West Virginia
Geological Survey

2018 ANNUAL REPORT

WEST VIRGINIA

Cover Photos

Top: Salina F-4 Salt core from PPG Industries Brine Well #36 (API #4705100674) in Marshall County *(Photo by J. Moore)*

Inset: Jointing in the Greenbrier Limestone as seen from Otter Creek Bridge, Randolph County *(Photo by J. Britton)*

Undated post card from the days when Mont Chateau was a State Park (*Boston Public Library Tichnor Brothers collection*)

West Virginia Geological and Economic Survey

Mont Chateau Research Center

1 Mont Chateau Road

Morgantown, WV 26508-8079

Phone: (304) 594-2331

FAX: (304) 594-2575

E-mail: info@geosrv.wvnet.edu

Web Site: http://www.wvges.org

Montage of fossils, people, and field experiences (Photos by WVGES staff)

Greetings from the Director

B. Mitchel Blake, Jr., Ph.D., Director and State Geologist

The Mission of the West Virginia Geological and Economic Survey is to conduct long-term analysis of the geological formations and economic resources of the state, especially coal, oil, gas, and non-fuel minerals, and to provide expertise and information to the citizens of West Virginia regarding those resources and the geological environment through direct contact, publications, and web-based applications.

It has been a year of change at the Survey. Former Director Michael Hohn retired at the end of 2017 after 11 years of service in that position and I was honored to be appointed to replace him. I am looking forward to the challenges facing me as I step into Mike's shoes. During the year, the Survey participated in many projects that increase our understanding of the State's abundant geologic resources. Sadly for the Survey, two long-serving, senior geologists, Scott and Jane McColloch, retired at the end of October, marking the beginning of what I call the "Boomer Bust" that will result as the Baby Boomers on our staff retire. Analysis of the Survey's current staff suggests the possible loss of 30% of the professional staff over the next several years due to retirements alone. This loss of institutional knowledge will be painful and severe. On a more positive note, State funding has stabilized, allowing cogent planning for the future. The Survey continues to provide easy public access to many aspects of the State's geology through our comprehensive website (www.wvges.org).

During Fiscal Year 2018, the Survey staff:

- Continued mapping all significant coal beds in the state and serving the results on our interactive web-based mapping application;
- Completed a study of the distribution of Rare Earth Elements (REEs) in West Virginia's coal beds and other strata;
- Located a potential non-coal source of REEs currently under investigation during FY2019;
- Completed mapping of the bedrock geology for four 7.5-minute quadrangles and started mapping in two new quadrangles targeting environmentally sensitive karst areas;
- Continued to expand our Mini-Museum. Drop in and visit our State Fossil!
- Continued to monitor production of hydrocarbons from the Marcellus and "Utica" shale units in the state; updated maps and spreadsheets are available for download from our website;
- Transferred over 20,000 plant fossil specimens to the National Museum for permanent preservation and study;
- Participated in the joint pilot effort of the WVU-USGS Appalachian Geoscience GeoCamp;
- Cooperated with WVU, Cornell University, and the University of California at Berkeley to identify low-temperature geothermal resources in northern West Virginia;
- Continued cooperative work as part of the Midwest Regional Carbon Sequestration Partnership, including assembly of a comprehensive petroleum fields database and regional cross-section;
- Cooperated with sister agencies, such as WVDEP, WVOMHST, and the WV Development Office on various projects.

Survey Partners: A portion of our budget supports the WV Geographic Information Systems (GIS) Technical Center at WVU and the Property Tax Division of the WV Tax Department, both of which provide important services to the citizens of the State. The WV GIS Tech Center continues to provide vital services by updating and adding new digital data layers to their system. This information is available to the public at no charge. In addition, the GIS Tech Center continually provides education and outreach, reports on various geologic hazards, and other aspects concerning West Virginia geography. Looking for hunting or fishing maps? Do you live on a flood plain? Worried about landslides? It is surprising how much information is available at www.mapwv.gov. All citizens are encouraged to visit this valuable website. The Property Tax Division continued their important task of statewide mapping of mineral parcel ownership and provided digital geospatial analysis for mineral parcel valuations.

Auger mining for coal (Photo by J. Britton)

COAL RESOURCES PROGRAM

Fiscal Year 2018 has continued to be busy for the Coal Program, with staff involved in a variety of activities including computer mapping, field mapping, sample collection, and public relations, all pertaining to geology in the Mountain State.

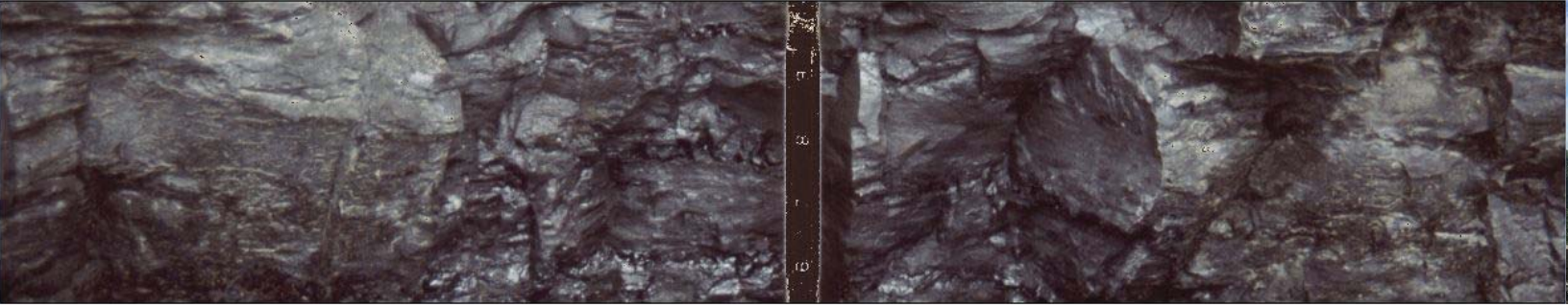
Coal Bed Mapping

Coal Program staff are involved in a multiyear project focused on remapping the Coal Measures of West Virginia. To date, the majority of the state has been completed, with small areas in the central and eastern portions of the state still pending. Map coverages for 85 coal seams and splits have been created; these include structural contour maps, mined and remaining areas by mining type, outcrops, study areas with associated grids showing total bed thickness, total coal thickness, and total partings thickness. Current staff efforts revolve around updating newly acquired mining data, adding new thickness and elevation data, and collecting coal and rock samples to add to WVGES's extensive coal sample repository and coal chemistry database, discussed below.

While the Coal Bed Mapping Program (CBMP) is nearing completion of its original tasks, acquisition of several thousand new mine maps required staff to redirect efforts to process them digitally, adding new mining footprints and associated thickness and elevation data to the CBMP database. Many thousands of new thickness and elevation points have been added which greatly improve and refine current coal bed maps. Staff continue to update coal parameter maps and serve all products to the public via the Survey's website: www.wvgs.wvnet.edu/www/coal/cbmp/coalims.html.

- **Mine Information Database System**
  Work continues on updating, expanding, and improving WVGES's Mine Information Database System (MIDS) as new mine maps, permits, and information become available. The MIDS database houses mine map information including location information (county and quadrangle), coal bed seam name, mine names, company names, permit numbers and other notes. MIDS contains records for every mine map publically available at WVGES and contains more than 48,000 documents with over 85,000 mines. Comments and submissions from the public are encouraged to make a better and more complete database.

- **Underground Mine Mapping Project**
  Geologists in the Coal Program worked in cooperation with West Virginia Office of Miners' Health Safety and Training (WVOMHST) in an employee time-match project to process various batches of "new" mine maps delivered to WVGES quarterly. Some of the new deliverables are of mines already represented in the WVGES database but they may contain additional information that needs to be added to the data model. WVOMHST has collected scanned images of vintage mine maps and property maps from various sources, including engineering companies, coal companies, and private



Coal lithotype (Photo by W. Grady)

individuals who possess legacy data. These quarterly updates provide us with an average of 500 new mine maps, and to date, several thousand new maps have been added to the system and are available to the public on our website at www.wvgs.wvnet.edu/www/coal/MIDS_Index.htm.

Service and Outreach

A major responsibility for the Coal Program is to answer questions and provide data to all parties interested in the Coal Measures and other rocks in West Virginia. The majority of queries are related to mining and mine subsidence and tax-related coal resource questions. Other commonly asked questions include general geology, paleontology, karst, non-fuel resources, landslides, geographic features, fossil and mineral identification, meteorite identification, precious metal deposits, and website content.

Staff geologists routinely speak to classes, individual students, and other groups on-site at WVGES, in schools, at state parks, and at other venues. Discussions include all aspects of West Virginia geology, including rocks, minerals, fossils, and specific topics requested by individual groups.

- **Paper map rescanning project**
  - **High resolution scanning** of existing paper mine maps housed at WVGES was completed during the fiscal year. Many of the original paper copies are on poor quality, acidic paper and are deteriorating. Many of the existing scans of these mine and property maps were of insufficient resolution to capture all the data from the maps. Therefore it was necessary to rescan the originals to ensure data preservation and data quality for future generations of industry and researchers. All of these data are available to the public.
  - **New additions** to the paper mine map collection have been scanned and added to the files as discussed above.

Bi-Yearly Updates

Coal Program geologists have been reviewing, updating, remapping, and conducting quality control for each mapped coal seam. Significant changes have occurred to many seam study area extents due, in large part, to the influx of data from the WVOMHST Underground Mine Mapping Project. New data sets have expanded the known extents of mining in some areas and have added specific documents in areas where there was known to be mining but no documentation existed previously. Improvements to the overall data model will provide more accurate information to users.

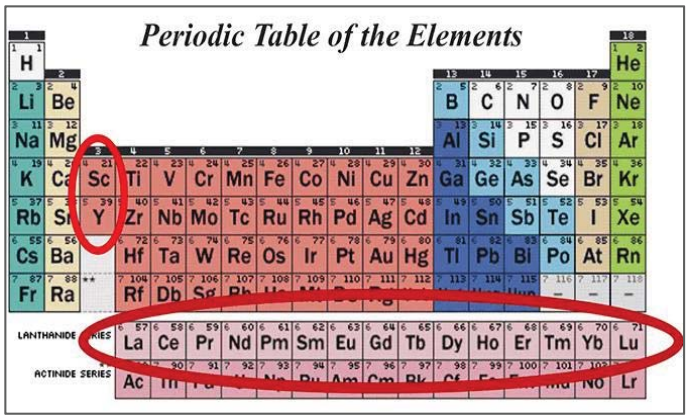
Coal Bed Chemistry Database

This fiscal year Program staff spent a significant amount of time integrating coal bed chemistry into the current Coal Bed Mapping Program's stratigraphic database, linking decades of recorded sampling to field book numbers. In addition to traditional coal chemistry data, rare earth element (REE) data were collected and analyzed as part of the increasing interest in REEs as a separate product stream from coal mining. The Coal Quality Database is not currently served directly to the public but specific queries are answered by Coal Program staff.

View of Blackwater Canyon from Lindy Point (Photo by J. Britton)

Rare Earth Elements (REE)

WVGES partnered with industry to investigate the relationship between Rare Earth Elements, plus yttrium and scandium (REE+Y+Sc), and coal seams. REEs are generally present in small concentrations in the Earth's crust rather than aggregated in minable deposits. They are extremely important in the manufacture of electronics, magnets for motors and turbines, catalysts, hybrid vehicles, petroleum refining, diesel additives, alloys, fuel cells, fiber optics, lasers, medical imaging, medical tracers, and fertilizers, among other things. Currently over 80% of REEs come from China. The project was funded with a grant awarded by the U.S. Department of Energy through the National Energy Technology Laboratory. It focused not only on coal seams but also on coal byproducts and adjacent associated materials – such as partings and interbedding – as well as roof and floor rock. Samples for analysis were selected from over 50,000 discrete locations identified from the Coal Bed Mapping Program, in addition to material samples instrumental in the collaborative REE+Y+Sc testing effort.



