The **Odd** Couple: Crossing *And* Restoring a Floodplain – All While Saving Millions per Day

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Image courtesy imdb.com
Project Background
Historical Crossing of Minnesota River

Ferry Crossing 1889

“Not safe for heavy loads or fast driving.” Combination Truss over Minnesota River built. Failed, 1914, under a 5-ton load.
Normal Conditions - TH101
Natural Functions & Benefits

Calcareous Fen Area

Generalized regional cross section:
- Recharge zone
- Peat apron formed over valley terrace (diffuse groundwater discharge)
- Discharge zone
- Calcareous fen

Raguet Wildlife Management Area
FEMA Floodplain Zone

Zone A

≈1 Mile

Zone A20
Study Elements

• Traffic forecasting and analysis
• Analysis of historical flooding
• Development of alternatives
• River modeling
• Evaluation of alternatives
• Public and Agency involvement
Flooding History – TH101

TH 101 Crossing Historical River Elevations

10-Year Flood Elev = 712.0
100-Year Flood Elev = 720.7
500-Year Flood Elev = 726.0
Spring 2011 Flood – TH101
Looking North Towards Chanhassen
Cost of Closures

- TH101 Closed 7 times since 1993
  - Total closure duration of ~180 Days

- 20,400 ADT (2009)


- Cost of TH 101 and TH 41 Closure (travel time and additional miles)*:
  - $670,000 per day (2009)
  - $1,675,000 per day (2030)
  - 25 days/closure x $1.675M/day = $42M/closure

* Costs developed using Metropolitan Council’s 2030 Regional Model.
Hydraulic Modeling Objectives

• Assess WSE for Existing Conditions
  – Approx. 35 Miles of MN River
  – From Carver to Confluence with Mississippi River
  – HEC-RAS 4.1.0

• Develop a Calibrated 2-D Model
  – Finite-Element Surface-Water Modeling System (FESWMS)
  – Done by Baird

• Assess Impact of Design Alternatives
  – Reduce Road Closure Frequency & Duration
Hydraulic Models

• HEC-RAS vs. FESWMS
  – HEC-RAS
    • Basic model used to evaluate alternatives
    • Regulatory model
    • Calibrated by USACE
  – FESWMS
    • Detailed data set
    • More accurately evaluates velocities, allowing for better bank stabilization design
  – D/S boundary condition: USGS Gage at Ft. Snelling
  – Flow values: USGS Gage near Jordan
Finite Element Grid Near TH101
2-D Model Calibration

- Hydrodynamic Modeling using FESWMS
  - Calibrated Using Field Data
    - March 28, 2011 Event (Approx. 30-yr Event)
    - Compared Flooded Area from Model to Flood Photos
    - Measured Flow, WSE, and Velocity
    - Adjusted Manning’s ‘n’ Values to Calibrate
2011 Flood Event – TH101
Design Alternatives

• Filling to Raise Road Profile
  – Modeling Showed Surcharge in 100-Yr Floodway WSE
  – Culverts Could Not Mitigate Surcharge

• Use of Upstream Storage
  – Not Feasible Due to Flat River Profile

• LOMR to Allow for Some Stage Increase
  – Not Practical Due to Length of Upstream Impact (30+miles)

• Land Bridge
Land Bridge Concept
Proposed Lands Bridge
TH101 Preferred Concept

- Minimum Road Centerline Elevation = 724.0’
- Bridge Length = 3,080 ft
- Bridge Deck Depth* = 84 inches
- Pier Spacing = 100 ft
- Pier Width = 1.5 ft
- 100-Year WSE Decreased From 720.7’ to 720.6’
- Closure Elevation Increased from 709.4’ to 722.0’

*Depth includes road cross-section, structural elements of bridge and railing/barrier.
TH101 Preferred Concept
Road Closure Frequency – TH101

TH 101 Crossing Historical River Elevations

Proposed Closure Elevation (722.0')
Current Closure Elevation (709.4')

Dates of Closure:
- 1951
- 1952
- 1965
- 1969
- 1993
- 1997
- 2001
- 2010
- 2011
- 2014

Elevation, ft

Dates:
- 11/7/1932
- 7/17/1946
- 3/25/1960
- 12/2/1973
- 8/11/1987
- 4/19/2001
- 12/27/2014
Road Closure Duration – TH101

TH 101 Crossing, Summer 1993

Proposed Closure Elevation (722.0')

Current Closure Elevation (709.4')

23 Days
Modeling Results

- Increased conveyance for all events
- “No Rise” Solution
  - HEC-RAS Results:
    - Peak WSE Decreases for 10-, 50-, and 100-Year Events
    - Peak WSE Unchanged for 500-Year Event
  - FESWMS Results:
    - Peak WSE Unchanged for All Modeled Events
- Velocity Decreased for all events
Evaluation Criteria

• Construction Cost
• Benefit/Cost
• Property Impacts and Costs
• Constructability
• Community Input
• Environmental Impacts/Opportunities
Project Benefits

• Cost-Effective Solution to reduce closure frequency & duration
  – $34 Million to Construct
  – Benefit/Cost = 3.8

• Floodplain Benefits
  – 150,000 CY Roadway Fill Removed
  – 8 Ac of Wetland Restoration
  – Restoration of environmental corridor connection
  – Restoration of natural flow regime

• Achieved balance between human needs and environmental sustainability
Contact Information

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Project Website:
http://www.dot.state.mn.us/metro/projects/hwy101river/
Thank you!