

Landslide mapping and research at the Kentucky Geological Survey

Matthew M. Crawford and
William M. Andrews Jr.

Geohazards In Transportation in the Appalachian
Region

Charleston, WV 2008

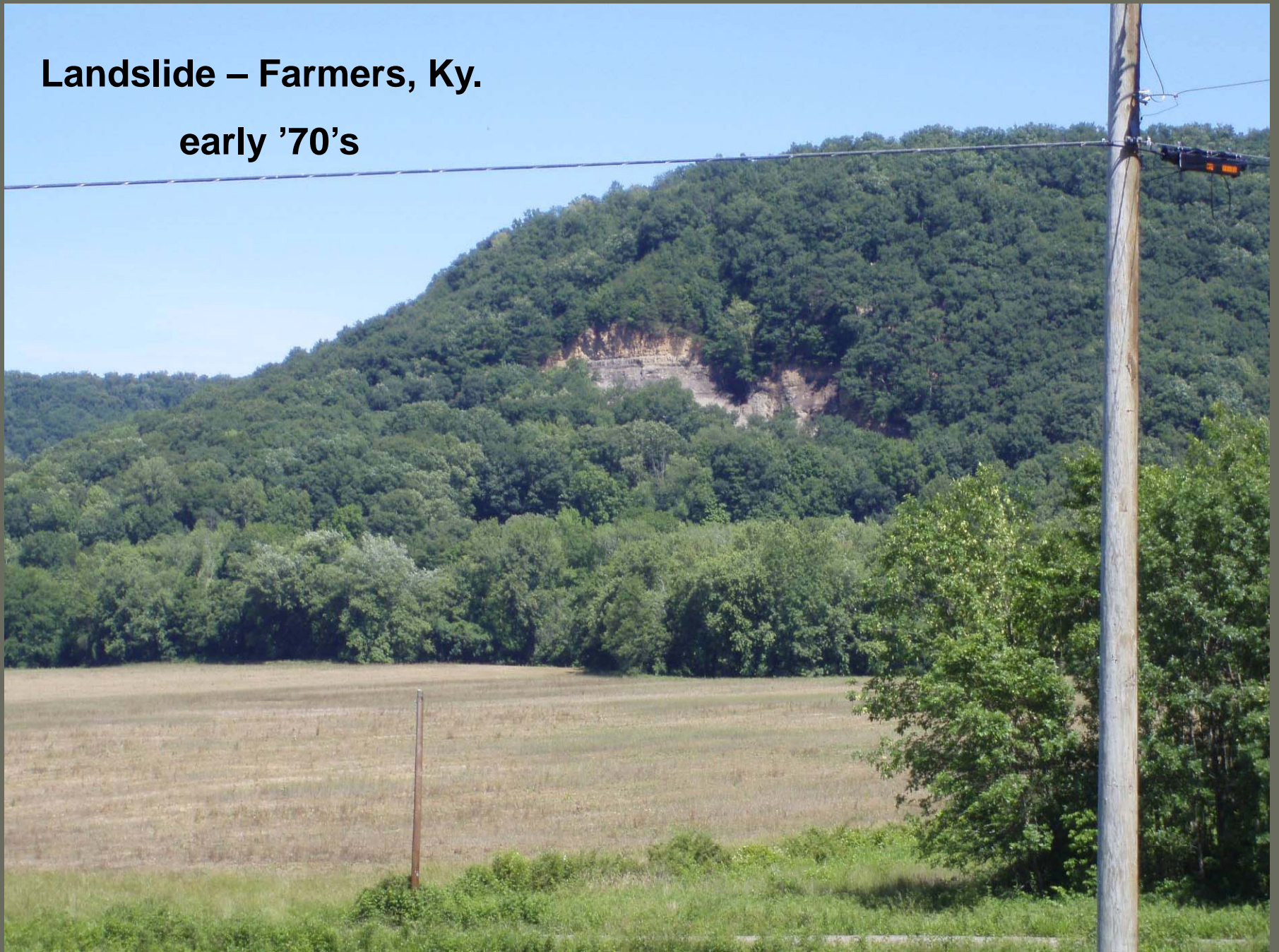
KGS activities

- Landslide inventory
- Surficial geologic mapping



- ✓ New geologic maps
- ✓ Surficial geology database
- ✓ Landslide susceptibility maps
- ✓ Landslide database
- ✓ Adding to existing online map services

**Landslide – Farmers, Ky.
early '70's**









Mudslide – Covington, Ky.

