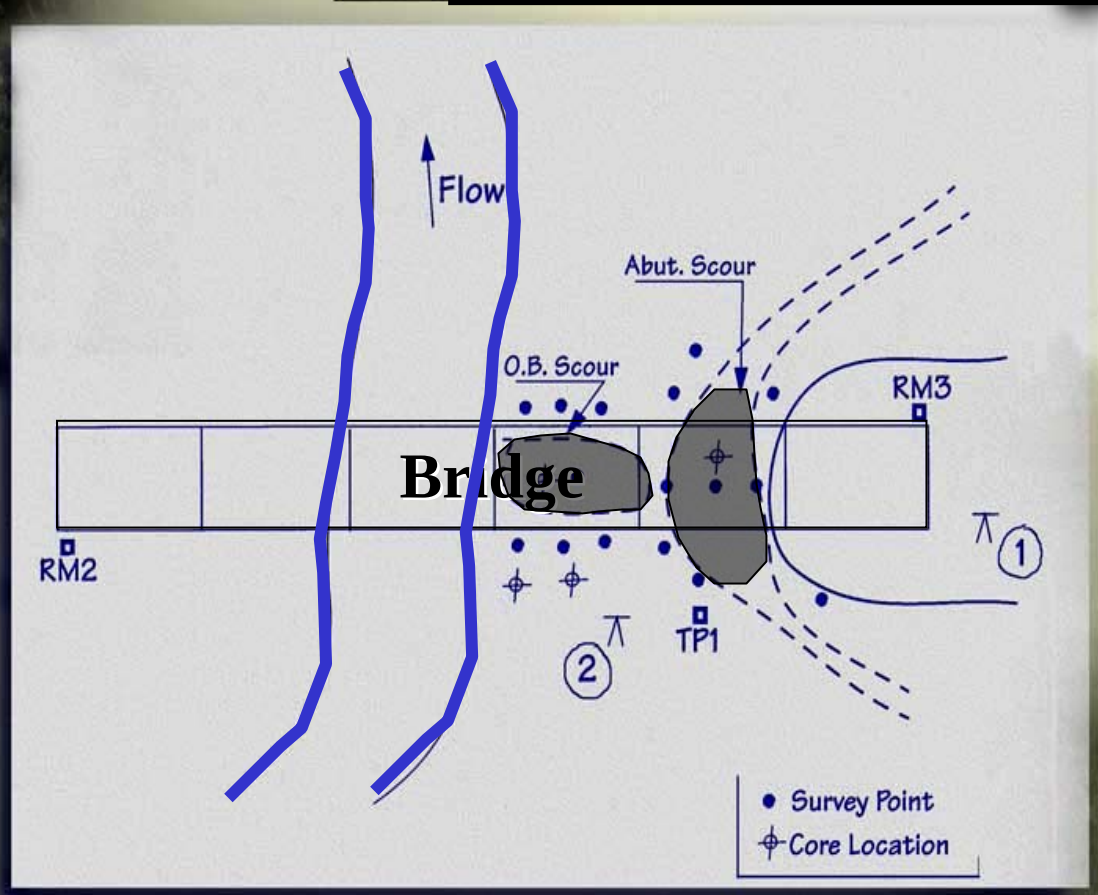




Data Collection

- **Contraction Scour**
  - **Clear-water**

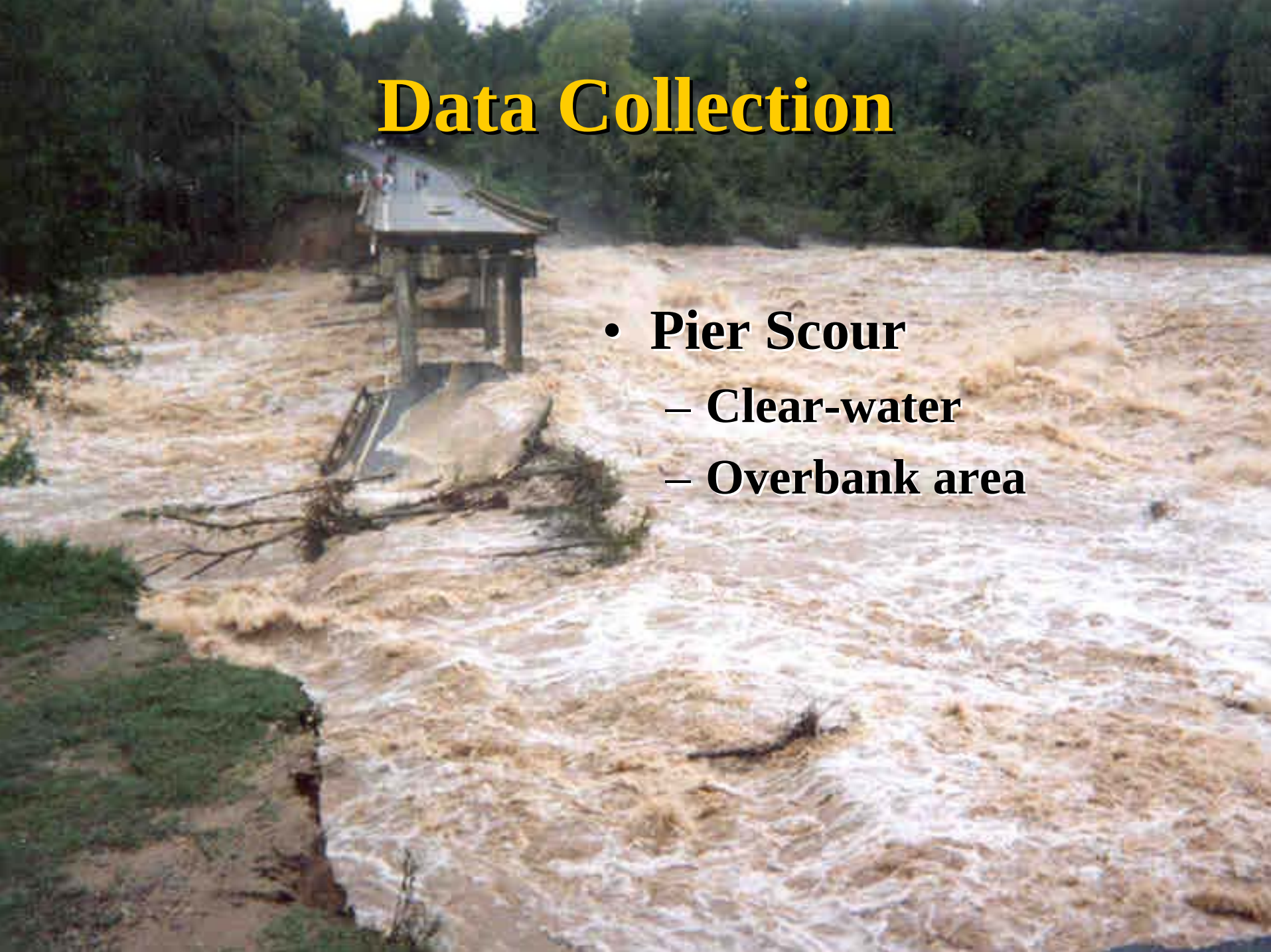
Collection of Overbank Contraction Scour



