

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division



Gauley River National Recreation Area

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic
Data for Gauley River National Recreation Area

[gari_geology.pdf](#)

Version: 9/19/2016

Geologic Resources Inventory Map Document for Gauley River National Recreation Area

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Geologic Resources Inventory Map Document



Gauley River National Recreation Area, West Virginia

Document to Accompany Digital Geologic-GIS Data

[gari_geology.pdf](#)

Version: 9/19/2016

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Gauley River National Recreation Area, West Virginia (GARI).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

- 1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.
- 2) **GRI Digital Maps and Source Citations** – A listing of all GRI digital geologic-GIS maps produced for this project along with sources used in their completion. In addition, a brief explanation of how each source map was used is provided.
- 3) **Digital Bedrock Geologic Map of Gauley River National Recreation Area**
 - a) **Map Unit Listing** – A listing of all bedrock map units present on the bedrock geology map.
 - b) **Map Unit Descriptions** – Descriptions for all bedrock map units present on the bedrock geology map.
 - c.) **Bedrock Geologic Cross Sections** – Geologic cross section graphics present on bedrock geology source map.
 - d) **Ancillary Source Map Information** – Additional source map information present on bedrock geology source map.

4) Digital Surficial Geologic Map of Gauley River National Recreation Area

- a) **Map Unit Listing** – A listing of all surficial map units present on the surficial geology map.
 - b) **Map Unit Descriptions** – Descriptions for all surficial map units present on the surficial geology map.
 - c.) **Ancillary Source Map Information** – Additional source map information present on surficial geology source map.
- 5) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

Stephanie O'Meara
Geologist/GIS Specialist/Data Manager
Colorado State University Research Associate, Cooperator to the National Park Service
1201 Oak Ridge Drive, Suite 200
Fort Collins, CO 80525
phone: (970) 491-6655
e-mail: stephanie.omeara@colostate.edu

About the NPS Geologic Resources Inventory Program

Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm>

Geologic Reports: Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage http://www.nature.nps.gov/geology/inventory/gre_publications.cfm

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: <http://irma.nps.gov/App/Reference/Search>. To find GRI data for a specific park or parks select the appropriate park

(s), enter "GRI" as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: <http://www.nature.nps.gov/geology/inventory>, or contact:

Bruce Heise
Inventory Coordinator
National Park Service Geologic Resources Division
P.O. Box 25287
Denver, CO 80225-0287
phone: (303) 969-2017
fax: (303) 987-6792
email: Bruce_Heise@nps.gov

The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division.

GRI Digital Maps and Source Map Citations

The GRI digital geologic-GIS maps for Gauley River National Recreation Area, West Virginia (GARI):

GRI Digital Bedrock Geologic-GIS Map of Gauley River National Recreation Area and Vicinity, West Virginia (*GRI Mapcode GARl*)

The GRI bedrock digital geologic-GIS map was produced from the following source digital data and map,

Hunt, Paula J., Wilson, Keri L., McColloch, Jane S. and McColloch, Gayle H. (Digital Cartography and Map Compilation by Gooding, Sarah E.), 2010, Gauley River National Recreation Area Bedrock Geologic Map; Ansted and Summersville Dam 7.5' Quadrangles, West Virginia: West Virginia Geological and Economic Survey, Open-File Report 1001, scale 1: 24,000. (*GRI Source Map ID 75478*).

GRI Digital Surficial Geologic-GIS Map of Gauley River National Recreation Area and Vicinity, West Virginia (*GRI Mapcode GARS*)

The GRI surficial digital geologic-GIS map was produced from the following source digital data and map,

Kite, J. Steven [Digital Cartography and Compilation by McCreary, Samantha J. and Gooding, Sarah E.], 2016, Surficial Geologic Map of the Gauley River National Recreation Area, West Virginia: West Virginia Geological and Economic Survey, Open File Report OF-1601, scale 1:12,000. (*GRI Source Map ID 76059*).

Additional information pertaining to each source map is also presented in the Source Map Information (GARIMAP) table included with the GRI geologic-GIS data.

Digital Bedrock Geologic-GIS Map of Gauley River National Recreation Area

Bedrock Map Unit List

The geologic units present in the digital geologic-GIS data produced for Gauley River National Recreation Area, West Virginia (GARI) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., PNa - Allegheny Formation, undifferentiated). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the Geologic Unit Information (GARIUNIT) table included with the GRI geologic-GIS data.

Paleozoic Era

Pennsylvanian Period

Middle Pennsylvanian Period

[PNa](#) - Allegheny Formation, undifferentiated

[PNan5b](#) - Allegheny Formation, No. 5 Block Coal Bed

[PNk](#) - Kanawha Formation, undifferentiated

[PNkstk](#) - Kanawha Formation, Stockton Coal Bed

[PNkcbg](#) - Kanawha Formation, Coalburg Coal Bed

[PNkn2g](#) - Kanawha Formation, No. 2 Gas Coal Bed

[PNkeag](#) - Kanawha Formation, Eagle Coal Bed

[PNklwe](#) - Kanawha Formation, Lower War Eagle Coal Bed

Lower Pennsylvanian Period

[PNnrun](#) - New River Formation, Upper Nuttall Sandstone

[PNnrln](#) - New River Formation, Uower Nuttall Sandstone

[PNnr](#) - New River Formation, middle members, undifferentiated

[PNnrsew](#) - New River Formation, Sewell Coal Bed

[PNnrural](#) - New River Formation, Upper Raleigh Sandstone

[PNnrllr](#) - New River Formation, Little Raleigh Coal Bed

Bedrock Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below. All unit descriptions are from WVGES Open-File Report OF 1001 ([Bedrock Geology of Gauley River National Recreation Area](#)) (GRI Source Map ID 75478).

PNa - Allegheny Formation, undifferentiated (Middle Pennsylvanian)

60 meters (200 feet), partial section.

This formation is composed of interbedded sandstones, shales, mudstones, siltstones, and coals. The No. 5 Block coal horizon (N5B) is present in the western portion of the mapped area. Where exposed, contact with the underlying Kanawha Formation is sharp.

PNan5b - Allegheny Formation, No. 5 Block Coal Bed (Middle Pennsylvanian)

Number 5 Block Coal Bed.

PNk - Kanawha Formation, undifferentiated (Middle Pennsylvanian)

365 meters (1,200 feet)

The Kanawha Formation is composed of interbedded sandstones, shales, siltstones, and coals. Sandstones are generally thin, discontinuous, orange, white to light gray, fine- to very coarse-grained, and are interbedded with shales, siltstones, claystones, mudstones, thin discontinuous coals, and carbonaceous shales. Siltstones, shales, mudstones, and claystones are tan, light to dark gray, or black. Shales are often micaceous, frequently silty to sandy, and are commonly interlaminated or interbedded with sandstone or siltstone or as partings within coal beds. Shales may contain marine and nonmarine invertebrate and plant fossils; vertebrate fossils have been found south of the map area. Siltstones are frequently sandy and usually grade vertically to sandstones, shales, or mudstones. Mudstones and claystones often occur beneath coal beds or carbonaceous shales and are clayey, silty, or sandy. Siderite nodules and discontinuous beds generally less than 1 cm thick occur in some marine-influenced shales. Coal beds mapped within the formation are locally known as the Lower War Eagle (LWE), Eagle (EAG), No. 2 Gas (N2G), Coalburg (CBG), and Stockton (STK). Contact with the overlying Allegheny Formation is sharp where exposed, and contact with the underlying New River Formation is unconformable, usually sharp, but often concealed.

