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Assessing Transportation Infrastructure: Geotechnical Assets, Elements and Features

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2015 Geohazards Forum

Topics

Examples of recent failures

Map-21 and Performance Management

Geotechnical Taxonomy

Risk-Based Asset Management Approach

Example Foundation Assessment

Conclusions and Challenges

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I-10 Bridge CA, July 2015

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I-43 Leo Frigo Bridge, Green Bay, Sept. 2013

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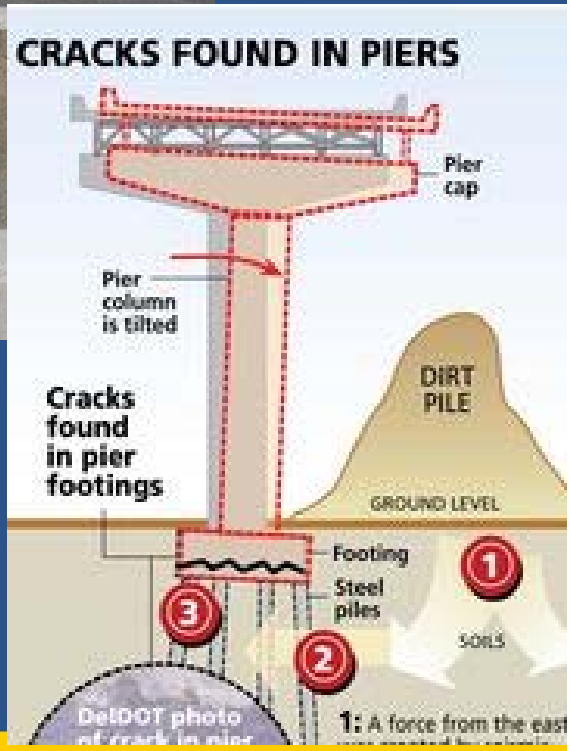
I-495 Delaware Christiana Bridge, June 1014



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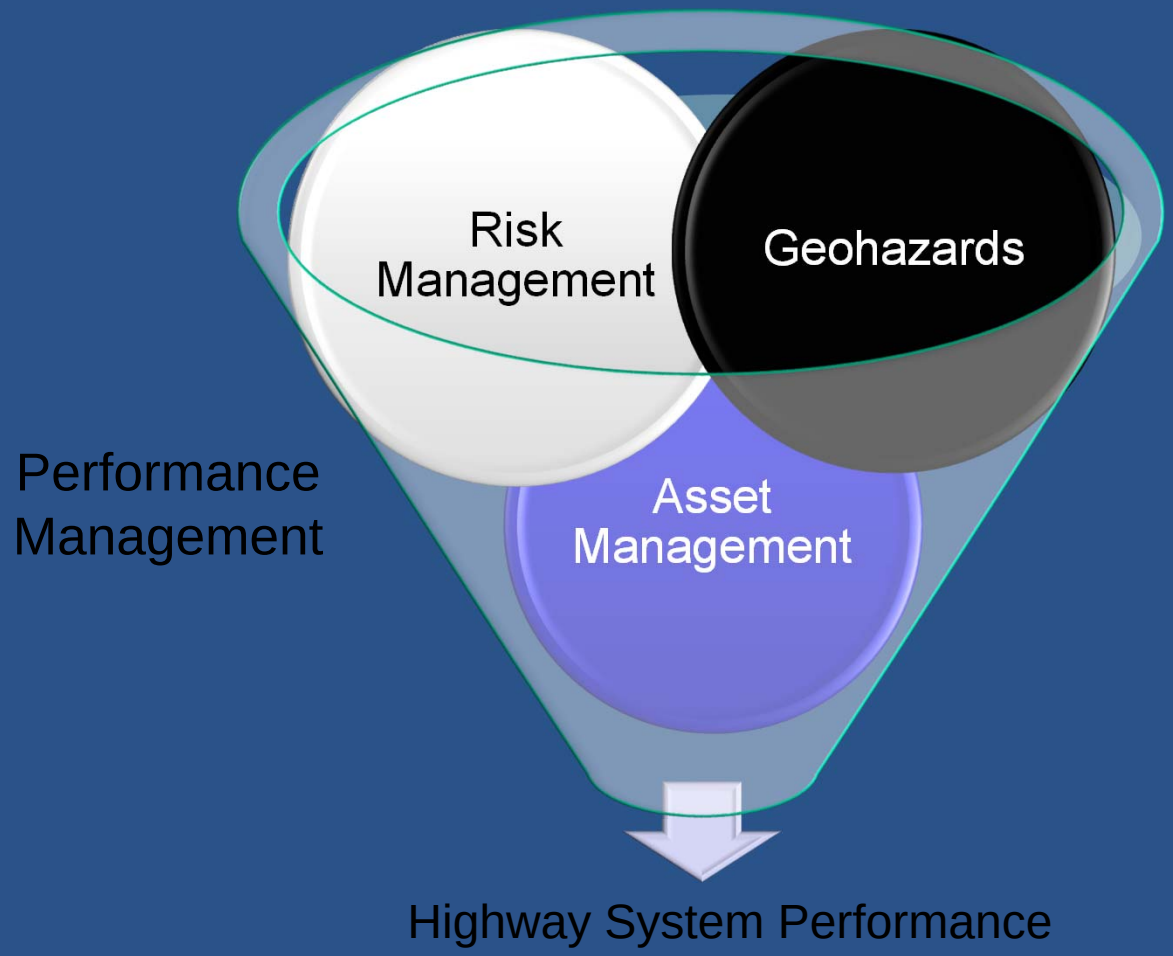
MAP-21 – Transportation Bill July 2012