Periodic Table highlighting Rare Earth Elements with Yttrium and Scandium
(from Blogs of the European Geosciences Union)

The analytical results vary relative to the state's two broad regions, the Northern Appalachia Basin and the Central Appalachia Basin. The highest REE+Y+Sc concentration occurrence of >300 parts per million (ppm) in the Northern Appalachia Basin was found in Barbour County, primarily in the Lower and Middle Kittanning coal seams. Partings and roof samples represented 14% and 13%, respectively, of the 300+ ppm strata samples from these two coal seams. The distribution of REE+Y+Sc in the Central Appalachia Basin strata was somewhat different from that of the Northern Basin. The most frequent occurrence in the central basin was in the partings (40% of the >300 ppm samples), followed by the roof material at 28%. Overall, the area south of Charleston in the Central Appalachia Basin, encompassing southern Kanawha, Boone, Logan, and Mingo counties, accounted for the highest concentration of >300 ppm readings. Additional investigation is needed to understand the depositional characteristics of REE+Y+Sc within the coal strata matrix.

ArcGIS™ Enterprise Applications

Work continues on the Coal Program's implementation of ArcGIS™ Enterprise interactive mapping applications and Representational State Transfer (REST) map services, which provide web-based public access to all of the coal resource data layers. Currently 78 individual coal beds and splits are represented as online services containing information related to coal elevation, approximate overburden thickness, net coal thickness, total bed thickness, percentages of parting, and areas of mining by method. Features represented as underground mining in the map layers are further linked to the WVGES's searchable Mine

Geologists from the Coal Program examine an outcrop on Corridor H (US 48) in Grant County (Photo by B. Blake)

Information Database System (MIDS) which contains information on mine maps, including mine names, company names, location information and permit numbers. ArcGIS Enterprise can be accessed at http://atlas.wvgs.wvnet.edu/arcgis/rest/services/Coal_Web_Mercator/All_Mining_WM/MapServer.

Interagency Cooperation

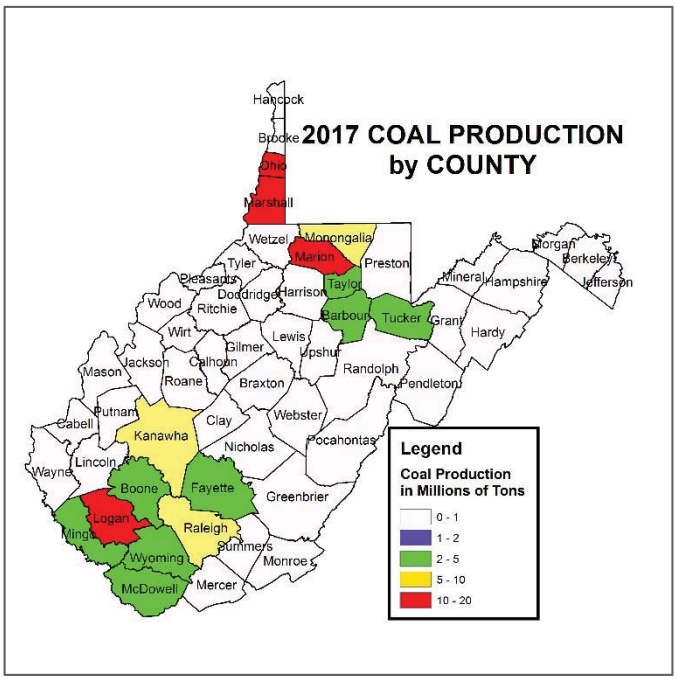
Cooperation with other state and federal agencies is an important aspect of the work conducted by the Coal Program. Program staff cooperated with the West Virginia Office of Miners' Health Safety and Training (WVOMHST), State Tax Department-Property Tax Division (WVSTD-PTD), Division of Highways (WVDOH), and Department of Environmental Protection (WVDEP) by providing information, data, and discussions on aspects of Carboniferous stratigraphy, coal geology, and general geology. The Coal Program has worked in cooperation with WVSTD-PTD to map newly-mined areas. They have documented mined-areas-by-method, and collected new information, including coal bed thickness and elevation data, permit numbers, drill hole locations, and outcrop information incorporating them into the various CBMP products. These data are continually updated and are available to the public in the Mine Information Database System (MIDS) at www.wvgs.wvnet.edu/www/coal/MIDS_Index.htm and are served in the GIS world by our ArcIMS site at www.wvgs.wvnet.edu/www/coal/cbmp/coalims.html.

Paleontology Service

Professional staff are available to identify rocks, minerals and fossils for interested parties. WVGES is fortunate that its Director is a professional paleobotanist/paleontologist and loves to identify mystery fossils. Many staff geologists make routine identifications as needed.

Paleontology services provided in FY2018 include:

- Identification of meteorite fragments (FYI, many fragments have been brought to the agency to be identified, but to date, none has been a legitimate meteorite fragment).
- Identification of plant and animal fossils for the public.
- Paleontological impact assessments prepared for studies to meet federal guidelines for pipeline construction.
- Peer review of paleobotanical articles for publication in professional journals.
- "Stump the Paleontologist" semiannual show at the Moundsville archeological site.

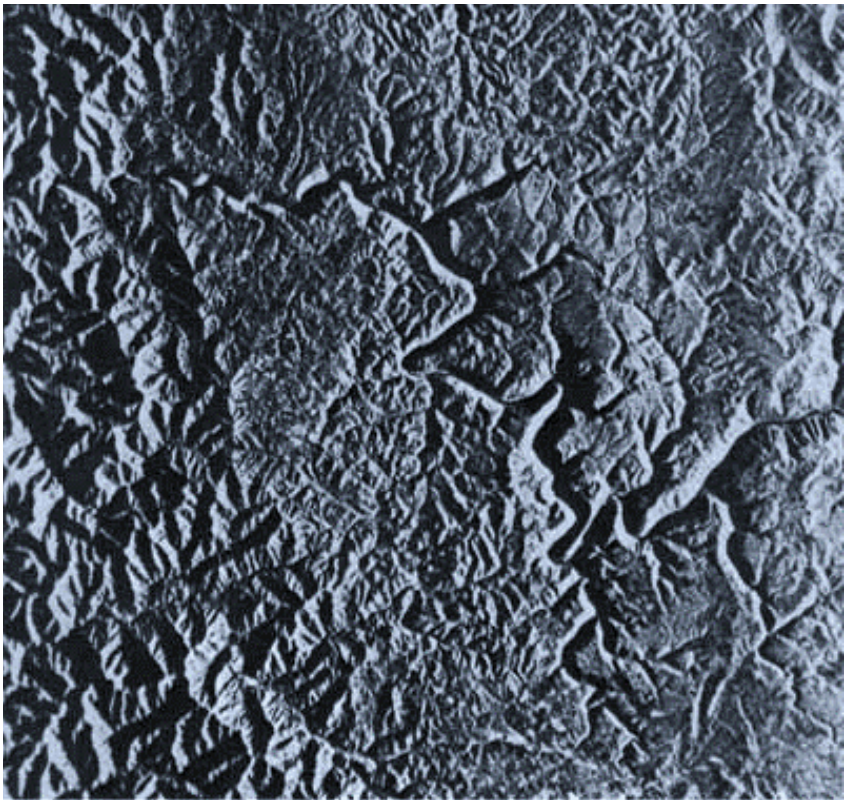


Coal produced in 2017 by county

Rock exposures along Corridor H at Mt. Storm (Photo by J. Britton)

Earth Science Information Center (ESIC)

The ESIC Program provides expertise on aerial photography, topographic features, geographic names, various "corporate" boundaries, and maintains an extensive collection of West Virginia aerial photography from as early as the 1930's. Although many of these images have been scanned and are available to all, currently there is no plan to serve these scans online due to their very large file size. Individual scans can be acquired on-site at the WVGES office in Morgantown.



Aerial image of the New River

The ESIC Program responded to approximately 300 service requests for various maps, aerial photography, geographic information, and geodetic information. The requests ranged from state residents to international groups and were used for ecological studies, environmental management studies, construction-site planning, environmental assessments, geologic mapping, recreation, and tourism in the Mountain State.

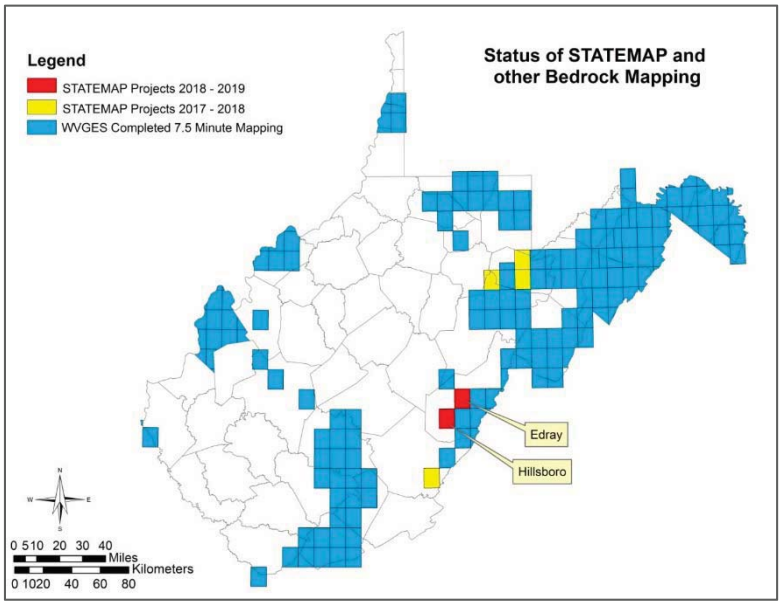
Geologist measuring strike and dip with a Brunton compass (Photo by B. Nugent)

GEOSCIENCE AND MAPPING PROGRAM

Geologic Mapping

Geologic Mapping at WVGES includes the direct acquisition of new geological information through field reconnaissance as well as the conversion of existing geological information from hard copy (paper, Mylar, etc.) to digital format.

- Acquisition of new geological data is carried out under the STATEMAP program funded jointly by the United States Geological Survey (USGS) and WVGES. During Fiscal Year 2018, WVGES geologists conducted field work on four projects in central, eastern, and southern West Virginia (Lead Mine, Montrose, Mozark Mountain, and White Sulphur Springs, the four 7.5-minute topographic quadrangles in yellow on the right figure). Published as WVGES Open File Reports, these data are available as paper maps, PDF files, and geographic information system (GIS) geodatabases. In August 2017, the STATEMAP Advisory Committee (Mapping Panel), composed of individuals from industry, government, and academia, met to evaluate new potential areas to map within West Virginia for the upcoming 2018 field season. In November 2017, WVGES submitted a proposal to the USGS and received partial funding to map the Edray and Hillsboro quadrangles in Pocahontas County (in red above) for Fiscal Year 2019.



Status of bedrock mapping projects in West Virginia for FY2018

Environmental Geoscience and Geochemistry

Environmental and geochemical work at WVGES deals primarily with the evaluation of geologic site characteristics for Underground Injection Control (UIC) permits for injection of fluids into the subsurface; the assembly of a database of selected metals content of the State's rock formations; and responding to inquiries regarding geology, surface water, groundwater, geologic hazards, and bedrock chemistry.

- Geochemical analyses for 47 rock samples were added to the existing stratigraphic geochemical database, bringing the total number of samples up to 1,153 and covering West Virginia rock units ranging in age from Precambrian through the Pennsylvanian. The database is available as a GIS layer that can be combined with or superimposed on other maps of West Virginia for use in environmental

Calamites fossil (Photo by G. McColloch)

and economic assessments of the near-surface bedrock of a particular geographic location. Because of interest in Rare Earth Elements (REEs), WVGES has increased the number of elements requested for analysis, which will be reflected in all future database entries.