PNkstk - Kanawha Formation, Stockton Coal Bed (Middle Pennsylvanian)

Stockton Coal Bed. No additional description provided.

PNkcbg - Kanawha Formation, Coalburg Coal Bed (Middle Pennsylvanian)

Coalburg Coal Bed. No additional description provided.

PNkn2g - Kanawha Formation, No. 2 Gas Coal Bed (Middle Pennsylvanian)

Number 2 Gas Coal Bed. No additional description provided.

PNkeag - Kanawha Formation, Eagle Coal Bed (Middle Pennsylvanian)

Eagle Coal Bed. No additional description provided.

PNklwe - Kanawha Formation, Lower War Eagle Coal Bed (Middle Pennsylvanian)

Lower War Eagle Coal Bed. No additional description provided.

PNnrun - New River Formation, Upper Nuttall Sandstone (Lower Pennsylvanian)

The Upper Nuttall Sandstone member is approximately 18 to 30 meters (60 to 100 feet) thick and is well indurated, fine- to coarse-grained quartz arenite, light gray, buff, or pink on fresh surface; it weathers tan to reddish tan, buff to orangish-buff, gray-brown, brown, or red. Quartz, shale, and siderite pebbles are present locally in lags, especially near the base of the unit. Iron staining is common, manganese staining is infrequent, and dark mineral grains are sometimes present. Detrital mica flakes sometimes drape bedding planes. Weathering in the form of Liesegang banding is present in some beds, and iron precipitate is present on fractures. Some beds contain fine-grained shaly clasts, clay galls, plant fossils, and coal spars. Bedding is thin to thick with crossbedding in the upper part of unit, more massive bedding in the middle part, and thin to thick bedding and cross bedding in the lower part of the unit. Sandstone is interbedded with sandy silt and carbonaceous shale in places and may contain nodules of

fine-to medium-grained sandstone, coal stringers or lenses, plant fossil fragments, and trace fossils. Contact with the overlying Kanawha Formation is usually concealed and is often marked by a break in slope. Contact with underlying units is usually sharp. Up to 8 meters (25 feet) of shaly, silty, very fine-grained sandstone and sandy silty shale may be present between the Upper and Lower Nuttall members

PNnrln - New River Formation, Lower Nuttall Sandstone (Lower Pennsylvanian)

The Lower Nuttall Sandstone member is approximately 24 to 33 meters (80 to 110 feet) thick and consists of well indurated quartz arenite, gray, buff, or pink on fresh surface, and weathers tan, buff, orange to orange-buff, orange-gray, or brown. Grain size ranges from very fine to coarse. Quartz pebbles are present locally in lags, often near the base of the unit. Mica and heavy mineral grains are present in some beds. The unit exhibits infrequent manganese staining and iron staining with Liesegang banding and rings in some beds. The unit contains sparse plant fossils, is thin to massively bedded, and sometimes cross bedded with ripple marks present at the base of some beds. Although this member is highly variable, it is generally more massive and conglomeratic than the Upper Nuttall, often forming overhanging cliffs with an undulating base. Contact with underlying units is unconformable and sharp.

PNnr - New River Formation, middle members, undifferentiated (Lower Pennsylvanian)

240 meters (800 feet)

The New River Formation below the Nuttall Sandstone is composed of interbedded sandstones, shales, siltstones, and coals. Carbonate cement is locally present. Plant fossils may be present in some beds, but marine fossils are unknown. Sand grains are fine to very coarse to pebbly and are comprised of quartz with lesser amounts of mica, feldspar, and rock fragments. Siltstones are micaceous, usually sandy, and may grade to sandstones, shales, and mudstones. Shales are commonly micaceous, silty or sandy locally, and often occur interlaminated or interbedded with sandstone or siltstone and as partings within coal beds. These units often contain nodules, concretions, or beds of siderite or septarian nodules. The Lower Guyandot sandstone is predominantly quartz, light gray, weathers buff to light brown, is fine to coarse grained and locally conglomeratic. Bedding ranges from 5 cm to 1 m thick, is locally crossbedded and may have shaley interbeds. The Guyandot (or Upper Guyandot) sandstone is buff to pinkish, weathers light brown to reddish brown to gray, and is fine grained. Bedding can be flaggy to massive ranging from 2 cm to 1 m thick, is locally crossbedded and may have shaley interbeds. It can be micaceous and have traces of dark minerals. The Harvey sandstone generally appears flaggy with beds often 5 cm thick, is light gray on fresh surface, weathers gray to dark gray to brown, has limonite and manganese banding less than 1 cm thick, fine to medium subrounded grains, and is sometimes micaceous. Occasional high-angle cross beds are observed; the unit may appear wavy locally. The Sewell (SEW) and Little Raleigh (LRL) coal horizons are the only New River Formation coals mapped in the study area. Where present these coal beds are up to 1 m thick.

PNnrsew - New River Formation, Sewell Coal Bed (Lower Pennsylvanian)

Sewell Coal Bed. No additional description provided.

PNnrural - New River Formation, Upper Raleigh Sandstone (Lower Pennsylvanian)

The Upper Raleigh sandstone member is approximately 15 meters (50 feet thick) and is a massive sandstone that weathers tan to orange-tan to buff, is fine grained, well indurated, and contains sparse

mica and sparse to abundant heavy mineral grains. It is iron stained, exhibits Liesegang banding, and bedding is medium to massive bedded with pervasive fine crossbeds. Contact with the underlying Little Raleigh (LRL) coal is sharp.

PNnrIrl - New River Formation, Little Raleigh Coal Bed (Lower Pennsylvanian)

Little Raleigh Coal Bed. No additional description provided.

Bedrock Geologic Cross Sections

The geologic cross sections present in the GRI digital geologic-GIS data produced for Gauley River National Recreation Area, West Virginia (GARI) are presented below. If viewing this file in it's digital format it is possible to zoom in to better view the cross section graphics.

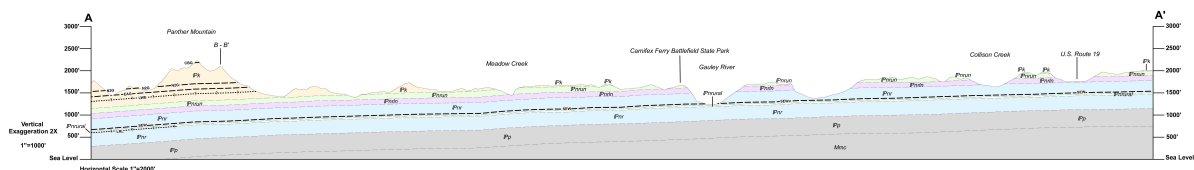
Units Listed Below Appear in Cross Section Only:

IPp Pocahontas Formation, 120 meters (400 feet)

Mississippian System

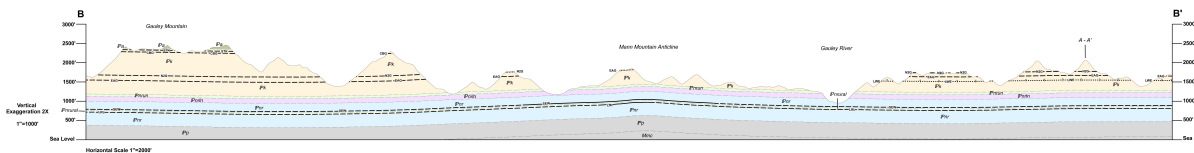
Mmc Mauch Chunk Group, partial section

Cross Section A-A'



Extracted from: (GRI Source Map ID 75478) ([Bedrock Geology of Gauley River National Recreation Area](#)).