Collect reference-surface elevation and low point of scour hole

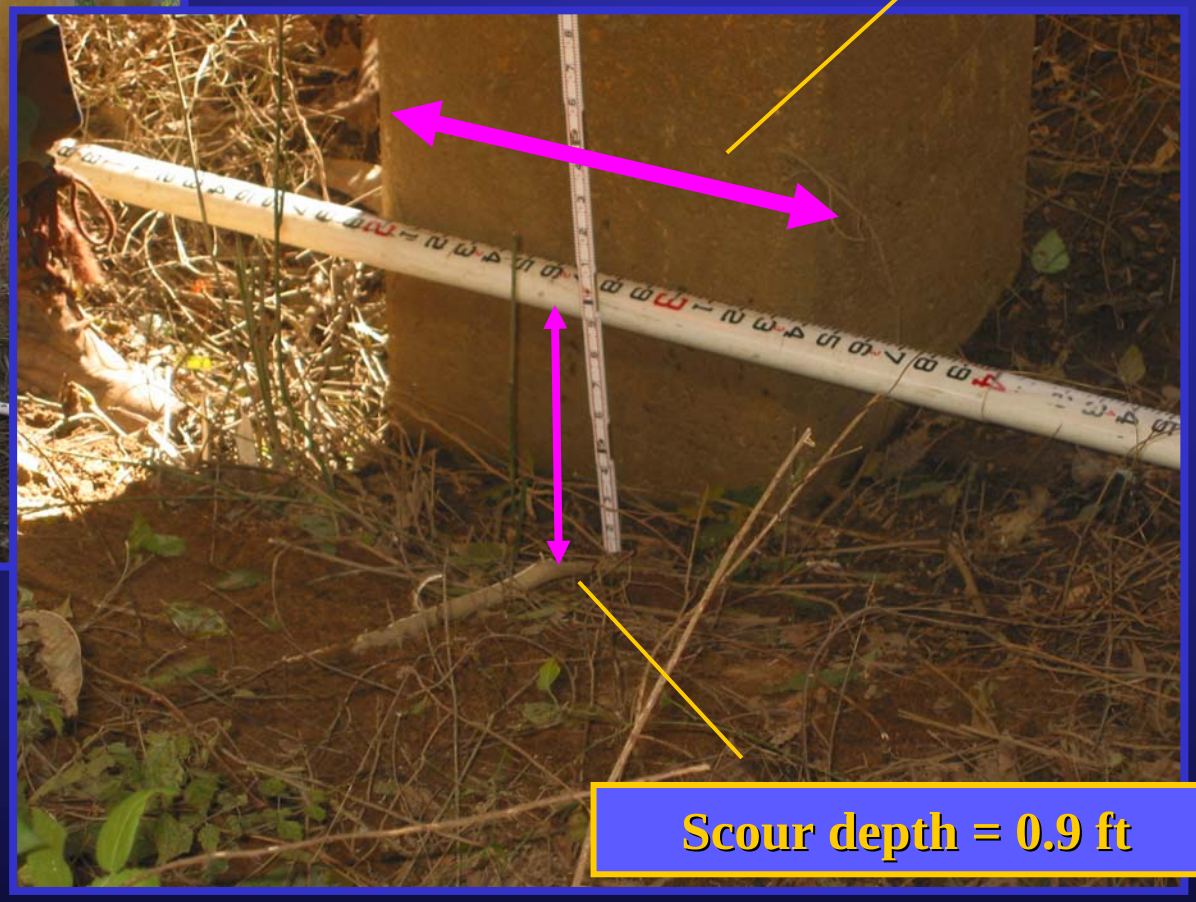
Overbank Contraction Scour in the Piedmont

Data Collection



- **Pier Scour**
  - **Clear-water**
  - **Overbank area**

Pier Scour



Collection of Pier-Scour Data in the Piedmont

Anderson County
Rocky Creek at Rd. S-263

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Collection of Pier-Scour Data in the Piedmont

