"Drilled Shafts for Bridge Foundation Stability Improvement Ohio 833 Bridge over the Ohio River" An Update

Meigs County, Ohio
Mason County, West Virginia

By

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FMSM Engineers

Fuller Mossbarger Scott & May

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Geohazards in Transportation
Appalachian Region Technical Forum
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Agenda

I. Introduction/Background
   A. General
   B. Initial Slope Movement
   C. Remediation Scheme
   D. Instrumentation Plan
II. Instrumentation Results/Recent Slope Movement
III. New Instrumentation on Existing Bridge
IV. Lessons Learned
V. Question/Answer

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I. Introduction/Background

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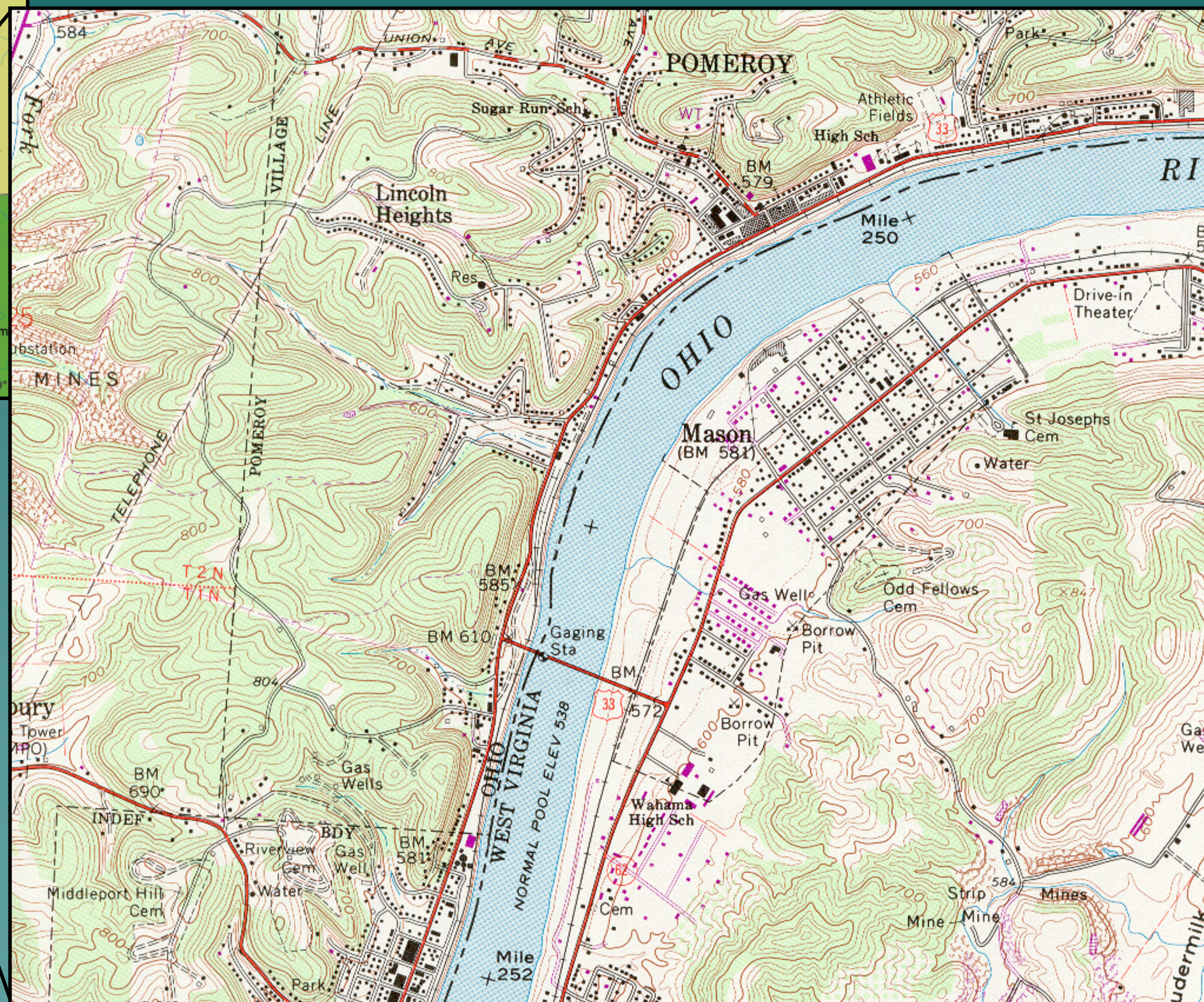
Project Location



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Project Team

- Owner: ODOT/WVDOH
- Designer: URS Corporation
- Contractor: Mahan/National Joint Venture
- Geotechnical Consultant – FMSM

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Existing Structure

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Proposed Structure

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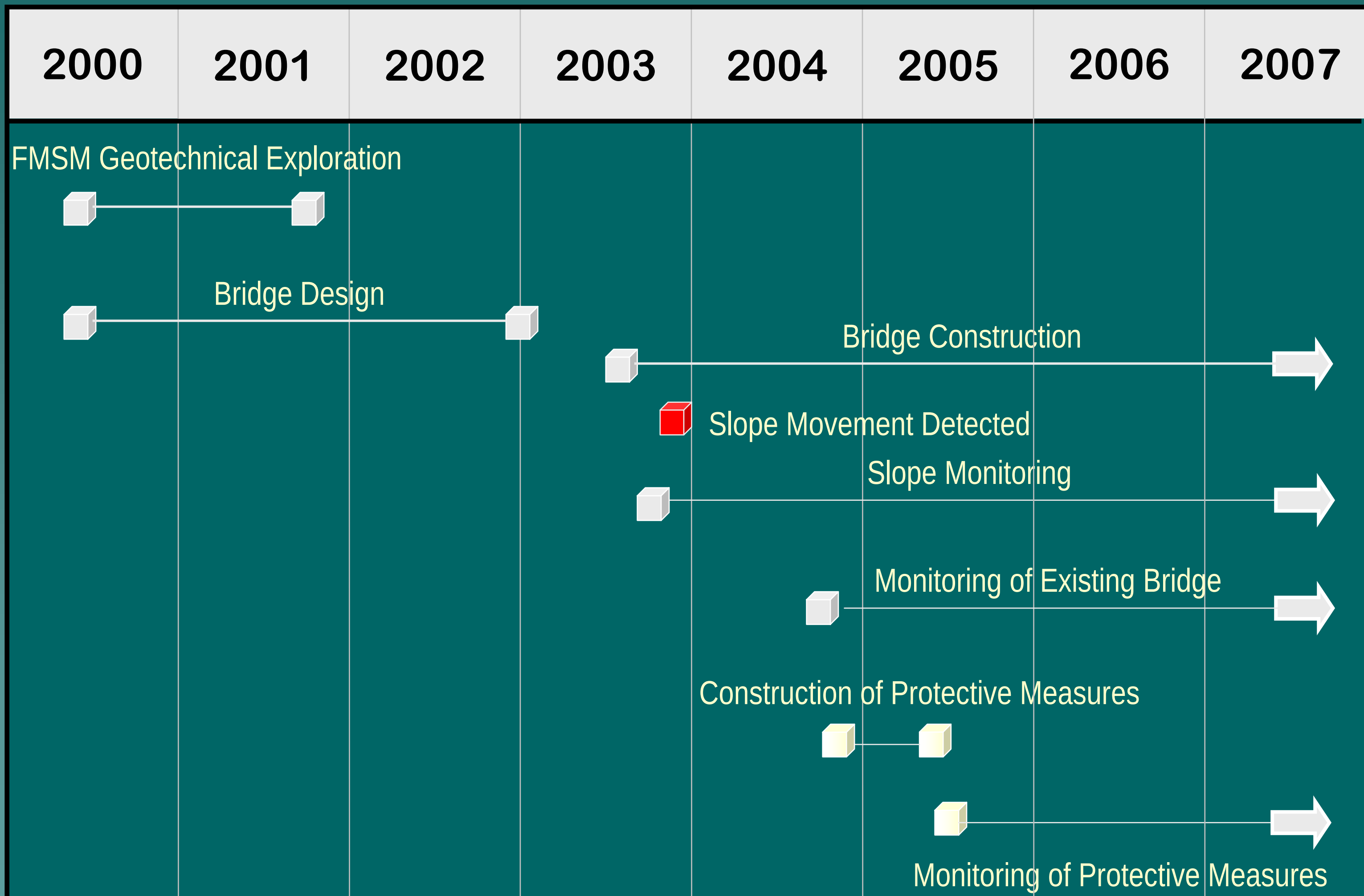
Project Timeline