Cross Section B-B'



Extracted from: (GRI Source Map ID 75478) ([Bedrock Geology of Gauley River National Recreation Area](#)).

Bedrock Ancillary Source Map Information

Open File Report OF 1001

Ancillary map information obtained from the following source map.

Hunt, Paula J., Wilson, Keri L., McColloch, Jane S. and McColloch, Gayle H. (Digital Cartography and Map Compilation by Gooding, Sarah E.), 2010, Gauley River National Recreation Area Bedrock Geologic Map; Ansted and Summersville Dam 7.5' Quadrangles, West Virginia: West Virginia Geological and Economic Survey, Open-File Report 1001, scale 1: 24,000. (Open-File Report 1001). (*GRI Source Map ID 75478*).

Stratigraphic Section

SUBSERIES	FORMATION	BED OR MEMBER	LITHOLOGY	BED OR MEMBER THICKNESS (ft)	FORMATION THICKNESS (ft)
MIDDLE PENNSYLVANIAN	ALLEGHENY FORMATION	No. 5 Block coal		2	200
		Kanawha Black Flint (of White, 1891) Stockton coal		1 to 4	
	KANAWHA FORMATION	Coalburg coal		1 to 137	
		Peerless coal		1 to 67	
		No. 2 Gas coal		1 to 127	
		Eagle coal		1 to 5	
		Lower War Eagle coal		1 to 4	
		Gilbert coal		3.1 to 3.5	
	NEW RIVER FORMATION	Upper Nuttall Sandstone		80 to 100	
		Lower Nuttall Sandstone		80-110	
		unconformity		5 to 20	
		Harvey sandstone		10 to 80	
		Guyandot sandstone		<1 to 3	
		Lower Guyandot sandstone		48-60	
		Sewell coal		<1 to 3	
		Upper Raleigh sandstone		<1 to 3	
		Little Raleigh coal		<1 to 3	

Scale 1"=100'

1:1200

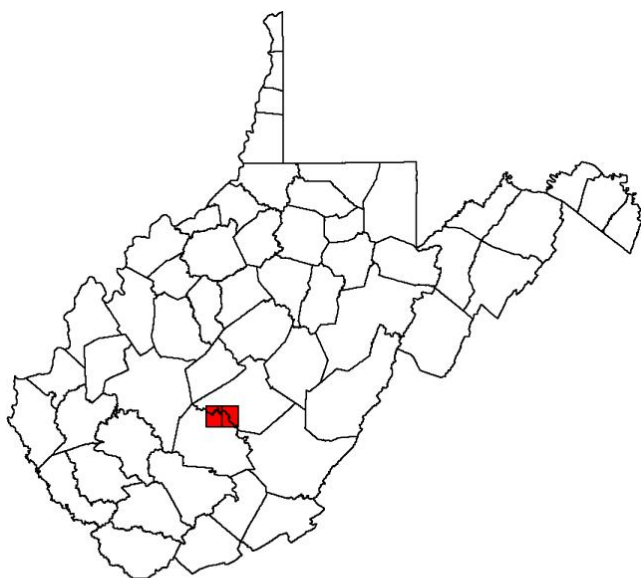
1035

735+

Lithology Symbols		Geological Units	
	Chert		Coal
	Shale		Fine-grained Sandstone
	Sandy Shale		Medium-grained Sandstone
	Silty Shale		Fine- to Coarse-grained Sandstone
			Pa - Allegheny Formation
			Pk - Kanawha Formation
			Pnr - New River Formation (Undiff.)
			Pnrun - Upper Nuttall Sandstone
			Pnrln - Lower Nuttall Sandstone
			Pnrul - Upper Raleigh Sandstone

Extracted from: (GRI Source Map ID 75478) ([Bedrock Geology of Gauley River National Recreation Area](#)).

Mapping Extent



Location Map

Extracted from: (GRI Source Map ID 75478) ([Bedrock Geology of Gauley River National Recreation Area](#)).

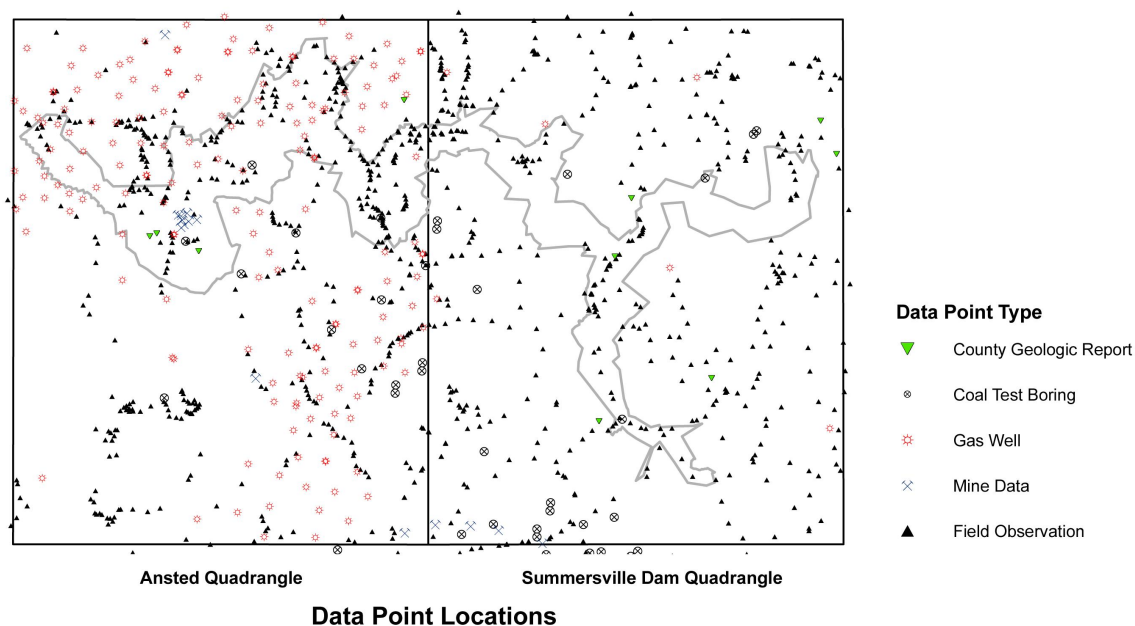
Map Legend

	Contact, Certain
	Contact, Approximately Located
	Contact, Inferred
	Contact, Inferred, Queried
	B - B' Cross Section Location
	Gauley River National Park Boundary
	Anticline Fold Axis
	Syncline Fold Axis
	Plunging Fold Axis, Showing Plunge Direction
	Sewell Coal Horizon Structure Contour (Feet Above Mean Sea Level)
	Sewell Coal Structure Contour, Location Approximate
	Coal Bed, Certain
	Coal Bed, Approximately Located
	Coal Bed, Inferred
	Coal Bed, Inferred, Queried

Extracted from: (GRI Source Map ID 75478) ([Bedrock Geology of Gauley River National Recreation Area](#)).

****Only geologic features and observations are present in the GRI digital geologic-GIS data.**

Data Points



Extracted from: (GRI Source Map ID 75478) ([Bedrock Geology of Gauley River National Recreation Area](#)).

The above data points locations exist as point features in two different feature classes with the GARI GIS dataset. Coal Test Borings, Gas Wells, and Mine Data are contained in the Mine Point Features feature class (garimin); County Geologic Reports and Field Observations are stored in the Geologic Observation Localities feature class (garigol). If available, point ID values have been retained in the GIS data to allow linkage back to point data sources if more information is desired. Below is a summary of the IDs that exist and where more information can be obtained.