Beginning in spring 2018, WVGES began examining petrographic thin sections made from drill core samples from Clay and Kanawha counties. This was followed by laboratory investigation of fracture and matrix permeability for the Tuscarora interval in a drill core taken from Preston County. More than 2,000 permeability measurements were taken from 270 feet of core using a new gas-injection permeameter acquired specifically for this project. Preliminary results of this investigation were submitted and accepted as a technical paper for the annual meeting of the Geothermal Resources Council, held in October 2018.

Geothermal Resources

During the fiscal year, WVGES participated in a U.S. Department of Energy (USDOE)-sponsored project entitled *Feasibility of Deep Direct Use Geothermal on the West Virginia University Campus – Morgantown, WV.* The goal of this ongoing project is to assess the possibility of replacing an existing gas-fired steam generation facility with one using geothermal formation water derived from a reservoir below the WVU campus in Morgantown. Geoscience personnel are tasked with investigating the reservoir characteristics of the Silurian Tuscarora Sandstone to help determine its suitability as an alternative energy source.

Seismic Monitoring

Two small earthquakes occurred in West Virginia during the fiscal year. Summaries of these and large (≥ 6.0 magnitude) earthquakes from around the world are posted on the WVGES website: www.wvgs.wvnet.edu/www/earthquakes/seismic.html.

The five seismic monitoring stations (not counting the permanent station at WVGES) remaining at the end of the Transportable Array Project continue to operate as part of the Central and Eastern United States Network (CEUSN) operated by the Incorporated Research Institutions for Seismology (IRIS) with funding from the National Science Foundation (NSF). Funding for this network has been extended through 2019.

Tiny, finely ornamented clam (Buchiola retrostriata) in the Devonian Millboro Shale, Greenbrier County (Photo by R. McDowell)

Outreach Activities

- In September 2017, Geoscience personnel conducted a two-day field trip in conjunction with the Eastern Section – American Association of Petroleum Geologists' meeting held in Morgantown. The purpose of the trip was to highlight the spectacular geology exposed by new construction along US 48 as part of the Corridor H Highway Project in eastern West Virginia.

Chartered bus for fieldtrip experiences engine trouble in Pendleton County; the joys of field work . . . (Photo by R. McDowell)

- Geoscience personnel participated in internet webinars and attended local and regional meetings featuring topics including digital mapping techniques, geological hazards, induced seismicity, and environmental issues related to oil and gas exploration and development, mine pool groundwater resources, protection of groundwater resources in karst regions, hazard mitigation, and disaster preparedness.

Geoscience and Mapping for FY2018 – *By the Numbers*:

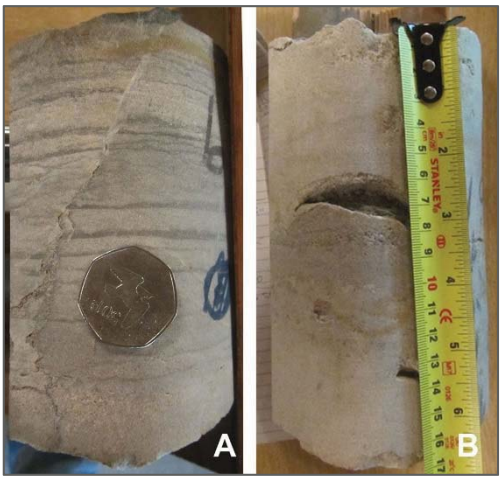
- **4** *new bedrock geologic maps completed*
- **2** *new bedrock geologic maps in progress*
- **6** *active seismic (earthquake) monitoring stations in the state*
- **1,153** *total number of rock samples analyzed geochemically (**47** new this fiscal year)*
- **2,262** *permeability measurements taken from Tuscarora drill core*
- **44** *Tuscarora thin sections analyzed*

- For overt 25 years, in cooperation with the West Virginia Division of Natural Resources, WVGES staff have visited selected state parks to give presentations on state and local geology. This fiscal year, a Visiting Geologist gave popular evening presentations at seven state parks on "The Geology of West Virginia" followed by a morning field trip on local park geology.

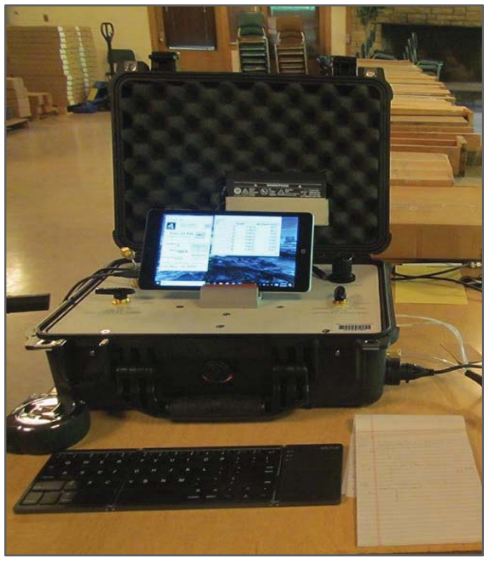
- Also as Visiting Geologists, Geoscience Program staff, gave presentations to school students in Preston County, judged Science Fair exhibits in December 2017, and hosted students on tours of the WVGES Mini-Museum.

- September 2017 was the annual fossil identification workshop at the Grave Creek Mound Museum in Moundsville where program staff identified fossils brought in by the public.

- Geoscience personnel taught evening classes in Geological Hazards and Historical Geology at Fairmont State University.



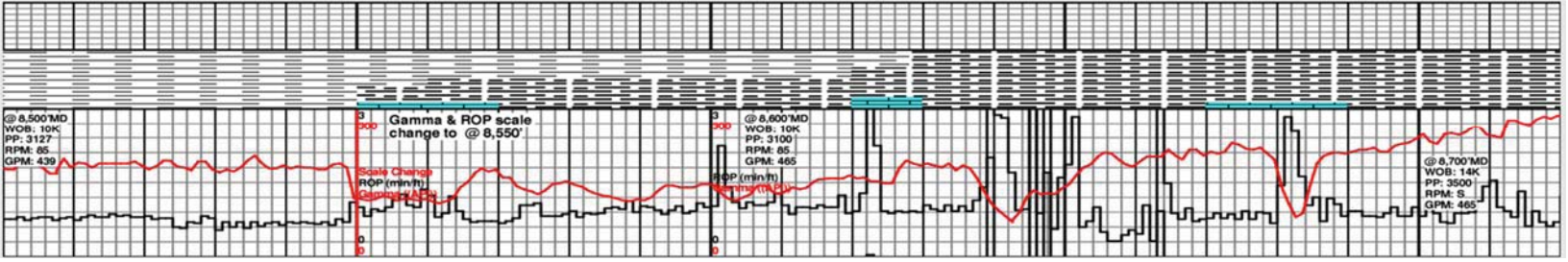
*Features observed in the Tuscarora Sandstone from well Preston 119. **A)** Nearly vertical stylolite (pressure solution feature); **B)** Large, open void from more than 7,000 ft. below the surface.*



Gas-injection permeameter in operation, taking a measurement on a portion of Tuscarora Sandstone from a drill core.

Geoscience Education Website

Geoscience Education Outreach continues to operate a digital program providing K-12 teachers with products designed for their classroom use. The link to this information on the WVGES website is www.wvgs.wvnet.edu/www/geoeduc/geoeduc.htm.



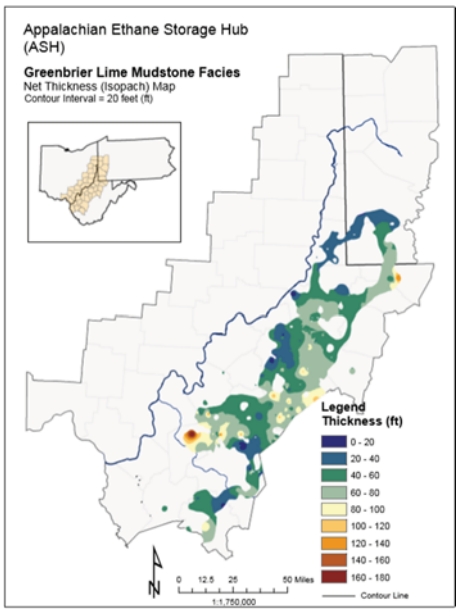
Portion of a gamma ray and rate-of-progress (ROP) log used to geo-steer a "horizontal" Marcellus well. Note the thin beds of limestone within thicker beds of dark gray and black shale.

OIL and GAS PROGRAM

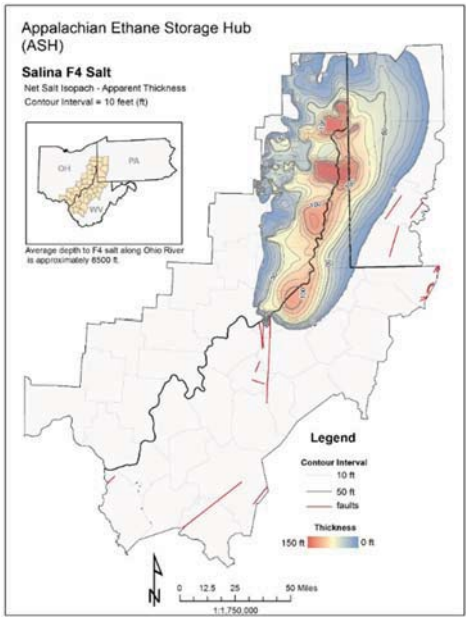
Appalachian Storage Hub

During fiscal year 2018, staff in the Oil and Gas Program participated in a major research project to identify potential locations for subsurface storage of natural gas liquids (NGLs) including ethane, used in making plastics. The study, which concluded in July 2017, was funded by the Claude Worthington Benedum Foundation with matching funds provided by thirteen industry partners. The Appalachian Oil and Natural Gas Research Consortium (AONGRC), a program of the West Virginia University Energy Institute's National Research Center for Coal and Energy, conducted the research.

Dubbed the Appalachian Storage Hub (ASH) Project, the team included researchers from the Ohio, Pennsylvania, and West Virginia geological surveys with administration by AONGRC. The goal of the study was to characterize all potential options for subsurface storage of liquid ethane and other NGLs along and adjacent to the Ohio River from southwestern Pennsylvania to eastern Kentucky, with a similar study along the Kanawha River in West Virginia. This involved the mapping and identification of areas of the Greenbrier Limestone at least 40 feet thick and suitable for hard-rock mining (see left figure); mapping and identification of areas where the Salina F4 salt is at least 100 feet thick and suitable for solution mining (see right figure); and mapping the thickness and extent of sandstone reservoirs in depleted gas fields that could be converted to NGL storage.



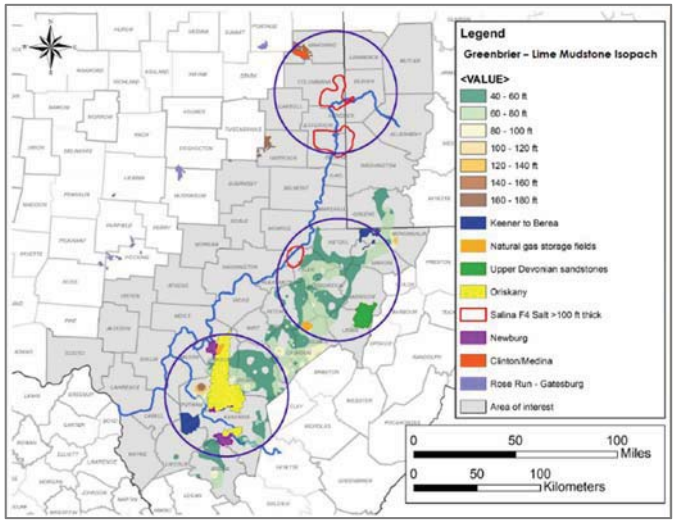
Thickness map of lime mudstone, an attractive target due to low porosity and high mechanical strength in the ASH study area



Isopach map (equal thickness contours) of the Salina F4 salt, the thickest salt unit of the Salina in the ASH study area.

