Late Cenozoic Drainage Reorganization of Former St. Lawrence Drainage Left a Legacy of On-Going Disequilibria in Upper Ohio River Basin Fluvial and Colluvial Systems

J. Steven Kite [1] (jkite@wvu.edu)

Mark D. Swift [1, 2]

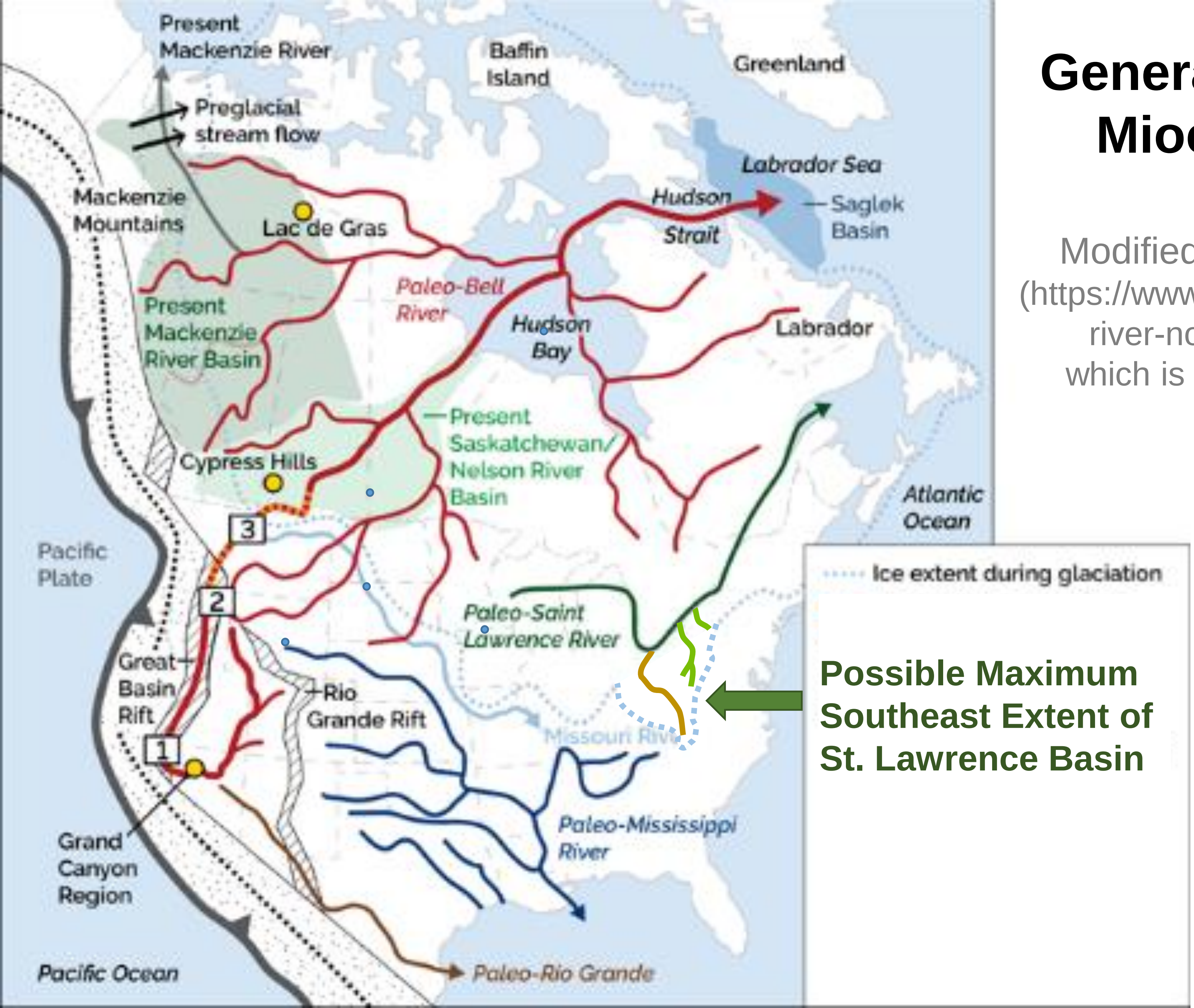
[1] West Virginia University Department of Geology & Geography

[2] Washington & Jefferson College Department of Music

Session T71: The New Appalachians: Cenozoic Deformation, Drainage Reorganization, and Landscape Disequilibrium in a Paleozoic Orogen

Paper 63-4 https://gsa.confex.com/gsa/2019AM/meetingapp.cgi/Paper/339747

2:20-2:40 PM, Sunday, 22 September 2019
229A North Building, Phoenix Convention Center



Generalized Reconstruction Miocene North America Drainage

Modified from Cantner & Jackson, 2018 (https://www.earthmagazine.org/article/paleo-bell-river-north-americas-vanished-amazon), which is based on Sears, 2013, GSA Today

Key Points

- → ***St. Lawrence Drainage Rearrangement Caused Incision & Knickzones***
- → ***Incision Led to Regional Slope Instability***
- → ***Both Are On-Going***

St. Lawrence - Upper Ohio River Evolution

Time Scale = ~10^6 Years

Modified After

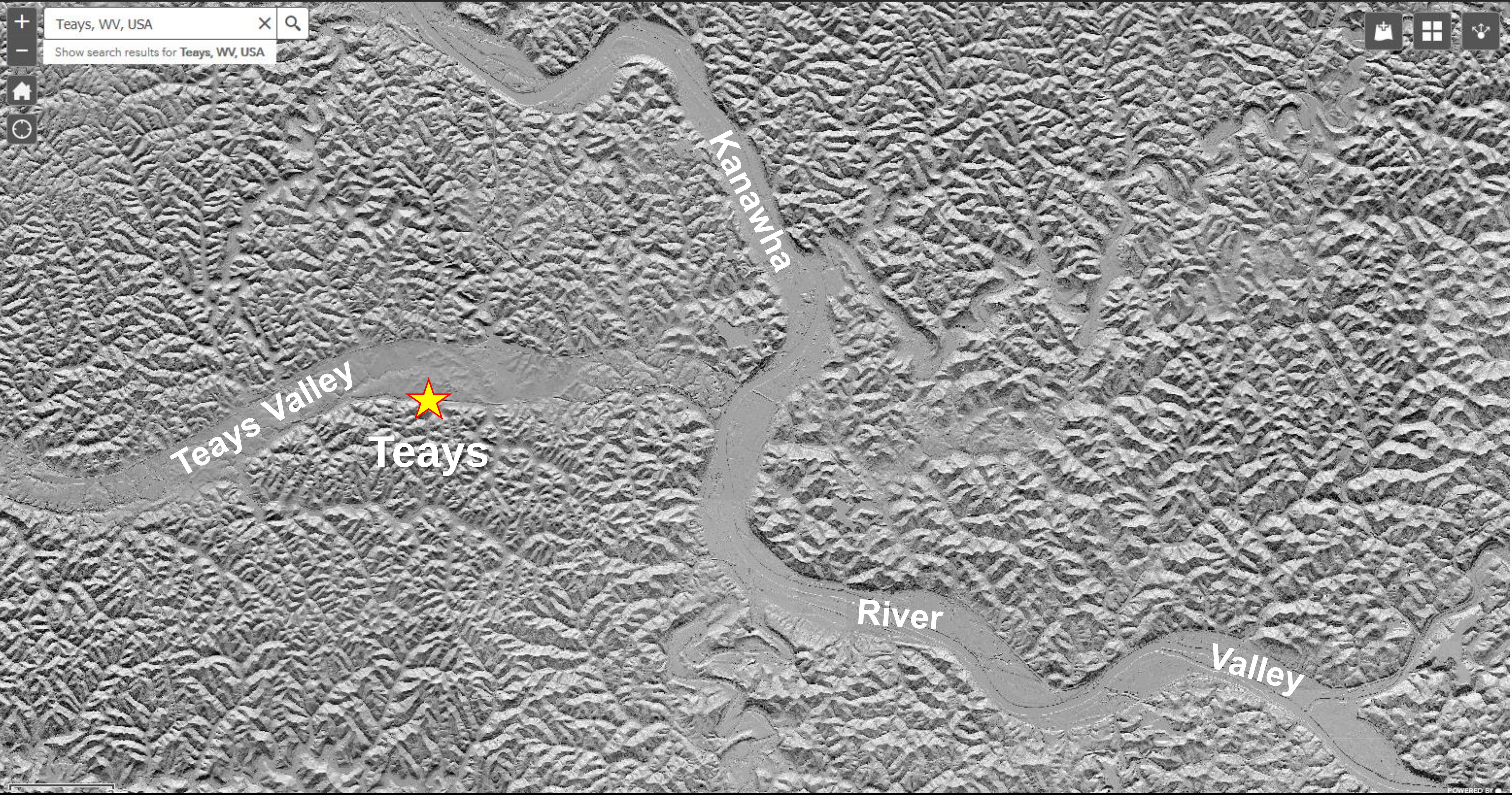
Salley, 2004

http://academic.emporia.edu/aberjame/student/salley3/teays.jpg

Hansen, 1995

https://geosurvey.ohiodnr.gov/portals/geosurvey/PDFs/GeoFacts/geof10.pdf

Teays – Ohio River Systems

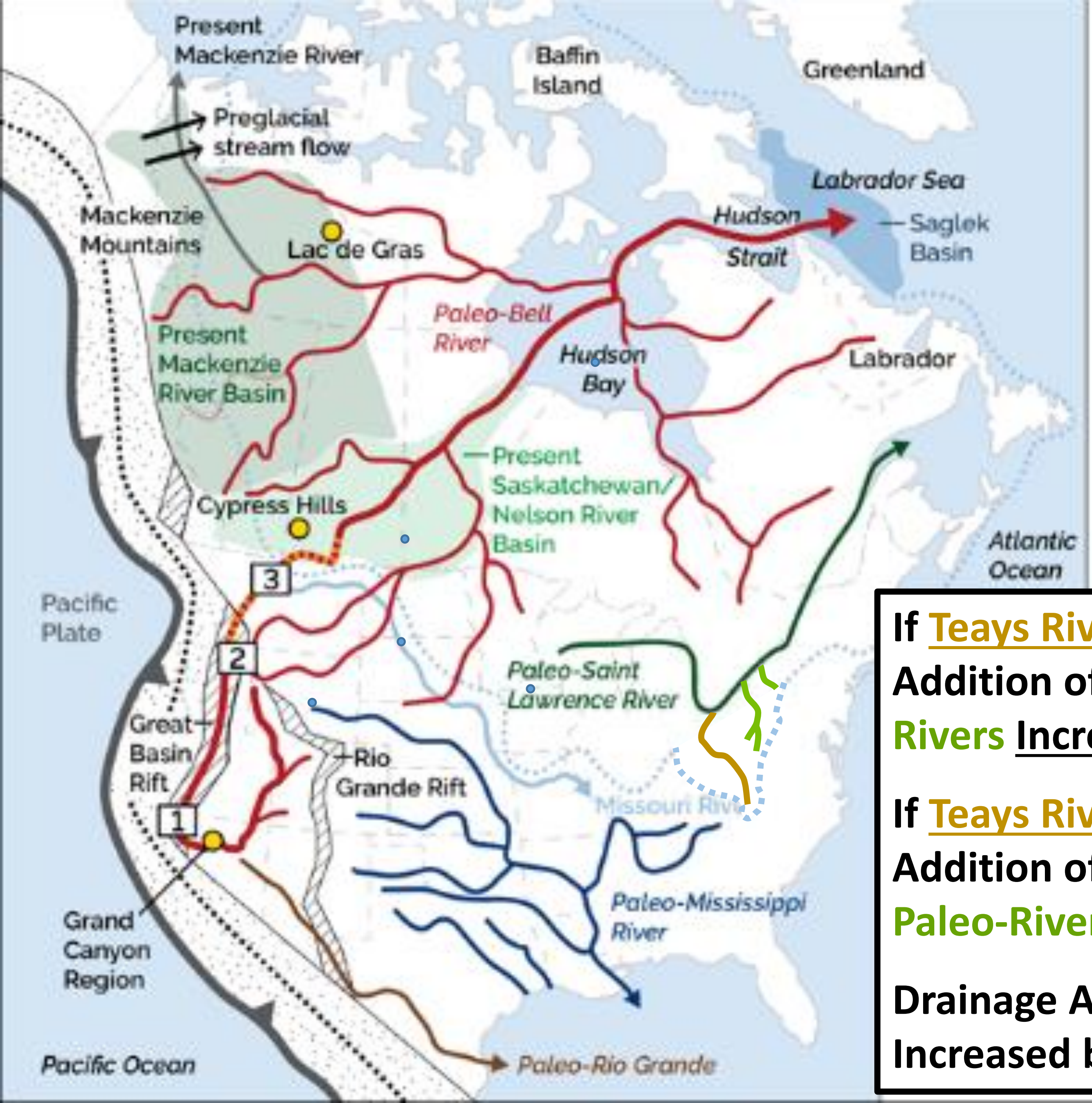


Teays Valley & Kanawha (Lower New) River Valley, West Virginia

Generalized Reconstruction Miocene North America Drainage

Modified from Cantner & Jackson, 2018 (https://www.earthmagazine.org/article/paleo-bell-river-north-americas-vanished-amazon), which is based on Sears, 2013, GSA Today

