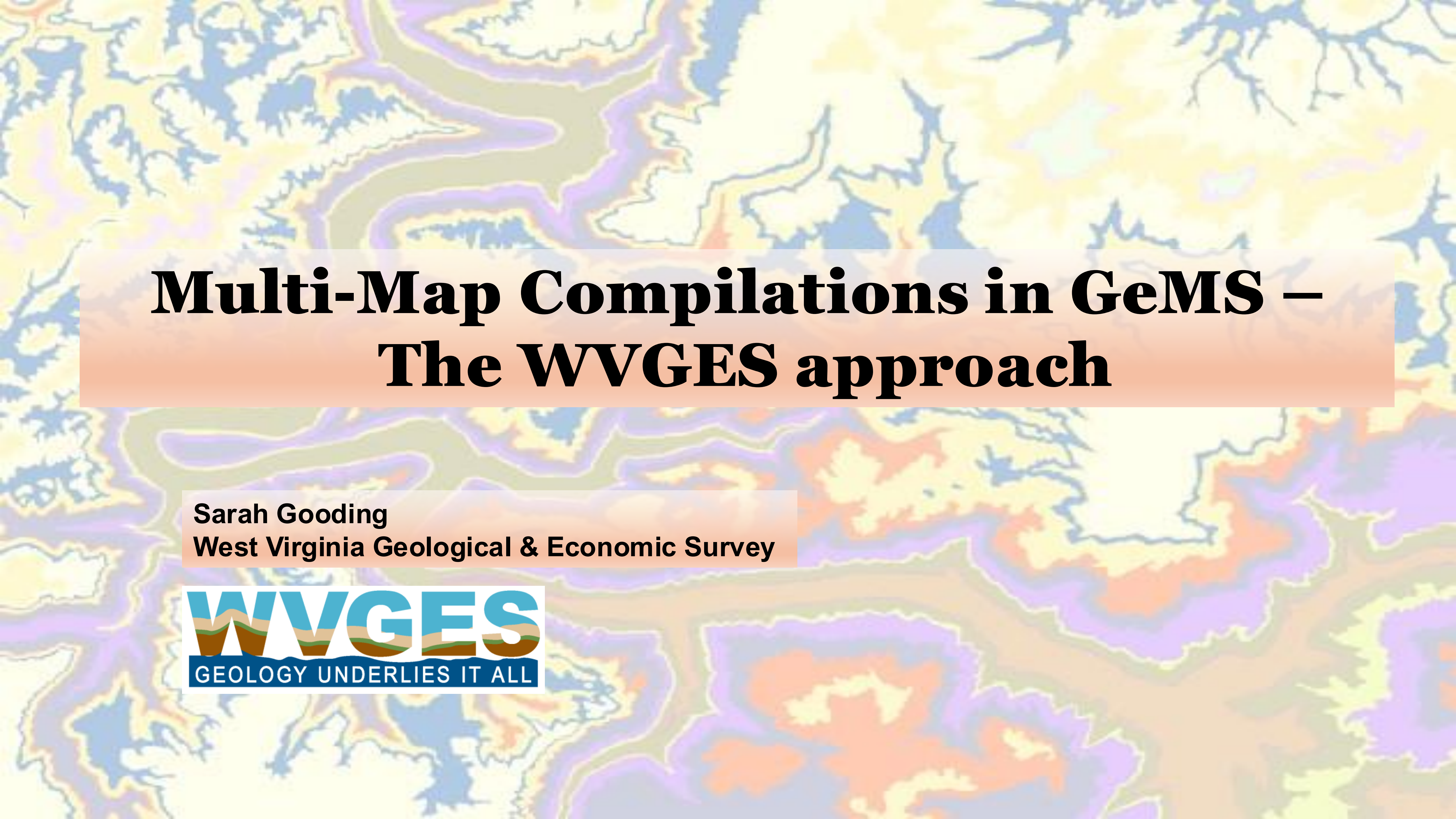
USGS
science for a changing world
AASG
Association of American State Geologists
DMT 2025

DIGITAL MAPPING TECHNIQUES 2025

The following was presented at DMT '25
May 18 - 21, 2025

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2025)
http://ngmdb.usgs.gov/info/dmt/



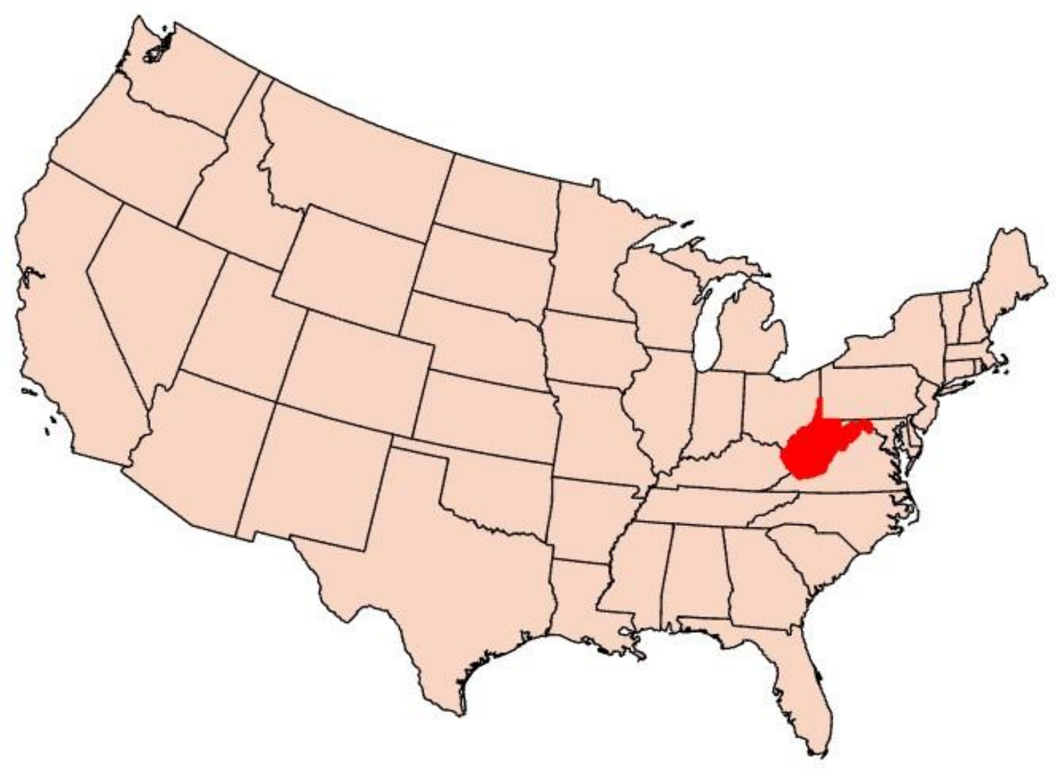
Multi-Map Compilations in GeMS – The WVGES approach