2008

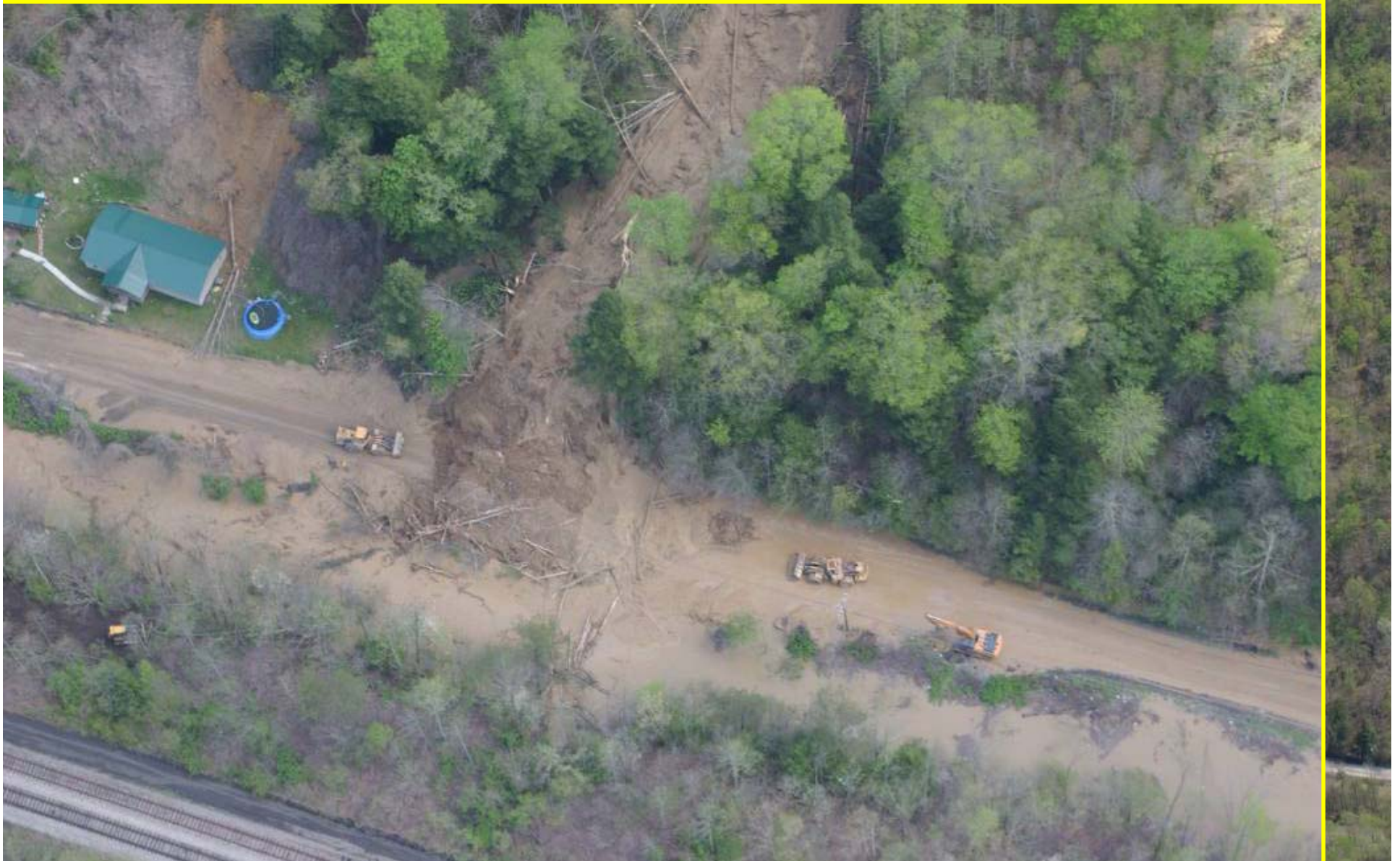




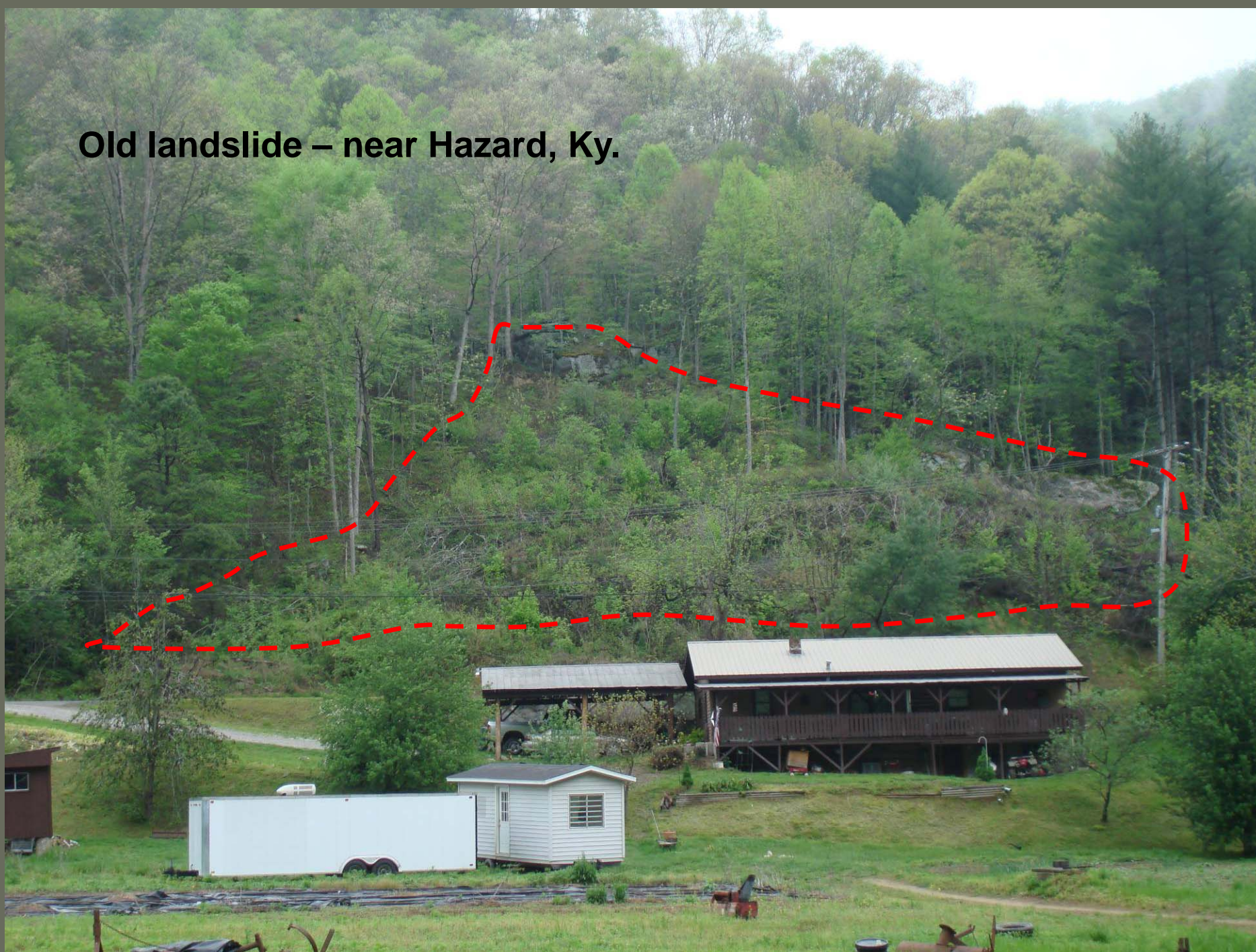


**Landslide – near
Owensboro, Ky.**

Landslide -
April 2006
Perry County



Old landslide – near Hazard, Ky.



Old landslide – near Hazard, Ky.



Landslide – near Hazard, Ky.





Mudslide – Bedford, Ky.

2008

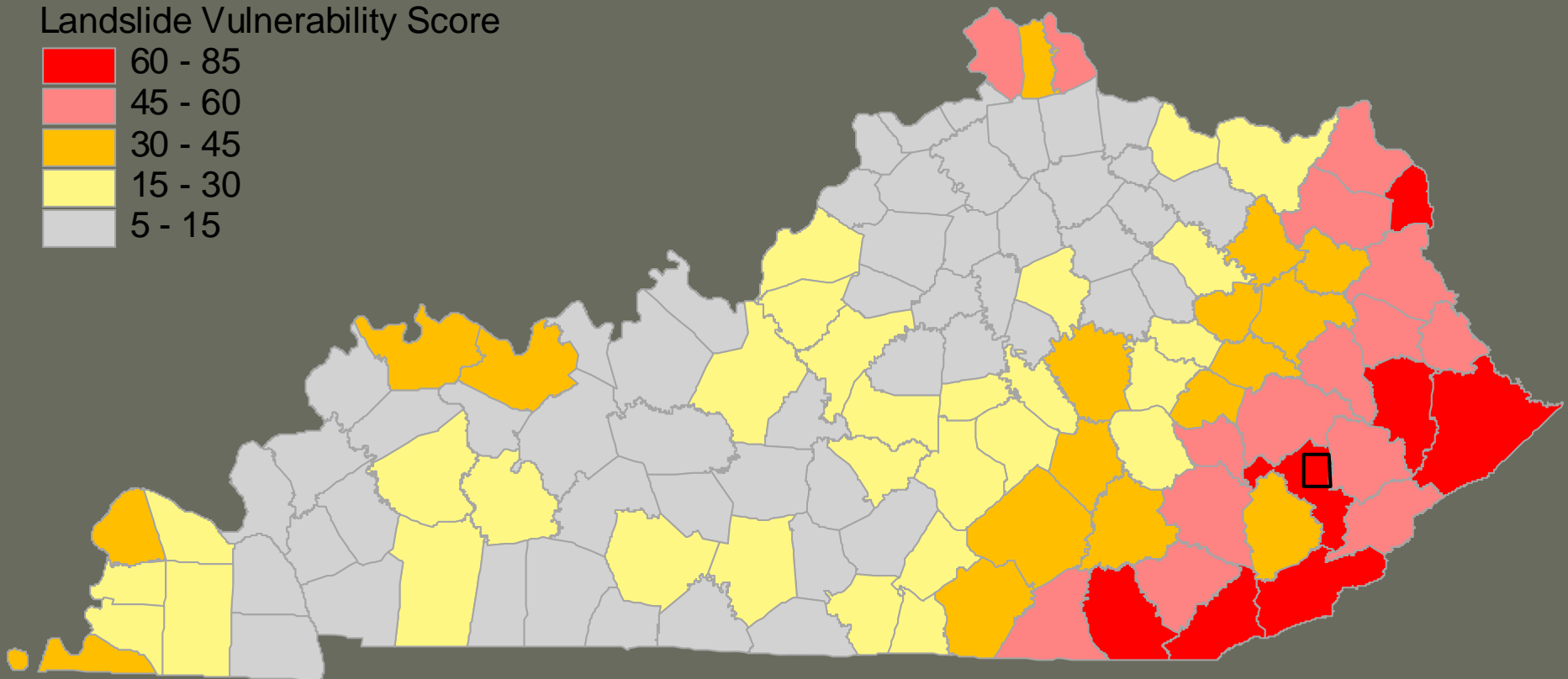
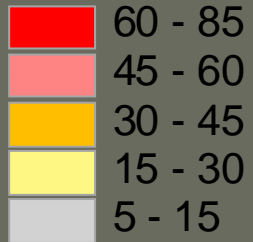