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Current State of Construction

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Stability Issues/Slope Movement/Reaction

- New Main Street Embankment
- Short-Term Stability Concerns
- Controlled Rate-of-Fill
  - Slope Inclinometers
  - Piezometers
- Initial Detection of Movement
- Additional Instrumentation

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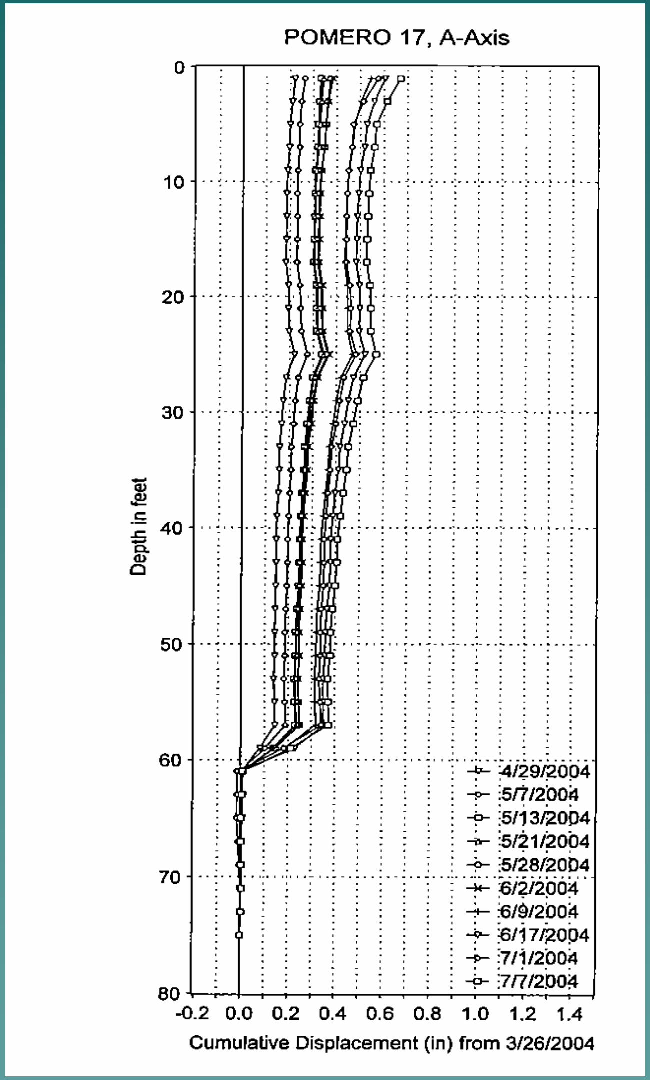
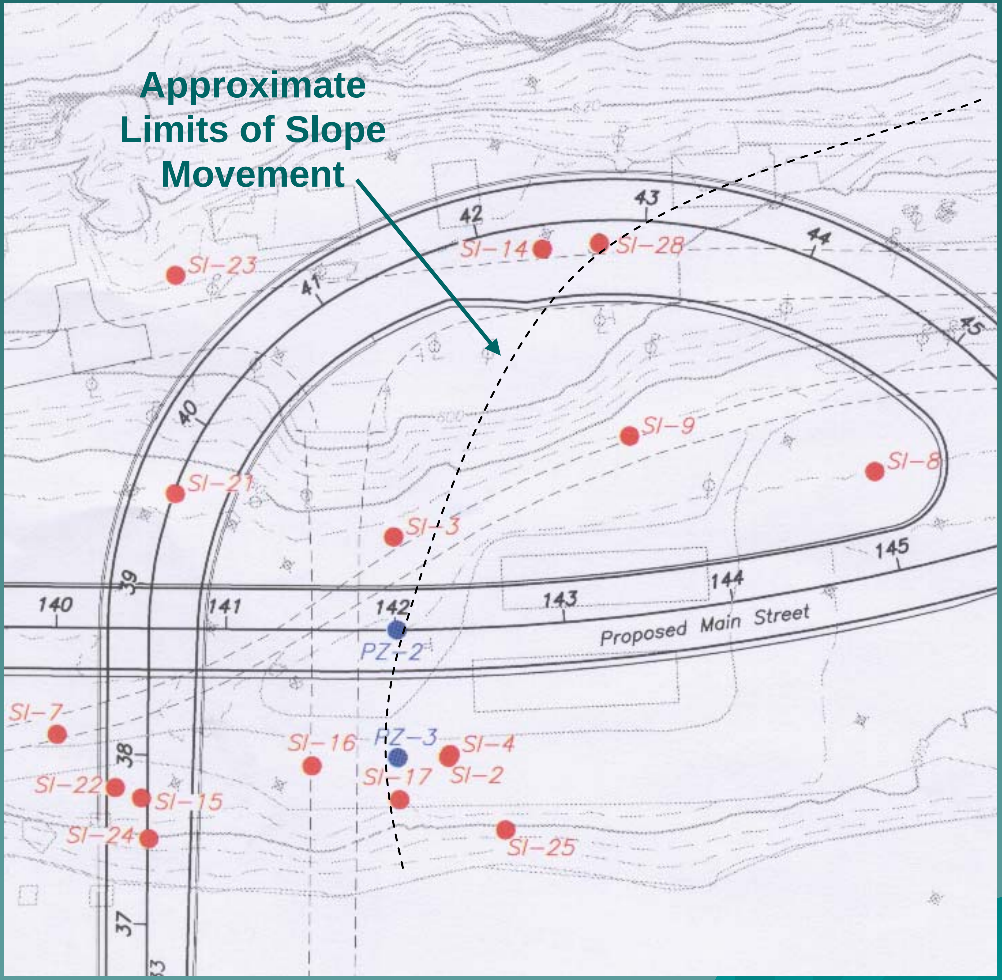
Original Extents of Slope Movement





