



Karst Geohazards Along Highways in East Tennessee

Identification and Mitigation



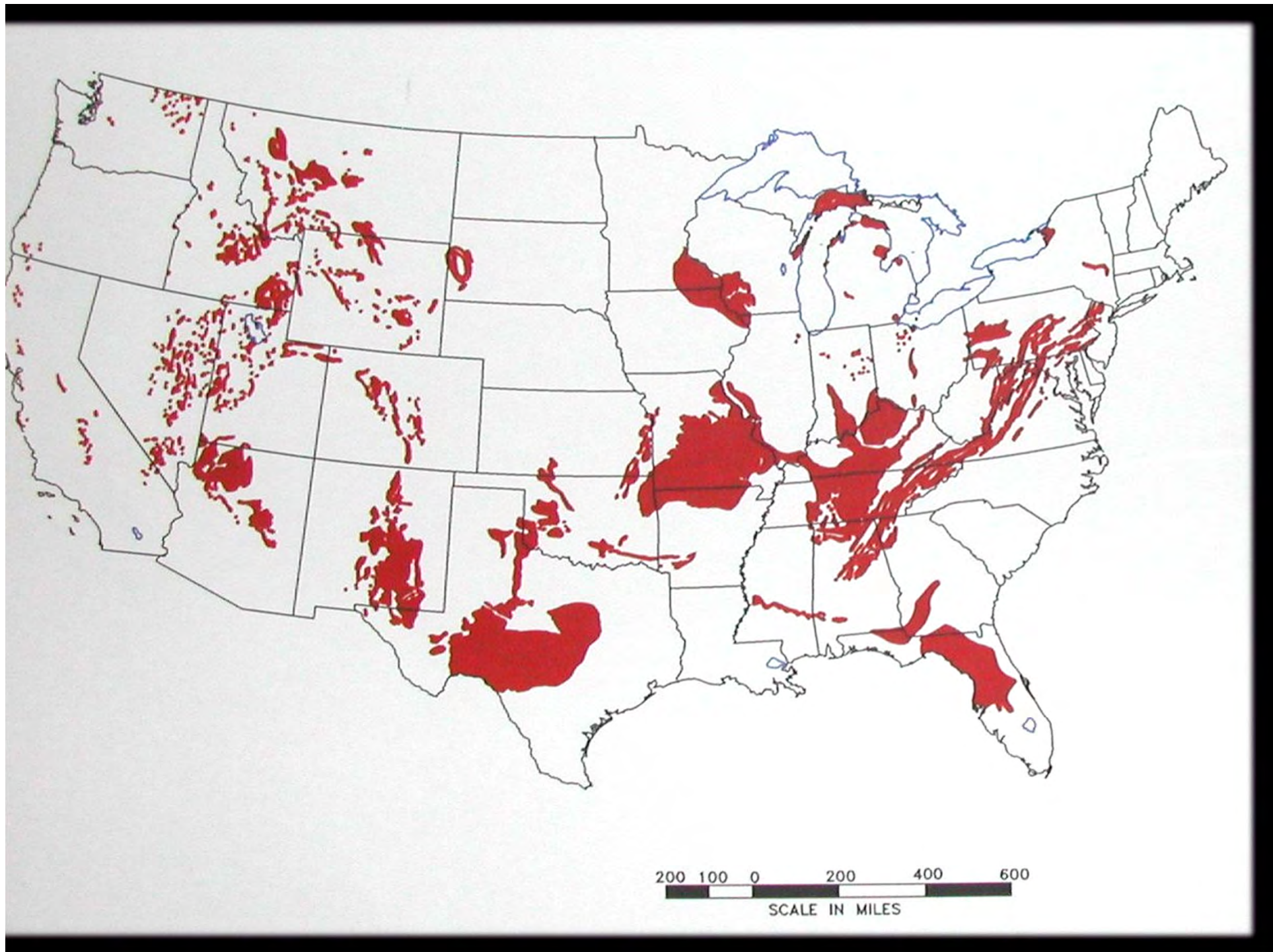
By
Harry Moore
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Atlanta, GA

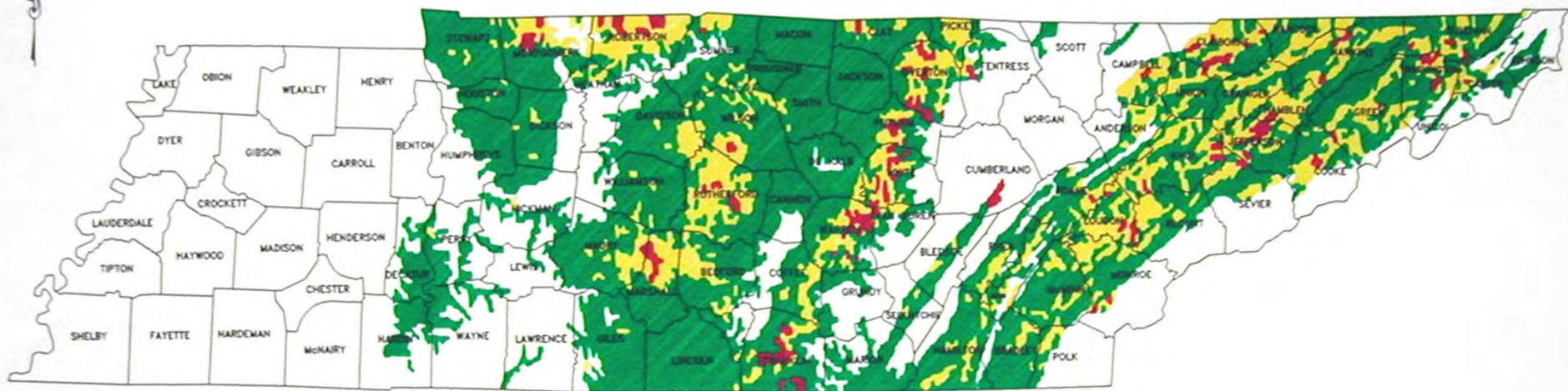


11th Annual Appalachians Geohazards Conference
Chattanooga, TN, August 2-4, 2011

Karst







EXPLANATION

NOTE: This map is intended for use as a general guide or planning tool. Because of the small scale of the map, the locations and boundaries of karst areas are generalized. Enlargement may result in misrepresentation of the data. The map should not be used for site-specific interpretations, nor should it be used as a substitute for field examination.

SOURCE: Map modified from the following sources:
 Crawford, N.C., and Webster, J., 1986, Karst hazard assessment of Tennessee—sinkhole flooding and sinkhole collapse: map prepared by the center for Cave and Karst Studies, Western Kentucky University, For U.S. Environmental Protection Agency, Region IV.
 Davies, W.E., Simpson, J.H., Ohmacher, G.C., Kirk, W.S., and Newton, E.G., 1984, Engineering aspects of karst: U.S. Geological Survey National Atlas, scale 1:7,500,000.

- NO RISK: Noncarbonate Areas
- LOWEST RISK: Carbonate Areas With Less Than 1% Sinkholes
- MODERATE RISK: Carbonate Areas With 1% to 10% Sinkholes
- HIGHEST RISK: Carbonate Areas With Greater Than 10% Sinkholes

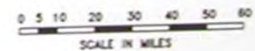


PLATE 13. SENSITIVE KARST AREAS OF TENNESSEE

DRAWING NO. TENN	 P.E. LeMoineux & Associates, Inc. Hydrologists, Geologists, Environmental Scientists, & Engineers © P. E. LeMoineux & Associates, Inc., 1984
DRAWN ABJ	
APPROVED	PROJECT TITLE FHWA
DATE 6/23/95	PLATE NO. 13 PROJECT NO. 570800 REV. NO. 0



