



West Virginia
Geological &
Economic
Survey

**ANNUAL
REPORT
2025**

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Cover Photo

Hannah Sphar, WVGES geologist, viewing large ripple marks in the Oriskany Sandstone while conducting geologic field mapping for the Cresaptown quadrangle. Photograph taken by Wayne Perkins.



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EXECUTIVE SUMMARY

Jessica Moore, Director and State Geologist

Welcome to the West Virginia Geological and Economic Survey's report of activities conducted during Fiscal Year 2025. This was a year of significant achievements for GES, including the purchase of the agency's first new dedicated storage facility in over 60 years. Acquisition of a new warehouse is a tremendous milestone for the agency, as our current storage facility is not climate controlled, has no work space for analyses, and is filled to absolute maximum capacity. The new space, located just 3 miles from GES headquarters, provides ample room to archive, analyze, and grow West Virginia's geological sample collection. This purchase was made possible through a Congressionally Delegated Spending award sponsored by the office of Senator Shelley Moore Capito. I can't express my gratitude enough to Senator Capito for her support of our initiative, but in my capacity as President of the Association of American State Geologists, I was able to present her with the 2025 AASG Pick and Gavel Award at a February ceremony held in Washington, D.C. The AASG Pick and Gavel award is presented each year to a government official or policy maker who recognizes the intersection of the geoscience enterprise (symbolized by the miners' pick) and Federal legislation (symbolized by the gavel). I can't think of any more deserving recipient than Senator Capito, given her strong support of natural resource development and long history of sensible policy accomplishments as Chair of the Senate Committee on Environment and Public Works. For the award itself, AASG presented Senator Capito with a handmade convertible brooch and necklace crafted by GES staff member, Susan Pool, from a specimen of the state gemstone, the fossil coral *Lithostrotionella*. Our deepest appreciation goes out to the Senator for her support of GES activities.



Jessica Moore, WVGES Director and State Geologist (right), presents the AASG Pick and Gavel Award to U.S. Senator Shelley Moore Capito (left).

I had many other exciting opportunities this year in my capacity as AASG President, but one that stands out was an interview with *The New York Times* reporter Rebecca Dzombak, who reached out to me and several of my colleagues when Federal STATEMAP funding for bedrock and critical minerals mapping was paused for an extended period of time, leading to concerns that state surveys would lose technical capabilities and staff and be unable to fulfill the Trump administration’s goals of energy dominance in critical minerals. The article, entitled, “There Might Not Be a Map for That: Budget Cuts Threaten Geological Surveys,” elevated state survey mapping to a level of visibility we’ve never experience before, hopefully raising public awareness of the importance of geologic mapping to U.S. infrastructure and manufacturing goals.

And finally, along with President Trump’s inauguration in January, West Virginia inaugurated Patrick Morrisey as the state’s 37th governor. Governor Morrisey spared no time getting to work and appointed Dr. Matt Herridge as his Secretary of Commerce. Under the leadership of Governor Morrisey and Secretary Herridge, GES is poised to achieve tremendous success and I look forward to executing their exciting vision for West Virginia’s energy future.



LEFT: AASG president, John Metesh (left), presents the gavel to president-elect, Jessica Moore (right)
UPPER RIGHT: Jessica Moore (center) at the Global CCS Institute DC Forum
LOWER RIGHT: AASG president, Jessica Moore signs the BOEM memorandum of understanding

Coal Program

Coalbed Mapping Project

The Coal Bed Mapping Program (CBMP) is a Geographic Information System (GIS) database that collects and publishes public data from current and historic coal mining throughout West Virginia. The collection of current mining data was aided by an agreement between the West Virginia Office of Miners' Health Safety and Training (WVOMHS&T) and the WVGES, which allows seamless sharing of digital mine map files between the agencies. Data from current active mined areas are considered confidential except for the mine map outlines. Therefore, no additional data is permitted to be extracted; however, this agreement gives the WVGES the ability to provide updates twice a year of current mining while providing WVOMHS&T a tertiary backup system of active mine maps.

The CBMP creates a model that provides detailed information in a GIS database for 86 mined coal seams and splits. Data is collected from WVOMHS&T, the West Virginia Department of Environmental Protection (WVDEP), West Virginia Department of Tax and Revenue Property Tax Division, and the Office of Surface Mining Reclamation and Enforcement (OSM-RE) in Pittsburgh, PA, as well as mine maps acquired from industry partners, private donations, and field work conducted by WVGES employees.

CBMP data is stored in an Oracle database that spatially records coal elevations and thicknesses, comprising 196,833 discrete data locations of which 19% (38,623 in total) are detailed drill holes. This database has over 3 million lines of stratigraphy and reflects data collected throughout the West Virginia coal fields for over a century. WVGES added 821 new drillers' logs, 24 new geologist logs, 97 measured sections, and 504 underground mine data points in FY25.

Category	New Points FY25	Total Points
Drillers Logs	821	37,192
Geologist Logs	24	1,431
Surface Sections	97	19,052
Underground Mine Points	504	138,798
Other		360
	Total Points	196,833

The West Virginia State Tax Department utilizes CBMP databases to accurately and equitably value mineral properties for tax assessment. Shape files of mine map location, mining type, coal thickness, coal elevation and coal partings, mined and remaining areas and overburden are created from CBMP for easy online public access. Data sets are free and made available to the public by the WVGES here:

<https://www.wvgs.wvnet.edu/www/coal/cbmp/coalims.html>

These data can be downloaded from the WVGES Coal Bed Mapping Program by submitting a Data Request Form found on the front page of our website.

Underground Mine Mapping Project

The Underground Mine Mapping Project strives to provide the best product possible using data collected from various sources including governmental, industrial, and private collections. All of our mine map data is preserved in digital format, but we attempt to archive original paper maps when possible. Aperture cards, which are microfilm images of mine maps, were provided by OSM-RE, who have been our partners for many years. Many of the early mine maps were scanned in less-than-optimal quality for current needs. The WVGES has partnered with OSM-RE to rescan paper maps and occasionally upgrade vintage scanned images using new technology available through a recently purchased aperture card microfilm scanner.

Several large donations of mine maps have occurred over the last couple of years, and these maps are processed and, when appropriate, replace existing maps. Several areas in West Virginia are known to be mined, but no mine maps existed in the WVGES database. During the processing of these new maps, many of which turned out to be duplicates and were discarded, several new maps of old mined areas were discovered and added to the GIS system. A few newly discovered mines were in areas with mining over 100 years old that had never been recorded.



CBMP updated all active mining polygons in the state twice during the 2025 fiscal year and will continue to do so for the foreseeable future thanks to an agreement forged between the WVGES and WVOMHS&T where the Survey acts as a tertiary backup site for active mine maps files and in turn receive timely updated materials. This agreement removes former obstacles that slowed and sometimes stopped the flow of data between agencies. A huge thank you goes to WVOMHS&T Director, Frank Foster and his crew for helping to make this happen.

Additional changes were made to Underground Mine Mapping Project thanks to our new equipment to rescan old microfilm aperture cards. In specific areas of study survey geologists were able to greatly improve the accuracy and completeness of historically mined areas. This has been particularly useful in the Preston County Upper Freeport coal mined areas that are being modelled by the WVGES and the West Virginia University Water Research Institute to alleviate acid mine drainage areas coming from historical mined areas. Not only is it important to know where historically mined areas are present, but it's incredibly beneficial to know how the individual mines interconnect hydrologically.

Mine Information Database System (MIDS)

The WVGES Mine Information Database System (MIDS) houses publicly available information collected primarily from underground mine maps and to a lesser extent surface mine maps and property maps. Available data includes mine name, company name, coal seam, mine location, map year, and various pertinent notes collected from the maps. The program gives the user the ability to search for available mine maps by county, quad, name, or bounding rectangle in UTM coordinates.

MIDS contains 50,107 documents representing 92,216 mines. Many maps are variations of the same mine showing slightly different mined areas, dates, data, etc. As new maps come into WVGES possession, they are processed, entered into the system, any new or improved mining is added to CBMP and any data points with elevation and/or thickness data are added to the database model where data is scarce or lacking. As a rule, the data is collected in approximately ¼ mile spacing.

As always, the WVGES encourages mine map submissions and remarks from the public to improve our database. If you have a mine map that you would like to donate, know of an archive that could be accessed or if you see an error in our database, please do not hesitate to contact us at info.wvgs.wvnet.edu or call 304-594-2331.

All maps listed in our database are available at <https://www.wvgs.wvnet.edu/www/mids/main.php>

The screenshot shows the 'West Virginia Mine Information Database System Search Page'. At the top, there is a navigation bar with 'login | search | advanced search' and a 'Document Number' field. The main heading is 'West Virginia Mine Information Database System Search Page'. On the left, there are several search filters: 'County' (dropdown menu with options: Any, Unknown, Barbour, Berkeley, Boone), 'Quadrange' (dropdown menu with options: Unknown), 'Bed: WVGES Specific' (dropdown menu with options: Any (Needs Addressed), 2 GAS, 2 GAS LS1, 2 GAS LS2), 'Company or Mine Name' (text input), 'Permit Number (Federal or State)' (text input), 'Map Year (Range):' (text input with 'to' separator), 'Corner Notes' (dropdown menu), and 'Show Mines Added After:' (checkbox, dropdown menu with 'January', '1', and '2025'). A 'Show Mines' button is at the bottom left. On the right, there is a text block: 'The West Virginia Mine Information Database System (MIDS) contains records of every mine map available at the West Virginia Geological and Economic Survey in Morgantown, WV. The database is comprised of over 49,000 documents and over 91,000 mines. Most of the mine map records contained in MIDS are available at the West Virginia Geological and Economic Survey in the form of paper maps, aperture cards (microfilm), and digitally scanned mine map images. Need help? [Click Here.](#)' Below this is a link: 'This work is presented in conjunction with the [West Virginia Office of Miners' Health, Safety and Training](#)'. There is a logo for 'WEST VIRGINIA OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING' and a 'Please Note' box with a red border containing the text: 'Please Note: 500XXX series numbers are internal numerical place savers for active mines delivered to WVGES as CAD files. These files are considered confidential by WVMHS&T and are therefore unavailable to users. We are given only the mine outline with no additional information.'