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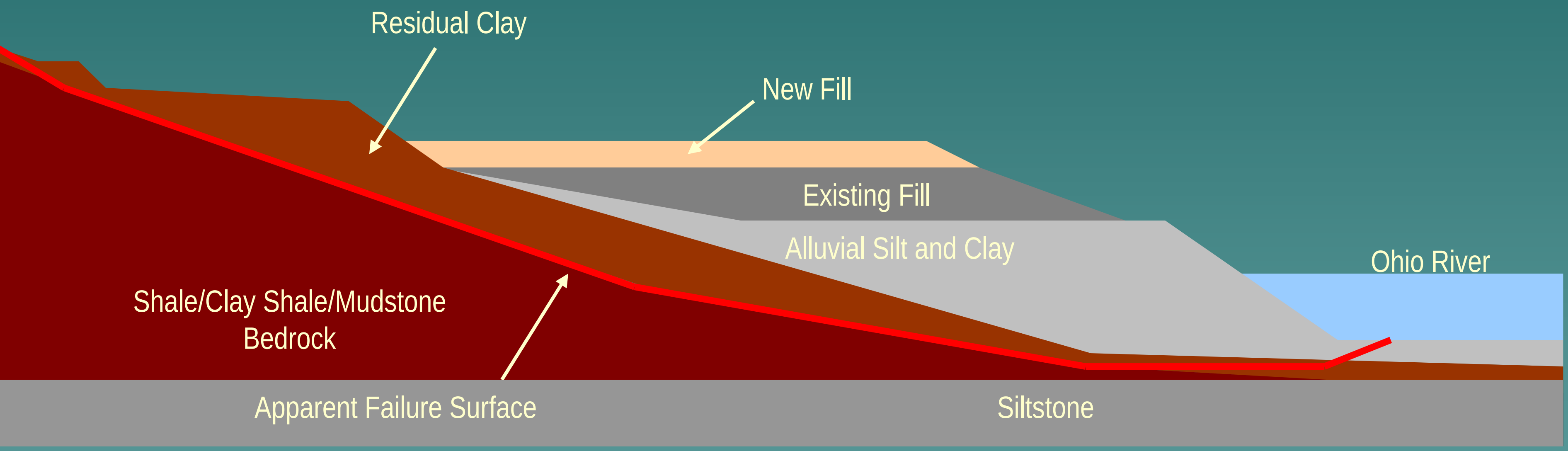
Probable Causes of Slope Movement

- Weak slickensided clay shale (mudstone)
- Possible ancient movement
- Construction activity/embankment
- Rapid drawdown cycles of Ohio River

Slope Geology/Geometry



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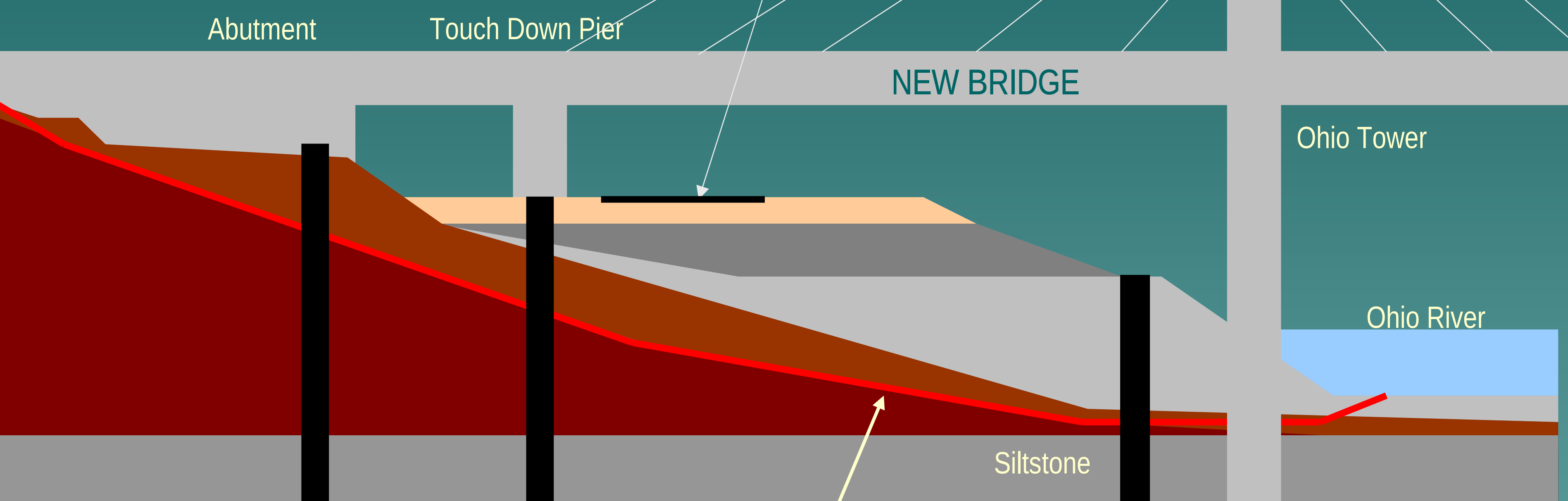
ODOT's Preferred Option and Related Decisions

Realign Main Street to Reduce Fill Height



Change Abutment and Land Pier Foundations to Drilled Shafts

Potential Failure Surface

One Row of Nine Drilled Shafts Between the Land Pier and the Water Pier

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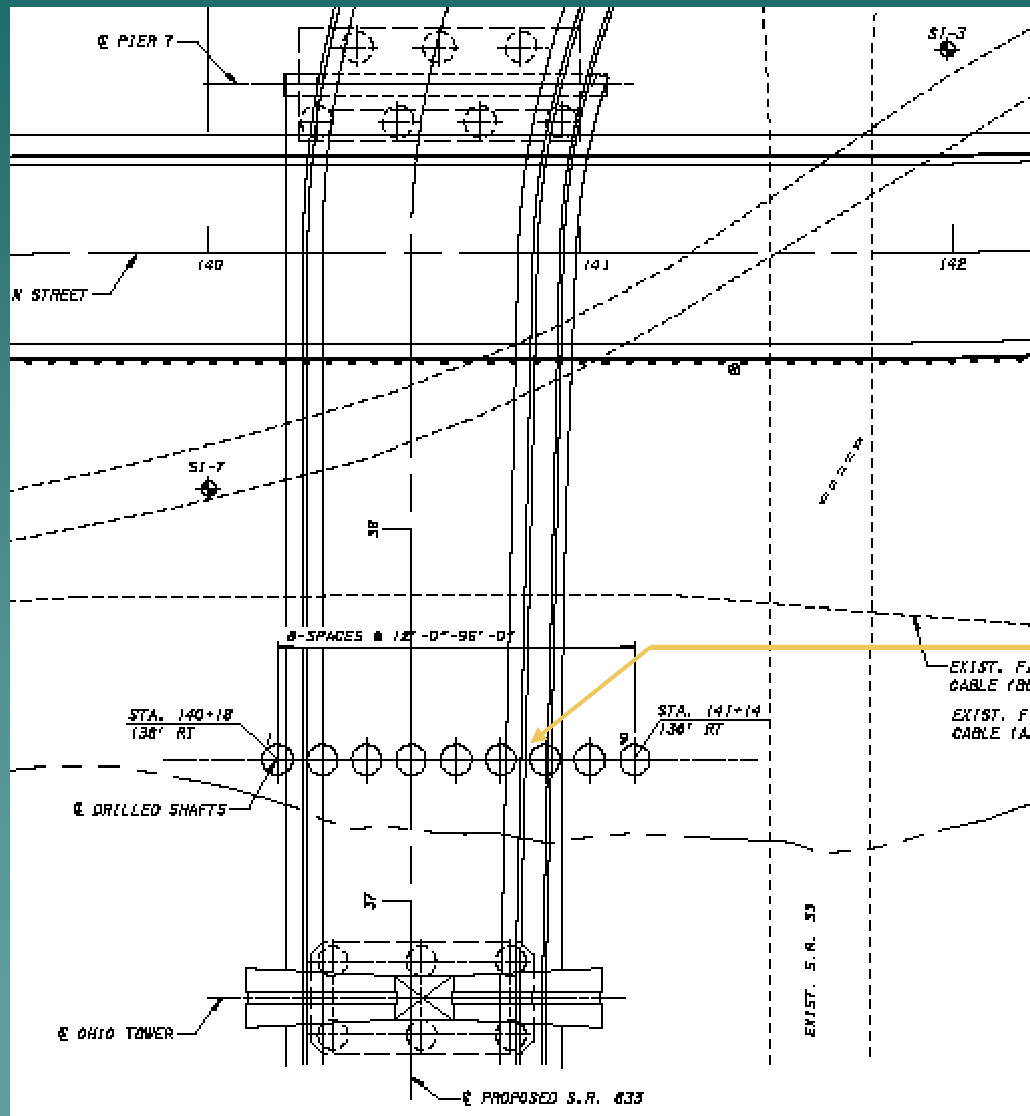
Plan View of Stabilization Shafts