**Old debris flow – near Hazard,
Ky.**

Landslide Hazards

Kentucky State Hazards Mitigation Plan

Landslide Vulnerability Score



Data courtesy of R.J. Human, University of Louisville,
Center for Hazards Research And Policy Development

Locations of Kentucky Transportation Cabinet landslide and rock fall projects and FY06 cost per mile of landslide-related maintenance costs in Kentucky.

Highway Maintenance Costs (\$ per mile)

Slides and Sinkholes

10,000 - 94,889

1,000 - 10,000

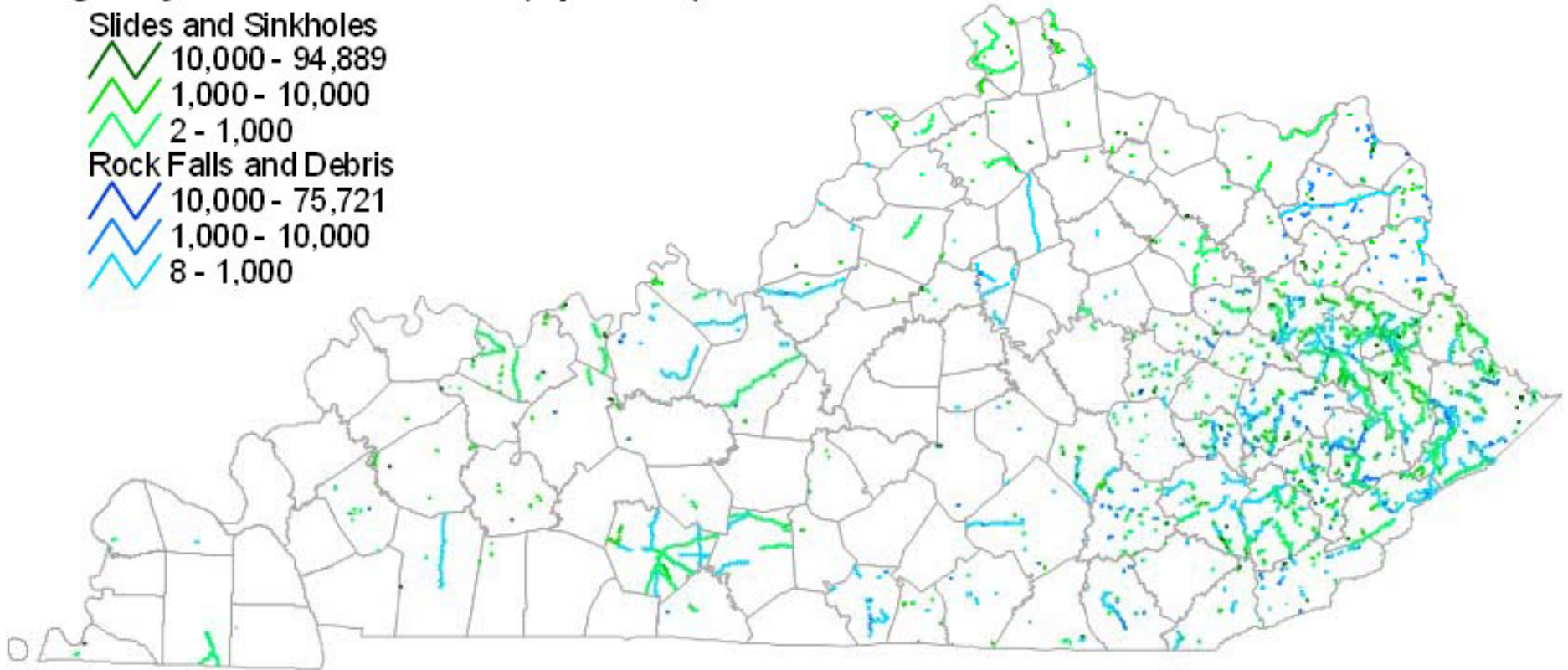
2 - 1,000

Rock Falls and Debris

10,000 - 75,721

1,000 - 10,000

8 - 1,000



Data courtesy of Geotechnical Branch,
Kentucky Transportation Cabinet

Gathering from data sources



- Existing maps
 - Landslide maps
 - Geologic maps
- Existing reports
 - KYTC 
 - Division of Natural Resources, Mining Reclamation
- Field work / mapping
- Anecdotal info
- Harvesting other state's inventory attributes
 - North Carolina
 - Oregon
 - Washington
 - California

Kentucky Transportation Cabinet Geotechnical Project Database

Search Result

Filter by

Resubmit

Project Type = Landslide

County	Project ID	Project Name	Main Line Station			
Allen						Summary
Anderson				View Geologic Map	View Basemap	Summary
Anderson				View Geologic Map	View Basemap	Summary
Anderson	L-020-1993			View Geologic Map	View Basemap	Summary
Anderson	L-023-1997			View Geologic Map	View Basemap	Summary
Ballard	L-041-1997					Summary
Barren	L-016-1991	LN-		View Geologic Map	View Basemap	Summary

MEMORANDUM

TO: Karen Doman, PE
Maintenance Engineer, District 7

FROM: William Boyles, PE
Geotechnical Branch Manager
Division of Structural Design

BY: Jason Wright
Geotechnical Branch

DATE: August 15, 2008

SUBJECT: Anderson County
KY 44 @ approximately MP 1.2
STA 1+36 to STA 1+64
Geotechnical Engineering Report
for Landslide Correction

The landslide is located in rural Anderson County, West of KY 1570, at approximately mile point 1.2. The slide is affecting approximately 120 ft of roadway. Stationing (STA 0+00) begins in the center of an existing cross drain, east of the slide area. Over the years as the shoulder has failed away, roadway Course Aggregate #1's were used to replace it. However, the Gabion Baskets containing sliding plane. With the added weight of the granular material and the extra weight of the pavement that is less added over the years, the area continues to slide. Due to the constant movement of the slide, two options were discussed: concrete pile wall or a Gabion Basket retaining wall.