Basin Configuration	Area km²	Diff.
Existing St. Lawrence	1,344,200	-
Existing St. Lawrence + Pittsburgh Paleo-River	1,411,200	+ 4.8 %
Existing St. Lawrence + Teays & Pittsburgh Paleo-Rivers	1,525,200	+ 11.9 %



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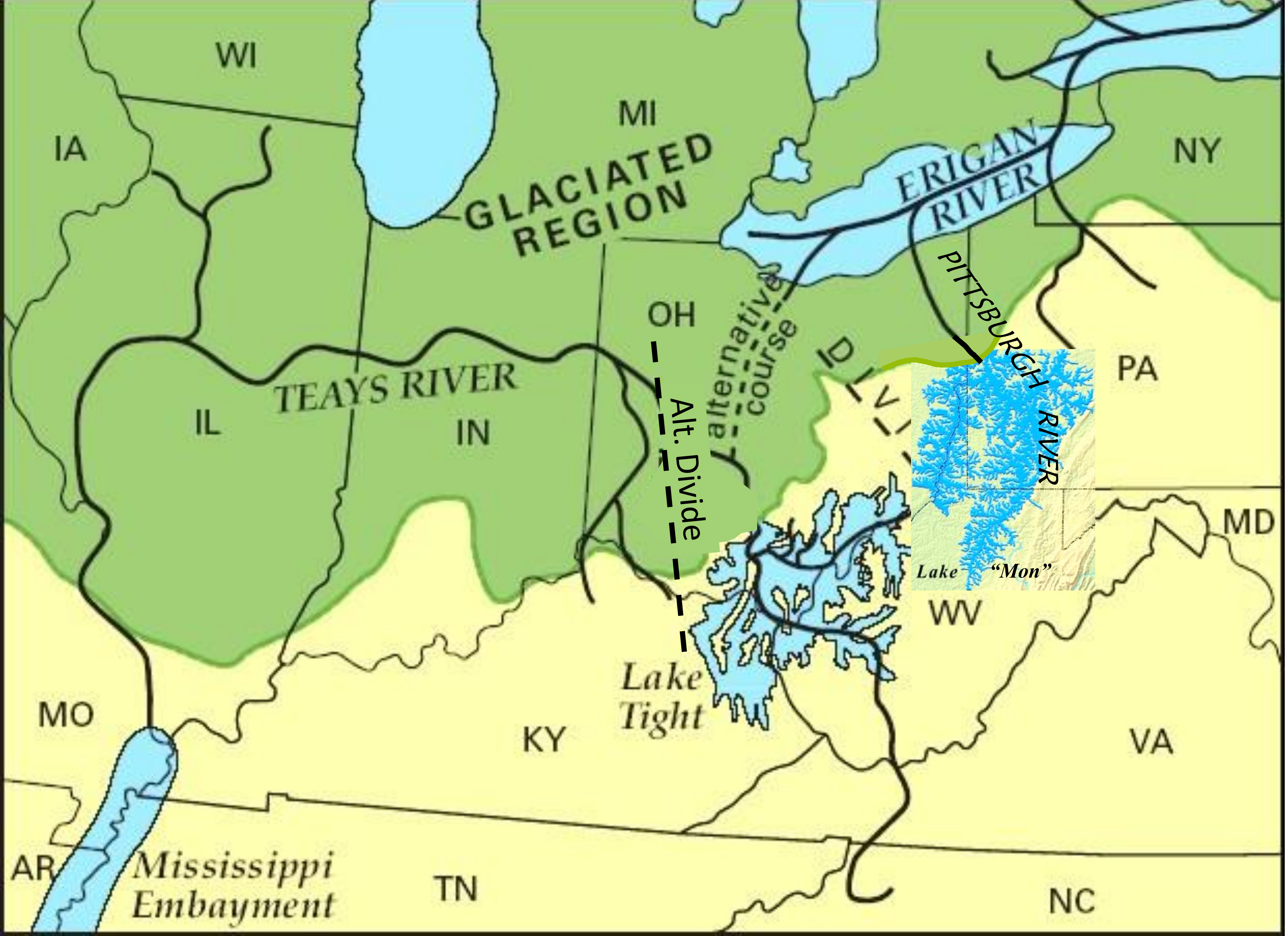
If Teays River Was Not Part of St. Lawrence River Basin, Addition of Pittsburgh & Ancestral Allegheny Paleo-Rivers Increased Ohio River Drainage Area by 12 %

If Teays River Was Part of St. Lawrence River Basin, Addition of Teays, Pittsburgh, & Ancestral Allegheny Paleo-Rivers Increased Ohio River Basin Area by 34 %

Drainage Area for Headwater Creeks at Breached Cols Increased by >10,000 %



Upper Ohio River Valley Evolution & Lake Monongahela

(named by I.C. White)

Modified After

Salley, 2004

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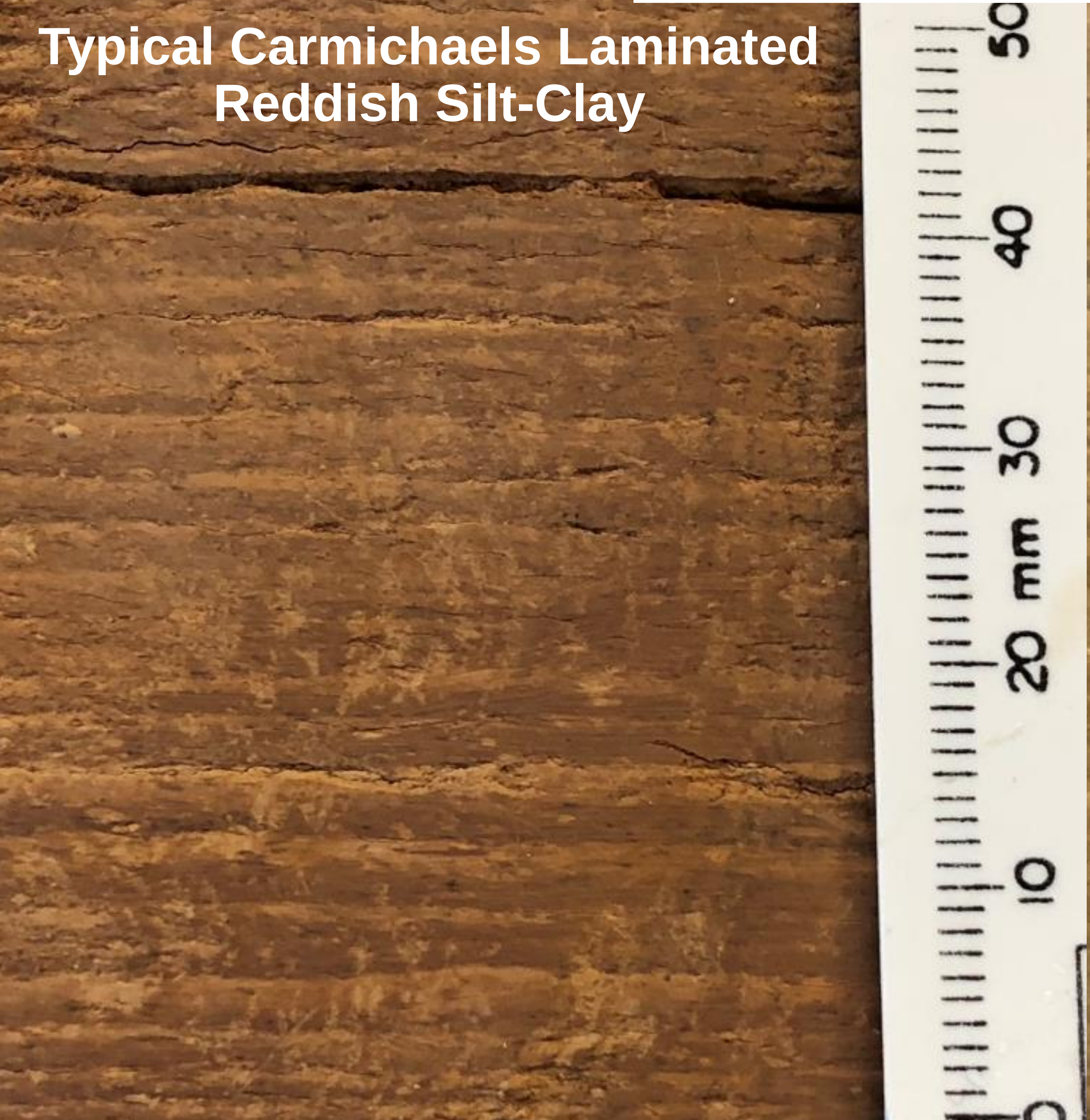
Hansen, 1995