The study was completed July 31, 2017 and delivered three main products: a regional subsurface geologic investigation of all geologic units of interest; a detailed reservoir characterization effort, including field-level studies; rating criteria used to screen candidate fields; the final ranking of storage candidates and presentation of three prospect areas (see figure next page); and a publicly-accessible website from which these items are served. The ASH Project web page has had more than 3,000 page views since its launch, with more than 11,000 hits. The website, created and maintained by the WVGES Information Services Program, can be found by visiting www.wvgs.wvnet.edu/ash.

Top of limestone quarry in Preston County (Photo by G. McColloch)



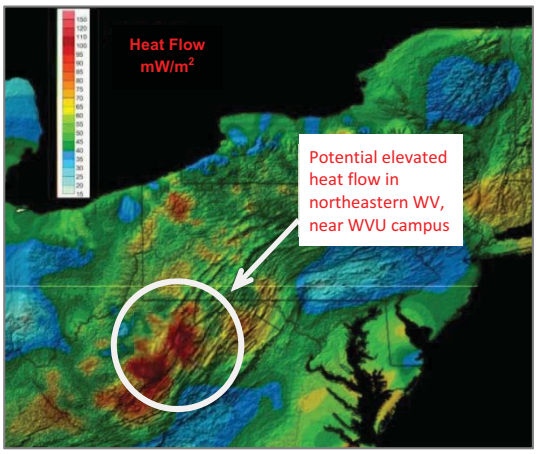
Three prospective areas for subsurface storage of NGLs identified during the ASH project: the Salina F4 salt in the northern portion; minor salt, moderate thicknesses of lime mud, and relatively shallow depleted gas fields in the central portion; and deeper gas fields along with thick intervals of lime mud in the southern portion of the study area.

Tuscarora Sandstone: Natural Analog for CO_2 Storage

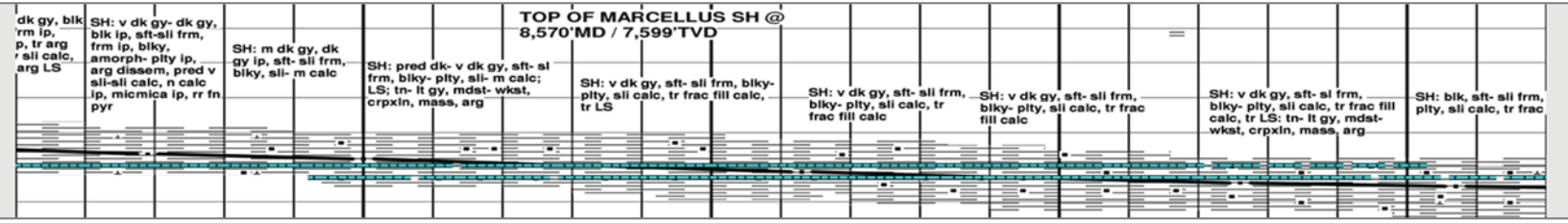
The Tuscarora Sandstone forms some of West Virginia's most impressive peaks, including the iconic Seneca Rocks. In that location, the exposed hard, white, super-mature, quartz sandstone is nearly vertical, but in FY2018 WVGES geoscientists worked on two intriguing subsurface studies of Tuscarora having much different properties. The first, a study of the natural occurrence of carbon dioxide in the Indian Creek field in Kanawha County, looks at the reservoir as a natural analog for carbon storage. The carbon dioxide (CO_2) in this field is generated by natural processes as part of the gas stream and is one of the only fields in the eastern United States to do so.

Understanding how the CO_2 formed in the Indian Creek field, the mechanisms by which it was trapped, and how production of the CO_2 can affect wellbore integrity is the focus of a three-year study conducted by WVGES and Battelle Memorial Institute and funded by the U.S. Department of Energy. The study, which concluded in September 2018, examined and compared well records, geophysical logs, thin sections, and geochemical analyses from wells both inside and outside of the Indian Creek field. An additional component of the proposed research, to test the sustained casing pressure of some of the wells, was unable to be completed due to lack of access to the production wells.

A second study of the Tuscarora, this time in northern West Virginia, looks at another unique feature of the reservoir—its ability to serve as a geothermal heat source for West Virginia University. The Tuscarora sits approximately 10,000 feet below the surface near Morgantown and is in proximity to a geothermal hot spot identified in Southern Methodist University's Geothermal Laboratory Heat Flow Map of the Conterminous United States (see right figure). Working in coordination with the West Virginia University Energy Institute, WVGES will investigate the porosity and permeability of the Tuscarora and work with project scientists at WVU, Cornell University, and the University of California at Berkeley to develop geologic and heat flow models of the reservoir.



Enlargement of Southern Methodist University's map of geothermal heat flow showing West Virginia (Blackwell et al., 2011).



Portion of a gamma ray and rate-of-progress (ROP) log used to geo-steer a "horizontal" Marcellus well. Note the thin beds of limestone within thicker beds of dark gray and black shale.

The Marcellus and Utica Shale Plays: What's In a Name?

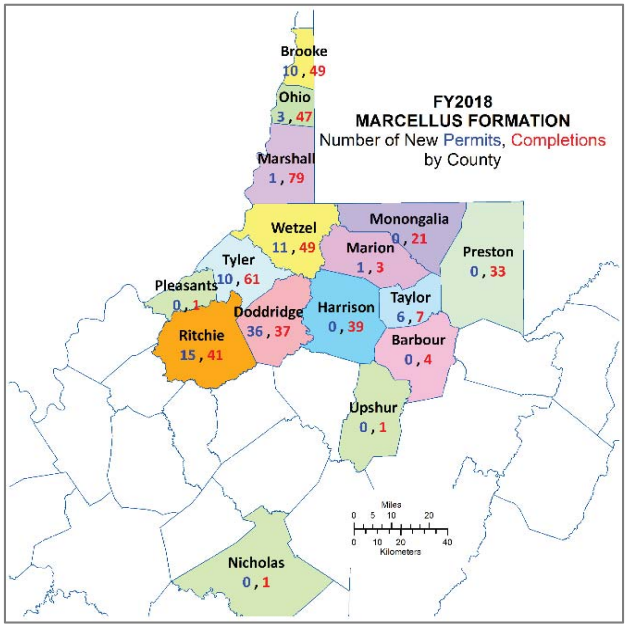
The first oil and gas wells were drilled in West Virginia more than 150 years ago. In the early days of the industry, new drilling locations were chosen with little to no background information or scientific forethought. Drillers devised their own names for the units they encountered, which led to development of highly localized lexicons. Incorporating these naming conventions into formal stratigraphic nomenclature is a difficult task, but is essential to understanding the geologic framework of the state and region.

Report of Investigations 35 (RI-35)

is available in its entirety for free download from the WVGES website at http://www.wvgs.wvnet.edu/www/MUDvnnSh/MUDvnnSh.htm, and includes the report text, 31 figures (including 19 isochore maps), ten gamma-ray geophysical well log lithostratigraphic cross-sections, an interactive mapping application, and a spreadsheet containing stratigraphic unit depths and interval thicknesses.

To this end, WVGES achieved a major milestone in fiscal year 2018. WVGES Geoscientist Susan Pool, working in collaboration with Dr. Ray Boswell (U.S. Department of Energy-National Energy Technology Laboratory), developed and published a revised lithostratigraphy of Middle and Upper Devonian organic-rich shales in West Virginia. This publication, WVGES Report of Investigations 35 (RI-35), develops a statewide formalization of the stratigraphic nomenclature focusing on the Marcellus and other organic-rich Devonian shales. Through this detailed characterization of the distribution and thickness of not only the organic-rich shales, but also the intervening siliciclastic and carbonate units, a revised and enhanced lithostratigraphic framework is developed.

One major finding of the research contained in RI-35 is the recognition of several distinct, regional, lithostratigraphic units within the Marcellus Shale in northern West Virginia, including a lower Union Springs Member, a middle Cherry Valley Member, and an upper Oatka Creek Member. Recognition of these regionally-mappable units elevates the Marcellus to formation status. Thus, the Marcellus Formation replaces the "Marcellus Shale" in West Virginia's formal lexicon.



Number of Marcellus wells permitted and completed this fiscal year

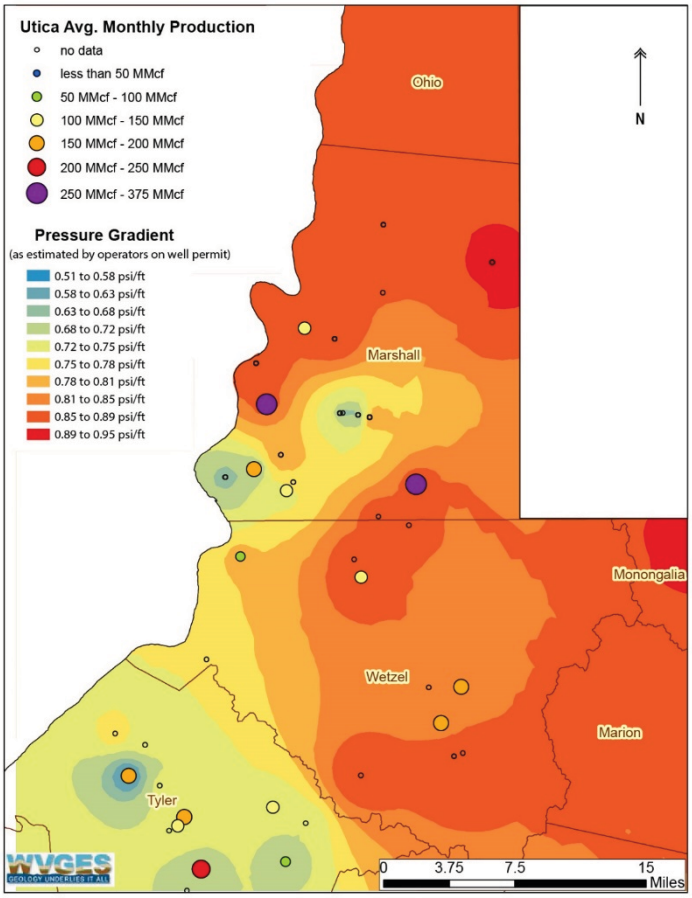
Hydrocarbon development of the Marcellus Formation continues to lead all other drilling in West Virginia. In FY2018, ninety-three wells were completed in the Marcellus (see right figure), with an additional 473 permits issued. A majority of the wells completed during FY2018 were located in Doddridge County, many of which are precisely located and spaced for maximum production from the reservoir—a far cry from the relatively random drilling of old.

A WVGES geologist examines an outcrop (Photo by B. Nugent)

Approximate lateral length ranges from 3,119 ft. to 12,391 ft., with an average lateral length of 8,287 ft. The number of completion stages ranges from 14 to 83, with an average of 40 stages per well.