8' Diameter Drilled Shafts on 12' c/c Spacing

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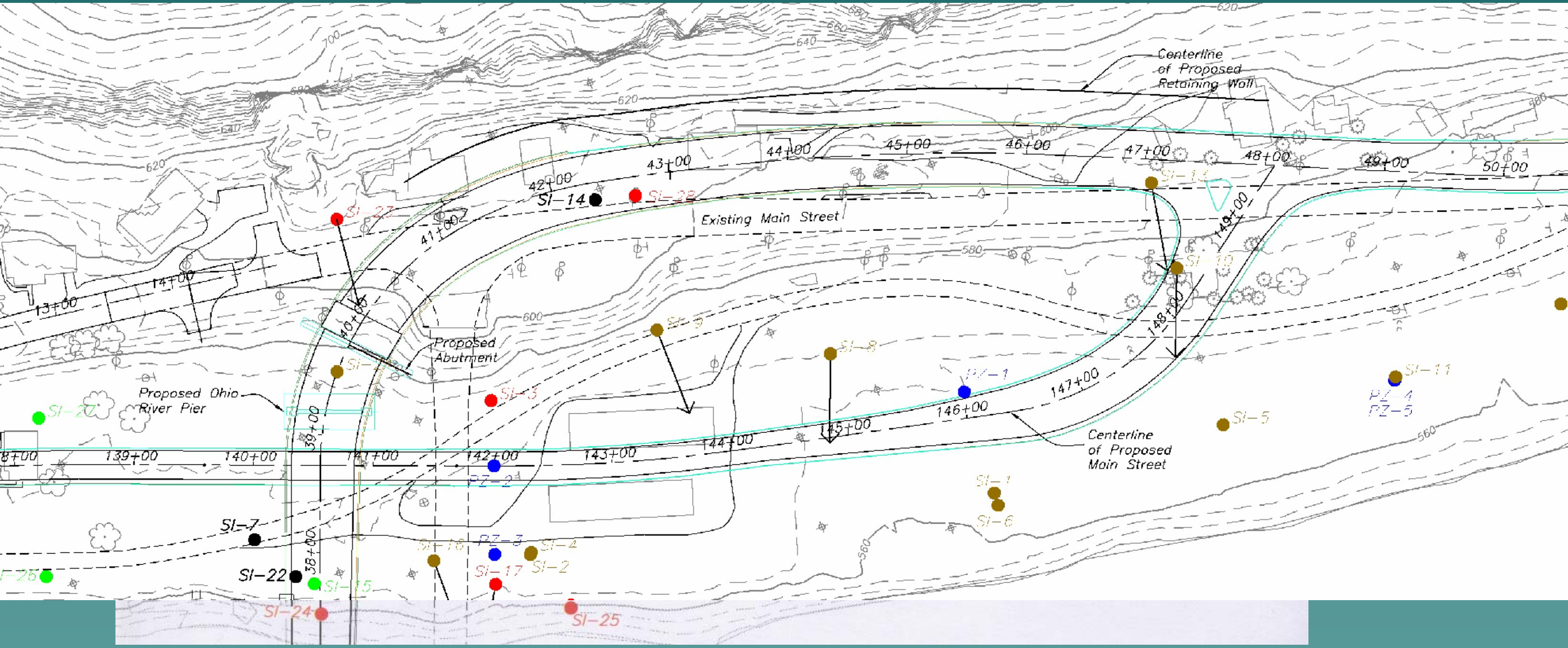
Revised Roadway Plan



Instrumentation Plan

- Site – Slope Inclinometers, Piezometers
- Existing Bridge – Tiltmeters, Survey Targets
- Touch Down Pier – Strain Gauges, In-Place and Manually Read Inclinometer
- Stabilization Shafts – Tiltmeters, Strain Gauges, In-Place and Manually Read Inclinometers

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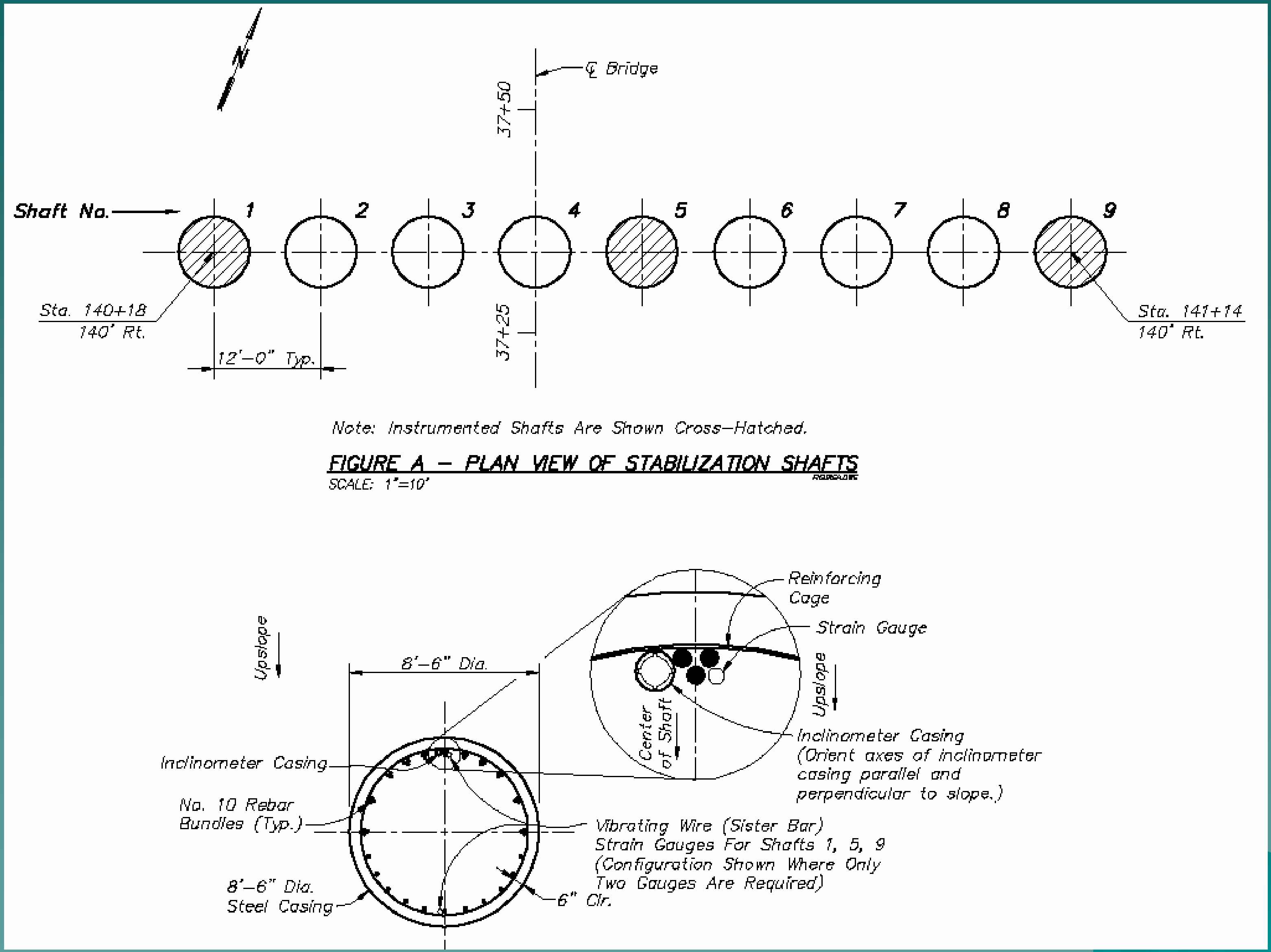
Stabilization Shaft Instrumentation Plan