https://geosurvey.ohiodnr.gov/portals/geosurvey/PDFs/GeoFacts/geof10.pdf

West Virginia Geological & Economic Survey, 2017

http://www.wvgs.wvnet.edu/www/faq/faqlm.htm

Lake Sediment Samples

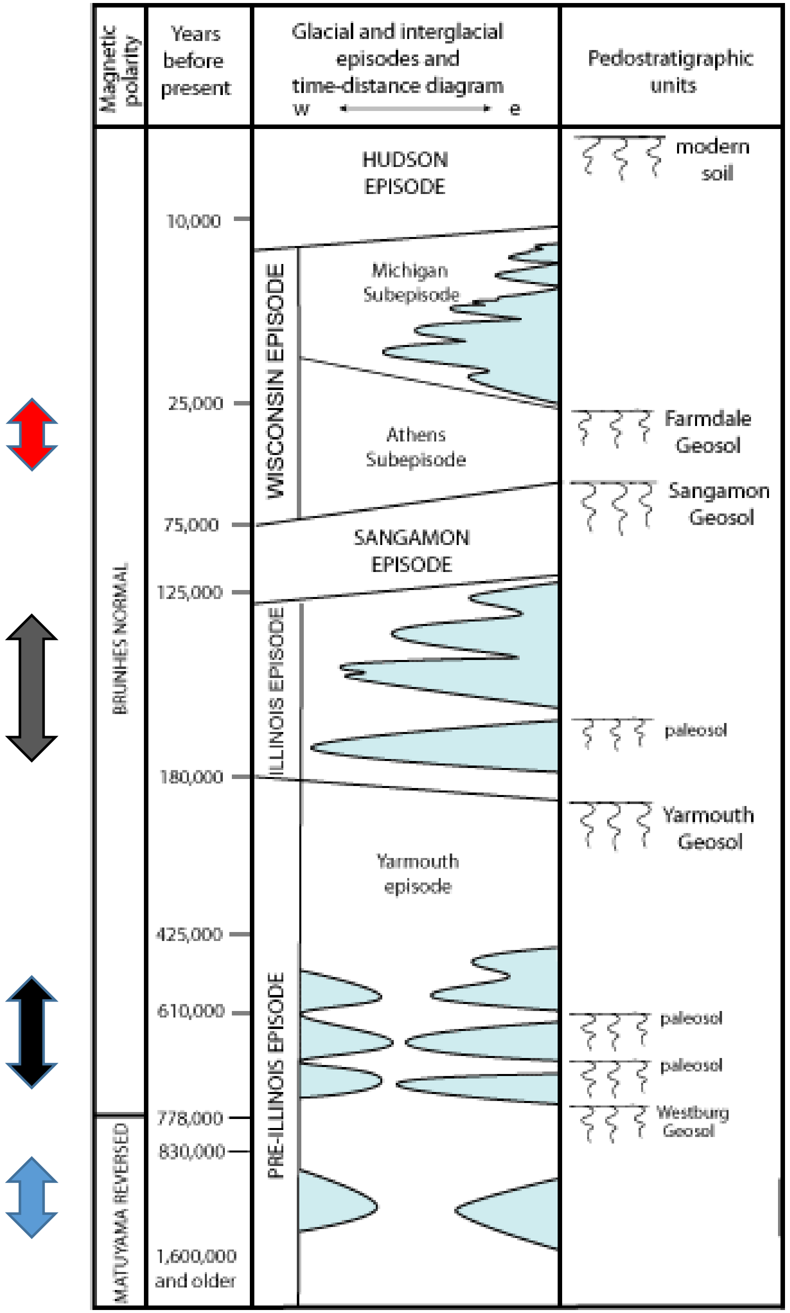


Lake Monongahela Age Assignments

Source	Age
White 1896	Pre-Illinoian
Campbell 1902	Pre-Illinoian (Kansan or Pre-Kansan)
Leverett 1934	Pre-Illinoian, Illinoian & Wisconsin
Lessig 1963	Pre-Illinoian; 1st regional glaciation
Clendening, et al. 1967 Gillespie & Clendening 1968	Farmdalian (Wisconsin) 22,000 ± 1000 14C-BP *[26,394 ± 1262 CalBP]* > 33,000 14C-BP *[> 37,500 CalBP]*
Jacobson 1985, 1987 Jacobson et al. 1988	Pre-Illinoian, Illinoian, *(Wisconsin Low Terraces)* > 40,000 14C-BP *[> 43,700 CalBP]* < 780,000 BP (Brunhes) > 780,000 BP (Matuyama)
Behling & Kite 1988 Kite unpublished data Morgan 1994	Pre-Illinoian, Illinoian *> 34,000* 14C-BP *[> 39,600 CalBP]* *> 38,000* 14C-BP *[> 42,000 CalBP]*
Marine 1997; Marine & Donahue 2000	Pre-Illinoian & Illinoian <780,000 BP (Brunhes)

Illinois State Geological Survey 2018

http://isgs.illinois.edu/outreach/geology-resources/classification-quaternary-time-and-deposits



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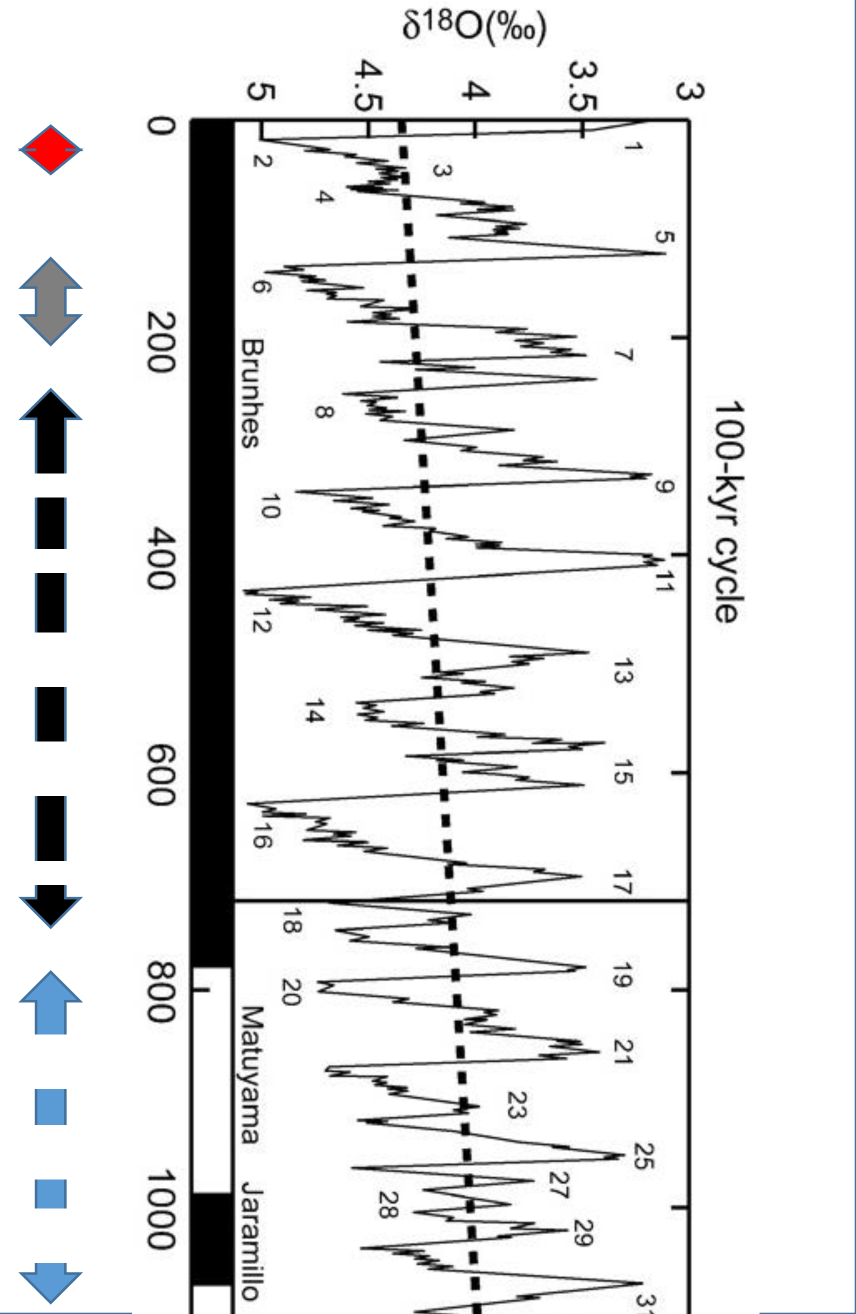
Walker & Lowe, 2007, Journal of the Geological Society 164 (6): 1073-1092



Lake "Mon" Reconstruction

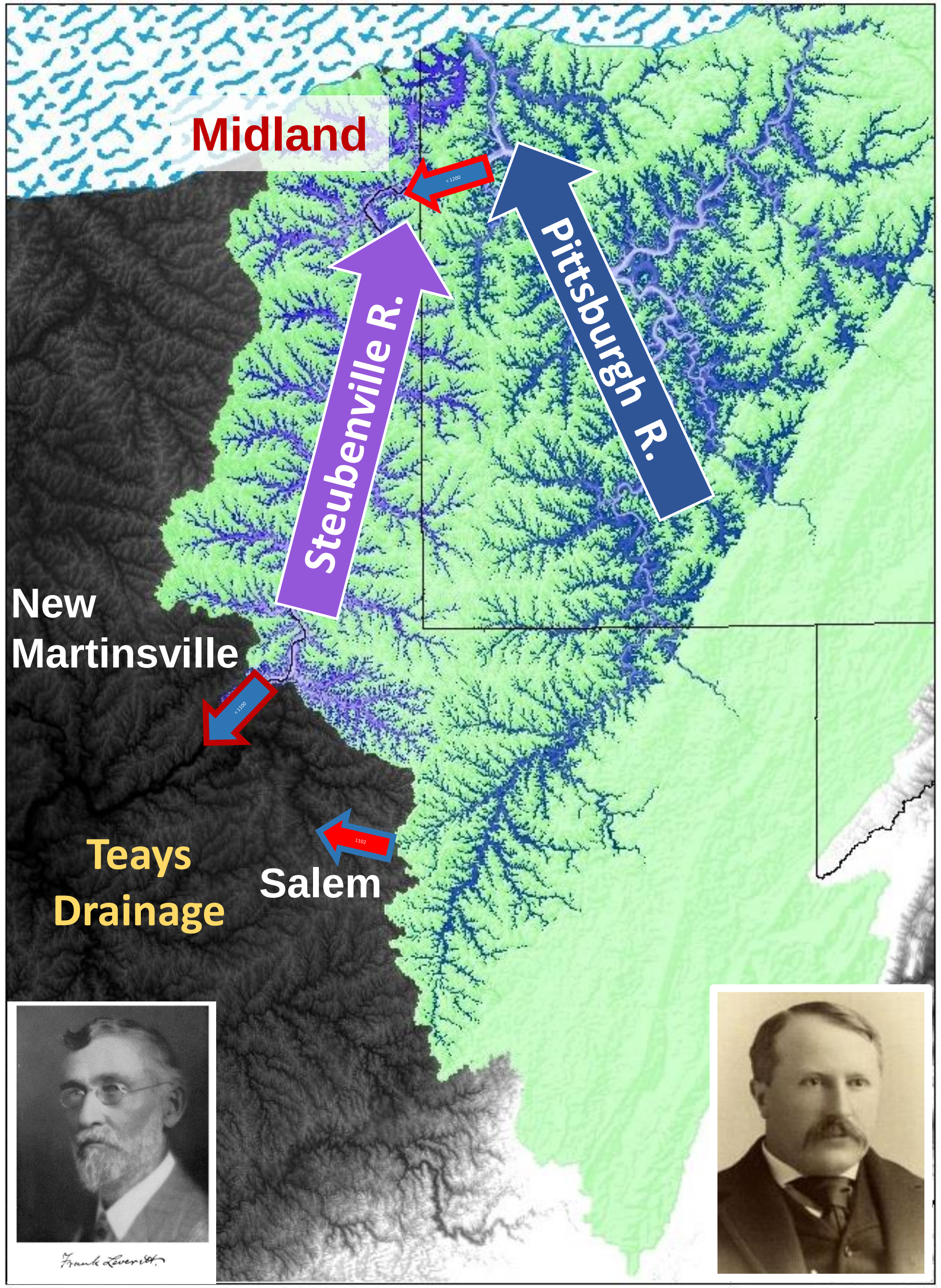
(Mark Swift, 2017)

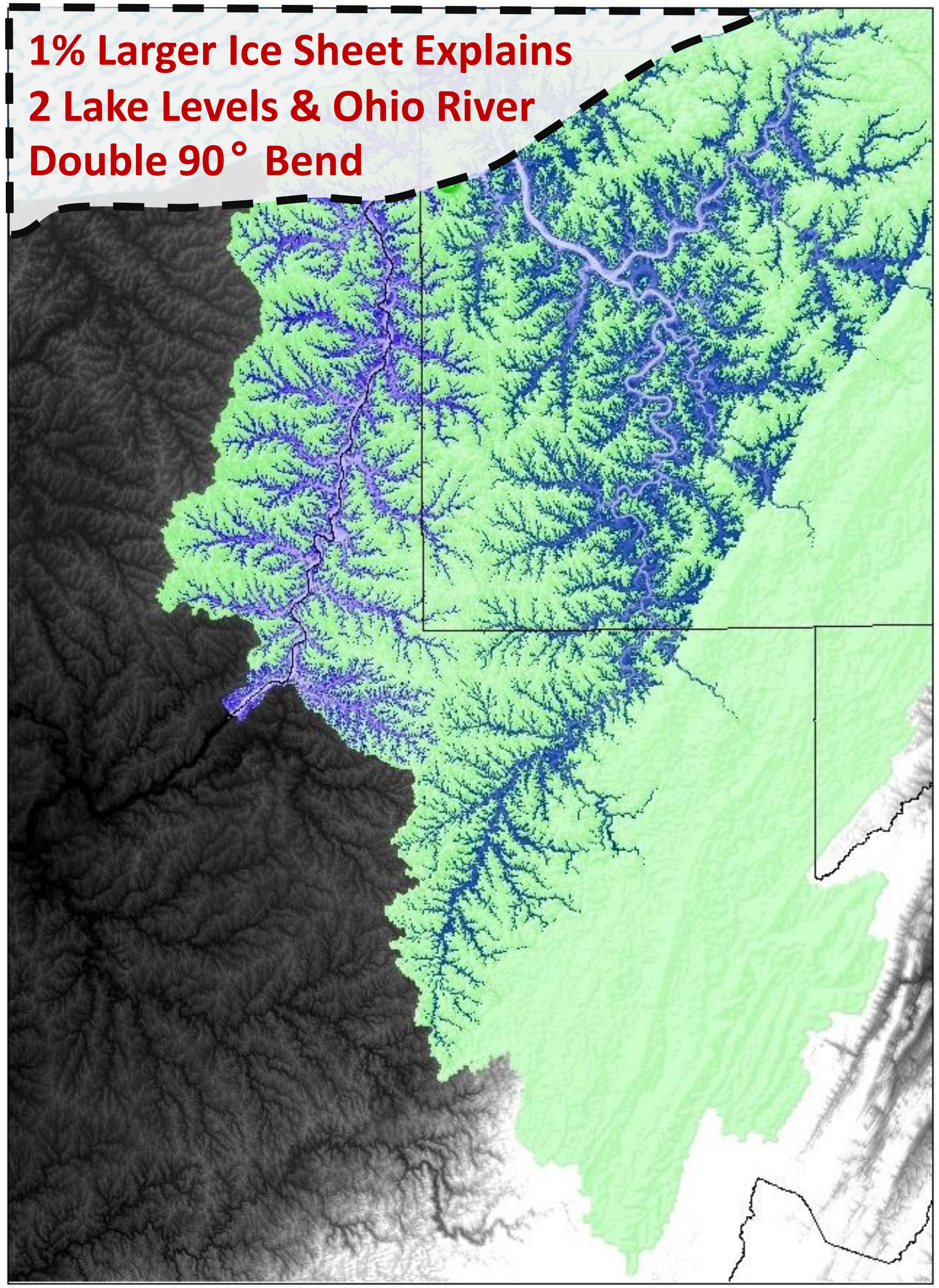
Existing Topography Filled to 335 m Elevation above Midland, PA