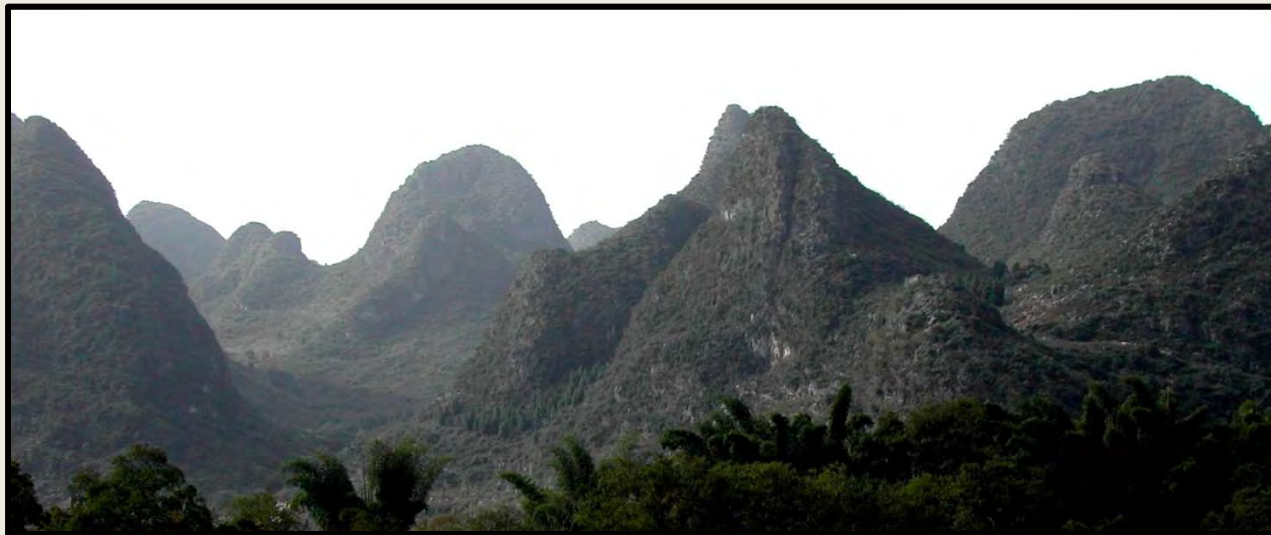




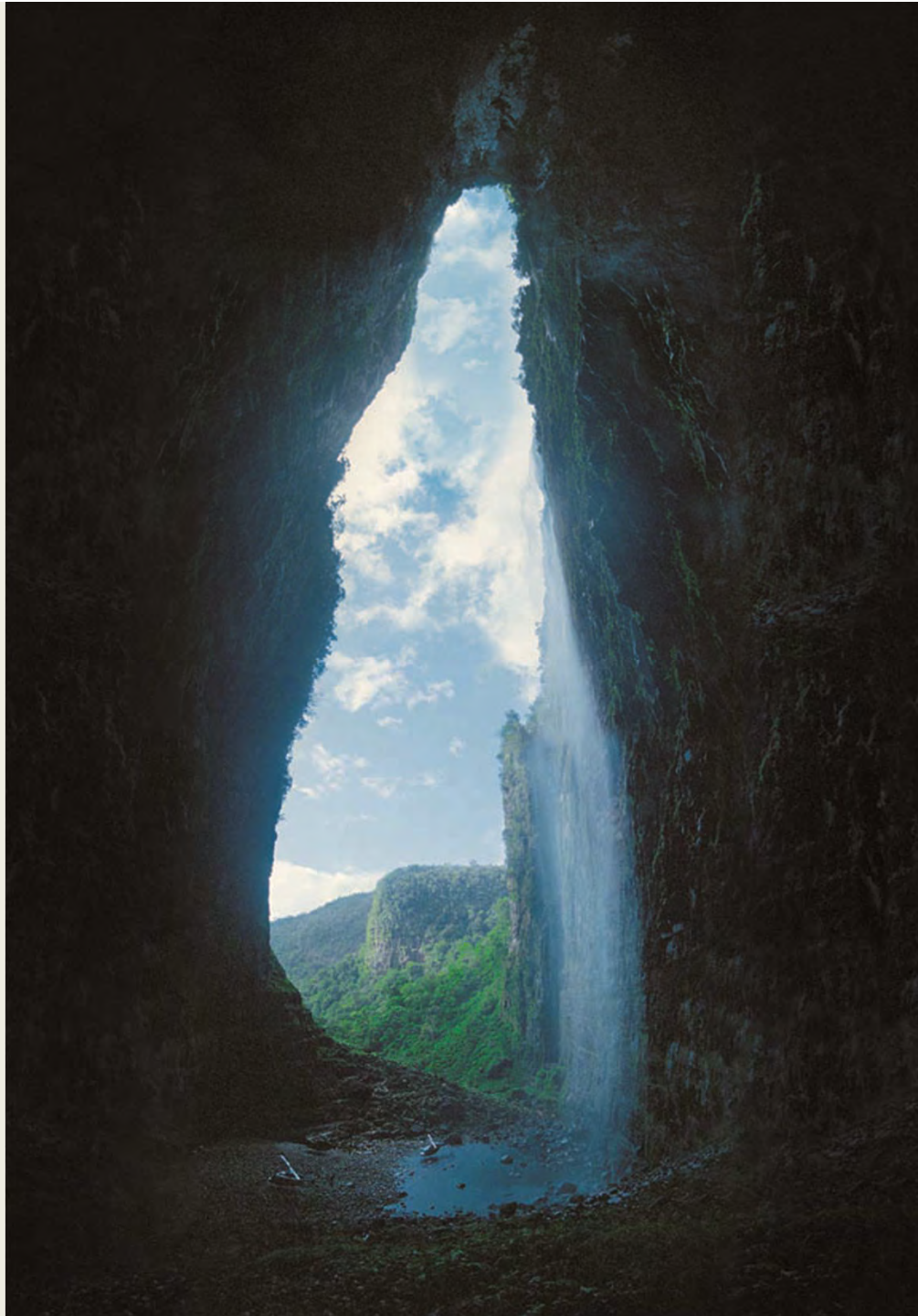






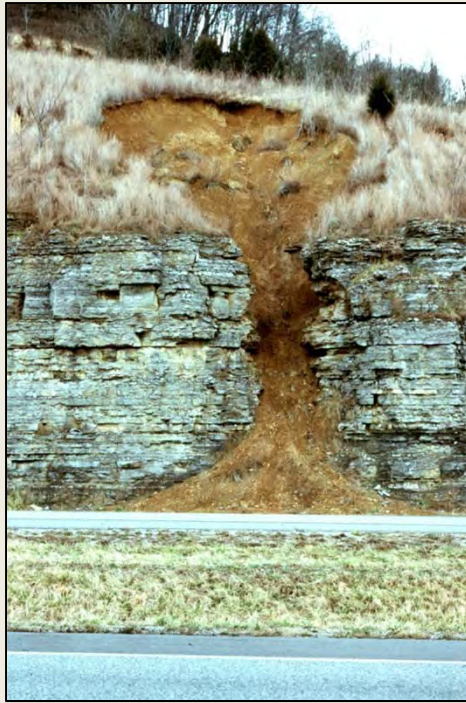








Karst Geohazards



















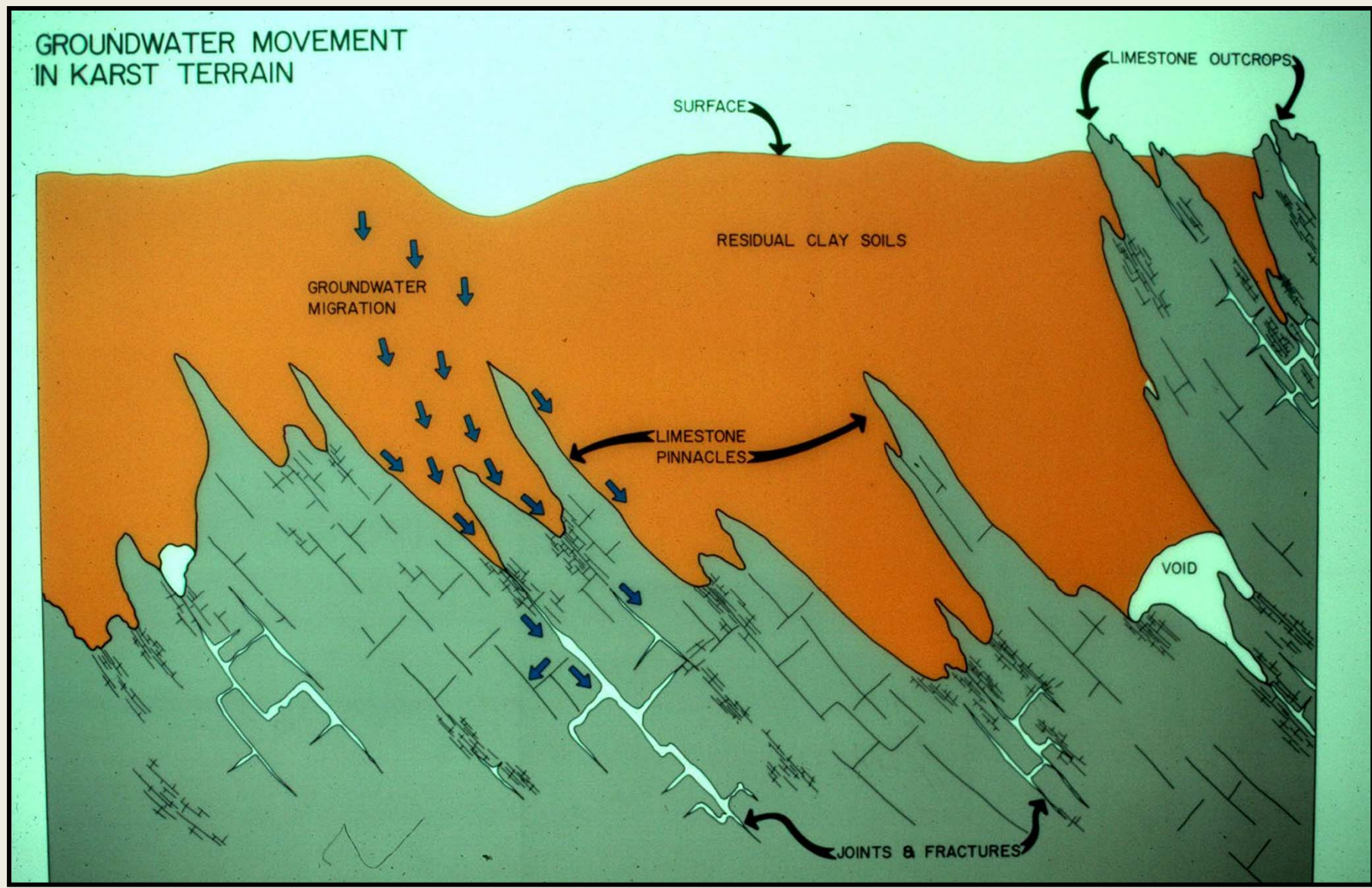




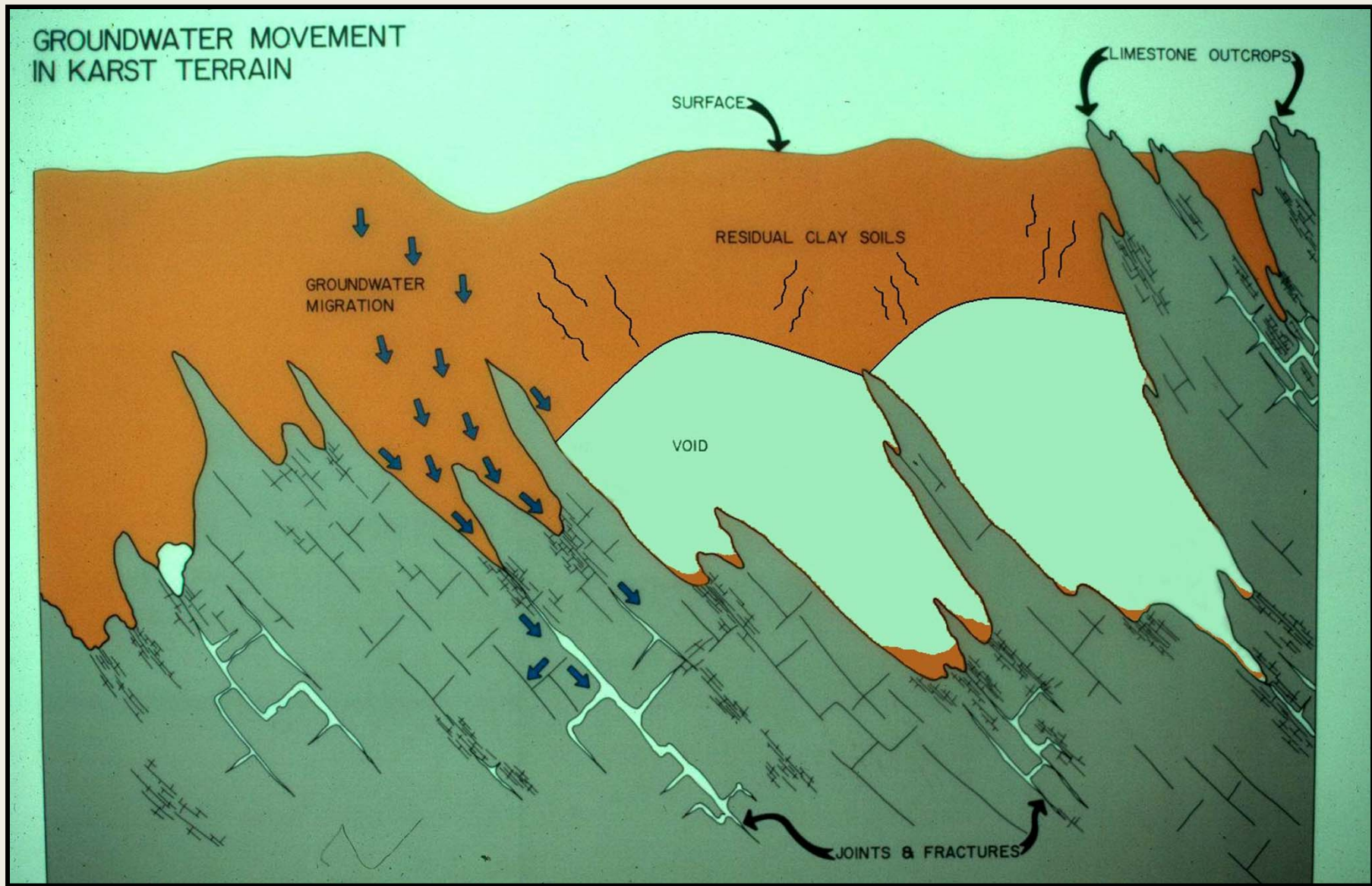


Sinkhole Collapse in Residual Soil