- **Establishes system performance requirements**
- **State Highway Agencies to develop asset management plan toward achieving national highway performance goals**
  - Risk-based plan to improve and preserve assets and performance of the system
  - Must include pavement and bridges
  - Encourages inclusion of all assets within the corridor right-of-way

MAP-21 National Performance Goals

1. Safety
2. Infrastructure Conditions: State of Good Repair
3. Congestion Reduction
4. System Reliability- improve efficiency
5. Freight Movement and Economic Vitality
6. Environmental Sustainability
7. Reduced Project Delivery Delays

Performance Management



2016 TRB Paper (Submitted)

Taxonomy for Geotechnical Assets, Elements, and Features

Scott A. Anderson, FHWA

Vernon R. Schaefer, Iowa State Univ.

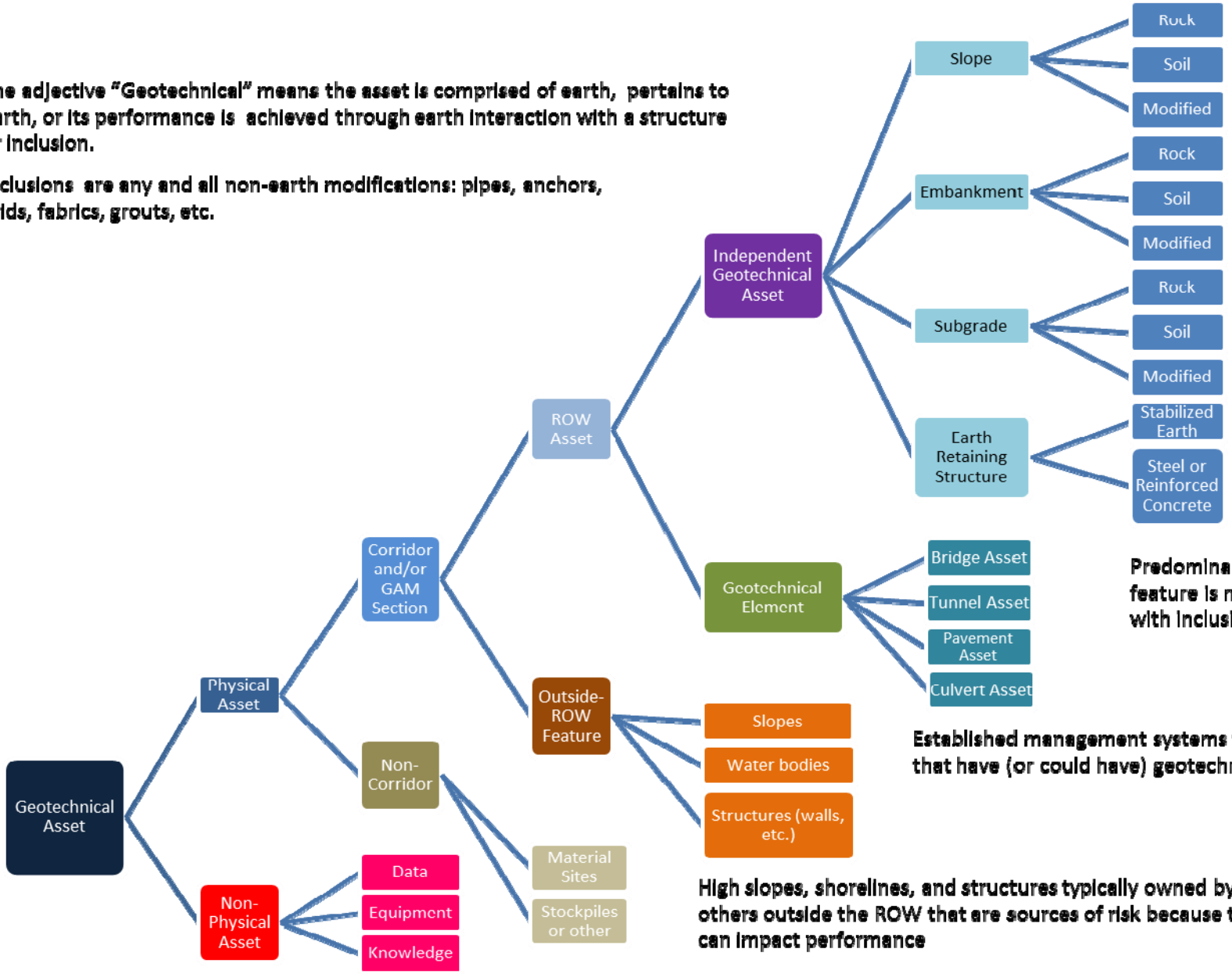
Silas C. Nichols, FHWA

- Precise definitions of nomenclature to facilitate communication and advancement of geotechnical and transportation asset management.

Proposed Geotechnical Asset Taxonomy

The adjective "Geotechnical" means the asset is comprised of earth, pertains to earth, or its performance is achieved through earth interaction with a structure or inclusion.

