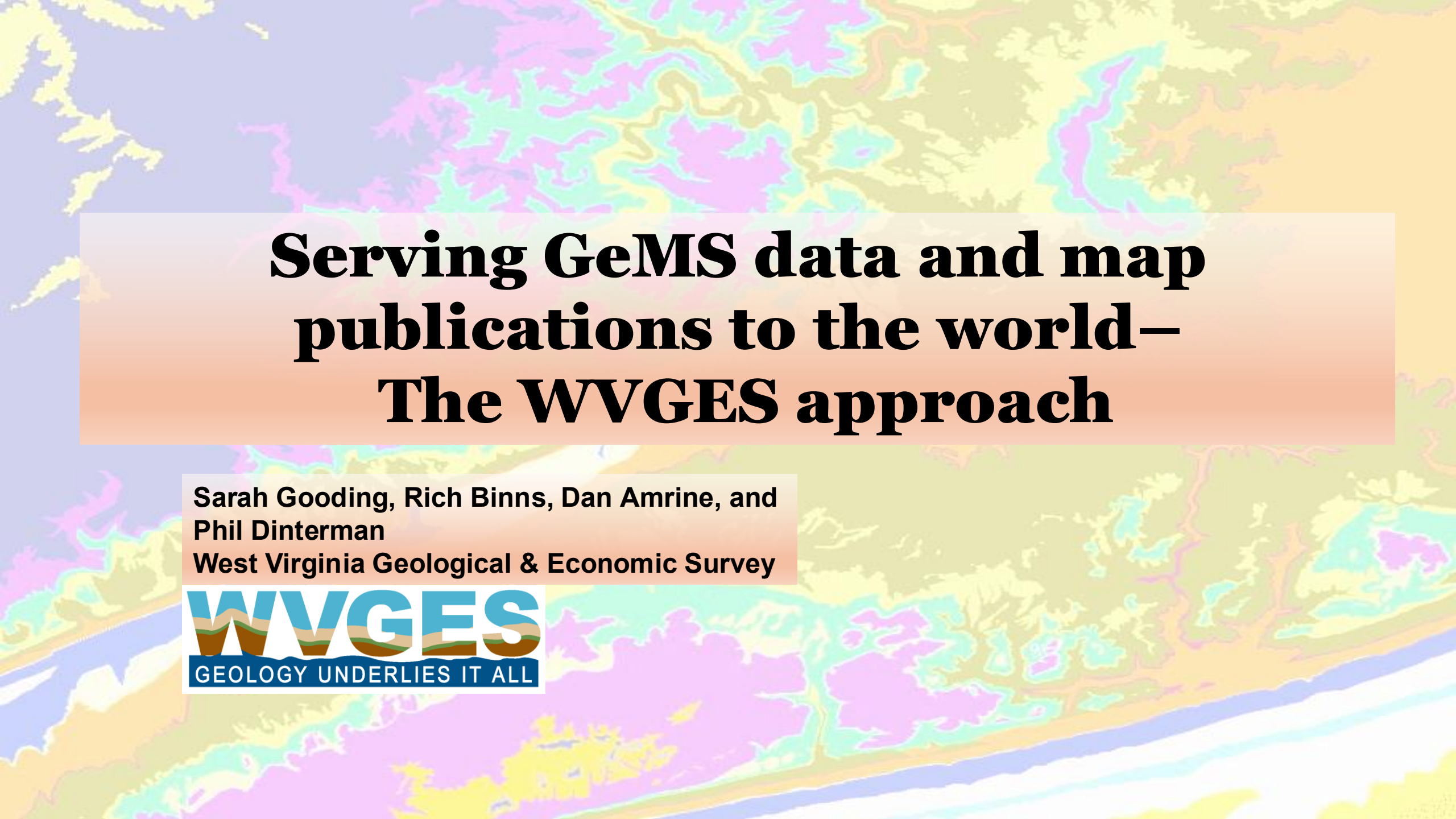


DIGITAL MAPPING TECHNIQUES 2026

The following was presented at DMT '26
May 10 - 13, 2026

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2026)
<http://ngmdb.usgs.gov/info/dmt/>