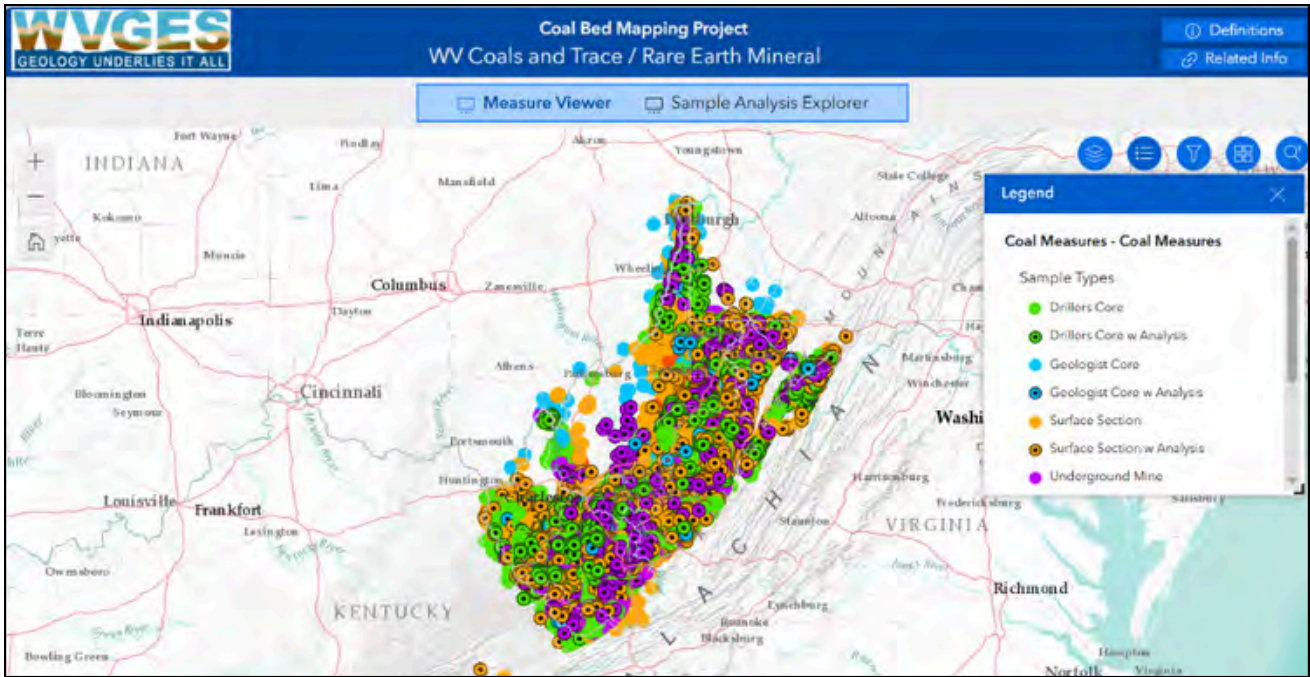
View of the landing page for the WVGES Mine Information Database System (MIDS)

Coal Chemistry Database

The WVGES Coal Chemistry Database contains information on coal analyses, assays of accessory minerals and critical mineral data, including Rare Earth Elements (REE's) and many other types of information for all named coals, both mined and unmined in WV. Included with this dataset is a large archive of physical coal samples, many of which have been reanalyzed for recent critical mineral projects.

Efforts in FY25 were made to update the locations of many previously mislocated data points associated with proximate analyses. This data is now available for browsing through our website at <https://www.wvgs.wvnet.edu>, which allows the viewer to explore coal trace and rare earth elements associated with the coal.

The physical coal samples include over 10,000 samples primarily from non-confidential laboratory analyses collected from many decades of field work and industry donations of every mined coal seam in the state. The samples are currently undergoing a repackaging project, replacing old, deteriorating packaging into new bottles in order to preserve these valuable samples for future projects.



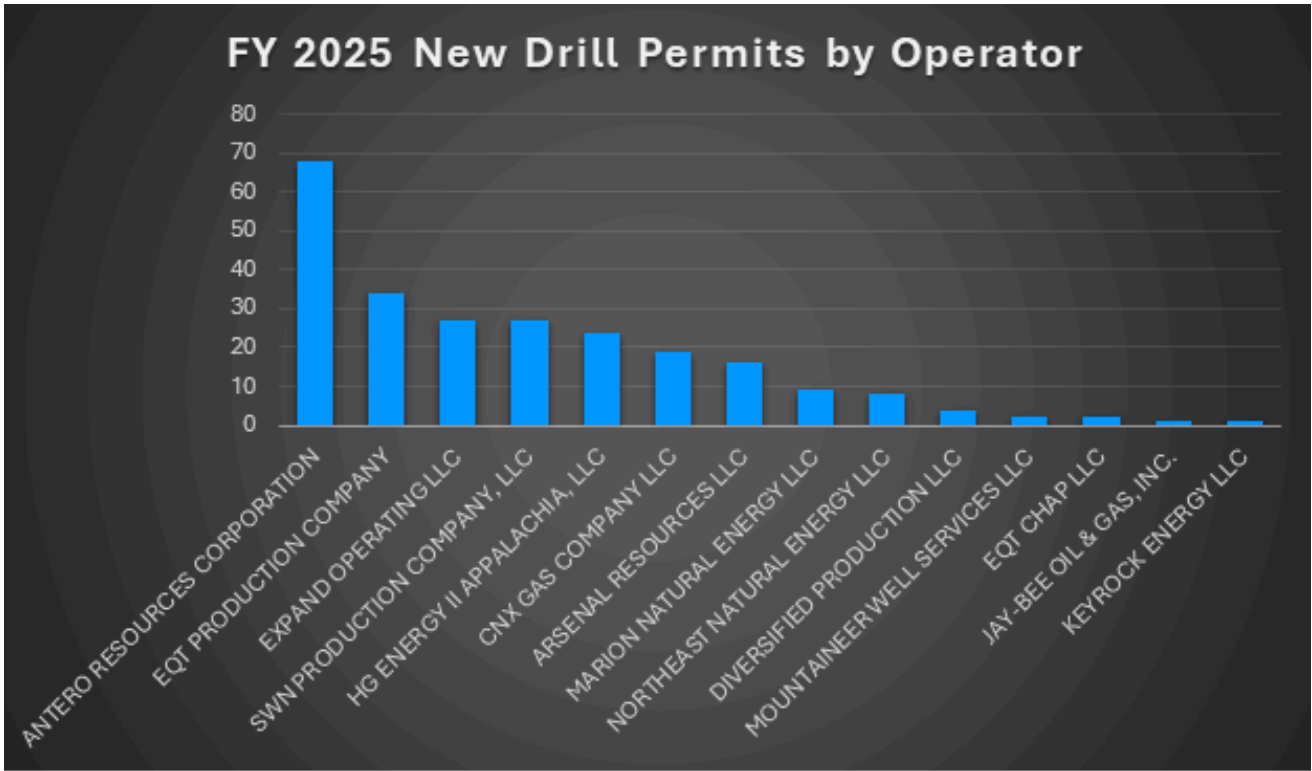
View of the WVGES interactive Coal Analysis map

Subsurface Investigations

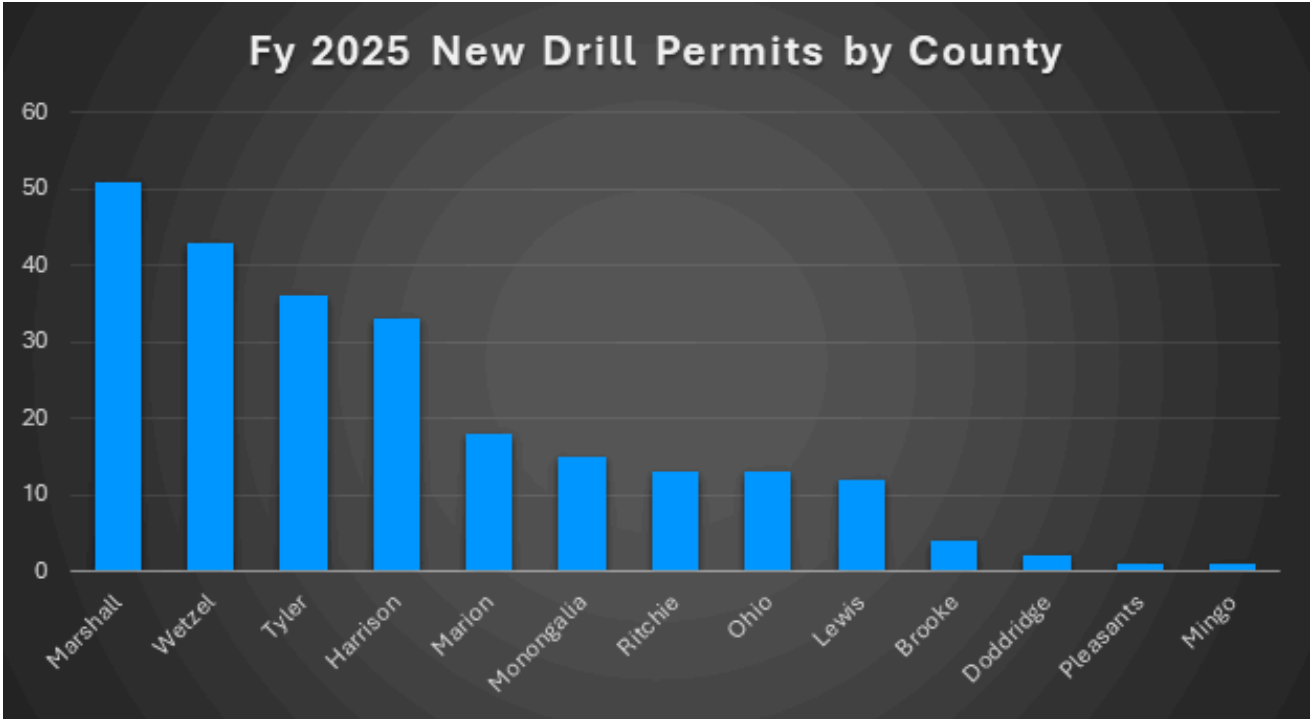
Oil and Gas Highlights

Oil and gas drilling permits increased by 15% in FY 2025. The number of new drilling permits in FY 2024 was 195, and increased to 224 in FY 2025. In 2025, Marshall County had the most permits at 51, and Antero led all operators with 68 new drilling permits. While there was an increase in new well permits in FY 2025, it is still unclear if the number of wells that were drilled during that period increased as well. According to the DEP, only 16 of the 224 wells permitted in FY 2025 have recorded production. In total, only 14 operators had new permits issued during this reporting period. This is an increase from FY 2024, where only 11 operators were issued new drilling permits. Lastly, a total of 222 wells were plugged in WV in FY 2025, while in FY 2024, a total of 201 were plugged.

The OIL & GAS PROGRAM is responsible for research into current oil and gas trends, fields, and the evaluation of specific horizons using data such as well logs, cores, and associated samples. Managing physical samples as well as database curation allows requests from researchers, industry professionals, and governments to be easily accommodated. Historical documents and legacy samples are of new interest as scientific advances are made.