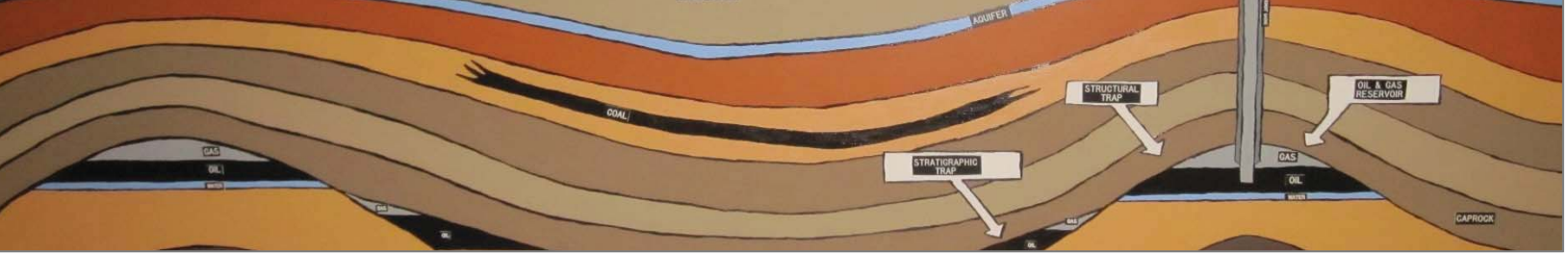
The Utica shale play trails the Marcellus in terms of drilling activity as well as adoption of a formal stratigraphic nomenclature. The drilling target in the "Utica" is actually the Ordovician Point Pleasant Formation and may also include the Logana Shale Member of the Lexington/Trenton Formation. Terminology for these units is pulled from neighboring states such as Ohio and Kentucky as the names Point Pleasant and Logana are still considered to be drillers' terms, rather than formal names, in West Virginia. The Utica Shale Play book is available on the WVGES website at www.wvgs.wvnet.edu/utica/playbook/index.aspx.

Understanding the distribution of the individual shale units in the "Utica" lags behind the Marcellus for several reasons. The Utica/Point Pleasant is a deeper target, which increases drilling costs and limits the number of wells that can be economically drilled. It is positioned stratigraphically below the Salina Formation, a thick and complex succession of halite, anhydrite, shale, and limestone, and so the unpredictable bedding of the Salina, coupled with complexities of fluid-based drilling through evaporites, also increases drilling costs. In addition, once the borehole reaches its target, the formation itself presents challenges. Original reservoir pressures in the Point Pleasant, as estimated by operators on well permit documents, are greater than 10,000 pounds per square inch (psi), with pressure gradients ranging from 0.53 psi/ft. to a staggering 0.95 psi/ft. (see left figure).



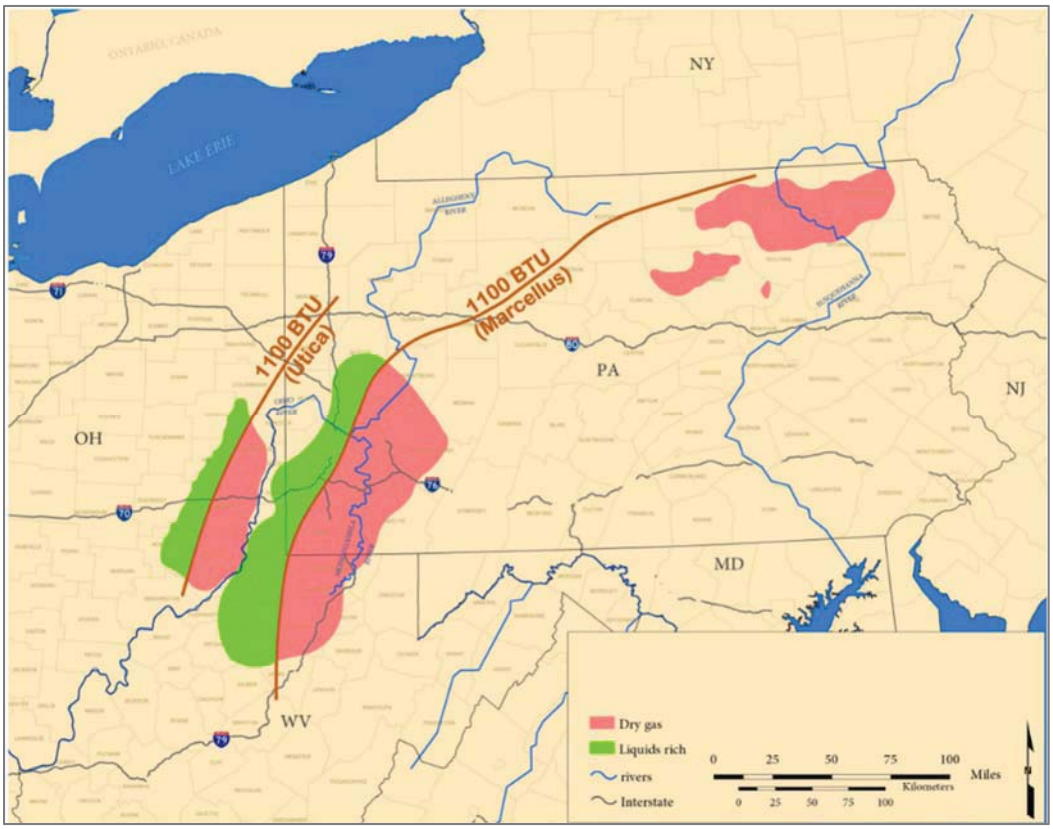
Utica/Point Pleasant pressure gradients reported on permit applications; most interpreted to be highly overpressured. Monthly production totals, while variable, are generally higher in areas of higher pressure.

For those companies willing to assume the additional drilling risk, the Utica/Point Pleasant presents an attractive target. At the conclusion of FY2018, WVGES records show 16 Utica/Point Pleasant wells are on-line and reporting production. Cumulative production at the end of calendar year 2017 for these 16 wells is more than 54.6 billion cubic feet (Bcf), and most of the wells have been online for fewer than three years. Annual production for 2017, the latest year for which production data are available, is 18.8 Bcf, with individual well production totals ranging from 4.1 Bcf to 0.128 Bcf.



Close up of an oil and gas display at the WVGES mini-museum

The gas stream in the Utica/Point Pleasant near West Virginia is methane; the wet/dry gas boundary for the "Utica" is located west of the Ohio River (see right figure). That a single well could produce more than 4 Billion cubic feet of gas in a single year was unthinkable just a few years ago, and is a testament to both advances in drilling technology and the incredible resource potential of Appalachian basin shale gas reservoirs.



Generalized dry gas (pink) and wet gas (green) areas in both the Marcellus and Utica shale gas plays, delineated by an 1100 British Thermal Unit (BTU) threshold. Note that the Utica dry gas region extends east into West Virginia and north into Pennsylvania, which is not shown on this map (Image from Antero Resources)

Rogersville Shale: Testing the Limits of Technology

At target depths nearing or exceeding 14,000 ft., the Cambrian Rogersville shale is the oldest and deepest shale gas reservoir currently under investigation in West Virginia. Cabot Oil and Gas Corporation drilled an exploratory well, or wildcat, in Putnam County in 2014, and a second well was subsequently permitted by Hard Rock Exploration in close proximity to the wildcat well. The second well was cancelled in fiscal year 2018. Completion information for the wildcat well, the Cabot 50 (API number 4707901538), was recently released by the West Virginia Department of Environmental Protection, and indicates that the vertical well was completed in both the Rogersville shale and the Cambrian Conasauga Group. The well is currently shut-in, so the mystery of which unit(s) may be producing hydrocarbons is yet to be unraveled. An overview of the Rogersville can be found on the WVGES web site at www.wvgs.wvnet.edu/www/presentations/posters_presentations.htm#Cambrian.

INFORMATION SERVICES PROGRAM

The Information Services Program is responsible for publications, the agency's website, maintaining the agency's network infrastructure and desktop operations, developing interactive mapping applications, and programming applications in support of other programs' projects. The Marcellus *Shale* is now officially the Marcellus *Formation* in West Virginia, and future publications will reflect the new name.

Public-Access Systems and Services:

- **Website**: The following were added to the Survey's website, www.wvges.org, during FY2018:
  - 2016 oil and gas well production data
  - Scientific Posters with abstracts:
    - *Trenton/Point Pleasant/Utica core from Wood County, WV The Sandhill Well, Power Oil Company Well #9634 (API #4710700351)*, Jessica Pierson Moore; poster presented at the Eastern Section - American Association of Petroleum Geologists (ES-AAPG) Meeting, September 2017.
    - *Salina F-4 Salt from Marshall County, WV. PPG Industries Brine Well #36 (API #4705100674),* Philip A. Dinterman; poster presented at the Eastern Section - American Association of Petroleum Geologists (ES-AAPG) Meeting, September 2017.
    - *Cross Sections from the Midwest Regional Carbon Sequestration Partnership: Visualizing Subsurface Carbon Storage Opportunities Across the Central and Eastern United States*, Philip Dinterman, Jessica Pierson Moore, J. Eric Lewis, Stephen F. Greb, Kenneth G. Miller, and William J. Schmelz; poster presented at the Geological Society of America (GSA) Annual Meeting, October 2017.
- **Research Reports posted on the Website**:
  - 2016 Marcellus Shale Production and Utica Information, Philip Dinterman.
- **Website pages** updated during the fiscal year include Earthquakes/Seismicity, STATEMAP Geologic Mapping, Geologic Maps of West Virginia, WV Broadband Map, Maps and Map Files, Oil/Gas Well Data DVD, Marcellus/Devonian Shale, Utica Shale Play Book, Appalachian Storage Hub Project, Summary Data, Geoscience Education Resources, Visiting Geologists at State Parks, News, Job Openings, and Mini-Museum.
- **Web-services** updated during the fiscal year include the oil and gas well ***"pipeline"*** service, ***"Pipeline-Plus"***, the daily update of Excel spreadsheets for Marcellus shale wells and horizontal wells, Scanned Well Logs, Coal Bed Mapping Project, MIDS (Mine Information Database System), and Scanned Mine Maps.

By the Numbers . . .

Website:

- *More than 3,000 static and dynamic web pages*
- *823,070 website visits*
- *22,680,910 page views*

Staff Service Requests:

- *Survey staff responded to more than 4,750 requests for information from the public, government agencies, business and industry, and education/academia.*

Fold in the Foreknobs Formation in Greenbrier County (Photo by P. Hunt)

- **Web-based interactive mapping applications** added or updated during FY2018 include:
  - Geology of the Marcellus Shale, Utica Shale Play, WV Oil and Natural Gas Wells, and the Coal Bed Mapping Project (updated; nearly 80 maps).
  - Interactive mapping applications on the WVGES website include: All (Coal) Mining Map and Coal Bed Mapping Project (nearly 80 maps), WV Oil and Natural Gas Wells, Appalachian Basin Tight Gas Plays, Utica Shale Play, Geology of the Marcellus Shale, Regional Geology of the Ordovician Trenton-Black River Formations, WV Geothermal Map, Broadband Mapping Project, A Geologic Transect Across West Virginia, and the Topographic Map Index.
- **Facebook** page: total posts – 35, total reach – 7,862 people, total clicks on the posts – 928, total page "Engagement" – 279.
- **Updates** made to the ***"pipeline"*** online oil and gas well data system reflect additions made to the well database.

IT Support and Professional Development:

- Program staff expanded programming to support the development and enhancement of project applications, databases, interactive mapping applications, and management of network infrastructure. Plans were underway to implement a faster internet data circuit for the agency.
- Geologist/GIS Programmer-Analyst Susan Pool co-authored a manuscript and associated GIS webpage on the lithostratigraphy of Middle and Upper Devonian organic shales in West Virginia, an extension of her earlier work on the Marcellus Shale in the state.

New Publications in FY2018

AR-2017 – ***Annual Report: Fiscal Year 2017***

RI-35 – ***Lithostratigraphy of Middle and Upper Devonian Organic-Rich Shales in West Virginia***, by R.M. Boswell and S.E. Pool

FTG-9 – ***What the H!?? Paleozoic Stratigraphy Exposed, Pre-Meeting Field Trip Guide for the 46th Annual Meeting, Eastern Section of the American Association of Petroleum Geologists (ESAAPG), Morgantown, WV, Sept. 24 & 25, 2017***, by P.J. Hunt, R.R. McDowell, B.M. Blake Jr., J. Toro, and P.A. Dinterman

FTG-10 – ***Appalachian Basin Stratigraphy, Tectonics, and Eustasy from the Blue Ridge to the Allegheny Front, Virginia and West Virginia***, by J.T. Haynes, A.D. Pitts, D.H. Doctor, R.J. Diecchio, and B.M. Blake Jr.