Filled to 330 m between Midland, PA & New Martinsville, WV

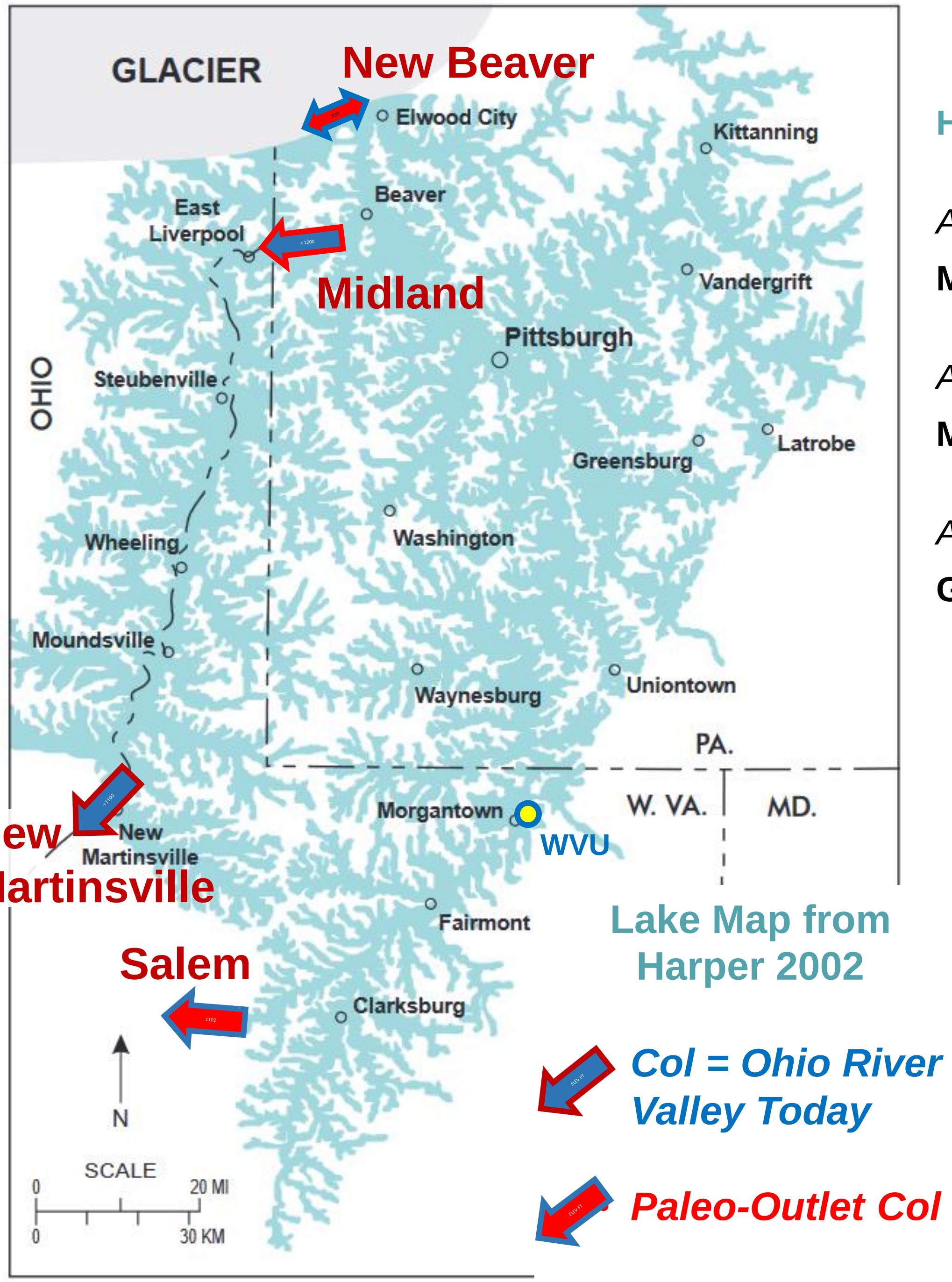
How to Reconcile Different Levels on Glacier-Dammed Lake at Traditional Pre-Wisconsin Limit

Leverett: Outwash Dammed Lake *vs.* White's Glacier Dammed Lake





Lake Monongahela Outlets



Lake Map from Harper 2002

Col = Ohio River Valley Today

Paleo-Outlet Col

Harper, J.A., 2002, Lake Monongahela: Anatomy of an immense ice age pond: Pennsylvania Geology, v. 32, no. 1

AFTER

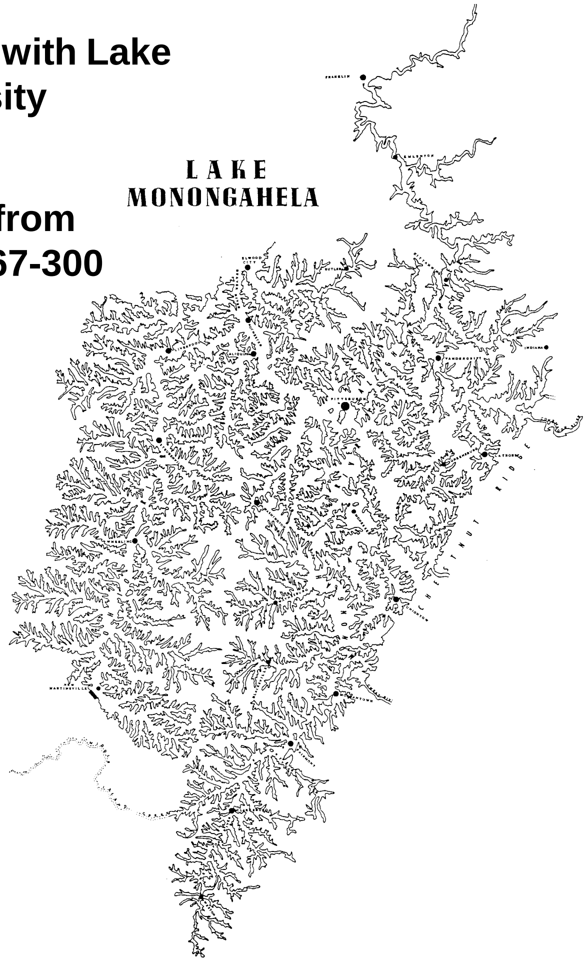
Marine, J.T., 1997, Terrace deposits associated with ancient Lake Monongahela in the lower Allegheny drainage, western Pennsylvania (MS thesis), U. Pittsburgh

AFTER

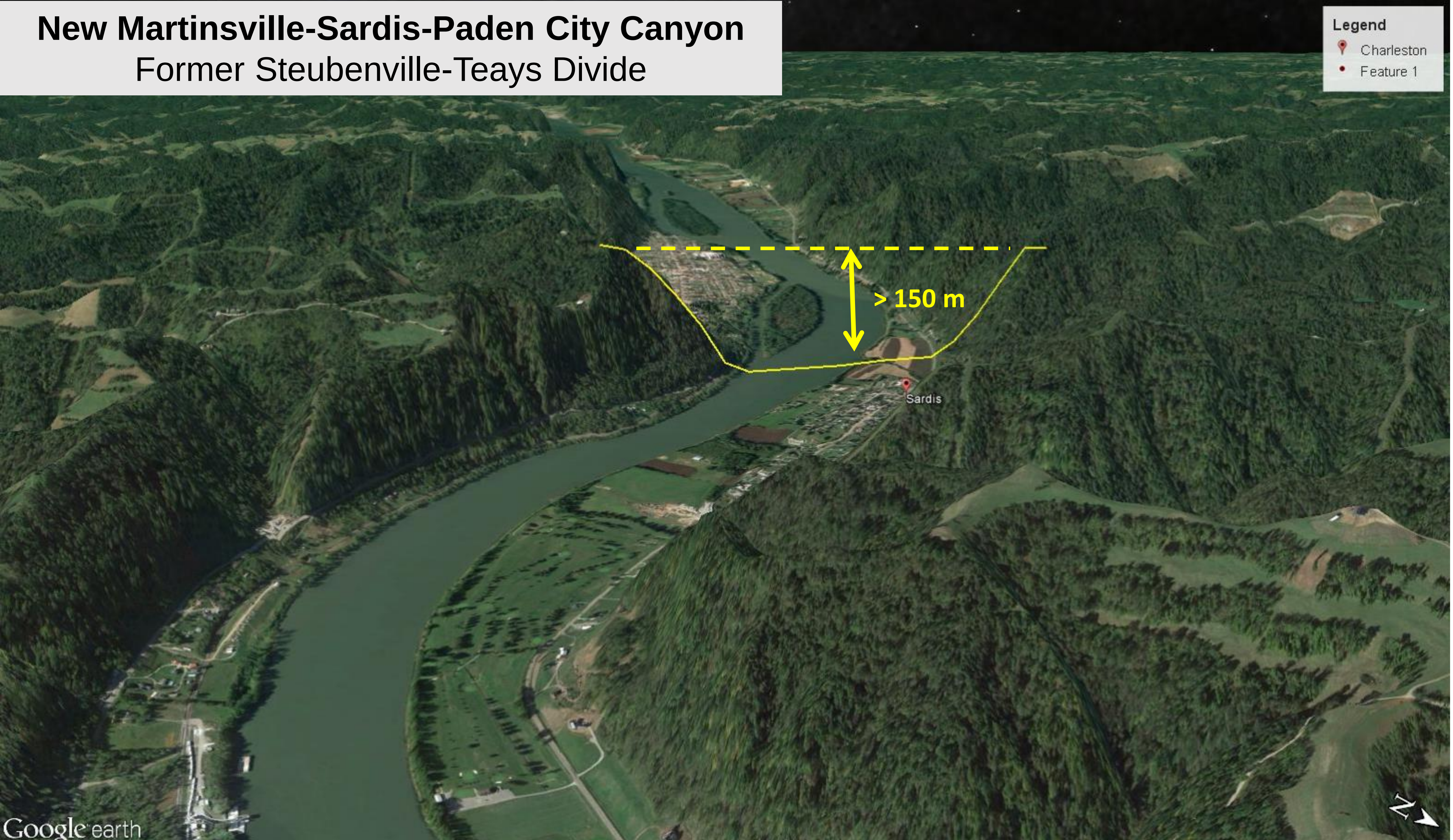
Morgan, S.A., 1994, Depositional facies associated with Lake Monongahela (MS thesis): West Virginia University

AFTER

Gillespie, W.H., and Clendening, J.A., 1968, A flora from proglacial Lake Monongahela: Castanea (303) 267-300