II. Recent Slope Movement/ Instrumentation Results

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Recent Movement (Oct ’06 - Feb ’07)

- Detection
  - Instrumentation Activity (late October)
  - Tension Cracks (early December)
  - Water Main Break (early December)
- Causes
  - Construction Activity
  - River Fluctuation

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Tension Cracks – 12/11/06

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Construction Activity – 11/30/06

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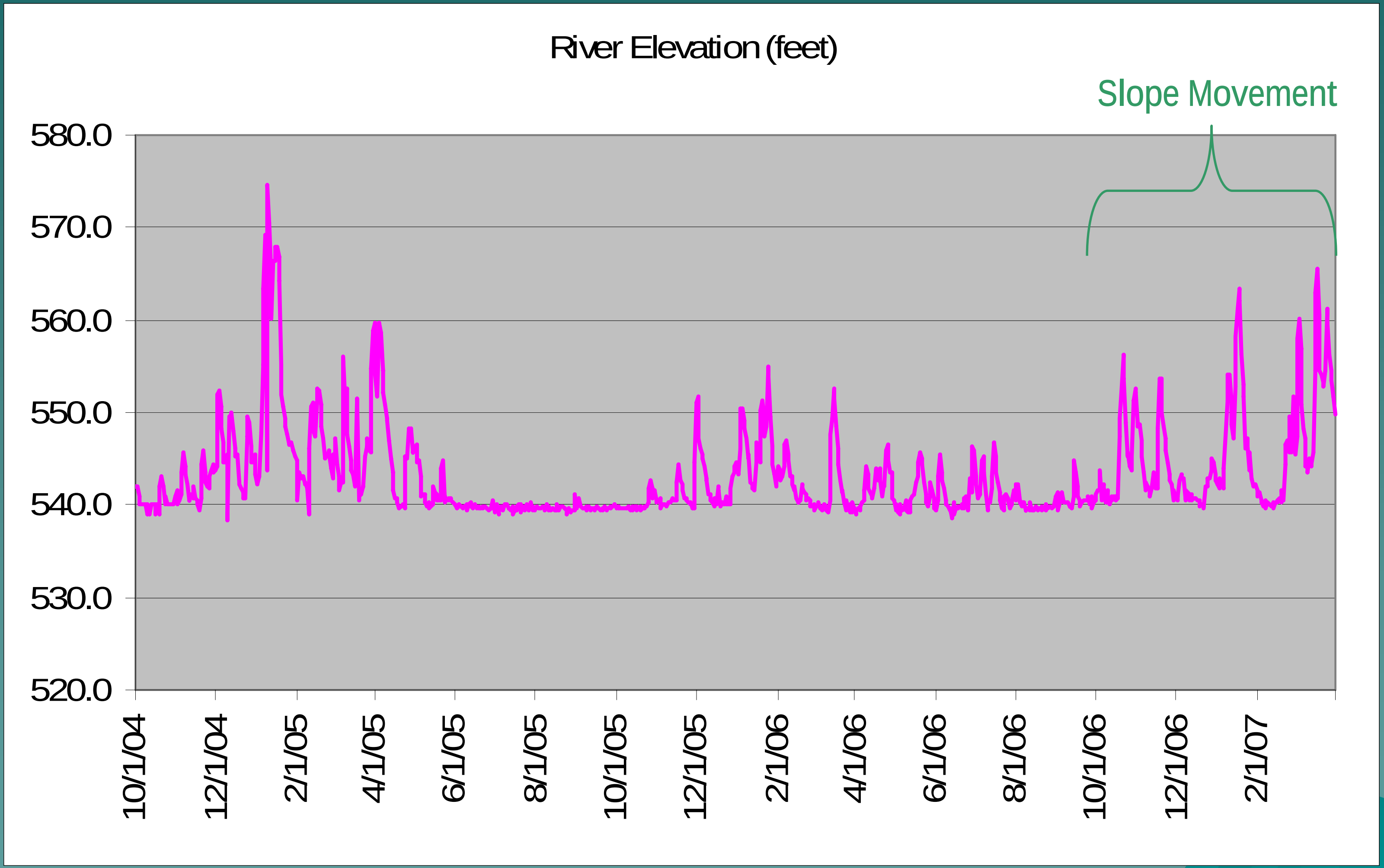
Ohio River Fluctuations



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Tied Back Retaining Wall

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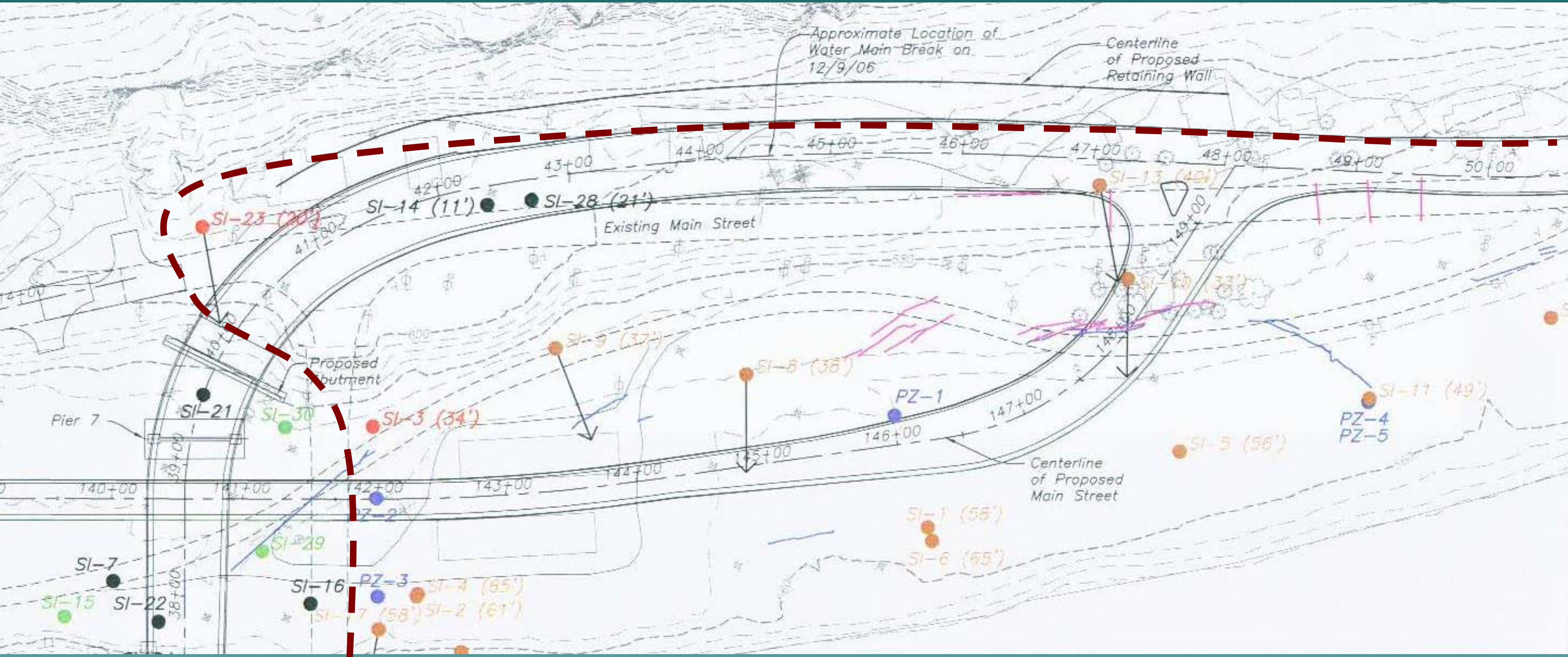
Results of Instrumentation