OF-1305 – ***A Preliminary Natural Gas Resource Assessment of the Marcellus Shale for West Virginia Using Basic Geologic Data and GIS***, by S. Pool

OF-1702 – ***Bedrock Geologic Map of the Montrose 7.5' Quadrangle, West Virginia***, by G.H. McColloch, J.S. McColloch, S.E. Gooding; Digital Cartography by S.E. Gooding

OF-1703 – ***Bedrock Geologic Map of the Lead Mine 7.5' Quadrangle, West Virginia***, by J.S. Chapman, J.W. Perkins, J.Q. Britton, R.J. Johnson; Digital Cartography by S.E. Gooding

OF-1704 – ***Bedrock Geologic Map of the Mozark Mountain 7.5' Quadrangle*, West Virginia**, by J.W. Perkins, J.S. Chapman, R.J. Johnson, J.Q. Britton, B.L. Nugent, G.W. Daft, Jr.; Digital Cartography by S.E. Gooding

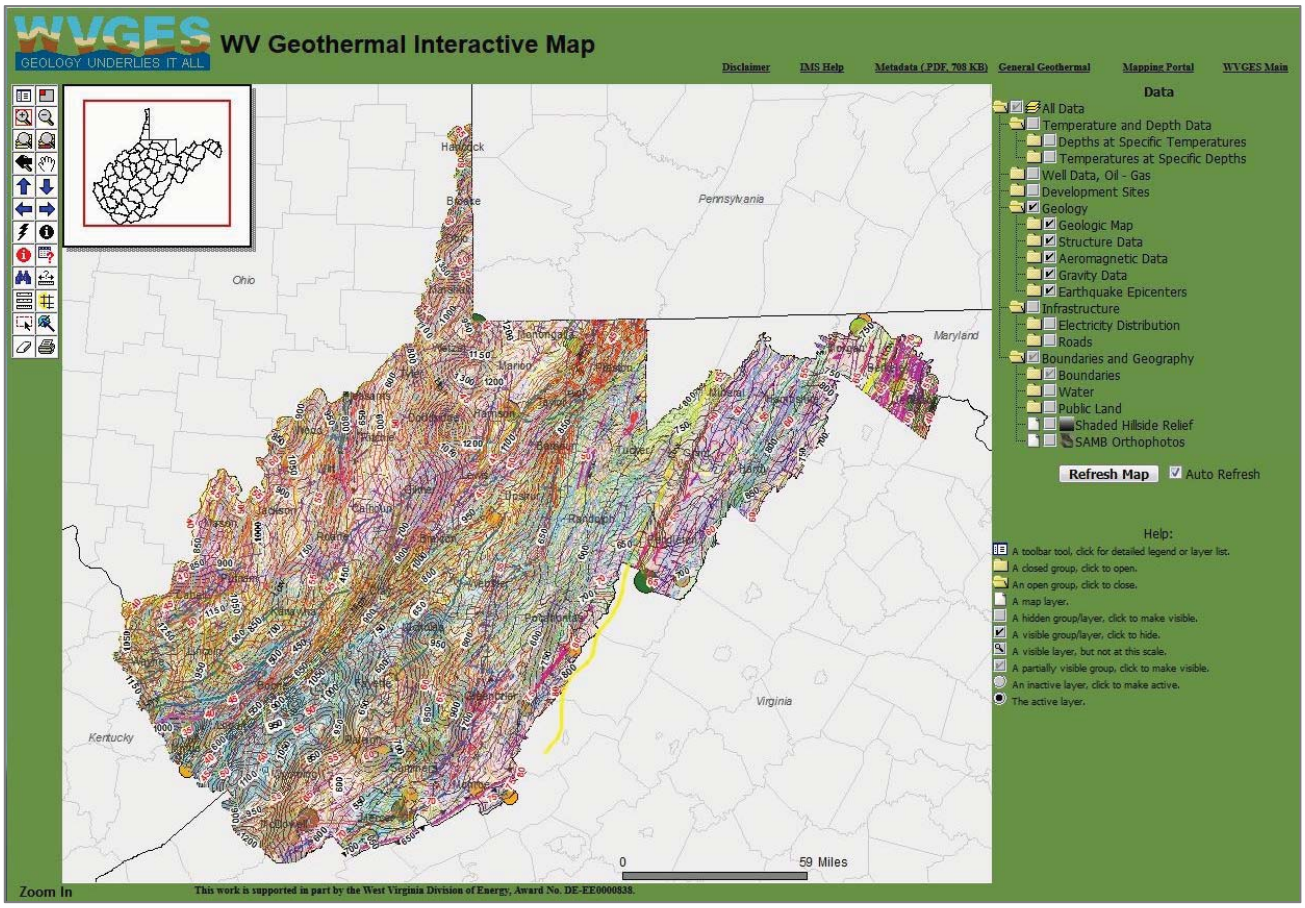
OF-1705 – ***Bedrock Geologic Map of the White Sulphur Springs 7.5' Quadrangle, West Virginia***, by P.J. Hunt, R.R. McDowell, M.S. Burns; Digital Cartography by S.E. Gooding

Publications Updated in FY2018

DDS-5 – ***WVGES Oil and Gas Well Data for West Virginia***, May 2018

Bobs Ridge Sandstone with Tioga Ash in Greenbrier County (Photo by P. Hunt)

- Services to Agencies: Staff prepared customized data analysis files requested by the WV Department of Environmental Protection - Division of Air Quality for their use in the preparation of reports to federal agencies. Staff analyzed and processed data for a database and interactive applications for the Broadband Enhancement Council.
- Program staff serve on the following committees: the State Information Technology Council (representing the Department of Commerce); the WV GIS Steering Committee; and the WV Association of Geospatial Professionals Communications Committee, Conference Committee, and Board of Directors.
- Staff designed and staffed a display booth at the annual "WV GIS Day" at the Legislature.



WV Geothermal Interactive Map with geology base layer shown (http://ims.wvgs.wvnet.edu/WVGeothermal/)

The dinos in their holiday hats at the WVGES mini-museum (Photos P Hunt)

WVGES Mini-Museum:

- The Mini-Museum housed in the Survey's office lobby and its associated web pages continue to be an important part of WVGES's outreach and educational programs. Museum displays continue to inspire and educate teachers, students, and visitors. The Mini-Museum is free and open to the public from 8:00 am until 5:00 pm Monday through Friday (except on State holidays). While no appointment is needed to visit the museum, organizations/groups/classes may request a guided tour in advance of their visit. The Mini-Museum can be found on the website at: http://www.wvgs.wvnet.edu/www/museum/museum.htm

- The skeletal reconstruction of West Virginia's State Fossil, ground sloth *Megalonyx jeffersonii*, has been repaired and is again on display in the WVGES lobby. This 9-foot-tall, 12-foot-long skeleton is one of the museum's most popular exhibits and provides a direct link to Thomas Jefferson, who first described *Megalonyx* in 1799. The claw bones that Jefferson described were found in a Monroe County cave and have recently been Carbon-14 dated at about 38,000 years. The skeleton is the only one on display in the State.

Megalonyx jeffersonii in the WVGES lobby in Morgantown (Photo by P. Hunt)

- Museum specimens of the *Dimetrodon* and *Smilodon* dinosaur skeletons continue to be a popular attraction at the I-68 Welcome Center in Preston County. Other interstate State Welcome Centers have requested exhibits, but unfortunately their lobbies and exhibit areas are too small to accommodate these large displays. Museum Curator Ray Garton has provided several dozen West Virginia-related fossil specimens for display at the Grave Creek Mound Complex located in Moundsville.

- To accommodate new exhibits, the Mini-Museum has expanded into the second floor balcony area, overlooking the main lobby.

- The largest additions to the museum have been the loan of a 13-foot-long, 7-foot-tall fleshed-out juvenile *Brachiosaurus* dinosaur model that overlooks the main lobby, and a 19-foot-wingspan Pterosaur model that will hang from the ceiling in the main lobby in the future.

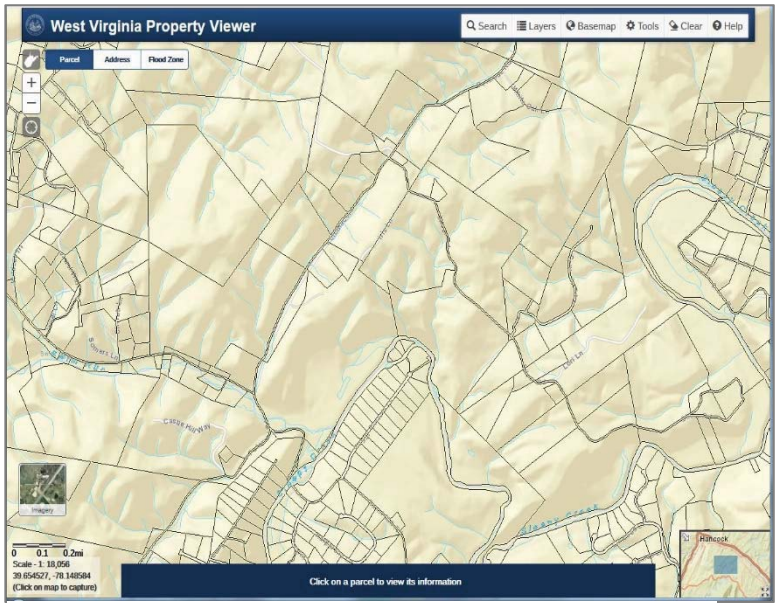
- Educational outreach has included the loan of specimens for display at the Harrison County Parks and Recreation annual Walking with Dinosaurs programs, where WVGES specimens were viewed by over 15,000 people in 60 days.

GEOGRAPHIC INFORMATION SYSTEM PROGRAM

This program is responsible for planning, organizing, coordinating, and delivering high level Geographic Information System (GIS) advice to agencies in state government; it is headed by the statewide GIS Coordinator, based in Charleston.

- The program continues to make headway in a number of critical areas: promoting data sharing between agencies; providing technical assistance to state, county, and local governments and the public; and fostering efficient and effective use of the state's geospatial capabilities.

- The GIS Coordinator continues to provide general administrative oversight of the Mineral Lands Mapping Program in collaboration with the Survey's Coal Bed Mapping Project and the State Tax Department - Property Tax Division. During the year, the GIS Coordinator assisted in the development of the Property Tax Division's Statewide GIS Cadastral platform.



West Virginia Property Viewer shows tax parcels, flood zones, and much more (www.mapwv.gov/parcel/)

- The GIS Coordinator, together with Survey GIS staff, provides technical assistance to the Broadband Enhancement Council regarding broadband coverage and mapping issues and is assisting in the design and development of a broadband interactive map for the State.