New drilling permits by operator for FY 2025. Antero Resources had the most with 68.



New drilling permits by county for FY 2025. Marshall had the most with 51 new permits.

Geothermal Update

WVGES coordinated with industry leaders and West Virginia University to evaluate the potential for geothermal energy in the state. A database containing all wells that penetrate the Black River Group and deeper was created, and the temperature at the bottom of the well was recorded. If applicable, other temperature readings at shallower depths were also recorded in each well. The recorded temperature was then divided by the corresponding depth to calculate the geothermal gradient in the well. Additional work is still ongoing, but this initial step indicated several areas that might have potential for geothermal energy.

Class VI Primacy

In March of 2025, WV was granted Class VI primacy for Carbon Sequestration wells. Since then, the WVGES has worked with the West Virginia Department of Environmental Protection (WVDEP) to provide subsurface expertise when reviewing Class VI permits. The Oil and Gas Team at the Survey has reviewed three different Class VI permit applications and has helped the WVDEP identify potential subsurface threats and suggest measures to mitigate risk.



Cross-bedding in Mauch Chunk Group - Laneville quadrangle, Randolph County

Grant Work

National Geological and Geophysical Data Preservation Program Grant (NGGDPP)

The U.S. Geological Survey NGGDPP program evaluates submitted proposals each year and, if approved, provides funding to rescue and preserve at-risk scientific data while also making those data publicly available in modern formats. WVGES has successfully been awarded funding multiple times and during FY2025 performed work on three projects. The first was completed in April 2025. A second is ongoing and a third project began in May 2025.

The activities undertaken by WVGES within this NGGDPP project will allow for better organization of the collections, improved curation, and provide easier retrieval for current and future study. Increasing access to available samples and data will allow for further research by the following: U.S. Geological Survey (USGS), WVGES, state entities, and surrounding states in need of physical geological samples. This access will allow our partners in both, academia and private industries to better characterize the resources of the country.

Completed Project (ending in April 2025)

WVGES began a two-year project in May 2024 that addresses several needs to preserve and make accessible geological data. Overall, six total subprojects were undertaken by Survey personnel. Two of these (critical mineral sample preservation and core photography) were continuations to previous work that allowed for a larger percentage of holdings to be preserved and be made accessible.

In addition to the continuing projects, work has commenced on multiple fronts to transfer data from legacy formats to modern formats as well as acquire new data from legacy geological samples. There is a publicly available existing “Mine Information Database System” (MIDS) maintained by the WVGES that contains information about specific mines in WV and includes data such as location, company name, mine name, permit number, and targeted coal bed. Additionally, many entries in this system have mine map images with associated coal thickness, elevation data and other important geologic notes. Details on many of these images are illegible because they were originally scanned at low resolution from microfilm. Funds were awarded to WVGES to purchase an aperture card/microfilm scanner to produce high resolution images of these aperture cards. There are over 40,000 aperture cards in the Survey’s collection and during this period WVGES scanned and made available through the MIDS system.

The WVGES curates a significant collection of both physical samples and digital data associated with those samples. Data is publicly available and comes from a wide variety of sources including expensive sample analysis conducted by industry partners. To make the collections of both more publicly accessible, a database of samples and data was constructed and the material made available through an interactive online map service for users to access inventory and data. The interface can be found at <https://atlas2.wvgs.wvnet.edu/portal/apps/webappviewer/index.html?id=6fef5634c2ff4b1299179bb08cd7d20e>. This is the first time that these data can be searched, accessed, and downloaded.

A digital framework of a comprehensive inventory and modern database of legacy coal samples and chemistry data was previously established by the Survey. This effort modernized a portion of a substantial coal chemistry database containing greater than 40,000 analyses and over 10,000 physical samples. The majority of which were collected from exploratory drilling, active underground mining operations, or other field work. In this period of performance, the WVGES focused on proximate and ultimate analysis which were added to the previously constructed database that included major and trace element geochemical data. This database was previously compiled in numerous tabular and document files, in unsupported formats, and was not linked to information on sample availability. A comprehensive modernization of this data was conducted using an Oracle cross-linked table-based interface focusing on major and trace element geochemistry. WVGES also created a web-based interface where this data can be searched by different variables (<https://atlas2.wvgs.wvnet.edu/portal/apps/experiencebuilder/experience/?id=dbd7811c6f8d484f9f460ee3a12ad751&page=Info>).

Completion of this work marks the first time much of this data and associated files have been available to the public via the WVGES website.

Finally, two hundred distinct samples were sent to the USGS Geochemical Laboratory for new analyses to further understanding of critical mineral resources in the rocks of WV. These sample results will be completely new analyses that will add to a growing dataset of critical mineral potential in the state. The samples submitted were collected during previous STATEMAP geologic mapping projects. The samples submitted included Eocene to Jurassic intrusive rocks, Devonian shales, glauconitic sandstones, Silurian sandstones, and Ordovician shales. These analyses will be publicly available and added to the national critical mineral datasets.

Ongoing Data Preservation Projects

Project 1 (May 2024-April 2026)

Building upon tasks in previously completed NGGDPP projects in West Virginia, WVGES began a two-year project in May 2024 that will continue several activities described above. In addition to this, work began on another project to return the ability to acquire analytical data with new scientific equipment. Overall, five total subprojects will be undertaken by WVGES personnel. Three of these (critical mineral sample preservation, core photography, critical

mineral geochemical analysis) are continuations to the ongoing projects described above. These ongoing and new projects will allow for a larger percentage of holdings to be preserved and more accessibility as well as increase data available for geoscience research. The process of transferring crushed rock samples to more permanent containers and storage has been continued. At the conclusion of this project, WVGES will have 30% of the collection catalogued. Also, core photography of six more cores is being undertaken. These include cores through the Marcellus and Utica intervals, which are the two current major gas and NGL producing targets in the state. Two other cores are being examined for possible carbon sequestration and/or underground storage.

The major task in this project has been to acquire a new portable x-ray fluorescence (pXRF) machine. WVGES previously had a device, but it became inoperable and too expensive to service. Scientific equipment of this type is very expensive. During FY2025 the process of acquiring the new pXRF machine has commenced and once received WVGES will begin to analyze samples for critical minerals analysis.

Another 200 distinct samples will be sent to the USGS Geochemical Laboratory for new comprehensive analyses of critical mineral resources in WV rocks. Samples used in this project will be taken from samples acquired during geologic mapping, oil and gas exploration, and other activities. Cores and well cuttings will be utilized for this research. These sample results will be completely new analyses that will add to a growing dataset of critical mineral potential in the state.

Project 2 (May 2025–April 2027)

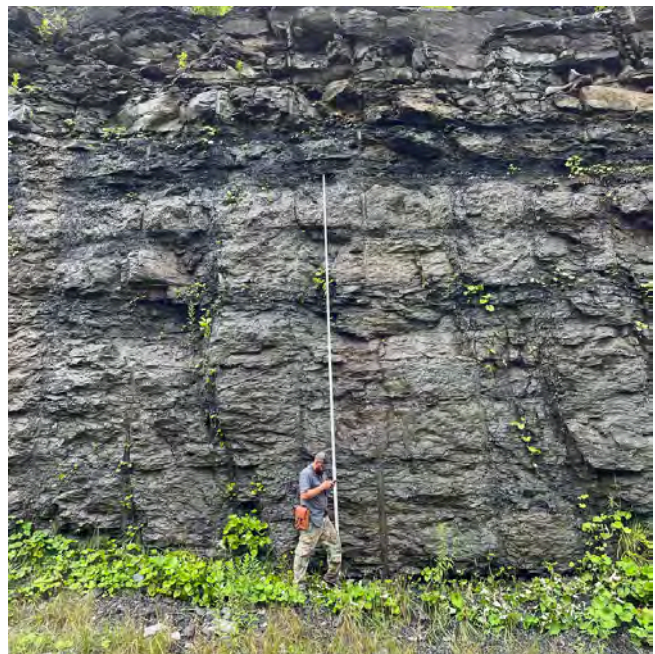
The most recent project will again build upon those undertaken in the past and/or currently active. In this project, WVGES will continue working on the curation of crushed rock samples from coal mining operations and at the end of this period of performance hope to have completed the preservation of 40% of the collection. WVGES will be re-boxing five rock cores that are currently in deteriorating boxes. These cores were collected during oil & gas exploration operations by industry entities and later donated to WVGES and the state. In addition, WVGES is working to enhance critical mineral sample analysis capabilities with the purchase of an x-ray diffraction (XRD) machine. This would allow WVGES to understand the elemental and mineral composition of rock units, searching for host minerals that could contain critical minerals and establishing a chemostratigraphic framework for West Virginia. Finally, 300 critical minerals samples will be submitted to the USGS for geochemical analysis and be included in dataset associated with West Virginia through the USGS EarthMRI program. These data will add to an already robust population of data for critical minerals in West Virginia.

Central Appalachian Partnership for Carbon Storage Development (CAP)

- WVGES is partnered with the PA Geological Survey to evaluate CO₂ sequestration potential in West Virginia and Pennsylvania.
- The project is ongoing and will continue through Q1 of 2026
- In June, the WVGES received the results from a well-cutting analysis done by Advanced Hydrocarbon Solution.
- The well cuttings from 4 deep wells in WV were analyzed using their proprietary technology for evidence of hydrocarbon migration through potential CCUS reservoirs.
- The analysis is still being reviewed, but some of the key findings are listed below:
 - The upper portion of the Copper Ridge Dolomite shows significant lateral migration of hydrocarbons
 - The middle portion of the Copper Ridge Dolomite and the Wells Creek Dolomite indicate very little evidence of hydrocarbon migration and could potentially be good confining layers.

Midwest Regional Carbon Initiative (MRCI)

- Collaborative effort between Battelle Memorial Institute and multiple states to identify CCUS reservoirs for carbon storage and CO₂ flooding.
- This project was originally intended to end in FY 2024; however, it did not finish until September of 2024.



WVGES geologist examining a coal ball (LEFT) and a coal seam (RIGHT) along the new Coalfields Expressway

Geoscience & Mapping Program

The main component of the program is bedrock geologic mapping, and the WVGES continues to map new areas at more detailed scales. The resulting maps and associated data serve as products to understand the surface geology of the state more fully. Much of the mapping is done in conjunction with the USGS STATEMAP program described below; however, WVGES conducts internal research on important geological projects across the state. In addition to mapping, the program oversees outreach and geologic education throughout the state. This involves engaging with the state government, state park visitors, general public, schools/students, and academia as well as curating the WVGES museum at Mont Chateau.