The Branch recommends installing a concrete pile wall with timber lagging. The wall will begin at STA 0+55 approximately fourteen feet (14') left of centerline and end at STA 1+64 approximately fourteen feet (14') left of centerline. Sixteen twenty-eight four (28") piles will be used for the entire project. Wallbackfill will consist of Kentucky Course Aggregate #1's or #2's in the Gabion baskets that are at the site. Lagging should be installed according to the attached drawings and will consist of 6" x 6" x 8' railroad ties. Railroad ties come in the dimension of 6" x 8" x 8'. The railroad ties will need to be cut to the dimension of 6" x 8" x 8'. Pile spacing will be eight feet (8') from center to center.

Material

14 x 102 (30 ksi) HRP Piles

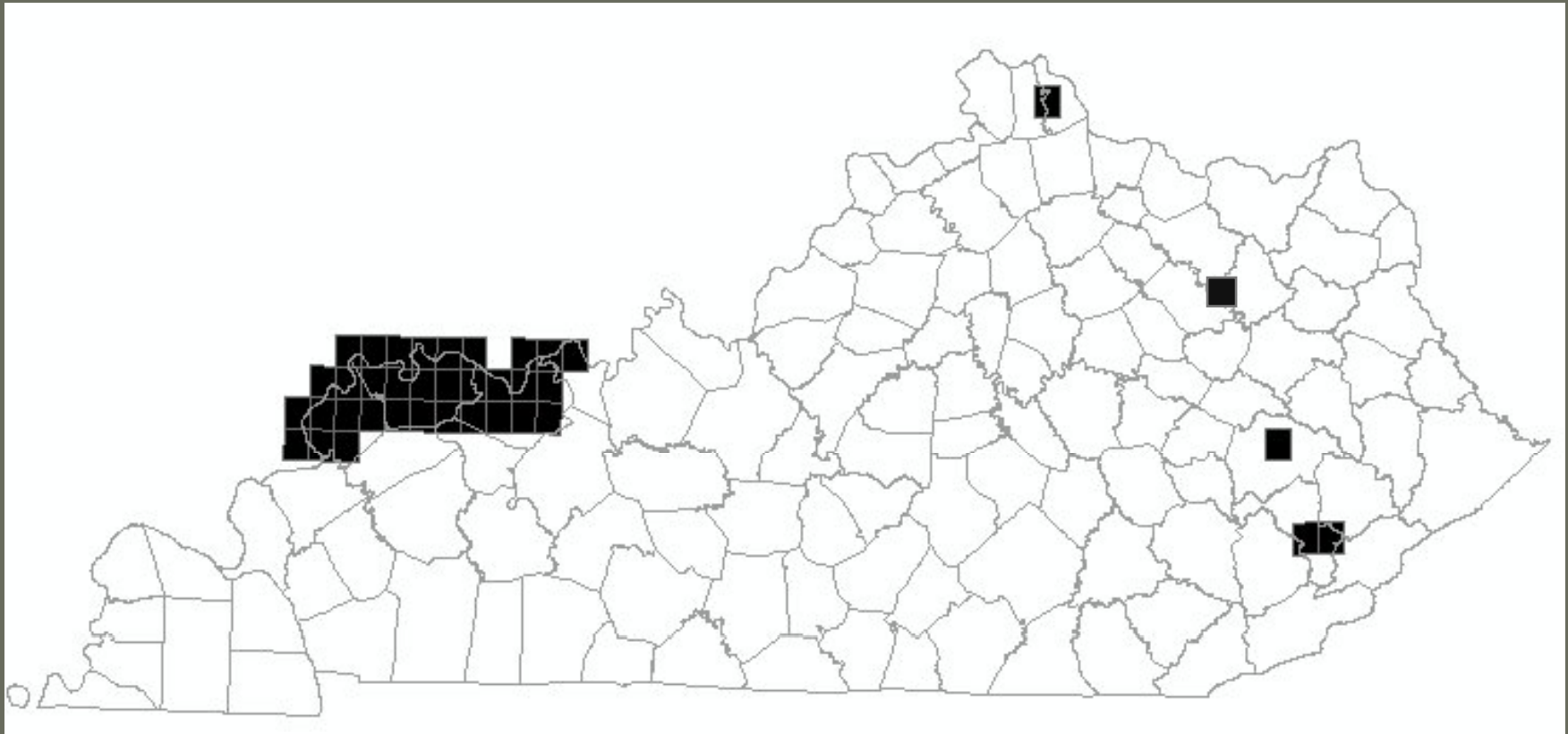
Quantity	Unit	Unit Cost	Estimated Cost
17 @ 28'	each	\$ 8.00	2,560
355	ln 8'	100.00	47,600
17 @ 28'	each	40.00	3,080
700	ln 8'		