Inclusions are any and all non-earth modifications: pipes, anchors, grids, fabrics, grouts, etc.



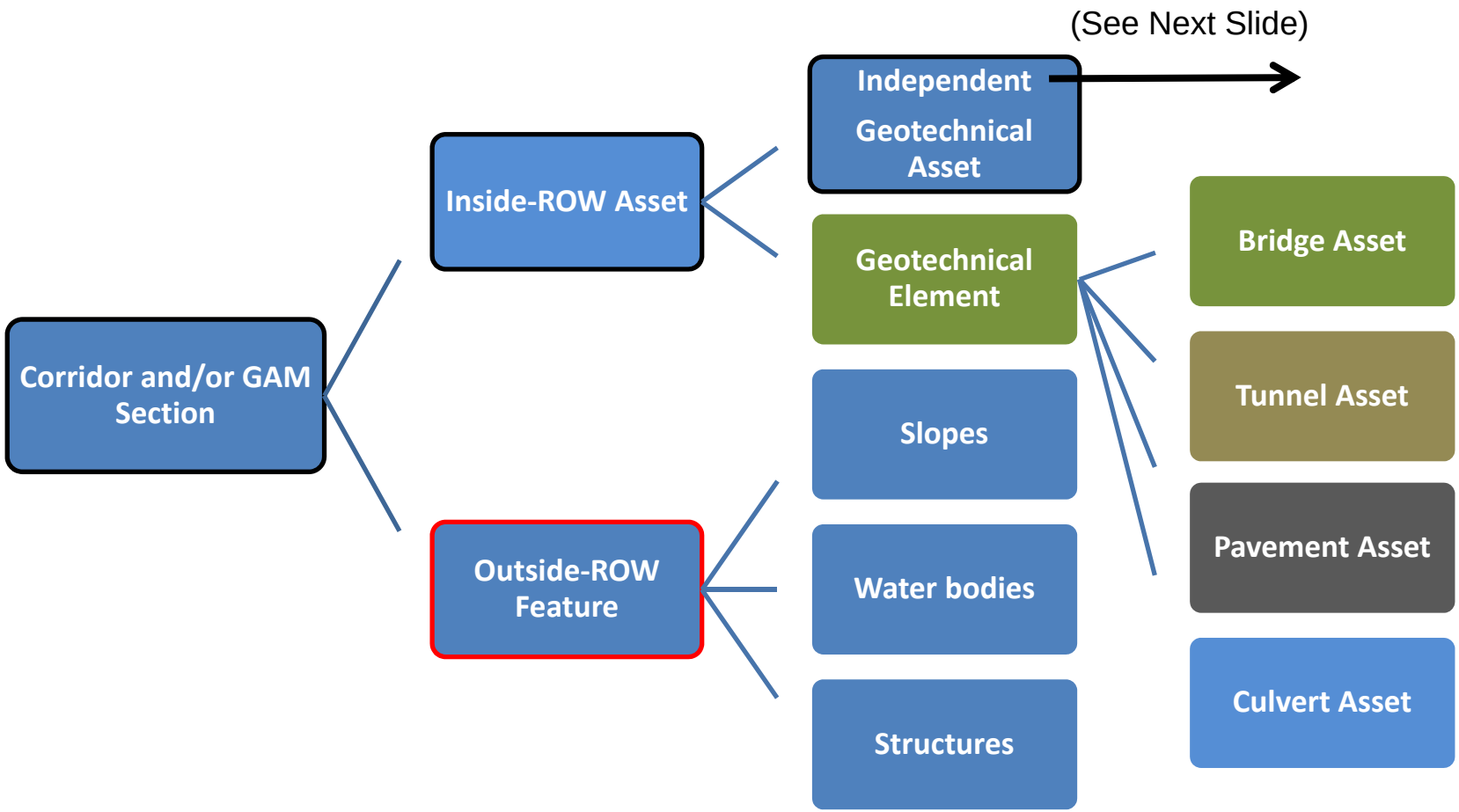
Predominant distinction in how feature is managed. Assets with inclusions are "modified".

Established management systems for other structures that have (or could have) geotechnical elements.