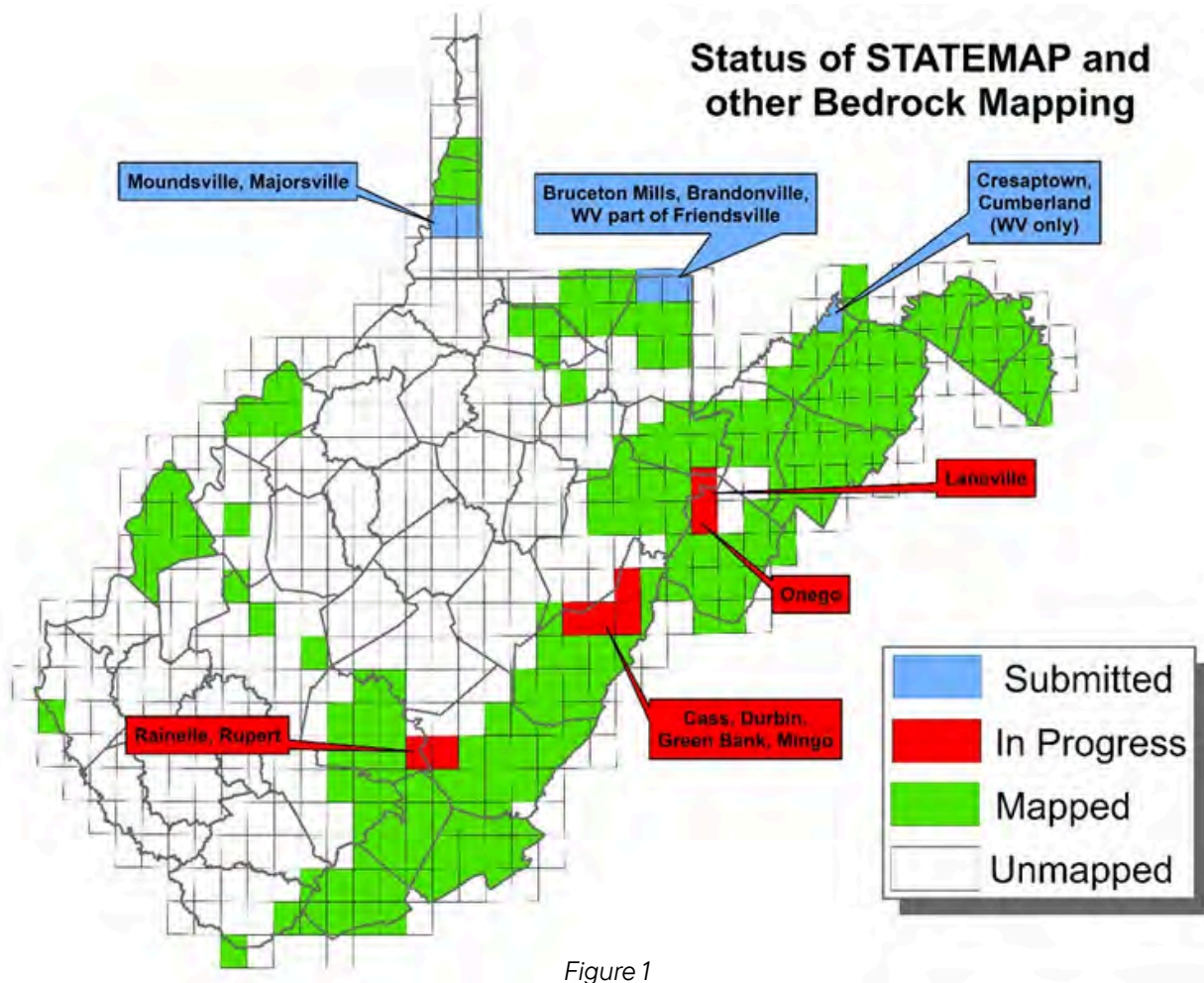
STATEMAP

The Survey has been producing geologic maps since the Survey's creation in 1897. Currently maps are produced at 1:24,000 scale in conjunction with the U.S. Geological Survey's (USGS) STATEMAP Program. This program is a part of the National Cooperative Geologic Mapping Program and partial funding is secured through the National Geologic Mapping Act. The program is a partnership between the USGS, the Association of State Geologists, and State Geological Surveys. Funding is a 1:1 match between WVGES and the USGS. The Survey completed one project in FY2025 and has two ongoing active mapping grants with mapping being conducted in multiple areas in the state. Also, WVGES has submitted a proposal to the USGS for mapping to begin in FY26.

Completed Projects

Notification of partial funding was received in April 2022 to proceed with mapping in three different areas of the state with a two-year project that began in September 2022 and ran through January 2025. Work was completed on five full and seven partial 1:24,000 quadrangles (Figure 1) in Greenbrier, Marshall, Mercer, Preston, and Summers counties. Full quadrangles included in this series were Brandonville, Bruceton Mills, Dawson, Majorsville, and Moundsville. Portions of the Alderson, Forest Hill, Fort Spring, Greenville, Peterstown, and Narrows quadrangles in Greenbrier, Mercer, and Summers counties were also included. Additional funding was requested to improve previously published geologic maps by edge-matching, digital database updates, addressing geologically difficult problem areas via focused field work, and using newly available LiDAR imagery. Under the U.S. Geoframework Initiative, the Survey is working to build seamless, edge-matched 1:24,000 geology organized by 1:100,000 sheets (Figure 2). During this project WVGES completed the WV portion of the Cumberland and Front Royal 100k map areas. WVGES converted multiple maps to geologic map databases in the required U.S. Geological Survey's Geologic Map Schema (GeMS) digital map database format. Finally,

WVGES worked with surrounding states to develop a draft cooperative interstate surficial mapping framework for creating seamless Appalachian surficial geology maps and databases across state lines. A multi-state report was generated and made available.



Active Projects

Project 1

A notification of partial funding was received in April 2023 to proceed with mapping in three different areas of the state with a two-year project beginning September 2023 that will run through January 2026. The project was to have ended in August of 2025, but a no-cost extension was requested and granted. The extension was requested due to personnel changes at WVGES. Mapping is in progress in Mineral, Pendleton, Greenbrier, and Fayette counties. This includes three full quadrangles (Onego, Rainelle, and Rupert) and two partial quadrangles (Cresaptown and Cumberland). In addition to the new mapping, compilations of the Frederick and Morgantown 100k map areas, and a compilation of six quadrangles in Mercer County are in progress. These compilations, along with those described above in the completed project description, will increase the area where seamless 1:24,000 scale geology is available to users.

Project 2

A notification of partial funding was received in April 2024 to proceed with mapping in two different areas within the state on a two-year project beginning September 2024 that will run through August 2026. WVGES personnel presented proposed mapping areas in WV. Mapping is in progress in Pocahontas, Randolph, and Pendleton counties and includes five full 1:24,000 quadrangles covering Mingo, Cass, Green Bank, Durbin, and Laneville. In addition, to the new mapping, WVGES will continue modernizing existing geologic map GIS and databases.

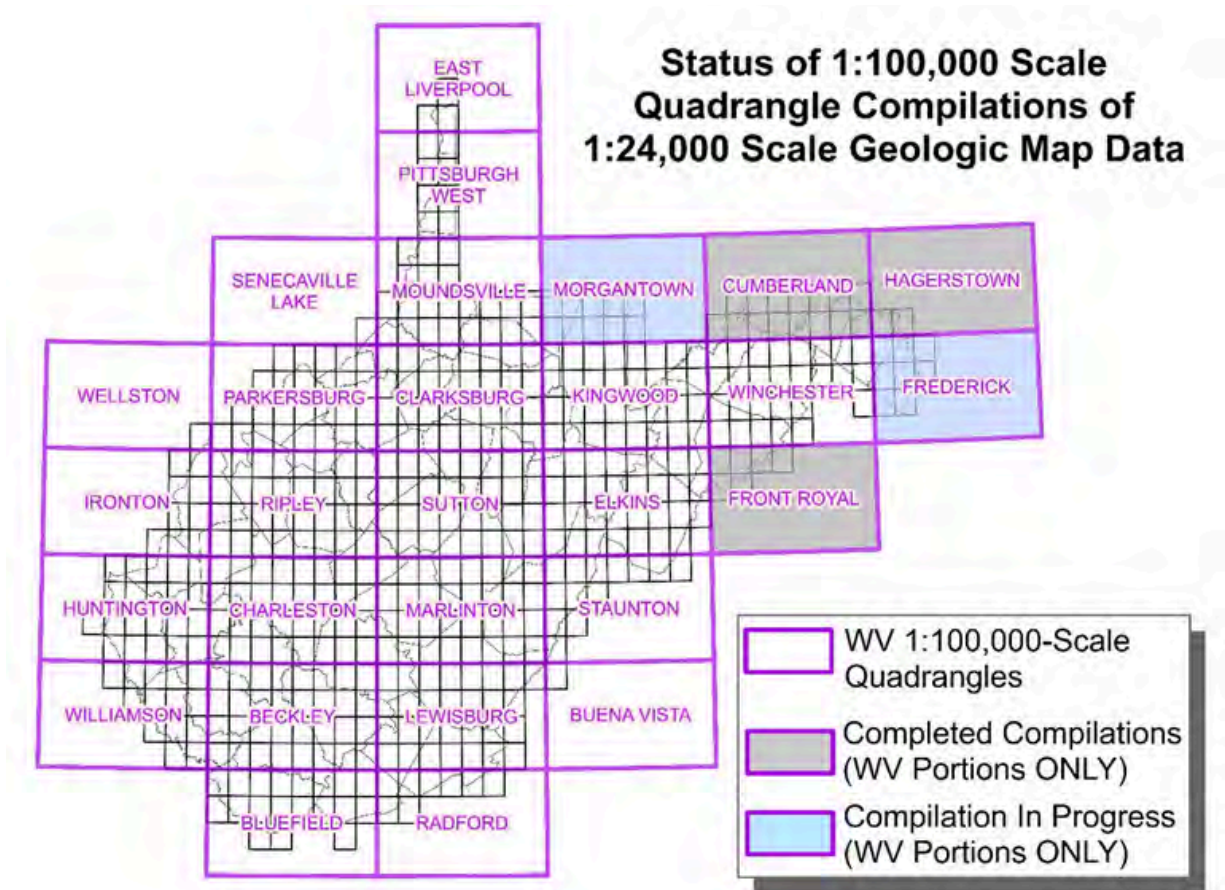


Figure 2

Proposed Projects

The program announcement from the STATEMAP program was released in September 2025 and the annual meeting of the STATEMAP Advisory Committee, a group of industry, academia, and government professionals, was held both in-person and virtually at WVGES offices in November 2024. WVGES personnel presented proposed mapping areas in WV and project proposal was submitted to the USGS in January 2025. This proposal included three projects. The first will be to produce karst susceptibility maps of Greenbrier, Mercer, and Summers Counties, which contain significant geologic deposits containing significant karst features. The

goal is to incorporate geologic mapping with additional data to create derivative maps that display a deeper understanding of the karst areas/systems. The second project is to collect rock samples and use geologic age dating to clarify confusing areas of geology in southeastern WV. Previous mapping in the area has identified difficulties in differentiating different geologic deposits. The final project will be to develop an ArcGIS StoryMap detailing the geology of the Deckers Creek Rail Trail and its effects on the local industries with the intent of making this product available to the public as educational outreach and will serve to produce geologic products that will reach expanded user groups. The goal of the Decker's Creek Trail project is to introduce the general public to the role that geology plays in natural history, industry, and historical development. Notice of partial funding was received in May 2025 and the project is projected to begin October 2025.