Estimated Drilling

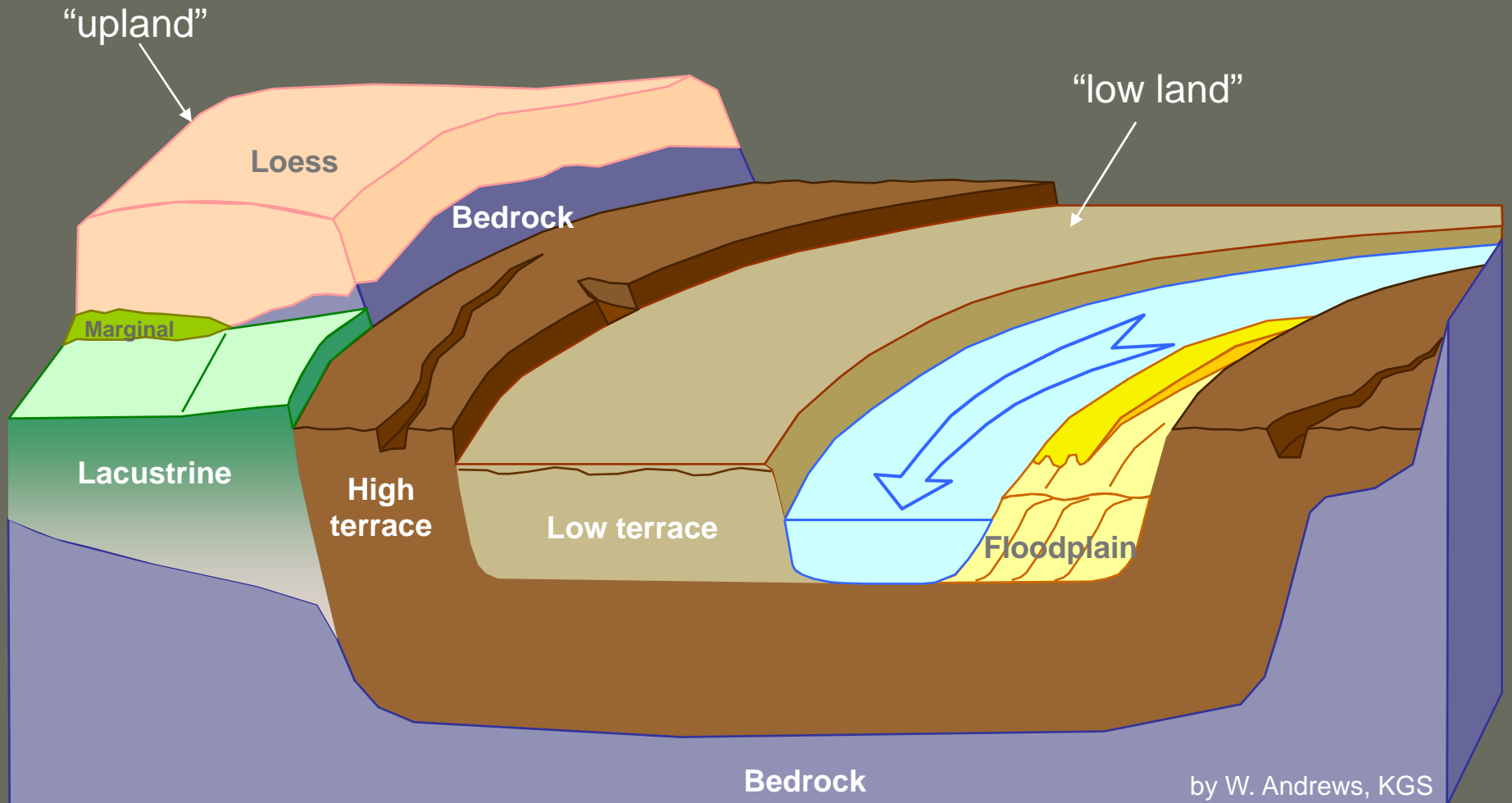
0000.00 Landslide

Surficial Geologic Mapping Program

- 2004-present

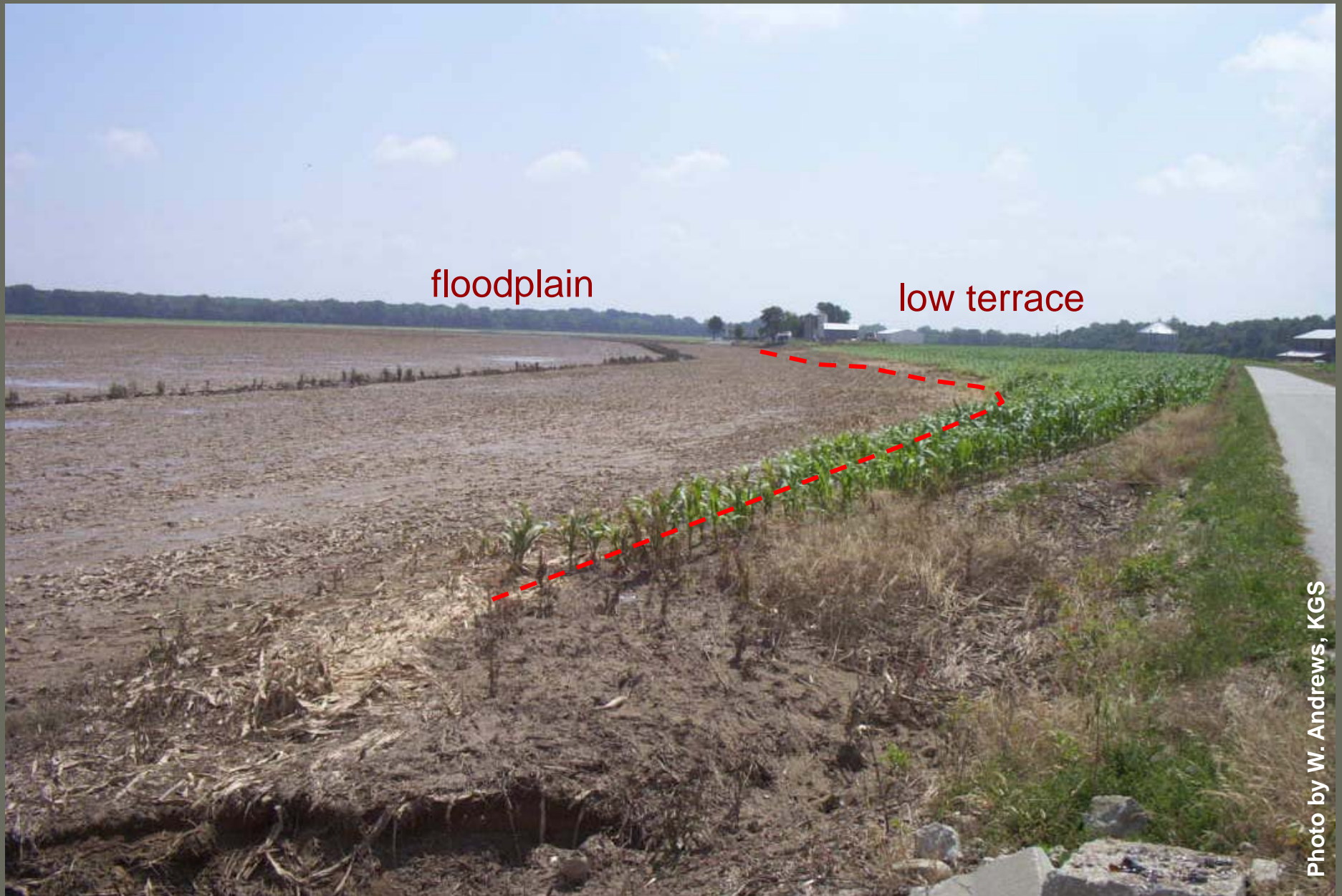


Ohio River Valley Model