- Site
  - 4 Years of Data
  - Numerous Inclinometers Sheared Due to Slope Movement
- Existing Bridge
  - 3 Years of Data
  - Abutment Tilt Due to Recent Movement
- New Bridge Touch Down Pier
  - 3 Years of Data
  - Top Deflection Due to Lateral Loading
- Stabilization Shafts
  - 2 Years of Data
  - Northernmost Shaft Being Loaded

Current Extents of Slope Movement



Limits of Movement

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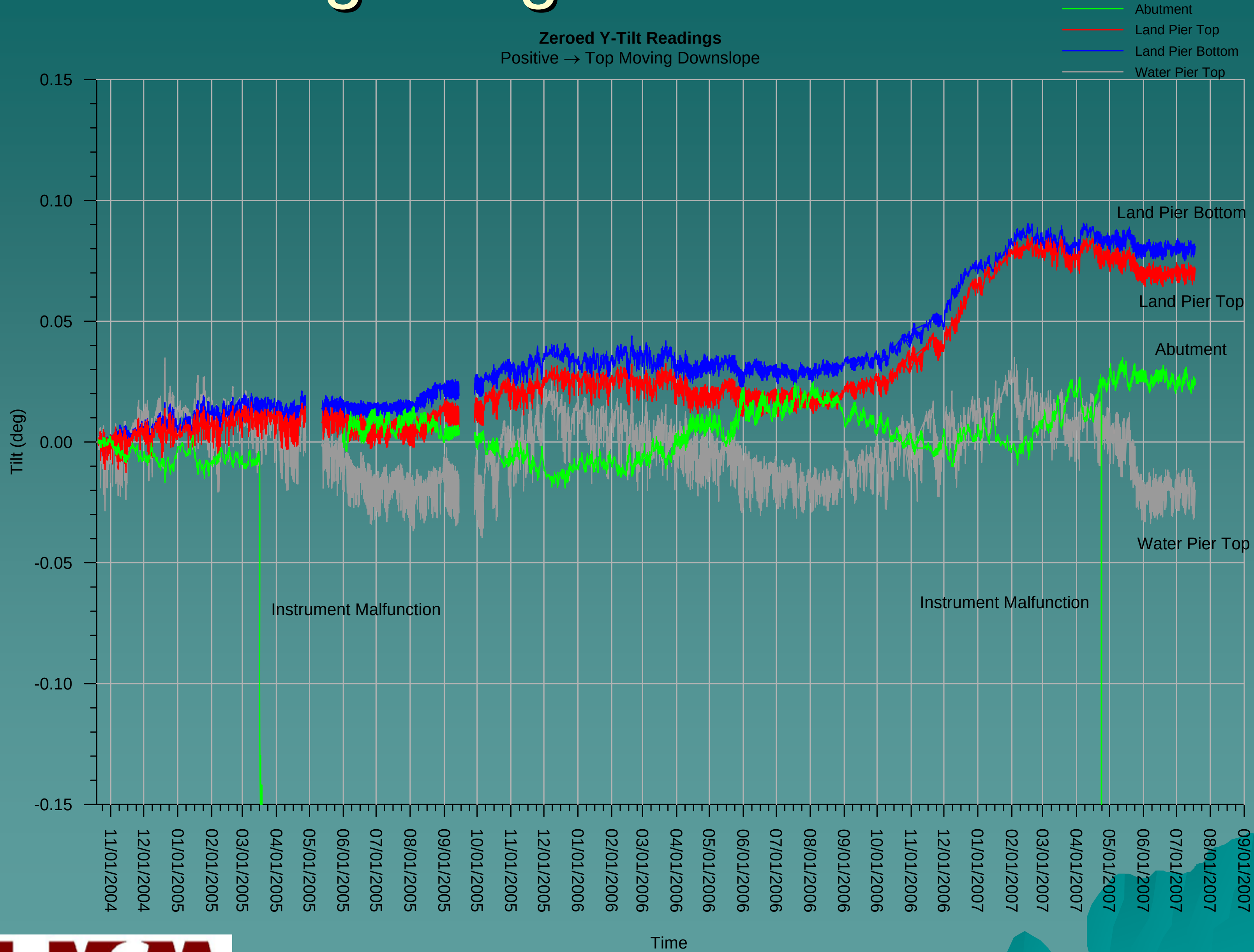
Existing Bridge Tiltmeter Results