Serving GeMS data and map publications to the world— The WVGES approach

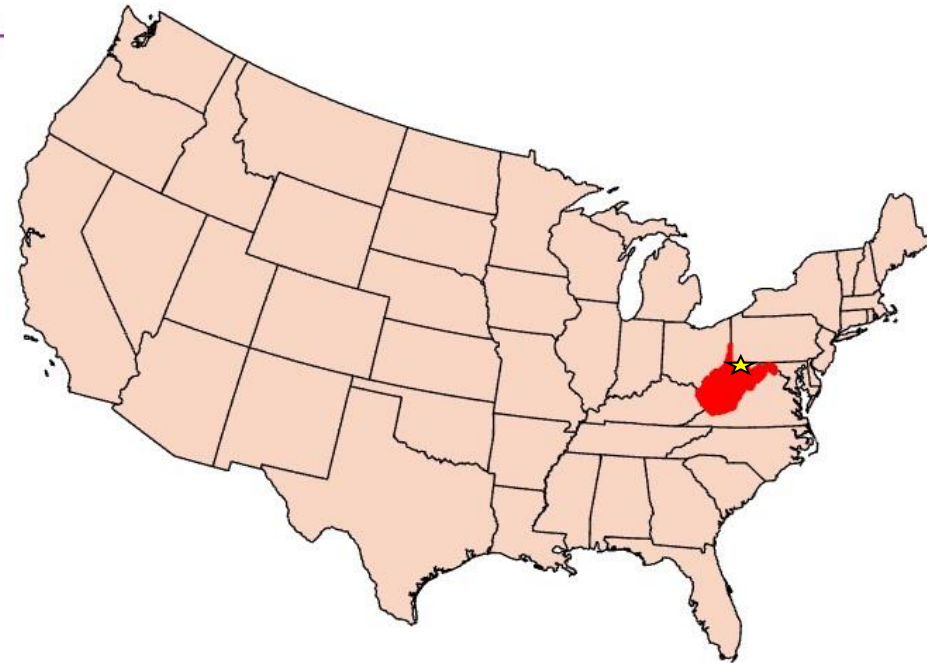
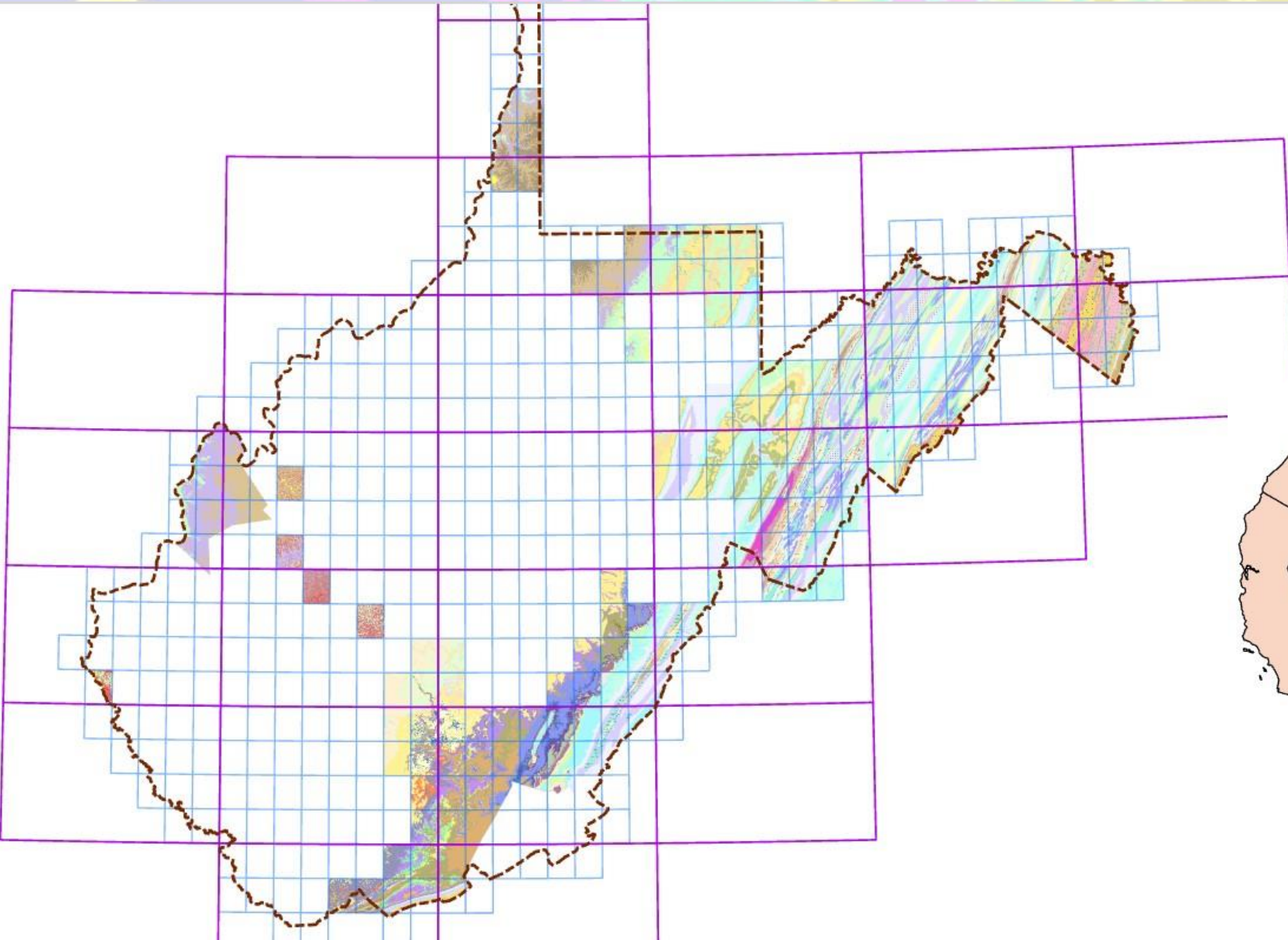
**Sarah Gooding, Rich Binns, Dan Amrine, and
Phil Dinterman
West Virginia Geological & Economic Survey**



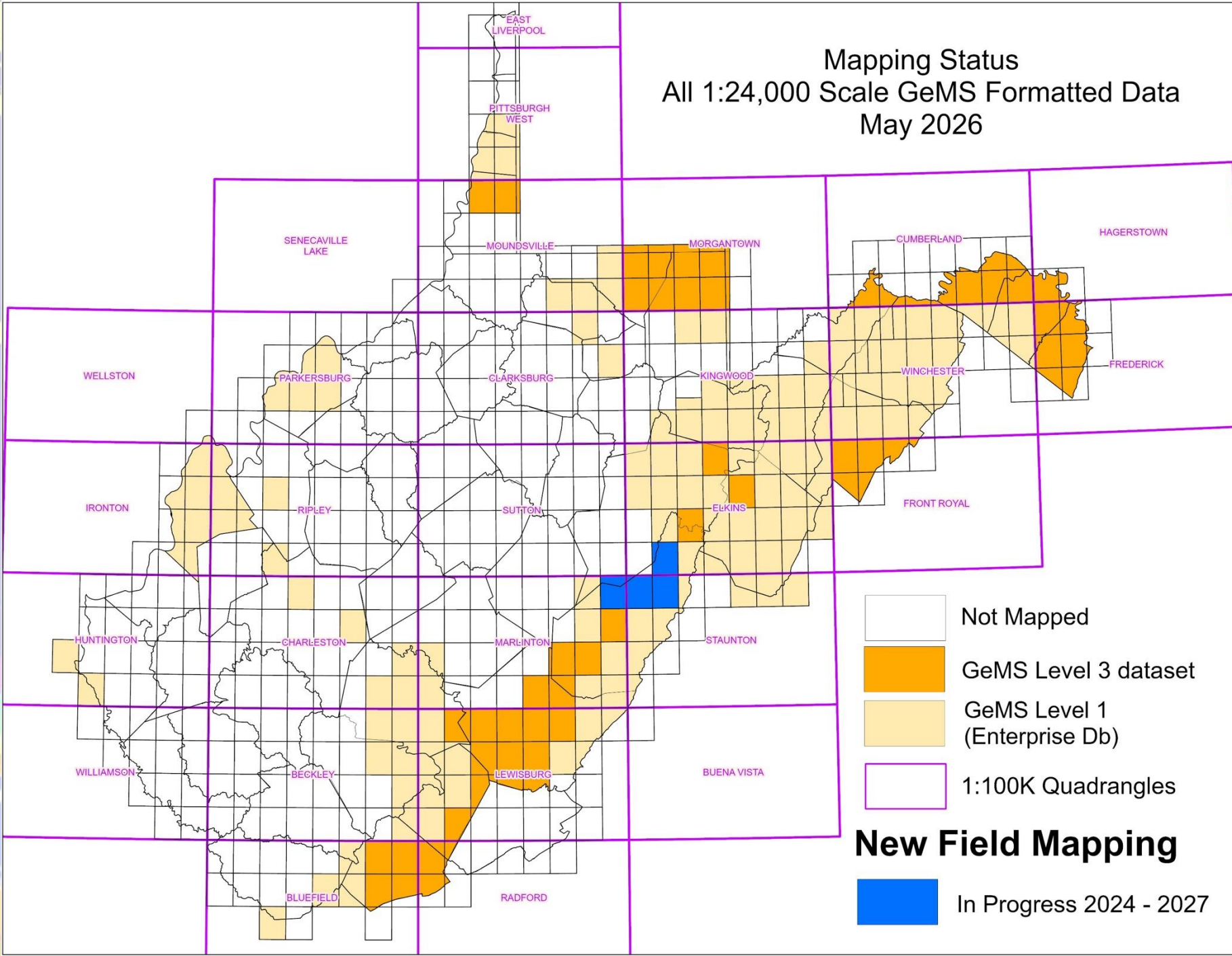
Quick Progress Update:

➤ Enterprise database progress

- ✓ New quads added
- ✓ More layers added
- ✓ Edge-matching progress
- ✓ Data improvements