Mine Point Features (garimin)

Type of feature: mine

ID type: West Virginia Geological and Economic Survey aperture card

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

Type of feature: gas well

ID type: American Petroleum Institute number

Link: <http://www.wvgs.wvnet.edu/pipe2/OGWISHelp.aspx>

Type of feature: borehole

ID type: West Virginia Geological and Economic Survey field book number and page number

Link: Not available online. Field books can be viewed at the West Virginia Geological and Economic Survey.

Geologic Observation Localities (garigol)

Type of feature: observation locality (pertains to points that have a County Geologic Report measured section ID)

ID type: West Virginia County Geologic Report measured section ID

Link: http://www.wvgs.wvnet.edu/wvges2/publications/pubcat_faqs.aspx

Note: ID values for observation locality points that are not related to a County Geologic Reports are merely GPS waypoint IDs. No additional information exists.

***Data points present in the GRI GIS digital geologic-GIS data are a subset of the points depicted on the graphic above. This is due to either a lack of geologic significance and/or proprietary data restrictions of the West Virginia Geological and Economic Survey.*

Geologic Report

Physiographic Location

This map of the bedrock geology in and around the National Park Service's Gauley River National Recreation Area covers the Ansted and Summersville Dam 7½-minute United States Geological Survey topographic quadrangles in Nicholas and Fayette counties, West Virginia. Surficial deposits were mapped within the National Park Service boundary, and the resulting map is a separate publication (Publication OF-1002). The study area is located in the relatively horizontal to gently folded rocks of the Appalachian Plateau physiographic province. It is within the Kanawha River drainage basin and is dominated by the Meadow and Gauley Rivers, which have exposed massive sandstone cliffs in their valley walls.

Stratigraphy

Rock units exposed at the surface in the map area are assigned to the Lower Pennsylvanian New River Formation, Lower and Middle Pennsylvanian Kanawha Formation, and the Middle Pennsylvanian Allegheny Formation. Bedrock consists of interbedded sandstones, siltstones, shales, and coals. These units are shown on the stratigraphic column along with their respective thicknesses. Except for resistant sandstones, rock exposures are limited by soil cover, colluvium, vegetation, and reclamation of mined areas. Where concealed, contacts between rock units were inferred from core holes, gas well records, aerial photography, digital elevation models, and outcrops on adjacent quadrangles.

The oldest rocks exposed in the map area are the shales beneath the Little Raleigh coal horizon. These units belong to the lower New River Formation and were observed where the Gauley River has breached the core of the Mann Mountain Anticline in the Ansted quadrangle. The base of the New River Formation is not exposed in the map area. The underlying Pennsylvanian Pocahontas Formation and Mississippian Mauch Chunk Group do not crop out in the map area, but are observed in drilling cores and are included in the cross sections.

The Sewell and Little Raleigh coal horizons of the New River Formation are shown on the map and cross sections. Although they are the most laterally continuous coal horizons in the two-quadrangle area, they are thinner and less continuous than elsewhere in the region. Therefore, they are referred to as coal horizons rather than coal beds on this map, and their map representations are dashed or dotted where they were not noted in cores, gas well logs, or in the field.

The Upper Raleigh sandstone member is a relatively massive sandstone exposed in the core of the Mann Mountain anticline in the Gauley River valley. Other sandstones, often thinner and less continuous but locally massive, have been named by past researchers (Hennen and Teets, 1919; Reger, 1921). Discontinuous sandstones are generally not useful as stratigraphic markers, and although these sandstones were observed in the study area, they were not included on the map. Examples of these are the Lower Guyandot sandstone, the Guyandot sandstone (sometimes called the Upper Guyandot sandstone), and the Harvey sandstone (or Harvey conglomerate). The Lower Guyandot sandstone, where

present, is located just above the Sewell coal and can be more than 15 meters (50 feet) thick. It is exposed at Sweets Falls on the Gauley River (near the eastern edge of the Summersville Dam quadrangle), at Carnifex Ferry (where the Meadow River joins the Gauley River), and other locations. The Guyandot sandstone is approximately 6 to 15 meters (20 to 50 feet) thick. It occurs approximately 15 to 24 meters (50 to 80 feet) above the Sewell coal and immediately above the Sewell B coal bed, where that coal is present. The Harvey sandstone is approximately 1.5 to 6 meters (5 to 20 feet) thick and occurs approximately 3.5 to 6 meters (12 to 20 feet) below the base of the Lower Nuttall Sandstone. A relatively good exposure of this sandstone is present along the abandoned rail corridor on the south side of the Meadow and Gauley Rivers in the Summersville Dam quadrangle.

The Upper and Lower Nuttall Sandstone members of the New River Formation are the most prominent laterally continuous sandstones in the Meadow and Gauley River valleys. They form the cliffs observed along U.S. Route 19 and the shores of Summersville Lake in the Summersville Dam quadrangle. They are light gray, orange, and pink quartz arenites with basal conglomeratic zones. The two units together are approximately 48 to 72 meters (160 to 240 feet) thick. Recent reinterpretation of the Nuttall Sandstones as incised valley fills (Blake, 1997; Blake et al., 2002; and Blake, personal communication, 2010), suggests that sometime in the late Middle Pennsylvanian, a paleovalley formed and was subsequently filled with fluvial sands that later became the Nuttall Sandstones. Because of this, the Nuttall Sandstones are relatively local and are younger than rock units occurring in the same stratigraphic position farther to the southwest outside the Nuttall valley fill. The base of the Lower Nuttall member is therefore unconformable. Discontinuous beds within the paleovalley cannot easily be correlated to beds outside the paleovalley. Coals located between the Sewell coal horizon in the New River Formation and the Gilbert coal horizon in the Kanawha Formation have been recorrelated (Blake, 1997). Previous workers had correlated the Gilbert coal bed as the Lower Douglas coal (Hennen and Teets, 1919; Reger, 1921) or the Douglas coal (Englund et al., 1977 and 1979).

Many Kanawha Formation coals occur in "families" with beds splitting and merging, and several Kanawha Formation coal beds are located in the map area. Where identifiable, marine sequences are useful markers for correlating coals in the Kanawha Formation (Blake, 1997). The base of the Kanawha Formation is placed at the base of a coal correlated with the Gilbert coal bed in southern West Virginia (Blake, 1997; Blake et al., 2002). This coal bed is relatively discontinuous and poorly exposed. For mapping purposes, the base of the Kanawha Formation is set informally at the top of the Upper Nuttall member of the underlying New River Formation, which occurs a few meters below the Gilbert coal horizon.

The youngest rocks exposed in the map area belong to the lower Allegheny Formation and cap several high knobs located in the western portion of the study area. Up to 60 meters (200 feet) of coals, shales, and sandstones of the lower Allegheny Formation are present there. The No. 5 Block coal horizon occurs approximately 30 meters (100 feet) above the base of the formation, which is placed at the top of the Kanawha Black Flint of White (1891).

Structural Geology and Tectonics

The general strike of rocks in the Appalachian Plateau is northeast-southwest (locally approximately N40°E). A structure contour map, constructed on the Sewell coal horizon because it is the most laterally continuous coal in the map area, shows that the strike in the eastern portion of the study area (the Summersville Dam quadrangle) is roughly parallel to the general northeast-southwest strike observed regionally, and the dip is approximately 1.5° to the northwest. The dominant subsurface feature in the western portion of the map area (the Ansted quadrangle) is the Mann Mountain Anticline. This anticline plunges to the northwest and its axis cuts diagonally across the Ansted quadrangle from southeast to northwest, trending approximately N25°W. This fold axis is almost perpendicular to the general northeast-southwest strike of the rocks of the Appalachian Plateau and to other folds of the Plateau

formed in the late Pennsylvanian during the Appalachian Orogeny. The unusual trend of the Mann Mountain Anticline is due to detachment in Devonian-age shales and the resultant rotation of strata during the Pennsylvanian Period (Perry, 1978).