TOP: WVGES geologists examining a marine zone in the Mauch Chunk Group, Dolly Sods - Laneville quadrangle, Tucker County

BOTTOM LEFT: WVGES geologist conducting geologic mapping field work in the Laneville quadrangle

BOTTOM RIGHT: Coal seam in the Pottsville Group - Laneville quadrangle

Outreach & Geoscience Education

Museum

The *Megalonyx* sp. skull known as “Skully” was approved to be on loan for another year by the Weed family. Bonnie Stark donated the Charles Barlow Collection – a collection of museum quality rocks, minerals, and fossils in honor of her late husband. These pieces will be put on display in the museum when space allows. In October 2024, new signs were installed to the highlight and explain the crinoid and Itmann fossil exhibits outside.

Specimens were loaned to the Watts Museum at West Virginia University and to the Appalachian Forest Discovery Center in Elkins.

People continue to visit the museum, including school groups, and scouts, as well as the occasional tourist or local who stop in to visit the Survey’s facilities. The Draw Jeff Contest (a *Megalonyx jeffersonii*, WV’s state fossil) was held for a third year for K-12 students across the state. The entries were divided into elementary, middle, and high school age groups with one winner from each. The winners received a gift certificate to the museum’s store and a personalized tour of the museum. In addition to this we hosted groups from WV Department of Natural Resources (WVDNR), Morgantown High School, The Village at Heritage Point, Tyler Consolidated High School, Mont Chateau Estates, Morgantown Chapter of Master Naturalists, and WVU Ecology Club.

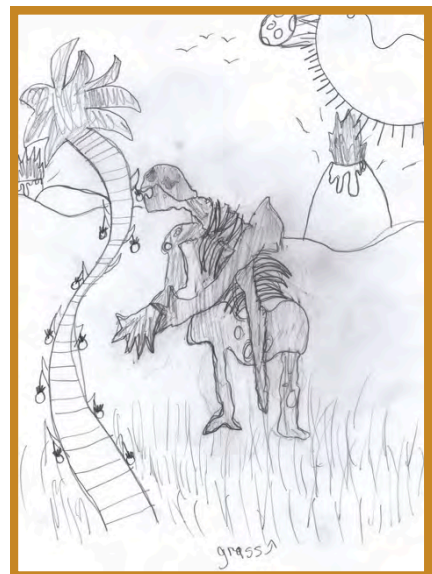
2025 Draw Jeff Contest Winners



Cora Fallon of Cheat Lake Elementary School, K-4th Grade winner



Lauren Minett of Hedgesville High School, 9-12th Grade winner and WVGES Staff Favorite

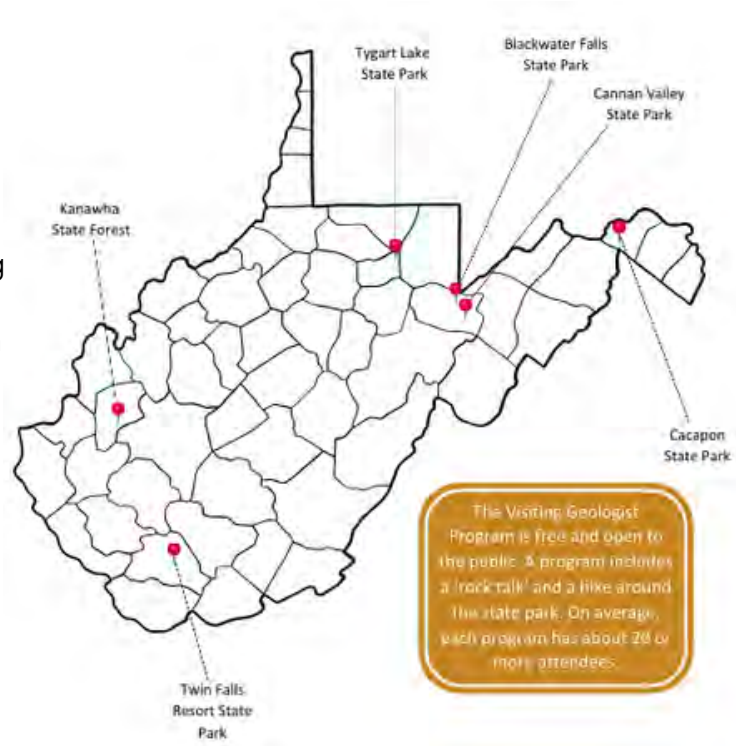


Maddox Hudgins of Montcalm Elementary School, 5-8th Grade winner

State Park Visiting Geologist Program

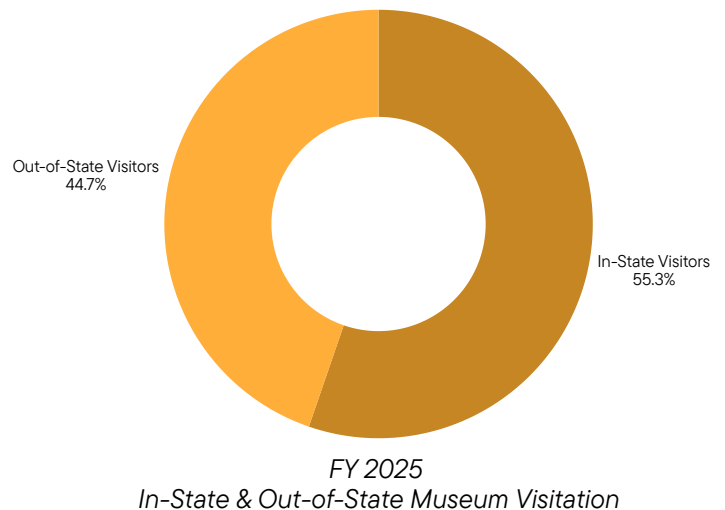
This program is hosted by each state park in conjunction with several WVGES geologists who enjoy assisting in public education and spending time in nature. For each visit scheduled there is a presentation as well as an accompanying nature walk led by the visiting geologist. These programs sometimes take place in one day or are spread out over a two-day period.

A total of six programs were held at the following state parks: Blackwater Falls State Park, Cacapon State Park, Canaan Valley State Park, Tygart Lake State Park, Kanawha State Forest, and Twin Falls Resort State Park.



Outreach

Survey staff ran the second Dr. Bob Behling Memorial Geology Field Trip for the West Virginia Science Teachers Association’s annual conference in October 2024. Survey staff also attended the West Virginia Science and Engineering Fair, Marion County STEAM and CTE Festival, and career day at Ridgedale Elementary events in March of 2025, a career fair at Kingwood Elementary in May of 2025, and KidsFest at the Huntington Children’s Museum in June of 2025 to help promote geoscience education as well as showcase future potential career opportunities. Students of all ages were able to learn about what the WVGES has to offer. A staff member was also present at the annual Fossil Day event held in March 2025 at the Grave Creek Archeological Complex in Moundsville.



Information Services

Network Security Upgrades

WVGES implemented major upgrades to the network security infrastructure designed to safeguard critical systems, maintain service availability, and protect the confidentiality and integrity of organizational data. The environment incorporates modern perimeter defenses, controlled network segmentation, identity management, and continuous monitoring to uphold a strong security posture. A major enhancement to the organization's perimeter security was the replacement of the legacy on site Cisco PIX firewall with a Cisco 2921 Integrated Services Router (ISR) hosted at WVNET which is configured with advanced firewall and security features. This upgrade provides:

- Increased throughput and improved processing capacity
- Enhanced functionality supporting modern encryption standards
- Advanced zone-based firewall capabilities for granular traffic control
- More flexible ACL configuration and deep-packet inspection

As part of the firewall modernization project, the organization transitioned from public IP addressing on internal network systems to private IP addressing. This change significantly improves security by:

- Preventing direct exposure of internal hosts to the internet
- Allowing NAT (Network Address Translation) to control and log external access
- Reduces attack vulnerability by reducing exposed address surface and minimizing unauthorized scanning and probing
- Improving internal address management and scalability

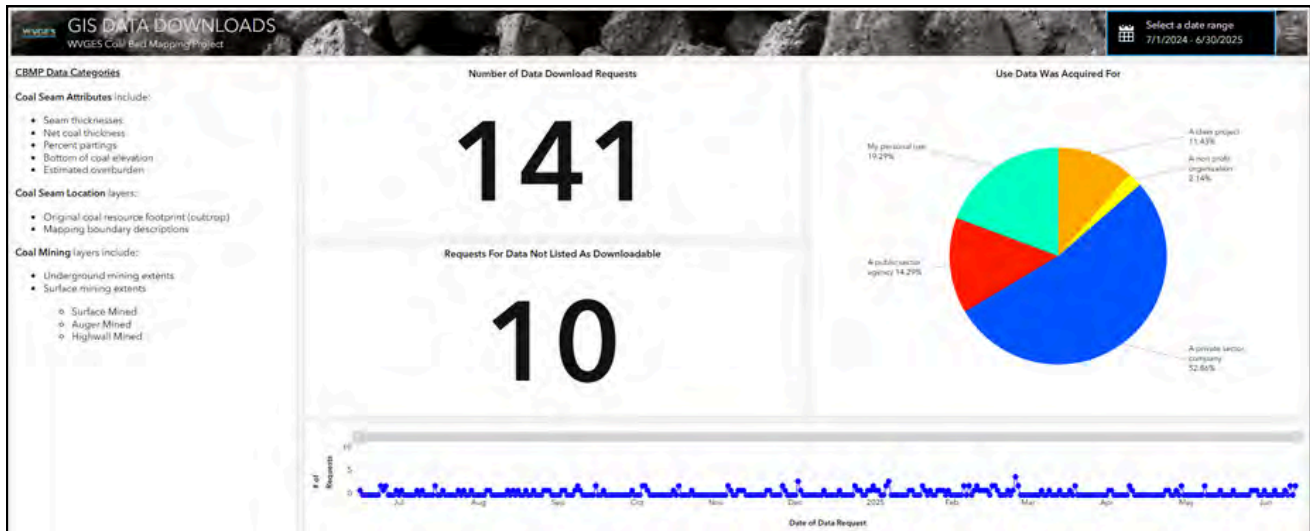
Private IP ranges are now assigned by WVNET through VLAN-based segmentation, with NAT policies on the Cisco 2921 controlling all external communication while internal assignments are managed by our internal networking personnel. To further strengthen perimeter defenses, the organization also relies on WVNET protection capabilities. These controls ensure the network remains available even during high-volume hostile traffic events, protections include:

