Observations of Floodway Definition for the Congaree River in Richland and Lexington Counties, SC

by

[redacted]

Overview

- USGS Review
- One-Dimensional –vs- Two-Dimensional Analysis
- Two Questions to be resolved
  - What is a Floodway?
  - With or Without Levee?
- Review of what has been done in Lexington/Richland County Floodway Determination

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USGS Review

- **Critical Points**
  - Included in review done by [redacted] & [redacted]
    - Conservation of Mass Issues
      - Ignored in FEMA study
    - Convergence
  - Values chosen to match FEMA study
    - Roughness Values
    - Calibration Data
      - Review done on model application, not base model
  - Conclusions based on definitions
    - Model should not include levee
    - Model does not confirm "No Floodway"

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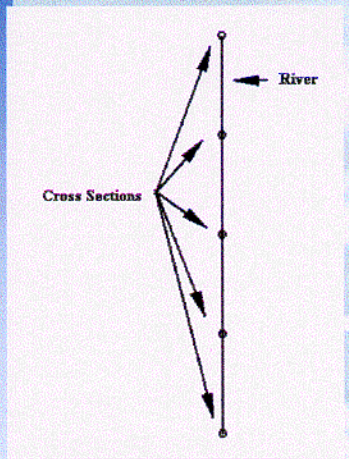
1D Models



- **Assumptions**
  - Flow perpendicular to cross sections
  - Flat water surface across cross section
  - Linear variation between cross sections
- **Limitations**
  - Non continuous solution
  - User defined effective flow regions

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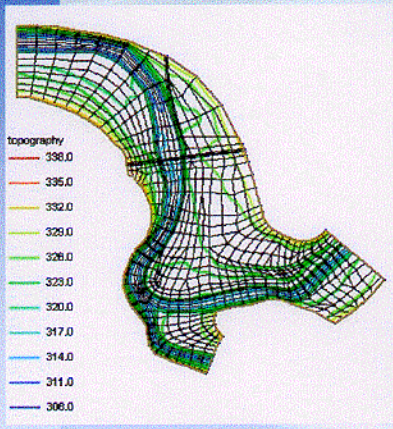
2D Models



- **Assumptions**
  - Negligible vertical component
  - Non stratified flow
  - All significant flow included in domain
- **Benefits**
  - Continuous solution
  - More flexible

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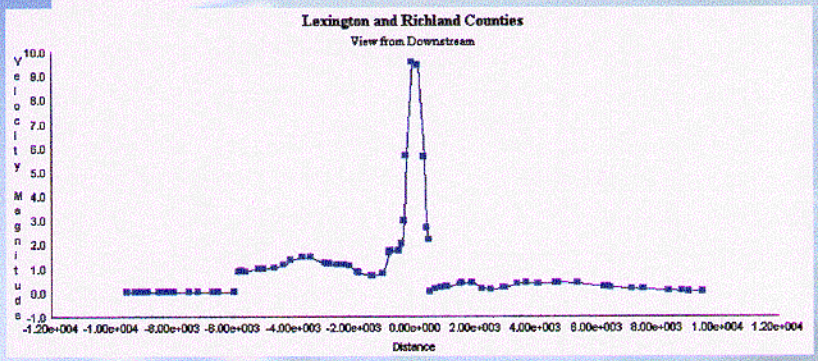
Calibration of 1D to 2D?

- **Impossible if 2D conditions exist**
- **Curve in 2D – Straight Line in 1D**



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Two Questions to be resolved

- **What is a Floodway**
  - Traditional Definition: Area adjacent to river preserved to convey floodwaters.
  - Exceptions: FEMA Appeal Resolution Document – Sept. 26, 2000
    - States objective of determining location, size and number of breaches
    - Indicates need for effective flow – (1 ft./sec)
- **With or Without Levee**
  - FEMA Standard – Remove Levee but exceptions implied
  - Affects the type of model to be used – but requires choice
    - Remove all existing structures and perform 1D analysis
    - Analyze existing conditions and perform 2D analysis

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Historical Summary

- **Complex Flow in Richland County**
  - Assumed due to complex system of levees
- **Confirmed by multiple studies**
  - 2D Analysis Performed w/Existing Conditions:
    - SCDOT – 1981, FEMA – 1999, Exponent – 2000
  - Exponent study calibrated to match FEMA study
    - February 2000 Model
  - Exponent study changed to evaluate worst case breaches
    - April 2000 Model
  - Exponent study revised to address concerns raised in peer review.