Sarah Gooding
West Virginia Geological & Economic Survey

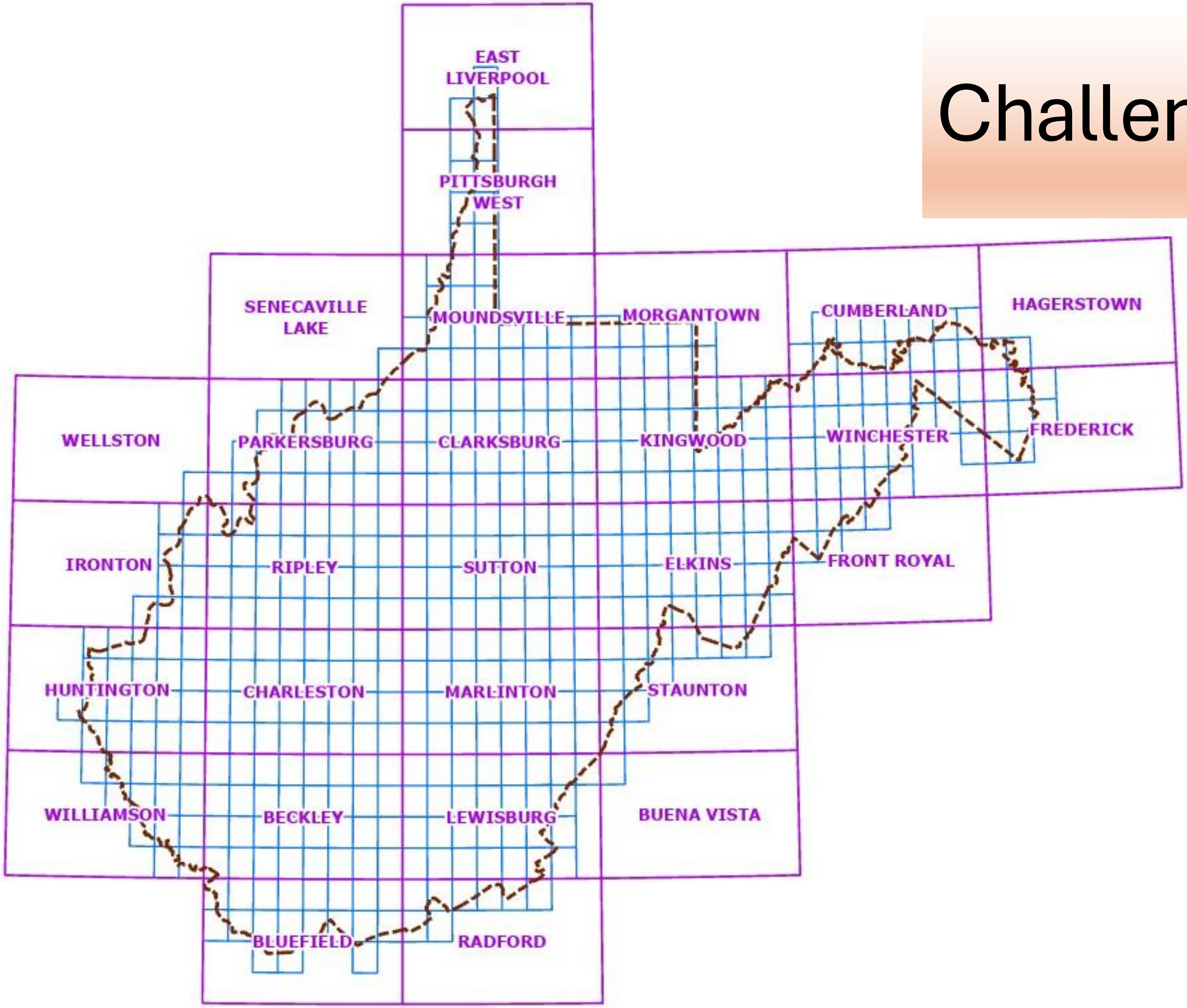
WVGES
GEOLOGY UNDERLIES IT ALL

Challenges faced combining single maps into seamless compilations:

- Organization
- Edge-matching
- Authorship & Data Source Tracking
- Combining Unit Descriptions From Multiple Sources