- Monitors all circuits and edge devices connected to our infrastructure using SolarWinds,
- 24/7/365 anomaly detection for sudden or abnormal traffic spikes
- Backs up our edge router configs
- Provides DDoS protection through manually blockage (blackhole) as identified by our upstream IPS providers

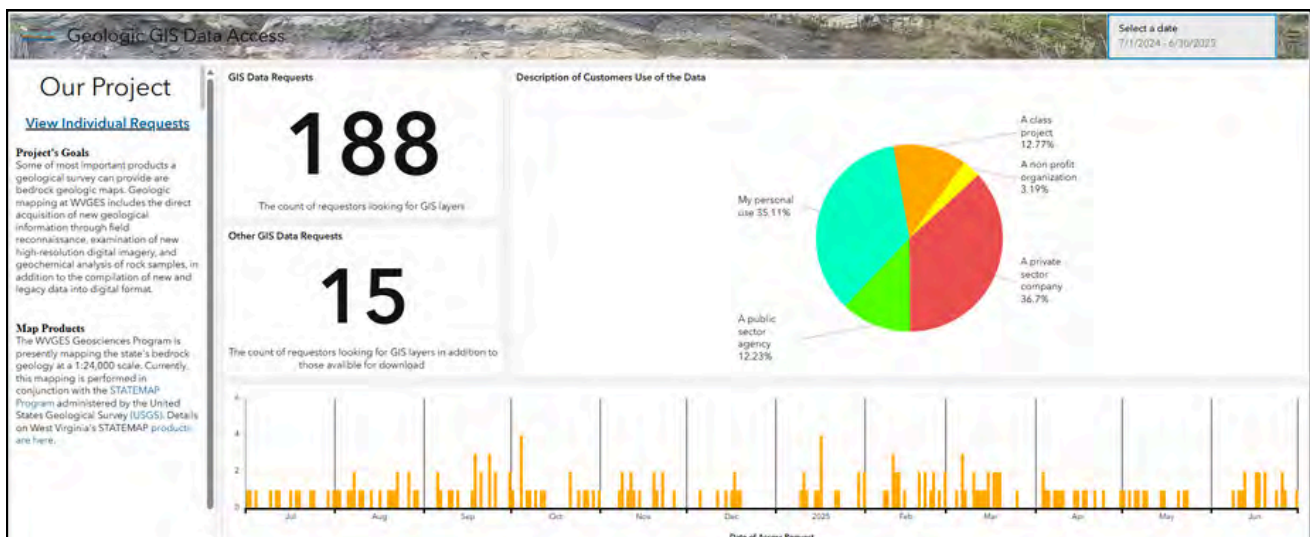
Endpoints are protected by enterprise-grade antivirus and endpoint detection and response (EDR) tools that provide real-time monitoring and automated remediation/notification. A structured patch-management process ensures timely security updates.

Data in transit is encrypted using secure, modern protocols supported by the upgraded perimeter infrastructure. Sensitive data is stored in repositories with controlled multi-factor

(MFA/2FA) access. Regular onsite, offsite, and cloud-based backups ensure resiliency and support disaster-recovery requirements. In conjunction, employees receive ongoing security training to help mitigate social-engineering risks and educate staff on policies governing acceptable use, access management, data handling, and endpoint security.



FY 2025 GIS data download totals



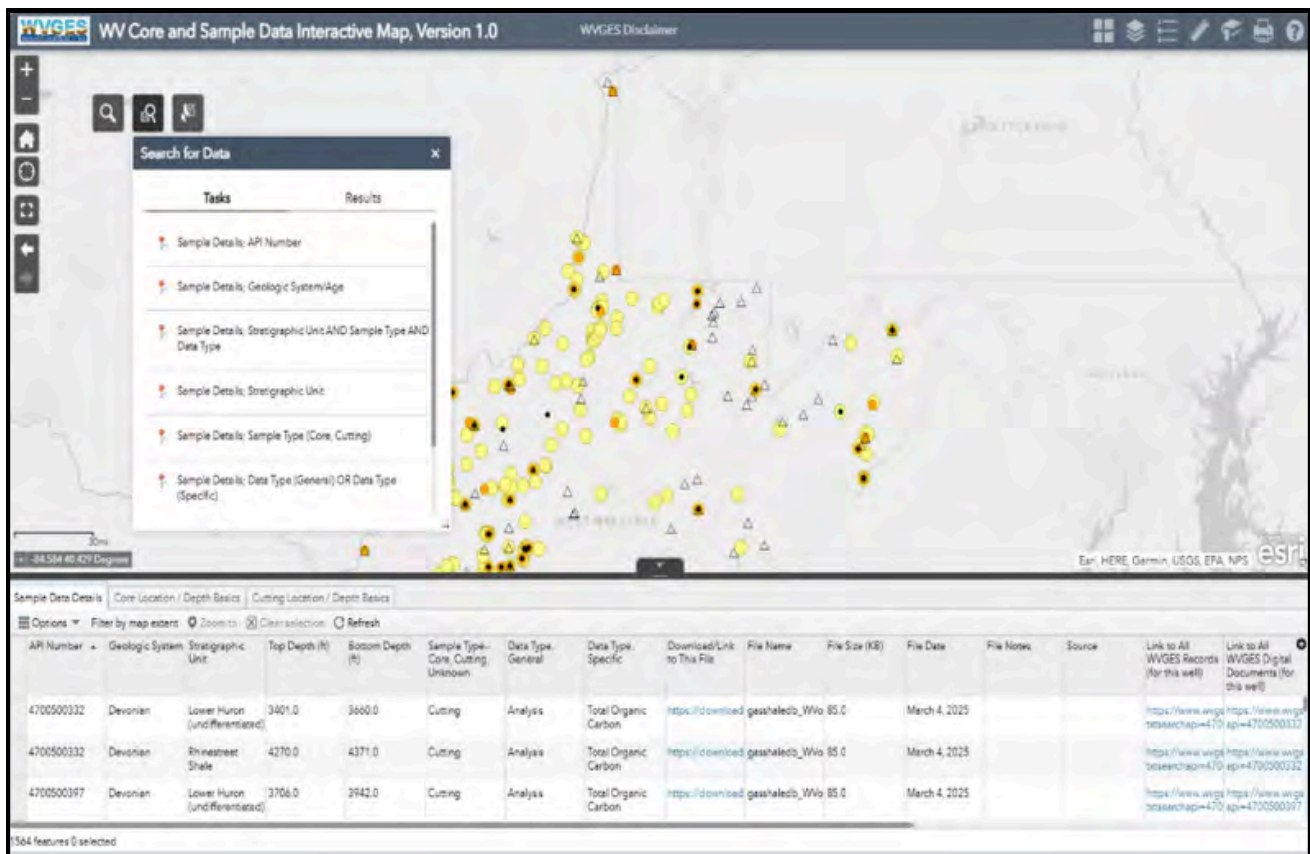
FY 2025 GIS data access totals

Applications

Three new interactive mapping applications were brought online to add to the extensive collection of data services hosted by WVGES.

Core and Sample Explorer

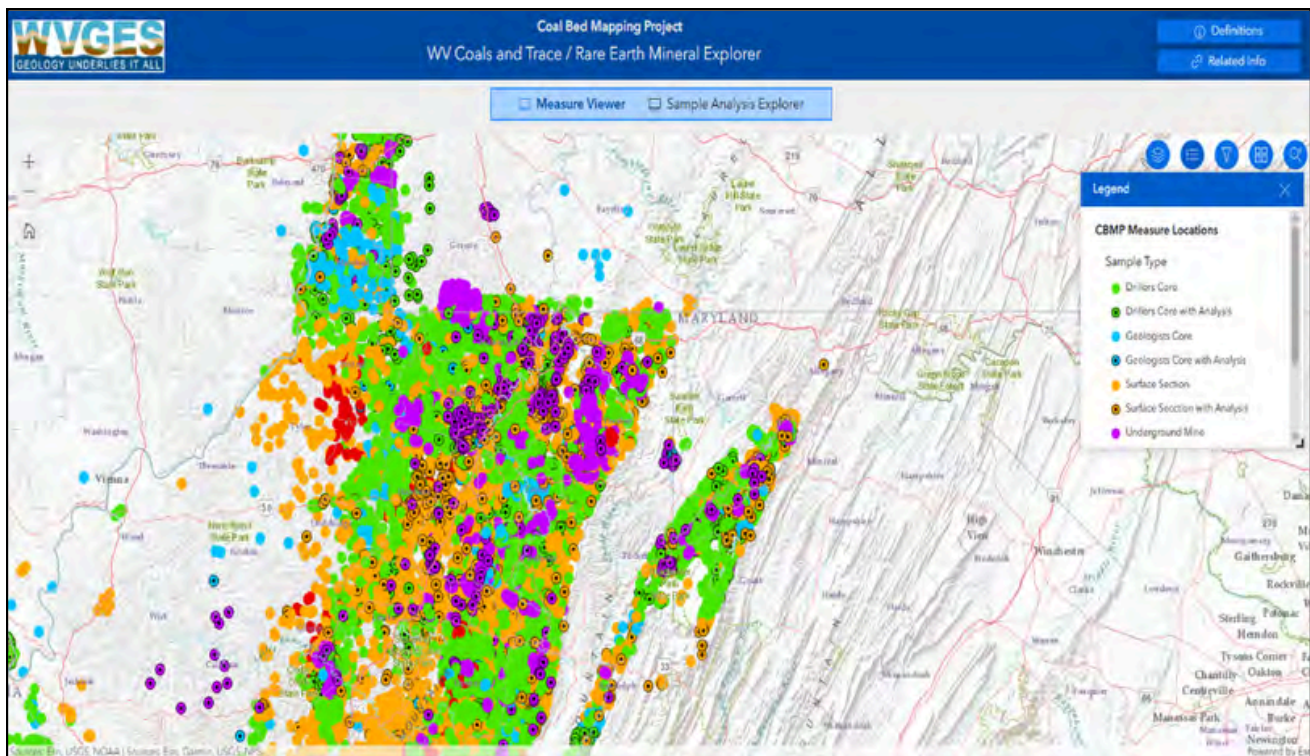
This map includes publicly available core and cuttings material curated by WVGES as well as available data associated with the physical material. These data have been acquired over decades by staff, as part of industry and/or academic research, donated by industry partners, and/or part of WVGES cooperative projects. This interface was partially supported by funding through the U.S. Geological Survey's National Geological and Geophysical Data Preservation Program.