GROUNDWATER MOVEMENT IN KARST TERRAIN



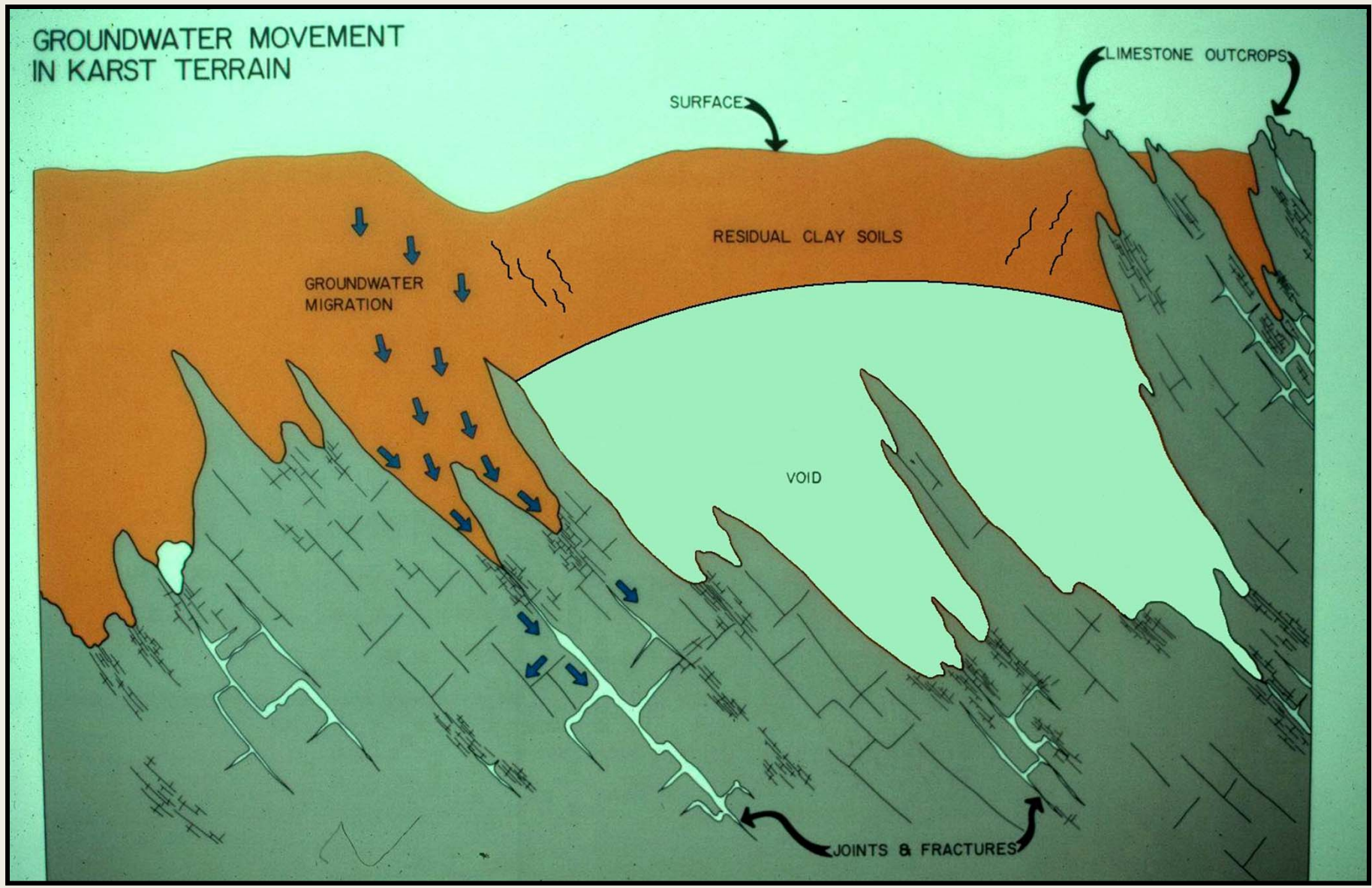
GROUNDWATER MOVEMENT IN KARST TERRAIN



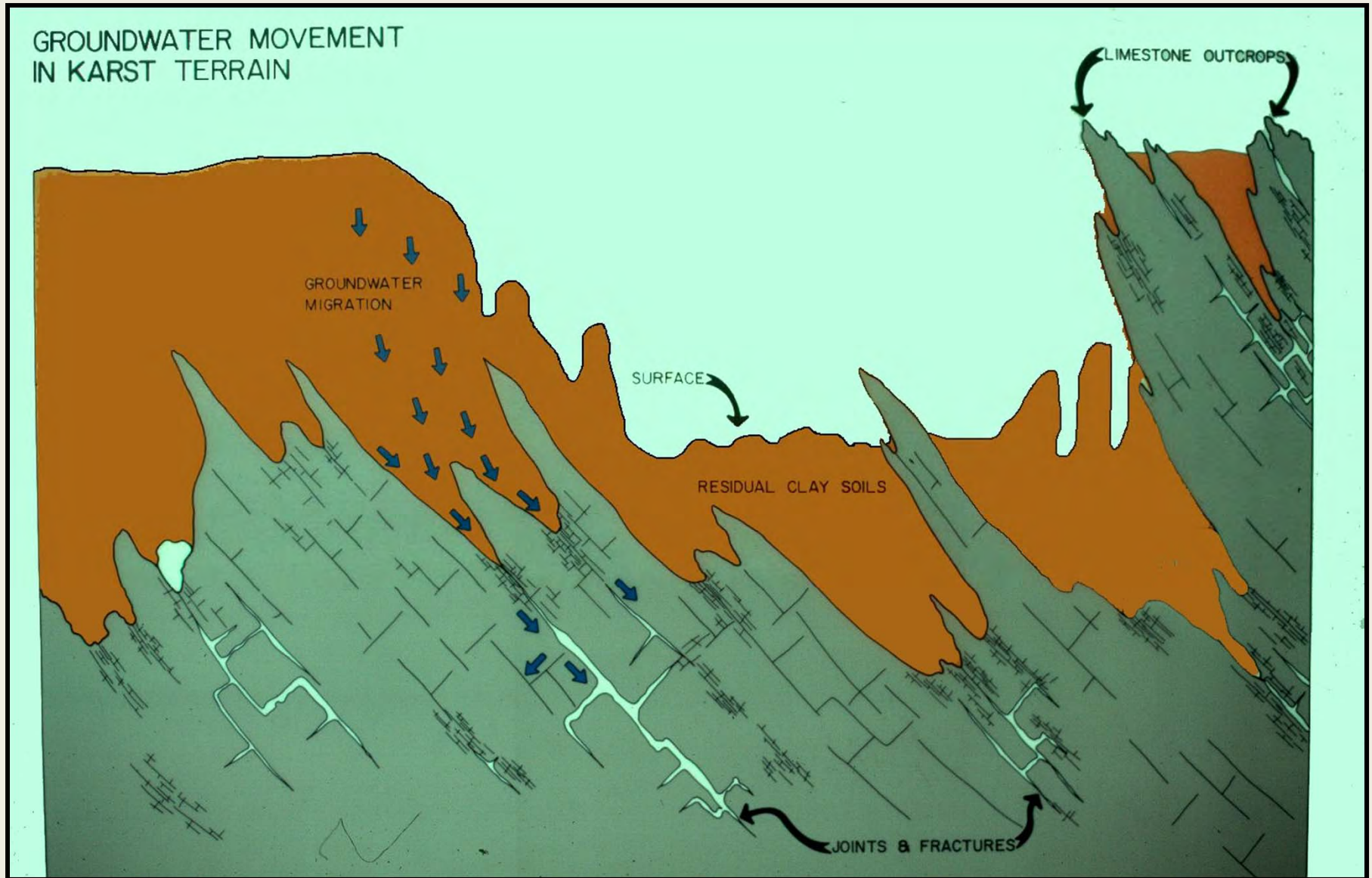


Void in Residual Soil in Karst

GROUNDWATER MOVEMENT IN KARST TERRAIN



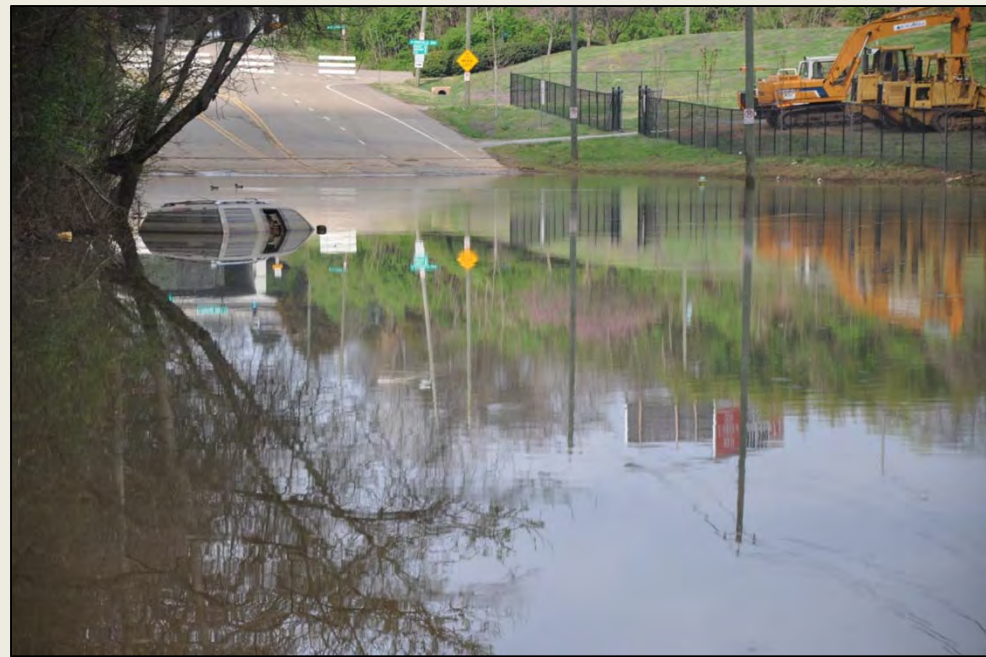