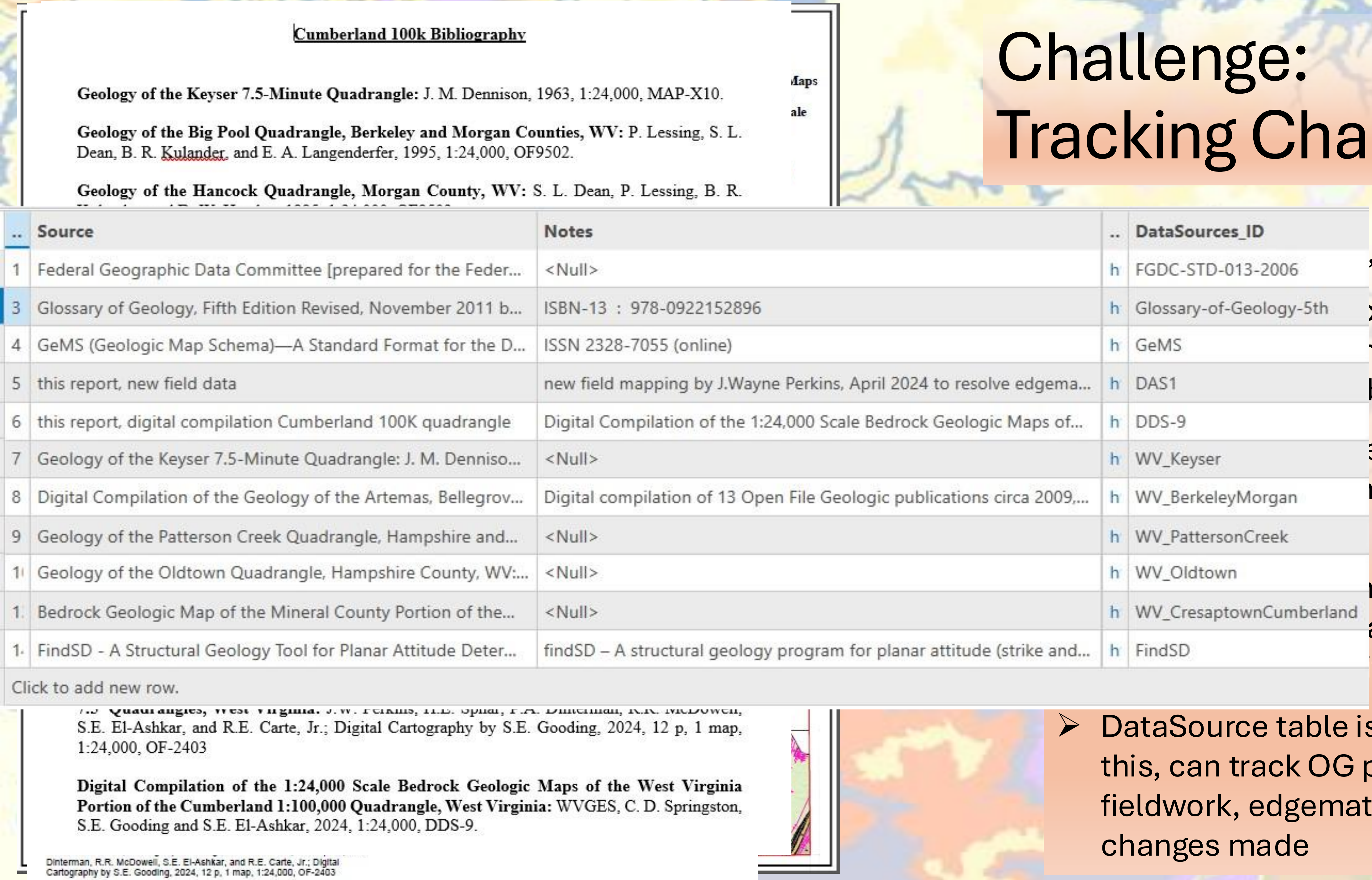


Challenge: Organization


EAST LIVERPOOL
PITTSBURGH WEST
SENECAVILLE LAKE
MOUNDSVILLE
MORGANTOWN
CUMBERLAND
HAGERSTOWN
WELLSTON
PARKERSBURG
CLARKSBURG
KINGWOOD
WINCHESTER
FREDERICK
IRONTON
RIPLEY
SUTTON
ELKINS
FRONT ROYAL
HUNTINGTON
CHARLESTON
MARLINTON
STAUNTON
WILLIAMSON
BECKLEY
LEWISBURG
BUENA VISTA
BLUEFIELD
RADFORD

- Enterprise Geodatabase built of all 24K Bedrock mapping
- Conversion to GeMS format (data structure and attributes)
- Edge-matching required!! Who? How? Fieldwork?
- How do we keep track of all the changes?
- *Decided to organize by 100K quadrangle “blocks” for compilations and distribution

Challenge: Tracking Changes



Cumberland 100k Bibliography

Geology of the Keyser 7.5-Minute Quadrangle: J. M. Dennison, 1963, 1:24,000, MAP-X10.

Geology of the Big Pool Quadrangle, Berkeley and Morgan Counties, WV: P. Lessing, S. L. Dean, B. R. Kulander, and E. A. Langenderfer, 1995, 1:24,000, OF9502.

Geology of the Hancock Quadrangle, Morgan County, WV: S. L. Dean, P. Lessing, B. R.

..	Source	Notes	..	DataSources_ID
1	Federal Geographic Data Committee [prepared for the Feder...	<Null>	h	FGDC-STD-013-2006
3	Glossary of Geology, Fifth Edition Revised, November 2011 b...	ISBN-13 : 978-0922152896	h	Glossary-of-Geology-5th
4	GeMS (Geologic Map Schema)—A Standard Format for the D...	ISSN 2328-7055 (online)	h	GeMS
5	this report, new field data	new field mapping by J.Wayne Perkins, April 2024 to resolve edgema...	h	DAS1
6	this report, digital compilation Cumberland 100K quadrangle	Digital Compilation of the 1:24,000 Scale Bedrock Geologic Maps of...	h	DDS-9
7	Geology of the Keyser 7.5-Minute Quadrangle: J. M. Denniso...	<Null>	h	WV_Keyser
8	Digital Compilation of the Geology of the Artemas, Bellegrov...	Digital compilation of 13 Open File Geologic publications circa 2009,...	h	WV_BerkeleyMorgan
9	Geology of the Patterson Creek Quadrangle, Hampshire and...	<Null>	h	WV_PattersonCreek
1	Geology of the Oldtown Quadrangle, Hampshire County, WV:...	<Null>	h	WV_Oldtown
1	Bedrock Geologic Map of the Mineral County Portion of the...	<Null>	h	WV_CresaptownCumberland
1	FindSD - A Structural Geology Tool for Planar Attitude Deter...	findSD – A structural geology program for planar attitude (strike and...	h	FindSD

Click to add new row.