Mapping Status
All 1:24,000 Scale GeMS Formatted Data
May 2026



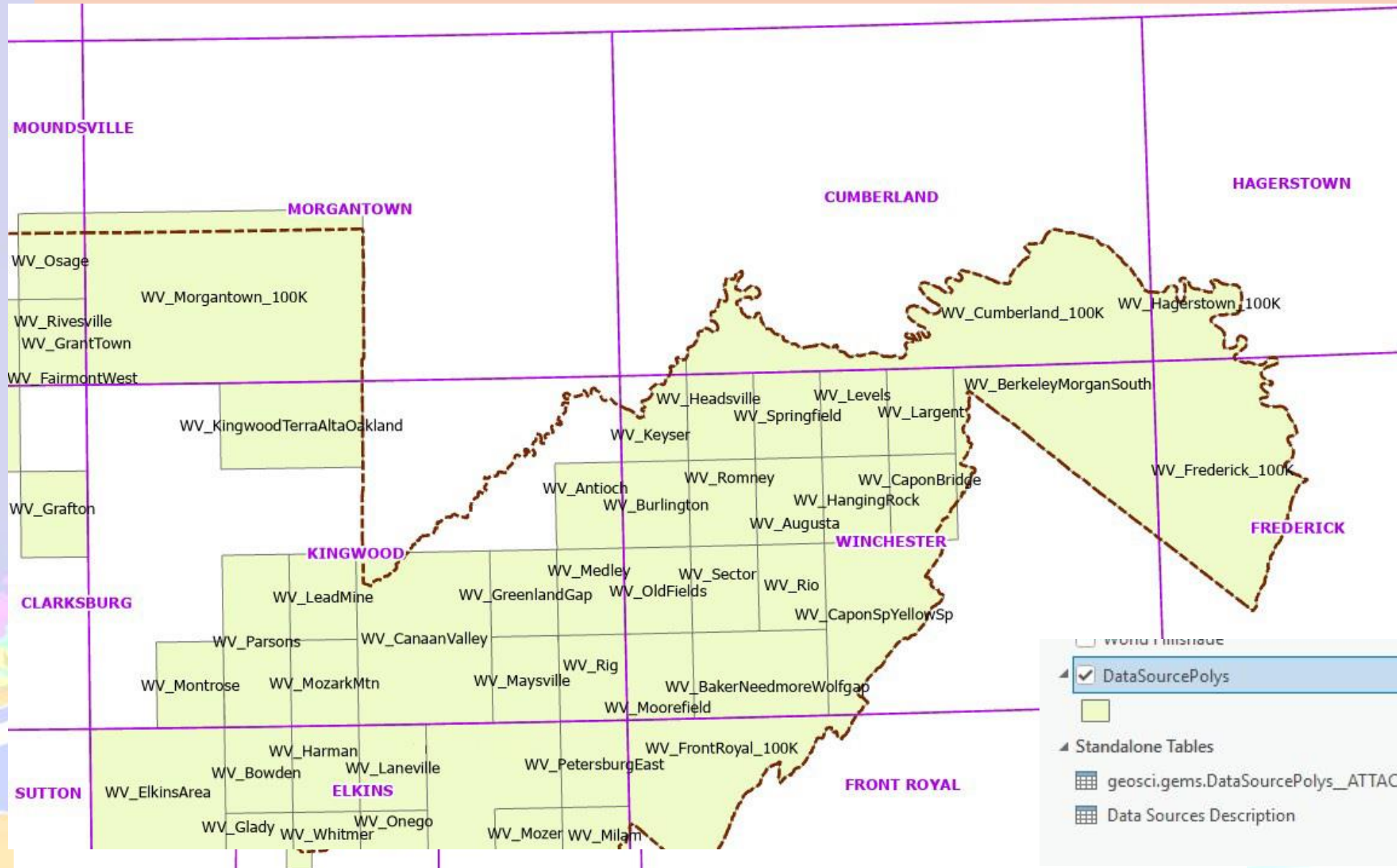
New Field Mapping

In Progress 2024 - 2027

➤ **GeMS formatted data progress**

- Enterprise Geodatabase built of all 24K Bedrock & Surficial mapping
- Conversion to GeMS format (data structure and attributes – Level 1)
- *Decided to organize by 100K quadrangle “blocks” for compilations and distribution
- Data remains 24K, just served in 100K blocks

Next Steps: Serving the data to staff and public

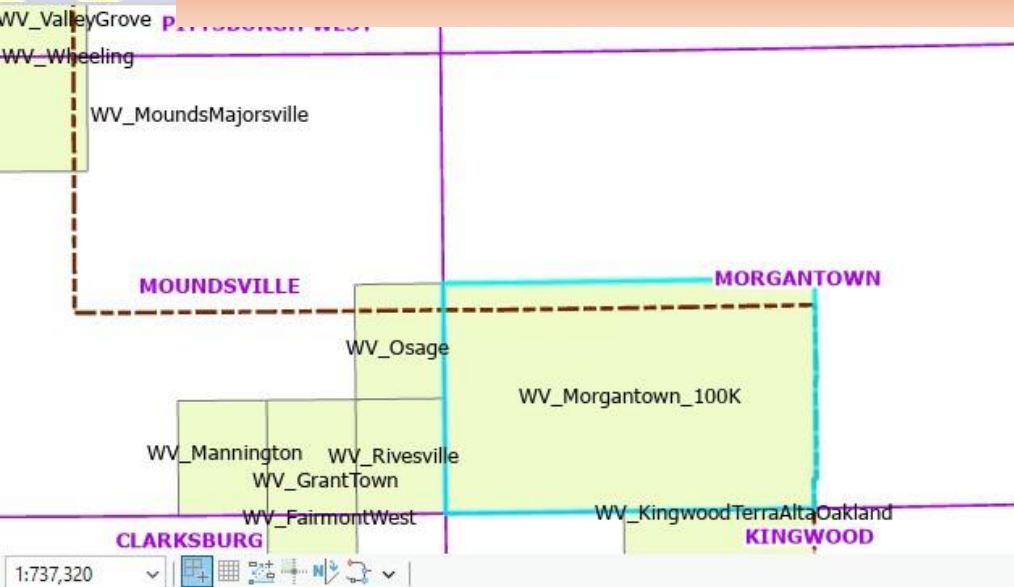


- Data Source Polys proved very useful for many things!
- *Eastern Panhandle closeup view
- *Tables in TOC
- Data Source extensions: Description table (custom) and Attachment table (Arc)

The screenshot shows a table of contents (TOC) with a legend. The legend includes the following items:

- World Fillshade
- DataSourcePolys
- Standalone Tables
- geosci.gems.DataSourcePolys_ATTACH
- Data Sources Description