GROUNDWATER MOVEMENT IN KARST TERRAIN







Sinkhole Flooding



Environmental Cave Issues

- Sensitive Environments**
- Groundwater Contamination**
 - Stability**











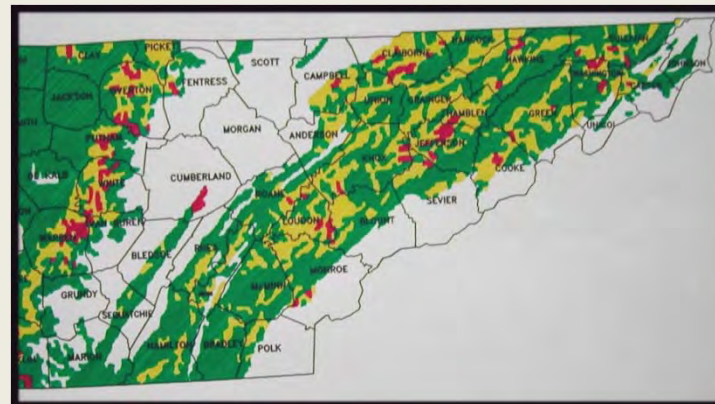
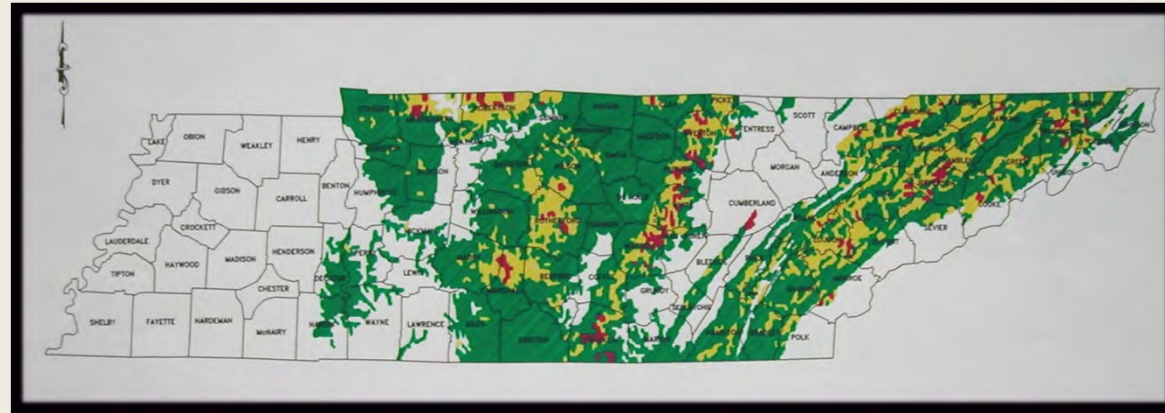