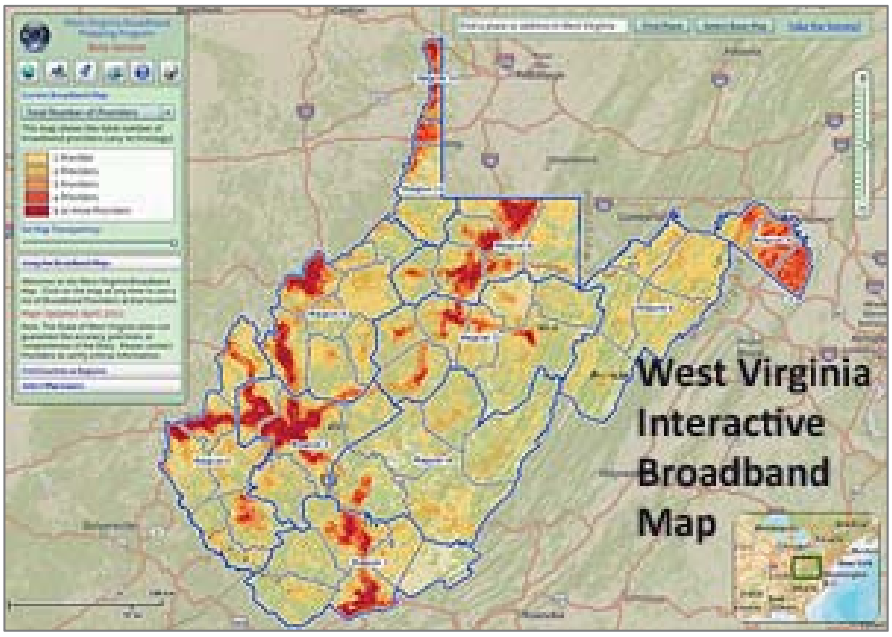
- During the fiscal year, the Coordinator provided GIS support to the Division of Homeland Security, Department of Environmental Protection, the Water Development Authority (WDA) - Infrastructure and Jobs Development Council (IJDC), the National Guard, the WV Intelligence Fusion Center - Hazard Mitigation Section, and other state, regional, and local agencies in their search for GIS contract services, funding, and GIS application development.

Folds in the Tonoloway Formation along US 48/Corridor H in Grant County (Photo by J. Britton)

- The State GIS Coordinator participated in the National States Geographic Information Council (NSGIC) NextGen 911 and Broadband workgroup. Documents developed by this group outline the strengths and challenges of the state's spatial data infrastructure needed for NextGen 911 and broadband deployment. The GIS Coordinator participated in discussions regarding the federal Geospatial Data Act. At the request of the West Virginia Congressional Delegation, he provided information regarding the Act and its impact on GIS practitioners in the Mountain State.

- The GIS Coordinator assisted the Federal Emergency Management Administration (FEMA) in the acquisition of Lidar coverage in areas impacted by Hurricane Sandy.

- Data exchange protocols to enhance data sharing and exchange between state and local agencies established in previous years continue to be successful. The protocol began the inclusion of state and locally produced datasets in the GIS Clearinghouse maintained by the WV GIS Technical Center in Morgantown.



West Virginia Broadband Mapping Program interactive map at www.wvgs.wvnet.edu/broadbandmaps

- GIS workshops developed and presented in collaboration with the WV Association of Geospatial Professionals, WV GIS Technical Center, County Assessors, and 911 directors continue to be popular among GIS professionals. These workshops are designed to inform, train, and advise county and local government officials that have GIS programs in the latest technology and at the same time educate those officials that have not embraced GIS technology in their own organizations. The workshops emphasize inter-agency collaboration and are presented at different locations throughout the state.

- The GIS Coordinator attended sessions and made presentations at the National States Geographic Information Council (NSGIC) in Providence, Rhode Island, and at the West Virginia Association of Geospatial Professionals (AGP) midyear and annual meetings. The Coordinator participated in sessions of the Geographical Information Systems Certification Institute (GISCI) Board of Directors, NSGIC Leadership Group, WV Information Technology Council, WV Broadband Enhancement Council, E911 Council, and the WV Association of Professional Surveyors.

WV GIS Technical Center

WV GIS Technical Center

The West Virginia GIS Technical Center, located in the Department of Geology and Geography at 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.

Geospatial Data Layers

To reduce the duplication of costly data development efforts among organizations, the Center plays a crucial role in not only serving critical spatial data to state users, but also in updating and integrating local geospatial data within state and national geospatial databases. These framework data layers are utilized by almost all state agencies, communities, and the general public for emergency response, risk assessments, economic development, energy resource exploration and management, transportation, natural resources, community planning, tax assessments, and health studies, to name a few. This past year, the Center focused on the development of the geospatial data layers listed in Table 1 to enhance the State's Spatial Data Infrastructure. The continued development and publishing of GIS layers through the state clearinghouse node hosted by the Center supports the Mineral Lands Mapping Program and other vital programs in the State that depend on current and accurate base mapping layers.

Table 1: Statewide Data Services provided by the Center

DATA LAYER	PURPOSE	PARTNERS
Aerial Imagery	Integrated hi-resolution aerial imagery from 20 counties into a statewide leaf-off imagery web map service	Counties
Parcels	Published parcel and assessment information for all 55 counties into a statewide parcel web layer	WV Property Tax Division & Counties
Addresses	Integrated addressing data for 47 counties into statewide addressing layers for address matching services and applications	WV DHSEM and County E-911 Offices
Public Lands	Finalized updates to state and local public land units for the Protected Areas Database of the United States (PAD-US)	USGS, State and local agencies
Hydrography	Updated nearly 28,000 stream segments of the National Hydrography Dataset (NHD) for all watersheds where streams have been altered due to mining, new roads, landfills, etc.	EPA, USGS, WV DEP
Elevation	Published new high-resolution elevation data and products	FEMA, USGS
Other Layers	Updated statewide recreational trails and flood hazard layers	WV DOT & WV DHSEM

GIS Map Applications

In addition to developing and updating geospatial base layers for the State, the Center also supports multiple state agencies with e-governance applications to meet their regulatory, communication, and information exchange goals (Table 2). A new WV Property Viewer web application (www.mapwv.gov/property) was released that displays real estate assessment information for all 55

Portion of digital elevation model produced by the WV GIS Tech Center from aerial imagery showing the Plateau in the west to the folds of the Valley and Ridge in the east

counties in West Virginia. The popular WV Flood Tool (www.mapWV.gov/flood), a critical system that supports the State's floodplain management program, received a Special Achievement in GIS (SAG) Award and was recognized at the 2018 ESRI User Conference. Additionally, during this fiscal year the Center modernized online web applications for the following state agencies: WV Division of Homeland Security and Emergency Management's Statewide Addressing and Mapping System, State Historic Preservation Office's Cultural Resources Map Viewer, and the Division of Natural Resources' Hunting and Fishing Tool. The Center also supported federal initiatives for the Marcellus Shale Energy and Environment Laboratory (www.mseel.org) and terrestrial biosphere carbon (www.carbonscapes.org).

Table 2: Statewide Map Applications supported by the Center

APPLICATION	PURPOSE	SPONSOR
WV Lidar Download Tool	Download raw lidar point cloud elevation data (www.mapwv.gov/lidar)	WV VIEW
WV Flood Tool	Flood hazard determinations, building permits, building damage estimates (www.mapwv.gov/flood)	WV DHSEM, FEMA
SHPO Map Viewer	Conduct Cultural Resource Section 106 reviews (www.mapwv.gov/SHPO)	SHPO
Statewide Addressing & Mapping System (SAMS)	Update address sites and road centerlines required for emergency response (www.mapwv.gov/address)	WV DHSEM, E-911 Address Coordinators
Hunting and Fishing	Search and identify hunting and fishing adventures (http://www.mapwv.gov/huntfish)	WV DNR
WV Trail Inventory	View publicly accessible recreational trails in the State (http://www.mapwv.gov/trails)	WV DOT
Highway Plans Locator	View and download archival highway plans (http://www.mapwv.gov/dotplans)	WV DOT
Conservation Planning Interagency Tool	Determine conservation planning measures for endangered species in support of environmental site evaluations (www.mapwv.gov/ICT)	WV DNR, NRCS
WV Property Viewer *(NEW)*	Search and display property information for all 55 counties in West Virginia (www.mapwv.gov/property)	WV Tax

Web Portals

The Center maintains two major web portals to distribute spatial data and information in the State. The **WV GIS Clearinghouse** (http://wvgis.wvu.edu) catalogs over 325 unique datasets and 120 web services valued at more than $60 million dollars, while **MapWV.gov** (http://mapwv.gov) provides a public gateway to online mapping resources in the Mountain State. These geospatial services are distributed through virtualized servers located at the Center with a storage capability of 150 TB. Web usage statistics reveal that over the last four quarters, the WV GIS Technical Center's site hosted an average of 657 visitors a day for a total of 239,835 visits by 96,125 unique visitors. Its companion site, MapWV.gov, hosted 292,354 unique visitors for an average of 1,739 visits per day and a grand total of 634,949 visits. The WV Flood Tool accounts for 21% of total visits to MapWV.gov while the WV Hunting, Trapping and Fishing Tool accounts for 19%.

Long exposure of the Helderberg Group along US 48/Corridor H in Grant County (Photo by W. Perkins)

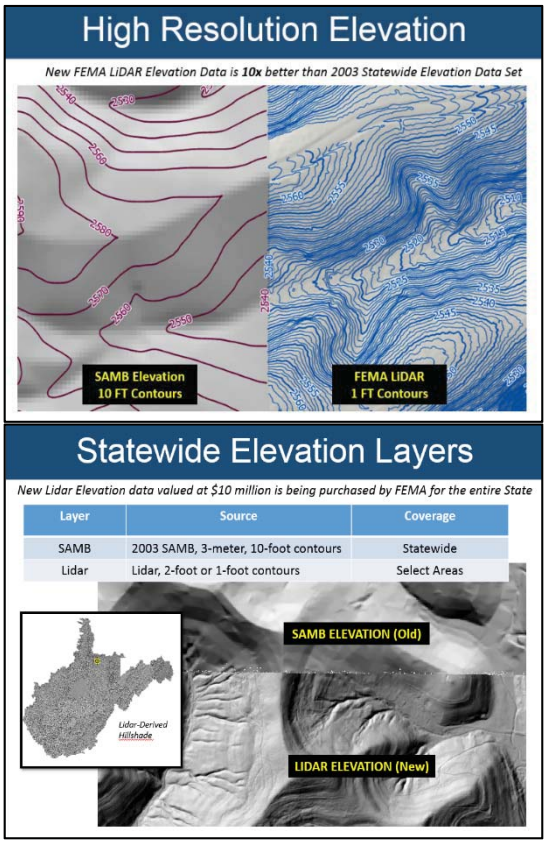
MapWV.gov's newest product, the WV Property Viewer (see figure), launched a few months before this report and already accounts for 5% of total visits. In June, to maintain a high-performance computing system for hosting these services, the Center purchased $100,000 in new servers and storage devices to upgrade its hardware infrastructure.

The new WV Property Viewer allows emergency responders and the public to search property addresses (www.mapwv.gov/property) and assessment records (www.mapwv.gov/assessment).

Services

This past year the WV GIS Technical Center continued to assist the WV Geospatial Community with advisory, training, and outreach services. These services are coordinated with the WV Office of GIS Coordination and WV Association of Geospatial Professionals.

- Taught six instructor-led GIS training courses and provided technical presentations for the following organizations:
  - Local/Regional: Greenbrier County Health Alliance, Eastern Panhandle GIS User Group, and 2017 GIS Day activities for a local high school.
  - State Conferences: WV Surveyors Conference, WV Floodplain Managers Conference, WV Tax Conference, WVDOT/MPO/FHWA Transportation Planning Conference, and WV GIS Conference.
  - Federal: EPA Exchange Network and FEMA Region III Mitigation Division.



New high-resolution lidar-derived elevation products for the Mountain State.

- Delivered training for E-911 addressing coordinators in support of the Statewide Addressing and Mapping System.
- Provided technical programming support to WV DEP for wetlands assessments.
- Received a Hazard Mitigation Grant from FEMA to conduct statewide multi-hazard risk assessments for 287 communities in West Virginia to support local and state hazard mitigation plans.