New Martinsville-Sardis-Paden City Canyon
Former Steubenville-Teays Divide



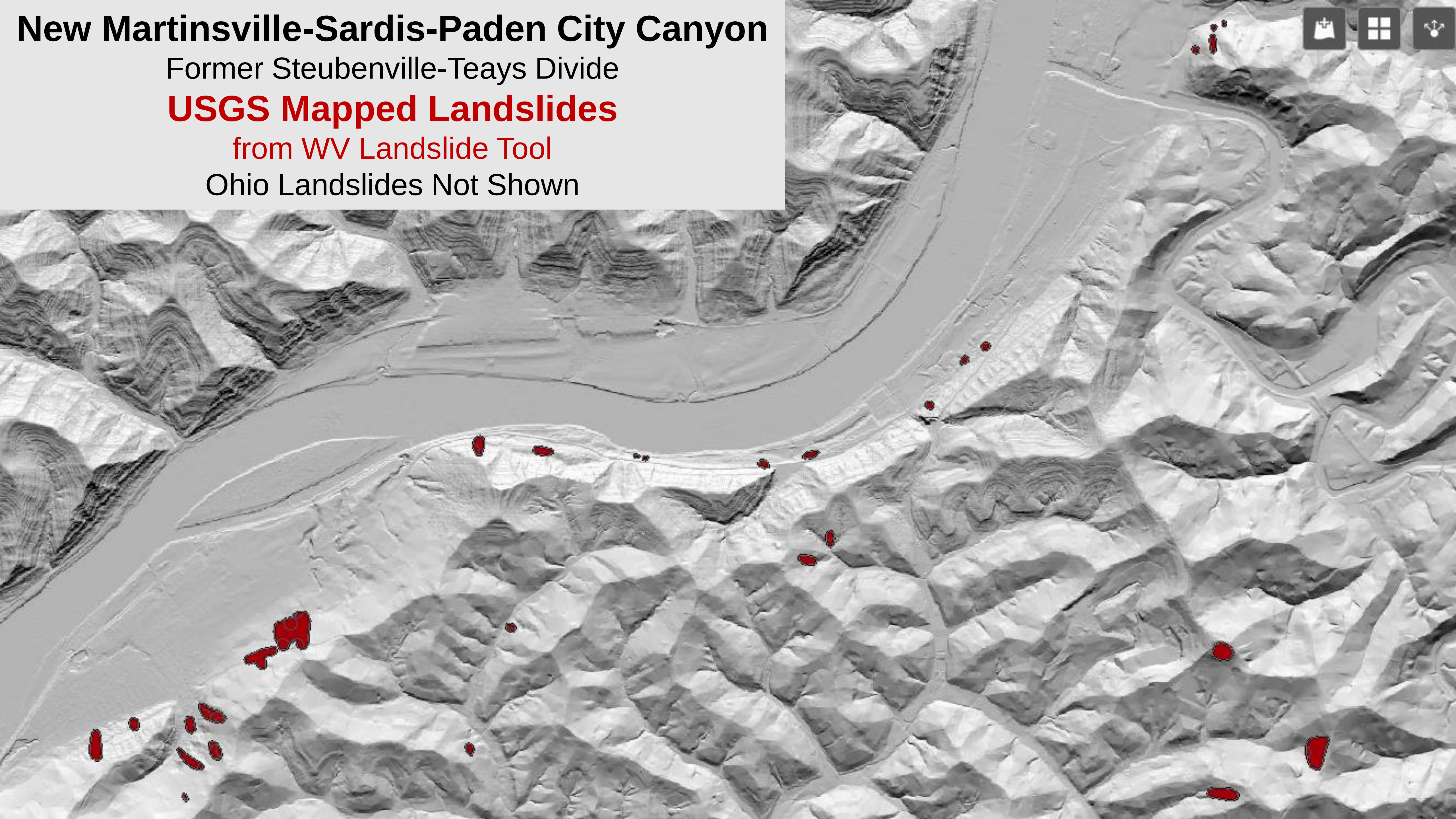
New Martinsville-Sardis-Paden City Canyon

Former Steubenville-Teays Divide

USGS Mapped Landslides

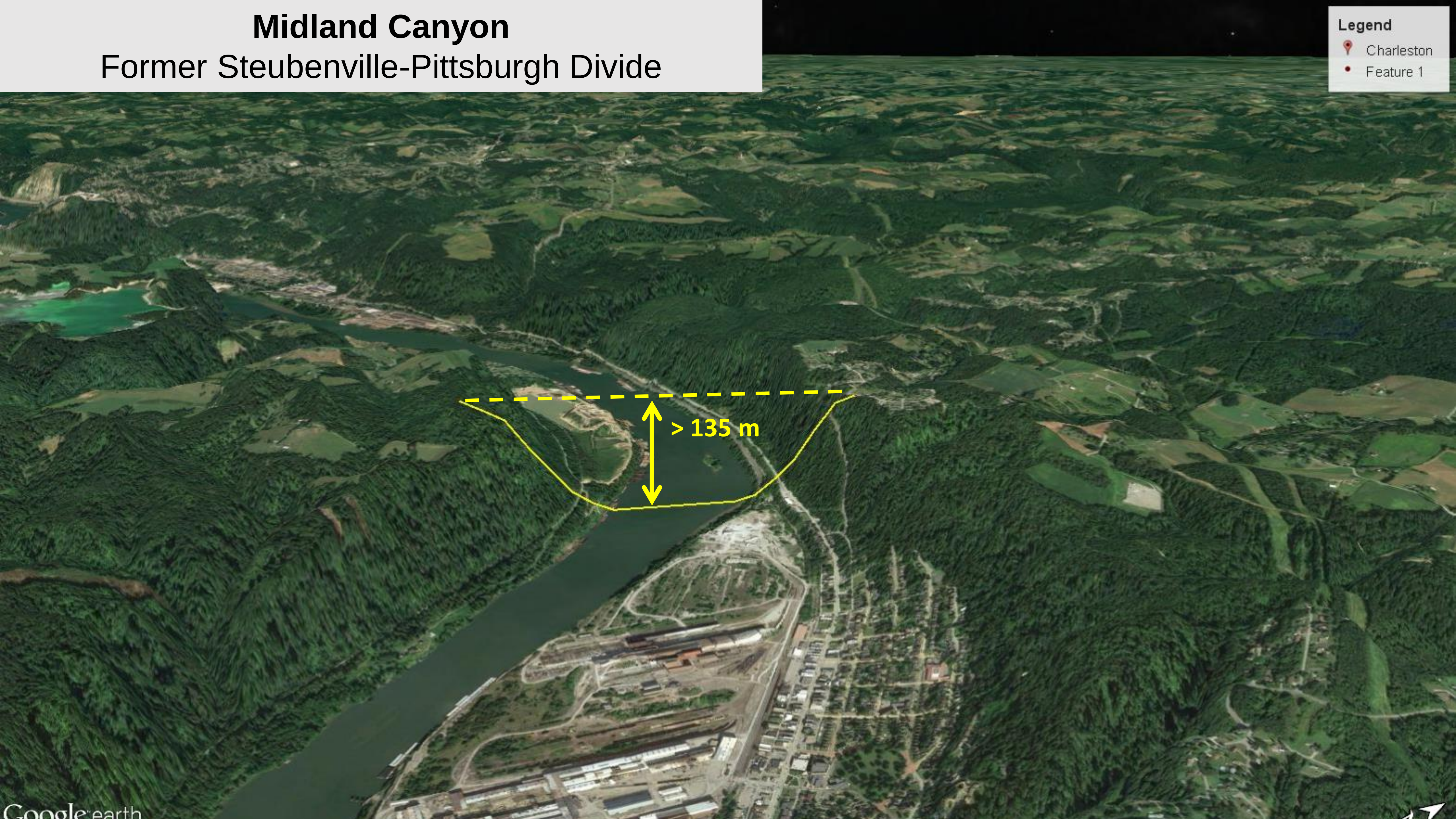
from WV Landslide Tool

Ohio Landslides Not Shown



Midland Canyon

Former Steubenville-Pittsburgh Divide

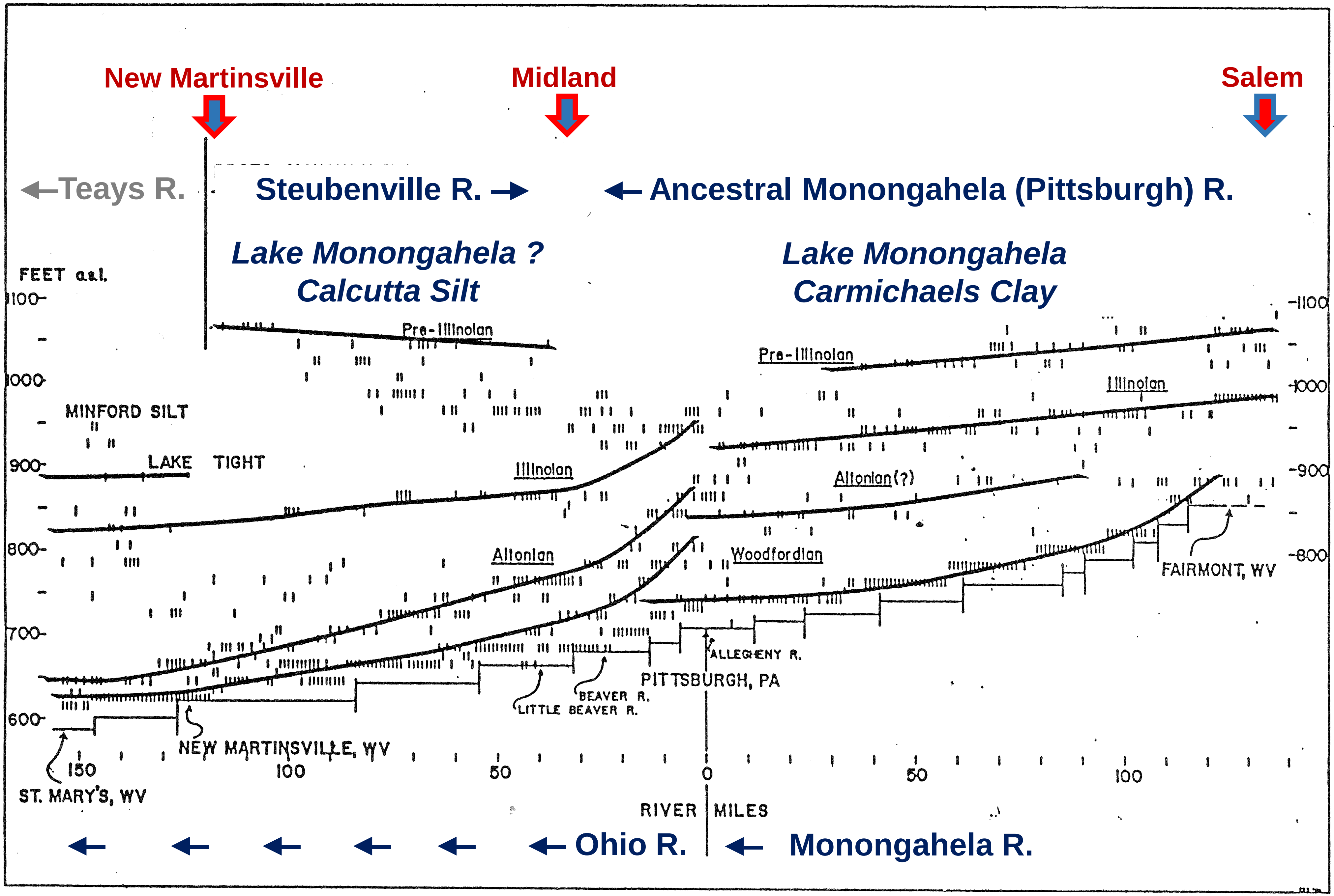


Jacobson (1985)

Correlations of Upper Ohio River Valley Lacustrine & Alluvial Terrace Deposits

Ohio River Profiles at Mouths of Outwash Sources (Allegheny, Beaver and Little Beaver Rivers) Suggest >30 m (~100 ft) of Aggradation in Last 3 Glaciations