S.E. El-Ashkar, and R.E. Carte, Jr.; Digital Cartography by S.E. Gooding, 2024, 12 p, 1 map, 1:24,000, OF-2403

Digital Compilation of the 1:24,000 Scale Bedrock Geologic Maps of the West Virginia Portion of the Cumberland 1:100,000 Quadrangle, West Virginia: WVGES, C. D. Springston, S.E. Gooding and S.E. El-Ashkar, 2024, 1:24,000, DDS-9.

Dinterman, R.R. McDowell, S.E. El-Ashkar, and R.E. Carte, Jr.; Digital Cartography by S.E. Gooding, 2024, 12 p, 1 map, 1:24,000, OF-2403

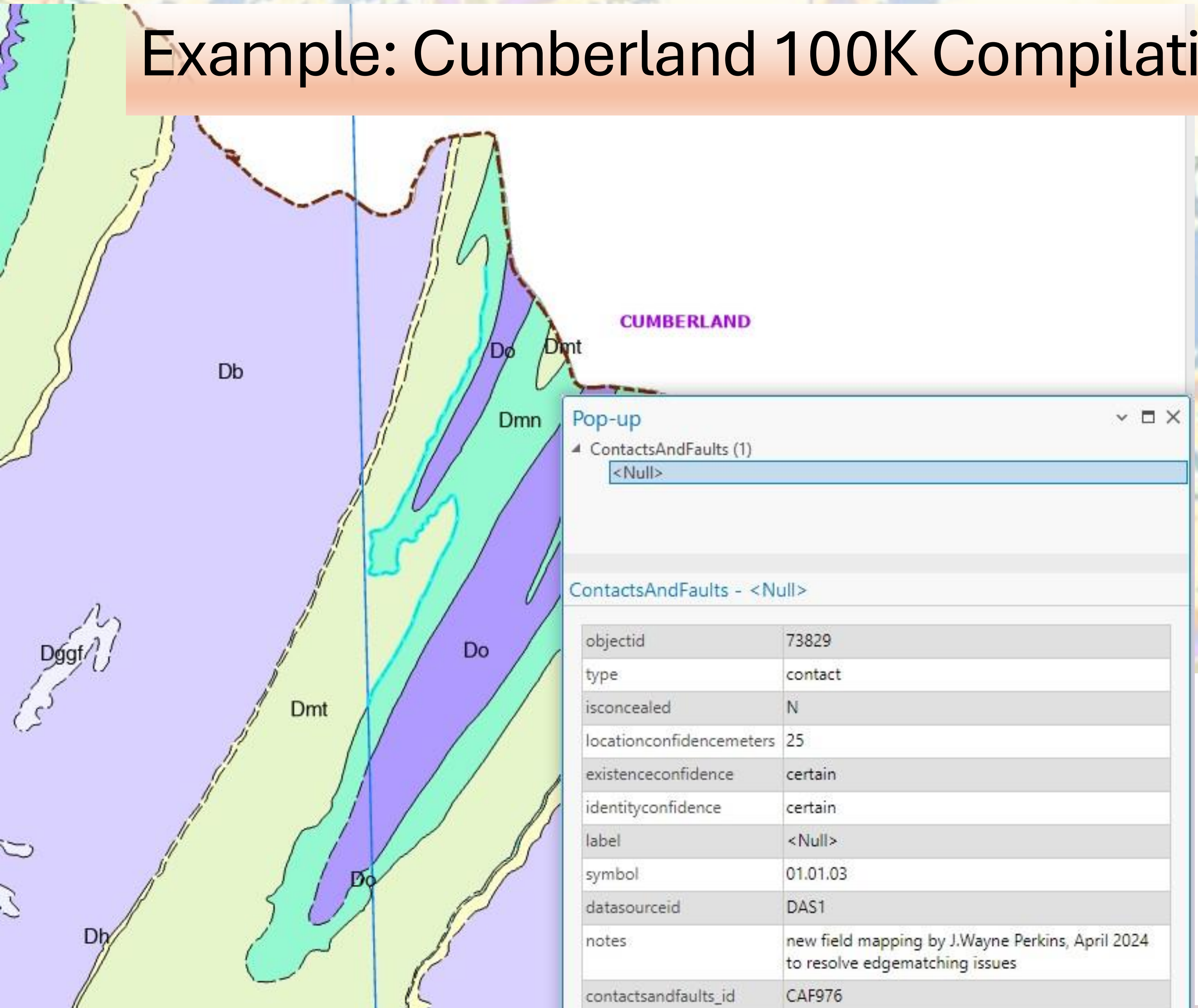
’ of authorship
cations to
npiled GIS
blication

et authorship
npilations
blication ID’s

nent
ataset – track
ts

- ➢ DataSource table is great for this, can track OG pubs, new fieldwork, edgematching changes made

Example: Cumberland 100K Compilation



Pop-up

ContactsAndFaults (1)