Coal Resources, Building Materials, and Gas Resources

Economic coal resources have essentially been mined out in the map area and remaining resources are in relatively thin and discontinuous beds. Most of the land surface disturbed by past mining has undergone reclamation. Except for the Sewell coal, New River coal beds are generally thin, laterally discontinuous, and have no documented commercial mining in the study area (West Virginia Geological and Economic Survey, 2010b). The New River coal beds present in the map area include the Little Raleigh, Welch, Sewell, Sewell A, Sewell B, and Castle, with only the Little Raleigh and Sewell horizons being thick and continuous enough to show on the map. Previous workers (Hennen and Teets 1919; Reger, 1921) have reported that the laeger, Hughes Ferry, and Castle coals are present in the map area, but these correlations are questionable because of the Nuttall incised valley fill.

The Little Raleigh coal horizon (LRL) is laterally discontinuous and has no documented commercial mining in the map area. Where present, this coal can be up to 1 meter (3 feet) thick. It is exposed along the Gauley River in the core of the Mann Mountain anticline.

The Sewell coal (SEW) is generally present below land surface except for a few locations where it crops out along the Meadow and Gauley Rivers. The Sewell coal is reported as being up to 2.5 meters (8 feet) thick in some portions of the map area, but is usually less than 0.3 to 1 meter (less than 1 to 3 feet) thick, and core data indicate it may be absent in the northern portion of the Summersville Dam quadrangle. Underground mines in the Sewell are present on the north side of the Gauley River southwest of Peters Junction, south of Mill Creek near Ansted, and south of U.S. Route 19 at the very southern edge of the Summersville Dam quadrangle (West Virginia Geological and Economic Survey, 2010b).

In general, Kanawha Formation coals are relatively high quality bituminous coals that tend to be low in total sulfur and used for both metallurgical and steam applications. Numerous Kanawha coal beds are present in the map area, and the following twelve coals have been mined commercially: Lower War Eagle, Middle War Eagle, Little Eagle, Eagle, Eagle A, Lower Powellton, Powellton, No. 2 Gas, Peerless, Williamson, Coalburg, and Stockton (West Virginia Geological and Economic Survey, 2010a). Of these, the Lower War Eagle (LWE), Eagle (EAG), No. 2 Gas (N2G), Coalburg (CBG), and Stockton (STK) are considered to be the more significant coals in the study area and are therefore shown on this map. The thickness ranges for these coals are shown on the accompanying stratigraphic column. Commercial mining (surface, underground, and auger) of Kanawha Formation coals occurred mostly in the western portion of the study area, with some occurring on the hills in the central and northeastern portions of the map area.

The No. 5 Block coal (N5B), the only Allegheny Formation coal horizon in the map area, is present in the northwestern portion of the mapped area on four hilltops north of the Gauley River and east of Peters Creek. No mining of this coal has been documented in the study area (West Virginia Geological and Economic Survey, 2009).

Although no large-scale rock quarries are present in the study area, sandstones have been quarried nearby and used for building materials locally. Reger (1921) reported several small quarries located outside the map area near the town of Summersville, and Hennen and Teets (1919) discussed a relatively small quarry located just northeast of Ansted. It appears that the discontinuous sandstones were favored over the more laterally continuous Nuttall, as the Nuttall Sandstones tend to be either too hard where massive or too friable where thinly bedded to be used in construction (Reger, 1921). Stone

for road building appears to have been used locally from several sandstone units.

Oil and gas wells have been completed in the area since the early 1900s. Most natural gas wells are located in the northwest and north-central portions of the study area and near the Mann Mountain Anticline. Wells in the three natural gas fields located in the map area have production from rocks of Mississippian age (Cardwell and Avary, 1982). The oil and natural gas potential of deeper strata was not assessed for this map.

Recreation

Abundant recreation opportunities are available within the map area. The National Park Service's Gauley River National Recreation Area, the U.S. Army Corps of Engineers' Summersville Lake, and West Virginia's Carnifex Ferry Battlefield State Park are popular destinations for whitewater paddling, rock climbing, motor boating, fishing, camping, hiking, mountain biking, and history tours.

Summersville Dam and Summersville Lake are located in the northeastern corner of the map area. Although the lake is usually viewed as a recreation destination, Summersville Dam was constructed for regional floodwater control. The U.S. Army Corps of Engineers supervised the damming of the Gauley River and the creation of Summersville Lake between 1960 and 1966. According to the Army Corps of Engineers (2010), the Summersville Dam is 118 meters (390 feet) high, 691 meters (2,280) feet long, and is the second largest rock-fill dam in the eastern United States. The summer pool elevation is 500 meters (1,652 feet) above sea level and the winter pool elevation is lowered to 477 meters (1,575 feet) to provide potential floodwater storage. A hydroelectric power plant was completed at the dam in 2001.

According to the National Park Service (2010), more than 60,000 people paddle the Gauley River every year. When water levels are high, as they are every fall during scheduled releases from Summersville Lake, the river level plunges more than 200 meters (660 feet) over 45 kilometers (28 miles) and goes through more than 100 rapids in what has been called one of the premier whitewater runs in the world. The Meadow River also attracts paddlers when water levels are favorable.

Rock climbing is popular on the Nuttall Sandstones around Summersville Lake, in the Gauley and Meadow River gorges, and on some of the other exposed sandstones along the Gauley River. The clean hard sandstone units form imposing cliffs and offer many popular climbing routes throughout the area.

Carnifex Ferry Battlefield State Park was the site of a strategic battle during the Civil War. What is now the park was once the Henry Patterson Farm, occupying the top of a ridge north of the Gauley River and overlooking Carnifex Ferry at the confluence of the Meadow and Gauley Rivers. On September 10, 1861 the Union Army pushed Confederate forces from their position on the Patterson Farm, and the Confederate soldiers retreated across the Gauley to the south side of the river during the night. The Confederate Army had been attempting to reclaim the Kanawha Valley and this defeat dealt a crippling blow to that effort (West Virginia Division of Natural Resources, 2008).

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Extracted from: (GRI Source Map ID 75478) ([Bedrock Geology of Gauley River National Recreation Area](#)).

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Extracted from: (GRI Source Map ID 75478) ([Bedrock Geology of Gauley River National Recreation Area](#)).

Digital Surficial Geologic-GIS Map of Gauley River National Recreation Area

Surficial Map Unit List

The surficial geologic units present in the digital geologic-GIS data produced for Gauley River National Recreation Area, West Virginia (GARI) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qd - Disturbed). Units are generally listed from youngest to oldest. Information about each geologic unit is also presented in the GRI Geologic Unit Information (GARSUNIT) table included with the GRI geologic-GIS data. Some source unit symbols were changed to include age or to conform to GRI naming conventions. See the Source Unit Symbol (SRC_SYM) field in the GIS data for source map unit symbols as these differ from unit symbols adopted by the GRI for surficial units.