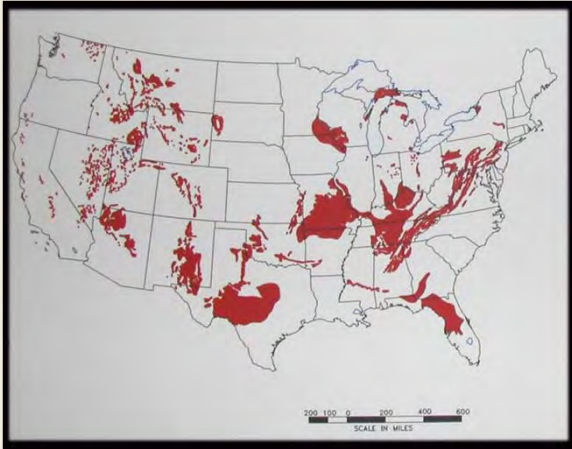


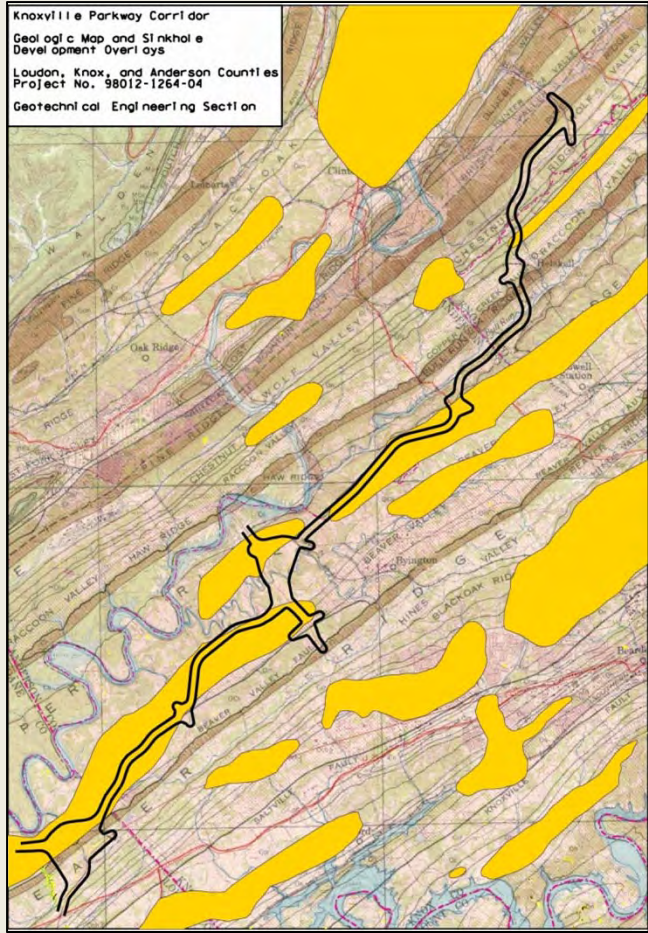


Avoidance

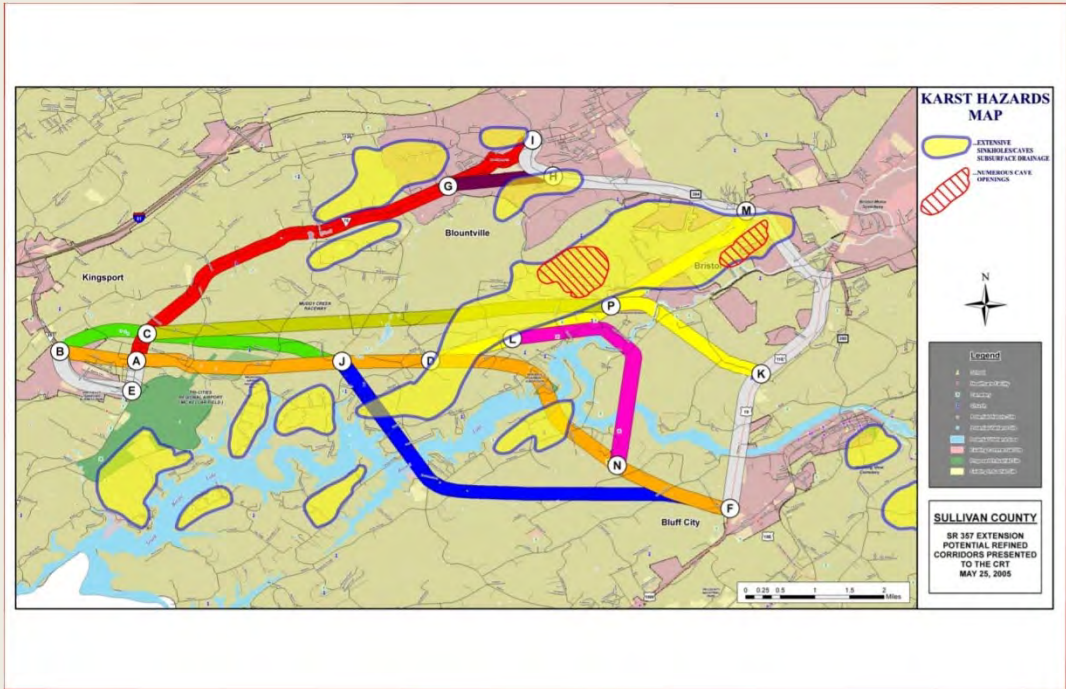
- **Identify Karst Areas and Issues**
 - Karst Maps, Sinkhole Maps, Cave Maps
- **Relocate Proposed Highways**
 - Avoid Karst Features: Sinkholes and Caves