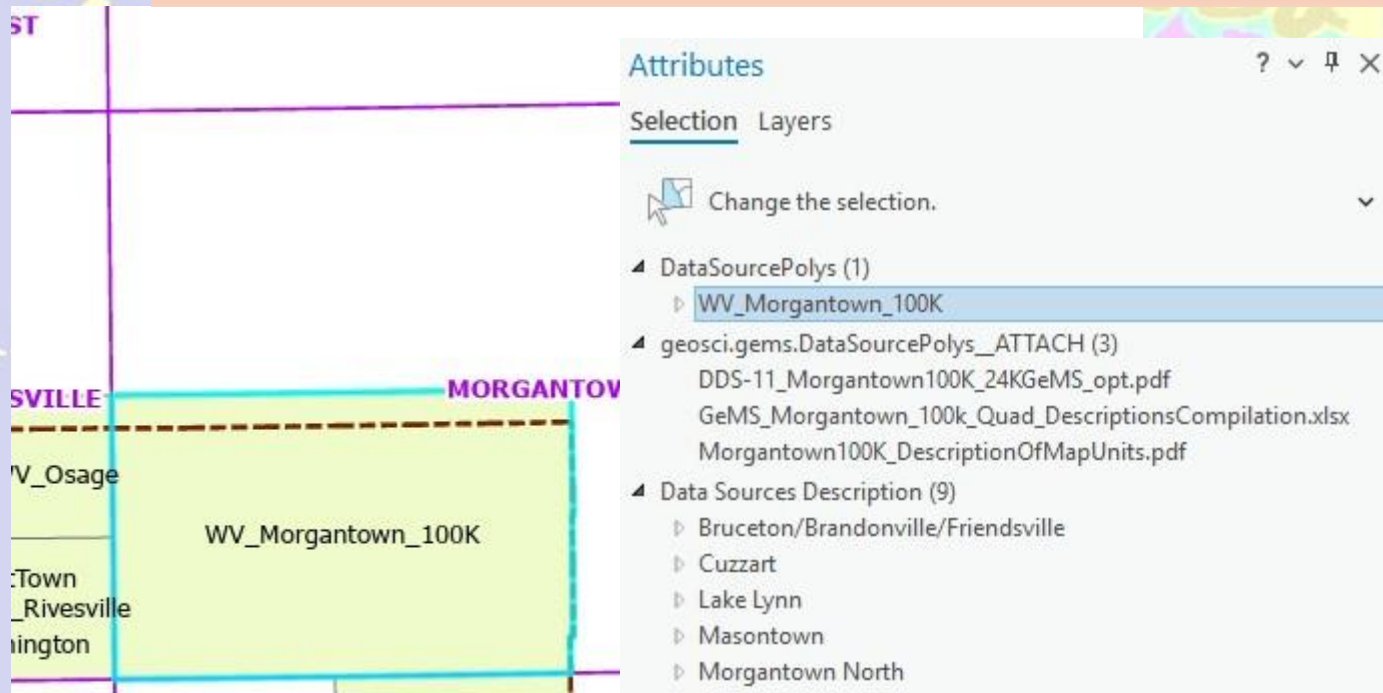
Example: Morgantown 100K Area DS Table extensions



- Morgantown 100K Compilation block selected
 - *Added a “DataSource Description” table with Many-to-One relationship
 - All “old/Superseded” individual DataSourcePolys dissolved into 1 new compilation DataSourcePoly
 - OG individual publication records of the Morgantown 100K compilation all retained and now point to same new DSPOLY : “SDpoly_133”
- ✓ Data sources tracked as areas compiled!

Field:	Add	Calculate	Selection:	Select By Attributes	Zoom To	Switch	Clear	Delete	Copy	Rows:	Insert	Selected Features: 1	Rows: 12
DataSourcePolys	DataSource Description												
..	Data Source ID *	Source Dataset	Area Name	Area Type	Geology Type	Publication ID	download_dataset	datasource_polyid *	Publication Status	...	Infographic		
6	9	WV_BergtonLostCity_etc	MAPWV37_Bergton_LostCity_etc\MAPWV37_Bergt...	Lost City	Quadrangle	Bedrock and Surfic	MAP-WV37	DDS-10_FrontRoyal100K_GeMS_Lvl3.zip	SDpoly_130	Superseded	{7}	<Null>	
7	1	WV_BergtonLostCity_etc	MAPWV37_Bergton_LostCity_etc\MAPWV37_Bergt...	Bergton	Quadrangle	Bedrock and Surfic	MAP-WV37	DDS-10_FrontRoyal100K_GeMS_Lvl3.zip	SDpoly_130	Superseded	{E}	<Null>	
8	4	WV_ValleyPointCuzzartSang...	ValleyPoint_Cuzzart_SangRunWV\ValleyPtCuzSR.gd...	Cuzzart	Quadrangle	Bedrock	OF-1504	DDS-11_Morgantown100K_GeMS_Lvl3...	SDpoly_133	Superseded	{E}	<Null>	
9	1	WV_MorgantownSouth	MorgantownSouth\MorgantownSouth_UTM83	Morgantown South	Quadrangle	Bedrock	OF-0404	DDS-11_Morgantown100K_GeMS_Lvl3...	SDpoly_133	Superseded	{E}	<Null>	
10	6	WV_Morgantown_100K	DDS-11_Morgantown100K_GeMS_Lvl3.zip	Morgantown_100K	Compilation	Bedrock	DDS-11	DDS-11_Morgantown100K_GeMS_Lvl3...	SDpoly_133	Completed	{C}	<Null>	
11	1	WV_ValleyPointCuzzartSang...	ValleyPoint_Cuzzart_SangRunWV\ValleyPtCuzSR.gd...	Sang Run	Quadrangle	Bedrock	OF-1504	DDS-11_Morgantown100K_GeMS_Lvl3...	SDpoly_133	Superseded	{4}	<Null>	
12	1	WV_ValleyPointCuzzartSang...	ValleyPoint_Cuzzart_SangRunWV\ValleyPtCuzSR.gd...	Valley Point	Quadrangle	Bedrock	OF-1504	DDS-11_Morgantown100K_GeMS_Lvl3...	SDpoly_133	Superseded	{7}	<Null>	
13	6	WV_BrucetonBrandonvilleFv	GeMS_BrucetonBrandonvilleFv.gdb	Bruceton/Brandonville/...	Quadrangles	Bedrock	OF-2401	DDS-11_Morgantown100K_GeMS_Lvl3...	SDpoly_133	Superseded	{4}	<Null>	
14	1	WV_MorgantownNorth	MorgantownNorth\MorgantownNorth_UTM83	Morgantown North	Quadrangle	Bedrock	OF-0403	DDS-11_Morgantown100K_GeMS_Lvl3...	SDpoly_133	Superseded	{E}	<Null>	
15	1	WV_Masontown	Masontown\Masontown.gdb\Masontown	Masontown	Quadrangle	Bedrock	OF-1403	DDS-11_Morgantown100K_GeMS_Lvl3...	SDpoly_133	Superseded	{E}	<Null>	
16	8	WV_Lakelynn	Lakelynn\Lakelynn_UTM83	Lake lynn	Quadrangle	Bedrock	OF-0405	DDS-11_Morgantown100K_GeMS_Lvl3...	SDpoly_133	Superseded	{2}	<Null>	
17	6	WV_Frederick_100K	100K_Compilations_DDS\Frederick100K	Frederick_100K	Compilation	Bedrock	DDS-12	DDS-12_Frederick100K_GeMS_Lvl3.zip	SDpoly_054	Completed	{E}	<Null>	
18	1	WV_BerkeleyJefferson	MAPWV_31&35\MAPWV_31&35_UTM83	Berryville	Quadrangle	Bedrock	MAP-WV35	DDS-12_Frederick100K_GeMS_Lvl3.zip	SDpoly_054	Superseded	{7}	<Null>	
19	3	WV_BerkeleyJefferson	MAPWV_31&35\MAPWV_31&35_UTM83	Charles Town	Quadrangle	Bedrock	MAP-WV35	DDS-12_Frederick100K_GeMS_Lvl3.zip	SDpoly_054	Superseded	{E}	<Null>	

Example: Morgantown 100K Area DS Table extensions



- Morgantown 100K Compilation block selected
- Added a “DataSource Attachment” table with Many-to-One relationship
- Attached files for published map, map unit descriptions (in table and word doc formats) for users to view from within database/web interface
- *What it looks like to users in Pro: Attribute pane, or...