Cenozoic Era

Quaternary Period

Holocene Epoch

[Qd](#) - Disturbed
[Qr](#) - River channel
[Qtd](#) - Tributary deposit
[Qflp](#) - Floodplain
[Qbfp](#) - Boulderly floodplain
[Qfc](#) - Fluvial channel

Holocene and late Pleistocene Epochs

[Qaf](#) - Alluvial fan
[Qbm](#) - Blocky mantle
[Qca](#) - Colluvial apron
[Qcf](#) - Colluvial fan
[Qcm](#) - Colluvial mantle
[Qcv](#) - Colluvial veneer
[Qt](#) - Terrace

Pleistocene Epoch

[Qht](#) - High terrace

Late Cenozoic Era

[Qres](#) - Residium

Surficial Map Unit Descriptions

Descriptions of all surficial geologic map units are presented below. All unit descriptions are from WVGES Open-File Report OF-1601 ([Surficial Geology of Gauley River National Recreation Area](#)) (GRI Source Map ID 76059) .

Qd - Disturbed (active, Holocene)

Wide variety of disturbed landforms, in which ≥ 30 percent of topography has been altered through excavation, mining, filling, or other anthropogenic process. Includes a large area disturbed during construction of Summersville Dam and related facilities, unusually wide or complex road or railroad grades, and mined lands. Landslides or eroding surfaces occur locally on steep slopes. Surficial materials vary greatly.

Qr - River channel (active, Holocene)

Perennial river channel, ≥ 30 m wide at bankfull stage. Coarse to extremely coarse bedload and coarse point-bar deposits. Rapids through the Recreation Area are controlled by accumulations of sandstone blocks or outcrops of thick resistant sandstone bedrock. Banks are dominated by large boulders and blocks derived from exceptionally coarse colluvial deposits.

Qtd - Tributary deposit (active, Holocene and late Pleistocene)

Irregular narrow bottomlands along tributary streams, locally confined by steep banks. Composed of alluvial deposits ranging from sand to boulders, with inclusions of bouldery to blocky lag. Complex origins include alluvial and colluvial deposition, modified by fluvial erosion.

Qflp - Floodplain (active, late Holocene)

Relatively flat river bottomland, episodically inundated by floods. Surface may be dissected by secondary stream channels active during high flows and floods. Includes some rarely inundated low terraces. Composed of alluvium sediments ranging from sands to boulders.

Qbfp - Bouldery floodplain (active, late Holocene)

Floodplain bottom land, episodically inundated by floods, largely composed of boulders, cobbles, and blocks of alluvially or colluvially transported boulders. Very common in the Recreation Area, reflecting the significance of underlying resistant sandstone bedrock.

Qfc - Entrenched stream channel (active, Holocene)

Very steep highly entrenched ≥ 30 m wide intermittent or perennial stream channels. Slumps and actively eroding banks are common on channel margins. Coarse to extremely coarse bed material may include bedrock outcrops and waterfalls; banks are commonly composed of boulders and blocks from adjacent very coarse colluvial diamictons.

Qaf - Alluvial fan (active, Holocene)

Gently sloping fan emanating from, and typically dissected by, one or two source tributary streams. Composed of alluvial sediments ranging from sand to boulders. Fans may include debris flow deposits. Varied soil profile development, reflecting complex age and genesis.

Qbm - Blocky mantle (Holocene and late Pleistocene)

Colluvial mantle with numerous blocks protruding above the surface topography. Landslides are common. Blocky mantle is composed of thick (>2 m) colluvial blocky diamicton, reflecting in *situ* or upslope occurrence of thick, highly resistant sandstone bedrock, such as Nuttall and Raleigh sandstones.

Qca - Colluvial apron (Holocene and late Pleistocene)

Footslope landform with slope gradient generally decreasing downslope and no surface expression of underlying bedrock stratigraphy and structure. Distinct landslides are common. Composed of thick (≥ 2 m) colluvial diamicton derived from unconfined upslope sources.

Qcf - Colluvial fan (Holocene and late Pleistocene)

Fan- or cone-shaped landform that can be traced to one or more confined sources, such as coves or hill-slope hollows. Composed primarily of colluvial diamicton; may include debris flow deposits or tributary alluvium.

Qcm - Colluvial mantle (Holocene and late Pleistocene)

Very steep to moderately steep slopes lacking surface expression of underlying bedrock stratigraphy and structure. Distinct landslides are common locally. Largely composed of thick (>2 m) colluvial diamicton reflecting upslope bedrock lithologies; may include deposits from sheet-flow and local fluvial processes.

Qcv - Colluvial veneer (Holocene and late Pleistocene)

Steep to vertical slopes with horizontally ribbed topography reflecting underlying bedrock stratigraphy and structure. Includes cliffs and bedrock benches formed on highly resistant Nuttall and Raleigh sandstones, but also includes ribbed upland topography underlain by Kanawha Formation. Rockfall is common along cliffs, other landslides occur locally. Regolith is generally composed of thin (<2 m) colluvial diamicton derived from *in situ* and upslope bedrock lithologies, interspersed with local outcrops of resistant bedrock, patches of residual soils, and pockets of thick colluvial diamicton that may include local fluvial and sheet-flow deposits.

Qt - Terrace (Holocene and late Pleistocene)

Relatively flat to gently sloping bottomland, less than 30 m (100 ft) above active rivers or streams, seldom or never inundated by floods, and rarely displaying old inactive channels. Composed of alluvial sediments ranging from silts and clays to boulders, commonly showing well-developed soil profiles. Commonly mantled by colluvial deposits derived from adjacent slopes. Clasts may have modest

weathering rinds.

Qht - High terrace (early to middle Pleistocene)

Gently sloping to moderately incised remnant of alluvial surface, 30 to 75 m (100 to 240 ft) above Gauley River at Koontz Bend. Composed of deeply weathered alluvium ranging from clays to well-rounded boulders, characterized by Cottonbend soil series with thick yellowish brown (10YR 5/4) to red (2.5 YR 4/8) clay loam Bt horizons on uneroded surfaces. Nearly all pebbles, cobbles, and boulders have substantial weathering rinds.

Qres - Residuum (Late Cenozoic)

Low-relief uplands, typically rolling topography, lithologically controlled benches, or crests and shoulders of ridges and spurs. Significant landslides are uncommon. Composed of *in situ* or nearly *in situ* weathering products of varying textures and thicknesses, with properties inherited from underlying bedrock lithologies. May include local colluvial deposits.

Surficial Ancillary Source Map Information

Open File Report OF-1601

Ancillary map information obtained from the following source map.

Kite, J. Steven [Digital Cartography and Compilation by McCreary, Samantha J. and Gooding, Sarah E.], 2016, Surficial Geologic Map of the Gauley River National Recreation Area, West Virginia: West Virginia Geological and Economic Survey, Open File Report OF-1601, scale 1:12,000. ([Open File Report OF-1601](#)) (GRI Source Map ID 76059).