Regional Karst Maps





Local Karst Maps



Scale makes a Difference

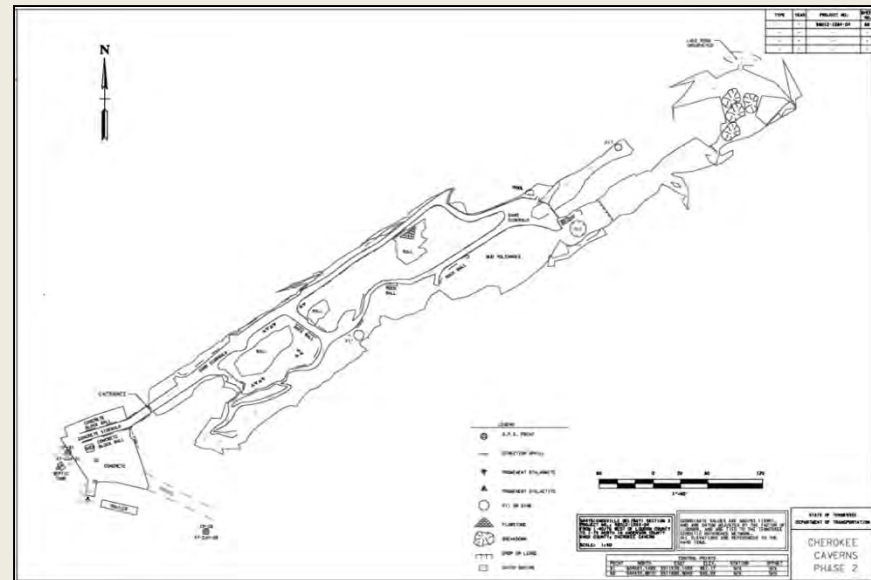
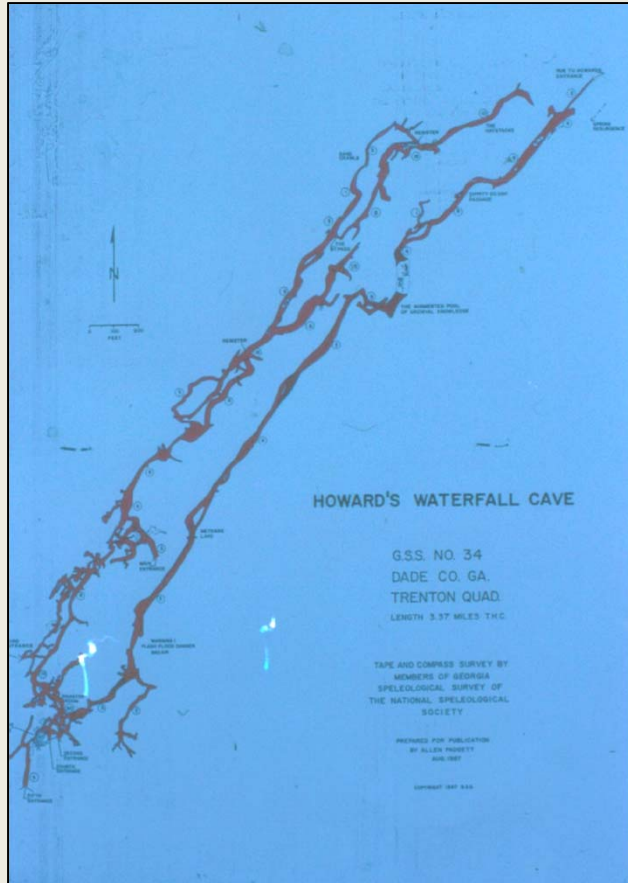


20-Foot
Contour Interval

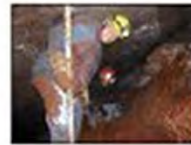


3-Foot Contour
Interval

Cave Maps



Cave Map Location



MEADES QUARRY CAVE (SOUTH KNOK - MOST ENTRANCE) JAY'S NATURE CENTER PARK SR 71 (EXT.) STUDY AREA KNOX COUNTY

SCALE: 1" = 10'

TAPE & HIPSONETER/COMPASS SURVEY
AUGUST 2009

BY:

TENN. DEPT. TRANSPORTATION
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LORI MIDWELL
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JAY MOORE (REG.) DESIGN OFFICE
SAM WILLIAMS
DRAFTED BY HARRY MOORE

TOTAL LENGTH SURVEY 1,318 FEET

LEGEND

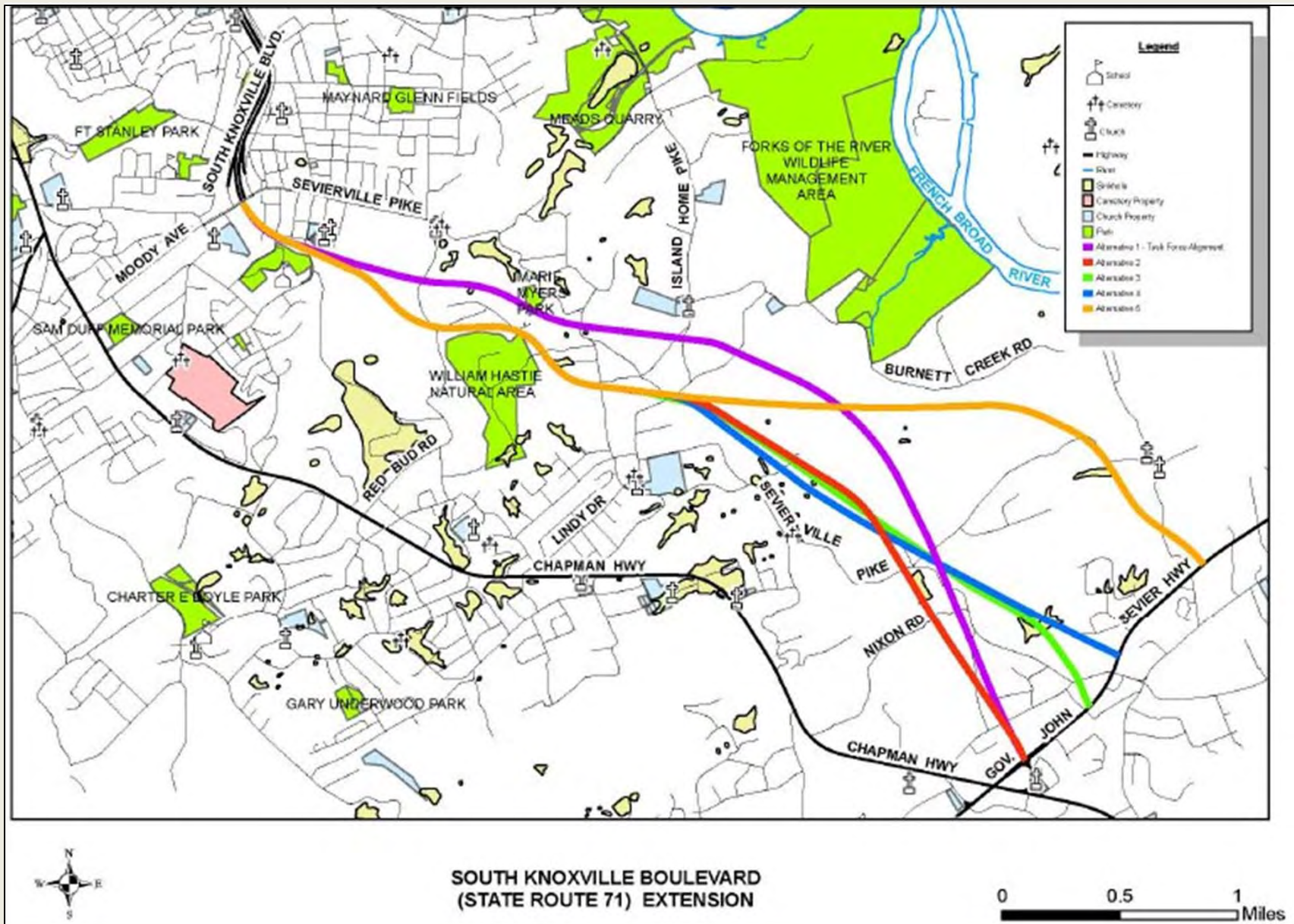
- SURVEYED CAVE PASSAGE
- CAVE PASSAGE LENGTH SURVEYED
WIDTH/HEIGHT UN-SURVEYED
- STREAM & FLOW DIRECTION
- SPELEOTHEMS (CAVE FORMATIONS)
- PROMINENT STALACTITE
- STEEP SLOPE (LINES POINT DOWN SLOPE)
- SURVEY POINT
- BREAKDOWN/BLOCKS OF ROCK