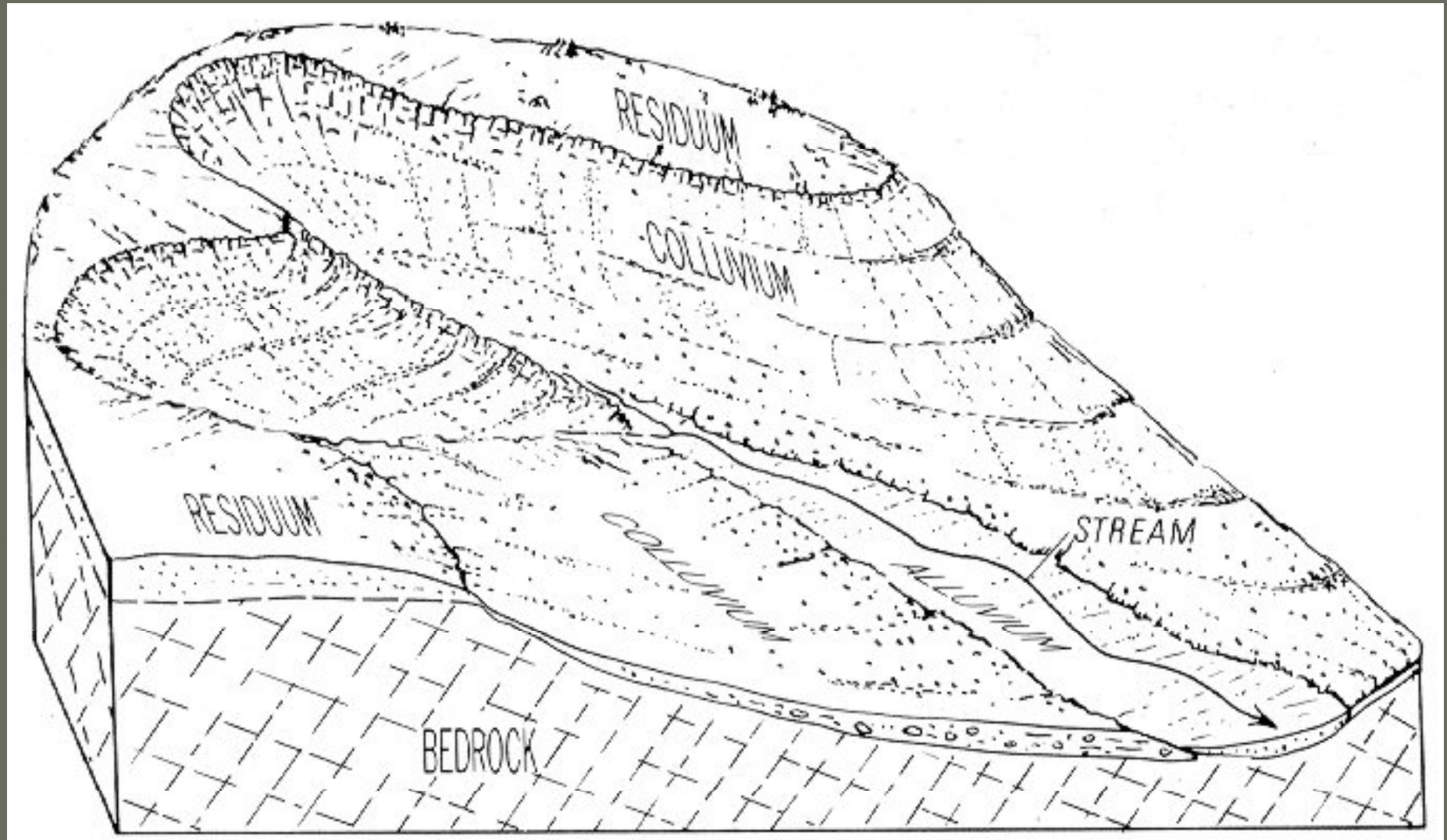


Generalized model for the Ohio River valley in the mapping area

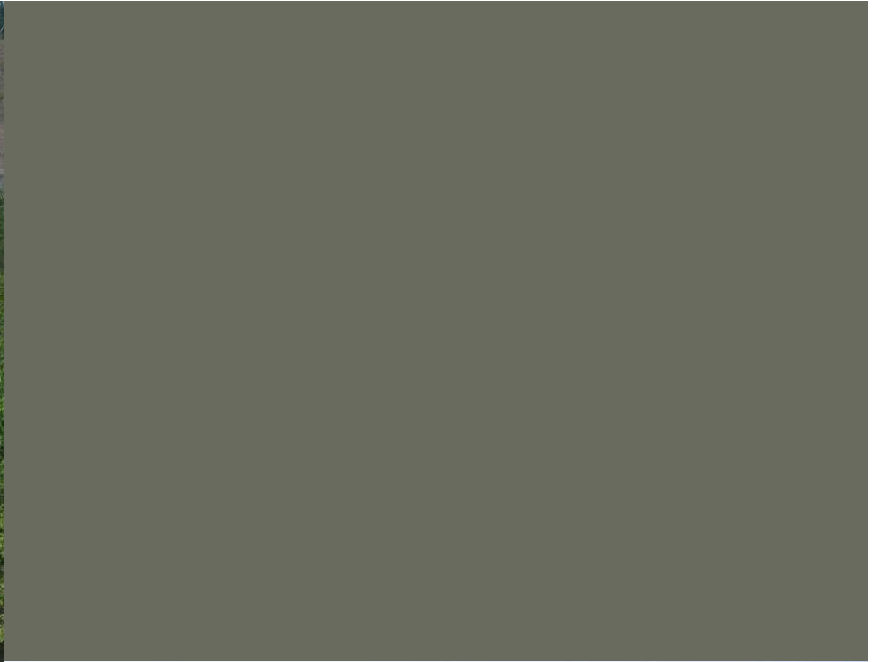
Subtle terrace scarp, following May 2004 flood