Description of Map Units Graphic

Description of Map Units:

A_Fan	Alluvial Fan Age: Active, Holocene Gently sloping fan emanating from, and typically dissected by, one or two source tributary streams. Composed of alluvial sediments ranging from sand to boulders. Fans with steep source basins may include debris flow deposits. Varied soil profile development, reflecting complex age and genesis.
B_Man	Blocky Mantle Age: Holocene, Pleistocene Colluvial mantle with numerous blocks protruding above the surface topography. Landslides are common. Blocky mantle is composed of thick (>2 m) colluvial blocky diamict, reflecting <i>in situ</i> or upslope occurrence of thick, highly resistant sandstone bedrock, such as Nuttall and Raleigh sandstones.
BFP	Bouldery Floodplain Age: Active, Late Holocene Floodplain bottomland, episodically inundated by floods, largely composed of boulders, cobbles, and blocks of alluvially or colluvially transported boulders. Very common in the Recreation Area, reflecting the significance of underlying resistant sandstone bedrock.
C_Apr	Colluvial Apron Age: Holocene, Pleistocene Footslope landforms with slope gradient generally decreasing downslope and no surface expression of underlying bedrock stratigraphy and structure. Distinct landslides are common. Composed of thick (≥ 2 m) colluvial diamict derived from unconfined upslope sources.
C_Fan	Colluvial Fan Age: Holocene, Late Pleistocene Fan- or cone-shaped landforms that can be traced to one or more confined sources, such as coves or hill-slope hollows. Composed primarily of colluvial diamict, but may include debris flow deposits or tributary alluvium.
C_Man	Colluvial Mantle Age: Holocene, Pleistocene Very steep to moderately steep slopes lacking surface expression of underlying bedrock stratigraphy and structure. Distinct landslides are common locally. Largely composed of thick (>2 m) colluvial diamict reflecting upslope bedrock lithologies; may include deposits from sheet-flow and local fluvial processes.
C_Ven	Colluvial Veneer Age: Holocene, Pleistocene Steep to vertical slopes with horizontally ribbed topography reflecting underlying bedrock stratigraphy and structure. Includes cliffs and bedrock benches formed on highly resistant Nuttall and Raleigh sandstones, but also includes ribbed upland topography underlain by Kanawha Formation. Rockfall is common along cliffs, other landslides occur locally. Regolith is generally composed of thin (≤ 2 m) colluvial diamict derived from <i>in situ</i> and upslope bedrock lithologies, interspersed with local outcrops of resistant bedrock, patches of residual soils, and pockets of thick colluvial diamict that may include local fluvial and sheet-flow deposits.
D	Disturbed Age: Anthropocene Wide variety of disturbed landforms, in which ≥ 30 percent of topography has been altered through excavation, mining, filling, or other anthropogenic process. Includes a large area disturbed during construction of Summersville Dam and related facilities, unusually wide or complex road or railroad grades, and mined lands. Landslides or eroding surfaces occur locally on steep slopes. Surficial materials vary greatly.
FC	Entrenched Stream Channel Age: Active, Holocene Very steep, highly entrenched, ≥ 30 m wide intermittent or perennial stream channels. Slumps and actively eroding banks are common on channel margins. Coarse to extremely coarse bed material may include bedrock outcrops and waterfalls; banks are commonly composed of boulders and blocks from adjacent very coarse colluvial diamict.
Flp	Floodplain Age: Active, Late Holocene Relatively flat river bottomland, episodically inundated by floods. Surface may be dissected by secondary stream channels active during high flows and floods. Includes some very rarely inundated low terraces. Composed of alluvium sediments ranging from sands to boulders.
HT	High Terrace Age: Early to Middle Pleistocene (?) Gently sloping to moderately incised remnant of alluvial surface, 30 to 75 m (100 to 240 ft) above Gauley River at Koontz Bend. Composed of deeply weathered alluvium ranging from clays to well-rounded boulders, characterized by Cottonbend soil series with thick yellowish brown to red clay loam Bt horizons on uneroded surfaces. Nearly all pebbles, cobbles, and boulders have substantial weathering rinds.
Res	Residium Age: Late Cenozoic Low-relief uplands, typically rolling topography, lithologically controlled benches, or crests and shoulders of ridges and spurs. Significant landslides are uncommon. Composed of <i>in situ</i> or nearly <i>in situ</i> weathering products of varying textures and thicknesses, with properties inherited from underlying bedrock lithologies. May include local colluvial deposits.
R	River Channel Age: Active Perennial river channels, ≥ 30 m wide at bankfull stage. Coarse to extremely coarse bedload and coarse point-bar deposits. Rapids through the Recreation Area are controlled by accumulations of sandstone blocks or outcrops of thick resistant sandstone bedrock. Banks are dominated by large boulders and blocks derived from exceptionally coarse colluvial deposits.
T	Terrace Age: Holocene, Late Pleistocene Relatively flat to gently sloping bottomland, less than 30 m (100 ft) above active rivers or streams, seldom or never inundated by floods, and rarely displaying old inactive channels. Composed of alluvial sediments ranging from silts and clays to boulders, commonly showing well-developed soil profiles. Commonly mantled by colluvial deposits derived from adjacent slopes. Clasts may have modest
Trib	Tributary Age: Active Channel of alluvial deposits ranging from sand to boulders, modified by fluvial erosion.

Extracted from: (GRI Source Map ID 76059) ([Surficial Geology of Gauley River National Recreation Area](#)).

The Surficial Geology of Gauley River National Recreation Area

Introduction and Methodology

Mapping of the surficial geology of the Gauley River National Recreation Area, designated as GARI by the U.S. National Park Service, was completed between 2010 and 2016 as part of a cooperative effort by the West Virginia Geological and Economic Survey (WVGES) and West Virginia University under the U.S. National Park Service Contract #C236009073. The Recreation Area lies within U.S. Geological Survey Ansted and Summersville Dam 7.5 minute quadrangles, encompassing the highly popular Gauley River whitewater run and the less frequented lower Meadow River. A bedrock geology map of the two GARI quadrangles was completed previously by the WVGES (Hunt et al., 2010).

Surficial geology mapping covered the 2010 extent of GARI, plus an additional 100 m buffer outside of park boundaries to insure coverage in case of boundary survey inaccuracies or mapping errors.

Mapping was accomplished through field work and analysis of remotely sensed imagery by J. Steven Kite of West Virginia University, with assistance from Marla Yates, Katelyn Huffman, and Catherine Patterson. Mapping drew upon the WVGES bedrock geology map (Hunt et al., 2010) and soils maps, particularly the USDA-NRCS Web Soil Survey (National Cooperative Soil Survey, 2016), USDA-Soil Conservation Service county soil surveys (Gorman and Espy, 1975; Carpenter, 1992), and a USDA-NRCS field study in GARI (Sattler and Bell, 2013).

Surficial geology mapping followed procedures used in Bluestone National Scenic River (Yates and Kite, 2014) and New River Gorge National River (Yates and Kite, 2015), except that the 0.45 m horizontal accuracy U.S. Army Corps of Engineers (2009) LiDAR used extensively in the two previous mapping efforts exists for only the westernmost 15% of GARI. A slope-shade layer derived from this high-resolution Corps of Engineers LiDAR helped guide mapping on western portions of the Ansted Quadrangle, but was not used as a base layer for any part of the map.

Two different digital slope-shade layers were combined to create the GARI surficial geology base map. DEMs based on lower-resolution (1 m horizontal spacing) West Virginia Department of Environmental Protection (2011) LiDAR were available for the western 85% of the GARI area, and a slope-shade layer derived from this coverage was used for most of the base map. These data were sufficiently detailed to show most landforms shown on the Bluestone and New River surficial geology maps, except that bouldery tributary deposits in GARI could not be differentiated from other tributary deposits, and most individual landslides could not be resolved on the slope-shade layers derived from WVDEP LiDAR. The slope-shade layers derived from US Corps of Engineers LiDAR did reveal individual landslides in the western 15% of GARI, but these are not shown in order to maintain consistency of mapping across the Recreation Area. A slope-shade layer developed from U.S. Geological Survey 3 m DEMs served as the base map for the remaining eastern 15% of the map area. With aid of Google Earth imagery, all of the mapped surficial geology units could be identified in the area near Summersville Dam, but mapping is significantly less accurate and precise than the rest of the GARI area.

