"Perceived Risk versus Cost in Karst Remediation – A Case History"

J. Samuel Vance, P.E.
Geotechnical Department Manager
AMEC Earth & Environmental, Inc.

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Project: Norfolk Southern mainline railroad, Milepost 96.1A; near Morristown, Tennessee.

**Site Conditions:** Curve built upon fill across closed depression; fill thickness up to about eight feet maximum; open fields adjacent to site; karst topography; some regional bedrock faulting; Knox and Mascot Limestone Formations.

**Problems:** Ground loss and subsidence near track; periodic slow orders for traffic (up to 30 trains per day); ongoing maintenance to add/regulate ballast, re-establish profile/SE; occasional repairs (boulder fill) to choke dropouts/rebuild shoulder.

**AMEC Scope:** To explore general subsurface conditions; develop remediation scenarios.
Talbot Quadrangle

About 3 miles to downtown Morristown

Highway 11E

About 30 miles to downtown Knoxville

Site

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Drainage path

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Dropouts/Rock Fill near Track

Dec

Apr

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AMEC Geotechnical Study
• 20 borings (plus one)
• Review of GPR data obtained by NSC
• Review of subsurface data from earlier studies performed by others
Houston, we have a problem........
Corridor of highly weathered rock

+/- 250'

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No brainer: Address surface drainage

Remediation schemes to address subsidence:
- Compaction/cap grouting: $250K to $400K
- Track shift: $750K to $950K plus additional right-of-way issue
  - Temporary (during repair work to treat voids)
  - Permanent
- Land or at-grade bridge: $1.5M +/-

Perceived Risks:
- “What if world fell from beneath us?” (catastrophic collapse or dropout)
- Derailment/safety
- Environmental contamination from HAZMAT spill affecting air and/or water
- No convenient run-around if track out of service: freight $, schedules
- Unknowns/uncertainties with grouting/history of site
- PR issue associated with accident and perception of not having adequately addressed concerns if used lower cost/higher risk fix

Client’s Selection:
- Client chose expensive but permanent, walk-away fix – land bridge
Land bridge

- Off-the-shelf railroad design using concrete deck and socketed, concrete-filled pipe piles supporting bents and abutments
Note improved surface drainage and removal/sealing of dropouts.
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Summary

• Risk-conscious client elected to minimize risk of future problems at specific high-risk site by utilizing expensive, low risk solution

• Risk of future problems within adjacent areas nonetheless