Quaternary History = Too Complicated to Reconstruct on Morphology Alone

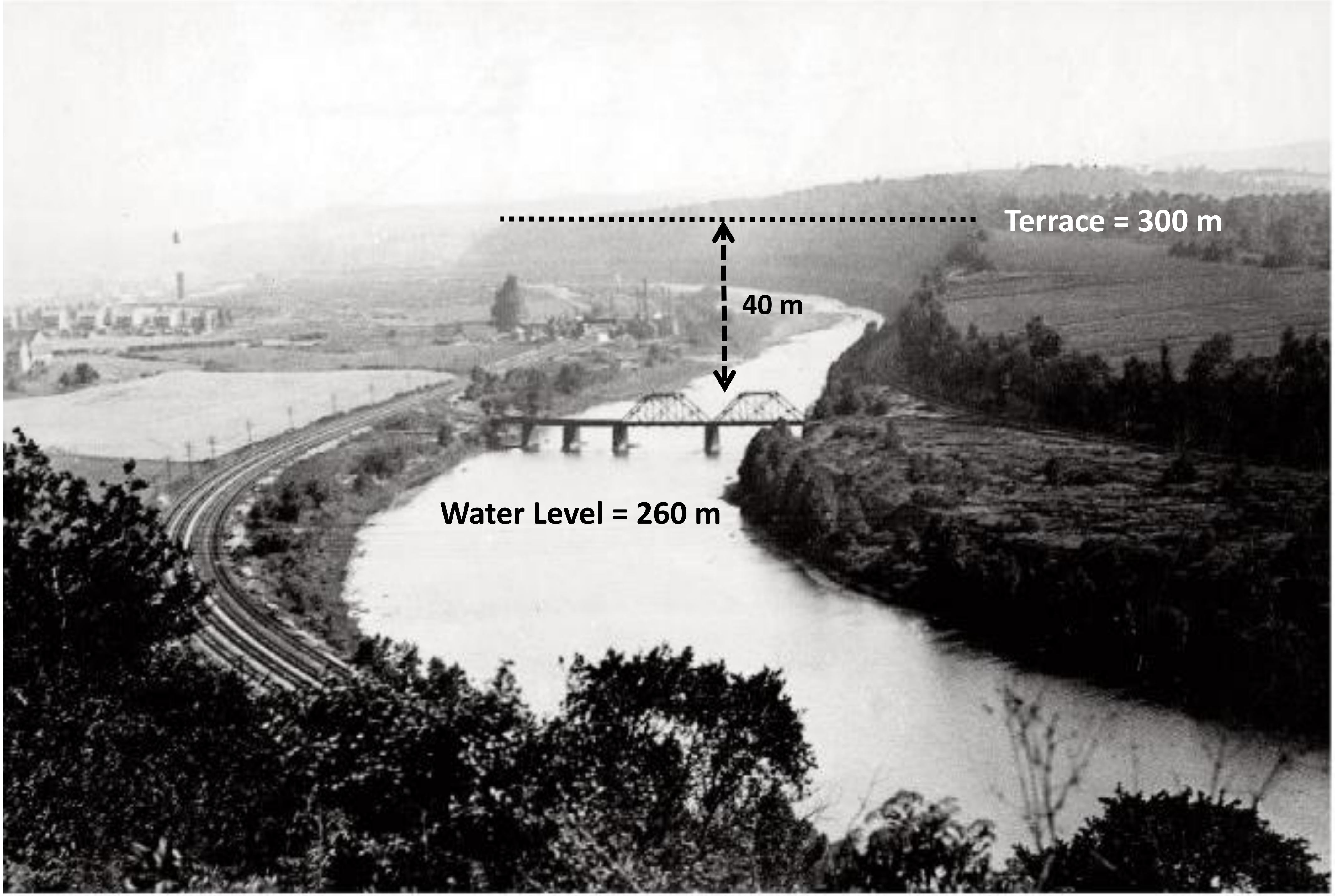


Youghiogheny River Terraces

~3 km NW of Connellsville, PA

W.O. Hikock
Photo, July 1934

Published in Pennsylvania Geology
Fall 2018, p. 21



WVU Woodburn Circle Excavation June 2017

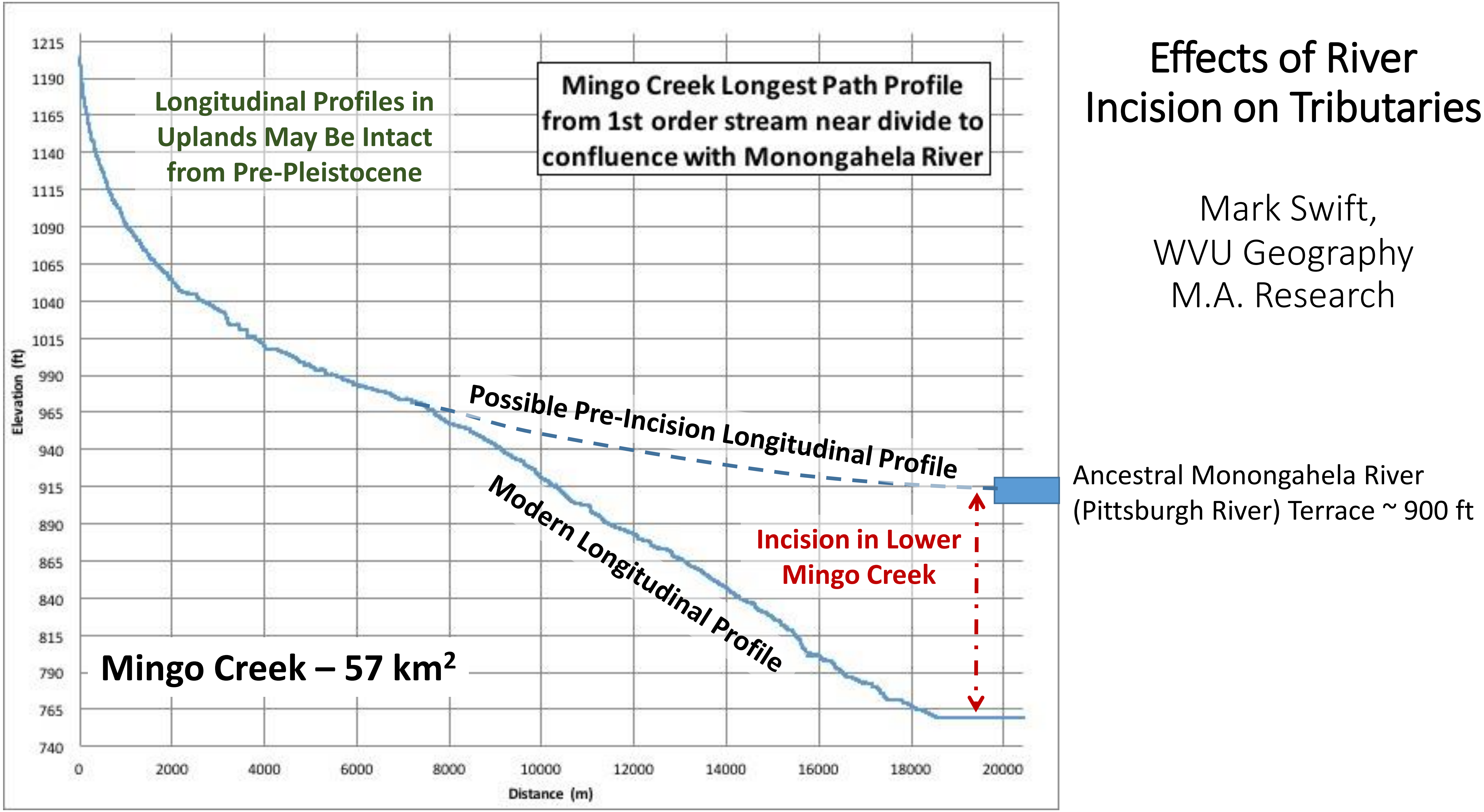
WVU Campus & Old Mountaineer Field ~1924