Surficial geology line work was constructed on a 1:12,000 base map, a scale that allowed paper maps of each individual quadrangle to be printed with wieldy dimensions. A 30 m (100 ft) wide ground feature has a map width of only 2.5 mm at 1:12,000 scale, and features that small are at the margins of resolution using slope-shade base maps based on WVDEP LiDAR and beyond resolution on maps derived from USGS 3 m DEMs; generally, most features <30 m wide were not mapped, regardless of length.

Bedrock Stratigraphy and Structure

Most of the Recreation Area lies within the 100 to 300 m deep canyons of the Gauley and

Meadow rivers, with some overlap on adjacent uplands. Its surficial geology is closely related to underlying bedrock structure and stratigraphy. A general 1° west-northwest dip throughout GARI is disrupted by a local unnamed syncline at Koontz Bend and the regionally significant Mann Mountain anticline, which trends across Gauley River between Koontz Bend and the western edge of the Ansted Quadrangle (Hunt et al., 2010). Both folds are north-plunging, leading to a ~1° northward dip at Koontz Bend and a relatively steep 2° westward dip near the western limits of mapping.

The interplay between structure, stratigraphy, and surface processes has led to a dramatic landscape with geographic variation across the map area. Relatively undissected broad uplands throughout the eastern half of the Summersville Lake Quadrangle and southeast of Koontz Bend on the Ansted Quadrangle give way toward the north and west to highly dissected uplands with steep slopes and narrow drainage divides. This change in character of the uplands is apparent on the map in the width and extent of residuum.

Only two bedrock formations crop out in the surficial geology map area: the lower Pennsylvanian New River and middle Pennsylvanian Kanawha formations (Hunt et al., 2010). The floors of the Gauley and Meadow river canyons and most of the canyon walls are underlain by the New River Formation, a unit dominated by quartz-rich sandstones, including the upper Nuttall, lower Nuttall, and upper Raleigh members. On steep slopes, these sandstones break down into blocks (particles with >4 m intermediate axes) and large boulders. The top of the thick upper Nuttall Sandstone is the top of the New River Formation, a boundary commonly coincident with a topographic break. Where exposed on steep slopes, the upper Nuttall Sandstone forms prominent outcrops, but on low-relief upland surfaces the sandstone is commonly so deeply weathered that good outcrops are sparse and surface material is apt to be deep sandy residuum. The lower Nuttall Sandstone in this area is among the most resistant strata anywhere in the Appalachian Plateaus. The Raleigh Sandstone is nearly as resistant, but exposed only along Gauley River near the axis of the Mann Mountain anticline (Hunt et al., 2010). All three of these prominent sandstones can be hard, cliff-forming units, dominating the geomorphology and surficial geology of landscapes in which they occur. Other sandstone members in the New River Formation have similar effect locally. When freshly exposed at the surface, the prominent sandstones form very steep slopes mapped as veneers, which typically include bedrock with extremely thin residual or colluvial deposits, bare rock cliffs up to 25 m (80 ft) high, nearly bare bedrock benches, or belts of large blocks. The cliffs within the veneers are the primary sources for thick downslope blocky mantles that may either terminate directly in active river channels or transition into slightly lower-sloping colluvial aprons.

The Kanawha Formation is composed of interbedded thin sandstones, shales, siltstones and coals (Hunt et al., 2010). Kanawha rocks types are not nearly as resistant as those of the New River, breaking down into much smaller particles than New River sandstones. Kanawha Formation slopes are readily eroded through fluvial processes and typically are deeply dissected wherever the remaining thickness of the unit is significant. In relatively undissected uplands, some distance from the canyons and near broad drainage divides, colluvial deposits derived from Kanawha formation bedrock and residuum form mantles composed of diamictons with few boulders or blocks.

The geographic variation throughout the Recreation Area largely stems from whether or not Kanawha Formation exists on the upper slopes, and the relative proportions of Kanawha and New River bedrock on the valley walls. The canyon rim for all of the Meadow River reach and much of the Gauley River reach is held up by either the upper or lower Nuttall Sandstones; low relief characterizes adjacent uplands underlain by weathered upper Nuttall Sandstone or shale-dominated beds of the lowermost Kanawha Formation. Upland and canyon wall topography is more dissected and surficial geology polygons are more discontinuous where a significant thicknesses of the Kanawha Formation lies above the canyon walls. The varied strata of the Kanawha are typically expressed at the surface as a steep horizontally ribbed topography covered by a thin veneer of colluvium, interspersed with sandstone benches, modest cliffs, and local residuum. Surface mining disturbance occurs locally in the Kanawha outcrop belt,

although surface mines are much more extensive west and north of GARI than in the Recreation Area itself.

Surficial Geology

The topography and surficial geology reach their greatest complexity on the western end of the map area, where the dip on the west limb of the Mann Mountain anticline brings upper and lower Nuttall Sandstones nearly down to river level and the adjacent slope morphology is dominated by short hollows carved by ephemeral streams on erodible Kanawha Formation bedrock.

Sandstone blocks occur extensively along Meadow River and on the Gauley River bed to within 1.5 km of the western limits of the map area. The largest, which may exceed 12 m, appear to be lag, but many smaller imbricated blocks suggest episodic fluvial transport during extreme floods. These blocks and boulders, and, to a lesser degree, Raleigh Sandstone outcrops, form the whitewater rapids that make the Recreation Area a truly exceptional recreational resource.

Alluvium is exceptionally coarse in the Recreation Area, typically comprised of coarse cobbles, boulders, and small blocks. Except for the lowermost 0.8 km of Gauley River in the map area, fine-grained floodplain occurs only on mappable surfaces that are hydraulically sheltered during large floods, or as unmapped patches of ephemeral waning stage deposits. Alluvial fans and colluvial fans are small and restricted to the mouths of tributaries, which may host narrow entrenched fluvial channels or tributary deposits. Colluvial aprons and blocky mantles lie adjacent to the Gauley and Meadow river channels throughout most of the map area, including much of the flood-prone area. Patches of river-transported sediments are widely interspersed amongst the colluvial landforms, but only in low-lying bars and islands adjacent to river channels are bouldery floodplain polygons large enough to be widely mapped.

Alluvial terraces have very limited extent on Gauley River, but are somewhat better developed on Meadow River and Peters Creek. With one notable exception at northern extent of Koontz Bend, terraces lie vertically within 30 m of modern drainage. Small patches of well-rounded alluvial cobbles, pebbles and boulders occur, but not as mappable terraces. At Koontz Bend, deeply weathered alluvial deposits do occur in two high terraces with elevations clustering around 325 m and 345 m elevation, respectively ~50 m (165 ft) and ~70 m (230 ft) above typical Gauley River low stage (Sattler and Bell, 2013). The general lack of terraces is testimony to the efficacy of late Cenozoic incision of the Gauley and Meadow rivers and a virtual lack of depositional accommodation space in their canyons. However, the two relatively intact high terraces suggest a stable Late Cenozoic valley bottom existed for a significant time before a more recent episode of accelerated Gauley River incision.

Disturbed land is concentrated at Summersville dam, completed in 1965, and along US Rt. 19, completed in the 1970s. Many lower slopes of the Gauley and Meadow river canyons have significant disturbance along railroad grades, and roads are widespread through uplands, but these narrow disturbances are underrepresented on the map because the impacted areas commonly do not reach the minimum mapped polygon width of 30m.

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- Extracted from: (GRI Source Map ID 76059) ([Surficial Geology of Gauley River National Recreation Area](#)).*

GRI Digital Data Credits

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GRI finalization by Stephanie O'Meara.

GRI program coordination and scoping provided by Bruce Heise (NPS GRD, Lakewood, Colorado).