WV Core and Sample Data Interactive Map landing page

Coal Measures and Analysis Explorer

This map, also partially supported by funding through the U.S. Geological Survey's National Geological and Geophysical Data Preservation Program, provides access to coal measurements and sample analysis for over 80 coal seams across West Virginia. The data set includes seam measurements and lithology as well as proximate, ultimate, major and trace element analysis for a select number of samples and coals.



View of the WVGES interactive Coal Analysis map

Midwest Regional Carbon Initiative Interactive Map

WVGES is the host site for this application which features maps and cross sections to aid in assessing carbon utilization and storage opportunities for portions of eastern and midwestern U.S. The Midwest Regional Carbon Initiative is a program funded by the Dept. of Energy comprised of team members from multiple state geological surveys, academic institutions, and industry. Backed by more than 20 years of experience in the field, the initiative works to connect science, technology, and research to advance CCUS acceptance and deployments in 20 states across the Midwest, Mid Atlantic and New England regions.



The West Virginia Office of GIS Coordination is housed at the West Virginia Geological & Economic Survey. Its mission is to serve the public good by collaborating with state agencies, WV’s GIS community, and regional and federal partners to provide and promote cooperative leadership, support, and innovative solutions using geospatial technology.

Established under **Executive Order 4-93**, the Office was created to coordinate and provide technical support for the development and operation of the state’s geographic information systems (GIS) and spatial data infrastructure. The **WV GIS Technical Center**, in partnership with the WV Geological & Economic Survey and all other state agencies, supports key statewide GIS services.



ABOVE: Taryn Moser, WV State GIS Coordinator

Year in Review (FY 2025)

It has been a productive first year for the State GIS Coordinator. Significant time was spent listening and learning about the needs of the GIS community across WV—from citizens and local governments to legislative partners.

Taryn Moser, West Virginia’s GIS Coordinator, brings over 20 years of experience working with geospatial technology in the Mountain State. She leverages this experience to strengthen, advocate for, and modernize statewide geospatial programs.

Statewide collaboration is essential for the success of major geospatial initiatives such as **Statewide Imagery and LiDAR programs**. These programs support daily operations across government agencies, private industry, and the general public. The **WV Parcel Viewer** is one of the state’s most frequently used GIS applications by both citizens and decision-makers.

State GIS Steering Committee

The State GIS Steering Committee—originally formed under Executive Order 4-93 and reactivated by the GIS Policy Council in 2008—has been reestablished with an updated membership. Representation includes:



- State agencies
- Local governments
- Academia
- Federal partners
- Private sector organizations
- A representative from the West Virginia Association of Geospatial Professionals (WVAGP)

Chaired by the State GIS Coordinator, the Steering Committee works in cooperation with the GIS Policy Council and West Virginia's GIS user community to provide active leadership in advancing the state's use of geospatial technology.

Upcoming Projects and Priorities

- **Planning and Funding Statewide Imagery & LiDAR Programs**
 - Collaboration among state agencies, local governments, and statewide partners is essential for these major initiatives.
- **Modernizing WV Code 7-2-6**
 - Updating the code to better reflect current geospatial practices and statewide needs.
- **Reinstating the GIS Policy Board**
 - Strengthening governance, coordination, and strategic planning across all levels of government.
- **State Master Agreement with Esri**
 - Working with Esri and the State Procurement Office to develop a statewide master agreement for licensing, training, and enterprise services

WV GIS Technical Center



The West Virginia GIS Technical Center, located in the Department of Geology and Geography, West Virginia University, provides focus, direction, statewide coordination, and leadership to users of geographic information systems (GIS), digital mapping and remote sensing within the state of West Virginia. The Center was established by Executive Order 4-93 to provide coordination and technical support in the development and operation of geographic information systems (GIS) for the state's spatial data infrastructure. Listed below are key statewide GIS services the Center provides for West Virginia, coordinated through the WV Office of GIS Coordination, WV Geological and Economic Survey.

- **State GIS Clearinghouse:** Serves critical spatial data to state users via the State GIS Clearinghouse. The Center currently provides nearly 200 TB of storage space in a virtualized environment configured to maximize availability and access. The system must have a large capacity to allow for downloading large datasets, such as such as LiDAR-derived digital elevation data, high spatial resolution aerial imagery, and other base maps.
- **GIS Data Development:** Plays a crucial role in not only serving critical spatial data to state users but in updating and integrating local geospatial data within state and national geospatial databases. These data layers are utilized by state agencies, communities, and the public for applications that include emergency response, risk assessments, economic development, energy resource exploitation and management, transportation, natural resources, community planning, tax assessments, real estate appraisals, health studies, and election management. For example, the Center updates statewide mapping data layers (tax parcels, E-911 addresses, political and public boundaries, aerial imagery, elevation data, etc.) that support the various critical infrastructure sectors like broadband, water, sewer, transportation, and flood mitigation.
- **State GIS Services Support:** Provides hosting and e-government services that support operational map layers for 14 state agencies that include mineral parcel, hazard, historical, transportation, and voting geospatial data needed by state users. In addition, key GIS support and hosting services are provided for local governmental offices that include E-911 (addresses), county assessor (tax parcel), and county clerk (elections and boundaries). The most popular web map services supporting the state's geospatial data infrastructure are tax parcels, E-911 addresses, leaf-off imagery, and boundaries. This past year statewide web map services via www.mapwv.gov increased by 19% to nearly 4 million visits.
- **State Base Layer Map Services:** Provides a publicly accessible gateway to essential base map layers and geoprocessing services (e.g., aerial imagery, elevation, address geocoding) utilized by many organizations in the state for their mapping activities. This includes redacting privacy information from select mapping files for state residents in accordance with Daniel's Law privacy requests.

WV GIS Technical Center



- **State Outreach Support:** Provides the West Virginia Geospatial Community with advisory, training, and outreach services that advance the state’s spatial data infrastructure. The Technical Center responds to an estimated 12 calls per week from the public and clients regarding GIS data and applications.

STATEWIDE GIS SERVICES	BASE MAP LAYERS	AGENCY MAP LAYERS
<ul style="list-style-type: none"> • State GIS Data Clearinghouse • State GIS Data Development • State GIS Services Support • State Base Map Services • State Data Privacy Requests • State Outreach Support 	<ul style="list-style-type: none"> • Addresses & Locator services • Aerial Imagery • Boundaries – Election, Legal, Public Lands, Tax District • Building Footprints • Elevation • Tax Parcels (Surface) 	<ul style="list-style-type: none"> • Archaeological & Historical • Delinquent Properties • Hazards Flood & Landslides • Highway Plans Archival • Hunting & Fishing • Mineral parcels • Trails • Voter Points & Polling Sites

- **Past and Future Accomplishments:** During this reporting cycle, the Center partnered with other stakeholders in enhancing the WV Flood Resiliency Framework (www.WVFRF.org), a virtual hub of risk assessment, visualization, planning, and training resources for building community flood resiliency in West Virginia. In the future, the Center plans on modernizing the State GIS Clearinghouse.

Property Tax Division

The West Virginia State Tax Division, in accordance with the Property Tax Division's e-filing initiative, is now in its second year of implementing an electronic data submission process for mined coal as part of the Natural Resources Program. These upgrades are replacing the traditional paper-based systems, allowing coal producers to submit their tax returns electronically which includes spreadsheets and supporting documents such as maps and plats digitally. This transition proposes to create a more efficient tax filling process by speeding up data intake and enhancing the validation of geospatial information.

A primary focus, following the first year of implementation, is the standardization of geospatial data formats. We are collaborating with leading software companies, other West Virginia State agencies, and taxpayers to establish an electronic format that can be implemented across platforms. This effort is closely integrated with the Reserve Coal Evaluation Model and the Coal Mapping Program workflow. Our primary goal is to refine the intake process, making it more precise and intuitive for coal producers to fulfill their data submission roles efficiently.

To ensure the quality and integrity of all digital submissions, strict adherence to standards and procedures is mandatory. This process includes complying with specific coordinate reference systems, cartographic representation standards, and other requirements detailed in the West Virginia State Code, as well as topology and commercial vector data formats. Maintaining these rigorous standards is crucial for the trustworthiness of our geospatial data.

Under the deployment of the Integrated Assessment System Platform for all the state of WV, the Geographic Information System (GIS) section is working on the development of quality assurance of the geospatial data submission for quality and integrity outlined by the West Virginia State Code. This process will assist in the internal reconciliation process for an accurate assessment.

We extend our gratitude to the West Virginia Geological and Economic Survey (WVGES) for your role as liaison with other state agencies as well as for your financial support. Your partnership is vital for our core goals and objectives.

Facilities

Building Repairs and Upgrades

Plumbing Repairs:

- Installed a new Pressure Regulator
- Drain Repairs in building

HVAC:

- Replaced main building pump motor in furnace
- Water heat line repaired after extended power outage. All damage repaired.

Fire Protection System:

- Replaced sprinkler system valve

General Maintenance:

- Installed a new facility sign made by WVDNR at front of building.
- Replaced roof on large storage building and garage
- Replaced garage door on garage and added opener on stable building
- Installed new parking lot lighting
- Acquired new warehouse storage building
- Added limestone boulders along property edge for security
- Lots of landscaping updates
- New signage at Itmann fossil and crinoid display



New signage for the crinoid (left) and Itmann fossil (right) displays

Presentations and Publications

Presentations

State Geologist, Jessica Moore FY 2025 Presentations

NETL Carbon Management Portfolio Review - Pittsburgh, PA, August 2024

- Moderator for CCS State Activity Plenary Session
- Presenter on CarbonBASE and State Survey Data

Geological Society of America (GSA) Annual Meeting - Anaheim, CA, September 2024

- Keynote Talk on Earth MRI Critical Minerals session
- Presented Brunton Compass to Best Student Geologic Map winner

USGS Earth MRI Workshop - Reston, VA, October 2024

- Provided the opening and closing remarks on behalf of the American Association of State Geologists (AASG).
- Presentation on Critical Minerals in WV

WV Governor's Energy Summit - Charleston, WV, October 2024

- Geothermal Potential in WV

Global CCS Institute Members Meeting - Houston, TX, November 2024

- Served as panel member for State CCS updates

American Association of State Geologists Pick and Gavel Award Ceremony - Washington, D.C., February 2025

- Presented Pick and Gavel Award to Senator Shelley Moore Capito

Global CCS Institute D.C. Forum - Washington, D.C., April 2025

- Panel member for State CCS updates

American Association of State Geologists (AASG) Annual Meeting - Baton Rouge, Louisiana, June 2025

- Presided over the annual meeting as AASG president



LEFT: Jessica Moore (left), WVGES Director and State Geologist, with the Best Student Geologic Map Competition winner at the 2024 GSA Annual Meeting.