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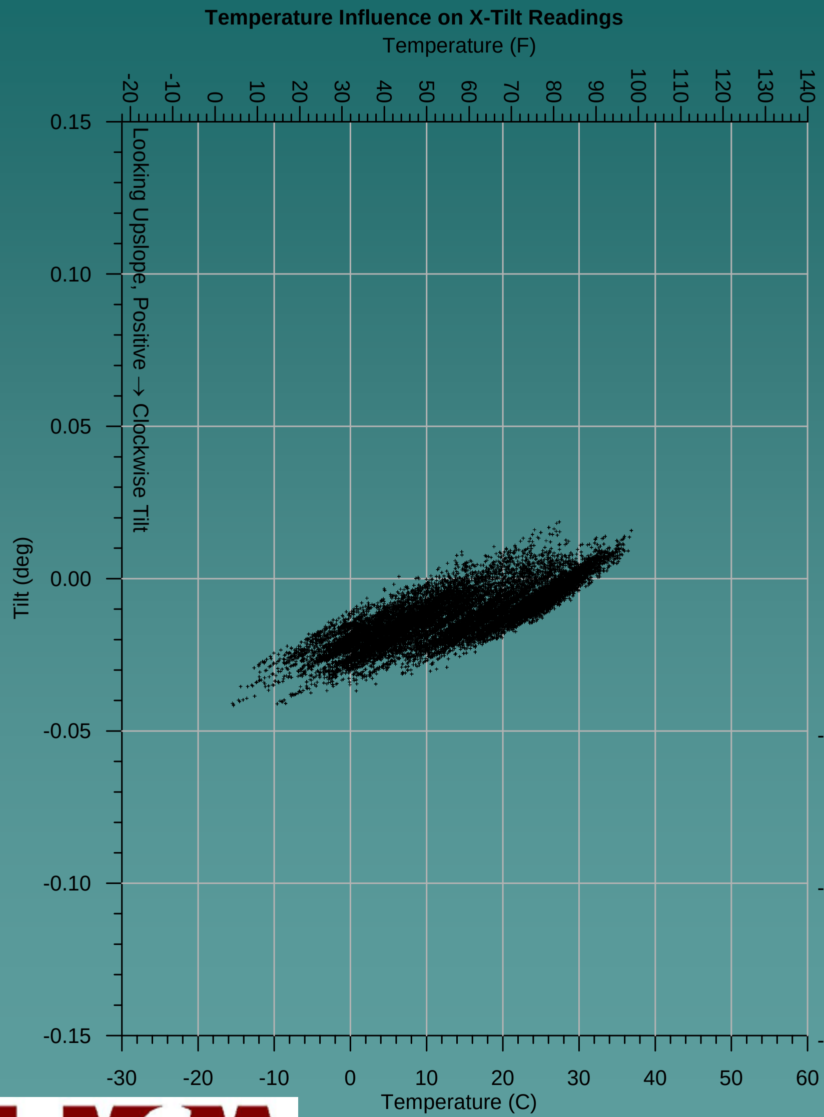
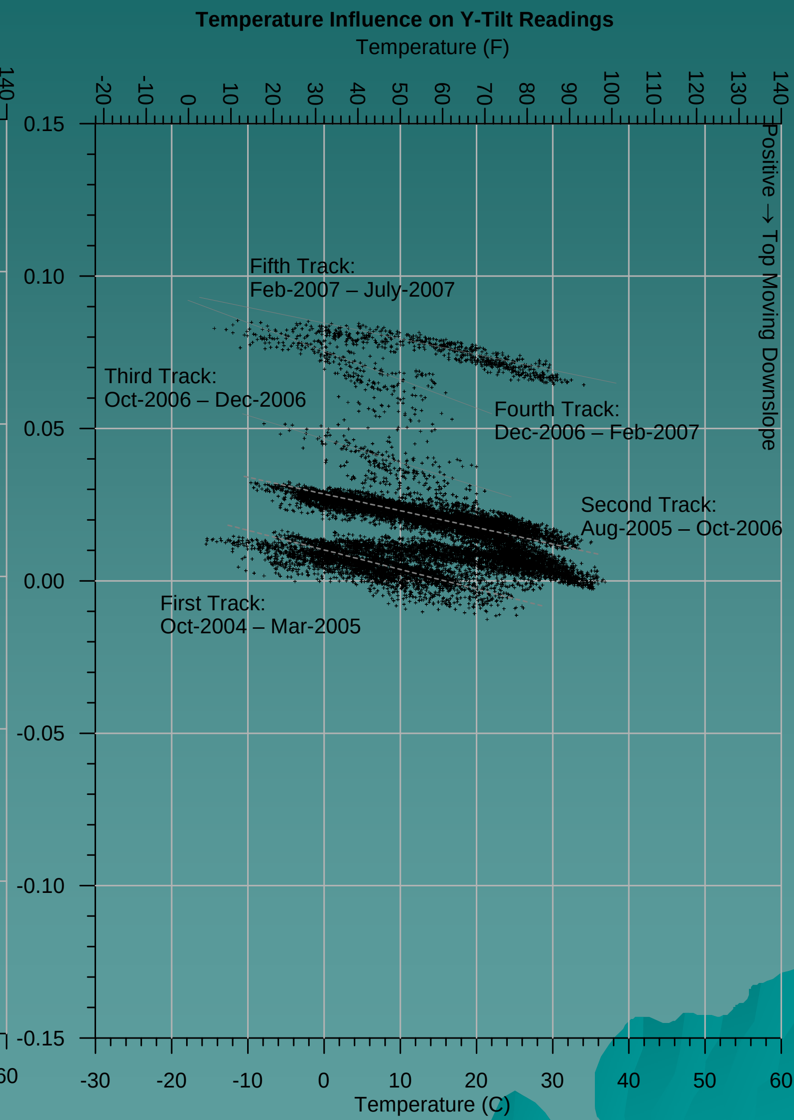
Existing Bridge Tiltmeter Results

Land Pier Top Tiltmeters





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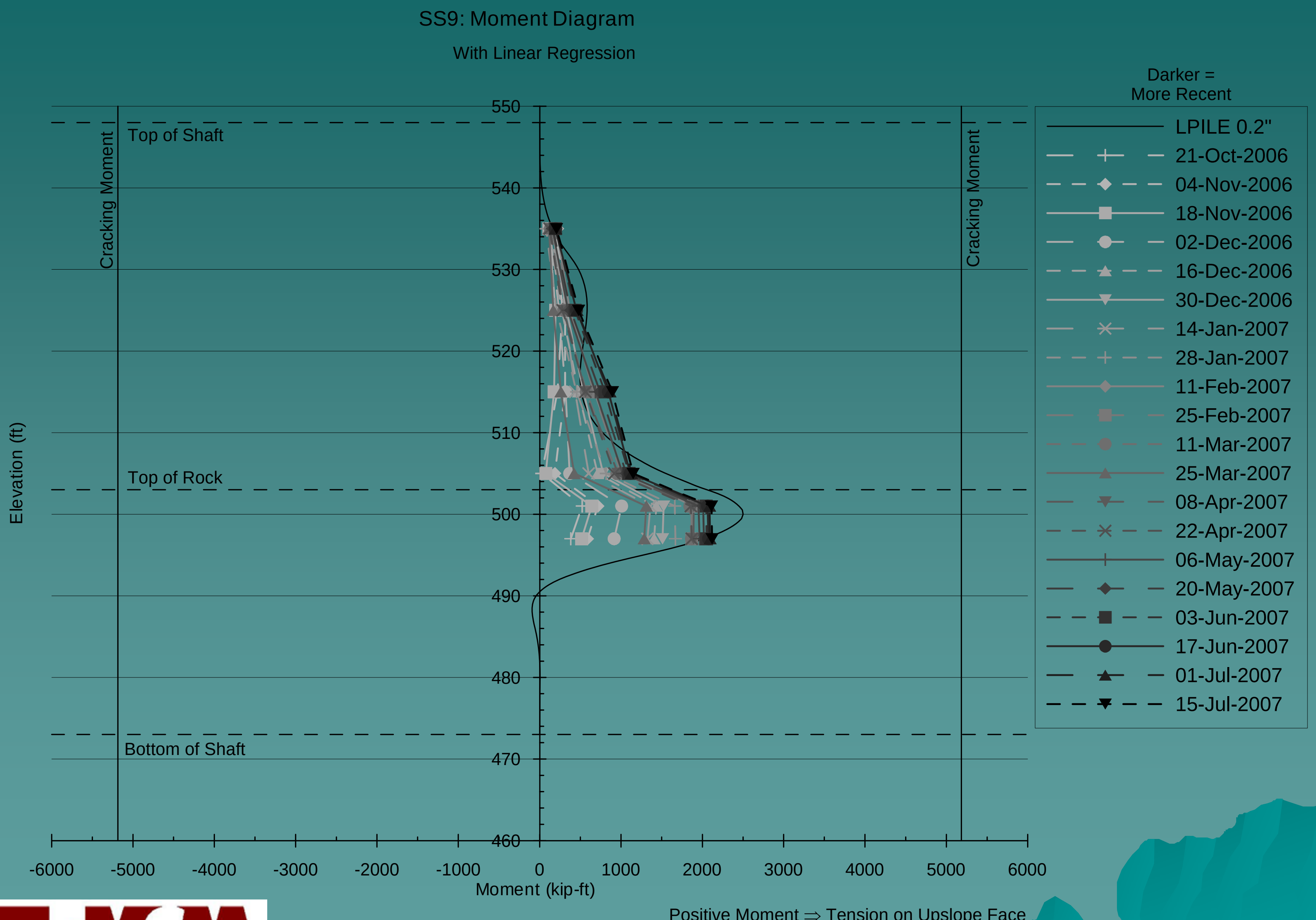
Stabilization Shaft Strain Gage Results