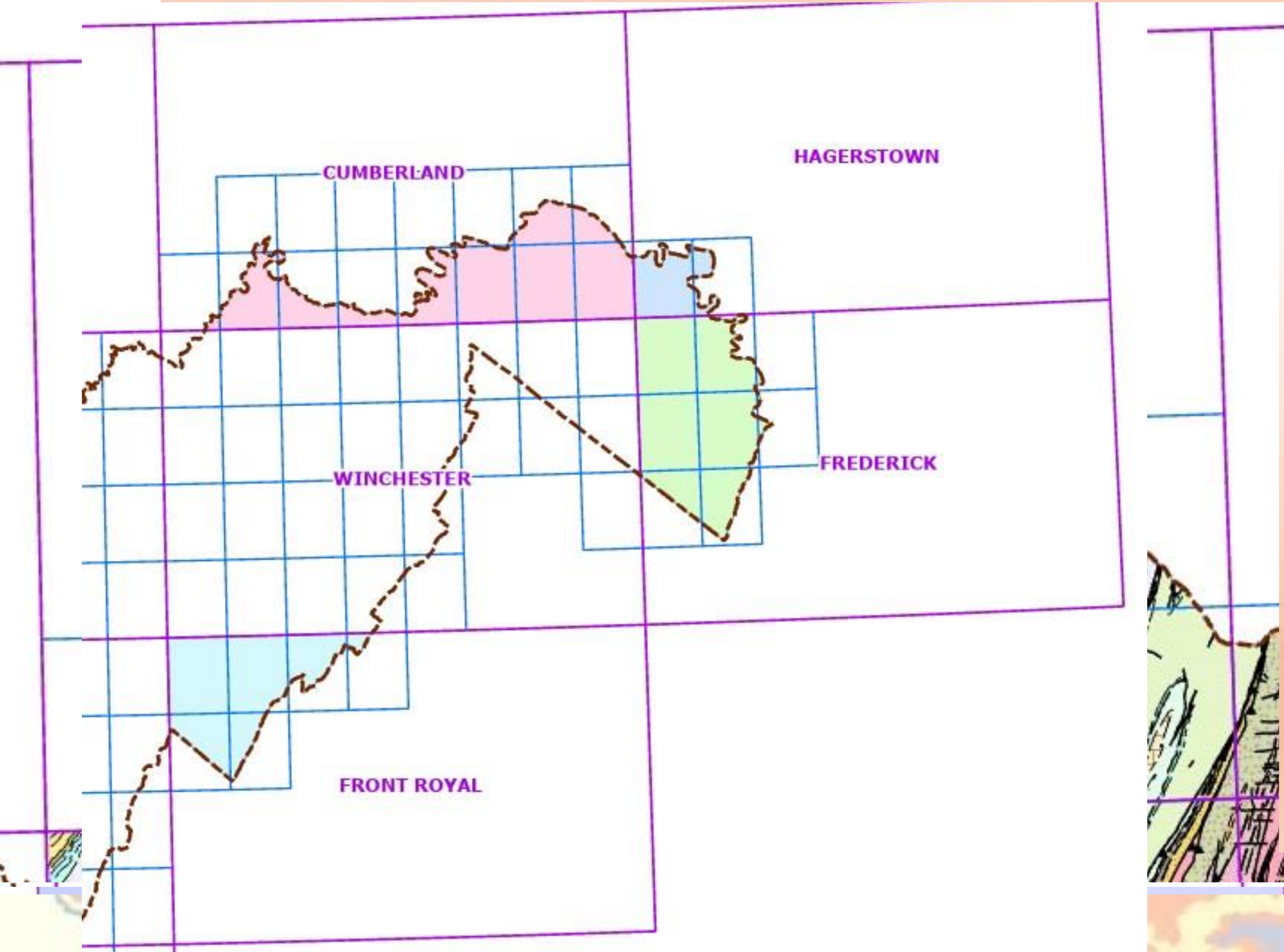
<Null>

ContactsAndFaults - <Null>

objectid	73829
type	contact
isconcealed	N
locationconfidencemeters	25
existenceconfidence	certain
identityconfidence	certain
label	<Null>
symbol	01.01.03
datasourceid	DAS1
notes	new field mapping by J.Wayne Perkins, April 2024 to resolve edgematching issues
contactsandfaults_id	CAF976

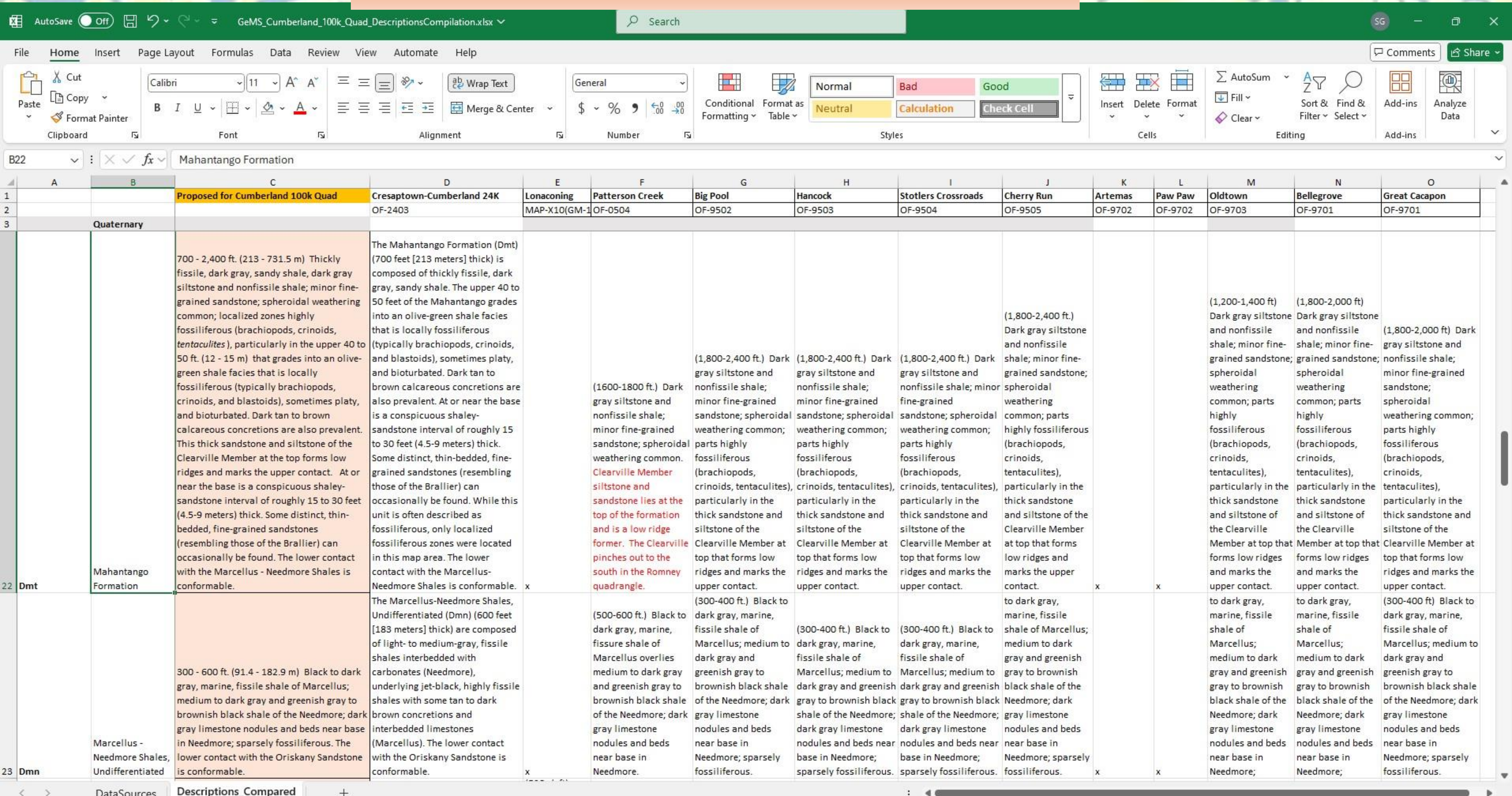
- Overview Cumberland area
- Had a head start with previously digitally compiled, edgematched area c2009: ‘BerkeleyMorgan’
- This digital compilation assigned a new publication ID “DDS-7” for citability/DataSource
- Other single maps from the 100K block added in (DS polys shown)
- New mapping to complete the block and fieldwork to resolve edgematching issues beyond the scope of GIS techs
- New fieldwork for revised line tagged with own datasource

