Geohazards Assessment for Highway Planning: The Karst Factor

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The Initial Project

The Knoxville Parkway State Route 475
Context Sensitive Design

Context sensitive design (CSD):

- Collaborative, interdisciplinary approach that involves all stakeholders
- Design that fits physical setting
- Preserves scenic, aesthetic, historic, and environmental resources
- Maintains safety and mobility
Context Sensitive Design

Design Considerations for Parkway Alignment

- Scenic
- Historic
- Environmental
- Safety and Mobility

- Noise
- Air
- Water Quality
- Karst Topography

- Caves
- Fauna
- Sinkholes

- Physical Location

* Non Traditional Roadway Design Considerations for Roadway Alignment
Ripe Geologic Setting

Proposed Knoxville Parkway
Need for a Cave Survey

- Surface Exposure of Cave May be Limited
- Extent of Cave can be Deceiving
- May be Able to Correlate Surface Features i.e. Sinkholes, to Underground Features
- Examine Cave for Environmental Factors
- Roadway Alignment can Significantly Alter the Ecosystem of a Cave Just as The Cave can Alter the Performance of the Roadway
Cave Survey

- Public Input Prompted Cave Survey Along Proposed Parkway Corridor
- Cave Survey Performed by AMEC Earth and Environmental Inc. (AMEC) and Vaughn & Melton (V&M)
- Cave Survey Performed After Beltway Alignment Was Chosen
Cave Locations for Survey Along Proposed Highway Alignment
Cave Survey

Ghost Cave
Duck Blind Cave
Environmental Impacts On Cave

Protected Species Found in Surveyed Caves Along Corridor:

**Indiana Bat – G2**
Imperiled Globally S1
Extremely rare and critically imperiled in the state

**Gray Bat – G3**
Globally Vulnerable S2 – Vary rare and imperiled in the state
Environmental Impacts On Cave

Protected Species Found in Surveyed Caves Along Corridor:

- Numerous Salamanders and Cave Crickets
Cave Impacts From Roadway

Distinct Hydrological Setting
• Alteration of Surface Drainage Significantly Impacts Cave Hydrology
• Contaminated Road Runoff Can Directly Enter Cave System
• Sedimentation from Road Construction and Blasting can Block and Contaminate Cave Streams

Constant Cave Climate
• Roadways can Change Internal Temperature of Caves
• This Affects Humidity as Warmer Air Holds More Water
• Cave Balance Easily Upset
Cave Impacts From Roadway

Stream Entering Duck Blind Cave
Future Cave Surveys and the Context Sensitive Design of Roadways

3D Laser Cave Surveys

- Can View Small Fissures that Conventional Cave Survey Methods Miss
- Before and After Surveys to Examine How Construction Affected Cave System
Future Cave Surveys and the Context Sensitive Design of Roadways

Thermal Imaging Satellites

- These Same Principles Can be Applied to Cave Discovery
- Searching Sinkholes for Cold Air Discharge
- Searching for Springs with Cold Water Discharge
Future Cave Surveys and the Context Sensitive Design of Roadways

Cave Surveys Should be an Initial Step in Context Sensitive Roadway Design to Avoid Environmental Issues with Roadway Alignment and Cave Systems