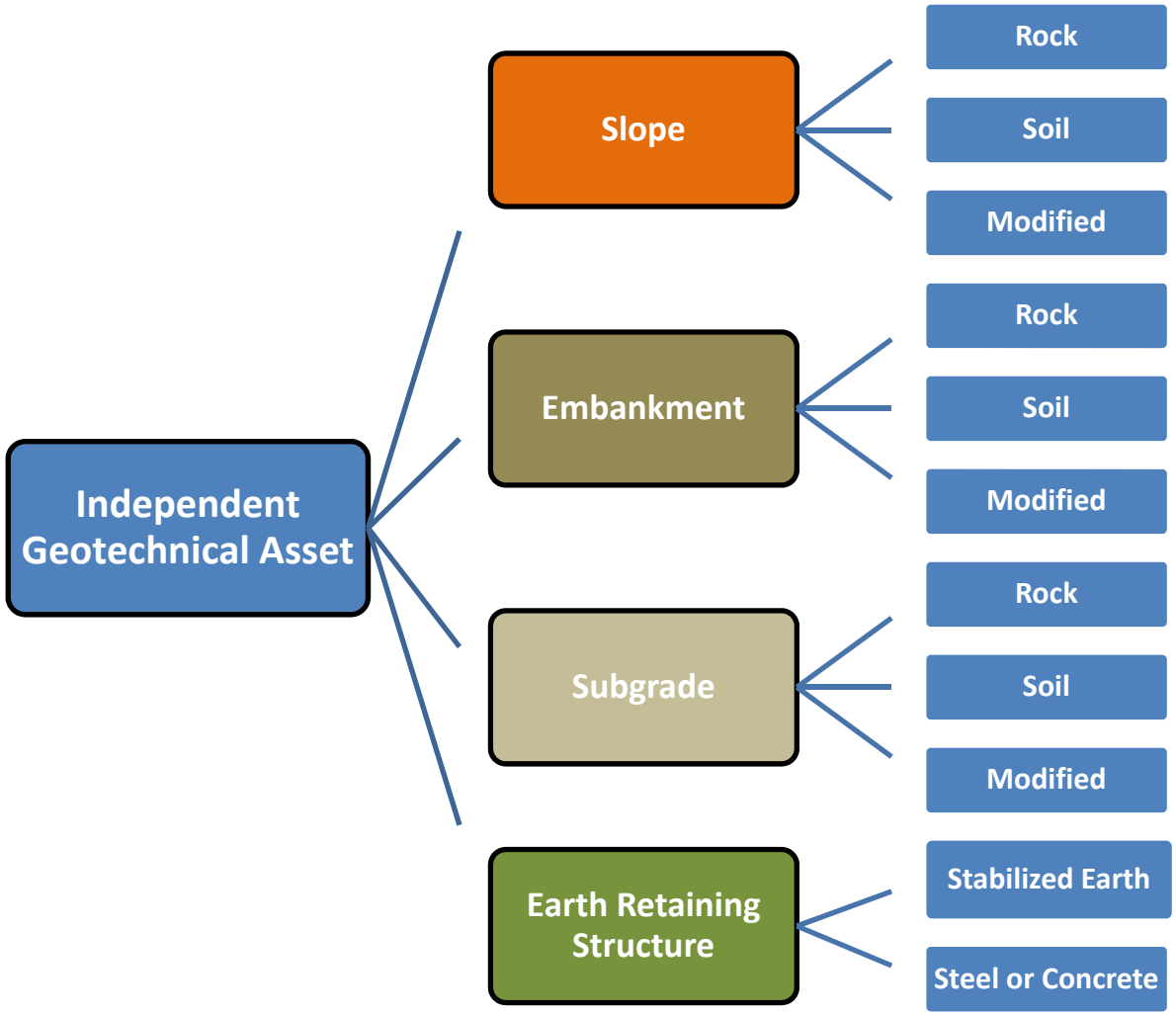
High slopes, shorelines, and structures typically owned by others outside the ROW that are sources of risk because they can impact performance

Investigation and test results, lab and field equipment, key personnel

Taxonomy (cont'd) – Corridor and/or GAM Section



Taxonomy (cont'd) – Independent Geotechnical Asset



Points to Consider

Many assets, elements and features affect system performance.

Standards change over time; existing infrastructure may not reflect certain considerations, so this must be captured within the risked-based asset management.

Absent a structured format, a geotechnical engineer might think of a failure event as a rock hitting a travel lane, a vehicle or injuring a person (all different), a failure of an embankment slope, or the structural collapse of a foundation but these events are not likely to be directly tied to stated **performance objectives**.

2016 TRB Paper (Submitted)

Communicating Multi-Objective Risk – A New Geotechnical Need for Transportation

Scott A. Anderson, FHWA

- Risk Cube concept – Visualization
- To facilitate the identification and communication of all significant risks, and to coordinate the best risk-based decisions.