Example: Cumberland 100K Compilation


CUMBERLAND
HAGERSTOWN
WINCHESTER
FREDERICK
FRONT ROYAL

- ➢ Final 100K block: “Before-After” new dataset, new publication DDS-9
- ➢ Old 24K data replaced with new block in enterprise database and for data downloadables to public
- ➢ Data remains 24K, just served in 100K blocks
- ➢ Finished compilation sheet example
- ➢ 100K blocks published so far (See in Map Blast!)

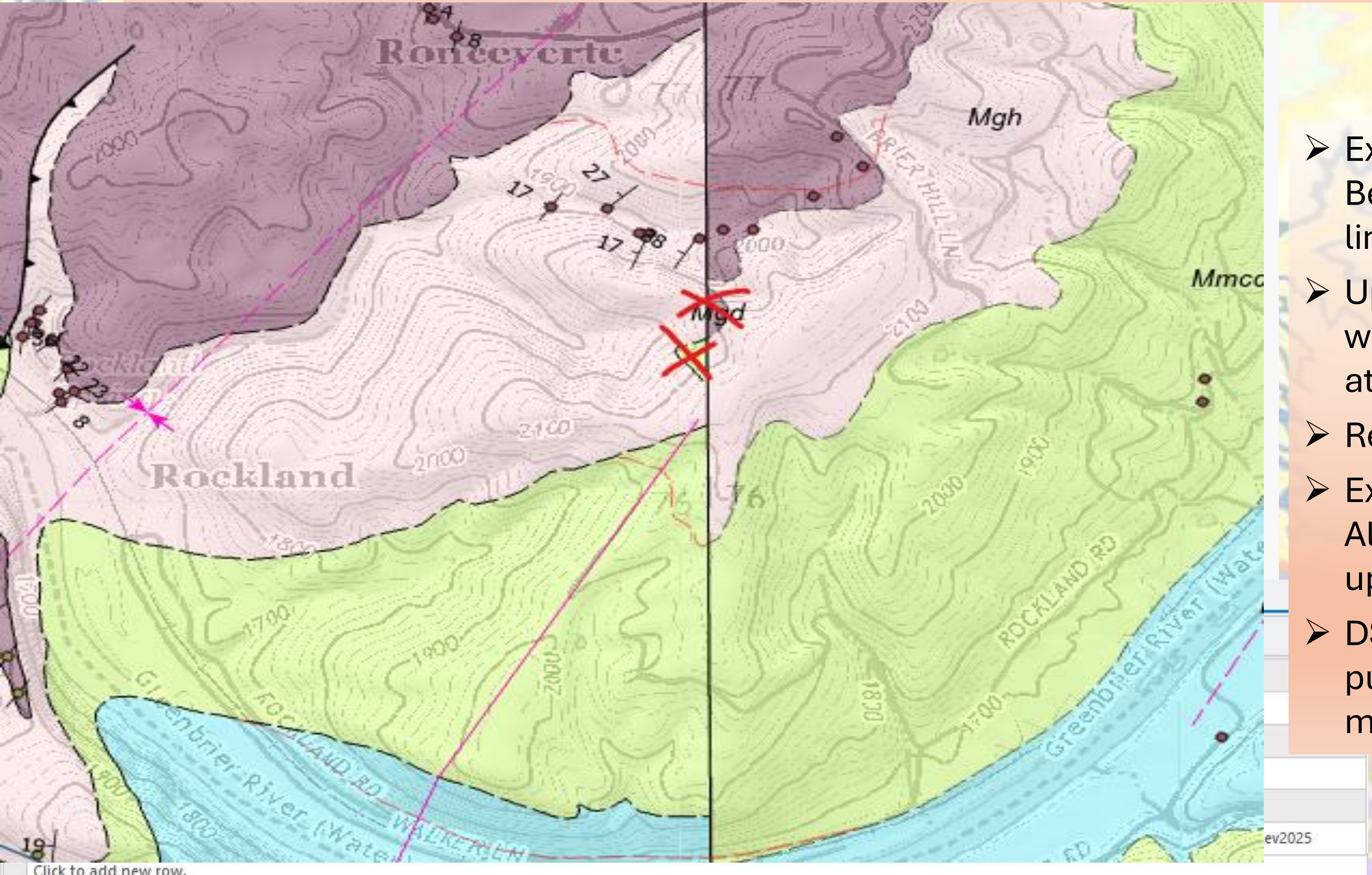
Challenge: Unit Descriptions



B22 | Mahantango Formation

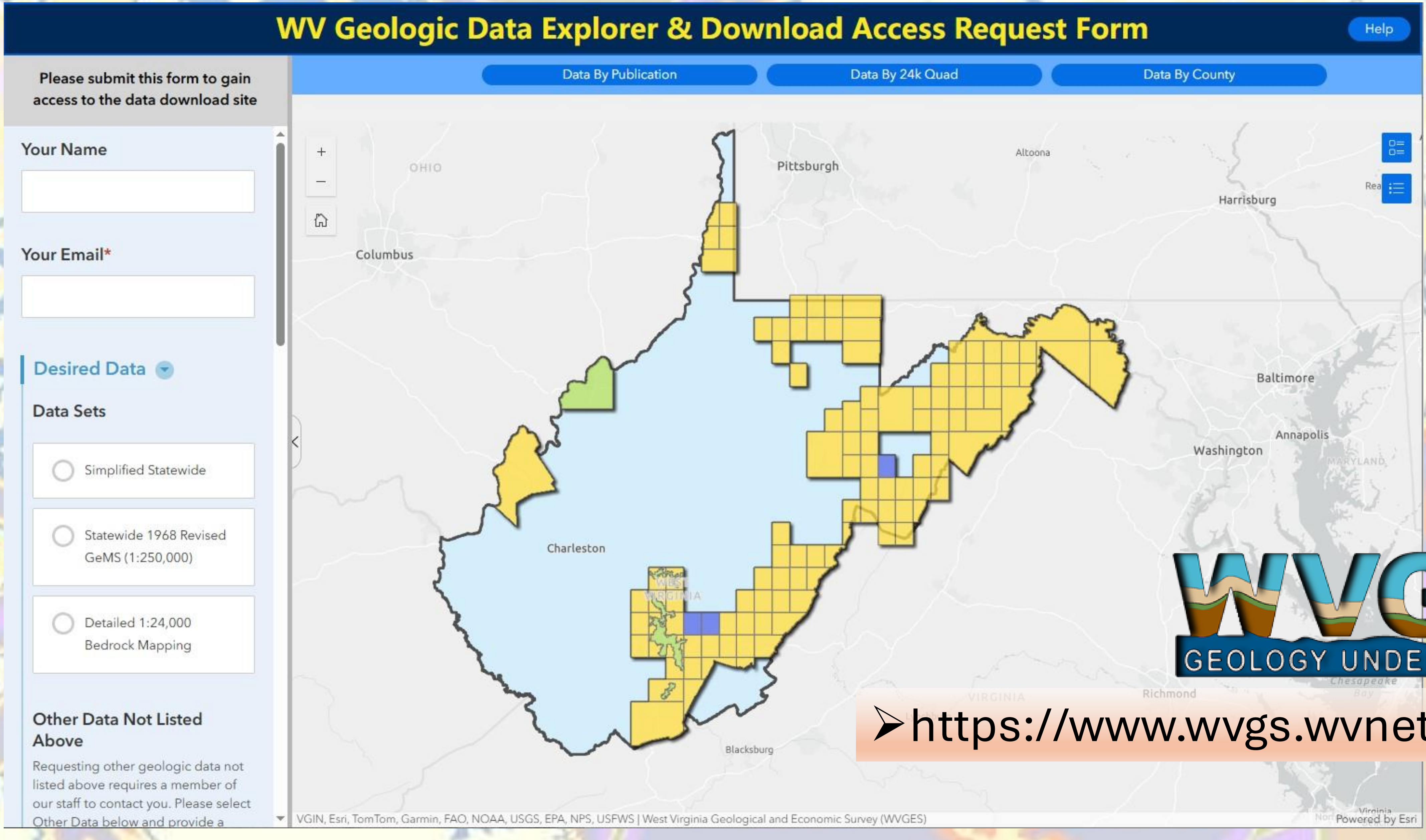
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1			**Proposed for Cumberland 100k Quad**	**Cresaptown-Cumberland 24K**	**Lonaconing**	**Patterson Creek**	**Big Pool**	**Hancock**	**Stotlers Crossroads**	**Cherry Run**	**Artemas**	**Paw Paw**	**Oldtown**	**Bellegrove**	**Great Cacapon**
2				OF-2403	MAP-X10(GM-1	OF-0504	OF-9502	OF-9503	OF-9504	OF-9505	OF-9702	OF-9702	OF-9703	OF-9701	OF-9701
3		**Quaternary**													
22	**Dmt**	Mahantango Formation	700 - 2,400 ft. (213 - 731.5 m) Thickly fissile, dark gray, sandy shale, dark gray siltstone and nonfissile shale; minor fine-grained sandstone; spheroidal weathering common; localized zones highly fossiliferous (brachiopods, crinoids, *tentaculites*), particularly in the upper 40 to 50 ft. (12 - 15 m) that grades into an olive-green shale facies that is locally fossiliferous (typically brachiopods, crinoids, and blastoids), sometimes platy, and bioturbated. Dark tan to brown calcareous concretions are also prevalent. This thick sandstone and siltstone of the Clearville Member at the top forms low ridges and marks the upper contact. At or near the base is a conspicuous shaley-sandstone interval of roughly 15 to 30 feet (4.5-9 meters) thick. Some distinct, thin-bedded, fine-grained sandstones (resembling those of the Brallier) can occasionally be found. The lower contact with the Marcellus - Needmore Shales is conformable.	The Mahantango Formation (Dmt) (700 feet [213 meters] thick) is composed of thickly fissile, dark gray, sandy shale. The upper 40 to 50 feet of the Mahantango grades into an olive-green shale facies that is locally fossiliferous (typically brachiopods, crinoids, and blastoids), sometimes platy, and bioturbated. Dark tan to brown calcareous concretions are also prevalent. At or near the base is a conspicuous shaley-sandstone interval of roughly 15 to 30 feet (4.5-9 meters) thick. Some distinct, thin-bedded, fine-grained sandstones (resembling those of the Brallier) can occasionally be found. While this unit is often described as fossiliferous, only localized fossiliferous zones were located in this map area. The lower contact with the Marcellus-Needmore Shales is conformable.	x	(1600-1800 ft.) Dark gray siltstone and nonfissile shale; minor fine-grained sandstone; spheroidal weathering common. Clearville Member siltstone and sandstone lies at the top of the formation and is a low ridge former. The Clearville pinches out to the south in the Romney quadrangle.	(1,800-2,400 ft.) Dark gray siltstone and nonfissile shale; minor fine-grained sandstone; spheroidal weathering common; parts highly fossiliferous (brachiopods, crinoids, tentaculites), particularly in the thick sandstone and siltstone of the Clearville Member at top that forms low ridges and marks the upper contact.	(1,800-2,400 ft.) Dark gray siltstone and nonfissile shale; minor fine-grained sandstone; spheroidal weathering common; parts highly fossiliferous (brachiopods, crinoids, tentaculites), particularly in the thick sandstone and siltstone of the Clearville Member at top that forms low ridges and marks the upper contact.	(1,800-2,400 ft.) Dark gray siltstone and nonfissile shale; minor fine-grained sandstone; spheroidal weathering common; parts highly fossiliferous (brachiopods, crinoids, tentaculites), particularly in the thick sandstone and siltstone of the Clearville Member at top that forms low ridges and marks the upper contact.	