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
SR 71 (EXT.)
SOUTH KNOK BLVD.
STUDY AREA
KNOX COUNTY







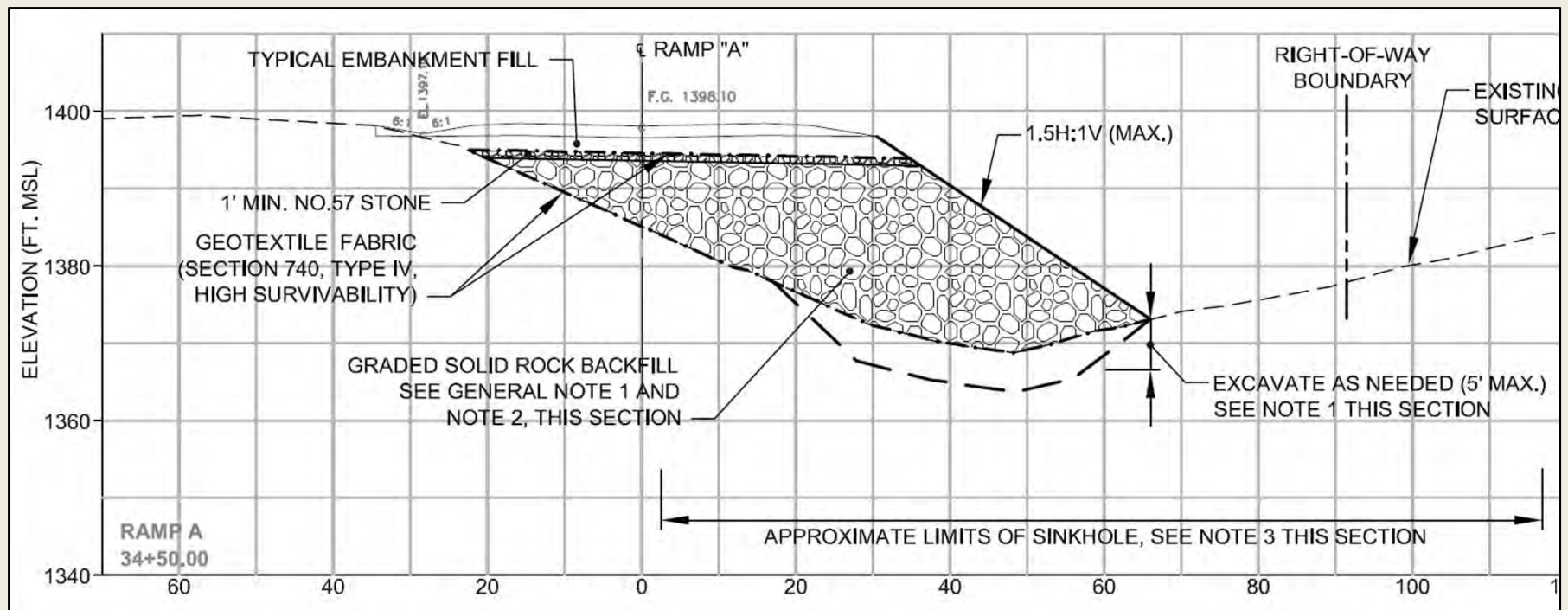


Avoiding Karst --- Moving Highway Alignments

Minimizing Impact to the Karst Environment



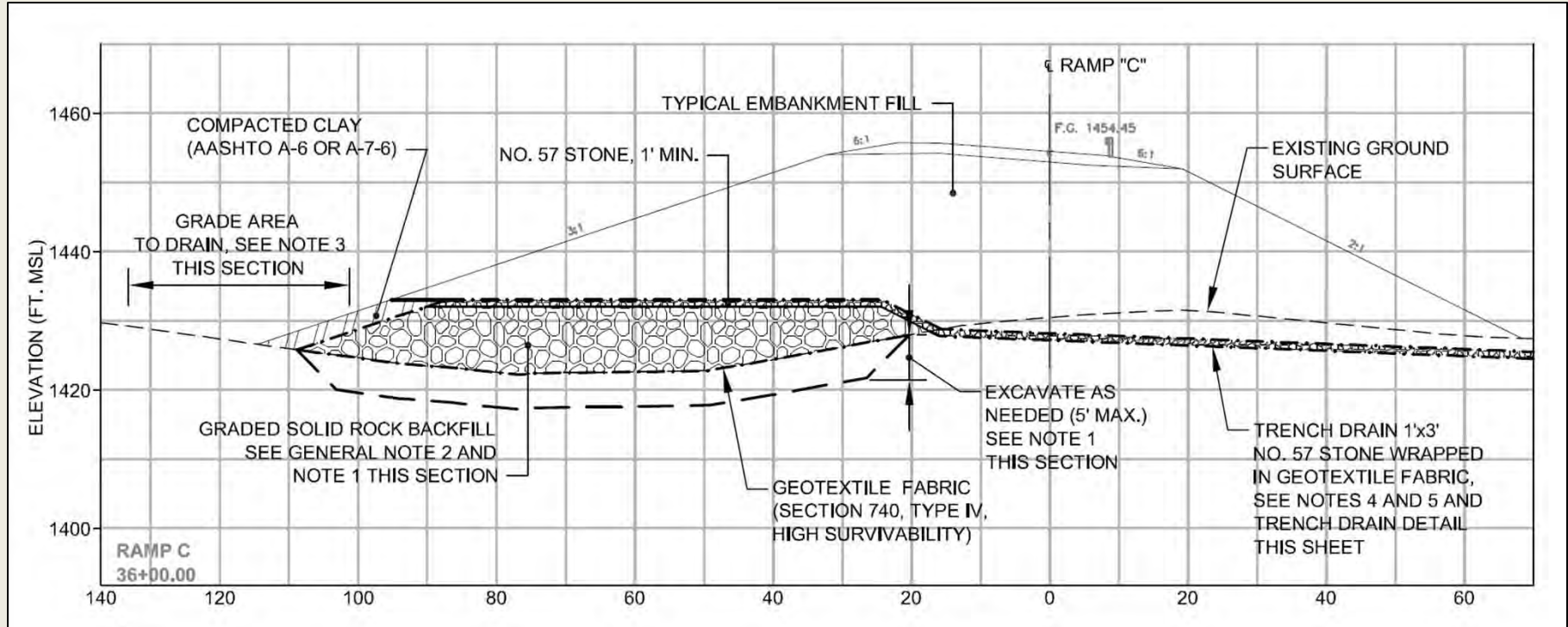
Roadway Design concepts Used to Minimize Impact to Karst



Graded Rock Embankments





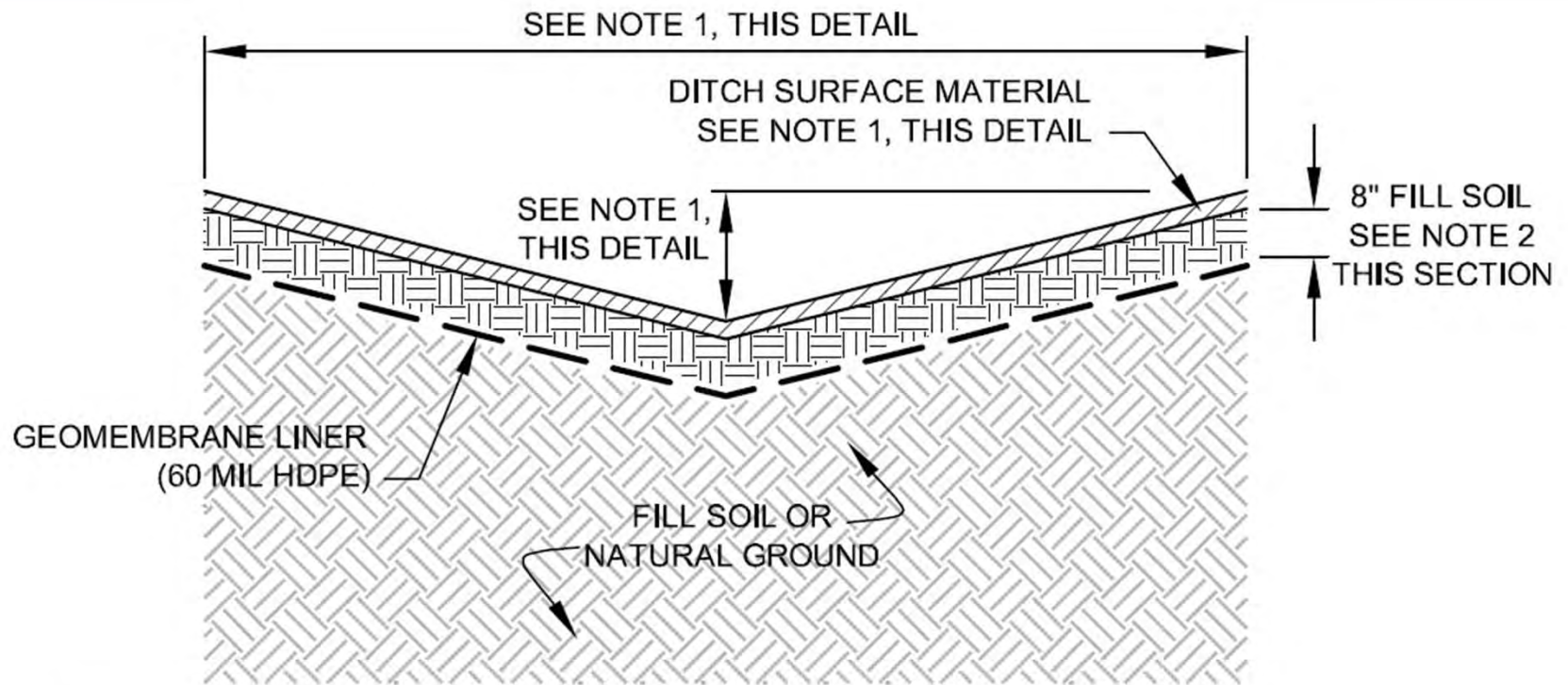


Graded Rock Pads



Graded Rock Pads in Sinkhole Areas





NOTES:

1. DITCH DIMENSIONS AND SURFACE MATERIAL TO BE DESIGNED BY OTHERS.
2. IF CONCRETE IS CHOSEN AS THE DITCH SURFACE MATERIAL, OMIT THE 8-INCH LAYER OF FILL SOIL.