WV State Tax Department, Property Tax Division - Mined Minerals/GIS Unit

Purpose

Per WV Code 11-6K, the State Tax Commissioner is to value the Natural Resources Properties in the state. Coal and other mined minerals are valued, per the law, by the Mined Minerals/GIS (MMGIS) unit of the Property Tax Division of the West Virginia State Tax Department. The unit's main goal is to accurately and equitably value the mined minerals within the state and to provide those values to the counties for taxation. The GIS Section is essential because much of the valuation process is based on extensive GIS analysis. The unit aims to map and/or ensure the mapping of all properties with mineral rights in the State, to provide accurate GIS data for the tax valuation of natural resources, and to advance the availability of GIS data.

Geology

The MMGIS unit's geologists perform a wide scope of geological work such as correlation and evaluation in the areas of mining, quarrying, and environmental preservation or impact. They perform quality control on geological work from outside sources and the in-house geological mapping by computer. Annually, the unit supplies the WV Geological and Economic Survey (WVGES) with core hole and drill hole data gathered from the Annual Appraisal for the Production of Coal tax returns ("Returns"). This information is vital to the WVGES Coal Bed Mapping Project (CBMP) by providing new data control points. Due to the CBMP being critical to valuation, the unit closely scrutinizes the information provided in these Returns, adding an extra layer of quality control for the WVGES.

The Unit has been updating 81 coal resource contour maps for coal seams. MMGIS performed hundreds of individual natural resource valuation analyses per taxpayer request. They collected mining information for WVGES for over 800 active and idle coal mines and various-type quarries such as limestone, sandstone, and shale.

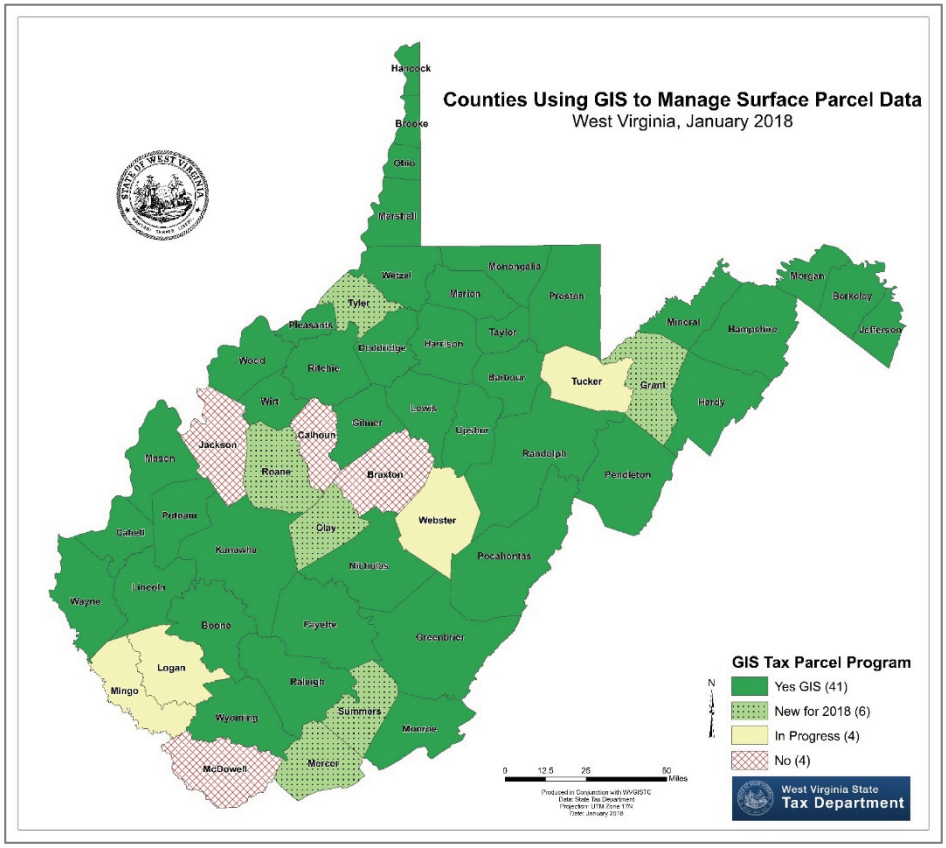
The MMGIS unit operates on an ESRI GIS software platform and has an inventory for the surface maps for all 55 counties in West Virginia. Estimates indicate that the Master Parcel Dataset (MMD) has 1.449 million parcels mapped of a possible 1.9 million parcels which includes both surface and minerals shapefiles. While most of the surface has been mapped, there are still many mineral parcels that need to be located and mapped. Using various analytical techniques, the MMGIS unit is responsible for locating areas that need to be mapped. In the last year, nearly 115,577 parcels have been mapped resulting in a net increase of 4,000 parcels containing coal reserves.

Map Distribution

Major changes were made this past year regarding the availability and distribution of county tax maps. Due to a change in the law, the MMGIS unit has transformed the way that it provides access to tax maps and shape files. The MMGIS unit distributes the counties' surface tax maps to the public and other government agencies. Anyone can view and print a map in the tax office using a digital kiosk that inventories the maps and allows customers to view the maps they want. Statewide property lines are available for download in a geodatabase format at: www.cdn.wv.gov/taxdept/PropertyTax/PropertyTax.SurfaceMaps.gdb.zip, and through a cooperative effort with the West Virginia GIS Technical Center, the county surface tax maps and shapefiles can be downloaded at: http://wvgis.wvu.edu/data/dataset.php?ID=371.

Mapping Maintenance

The MMGIS unit works closely with the county tax assessors and their mapping personnel to ensure the compliance of their tax maps to the regulations set forth by the Property Valuation Training and Procedures Commission (PVC). The unit receives maps and shapefiles (if available) from all West Virginia counties every year. To further ensure compliance with the mapping regulations, the unit monitors all 55 counties' tax maps and their map changes in a 3-year cycle. The unit also oversees manual mapping updates completed for the counties by mapping contractors and maintains Mylar and linen maps for the manual counties if needed. During this past year, 17 counties have been monitored for map design, content, maintenance, submission, and digital parcel submission (if applicable).



GIS is an essential part to the valuation process by providing access to contours, layers, and other natural resource features. The unit updates and maintains the geological, economic, infrastructure, and environmental mapping. It is also an invaluable asset in the location of properties for valuation as well as the mapping of Managed Timberland throughout the state. Annually, the unit performs digital geospatial analysis for Managed Timberland, CBMP (Coal Bed Mapping Project), Coal Quality, and Economic and Environmental Impact of the Mining and Severance of Natural Resources.

Recent Achievements and Future Goals

Our achievements during this past year include improvements to our internal web resources and complete update of our geologic, economic, and infrastructure mapping with our ever-changing geospatial resources. We are in the process of out-sourcing some field mineral-mapping to the WV GIS Technical Center in an effort to discover more efficient methods to map new mineral parcels. There may be other possible resources which may be used in the future.

Some of our current goals include filling vacant positions and setting up a paid internship with local colleges to screen future applicants for replacing high turnover positions. We will continue work on integration of our GIS system to the upcoming web-based Integrated Assessment System and possible external public uses.

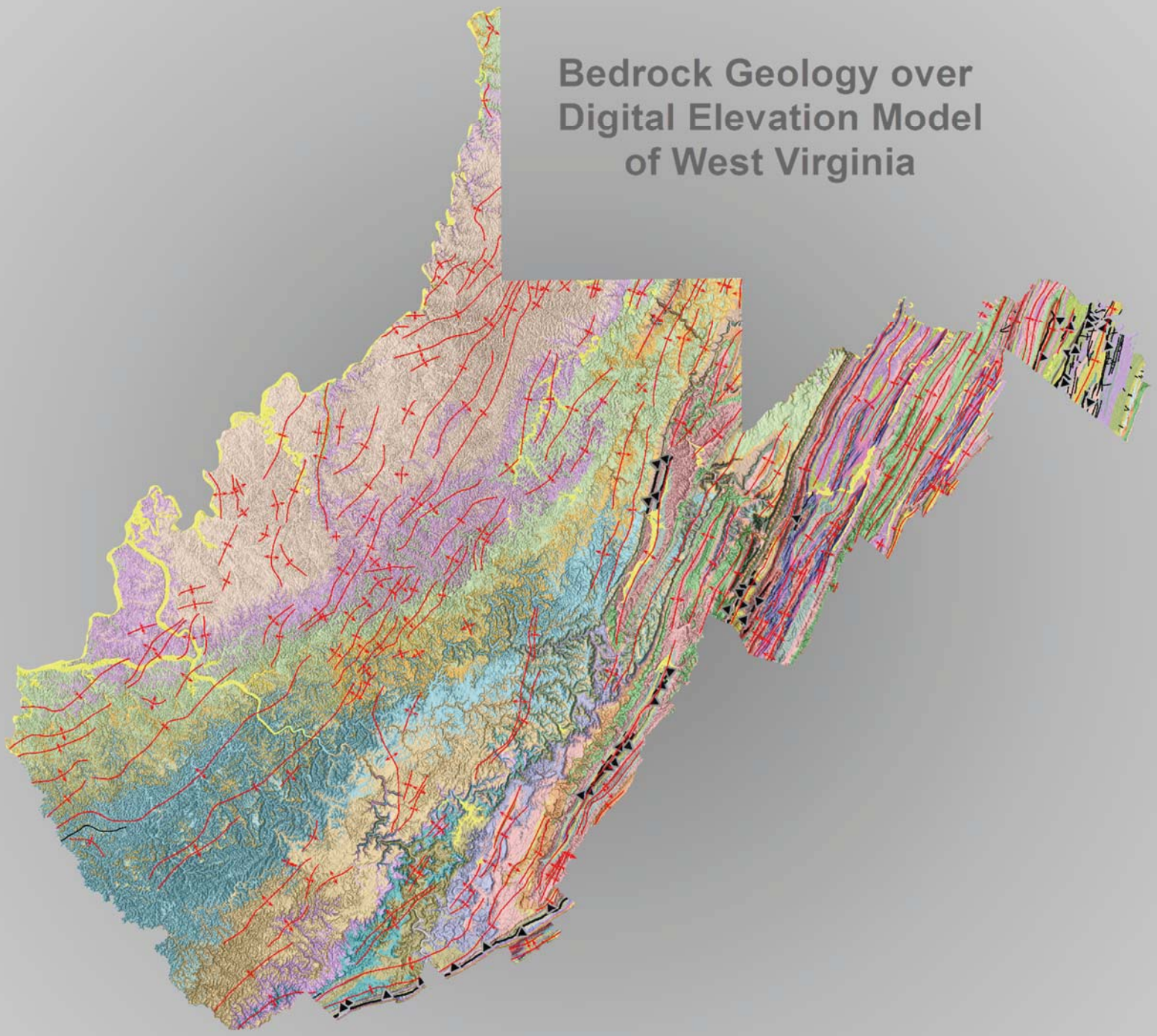
Page intentionally blank

Principal Staff Directory and Points of Contact
June 2018

Director and State Geologist	*B. Mitchel Blake, Jr., Ph.D.*
GIS Program and Statewide GIS Coordinator	*Tony Simental*
Coal Resources	*James Q. Britton*
Geoscience and Geologic Mapping	*Ronald R. McDowell, Ph.D.*
Oil and Gas Resources	*Jessica Pierson Moore*
Information Services and Publications	*Mary C. Behling*
Earth Science Information Center (ESIC)	*Paul R. Liston*
Public Service	*Kenneth C. Ashton*

West Virginia Geological and Economic Survey
Mont Chateau Research Center
1 Mont Chateau Road • Morgantown, WV 26508-8079
304.594.2331 • fax: 304.594.2575
www.wvges.org • info@geosrv.wvnet.edu
39°39’30” N, 79°50’57” W

Hours: 8 a.m. to 5 p.m. Monday through Friday *(closed holidays)*

Back cover image: Bedrock geology of West Virginia draped over a digital elevation model (DEM)

Bedrock Geology over Digital Elevation Model of West Virginia