DataSourcePolys Data Source

Field: Selection:

	attachmentid *	content_type
1	1	{€ application/p
2	455	{€ application/vr
3	459	{€ application/p
Click to add new row.		

Attributes Geometry Attachments (3)

Attachment
DDS-11_Morgantown100K_24KGeMS_opt.pdf
GeMS_Morgantown_100k_Quad_DescriptionsCompilation.xlsx
Morgantown100K_DescriptionOfMapUnits.pdf

+ Add

polys_ATTACH X

Rows: + -

	data_size
pdf	3953421	B	{E
onsCompilation.xlsx	29380	B	{E
.pdf	140650	B	{E

Example: Morgantown 100K Area DS Table extensions

The screenshot shows a map interface with a highlighted area labeled 'WV_Morgantown_100K'. A pop-up window is open, displaying a tree view of data sources and a table of metadata for a specific data source.

Pop-up

- DataSourcePolys (1)
 - WV_Morgantown_100K
 - geosci.gems.DataSourcePolys_ATTACH - attachment (3)
 - DDS-11_Morgantown100K_24KGeMS_opt.pdf
 - GeMS_Morgantown_100k_Quad_DescriptionsCompilation.xlsx
 - Morgantown100K_DescriptionOfMapUnits.pdf
 - Data Sources Description (9)
 - Cuzzart
 - Lake Lynn
 - Masontown
 - Morgantown North
 - Morgantown South
 - Sang Run
 - Valley Point
 - Bruceton/Brandonville/Friendsville
 - Morgantown_100K

DataSourcePolys - WV_Morgantown_100K

objectid	940
datasourceid	WV_Morgantown_100K
datasourcepolys_id	SDpoly_133
notes	100K_Compilations_DDS\Morgantown100K PubID: DDS-11
created_user	GEMS
created_date	2/3/2026 3:15:13 PM
last_edited_user	GEMS
last_edited_date	4/7/2026 12:07:28 PM
globalid	{682CF996-03FE-4EA2-AFFD-CBDD7F645F9F}
st_area(shape)	1242880067.948498
st_length(shape)	145240.116788
status	Completed

Morgantown100K_DescriptionOfMapUnits.pdf

608,237.19E 4,386,933.90N m

- **Morgantown 100K Compilation block selected**
- **What it looks like to the user: within ArcPro pop-up window, users can click and view the various attachments**
- **Pop-up window will be how external users see and access info on web interface, internal users can view in multiple ways**

Example: User Views: Related files to data block

The screenshot shows a PDF viewer window with the following content:

- Title Bar:** DDS-11_Morgantown100K_24KGeMS_opt.pdf - Adobe Acrobat Pro
- Navigation Bar:** File Edit View Window Help, Create, 1 / 1, 31.4%, Tools Comment Share
- Text Content:**
 - Description of Units in Stratigraphic Order:**
 - Pennsylvanian System:** Includes units like Harlow Coal, Clanton Coal, Greenbrier Formation, and Allegheny Formation.
 - Mississippian System:** Includes units like Mauch Chunk Formation and Upper Freeport Coal.
- Map:** A geological map of the Morgantown area with a scale of 1:100,000. It shows various geological units and structural features.
- Legend:**
 - Map Symbols:** State Boundary, Map Boundary, Formation Contacts, Contact, Approximate, Contact, Inferred, Opened, Coal Bed, Certain, Coal Bed, Approximate, Coal Bed, Inferred, Opened.
 - Structure Contour Lines of the Pittsburgh Coal:** Indic Contour (Feet Above Mean Sea Level), Interpretation Contour (Feet Above Mean Sea Level).
 - Fold Axes:** Anticline, Hanging Anticline, Syncline, Hanging Syncline.

- Morgantown 100K Compilation block example
- Attached files for published map, map unit descriptions (in table and word doc formats) for users to view from within database/web interface
- What it looks like to the user from pop-up window, users can click and view the various attachments within ArcPro (or web)
 - *map (final only - bc reasons)
 - * DMU comp table

Example: User Views: Related files to data block

Unit	Quaternary	Pennsylvanian	Morgantown North	Morgantown South	Lake Lynn	Masontown	Bruceton Mills, Brandonville and Friendsville	Valley Point, Cuzzart and Sang Run
	Not including in this dataset							
Pd	Dunkard Group	Formations. Extends from the top of exposed bed rock section to the top of the Waynesburg Coal or Cassville Shale. Includes the Washington coals and limestones. Palynological evidence favors a Pennsylvanian age.		x	x			
Pm	Monongahela Group	150 - 360 ft. (46 - 110 m) Non-marine cyclic sequences of sandstone, siltstone, red and gray shale, limestone, and coal. The Monongahela Group includes the Uniontown and Pittsburgh Formations. It extends from the top of the Waynesburg coal (WAY) to the base of the Pittsburgh coal (PGH). The group locally includes the Waynesburg, Sewickley, Redstone and Pittsburgh coals.					x	
WAY	Waynesburg Coal of the Monongahela Group	marks the contact between the Dunkard and Monongahela groups and while occasionally surface mined in the area where it crops out, it has more stratigraphic than economic significance in the map area.	x	x	x		x	
PGH	Pittsburgh Coal of the Monongahela Group	5 - 8 ft. (1.5 - 2.4 m) The Pittsburgh coal (PGH) marks the contact between the Monongahela and Conemaugh groups and has been extensively surface and underground mined in the region, it has both stratigraphic and great economic significance in the map area.	Along with standard mapping units we have mapped the economically important (and heavily mined) Pittsburgh and Upper Freeport coal beds.	Along with standard mapping units we have mapped the economically important (and heavily mined)	Along with standard mapping units we have mapped the economically important (and (580-600 feet) Cyclic sequences of red and gray shale, siltstone, and sandstone, with thin limestones and coals. Mostly nonmarine. Extends from the base of the	(580-600 feet) Cyclic sequences of red and gray shale, siltstone, and sandstone, with thin limestones and coals. Mostly nonmarine. The		
Pc	Conemaugh Group	(580-600 feet) Cyclic sequences of red and gray shale, siltstone, and sandstone, with thin limestones and coals. Mostly nonmarine. The Conemaugh Group extends from the base of the Pittsburgh coal to the top of the Upper Freeport coal. The exposed portion of this formation is mainly composed of cyclic sequences of mostly non-marine sandstones, shales, red mudstones, thin marine and nonmarine limestones, and coal beds. The Brush Creek and Ames Limestone members are important marine	(580-600 feet) Cyclic sequences of red and gray shale, siltstone, and sandstone, with thin limestones and coals. Mostly nonmarine. Extends from the base of the	(580-600 feet) Cyclic sequences of red and gray shale, siltstone, and sandstone, with thin limestones and coals. Mostly nonmarine. The	(~400 feet, partial) The exposed portion of this formation is mainly comprised of sandstones, shales, red mudstones, thin marine and nonmarine limestones, and coal	(115 feet, partial) Only the bottom portion of the Conemaugh Group is present. The basal Mahoning Sandstone is a thick- to massive bedded sandstone, medium-grained unit with quartz, feldspar, mica, and lithic fragments. It can be cross-bedded, well-sorted, and a grey to tan channel unit. Above the Mahoning Sandstone are numerous	(590 feet) The exposed portion of this formation is mainly comprised of sandstones, shales, red mudstones, thin marine and nonmarine limestones, and coal beds. The Brush Creek and Ames Limestone members are	