Monongahela: Unami (Algonquian) Word Meaning **"Falling Banks"**

https://wvhistoryonview.org/image/020135.jpg

Effects of River Incision on Tributaries

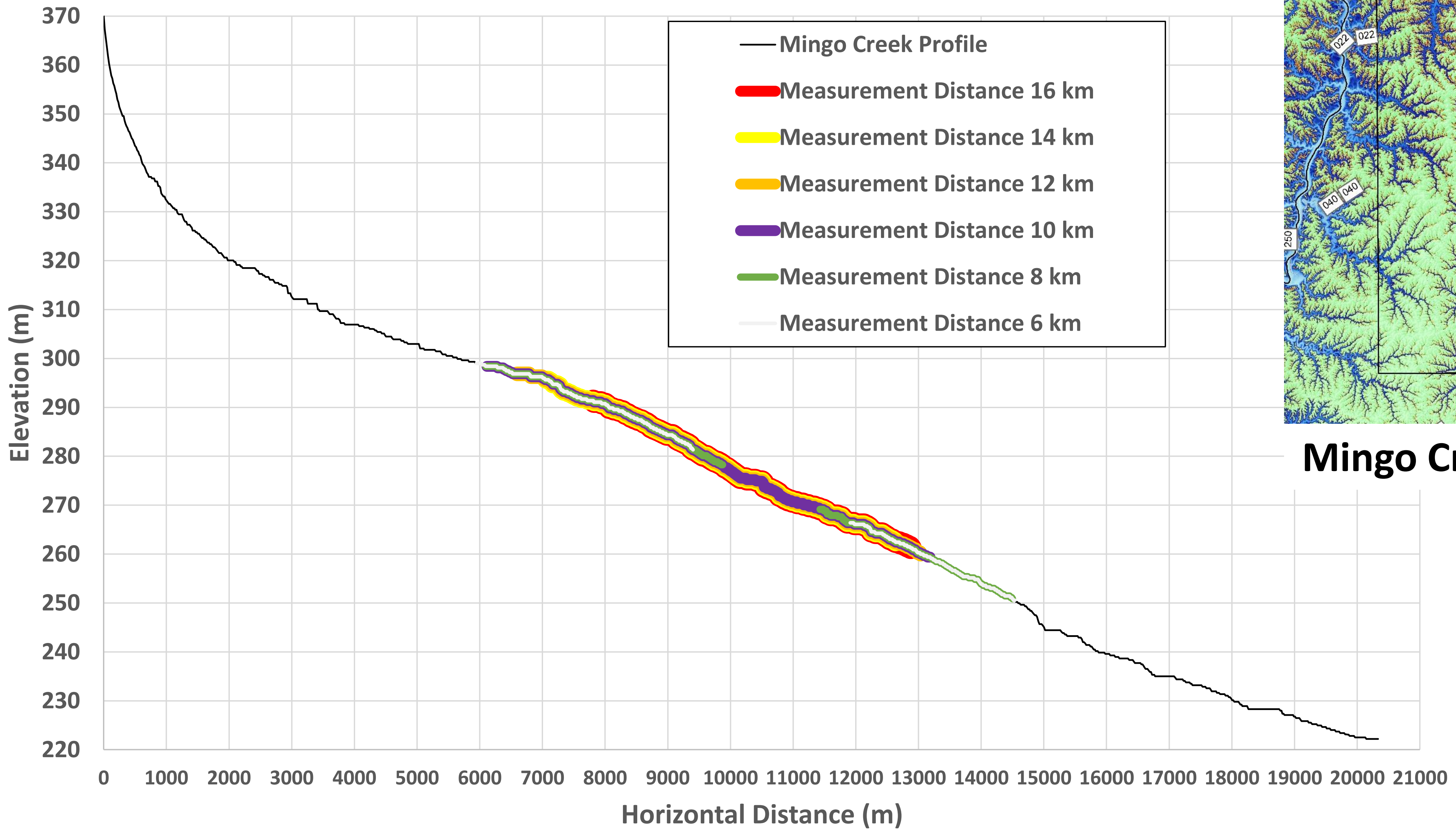
Mark Swift,
WVU Geography
M.A. Research

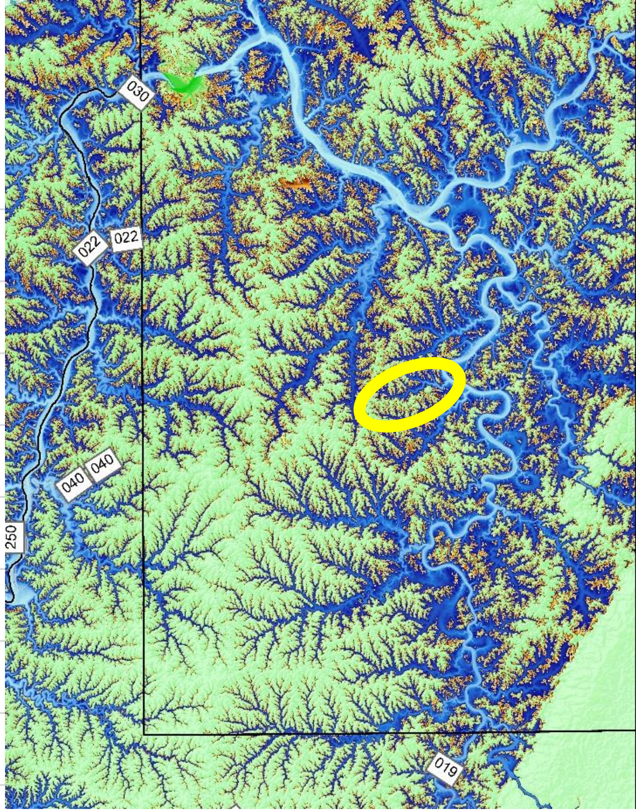


Mingo Creek- Zones With Downstream Gradient Steeper than Upstream Gradient

Measurement Distance (d)= 16 km, 14 km, 12 km, 10 km, 8 km, 6 km

Lower Reach Gradient > 0.001 and **Ratio of Lower Reach to Upper Reach > 1.2**



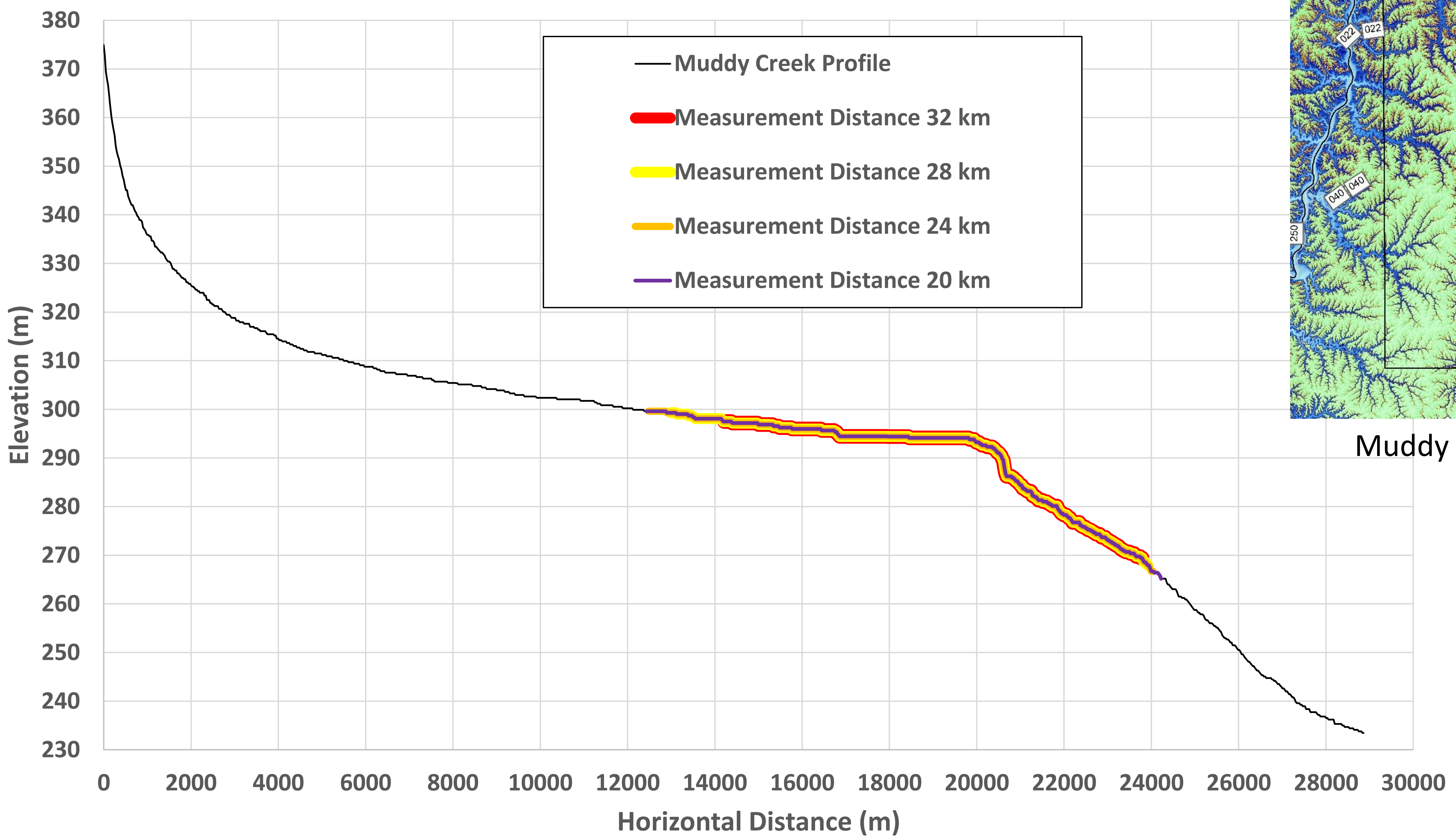


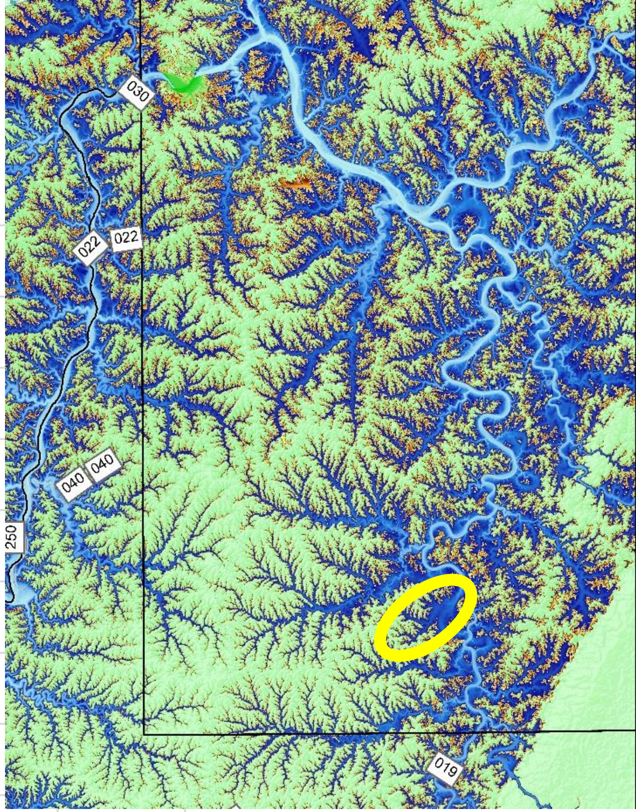
Mingo Creek – 57 km^2

Muddy Creek - Zones With Downstream Gradient Steeper than Upstream Gradient

Measurement Distance (d)= 32 km, 28 km, 24 km, 20 km

Lower Reach Gradient > .001 and **Ratio of Lower Reach to Upper Reach > 1.2**



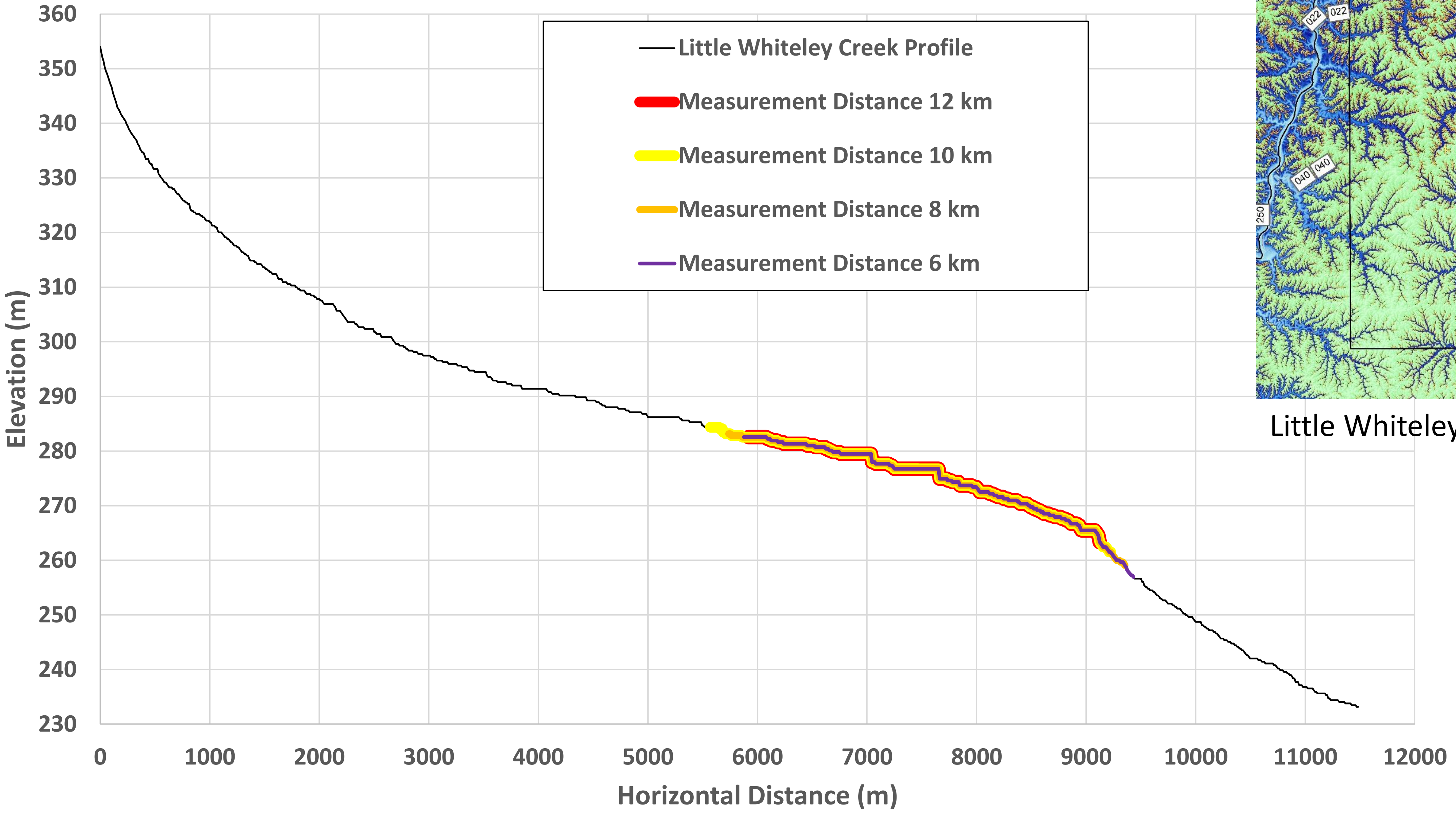


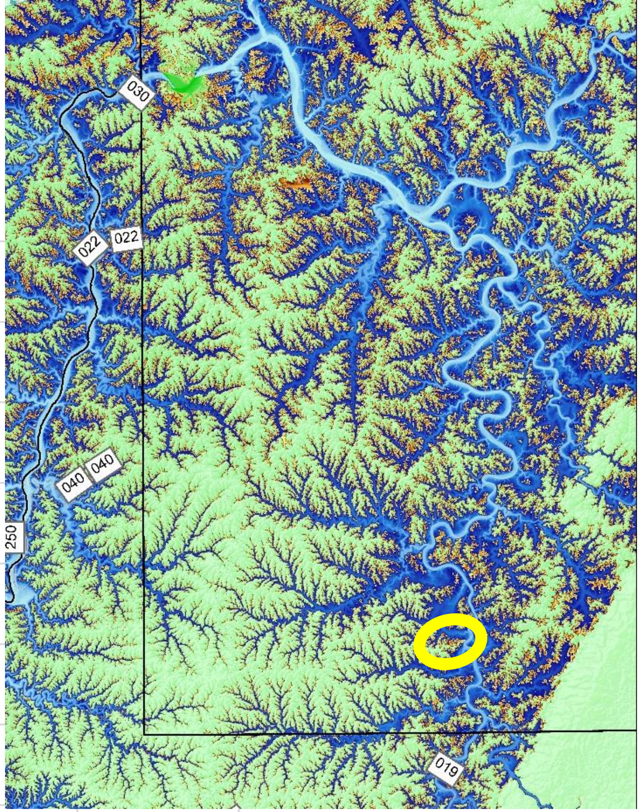
Muddy Creek – 82 km^2

Little Whiteley Creek - Zones With Downstream Gradient Steeper than Upstream Gradient