GEOMEMBRANE LINED DITCH DETAIL

NTS



Geomembrane-lined ditches



Mitigation Concepts

- **Graded Rock Backfill**
- **Lined Ditchlines**
- **Surface Water Run-off Filtration Systems**
- **Grouting**
- **Other Concepts (bridging, overflow channels, Drainage Wells, etc.)**



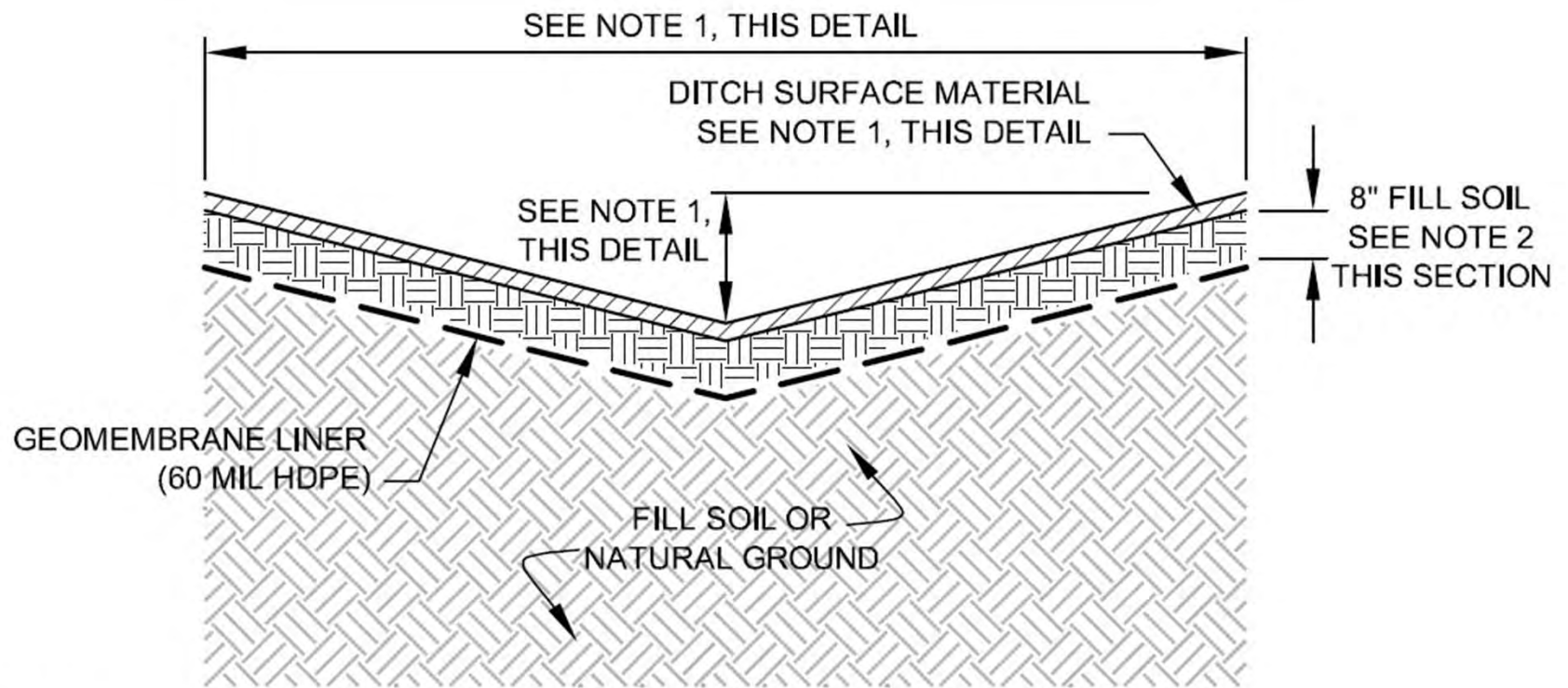
**Graded Rock
Backfill
And
Geomembrane
For
Sinkhole
Collapse**





Paved Ditchlines & Geomembrane





NOTES:

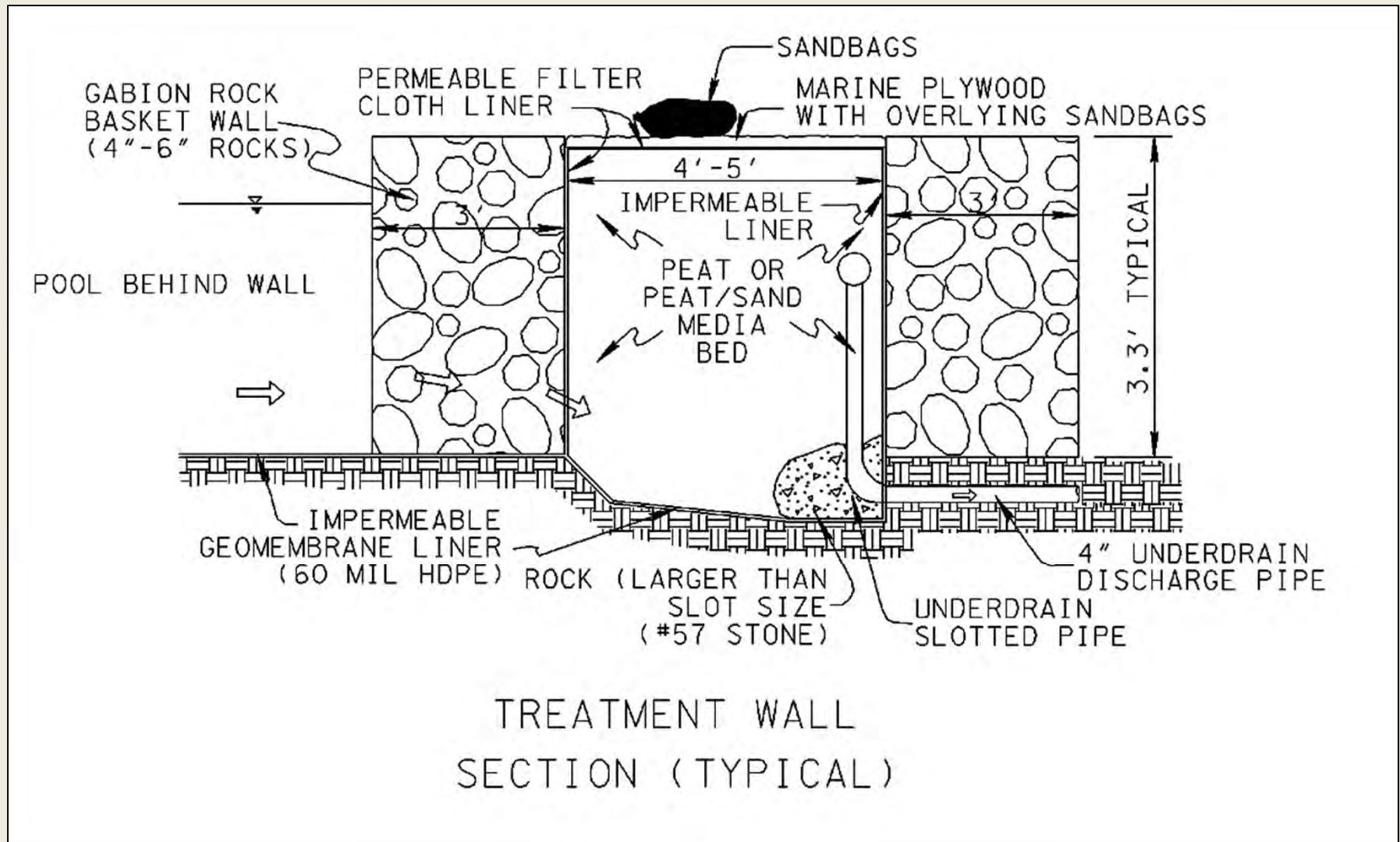
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GEOMEMBRANE LINED DITCH DETAIL

NTS



Sinkhole Filtration Systems For Highway Runoff



Horizontal Peat Moss Filter For Sinkhole Filtration



Grouting Sinkhole Collapse

Summary

Avoidance

Minimize impact

Mitigate impacts

The End