- **Morgantown 100K Compilation block example**
- **Attached files for published map, map unit descriptions (in table and word doc formats) for users to view from within database/web interface**
- **What it looks like to the user: from pop-up window, users can click and view the various attachments within ArcPro (or web)**
 - ***map (final only - bc reasons)**
 - *** DMU comp table**

Example: User Views: Internal vs Public interfaces

Geologic Mapping Extents - Data Source Ext...

Properties

Information

Symbology

Show in map legend

Geologic Mapping Extents - Data Source Extents

status

- Completed
- In Progress
- Not for Distribution
- Superseded
- others

Edit layer style

Appearance

Blending

Normal

Transparency

0% 25% 50% 75%

Visibility

“Not For Distribution”

- Superseded datasets
- In-progress mapping
- Donated, unreviewed mapping
- Non-WV authored mapping (USGS, other states, EDMAP data)

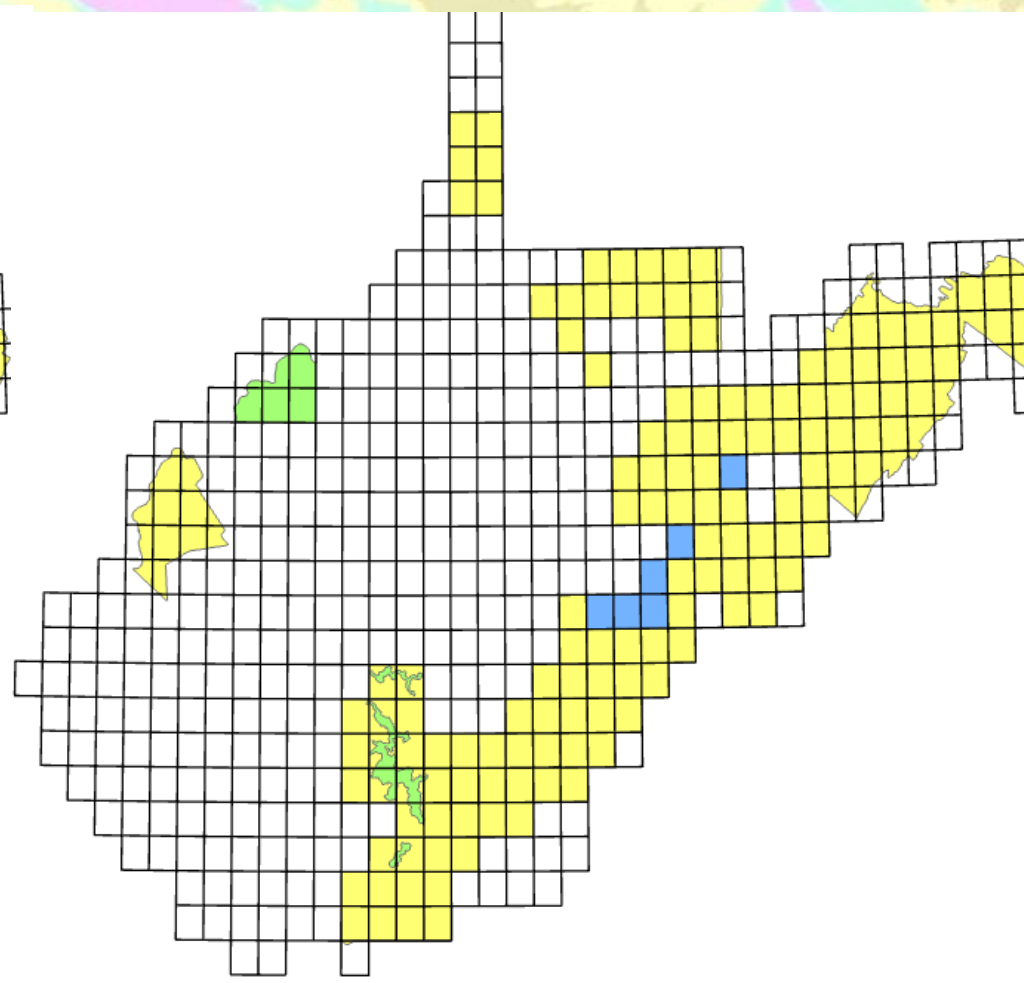
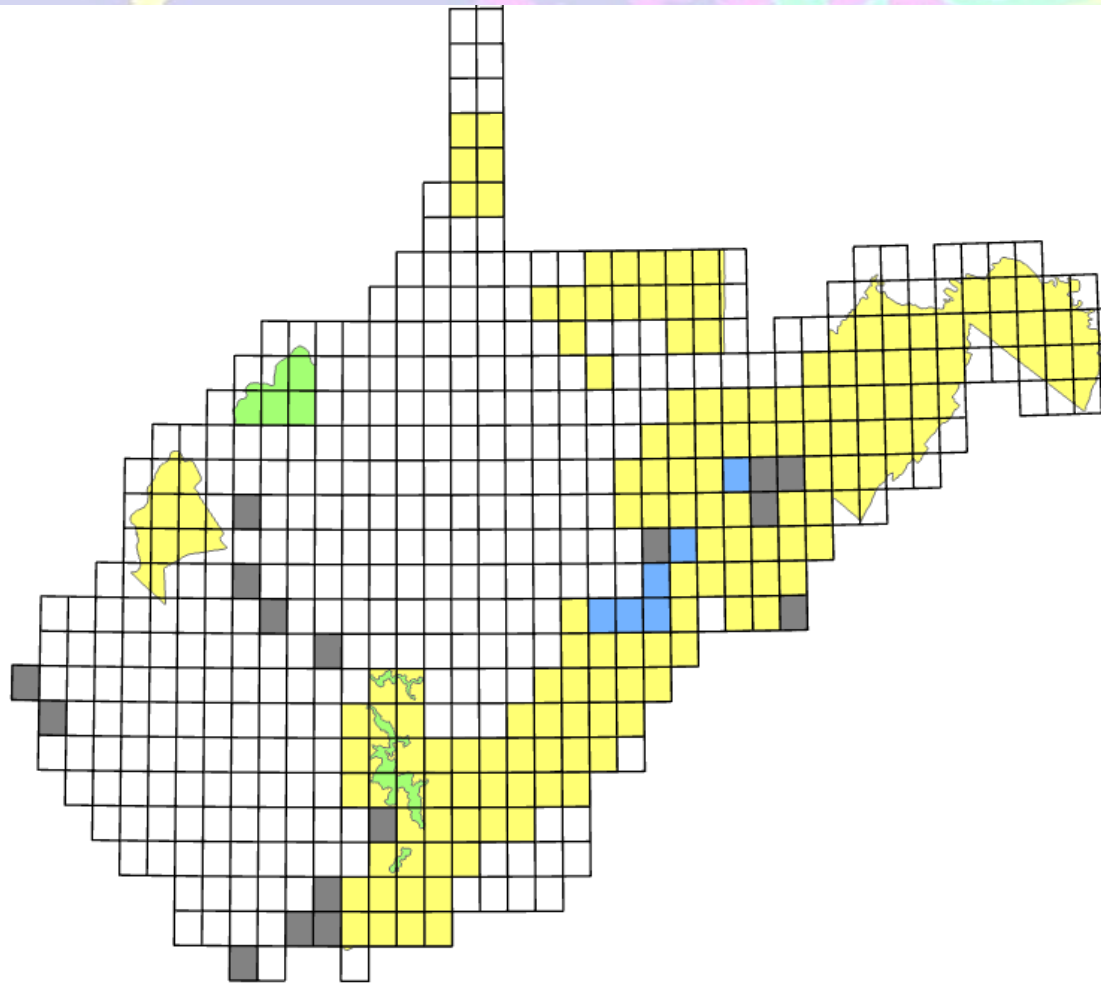
This is an attribute field we added to the DataSourcePoly layer