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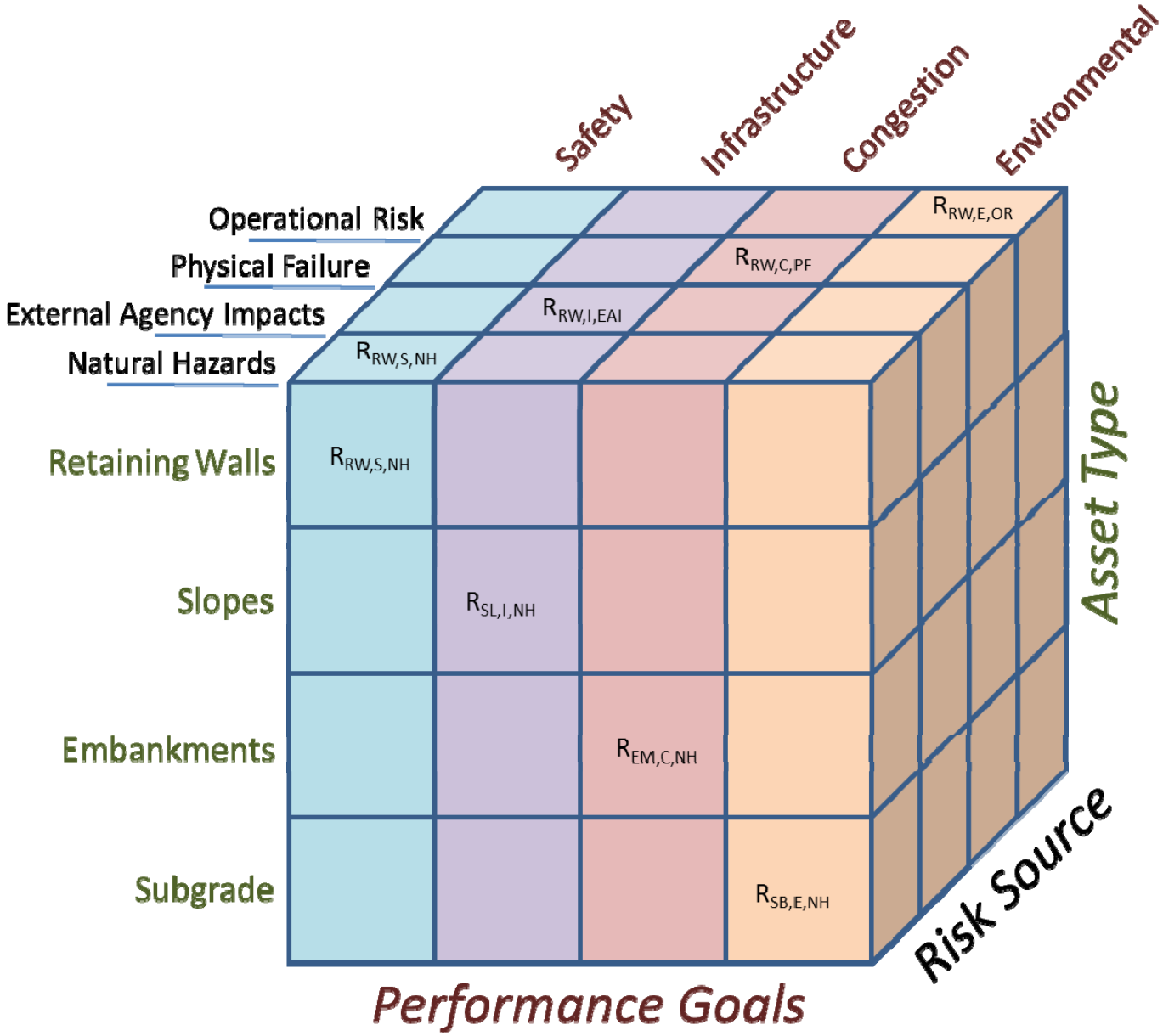
Risk Cube



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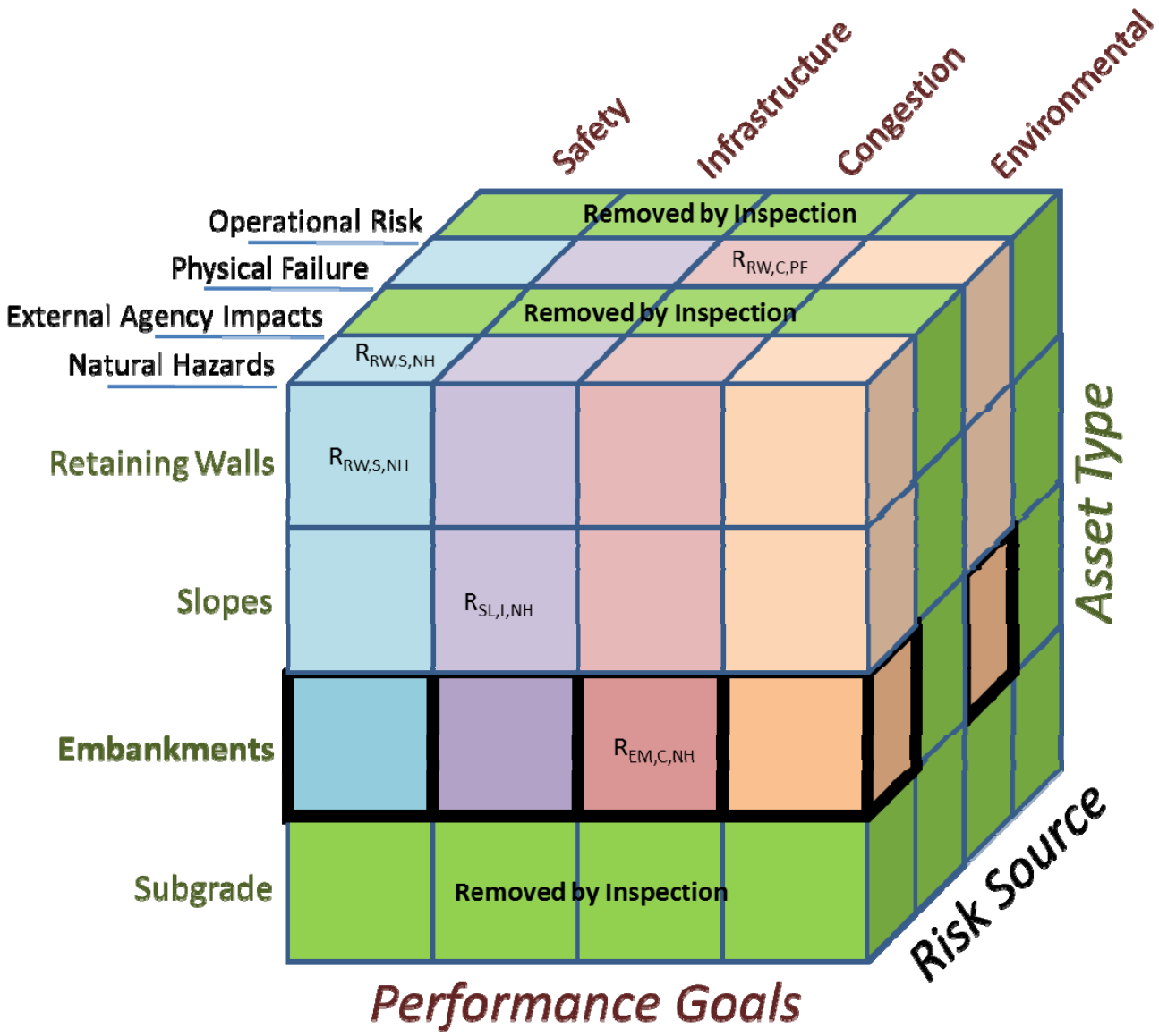
Example – For Embankments