Fairfield County
Little Wateree Creek at I 77

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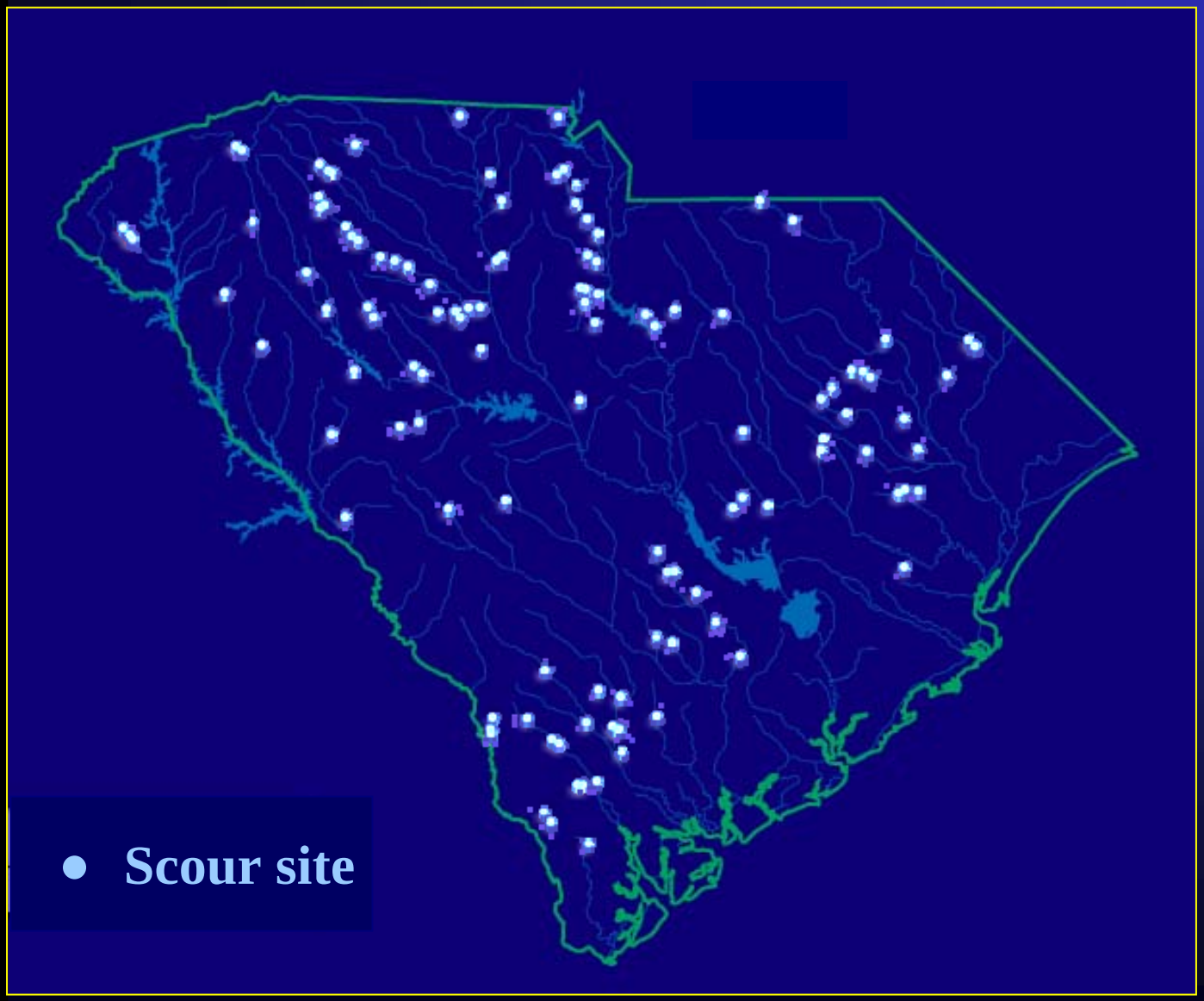
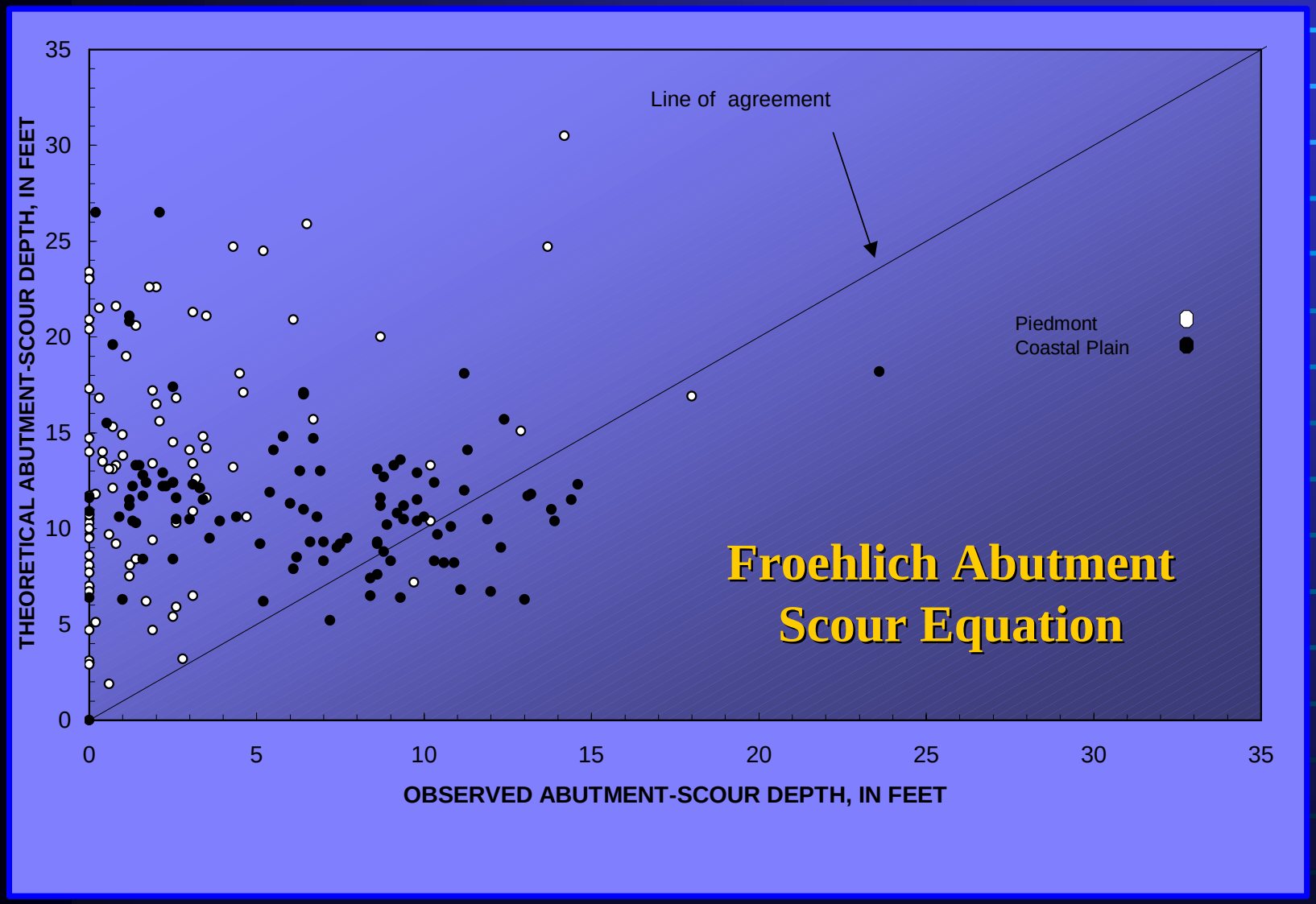
Distribution of Clear-Water Scour Sites