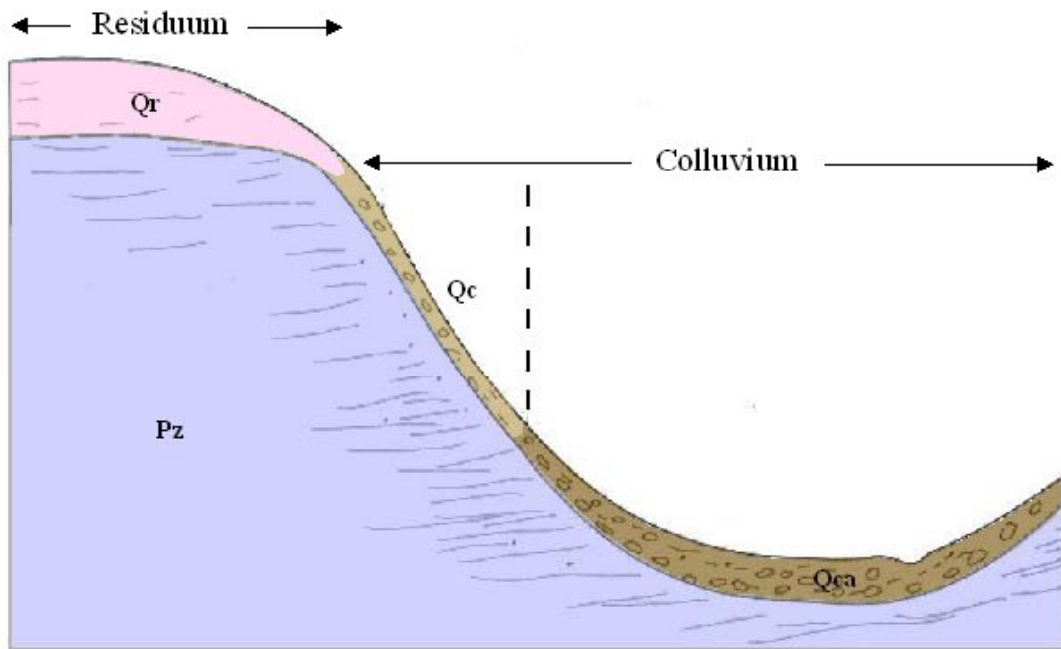


Eastern Kentucky Model



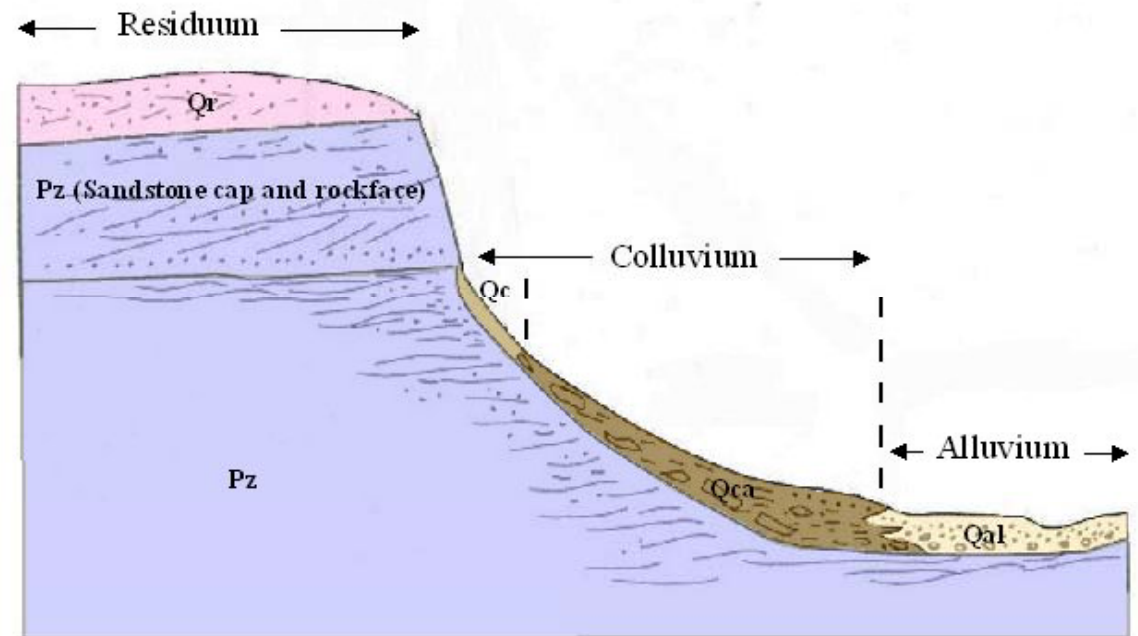
From Newell, 1978

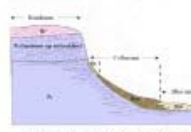
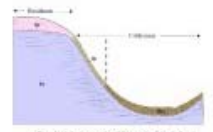
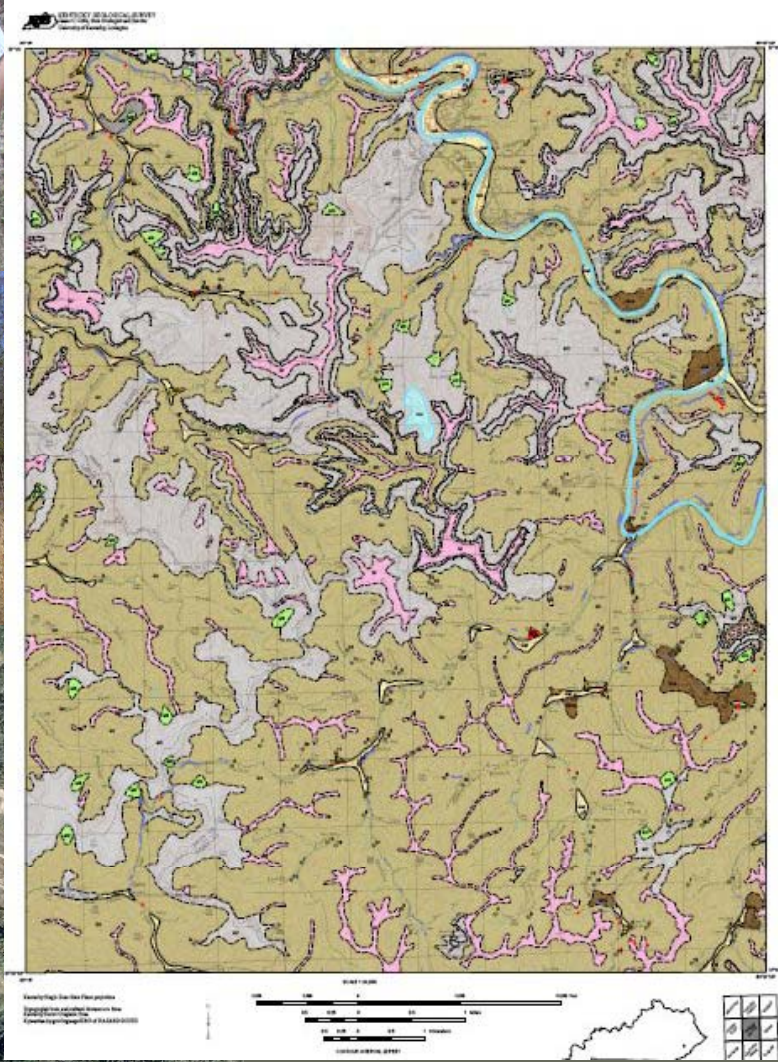
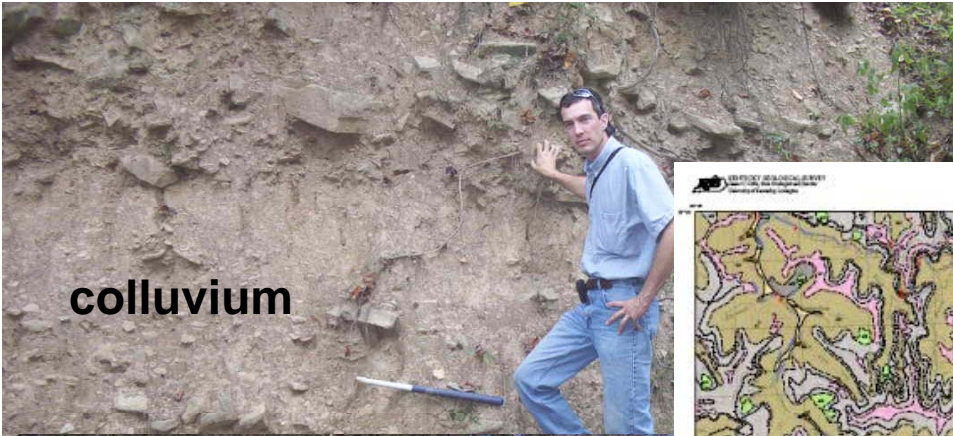




Hillslope profile formed on siltstone and shale. From Newell, 1978.

Hillslope profile formed on controlled by sandstone cap. From Newell, 1978.





Mapping Criteria / Methodology

- How to take the both models and delineate surficial deposits?
- Reclassification of soils maps
- Utilizing well data, depth to bedrock
- Utilizing DEM's, slope maps, aerial photography mine map data, and geology
- Landform observation
 - Alluvial fans, terraces, landslides, other accumulation zones, disturbed areas
- Soil descriptions
 - Thickness, genetic origin, and USDA - USCS classifications

Research questions...

Is the surficial geology picking up the necessary units?

How much can we rely on landforms?

Can we differentiate colluvium into more useful units?

Are the right elements being acquired for derivative geologic maps >>>> landslide potential

Kentucky Geological Survey Field Data Entry Tool

Current User: CRAWFORD, MATT | Not this user? Please start over: <http://kgsmap.uky.edu/website/KGSfieldTool/main.asp>



Map Scale: choose a map scale

Enter a Custom Map Scale:

zoom



Data Entry Frame

Either use the "define field point" tools: or to initiate data entry for a site, or select a previously defined site from the right frame to edit.