RIGHT: 2025 PCOR Partnership Regulatory Roundup in Deadwood, South Dakota

WVGES Staff FY 2025 Presentations

Abandoned Mine Pools as Beneficial Resources in Lewisburg, Pennsylvania in June 2025: “Assessing Mine Pool Geothermal Potential in West Virginia using the WVGES Coal Bed Mapping Project (CBMP) Database.”

National Association of Abandoned Mine Land Programs (NAAML) Annual Conference in Canaan Valley, WV, September 2024: “Beneficial Reuse of Abandoned Mine Lands for Advanced Energy Technologies (An Overview).”

Digital Mapping Techniques (DMT) Conference in Norman, OK, May 2025: “Multi-Map Compilations in GeMS-The WVGES Approach.”

Geological Society of America (GSA) Southeastern Section Meeting in Harrisonburg, VA, March 2025: “Stratigraphic Problems in Southern West Virginia: Addressing Discrepancies and Bridging Gaps Through Recent Bedrock Mapping and Map Compilation.”

Publications

DDS-9 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 map, 1:24,000, 36" x 38". Digital compilation of 10 1:24,000 Scale Map and Open File Geologic publications originally published 1963 – 2006 and 2024, into one internally edgematched geodatabase for GIS. Digitized map layers include geologic contacts and faults, geologic polygons, fold axis lines, strike and dip (bedding) points, and any other relevant layers as needed. 1:24,000 Scale GIS DATA for a block of 13 7.5-minute quadrangles, displayed on one map sheet at 1:100,000 scale. See individual publication records for more information about each quadrangle: Artemas, Bellegrove, Big Pool, Cherry Run, Cresaptown, Cumberland, Great Cacapon, Hancock, Lonaconing, Oldtown, Patterson Creek, Paw Paw, Stotlers Crossroads MAP-X10(GM-1), OF-9502, OF-9503, OF-9504, OF-9505, OF-9701, OF-9702, OF-9703, OF-0504, OF-2403.

DDS-10 Digital Compilation of the 1:24,000 Scale Bedrock Geologic Maps of the West Virginia Portion of the Front Royal 1:100,000 Scale Quadrangle, Hardy County, West Virginia:

WVGES, S.E. El-Ashkar, S.E. Gooding, and D.L. Spurgeon, 2024, 1 maps, 1:24,000, 30" x 20". Digital compilation of 3 1:24,000 Scale Map and Open File Geologic publications originally published 1985 - 1992, into one internally edgematched geodatabase for GIS. Digitized map layers include geologic contacts and faults, geologic polygons, fold axis lines, strike and dip (bedding) points, and any other relevant layers as needed. 1:24,000 Scale GIS DATA for a block of 6 7.5-minute quadrangles, displayed on one map sheet at 1:100,000 scale. See individual publication records for more information about each quadrangle: Bergton, Lost City, Lost River State Park, Orkney Springs, Wolf Gap, and Woodstock MAP-WV26, MAP-WV37, OF-9201.

OF2401 Bedrock Geologic Map of the Bruceton Mills, Brandonville, and Friendsville (WV Portion) 7.5' Quadrangles, Preston County, West Virginia:

J.K. Tudek, E.C. Rhenberg, D.L. Spurgeon, S.E. El-Ashkar, H.E. Sphar, S.J. Hostetler, M.R. Urse; Digital Cartography by S.E. Gooding, 2024, 1:24,000 scale, 9 p, 42" x 65", full color map shows geology and structure, strike/dip. Map layout includes legend, cross sections and stratigraphic column. Text in booklet. Files for GIS available.

OF2402 Bedrock Geologic Map of the Moundsville and Majorsville 7.5' Quadrangles, Marshall County, West Virginia:

E.C. Rhenberg, J.K. Tudek, D.L. Spurgeon, S.E. El-Ashkar, M.R. Urse, H.E. Sphar, P.A. Dinterman; Digital Cartography by S.E. Gooding, 2024, 1:24,000 scale, 9 p, 42" x 58", full color map shows geology and structure, strike/dip. Map layout includes legend, cross sections and stratigraphic column. Text in booklet. Files for GIS available.

OF2403 Bedrock Geologic Map of the Mineral County Portion of the Cresaptown and Cumberland 7.5' Quadrangles, West Virginia:

J.W. Perkins, H.E. Sphar, P.A. Dinterman, R.R. McDowell, S.E. El-Ashkar, and R.E. Carte, Jr.; Digital Cartography by S.E. Gooding, 2024, 1:24,000 scale, 12 p, 42" x 50", full color map shows geology and structure, strike/dip. Map layout includes legend, cross sections and stratigraphic column. Text in booklet. Files for GIS available.

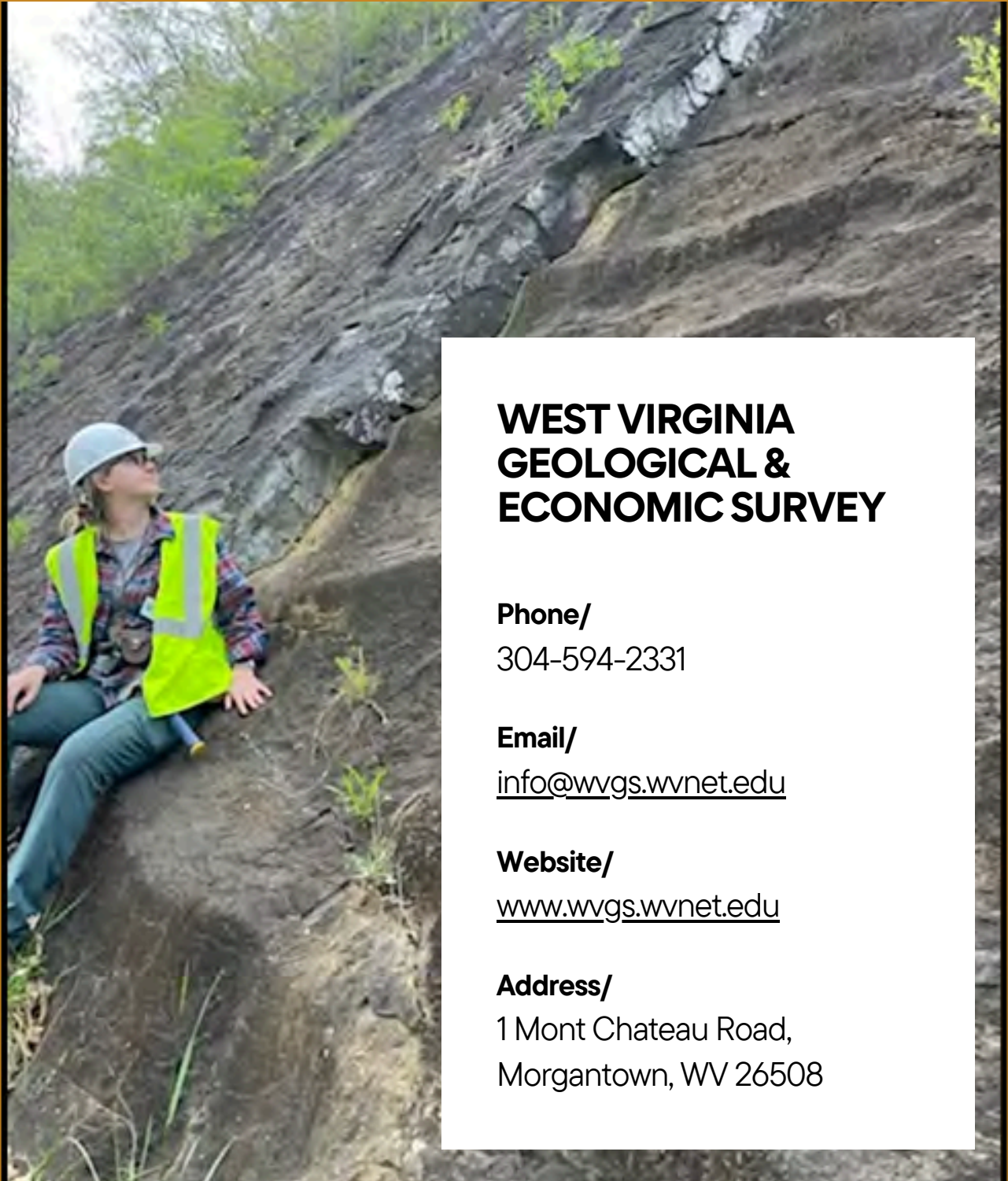
RI-37 Regional Investigation of Rare Earth Element-Enriched Underclay Deposits in the Central and Eastern United States: an Earth Mapping Resources Initiative (Earth MRI) Geochemical Reconnaissance Study:

J. Moore, H. Hanna, B. Royce, G. Daft, Jr., W. Andrews, C. Eble, S. Brown, 2024, 31 p, 15 f, 1 table, 964 p Appendix. The U.S. Geological Survey's (USGS) Earth Mapping Resources Initiative (Earth MRI) works to identify mineralized areas or deposits across the United States that may host critical minerals to be utilized as a domestic resource. Aluminum-rich clays associated with coal horizons in Pennsylvanian-age strata occur throughout the Appalachian Plateau Province, the Central Appalachian Basin, and the Illinois Basin and have the potential to be low-grade, large-volume, critical mineral feedstocks. Understanding of the distribution of metals in varying lithologies and stratigraphic positions is limited by data density and a lack of modern geochemical data. Led by the West Virginia Geological and Economic Survey and including the participation of eight state geological surveys, a multi-year, regional reconnaissance study collected over one thousand stratigraphic and spatially representative underclay samples in the Appalachian and Illinois Basins. The samples were collected from both core and outcrops and were analyzed by the USGS and are presented in this peer-reviewed report. The full publication is being freely distributed on the WVGES web site:

https://www.wvgs.wvnet.edu/wvges2/publications/PubCat_FreeDownloadablePublications.aspx



WVGES geologist examining the cross-bedding in the Upper Raleigh Sandstone of the New River Formation (Pennsylvanian Pottsville Group) on Route 60 - Rainelle quadrangle



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