Comparison of Field and Predicted Data



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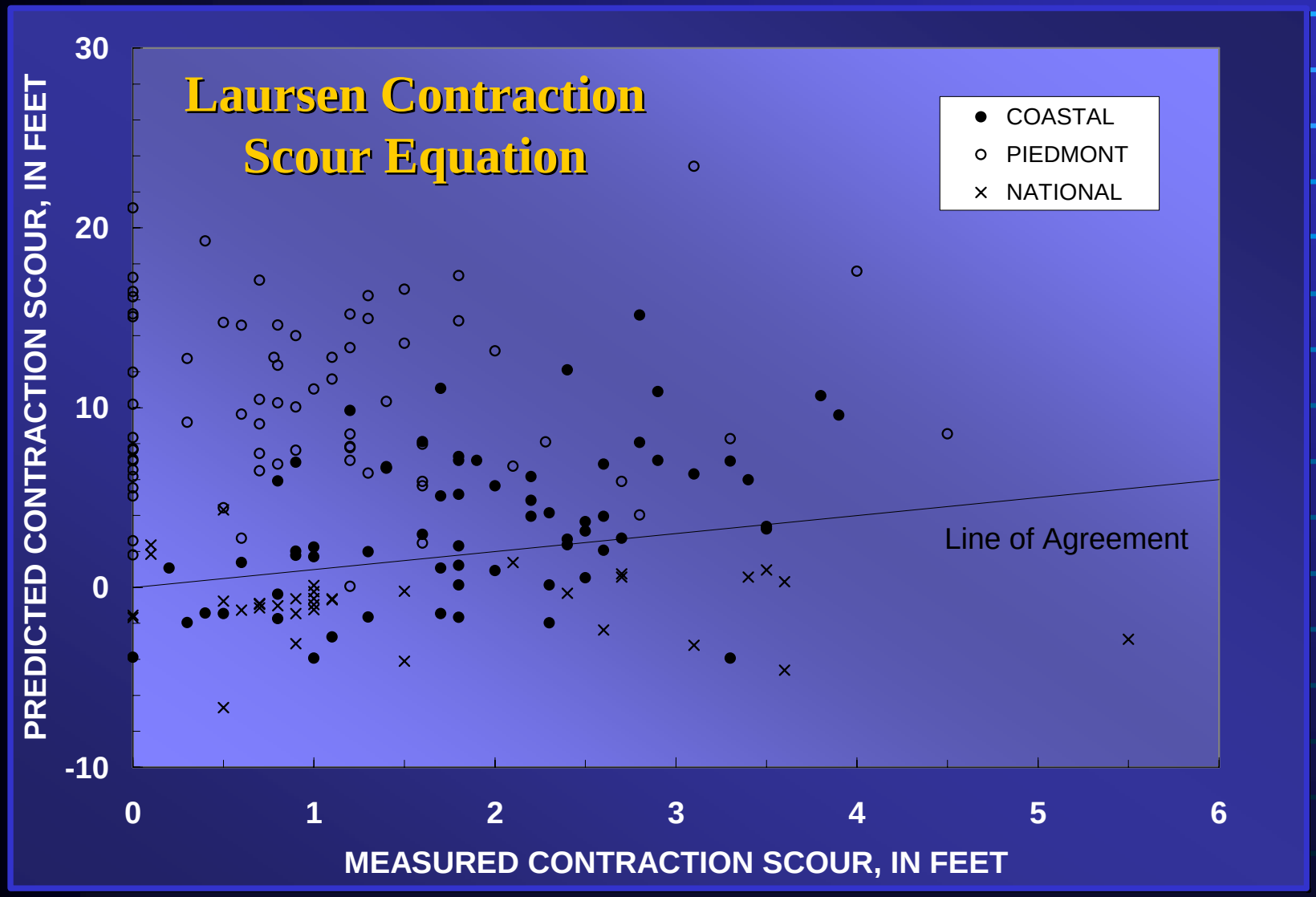
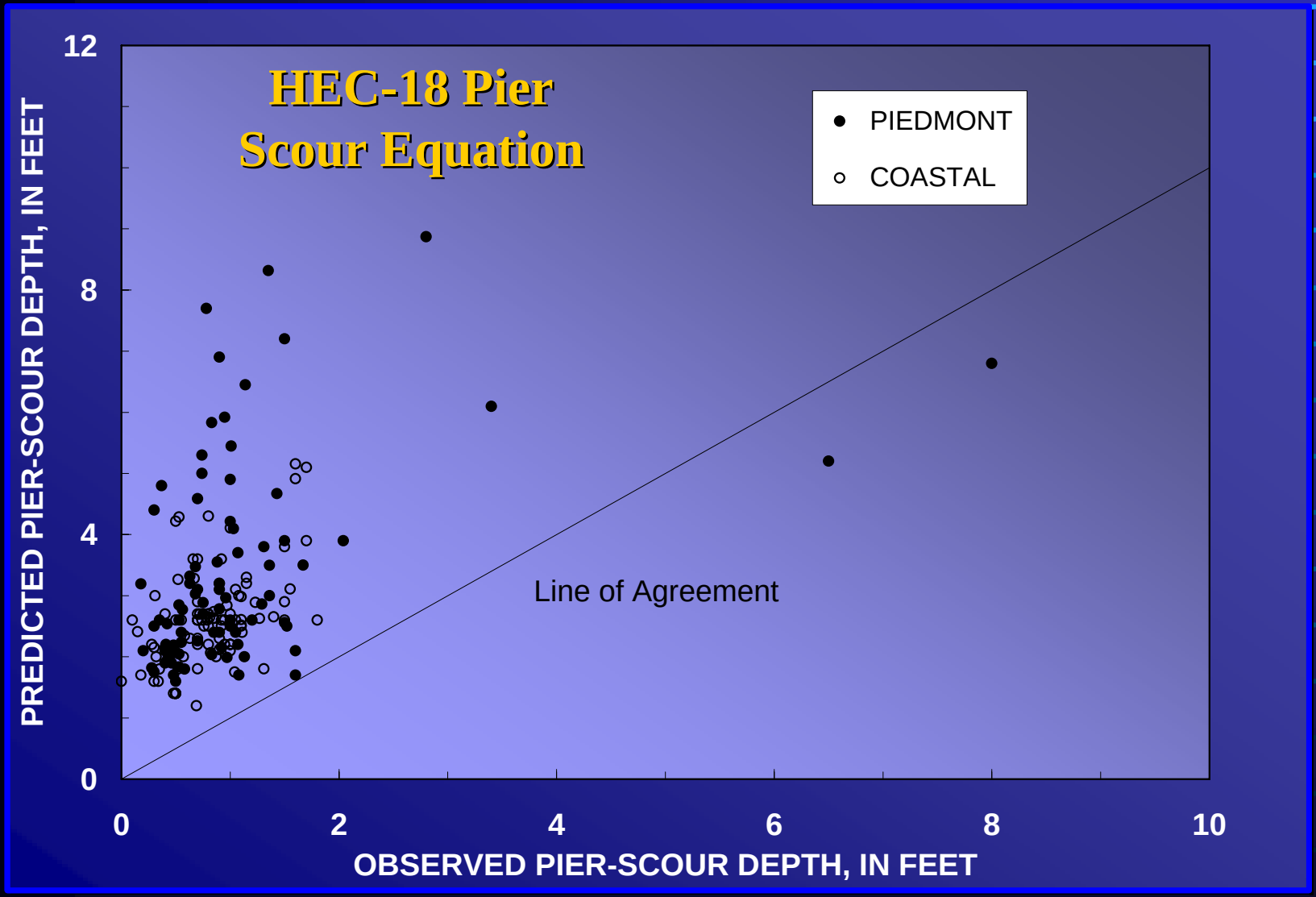


Comparison of Field and Predicted Data



Perspective on Envelope Curves

- Sediment transport is an inexact science
  - unlikely to find universal equation in near future
- Envelopes are used in lab analysis
  - can use similar pattern for field data
- Dominant explanatory variables in lab are geometry
  - should expect similar pattern in field data
- Scour driven by hydrology, geology, and geometry
  - therefore should expect regional trends
  - South Carolina curves will not work in Alaska