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Conclusion

- 2-D Flow Exists Behind Manning Levee
- 2-D Model Results should be basis of management decisions
  - Inappropriate to use a 1-D model to determine the floodway

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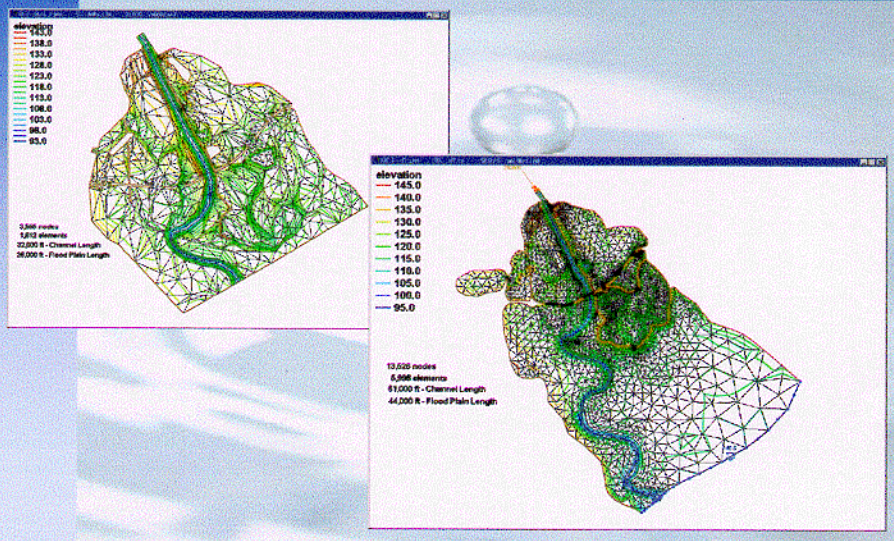
Extent of Area



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Number of Elements/Nodes

	FEMA	Exponent, Inc.
Elements	1612	5996
Nodes	3555	13526

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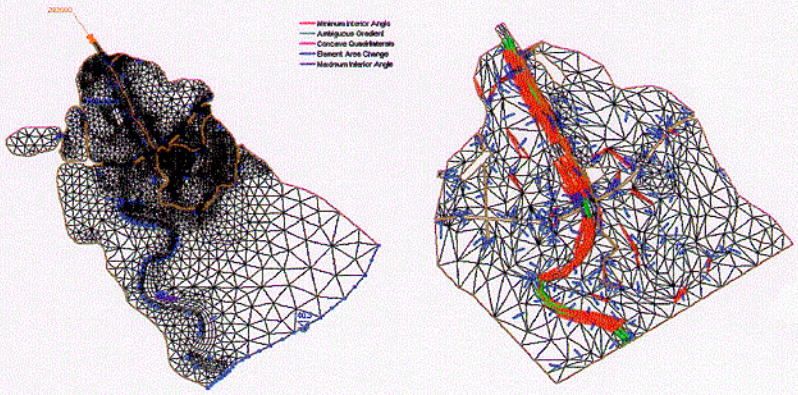
Mesh Quality



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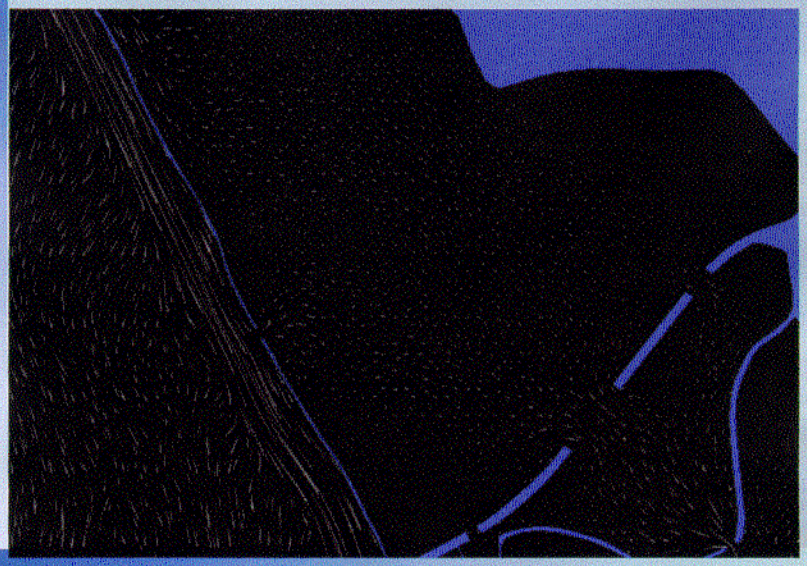
Flow Trace Animation