VGIN | Esri | TomTom | Garmin | USGS | FAO | NOAA | EPA | NPS | USFWS
Powered by Esri

Example: User Views: Internal vs Public interfaces

Internal (Staff) see:

Public (Website) sees:



➤ “Not For Distribution”

- Superseded datasets
- In-progress mapping
- Donated, unreviewed mapping
- Non-WV authored mapping (USGS, other states, EDMAP data)

➤ * Filtered view with Definition Query

Example: User Views: Internal vs Public interfaces

Internal (Staff) see:

Public (Website) sees:

Layer Properties: Published Geologic Mapping Datasets

Search

General
Metadata
Source
Elevation
Selection
Display
Cache
Definition Query
Time
Range
Indexes
Joins
Relates
Page Query

Definition Queries

+ New definition query

Query 1
((publication_status = 'Completed' Or publication_status = 'In Progress') and (publication_status = 'Completed' Or publication_st... Edit

Query 1:PreviousFilterForJoin_DataSo
publication_status = 'Completed' Or publication_status = 'In Progress' Edit

Query 1:PreviousFilterForJoin_DataSo
(publication_status = 'Completed' Or publication_status = 'In Progress') and (publication_status = 'Completed' Or publication_st... Edit

3 Queries

Active definition query: Query 1

OK Cancel Apply

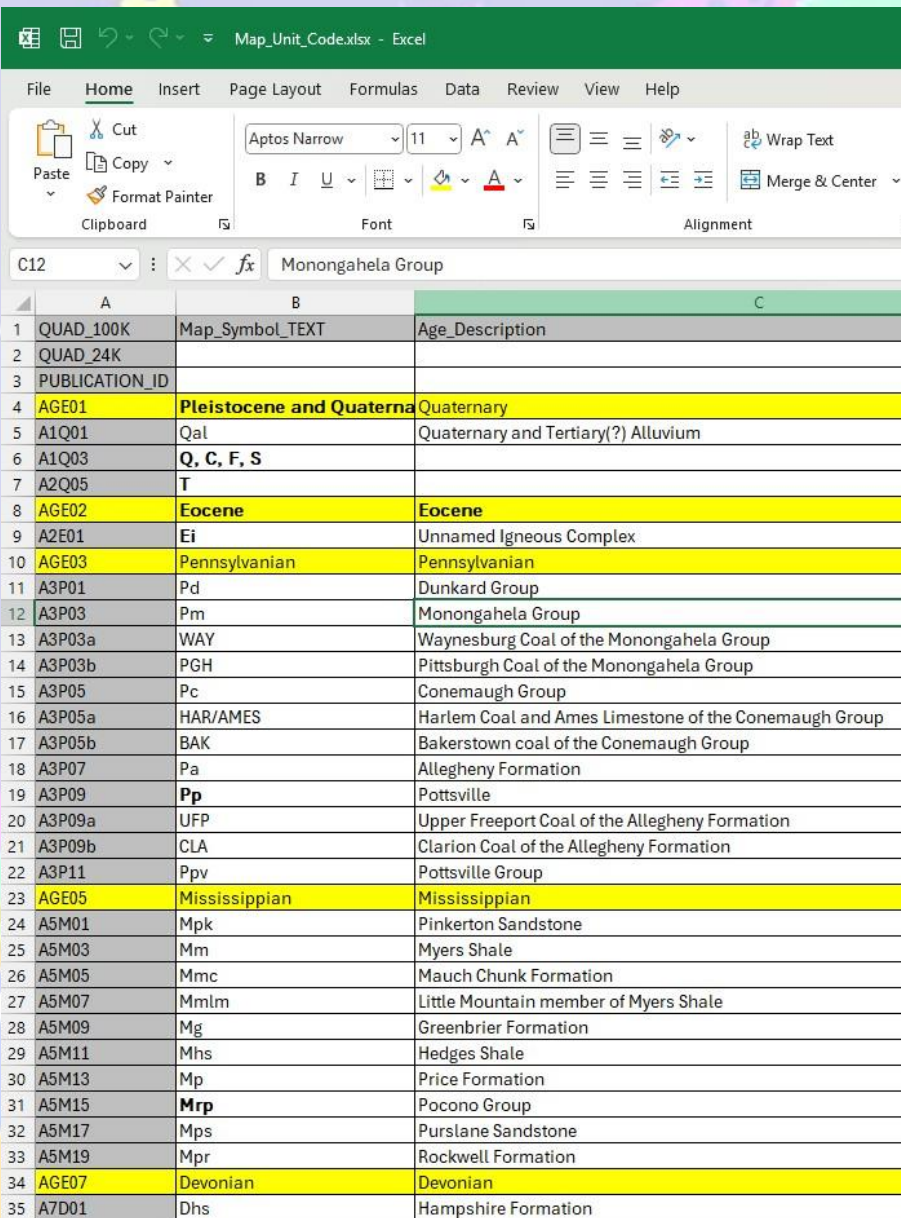
➤ “Not For Distribution”

- Superseded datasets
- In-progress mapping
- Donated, unreviewed mapping
- Non-WV authored mapping (USGS, other states, EDMAP data)

➤ * Filtered view with Definition Query

Future Work

- Enterprise-level Master DMU Table * *
- *Streamlined Downloadables in 100K blocks + GeMS!
(and other improvements!)