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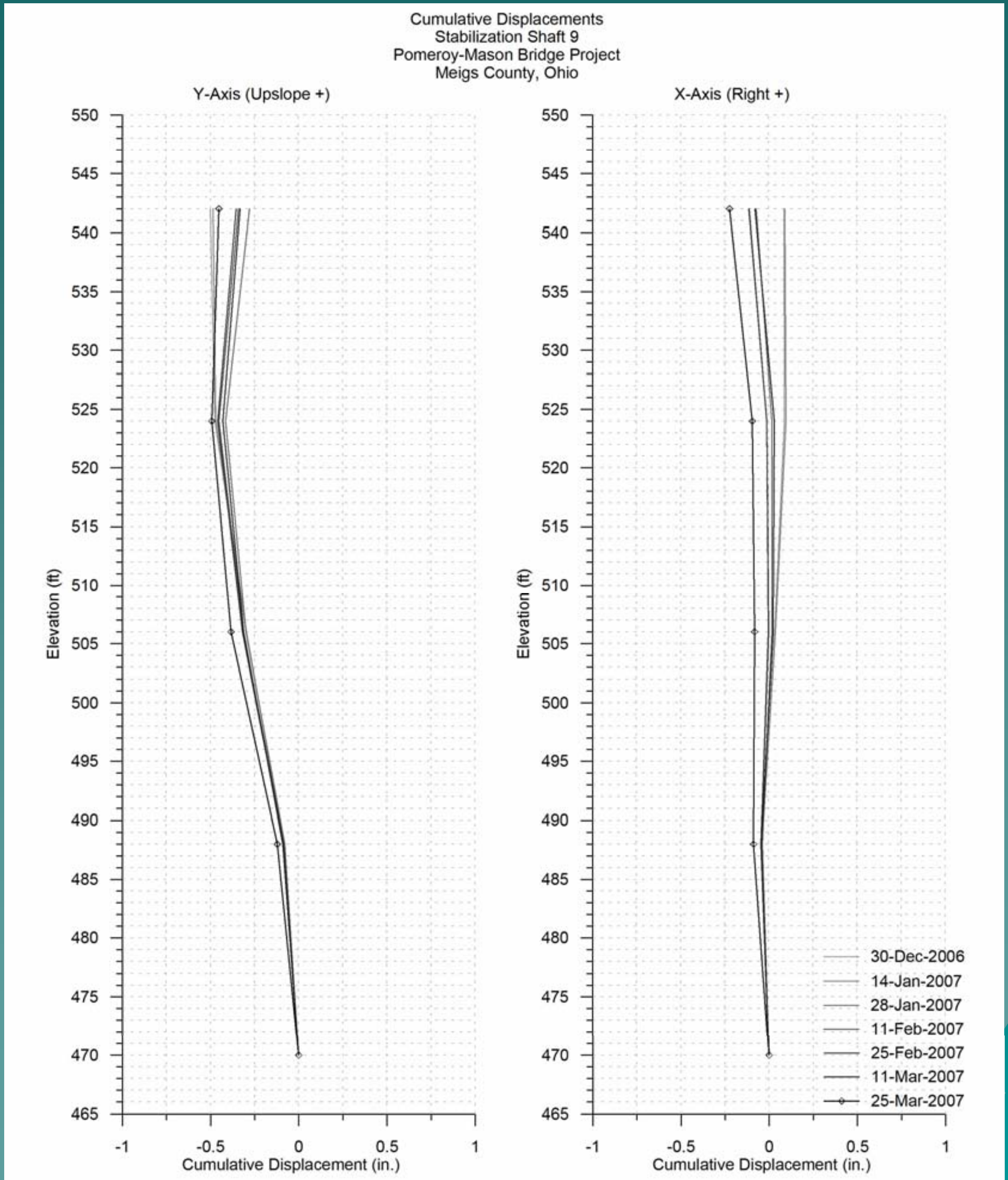
Stabilization Shaft 9 – IPI Plot



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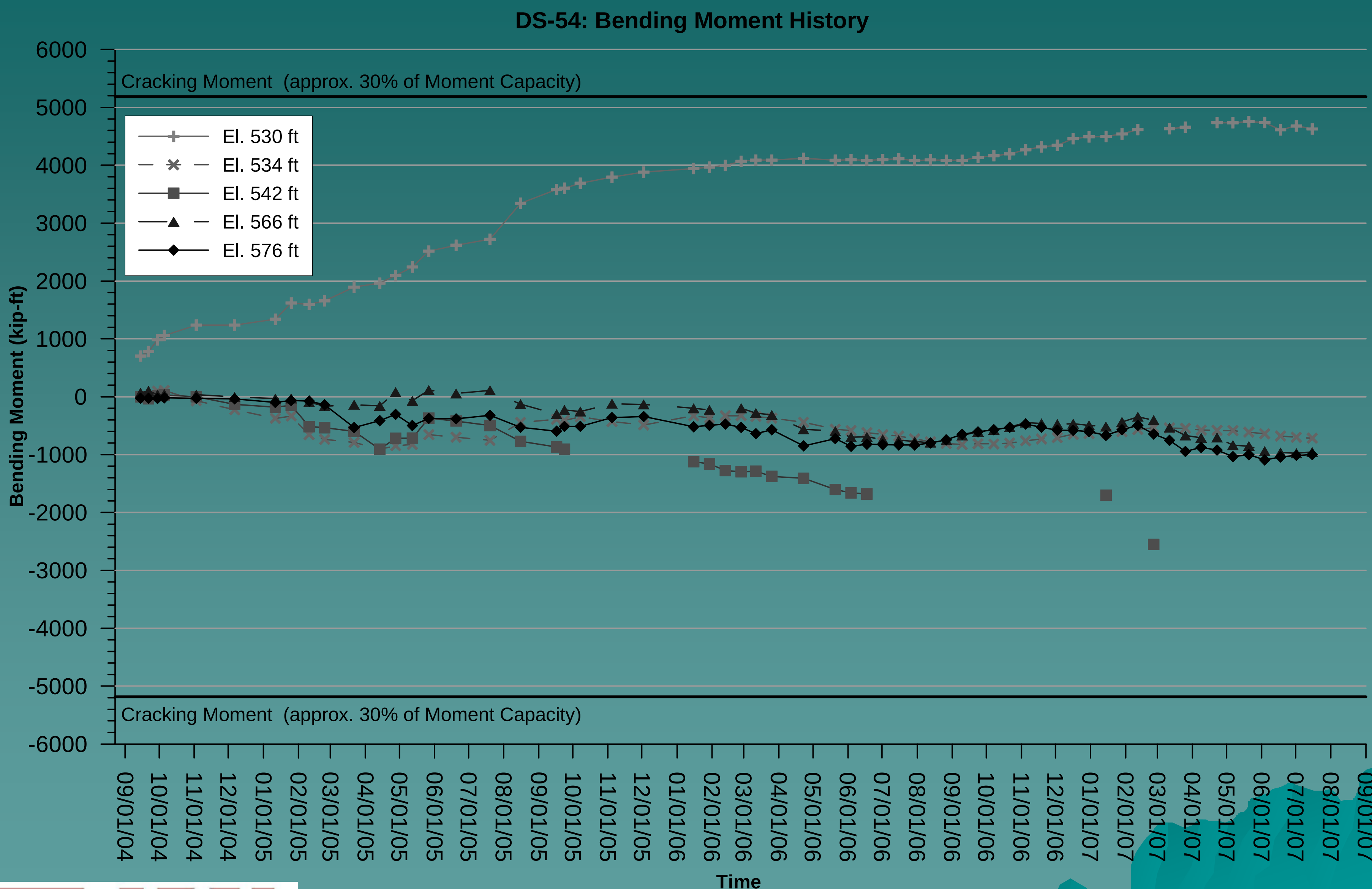
Touch Down Pier Strain Gage Results



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III. New Instrumentation on Existing Bridge

- Jointmeters (3 Joints on Ohio Side)
- Tiltmeters on Linkage Assemblies
- Strain Gages on Truss Members

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IV. Lessons Learned

- Difficulty with Instrumentation Durability in Construction/River Environment
- Sole-Source Instrumentation Consultants
- Communication Between Contractor and Engineer Key
- Better Results from Tiltmeters/Strain Gages than IPI's
- Look for Agreement Between Instruments
- Human Intervention with Instruments Necessary At Times
- Installation and Access Can Be Difficult

V. Questions/Answers

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