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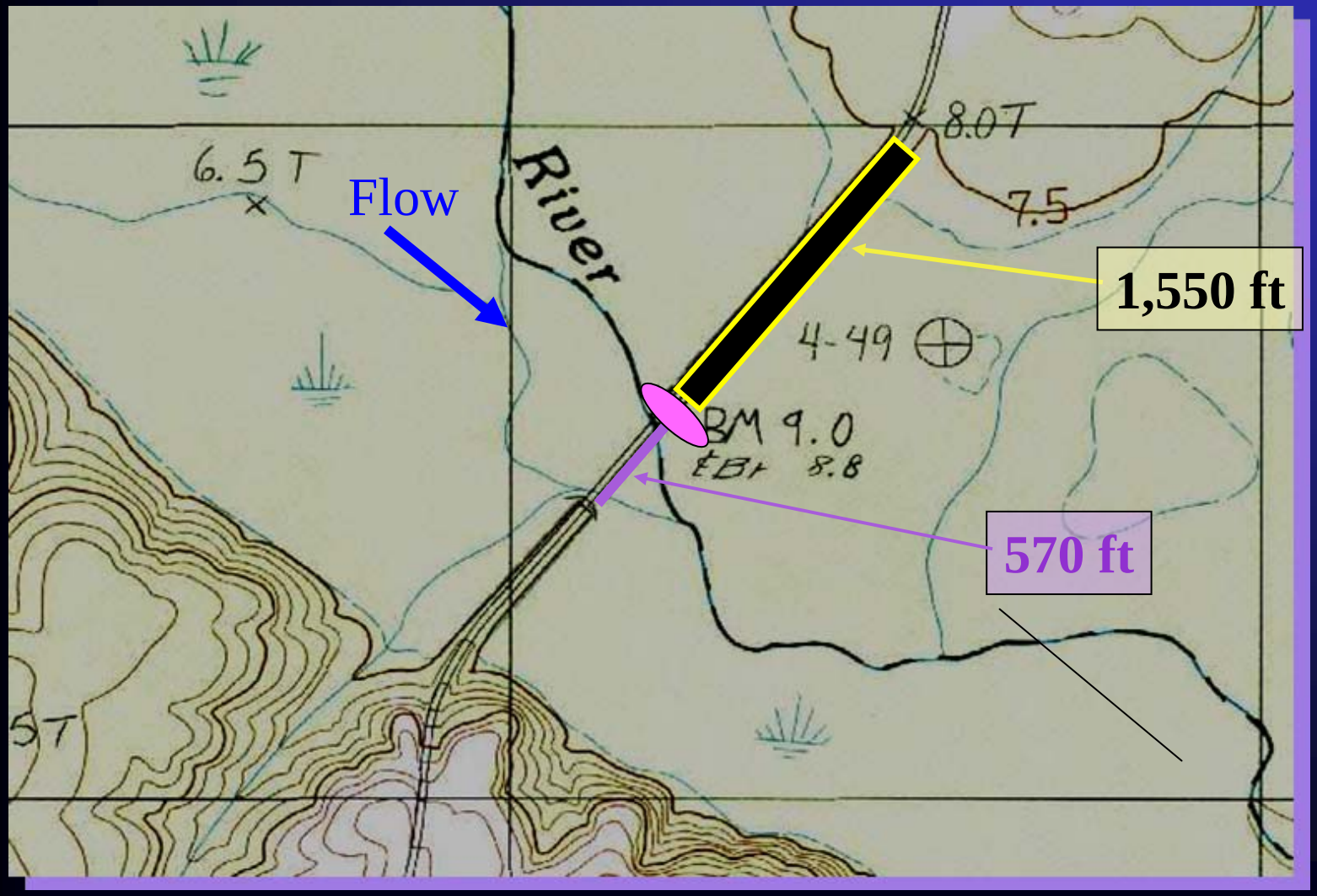
Envelope Curves