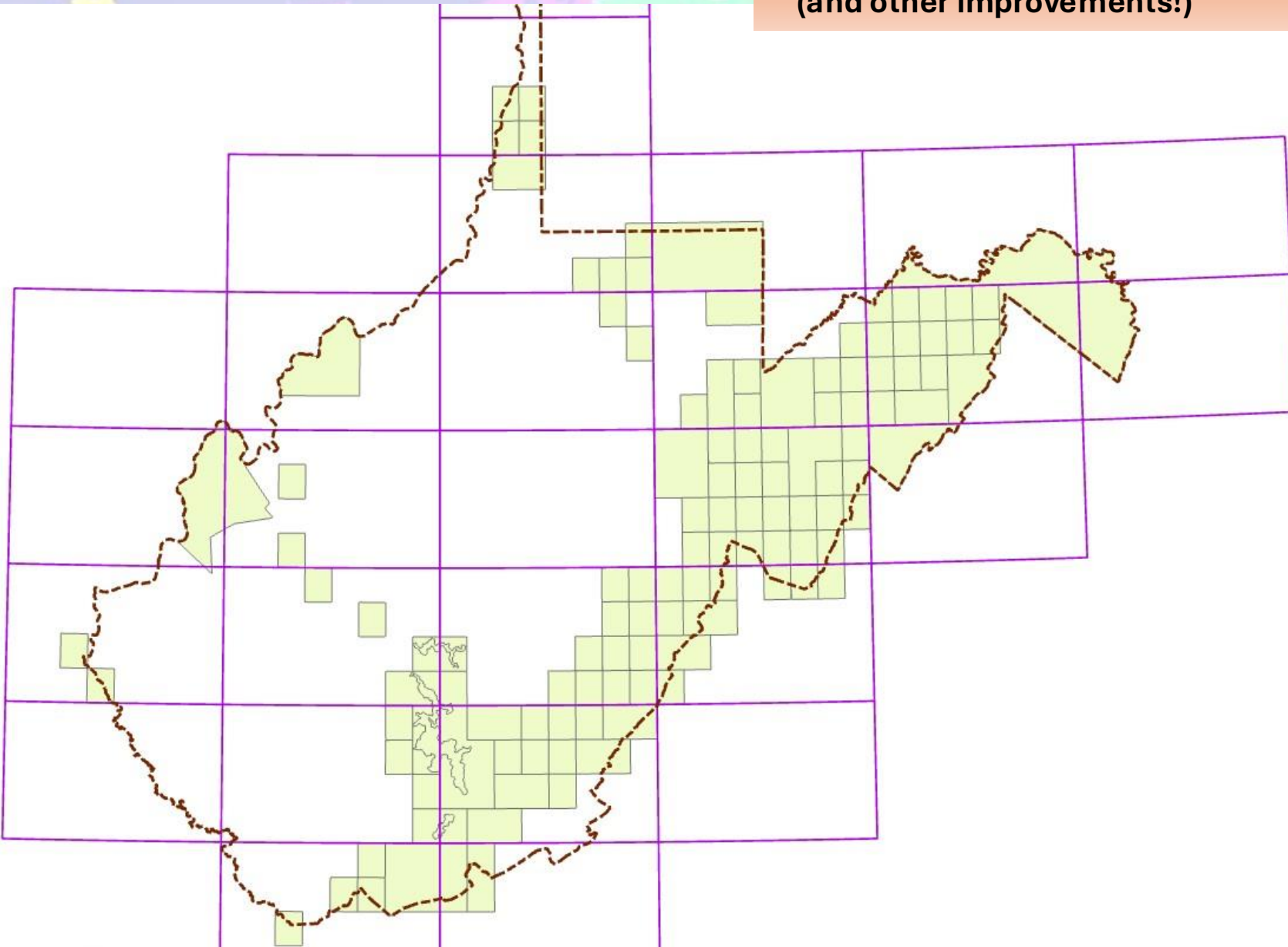


	A	B	C
1	QUAD_100K	Map_Symbol_TEXT	Age_Description
2	QUAD_24K		
3	PUBLICATION_ID		
4	AGE01	Pleistocene and Quaternary	Quaternary
5	A1Q01	Qal	Quaternary and Tertiary(?) Alluvium
6	A1Q03	Q, C, F, S	
7	A2Q05	T	
8	AGE02	Eocene	Eocene
9	A2E01	Ei	Unnamed Igneous Complex
10	AGE03	Pennsylvanian	Pennsylvanian
11	A3P01	Pd	Dunkard Group
12	A3P03	Pm	Monongahela Group
13	A3P03a	WAY	Waynesburg Coal of the Monongahela Group
14	A3P03b	PGH	Pittsburgh Coal of the Monongahela Group
15	A3P05	Pc	Conemaugh Group
16	A3P05a	HAR/AMES	Harlem Coal and Ames Limestone of the Conemaugh Group
17	A3P05b	BAK	Bakerstown coal of the Conemaugh Group
18	A3P07	Pa	Allegheny Formation
19	A3P09	Pp	Pottsville
20	A3P09a	UFP	Upper Freeport Coal of the Allegheny Formation
21	A3P09b	CLA	Clarion Coal of the Allegheny Formation
22	A3P11	Ppv	Pottsville Group
23	AGE05	Mississippian	Mississippian
24	A5M01	Mpk	Pinkerton Sandstone
25	A5M03	Mm	Myers Shale
26	A5M05	Mmc	Mauch Chunk Formation
27	A5M07	Mmlm	Little Mountain member of Myers Shale
28	A5M09	Mg	Greenbrier Formation
29	A5M11	Mhs	Hedges Shale
30	A5M13	Mp	Price Formation
31	A5M15	Mrp	Pocono Group
32	A5M17	Mps	Purslane Sandstone
33	A5M19	Mpr	Rockwell Formation
34	AGE07	Devonian	Devonian
35	A7D01	Dhs	Hampshire Formation



Future Work

- Enterprise-level Master DMU Table * *
- *Streamlined Downloadables in 100K blocks + GeMS!
(and other improvements!)



A7D21	A7D23	A7D25	A7D27
Dmtc	Dmt	Dmn	Dr
Clearville Member of the Mahantango Formation	(Hamilton Formation) Mahantango Formation	Marcellus - Needmore Shales, Undifferentiated	Ma
x	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.	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 Driskany Sandstone is conformable.	x
x	x	x	(52 pyri thir cal yell Inte abc lent sha cor fou oth soe noc inte Ma nee 2-3 Me we: gra

Thank you!! Any questions?

WV Geologic Data Explorer & Download Access Request Form

Help

Data By Publication | Data By 24k Quad | Data By County

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

Map showing geologic data distribution in West Virginia. The map includes labels for cities like Columbus, Pittsburgh, Altoona, Harrisburg, Charleston, Blacksburg, Richmond, Washington, Annapolis, Baltimore, and Harrisburg. It also shows state boundaries for OHIO, MARYLAND, and VIRGINIA. A legend in the bottom right corner reads 'WVGES GEOLOGY UNDERLIES IT ALL'. The map is overlaid with a grid of yellow and blue squares, indicating data availability by 24k quad.

VGIN, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS | West Virginia Geological and Economic Survey (WVGES) | Virginia North Powered by Esri

➤ <https://www.wvgs.wvnet.edu>