Risk Categories for Embankments – Considering Physical Failure and Natural Hazards

- Risk to safety from *natural hazards* acting on embankment
- Risk to infrastructure condition from *natural hazards* acting on embankment
- Risk to congestion from *natural hazards* acting on embankment
- Risk to environment from *natural hazards* acting on embankment
- Risk to safety from *physical failure* acting on embankment
- Risk to infrastructure condition from *physical failure* acting on embankment
- Risk to congestion from *physical failure* acting on embankment
- Risk to environment from *physical failure* acting on embankment

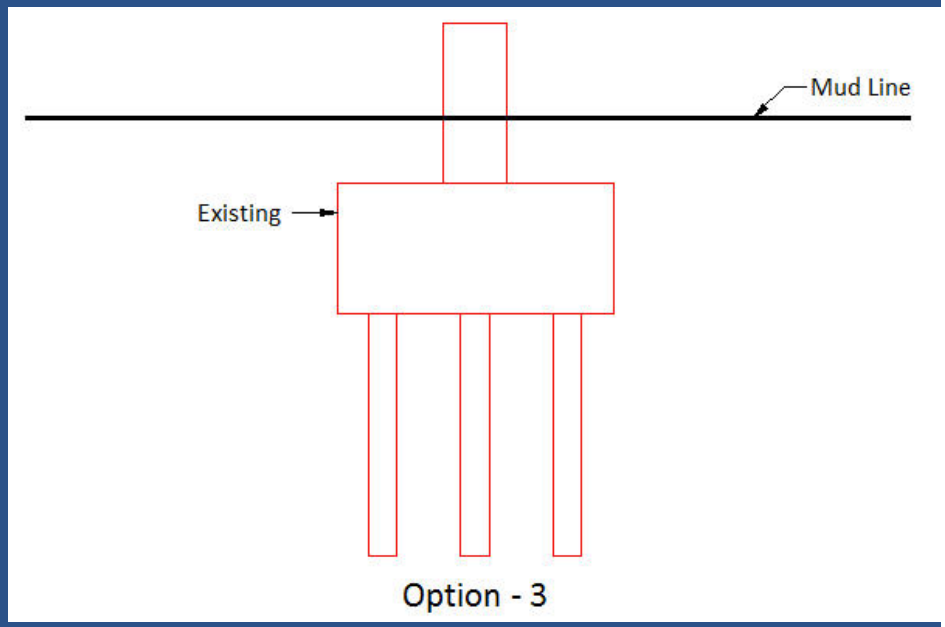
Tie to Geotechnical Performance

Relate System Performance Risks to Geotechnical Performance Criteria

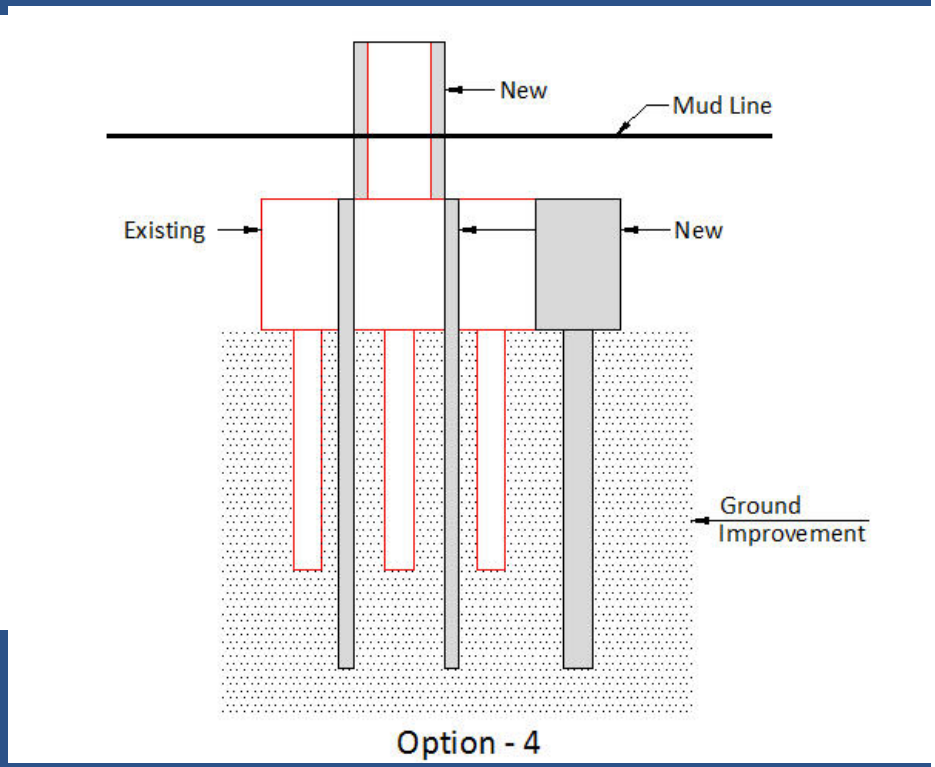
Ideally, design and performance standards would match performance expectations