[Map Legend](#) [Map Layers](#) [Field Data Outcrop/Ot](#)

- uploaded waypoints:

- click the "upload a waypoint file" button to load locations and assignment of profile id's

upload a waypoint file

- outcrops & observations ():

limit records:

- only list records entered by current scribe ()
- only list records within the current extent (d)

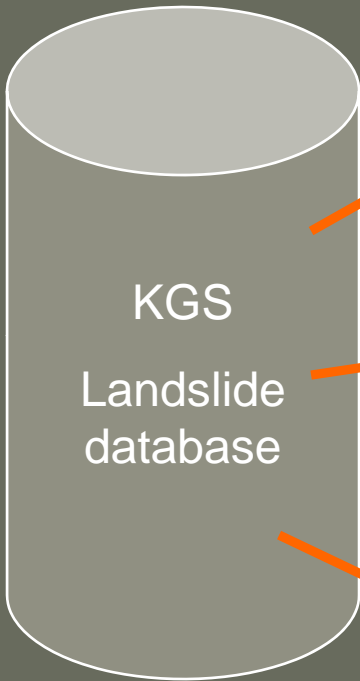
*click header to sort by that field

*click profile id to view all data for a profile

*yellow highlighted profile id's are profiles within t

key to icons:

- yellow icon highlight indicates images
- left-side superscript ² = total number of profile.
- right-side subscript ₅ = total number of
- depth to bedrock (1 per profile):



KGS

Landslide database

Water Can Cause Landslides

Tree removal/water runoff

Seepage

Shale

Sandstone

Kentucky Geological Map Information Service
Kentucky Geological Survey

Note: please disable popup blocking software for full functionality.

KGS Home > Maps, Pubs. & Data > Geologic Map Service

Map Legend Map Layers Geologic Information

Geologic Units In Current View:
- hide geologic units
1:24,000 scale data (detailed geology)

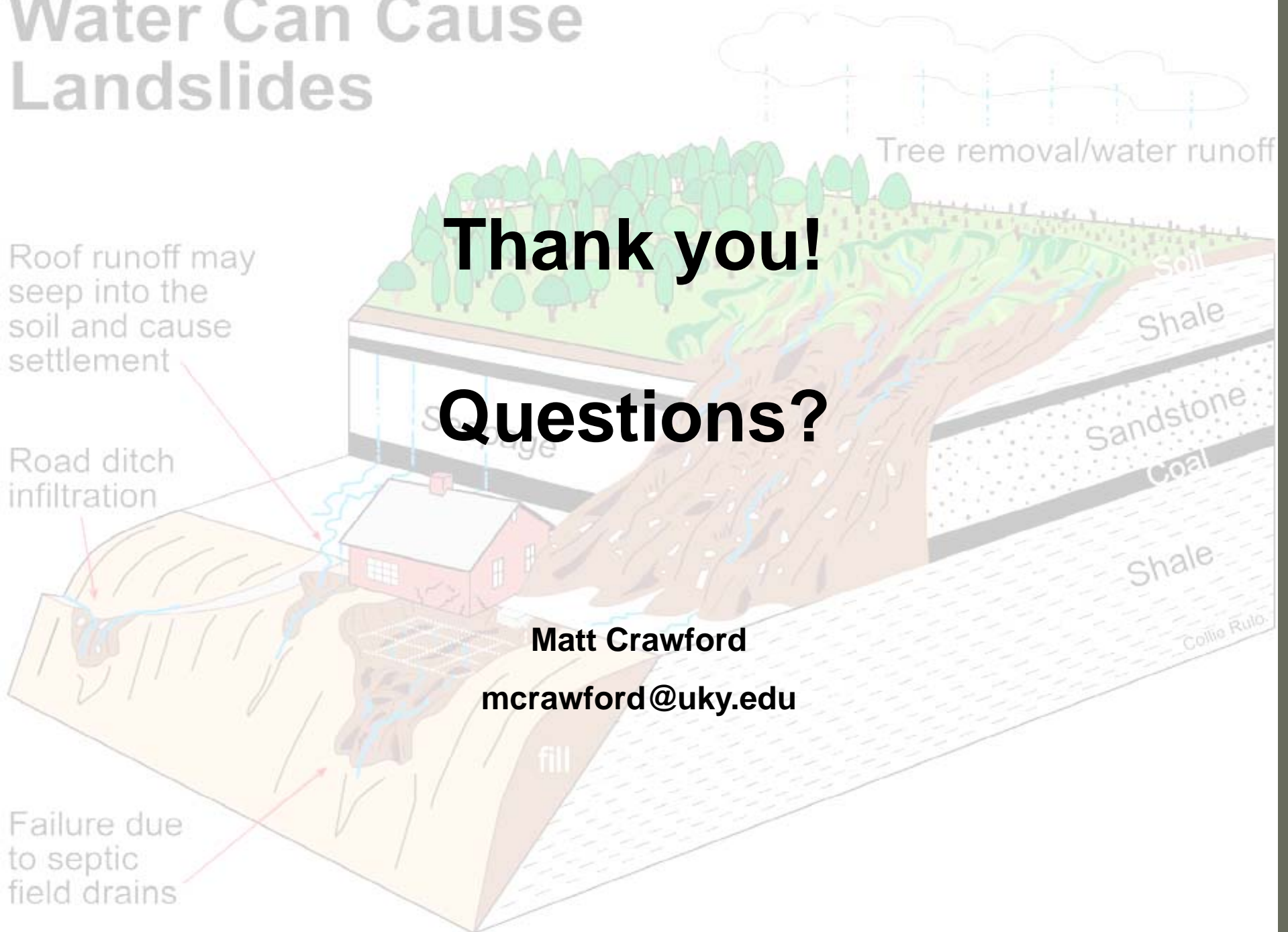
- Qal Alluvium (Quaternary - Quaternary)
- Qls Landslide deposits (Quaternary - Quaternary)
- Pg Grundy Formation (Lower Pennsylvanian - Middle Pennsylvanian)
- Plc Corbin Sandstone Member of Lee Form. (Lower Pennsylvanian - Middle Pennsylvanian)
- Pgs Unnamed Sandstone Member of Grundy (Lower Pennsylvanian - Middle Pennsylvanian)
- Msla Slade Formation (Upper Mississippian - Upper Mississippian)
- Mbu Borden Formation, Upper Part (Lower Mississippian - Lower Mississippian)
- Mbc Cowbell Member (Lower Mississippian - Lower Mississippian)
- Mbn Nancy Member (Lower Mississippian - Lower Mississippian)
- Mbf Farmers Member (Lower Mississippian - Lower Mississippian)
- Msu Sunbury Shale (Lower Mississippian - Lower Mississippian)

1:61800 - 24K geologic map data,
Kentucky Geological Survey, 7/21/2008

Conclusions / future work

- New surficial geologic mapping
- Landslide inventory
- Building more robust databases of surficial and engineering geology properties
- Derivative maps for hazard mitigation
 - Landslide potential, seismic hazards
- Additions to existing geologic map services

Water Can Cause Landslides



Thank you!

Questions?

Matt Crawford

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