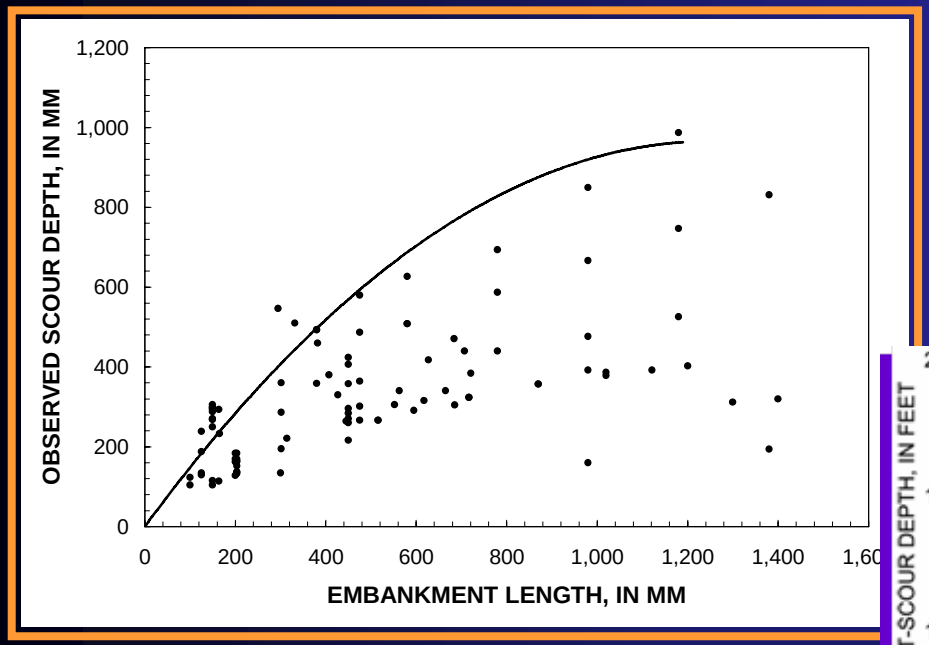
- Abutment Scour -

Definition of Embankment Length

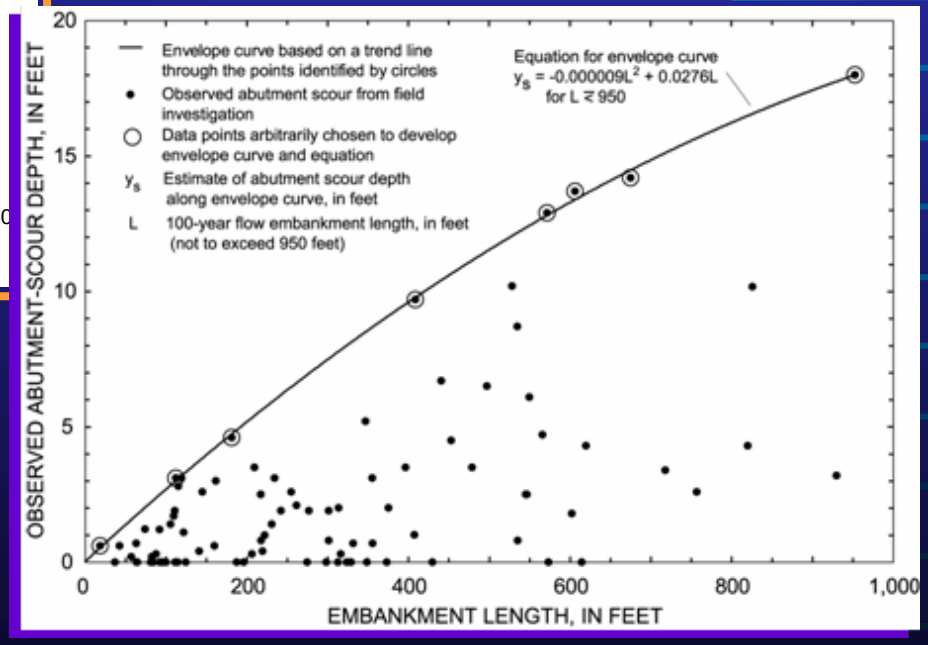


Embankment Length Envelope

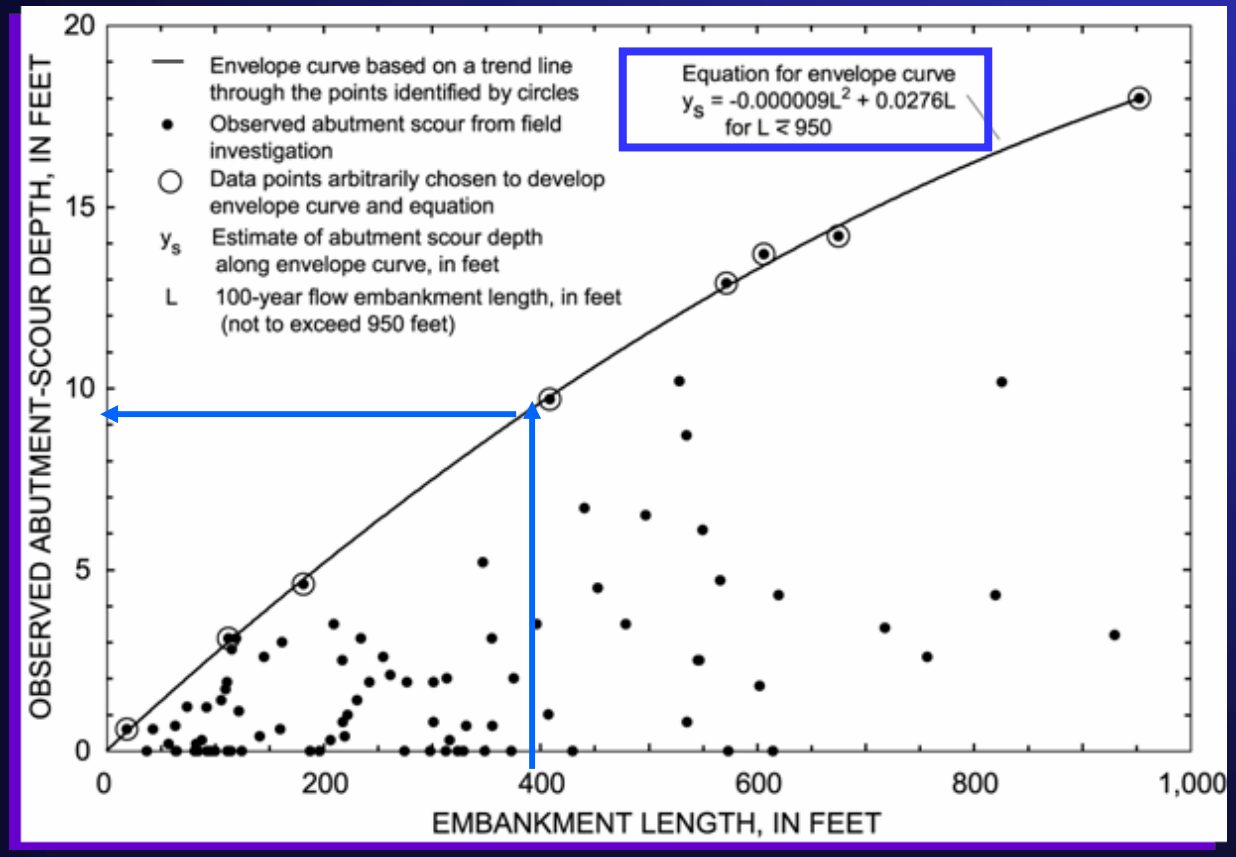
Laboratory Data



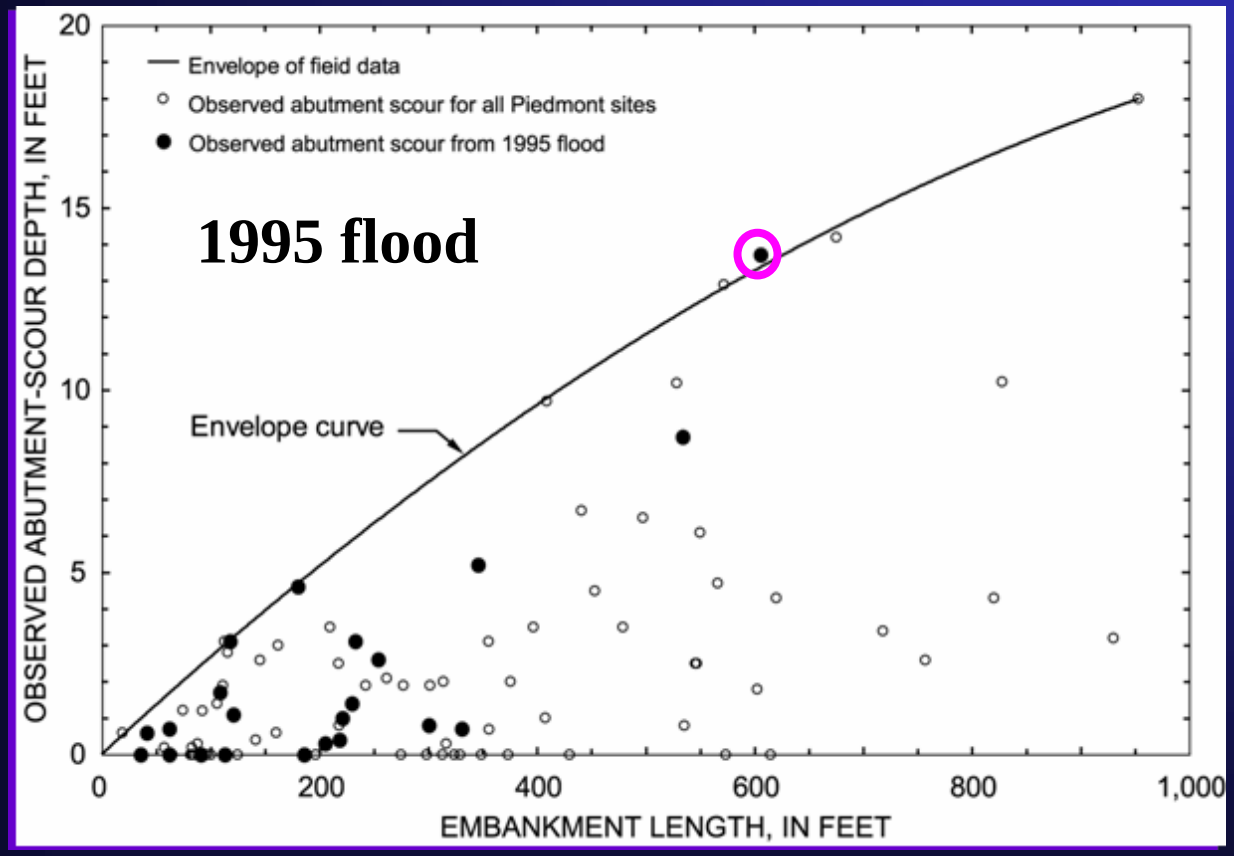
Piedmont Field Data



Embankment Length Envelope Piedmont



Embankment Length Envelope Piedmont

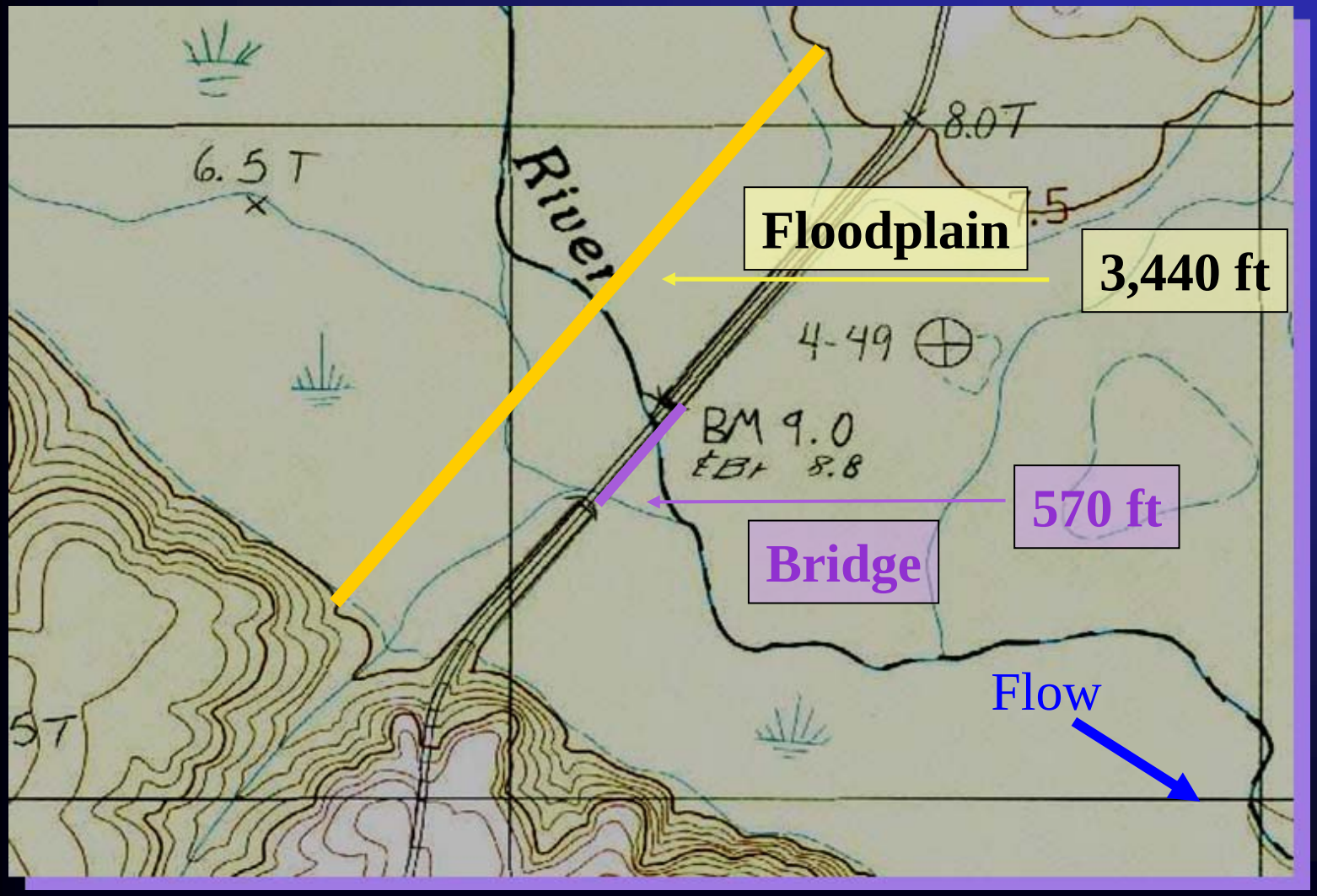


Envelope Curves

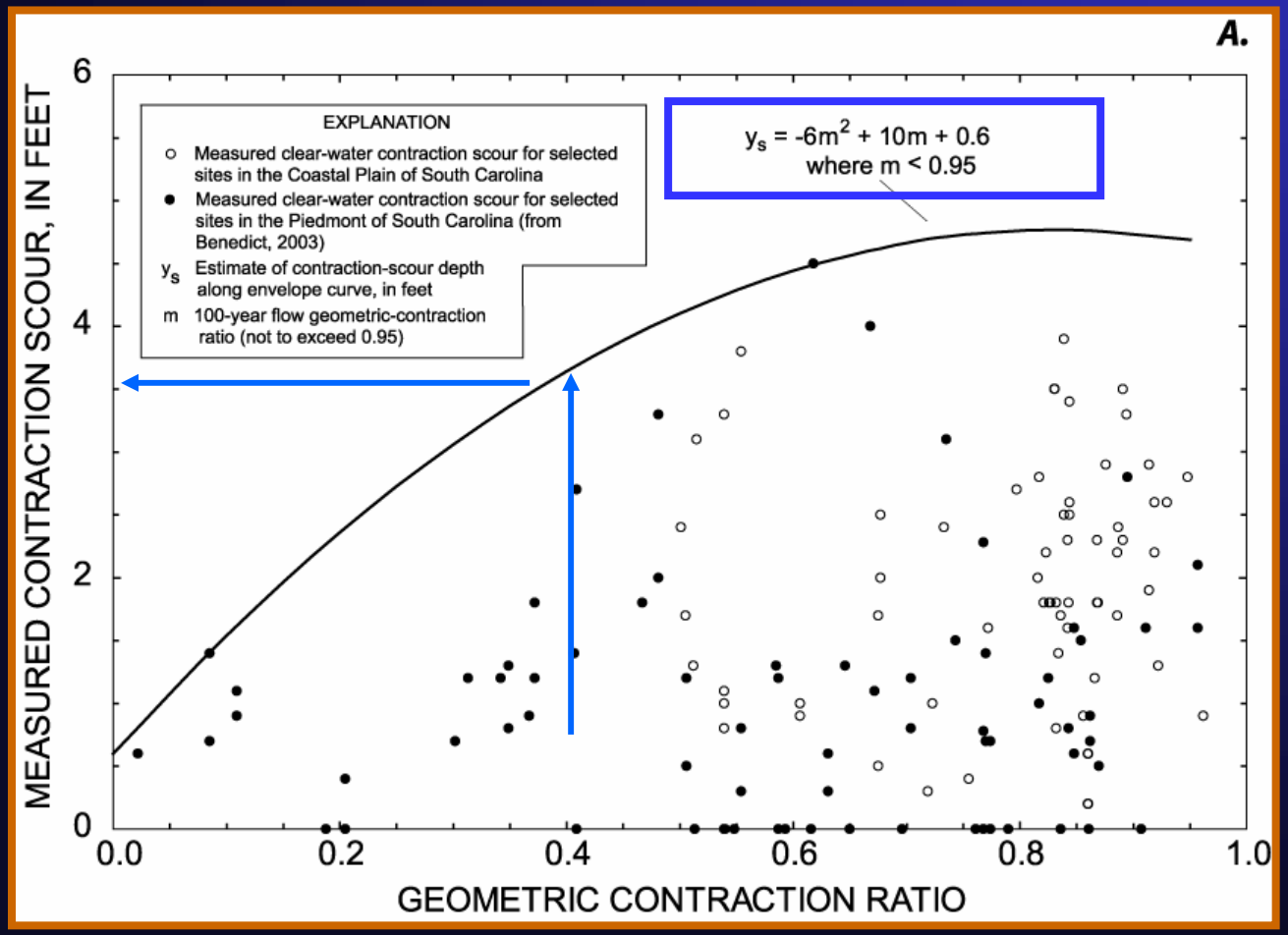
- Contraction Scour -

Definition of Geometric Contraction Ratio

1-b/B = 1 - 570/3440 = 0.83