Measurement Distance (d)= 12 km, 10 km, 8 km, 6 km

Lower Reach Gradient > .001 and **Ratio of Lower Limb to Upper Limb > 1.2**





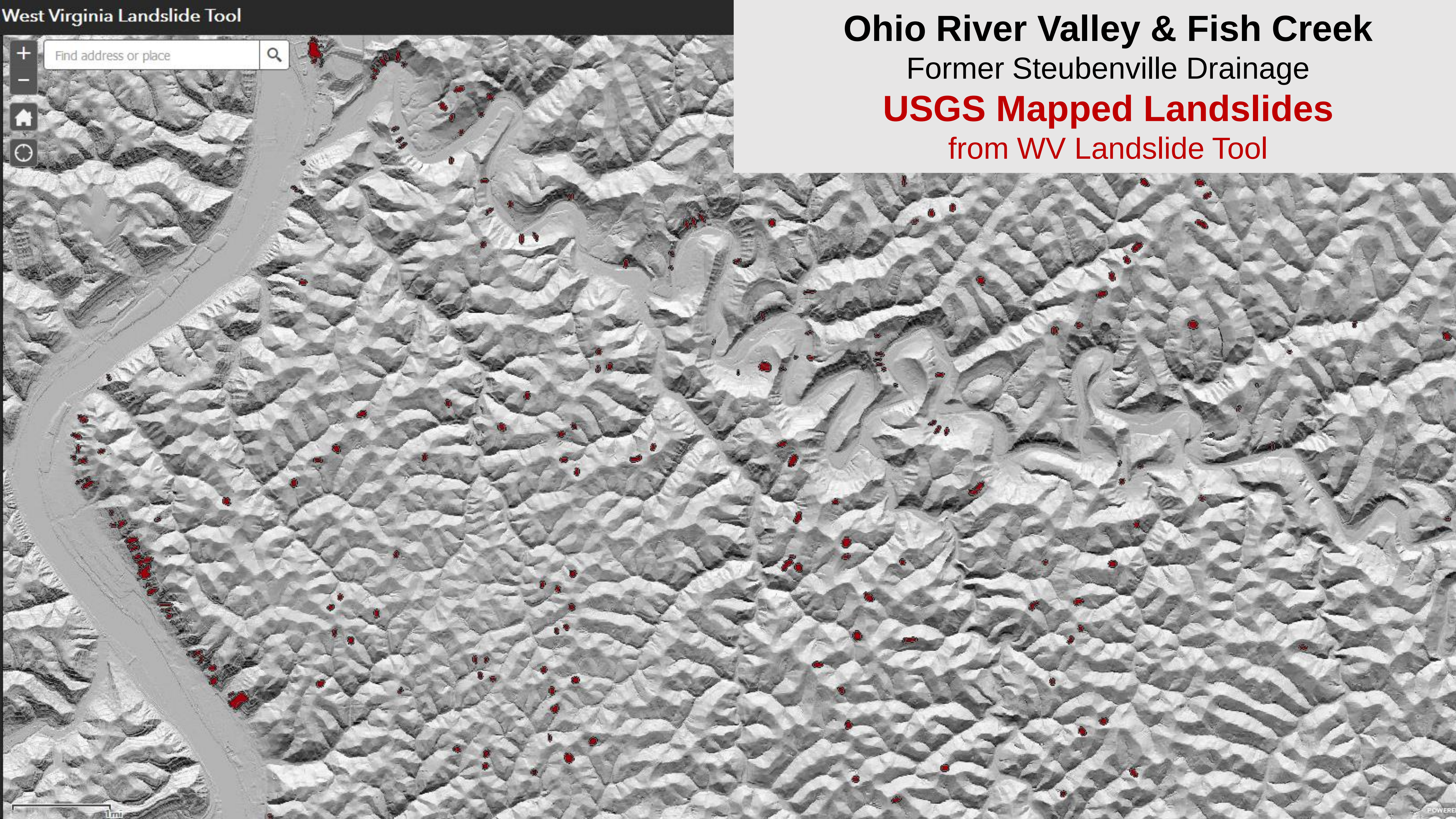
Little Whiteley Creek – 23 km^2

Ohio River Valley & Fish Creek

Former Steubenville Drainage

USGS Mapped Landslides

from WV Landslide Tool

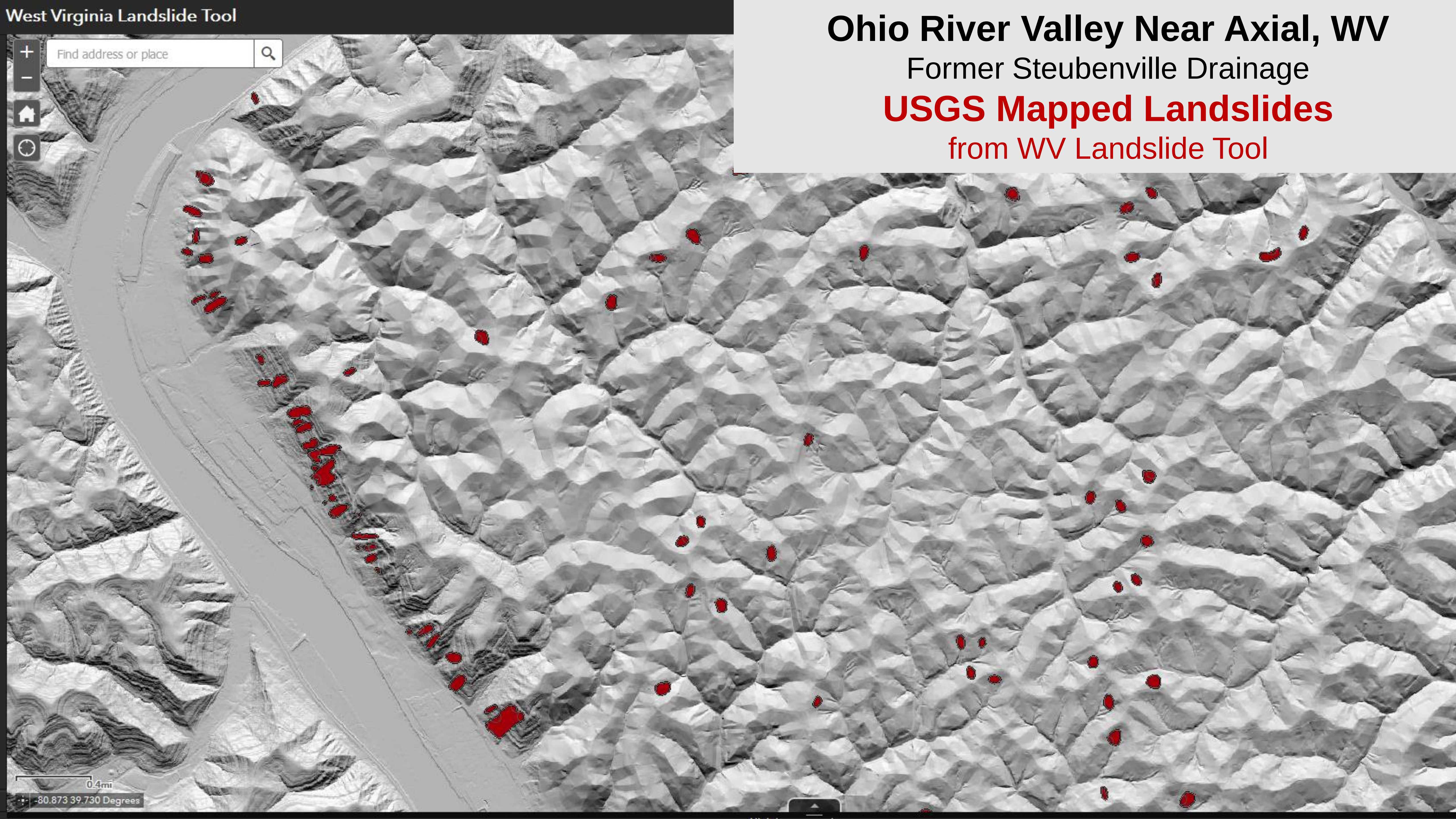


Ohio River Valley Near Axial, WV

Former Steubenville Drainage

USGS Mapped Landslides

from WV Landslide Tool

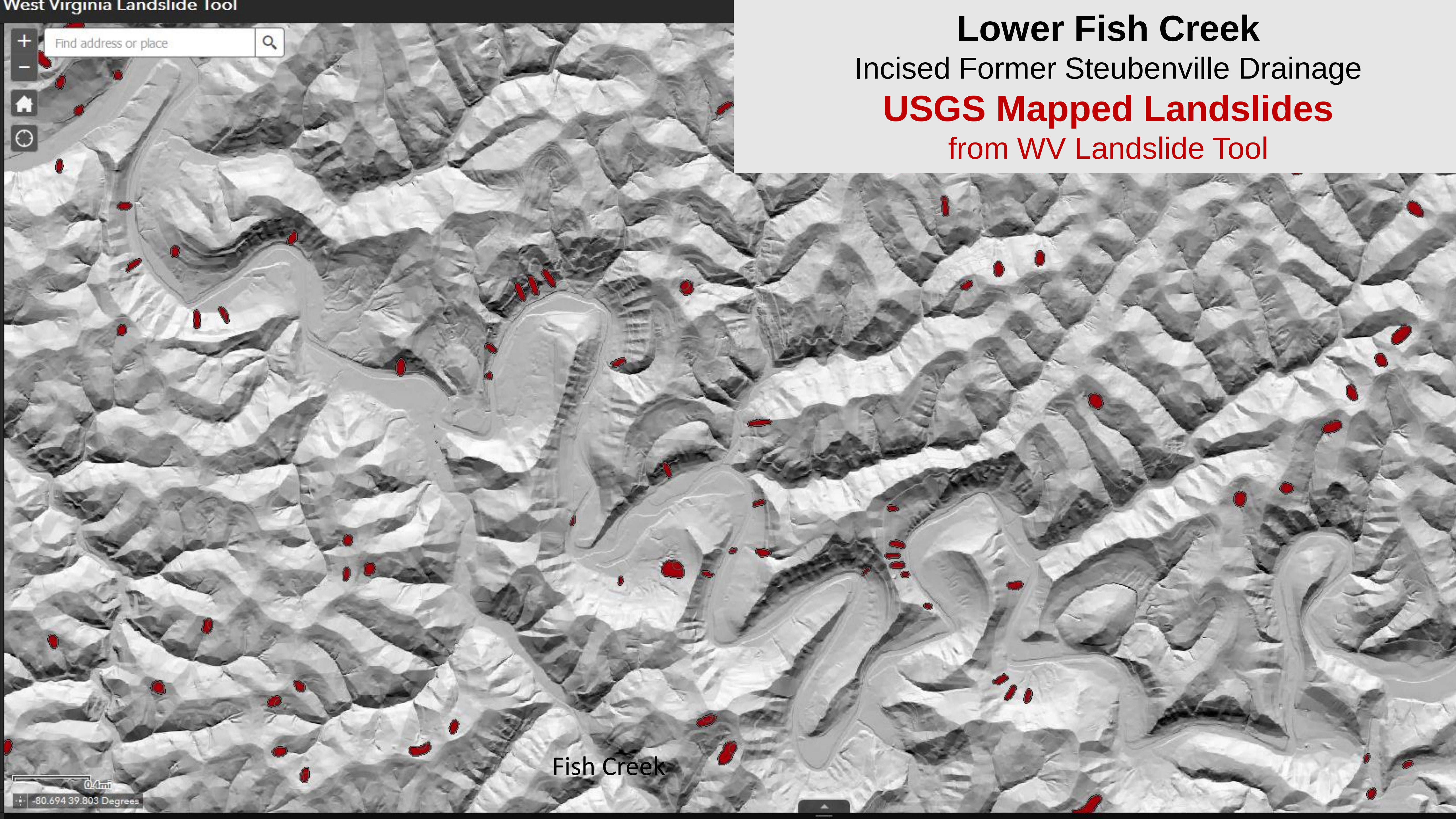


Lower Fish Creek

Incised Former Steubenville Drainage

USGS Mapped Landslides

from WV Landslide Tool



Segue into "Building a Landslide Inventory for West Virginia…"

- **Much of Upper Ohio River Basin Has "High Landslide Incidence"**
- **West Virginia = 1/9th of 1973-1983 Landslide Damage in 48 States**
  - **#1 in *Per Capita* Landslide Damage** (Brabb, 1984, USGS OF 84-486).

Coterminous U.S. Landslide Overview Map USGS PP 1183