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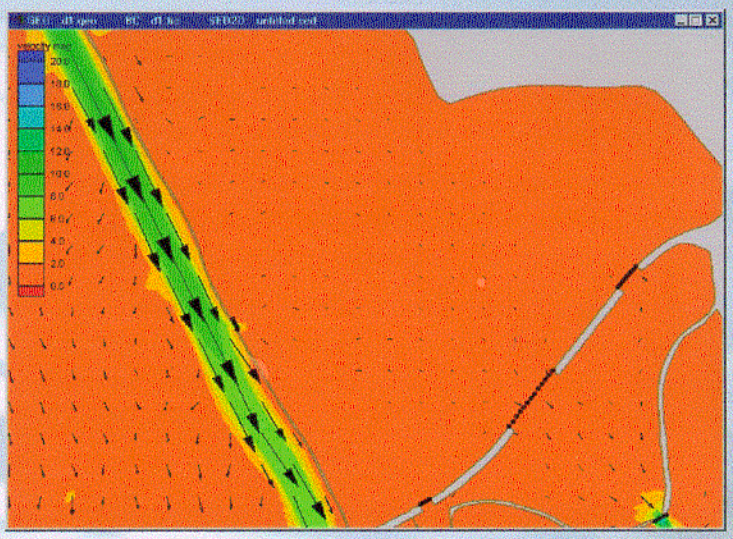
Scaled Velocity Vectors



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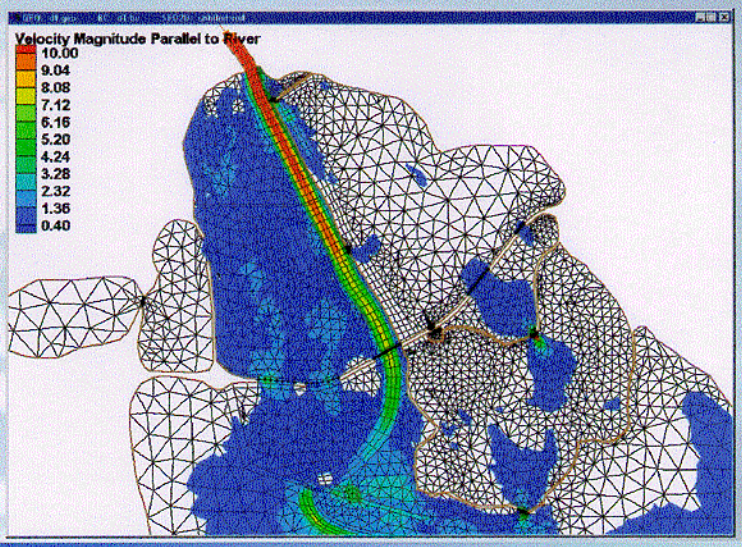
Velocity Parallel to River



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Conclusion

The Exponent Inc. Model Provides best representation of flow patterns.

- Superior element quality
- Superior distribution of elements
- Superior representation of geometry

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Options

- **Model with existing conditions – 2D.**
  - Manning Levee has affected flow and design in flood plain.
  - I-77 design based of flood plain, not floodway
  - FEMA model and appeal resolution implies this approach
- **Model idealized conditions – 1D.**
  - Remove Manning Levee
  - Remove I-77 and 12th Street embankments
  - Remove smaller levees downstream

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Conclusion

2D Model Exists to give understanding of conditions

Flow in Richland County is not consistent with effective flow in a floodway.

- Velocity parallel to river on Richland floodplain generally less than 0.4 ft/sec.

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