Overbank Contraction Scour

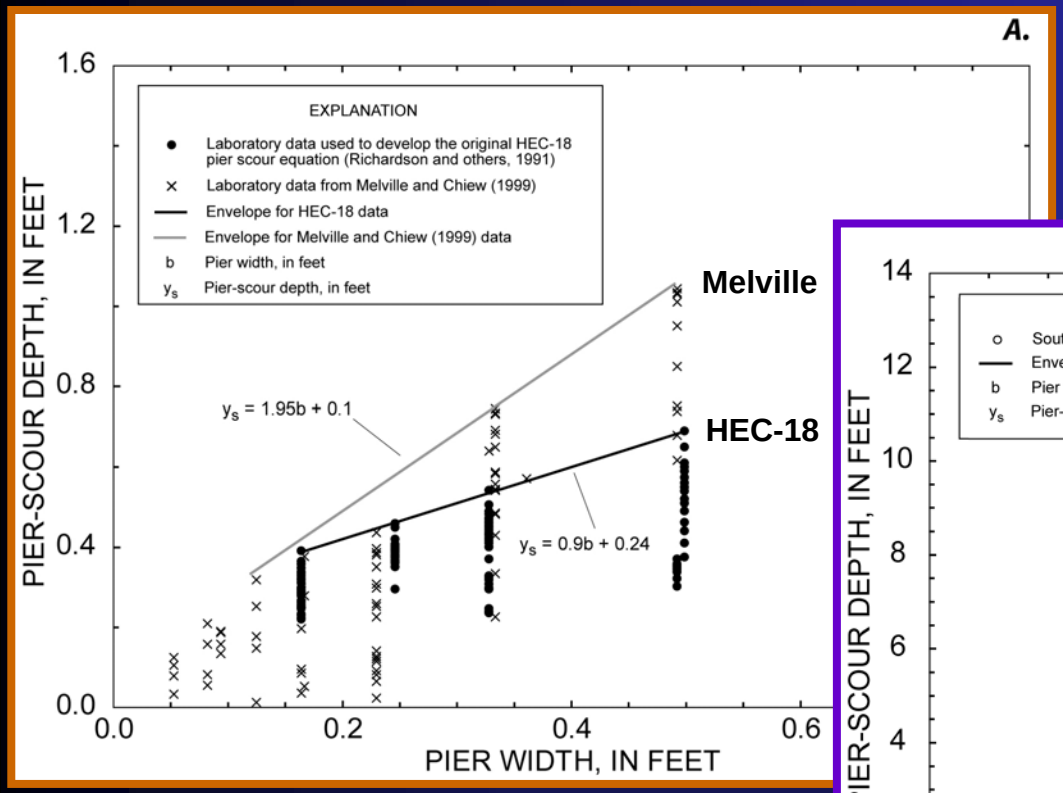


Envelope Curves

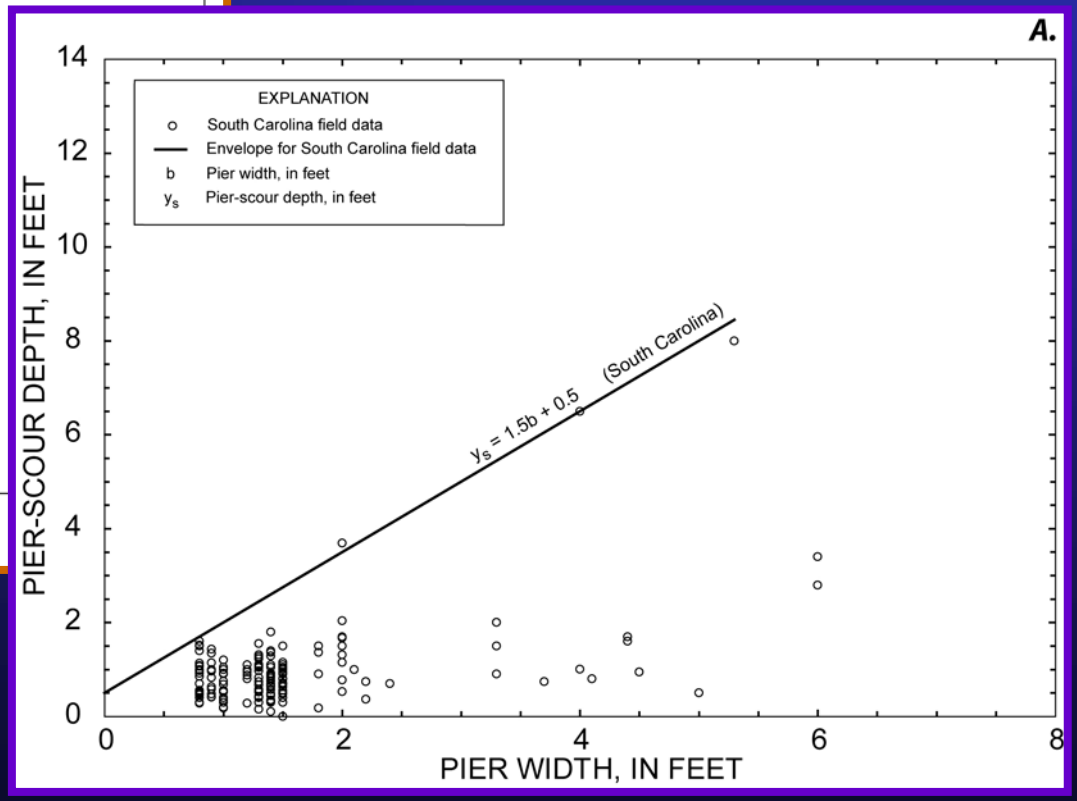
- Pier Scour -

Pier Scour in the South Carolina

Laboratory Data



Field Data



Envelope Curves

- Very simple but useful tools
- Based on field data offering an advantage over lab relations
- Gives engineer a tool for making judgment calls
- Other states can do these types of projects and meet with success

Reports

Benedict, S.T. and Caldwell, A.W., 2005, Development and evaluation of clear-water pier and contraction scour envelope curves in the Coastal Plain and Piedmont Provinces of South Carolina: U.S. Geological Survey SIR 2005-5289, 112 p.

http://pubs.usgs.gov/sir/2005/5289

Benedict, S.T., 2003, Clear-water abutment and contraction scour in the Coastal Plain and Piedmont Provinces of South Carolina, 1996-99: U.S. Geological Survey Water Resources Investigation Report 03-4064, 137p.

http://sc.water.usgs.gov/publications/pdfs/WRIR-03-4064.pdf

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Questions?

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