(1,800-2,400 ft.) Dark gray siltstone and nonfissile shale; minor fine-grained sandstone; spheroidal weathering common; parts highly fossiliferous (brachiopods, crinoids, tentaculites), particularly in the thick sandstone and siltstone of the Clearville Member at top that forms low ridges and marks the upper contact.	x	x	(1,200-1,400 ft) Dark gray siltstone and nonfissile shale; minor fine-grained sandstone; spheroidal weathering common; parts highly fossiliferous (brachiopods, crinoids, tentaculites), particularly in the thick sandstone and siltstone of the Clearville Member at top that forms low ridges and marks the upper contact.	(1,800-2,000 ft) Dark gray siltstone and nonfissile shale; minor fine-grained sandstone; spheroidal weathering common; parts highly fossiliferous (brachiopods, crinoids, tentaculites), particularly in the thick sandstone and siltstone of the Clearville Member at top that forms low ridges and marks the upper contact.	(1,800-2,000 ft) Dark gray siltstone and nonfissile shale; minor fine-grained sandstone; spheroidal weathering common; parts highly fossiliferous (brachiopods, crinoids, tentaculites), particularly in the thick sandstone and siltstone of the Clearville Member at top that forms low ridges and marks the upper contact.
23	**Dmn**	Marcellus - Needmore Shales, Undifferentiated	300 - 600 ft. (91.4 - 182.9 m) Black to dark gray, marine, fissile shale of Marcellus; medium to dark gray and greenish gray to brownish black shale of the Needmore; dark gray limestone nodules and beds near base in Needmore; sparsely fossiliferous. The lower contact with the Oriskany Sandstone is conformable.	The Marcellus-Needmore Shales, Undifferentiated (Dmn) (600 feet [183 meters] thick) are composed of light- to medium-gray, fissile shales interbedded with carbonates (Needmore), underlying jet-black, highly fissile shales with some tan to dark brown concretions and interbedded limestones (Marcellus). The lower contact with the Oriskany Sandstone is conformable.	x	(500-600 ft.) Black to dark gray, marine, fissure shale of Marcellus overlies medium to dark gray and greenish gray to brownish black shale of the Needmore; dark gray limestone nodules and beds near base in Needmore.	(300-400 ft.) Black to dark gray, marine, fissile shale of Marcellus; medium to dark gray and greenish gray to brownish black shale of the Needmore; dark gray limestone nodules and beds near base in Needmore; sparsely fossiliferous.	(300-400 ft.) Black to dark gray, marine, fissile shale of Marcellus; medium to dark gray and greenish gray to brownish black shale of the Needmore; dark gray limestone nodules and beds near base in Needmore; sparsely fossiliferous.	(300-400 ft.) Black to dark gray, marine, fissile shale of Marcellus; medium to dark gray and greenish gray to brownish black shale of the Needmore; dark gray limestone nodules and beds near base in Needmore; sparsely fossiliferous.	to dark gray, marine, fissile shale of Marcellus; medium to dark gray and greenish gray to brownish black shale of the Needmore; dark gray limestone nodules and beds near base in Needmore; sparsely fossiliferous.	x	x	to dark gray, marine, fissile shale of Marcellus; medium to dark gray and greenish gray to brownish black shale of the Needmore; dark gray limestone nodules and beds near base in Needmore;	to dark gray, marine, fissile shale of Marcellus; medium to dark gray and greenish gray to brownish black shale of the Needmore; dark gray limestone nodules and beds near base in Needmore;	(300-400 ft) Black to dark gray, marine, fissile shale of Marcellus; medium to dark gray and greenish gray to brownish black shale of the Needmore; dark gray limestone nodules and beds near base in Needmore; sparsely fossiliferous.