Need: Relate to reliability of design (or improvement) and probability that geotechnical performance is not met (geotechnical failure) – In LRFD, this would mean for all limit states – Strength, Service, Extreme Event…

Consider a new bridge superstructure reusing an existing foundation system…



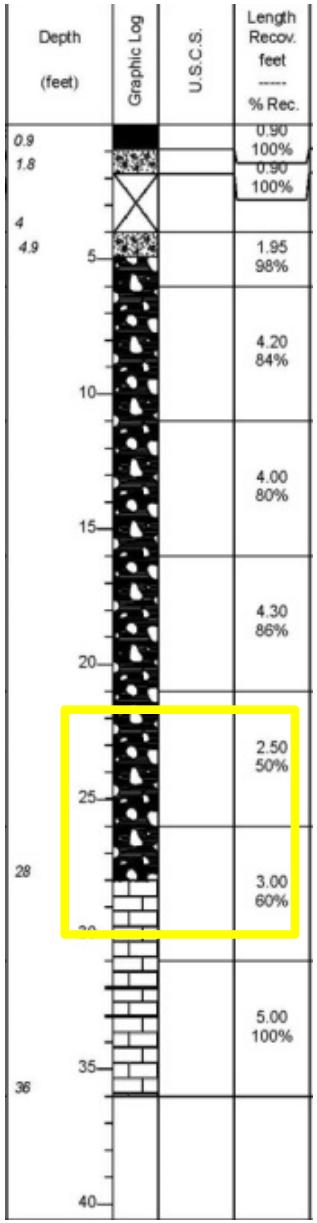
Complete Reuse

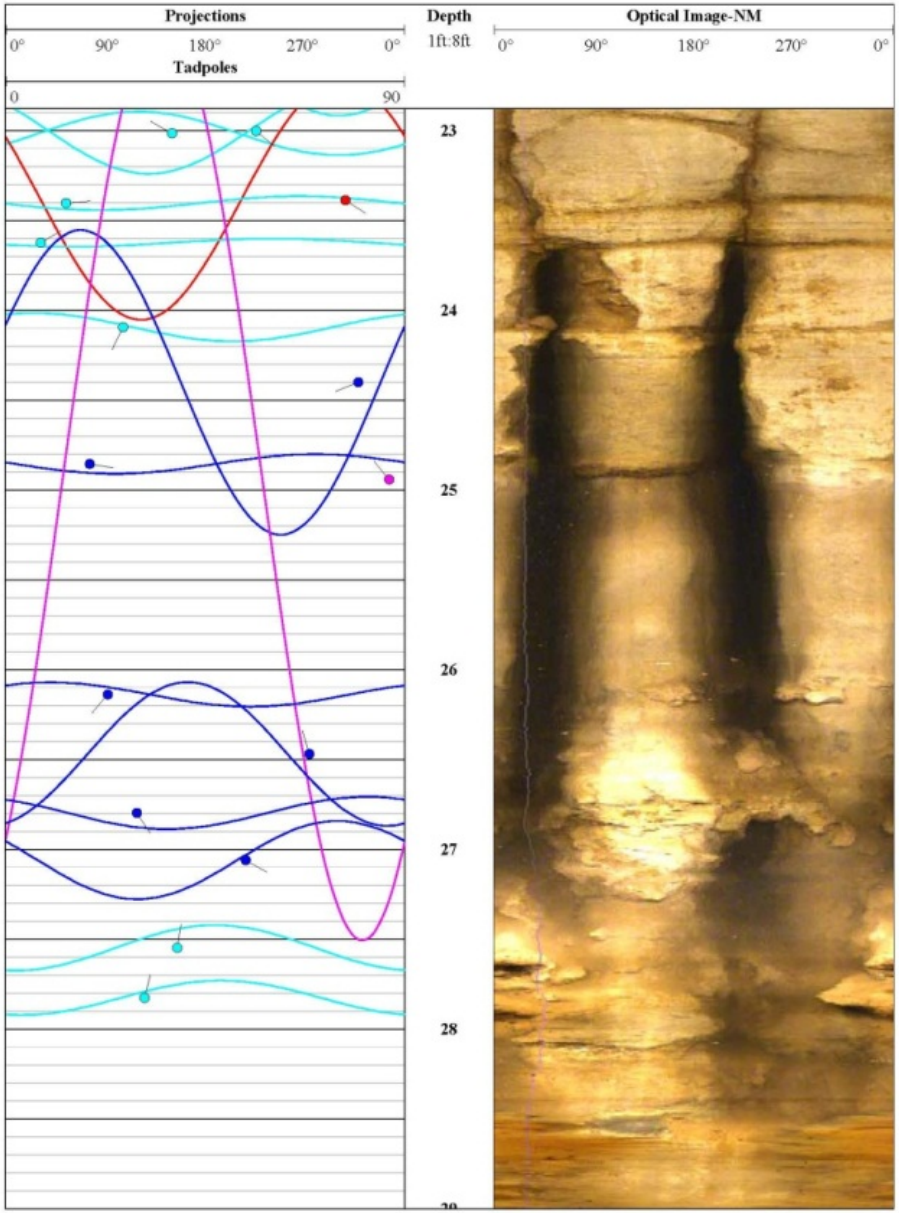


Partial Reuse/Retrofit

From Jalinoos, 2015

Example: Willow Valley Bridge, Abutment 1



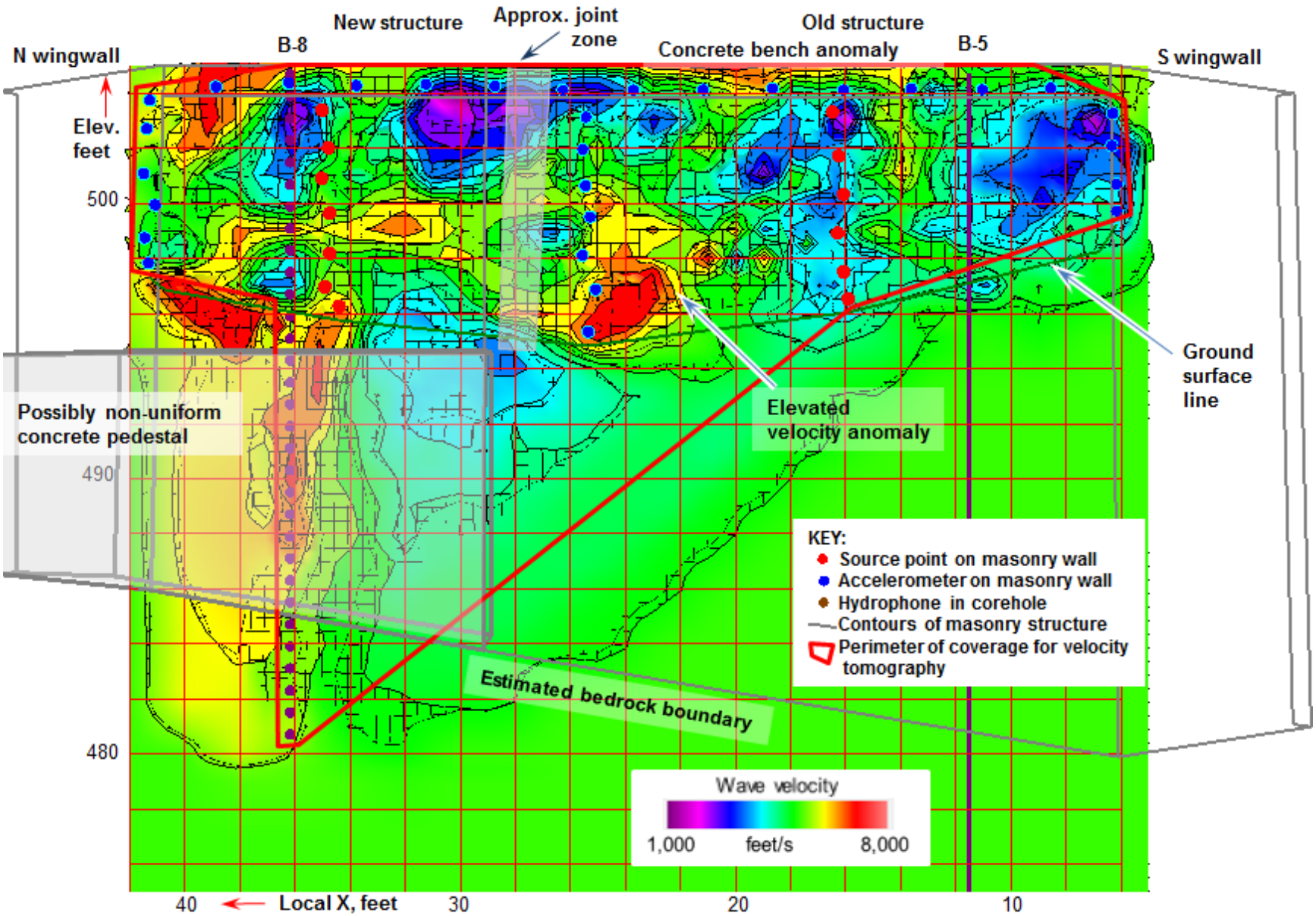


From Jalinoos, 2015

Image Source: Colog, Inc.

Example: Willow Valley Bridge, Abutment 1

From Jalinoos, 2015 Image Source: C-Thru Ground



Conclusions and Challenges

Many assets, elements and features affect system performance.

Standards change over time; risked-based asset management necessary.

Must relate geotechnical performance criteria to system performance objectives

Need: A unified reliability-based (probabilistic) geotechnical design/performance standard

Last Week Tonight with Jon Oliver: Infrastructure

Questions?