Example: Edge-matching for future compilations


Ronceverte
Mgh
Mmcc
Mgd
Rockland
PRIER HILL LN
ROCKLAND RD
Greenbrier River (Water
Greenbrier River (Water
ROCKLAND RD
WALKER LN
ev2025
Click to add new row.

- Ex1: VA border area EM. Before --> updated (Red lines)
- Updated lines tagged with “Rev2025” attributes in DS field
- Rev2025 in the DS table
- Ex2: Ronceverte-Alderson qds, red lines updated (before, after)
- DS table tracks post-publication updates to map

Thank you!! Any questions?



WV Geologic Data Explorer & Download Access Request Form

Please submit this form to gain access to the data download site

Your Name

Your Email*

Desired Data

Data Sets

○ Simplified Statewide

○ Statewide 1968 Revised GeMS (1:250,000)

○ Detailed 1:24,000 Bedrock Mapping

Other Data Not Listed Above

Requesting other geologic data not listed above requires a member of our staff to contact you. Please select Other Data below and provide a

Help
Data By Publication
Data By 24k Quad
Data By County
OHIO
Pittsburgh
Altoona
Harrisburg
Columbus
Baltimore
Annapolis
Washington
MARYLAND
Charleston
WEST VIRGINIA
VIRGINIA
Richmond
Blacksburg
Chesapeake Bay
VGIN, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS | West Virginia Geological and Economic Survey (WVGES)
Powered by Esri

WVGES

GEOLOGY UNDERLIES IT ALL

- ➢https://www.wvgs.wvnet.edu